

Prüfbericht-Nr.: Seite 1 von 58 50073671 001 Auftrags-Nr.: 114058593 Page 1 of 58 Test Report No.: Order No.: Kunden-Referenz-Nr.: N/A Auftragsdatum: 17-Nov-2016 Client Reference No.: Order date: Auftraggeber: Molekule, Inc., 2507 Bryant St, San Francisco, CA 94110 Client: Prüfgegenstand: Molekule Home One Air Purifier Test item: Bezeichnung / Typ-Nr.: MH1-AAA Identification / Type No.: **Auftrags-Inhalt:** FCC Part 15C / IC RSS-247 Test report (WiFi 2.4GHz) Order content: Prüfgrundlage: Test specification: FCC 47CFR Part 15: Subpart C Section 15.247 RSS-247 issue 2 Feb. 2017 Wareneingangsdatum: 7-Feb-2017 Date of receipt: Prüfmuster-Nr.: A000493326-005 Test sample No.: A000493326-001 Prüfzeitraum: 10-Feb-2017 - 06-Mar-2017 Testing period: Ort der Prüfung: **EMC** Laboratory Taipei Place of testing: Prüflaboratorium: TUV Rheinland Taiwan Ltd. Testing laboratory: Prüfergebnis*: **Pass** Test result*: geprüft von I tested by: kontrolliert von I reviewed by: Rene Charton/Senjor Project Manager 2017-03-06 Amy S.R.Hsu /Engine 2017-03-06 Unterschrift Datum Name / Stellung Datum Name / Stellung Unterschrift Date Name / Position Signature Date Name / Position Signature Sonstiges I Other. Zustand des Prüfgegenstandes bei Anlieferung: Prüfmuster vollständig und unbeschädigt Condition of the test item at delivery: Test item complete and undamaged 4 = ausreichend * Legende: 1 = sehr aut 2 = gut 3 = befriedigend 5 = mangelhaft

Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.

F(ail) = failed a.m. test specification(s)

F(ail) = entspricht nicht o.g. Prüfgrundlage(n)

3 = satisfactory

N/A = nicht anwendbar

N/A = not applicable

4 = sufficient

N/T = nicht getestet

N/T = not tested

5 = poor

P(ass) = entspricht o.g. Prüfgrundlage(n)

P(ass) = passed a.m. test specification(s)

1 = very good

2 = good

Leaend:

This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.



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TEST SUMMARY

5.1.1 ANTENNA REQUIREMENT

RESULT: Passed

5.1.2 PEAK OUTPUT POWER

RESULT: Passed

5.1.3 6dB Bandwidth and 99% Bandwidth

RESULT: Passed

5.1.4 POWER DENSITY

RESULT: Passed

5.1.5 CONDUCTED SPURIOUS EMISSIONS AND FREQUENCY BAND EDGE MEASURED IN 100kHz BANDWIDTH

RESULT: Passed

5.1.6 Spurious Emission

RESULT: Passed

5.2.1 Mains Conducted Emissions

RESULT: Passed

6.1.1 ELECTROMAGNETIC FIELDS

RESULT: Passed

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1. General Remarks

1.1 Complementary Materials

The following attachments are integral parts of this test report:

Appendix P: Photo Documentation

(File Name: 50073671APPENDIX P)

Appendix D: Test Result of Radiated Emissions

(File Name: 50073671APPENDIX D)

Test Specifications

The following standards were applied (in bold: product standards, otherwise: basic standards).

Table 1: Applied Standard and Test Levels

Radio

FCC CFR47 Part 15: Subpart C Section 15.247 RSS-247 issue 2 Feb. 2017 RSS-Gen, Issue 4, November 2014 ANSI C63.10:2013

KDB558074 D01 DTS Meas Guidance v03r05



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2. Test Sites

2.1 Test Laboratory

TUV Rheinland Taiwan Ltd. Taichung Branch Office

No.9, Lane 36, Minsheng Rd., Sec. 3, Daya District, Taichung City 428
Taiwan (R.O.C.)

2.2 Test Facilities

TUV Rheinland Taiwan Ltd. Taipei Office

11F. No.758, Sec. 4, Bade Rd., Songshan Dist. Taipei City 105
Taiwan (R.O.C.)

FCC RegistrationNo.: 365730 IC Canada Registration No.: 9465A-1

TAF Accredited NCC Test Lab. No.:0759

TAF ISO17025 Certification effective periods: 2016-Jul-1st to 2019-Jun-30th



Testing Laboratory 0759

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2.3 List of Test and Measurement Instruments

Table 2: List of Test and Measurement Equipment

Kind of Equipment	Manu-facturer	Туре	S/N	Last Calibration	Next Calibration
Test Software	Farad	EZ_EMC	Ver. TUV3A1	N/A	N/A
EMI Test Receiver	R&S	ESR7	101062	2016/09/12	2017/09/12
Spectrum Analyzer	R&S	FSV 40	100921	2016/04/21	2017/04/21
Spectrum Analyzer	Agilent	N9010A	MY53470241	2016/04/25	2017/04/24
Preamplifier (30MHz -1GHz)	HP	8447F	2805A03335	2016/07/29	2017/07/29
Preamplifier (18 GHz -40 GHz)	COM- POWER	PAM-840	461257	2016/12/01	2017/12/01
Pre-Amplifier (1GHz~18GHz)	EM Electronics	EM01G18G	060558	2016/11/17	2017/11/17
Bilog Antenna	TESEQ	CBL6111D	29804	2016/06/23	2017/06/23
Horn Antenna	ETS- Lindgren	3117	138160	2016/05/03	2017/05/03
Horn Antenna (18GHz~40GHz)	COM- POWER	AH840	101029	2016/10/11	2017/10/11
Loop Antenna	Schwarzbeck	FMZB 1513	1513-076	2016/05/11	2017/05/11
Spectrum Analyzer	R&S	FSL3	101943	2015/09/07	2017/09/07
Temp. & Humid. Chamber	Giant Force	GCT-099-40-S	MAF0103- 007	2015/07/13	2017/07/12
LISN (1 phase)	R&S	ENV216	101243	2016/06/02	2017/06/02
LISN	R&S	ENV216	101262	2016/06/16	2017/06/16
Test Software	Audix	e3	Ver. 9	N/A	N/A

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2.4 Traceability

All measurement equipment calibrations are traceable to NML(Taiwan)/NIST(USA) or where calibration is performed outside Taiwan, to equivalent nationally recognized standards organizations.

2.5 Calibration

Equipment requiring calibration is calibrated periodically by the manufacturer or according to manufacturer's specifications. Additionally all equipment is verified for proper performance on a regular basics using in house standards or comparisons.

2.6 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements are $\pm 3 \text{dB}$.

Table 3: Emission Measurement Uncertainty

Parameter	Uncertainty
RF power, conducted	± 1.5 dB
Adjacent channel power	± 3 dB
Radiated emission of transmitter, valid up to 26 GHz	± 6 dB
Radiated emission of receiver, valid up to 26 GHz	± 6 dB
Temperature	± 2 °C
Humidity	± 10 %



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3. General Product Information

3.1 Product Function and Intended Use

The EUT is a Air Purifier. It contains a Bluetooth/ WLAN 802.11b/g/n compatible module enabling the user to communicate data through a Wireless interface. For details refer to the User Guide, Data Sheet and Circuit Diagram.

3.2 System Details and Ratings

Table 4: Basic Information of EUT

Item EUT information	
Kind of Equipment	Molekule Home One Air Purifier
Type Designation	MH1-AAA
FCC ID	2AJ7M-MH1

Table 5: Technical Specification of EUT

Technical Specification	Value
Operating Frequencies	2412 MHz ~ 2462 MHz
Channel Spacing	5 MHz
Channel number	802.11b/g/n :11 (2412 MHz ~ 2462 MHz)
Operation Voltage	AC 120V
Modulation	802.11b: DSSS; 802.11g/n: OFDM
Antenna gain	5.8 dBi



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3.3 Independent Operation Modes

Basic operation modes are:

- A. Transmitting
 - 1. Low channel
 - 2. Middle channel
 - 3. High channel
- B. Receiving
- C. Standby
- D. Off

3.4 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

3.5 Submitted Documents

- Bill of Material
- PCB Layout
- Photo Document
- Technical Description

- Circuit Diagram
- Instruction Manual
- Rating Label



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4. Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

The equipment under test (EUT) was configured to measure its maximum power level. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

Setup for testing: Test samples are provided with a USB interface which makes it possible to control them through a test software installed on a notebook computer.

This software was running on the laptop computer connected to the EUT. It was used to enable the operation modes listed in section 3.3 as appropriate.

The samples were used as follows:

Conducted: **A000493326-001**Radiation: **A000493326-005**

Full test was applied on all test modes, but only worst case was shown

IEEE 802.11b mode:

Channel Low (2412MHz), Channel Mid (2437MHz) and Channel High (2462MHz) with 1Mbps data rate were chosen for full testing.

IEEE 802.11g mode:

Channel Low (2412MHz), Channel Mid (2437MHz) and Channel High (2462MHz) with 6Mbps data rate were chosen for full testing.

IEEE 802.11n HT 20 mode:

Channel Low (2412MHz), Channel Mid (2437MHz) and Channel High (2462MHz) with 6.5Mbps data rate were chosen for full testing.

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4.3 **Special** Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

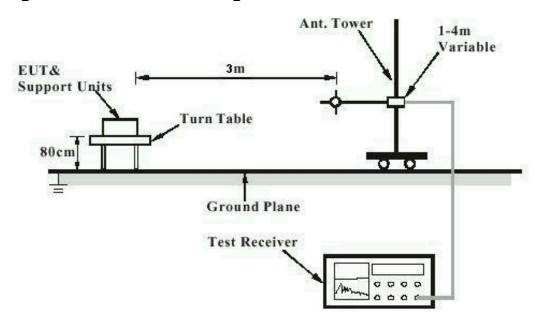
Description	Manufacturer	Model No.	Serial No.
Notebook(EMC-06)	Lenovo	TP00048A	PB-0F8B2

4.4 Countermeasures to achieve EMC Compliance

The test sample which has been tested contained the noise suppression parts as described in the Constructional Data Form or the Technical Construction File. No additional measures were employed to achieve compliance.

4.5 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test



Note: Measurements above 1 GHz are done with a table height of 1.5m.



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Diagram of Measurement Equipment Configuration for Mains Conduction Measurement (if applicable)

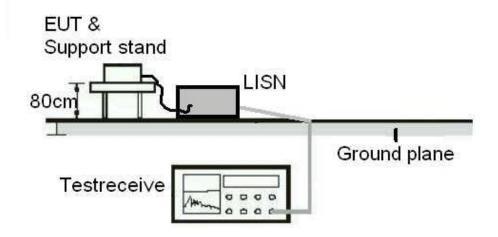
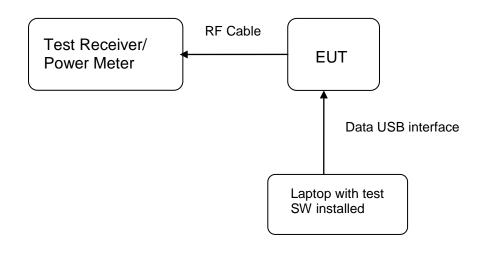


Diagram of Measurement Equipment Configuration for Conducted Transmitter Measurement



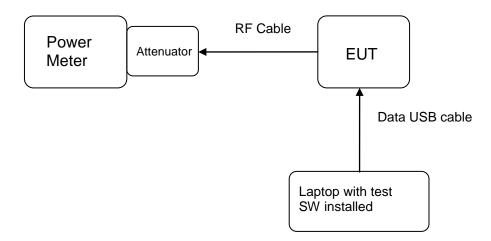


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Diagram of Measurement Equipment Configuration for Conducted Transmitter Measurement (Power meter)





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5. Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT: Passed

Test standard : LP0002(2016): 3.10.1,(4)

FCC Part 15.247(b)(4), Part 15.203 and RSS-

Gen 8.3

Limit : the use of antennas with directional gains that do not

exceed 6 dBi

According to the manufacturer declaration, the EUT has an antenna with a directional gain of 5.8 dBi .The antenna is a Monopole Antenna with no possibility of replacement with a non-approved antenna by the end-user. Therefore, the EUT is considered to comply with this provision.

Refer to EUT photo for details.



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5.1.2 Peak Output Power

RESULT: Passed

Test standard LP0002(2016): 3.10.1,(6.2.A)

FCC Part 15.247(b)(3), RSS-247 5.4(4)

Basic standard ANSI C63.10:2009, KDB558074

Limit 1 Watt

Kind of test site Shielded room

Test setup

Test Channel Low/ Middle/ High

Operation Mode

Ambient temperature : Relative humidity : 22-26 °C Relative humidity : Atmospheric pressure : 50-65 % 100-103 kPa



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Table 6: Test result of Peak Output Power (802.11b)

Channel	Channel Frequency	Output Power		Limit
	(MHz)	(dBm)	(W)	(W)
Low Channel	2412	13.14	0.02061	1
Middle Channel	2437	13.95	0.02483	1
High Channel	2462	13.06	0.02023	1

Table 7: Test result of Peak Output Power (802.11g)

Channel	Channel Frequency	Output Power		Limit
	(MHz)	(dBm)	(W)	(W)
Low Channel	2412	12.39	0.01734	1
Middle Channel	2437	11.71	0.01483	1
High Channel	2462	12.32	0.01706	1

Table 8: Test result of Peak Output Power (802.11n HT20)

Channel	Channel Frequency	Output Power		Limit
	(MHz)	(dBm)	(W)	(W)
Low Channel	2412	12.39	0.01734	1
Middle Channel	2437	11.37	0.01371	1
High Channel	2462	12.31	0.01702	1



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5.1.3 6dB Bandwidth and 99% Bandwidth

RESULT: Passed

FCC Part 15.247(a)(2), RSS-247 5.2(1) Test standard ANSI C63.10:2009, KDB558074 Basic standard

Kind of test site Shielded room

Test setup

Test Channel Low/ Middle/ High

Operation Mode

Ambient temperature : Relative humidity : Atmospheric pressure : 22-26°C 50-65% 100-103 kPa



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Table 9: Test result of 6dB Bandwidth (802.11b)

Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
Low Channel	2412	8.596	0.5	Pass
Mid Channel	2437	9.040	0.5	Pass
High Channel	2462	9.060	0.5	Pass

Table 10: Test result of 6dB Bandwidth (802.11g)

Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
Low Channel	2412	15.41	0.5	Pass
Mid Channel	2437	15.71	0.5	Pass
High Channel	2462	15.47	0.5	Pass

Table 11: Test result of 6dB Bandwidth (802.11n HT20)

Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
Low Channel	2412	15.41	0.5	Pass
Mid Channel	2437	16.37	0.5	Pass
High Channel	2462	15.70	0.5	Pass



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Table 12: Test result of 99% Bandwidth (802.11b)

-	i	
Channel	Channel Frequency (MHz)	99% Bandwidth (MHz)
Low Channel	2412	14.053
Mid Channel	2437	14.064
High Channel	2462	13.993

Table 13: Test result of 99% Bandwidth (802.11g)

Channel	Channel Frequency (MHz)	99% Bandwidth (MHz)
Low Channel	2412	16.422
Mid Channel	2437	16.408
High Channel	2462	16.439

Table 14: Test result of 99% Bandwidth (802.11n HT20)

Channel	Channel Frequency (MHz)	99% Bandwidth (MHz)
Low Channel	2412	17.555
Mid Channel	2437	17.557
High Channel	2462	17.568



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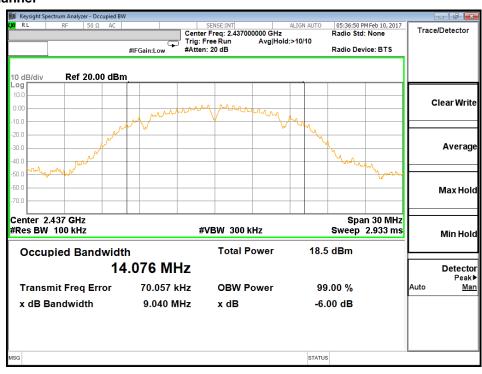
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Test Plot of 6dB Bandwidth (802.11b)

Low Channel



Middle Channel





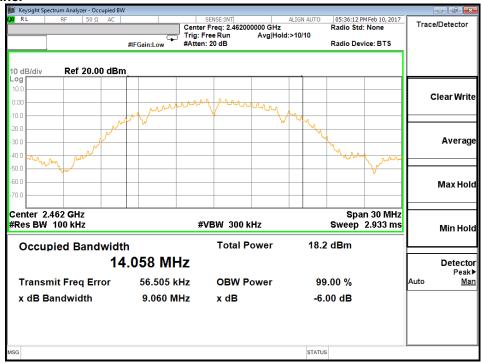
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High Channel





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Test Plot of 6dB Bandwidth (802.11g)

Low Channel



Middle Channel



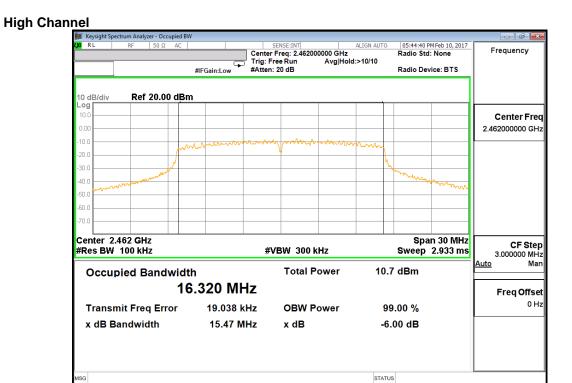


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Test Plot of 6dB Bandwidth (802.11n HT20)

Low Channel



Middle Channel





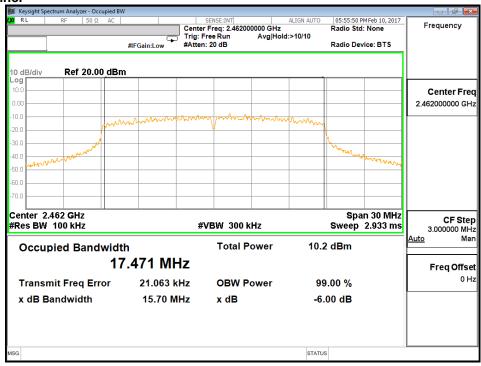
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High Channel





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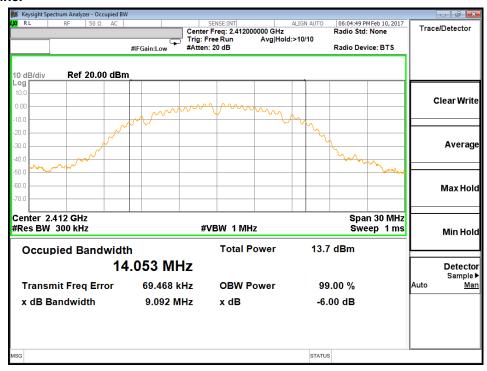
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Test Plot of 99% Bandwidth (802.11b)

Low Channel



Middle Channel





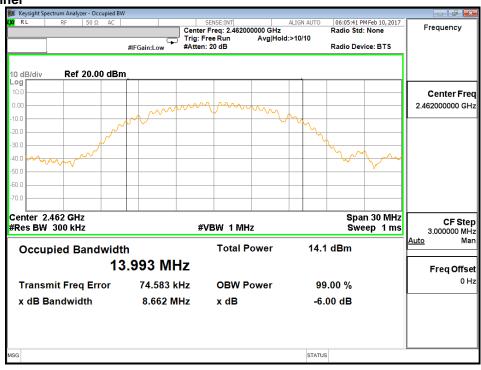
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Test Plot of 99% Bandwidth (802.11g)

Low Channel



Middle Channel





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Test Plot of 99% Bandwidth (802.11n HT20)

Low Channel



Middle Channel



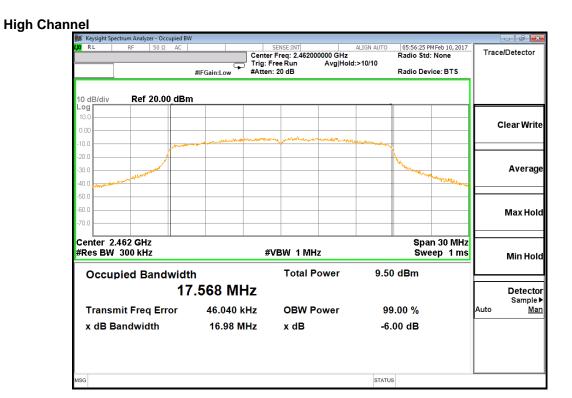


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5.1.4 Power Density

RESULT: Passed

Test standard LP0002(2016): 3.10.1,(6.2.B)

FCC Part 15.247(e), RSS-247 5.2(2)

Basic standard ANSI C63.10:2009, KDB558074

Kind of test site Shielded room

Test setup

Test Channel Low/ Middle/ High

Operation Mode

Ambient temperature 22-26°C Relative humidity 50-65% Atmospheric pressure : 100-103 kPa



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Table 15: Test result of Power Density (802.11b)

Channel	Channel Frequency	Power Density	Limit
	(MHz)	(dBm)	(dBm)
Low Channel	2412	2.85	8
Middle Channel	2437	2.36	8
High Channel	2462	2.79	8

Table 16: Test result of Power Density (802.11g)

Channel	Channel Frequency	Power Density	Limit
	(MHz)	(dBm)	(dBm)
Low Channel	2412	-7.81	8
Middle Channel	2437	-8.72	8
High Channel	2462	-7.56	8

Table 17: Test result of Power Density (802.11n HT20)

Channel	Channel Frequency	Power Density	Limit
	(MHz)	(dBm)	(dBm)
Low Channel	2412	-9.58	8
Middle Channel	2437	-8.71	8
High Channel	2462	-7.72	8



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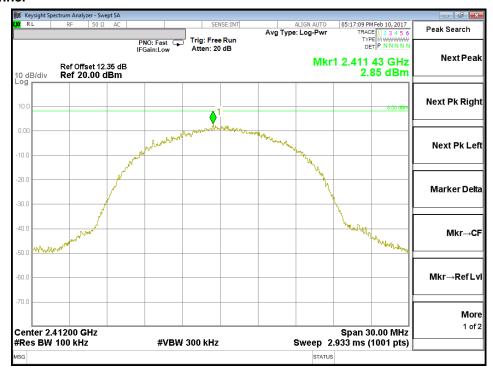
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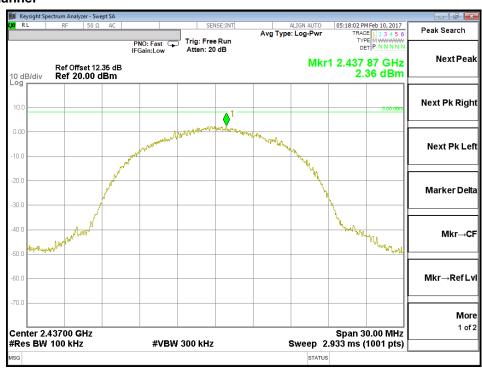
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Test Plot of Power Density (802.11b)

Low Channel



Middle Channel





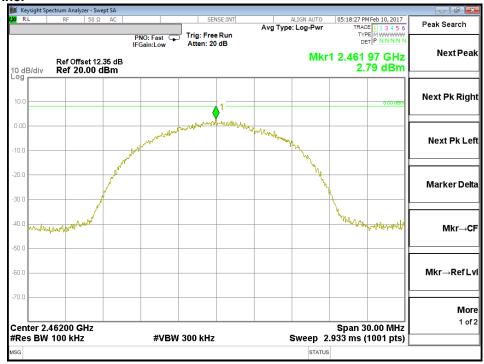
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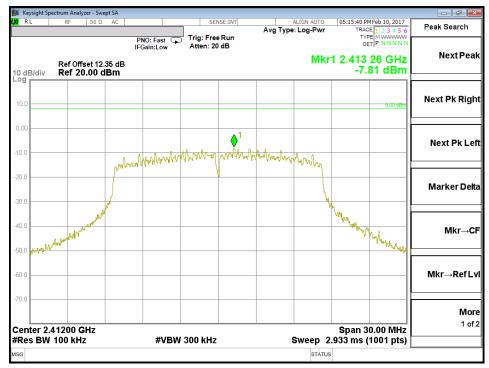
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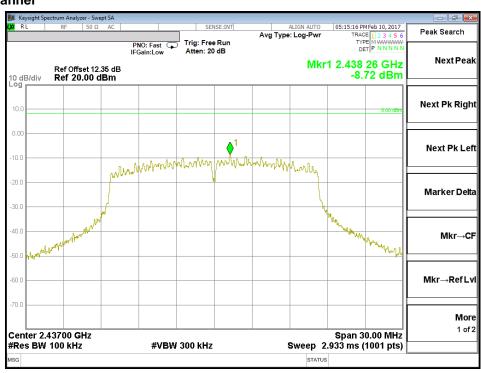
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Test Plot of Power Density (802.11g)

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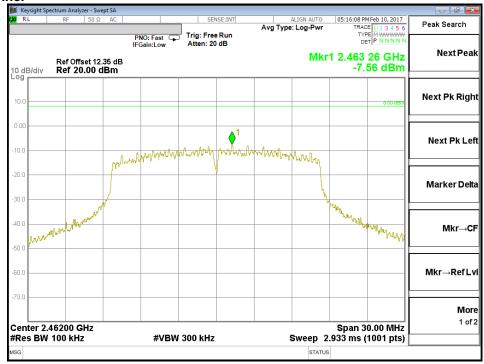
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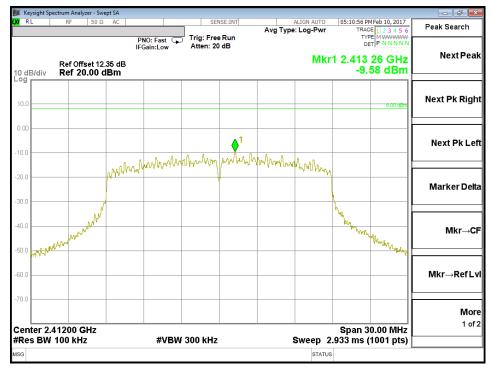
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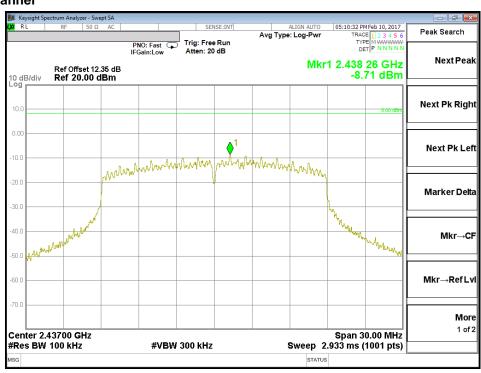
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Test Plot of Power Density (802.11n HT20)

Low Channel

Test Report No.







More 1 of 2

Span 30.00 MHz Sweep 2.933 ms (1001 pts)

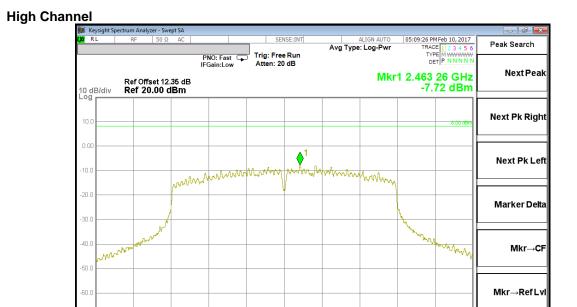
Produkte

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Center 2.46200 GHz #Res BW 100 kHz **Seite 40 von 58** *Page 40 of 58*

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#VBW 300 kHz



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5.1.5 Conducted spurious emissions and Frequency Band Edge measured in 100kHz Bandwidth

RESULT: Passed

Test standard LP0002(2016): 3.10.1, (5)

FCC part 15.247(d), RSS-247 5.5

Basic standard ANSI C63.10:2009, KDB558074

Limit 20dB (below that in the 100kHz bandwidth within the

band that contains the highest level of the desired power)

Kind of test site Shielded room

Test setup

Test Channel Low/ High

Operation mode

Ambient temperature 22-26°C Relative humidity 50-65% Atmospheric pressure 100-103 kPa

All emissions are more than 20dB below fundamental, details refer to following test plot, and compliance is achived as well.

Due to the small size of the product and that there are no inductive components of significant size, 9kHz to 30MHz frequency range is not tested based on technical judgment.



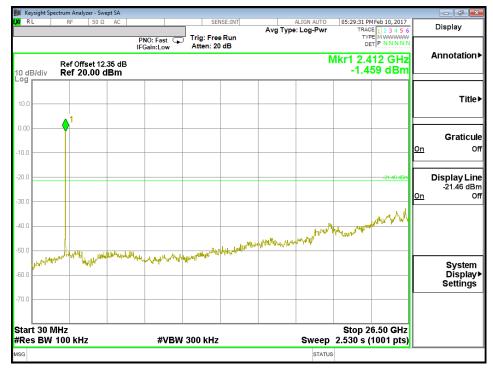
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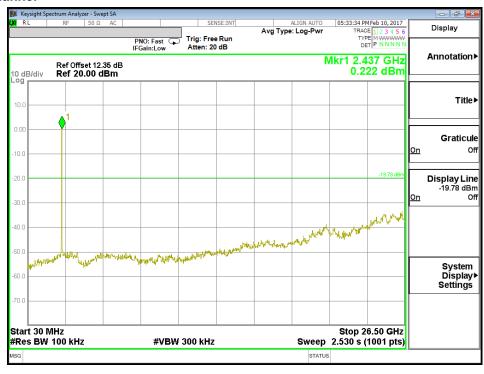
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Test Plot 100kHz Conducted Emissions (802.11b)

Low Channel







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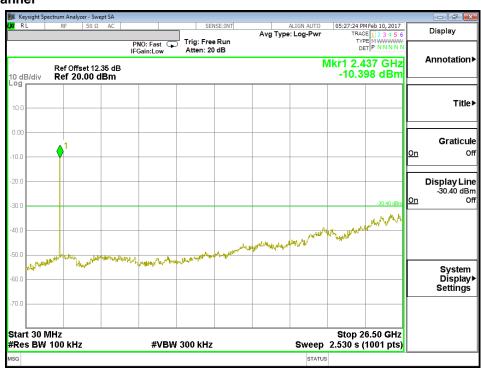
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Test Plot 100kHz Conducted Emissions (802.11g)

Low Channel







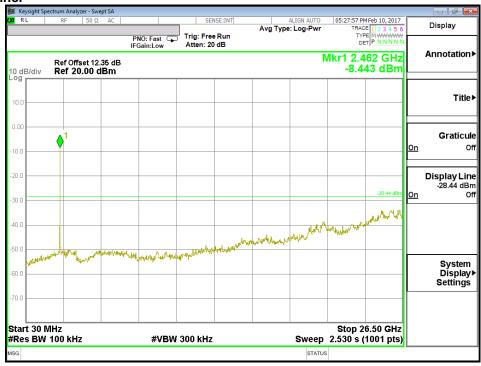
Products

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Produkte Products

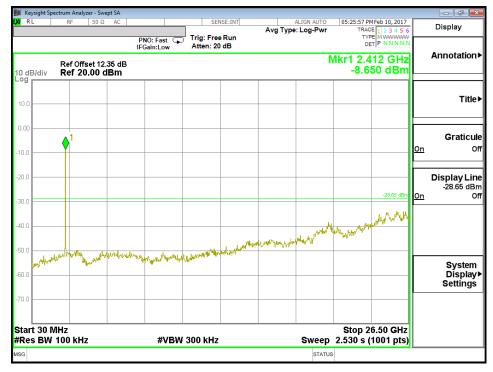
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Test Plot 100kHz Conducted Emissions (802.11n HT20)

Low Channel

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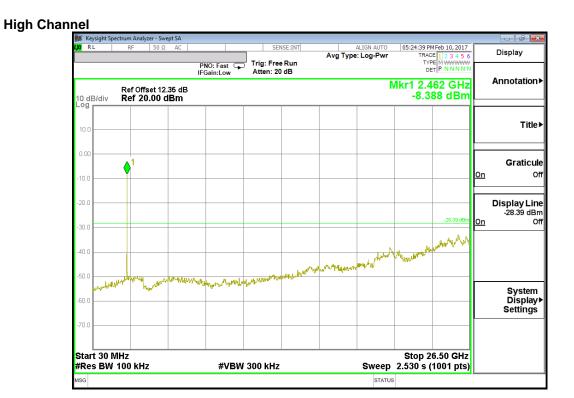


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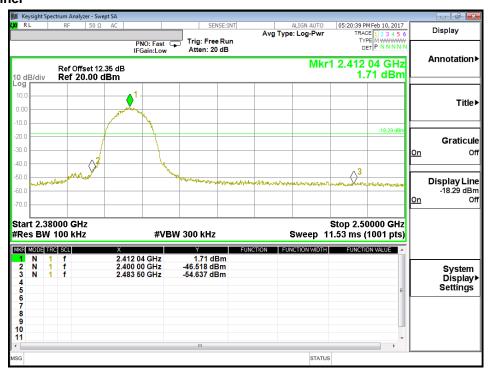
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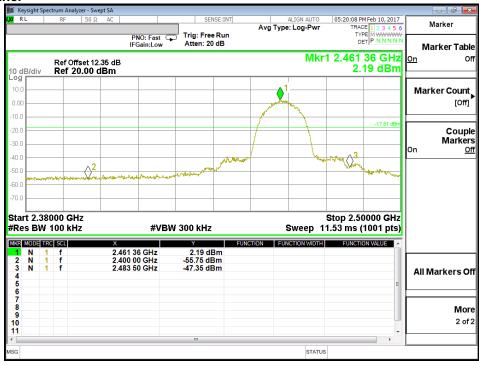
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Test Plot 100kHz RBW of Band Edge (802.11b)

Low Channel







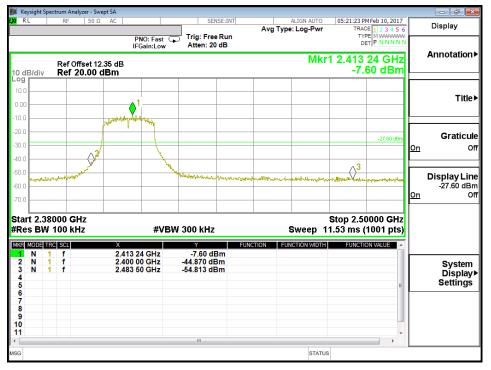
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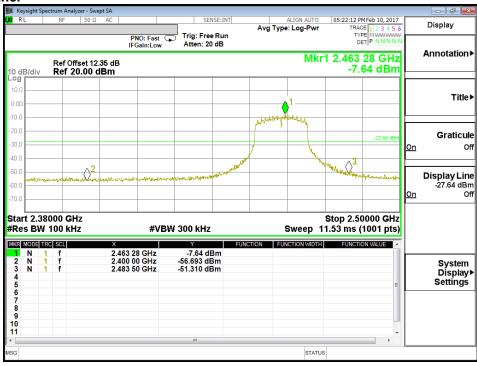
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Test Plot 100kHz RBW of Band Edge (802.11g)

Low Channel







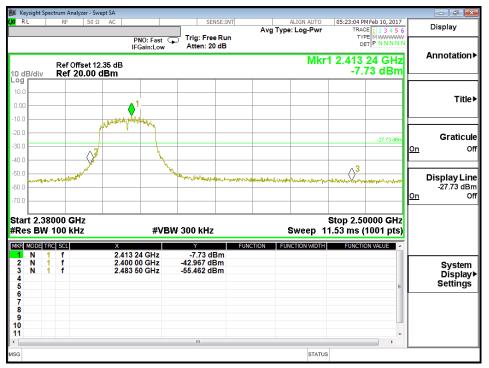
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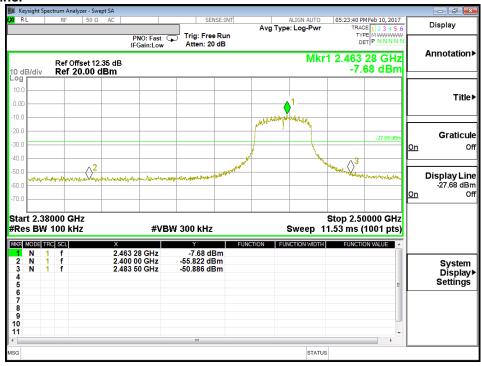
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Test Plot 100kHz RBW of Band Edge (802.11n HT20)

Low Channel







Produkte Products

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Test Report No.

5.1.6 Spurious Emission

RESULT: Passed

Test standard FCC part 15.247(d), FCC 15.205, FCC 15.209, :

RSS-210 2.2, RSS-247 5.5 and RSS-Gen 8.9

LP0002(2016): 3.10.1, (5)

Basic standard ANSI C63.10: 2009

Radiated emissions which fall in the restricted Limits

bands, as defined in FCC 15.205(a) and RSS-Gen i4, 8.9 (Table 6), must comply with the radiated emission limits specified in FCC 15.209(a) and RSS-Gen i4, 8.9 (Table 4 and

Radiated emissions which fall in the restricted bands, as defined in LP0002(2016): 2.7, must

comply with the radiated emission limits

specified in LP0002(2016): 2.8

Emission radiated outside the specified frequency bands must comply with the radiated emission limits specified in FCC 15.209(a) and FCC 15.249(a), RSS-Gen i4, 8.9 (Table 4 and 5) and RSS-210 A2.9(a). Emission radiated outside the specified frequency bands must comply with the radiated emission limits specified in

LP0002(2016): 2.8

3m Semi-Anechoic Chamber Kind of test site

Test setup

Test Channel Low/ Middle/ High

Operation mode A, B

Remark: Testing was carried out within frequency range 30MHz to the tenth harmonic.

For details refer to Appendix D.

The Radiated Emissions testing was performed in the X, Y and Z axis orientation. The X Axis orientation is the worst-case and recorded in this test report. Due to the small size of the product and that there are no inductive components of significant size, 9kHz to 30MHz frequency range is not tested based on technical judgment.



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Test Report No.

5.2 Mains Emissions

5.2.1 Mains Conducted Emissions

RESULT: Passed

FCC Part 15.207 Test standard

FCC Part 15.107 RSS-Gen 8.8 LP0002(2016): 2.3

Limits Mains Conducted emissions as defined in

above standards

Kind of test site Shielded Room

Test setup

Test Channel Middle Operation mode

Remark: For details refer to Appendix D.



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6. Safety Human exposure

6.1 Radio Frequency Exposure Compliance

6.1.1 Electromagnetic Fields

RESULT: Passed

Test standard : FCC KDB Publication 447498 D01 v06

RSS--102

Separation distance is more than 20 cm, thus mobile device exposure limits can be applied

Maximum Exposure:

Power to Antenna (mW)	24.83 mW
Power to Antenna (dBm)	13.9 dBm
Antenna Gain	5.8 dBi
Power+Ant Gain	94.4 mW
Distance	20 cm
S=	0.019 mW/cm^2

Limit FCC:

0.3-1.34 MHz (100) mW/cm² 1.34-30 MHz (180/f2) mW/cm² 30-300 MHz 0.2 mW/cm² 300-1500 MHz f/1500 mW/cm² 1500-100,000 MHz 1.0 mW/cm²

Limit Canada: $0.02619f^{0.6834}$

---End---



Produkte Products

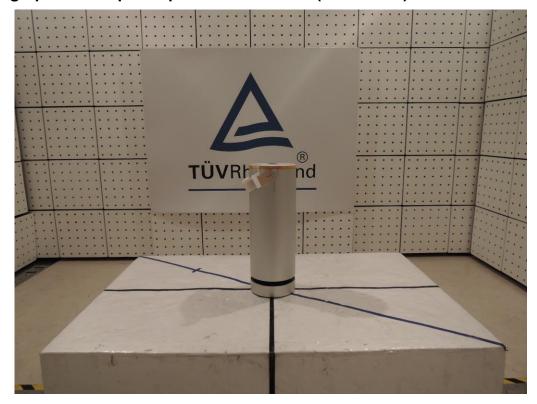
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7. Photographs of the Test Set-Up

Photograph 1: Set-up for Spurious Emissions (Front View)



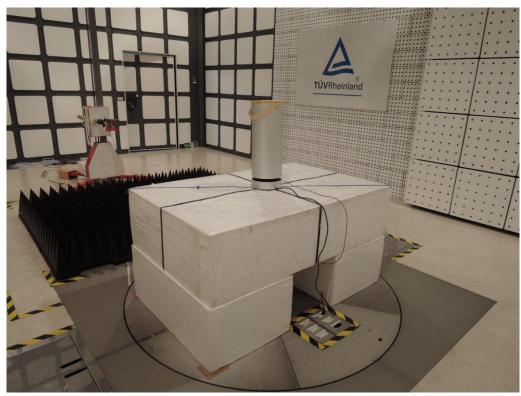


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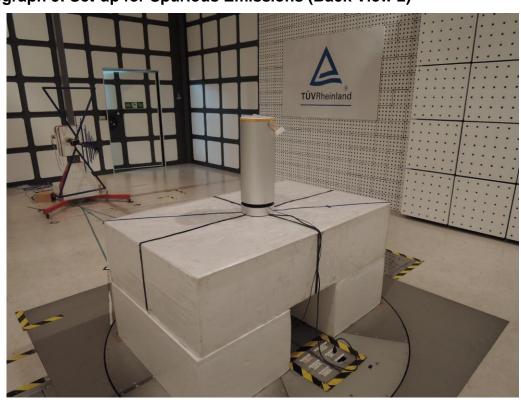
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Photograph 2: Set-up for Spurious Emissions (Back View 1)



Photograph 3: Set-up for Spurious Emissions (Back View 2)



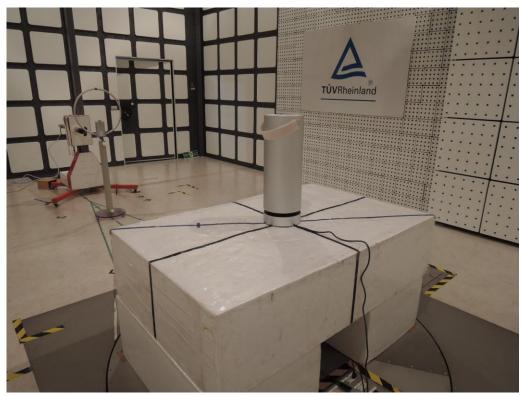


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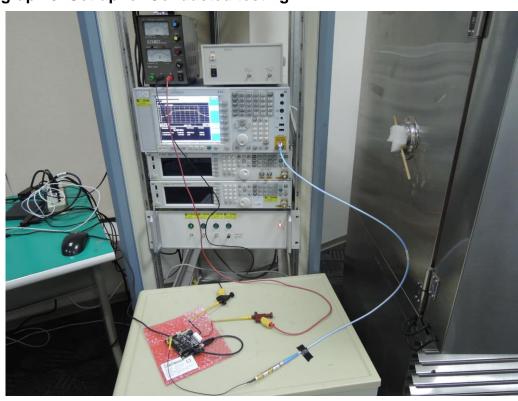
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Photograph 4: Set-up for Spurious Emissions (Back View 3) 9k-30M



Photograph 5: Set-up for Conducted testing





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Photograph 6: Set-up for for Mains Conducted testing Back



Photograph 7: Set-up for Mains Conducted testing Front





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