

Prüfbericht-Nr.: Test Report No.:	50254635 001	Auftrags-Nr.: Order No.:	238105196	Seite 1 von 47 Page 1 of 47
Kunden-Referenz-Nr.: Client Reference No.:	N/A	Auftragsdatum: Order date:	10-May-2019	
Auftraggeber: Client:	Testo SE & Co. KGaA Testostraße 1, 79853 Lenzkirch, Germany			
Prüfgegenstand: Test item:	Testo Control Unit			
Bezeichnung / Typ-Nr.: Identification / Type No.:	0480 0069			
Auftrags-Inhalt: Order content:	NCC Test report (WiFi 2.4G)			
Prüfgrundlage: Test specification:	NCC Low-power Radio-frequency Devices Technical Regulations LP0002(2018) Section 3.10.1			
Wareneingangsdatum: Date of receipt:	10-May-2019			
Prüfmuster-Nr.: Test sample No.:	A000920575-001,002			
Prüfzeitraum: Testing period:	13-May-2019 – 24-May-2019			
Ort der Prüfung: Place of testing:	EMC/RF Laboratory Taipei			
Prüflaboratorium: Testing laboratory:	TUV Rheinland Taiwan Ltd.			
Prüfergebnis*: Test result*:	Pass			
geprüft von / tested by:		kontrolliert von / reviewed by:		
 2019-06-05 Mars Y.J. Lin / Project Engineer Datum Name / Stellung Unterschrift Date(Report Date) Name / Position Signature		 2019-06-05 Rene Charton / Expert, Electrical Datum Name / Stellung Unterschrift Date Name / Position Signature		
Sonstiges / Other:				
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery:		Prüfmuster vollständig und unbeschädigt Test item complete and undamaged		
* Legende: 1 = sehr gut 2 = gut 3 = befriedigend 4 = ausreichend 5 = mangelhaft P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet Legend: 1 = very good 2 = good 3 = satisfactory 4 = sufficient 5 = poor P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested				
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. <i>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.</i>				

TEST SUMMARY

5.1.1 ANTENNA REQUIREMENT

RESULT: Passed

5.1.2 PEAK OUTPUT POWER

RESULT: Passed

5.1.3 6dB 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

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1. General Remarks

1.1 Complementary Materials

These attachments are integral parts of this test report:

Appendix P: Photo Documentation internal view
(File Name: 50254635 001APPENDIXP)

Appendix D: Test Result of Radiated Emissions
(File Name: 50254635 001APPENDIXD)

Test Specifications

The following standards were applied.

Table 1: Applied Standard and Test Levels

Radio
NCC Low-power Radio-frequency Devices Technical Regulations LP0002(2018)(107 年 1 月 10 日) ANSI C63.10 (2013)

1.2 Complementary Materials

The decision rule of conformity of this test report is following the requirements of the requested standard in the quotation, and agreed among testing laboratory and manufacturer (applicant) to exclude the consideration of Measurement Uncertainty, unless it is required by the specific standard.

2. Test Sites

2.1 Test Laboratory

TUV Rheinland Taiwan Ltd.
Taipei Testing Laboratories

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

2.2 Test Facility

TUV Rheinland Taiwan Ltd.

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

TAF Accredited NCC Test Lab. No.:3567
TAF ISO17025 Certification effective period: 6th-May-2019 to 05th-May-2022



Testing Laboratory
3567

2.3 List of Test and Measurement Instruments

Table 2: List of Test and Measurement Equipment

Kind of Equipment	Manu-facturer	Type	S/N	Last Calibration	Next Calibration
Test Software	Audix	e3	Ver. 9	N/A	N/A
Spectrum Analyzer	R&S	FSV 40	100921	2019/05/02	2020/05/01
EXA Signal Analyzer	KEYSIGHT	N9010A	MY52221334	2019/02/11	2020/02/11
Preamplifier (30MHz -1GHz)	HP	8447F	2805A03335	2018/08/14	2019/08/13
Preamplifier (18 GHz -40 GHz)	COM-POWER	PAM-840	461257	2019/01/18	2020/01/17
Pre-Amplifier (1GHz~18GHz)	EM Electronics	EM01G18G	60558	2018/11/21	2019/11/20
Bilog Antenna	TESEQ	CBL6111D	29804	2018/08/18	2019/08/17
Horn Antenna	ETS-Lindgren	3117	201918	2018/08/18	2019/08/17
Horn Antenna (18GHz~40GHz)	COM-POWER	AH-840	101029	2018/11/28	2019/11/27
Loop Antenna	Schwarzbeck	FMZB 1513	1513-076	2018/06/14	2019/06/13
EMI Test Receiver	R&S	ESR 7	101549	2018/11/10	2019/11/09
Temp. & Humid. Chamber	Giant Force	GCT-099-40-S	MAF0103-007	2019/03/09	2020/03/09
LISN (1 phase)	R&S	ENV216	101243	2018/06/18	2019/06/17
LISN	R&S	ENV216	101262	2018/06/22	2019/06/21
Spectrum Analyzer	Agilent	N9010A	MY53470241	2018/06/04	2019/06/03

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 in a suitably accredited Calibration Lab. Additionally all equipment is verified for proper performance on a regular schedule using in house standards or comparisons.

2.6 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements .

Table 3: Emission Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	± 0.1 ppm
RF power, conducted	± 1.5 dB
RF power density, conducted	± 3 dB
spurious emissions, conducted	± 3 dB
all emissions, radiated	± 6 dB
Temperature	± 1 °C
Humidity	± 5 %
DC and low frequency voltages	±3 %

3. General Product Information

3.1 Product Function and Intended Use

The EUT is a Control Unit. It contains a WiFi 2.4G compatible module enabling the user to communicate data through a Wireless interface.
For details refer to the User Guide, Data Sheet and Block Diagram.

3.2 System Details and Ratings

Table 4: Basic Information of EUT

Item	EUT information
Kind of Equipment/Test Item	Testo Control Unit
Type Identification	0480 0069
Brand Name	testo

Table 5: Technical Specification of EUT

Technical Specification	Value
Operating Frequencies	2412MHz ~ 2462MHz
Channel Spacing	5MHz
Channel number	802.11b/g/n20 : 11, 802.11n40 : 9
Operation Voltage	110-240Vac
Modulation	802.11b : DSSS(BPSK, QPSK, CCK) 802.11g/n : OFDM(BPSK, QPSK, 16QAM, 64QAM)
Antenna gain	1.5 dBi

3.3 Independent Operation Modes

Basic operation modes are:

- A. Transmitting
 - 1. Low channel
 - 2. Middle channel
 - 3. High channel
- B. Receiving

3.4 Noise Generating and Noise Suppressing Parts

Refer to the Block Diagram.

3.5 Submitted Documents

- Block Diagram
- Instruction Manual
- Rating Label
- Technical Description

4. Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

The test modes were adapted accordingly in reference to the instructions for use.

During testing, Channel and Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Table 6: Table for Parameters of Test Software Setting

Mode	Channel Frequency					
	NCB: 20MHz			NCB: 40MHz		
	2412 MHz	2437 MHz	2462 MHz	2422 MHz	2437 MHz	2452 MHz
802.11b	24	24	22	x	x	x
802.11g	24	24	18	x	x	x
802.11n MCS0 HT20	24	24	17	x	x	x
802.11n MCS0 HT40	x	x	x	16.5	24	16

4.2 Test Operation and Test Software

Setup for testing: The test sample itself has a screen, and the operation mode required for the test can be selected by the sample itself. It was used to enable the operation modes listed in section 3.3 as appropriate.

The samples were used as follows:

Conducted test: A000920575-002

Radiated test: A000920575-001

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

4.3 Special Accessories and Auxiliary Equipment

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

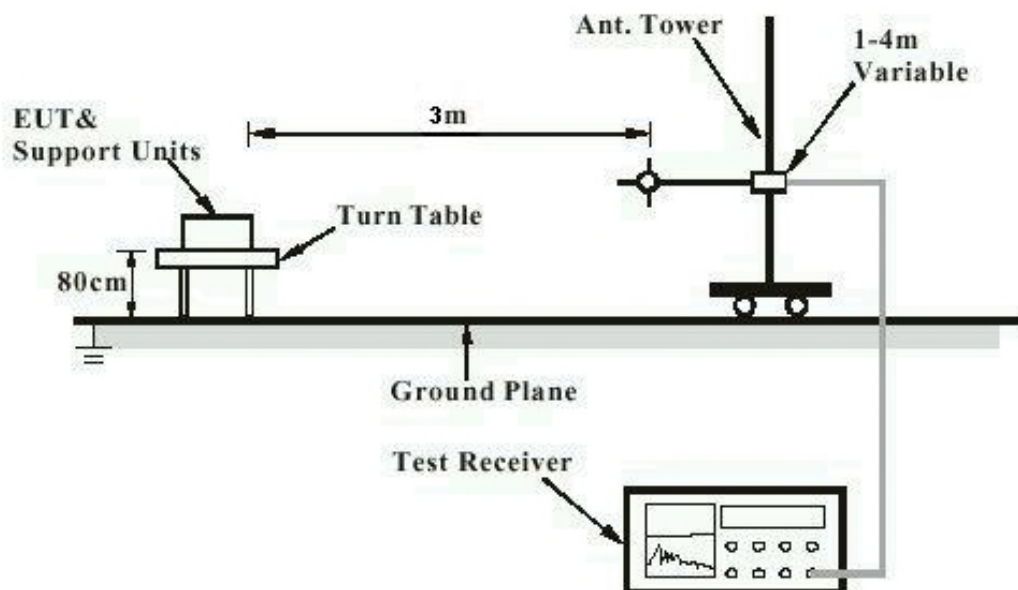
N/A

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

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

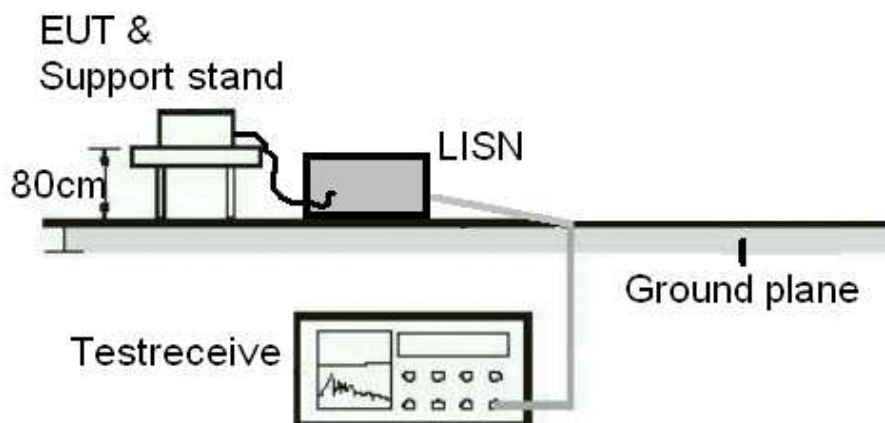
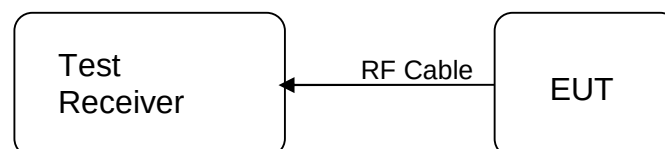


Diagram of Measurement Equipment Configuration for Conducted Transmitter Measurement



5. Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT:**Passed**

Test standard : LP0002(2018): 3.10.1.3, 3.10.1.4

Requirement : use of approved antennas only with directional gains that do not exceed 6 dBi

According to the manufacturer declaration, the EUT has an antenna with a directional gain of 1.5 dBi. The antenna is a printed 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.

5.1.2 Peak Output Power

RESULT:
Passed

Test standard : LP0002(2018): 3.10.1.2 (1)(C)
 Basic standard : ANSI C63.10 (2013)
 Limit : 1 Watt
 Kind of test site : Shielded room

Test setup

Test Channel : Low/ Middle/ High
 Operation Mode : A
 Ambient temperature : 20-24 °C
 Relative humidity : 50-65 %
 Atmospheric pressure : 100-103 kPa

Table 7: Test result of Peak Output Power

Band	Date Rate	CH	Frequency	Conducted power		Limit
			(MHz)	(dBm)	(W)	(dBm)
802.11b	1M	1	2412.0	18.45	0.06998	30
802.11b	1M	6	2437.0	20.62	0.11535	30
802.11b	1M	11	2462.0	20.73	0.11830	30
802.11g	6M	1	2412.0	19.79	0.09528	30
802.11g	6M	6	2437.0	21.21	0.13213	30
802.11g	6M	11	2462.0	21.17	0.13092	30
802.11n20	MCS0	1	2412.0	19.91	0.09795	30
802.11n20	MCS0	6	2437.0	21.02	0.12647	30
802.11n20	MCS0	11	2462.0	20.72	0.11803	30
802.11n40	MCS0	3	2422.0	20.36	0.10864	30
802.11n40	MCS0	6	2439.0	21.21	0.13213	30
802.11n40	MCS0	9	2452.0	20.61	0.11508	30

Pmax: 132.1296mW

5.1.3 6dB Bandwidth

RESULT:
Passed

Test standard : LP0002(2018): 3.10.1.6 (2)(A)

Basic standard : ANSI C63.10 (2013)

Kind of test site : Shielded room

Test setup

Test Channel : Low/ Middle/ High

Operation Mode : A

Ambient temperature : 20-24°C

Relative humidity : 50-65%

Atmospheric pressure : 100-103 kPa

Table 8: Test result of 6dB Bandwidth

Band	Data Rate	CH	Frequency	6dB Bandwidth	Limit	Result
			(MHz)	(MHz)	(kHz)	
802.11b	1M	1	2412.0	10.05	>500	PASS
802.11b	1M	6	2437.0	10.12	>500	PASS
802.11b	1M	11	2462.0	10.09	>500	PASS
802.11g	6M	1	2412.0	15.16	>500	PASS
802.11g	6M	6	2437.0	15.16	>500	PASS
802.11g	6M	11	2462.0	15.36	>500	PASS
802.11n20	MCS0	1	2412.0	15.97	>500	PASS
802.11n20	MCS0	6	2437.0	15.35	>500	PASS
802.11n20	MCS0	11	2462.0	15.17	>500	PASS
802.11n40	MCS0	3	2422.0	35.24	>500	PASS
802.11n40	MCS0	6	2437.0	35.24	>500	PASS
802.11n40	MCS0	9	2452.0	35.25	>500	PASS

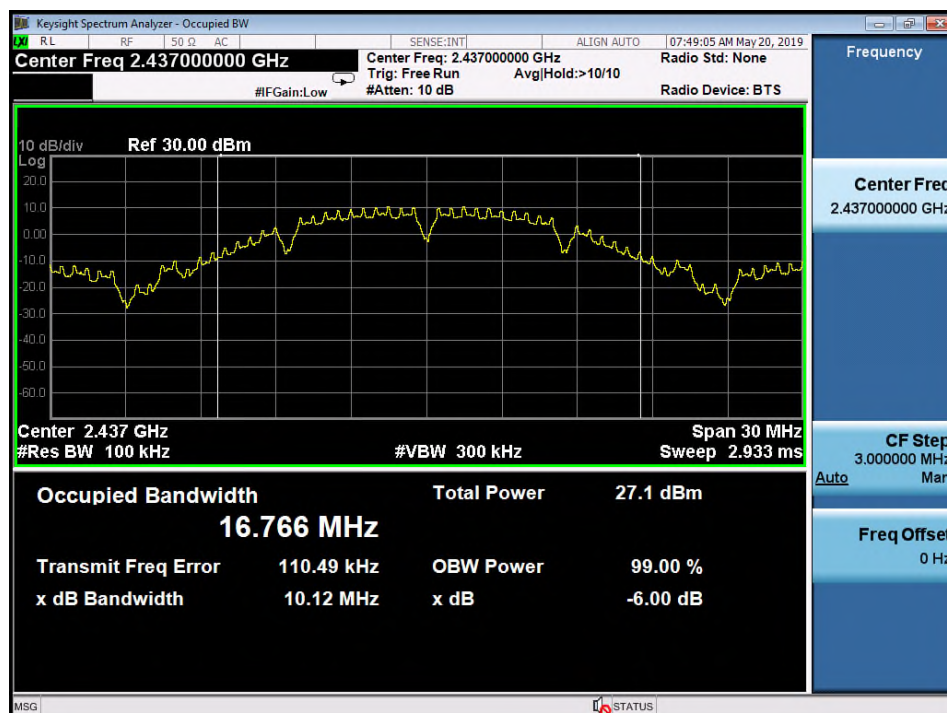
Test Plot of 6dB Bandwidth

802.11b

Low Channel



Middle Channel

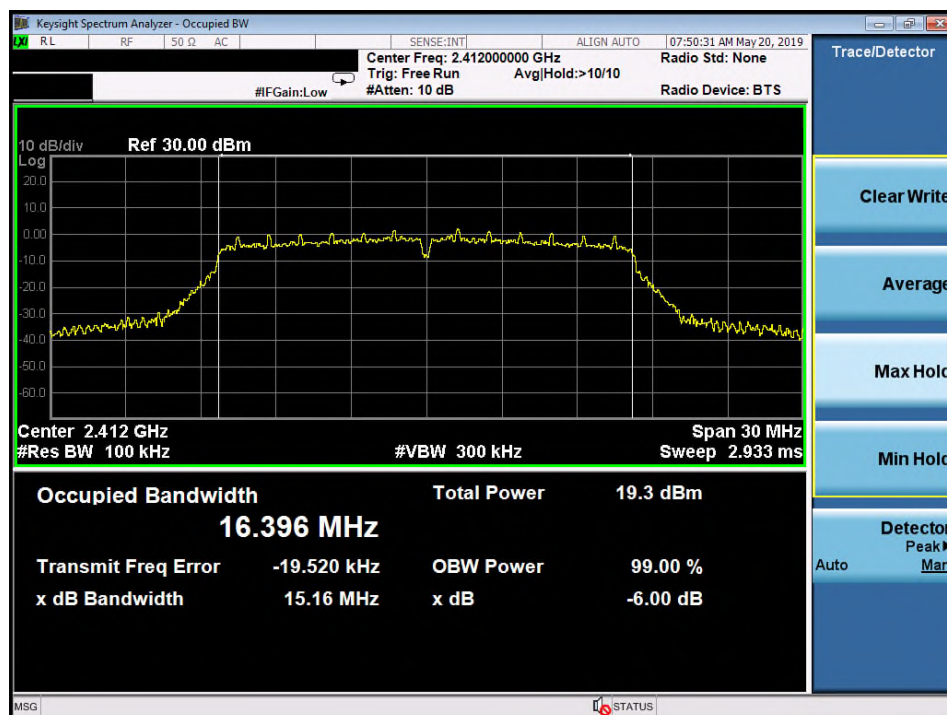


High Channel

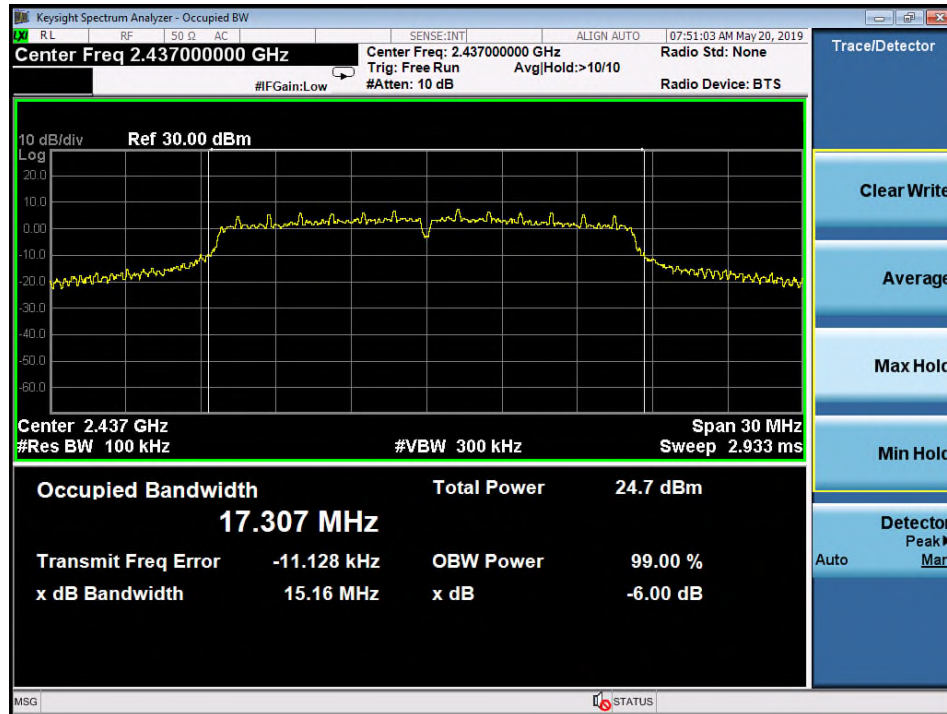


802.11g

Low Channel



Middle Channel

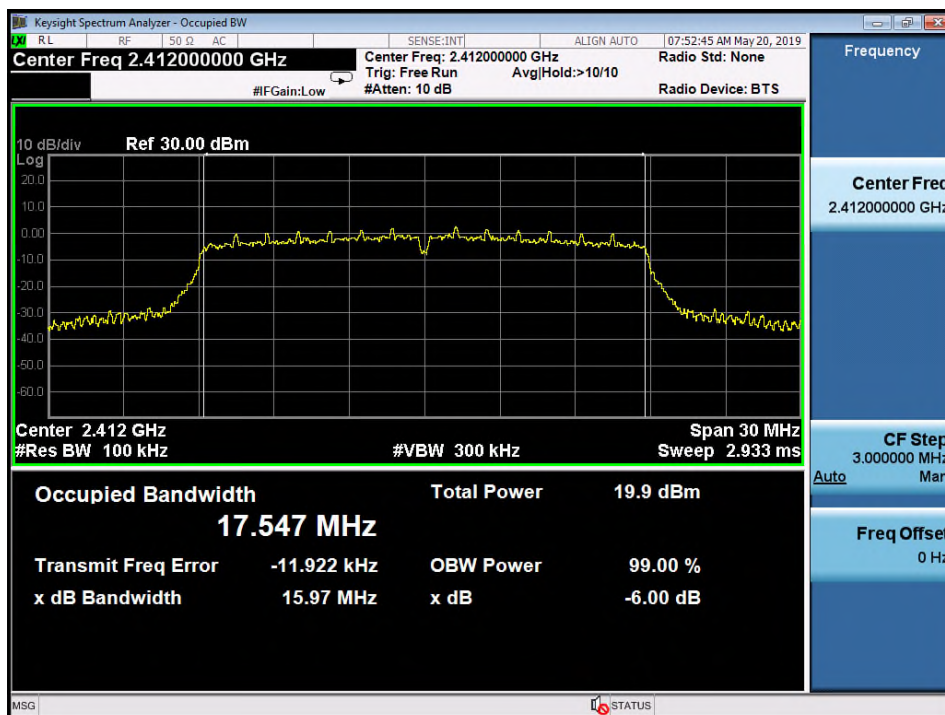


High Channel

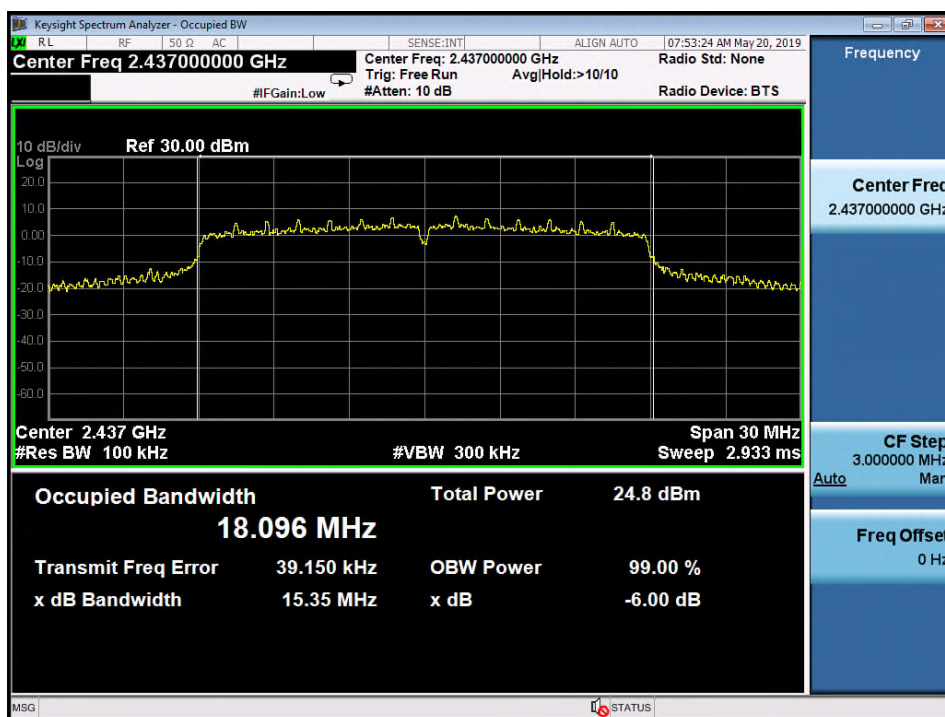


802.11n20

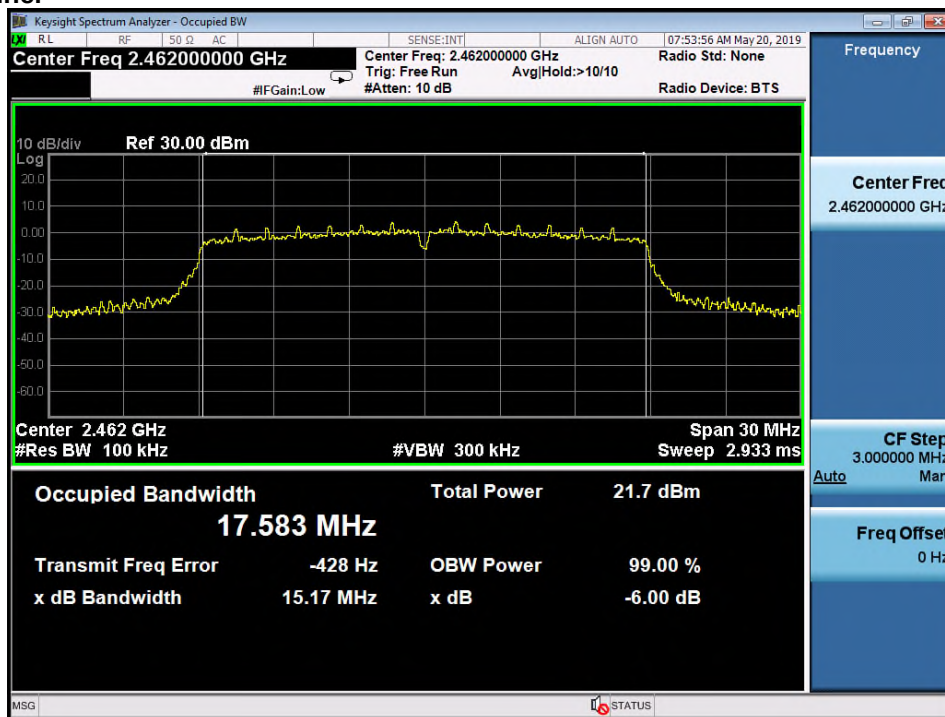
Low Channel



Middle Channel

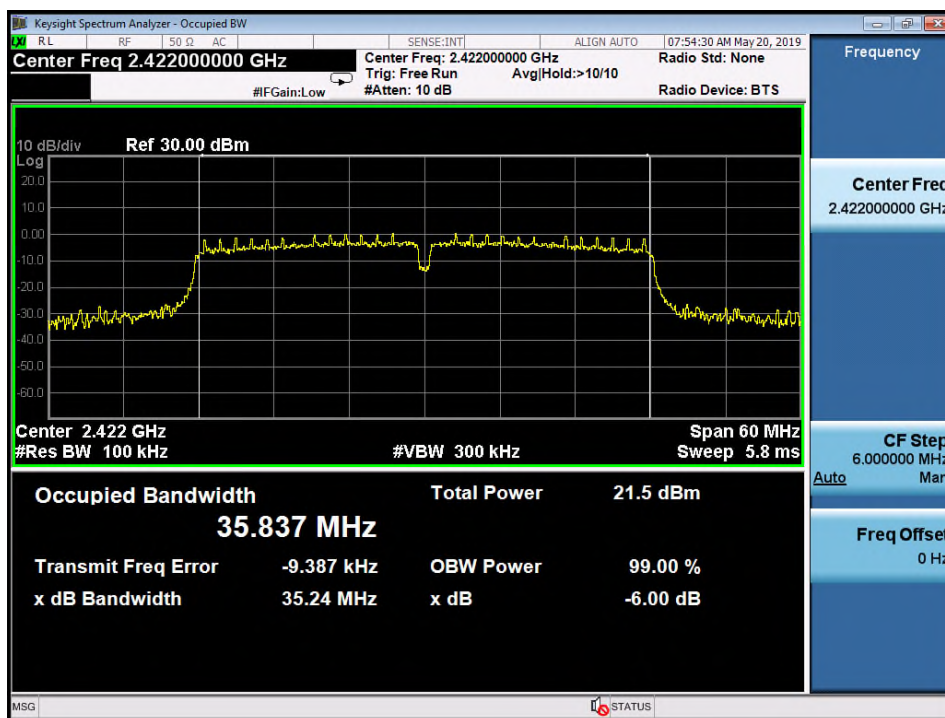


High Channel

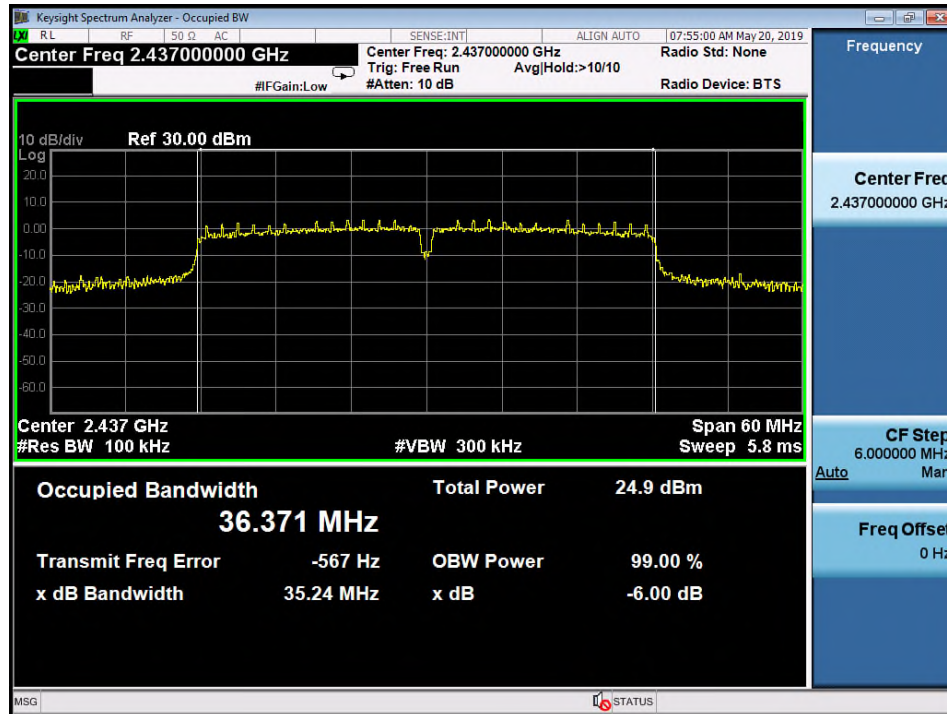


802.11n40

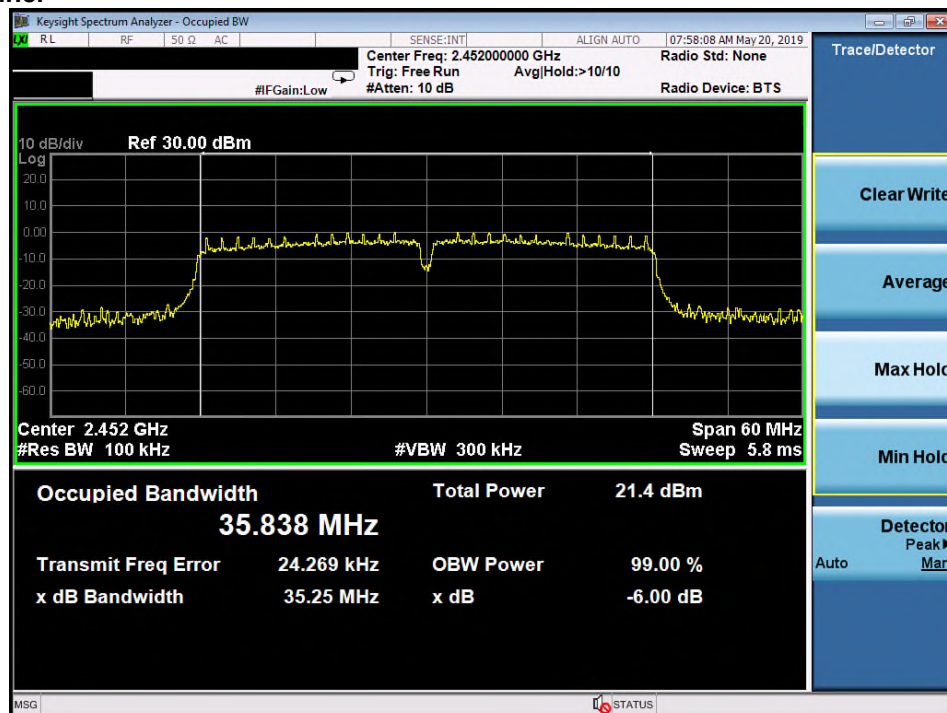
Low Channel



Middle Channel



High Channel



5.1.4 Power Density

RESULT:
Passed

Test standard : LP0002(2018): 3.10.1.6, (2)(B)

Basic standard : ANSI C63.10 (2013)

Kind of test site : Shielded room

Test setup

Test Channel : Low/ Middle/ High

Operation Mode : A

Ambient temperature : 20-24°C

Relative humidity : 50-65%

Atmospheric pressure : 100-103 kPa

Table 9: Test result of Power Density

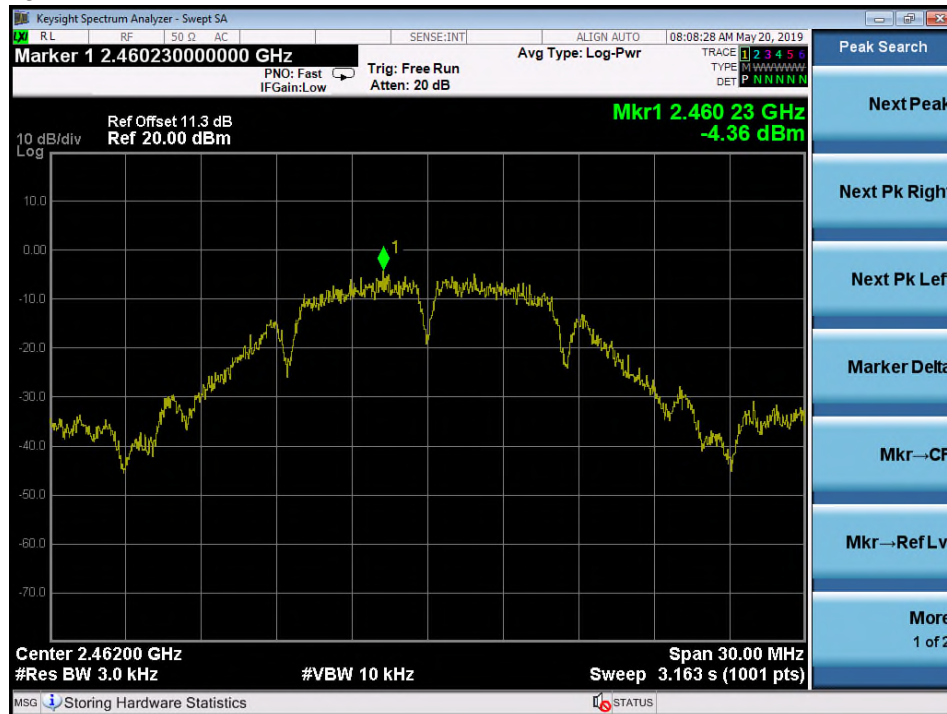
Band	Date Rate	CH	Frequency	Power Density	Limit	Result
			(MHz)	(dBm)	(dBm)	
802.11b	1M	1	2412.0	-6.88	8	PASS
802.11b	1M	6	2437.0	-3.55	8	PASS
802.11b	1M	11	2462.0	-4.36	8	PASS
802.11g	6M	1	2412.0	-11.83	8	PASS
802.11g	6M	6	2437.0	-7.67	8	PASS
802.11g	6M	11	2462.0	-9.94	8	PASS
802.11n20	MCS0	1	2412.0	-12.02	8	PASS
802.11n20	MCS0	6	2437.0	-8.83	8	PASS
802.11n20	MCS0	11	2462.0	-10.33	8	PASS
802.11n40	MCS0	3	2422.0	-14.60	8	PASS
802.11n40	MCS0	6	2437.0	-10.56	8	PASS
802.11n40	MCS0	9	2452.0	-14.82	8	PASS

Test Plot of Power Density

802.11b
Low Channel

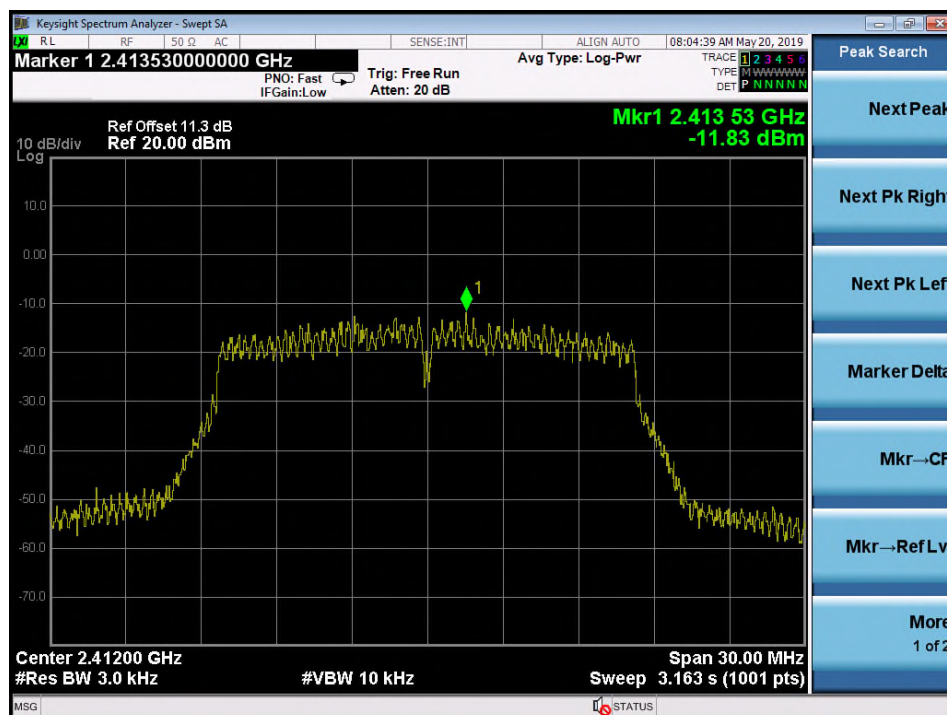
Middle Channel


High Channel

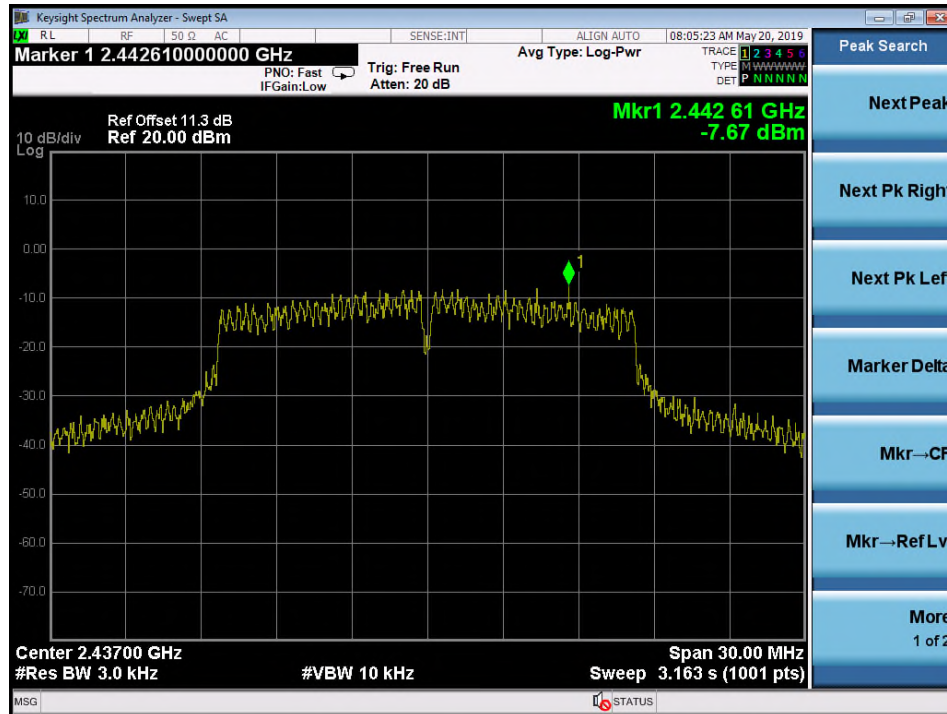


802.11g

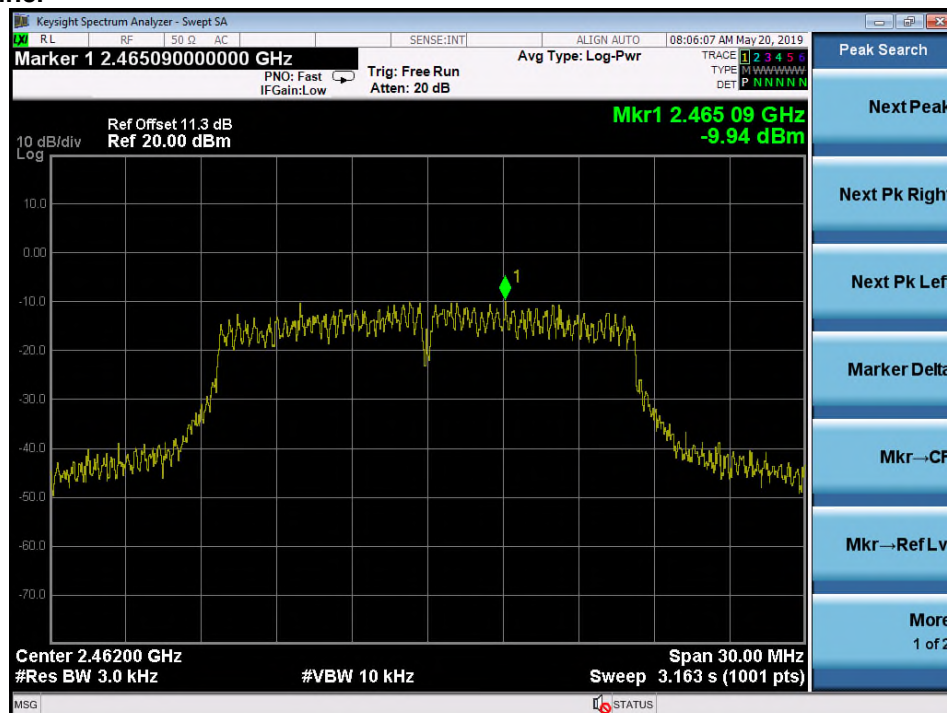
Low Channel



Middle Channel

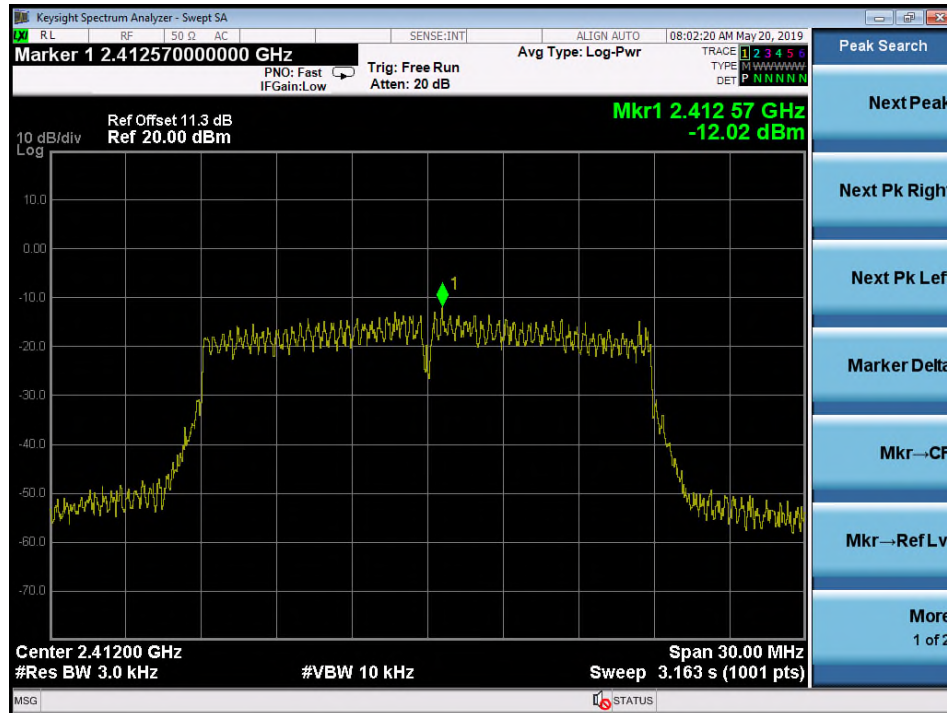


High Channel

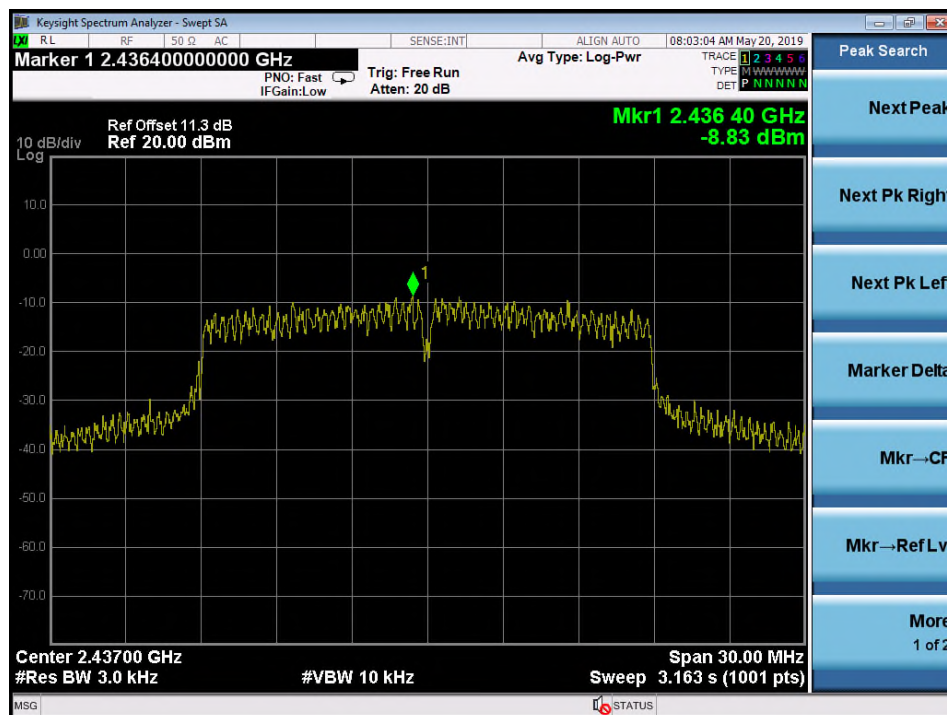


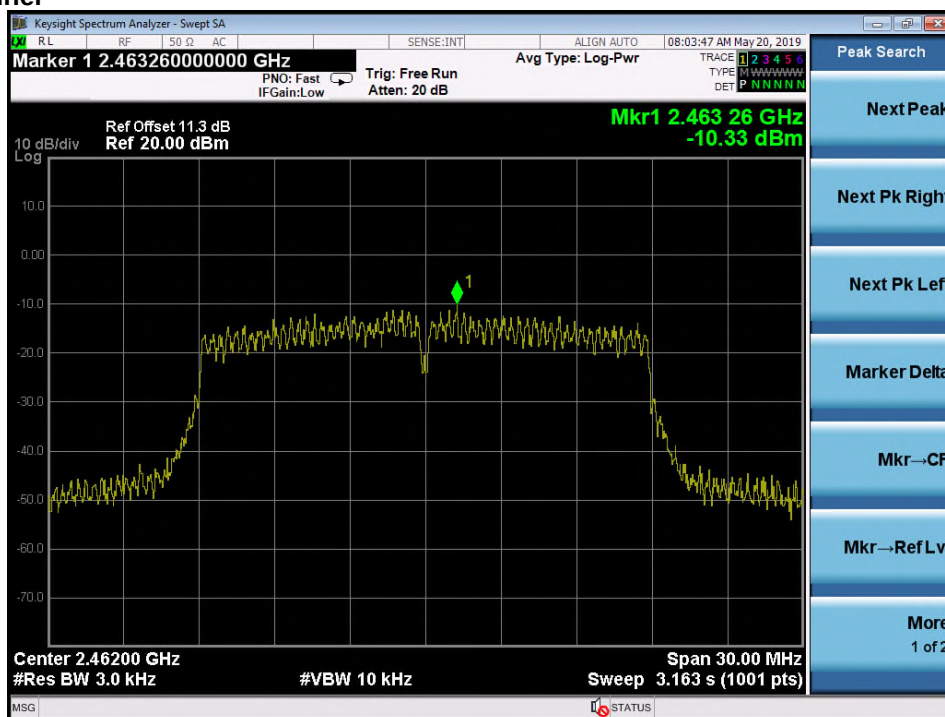
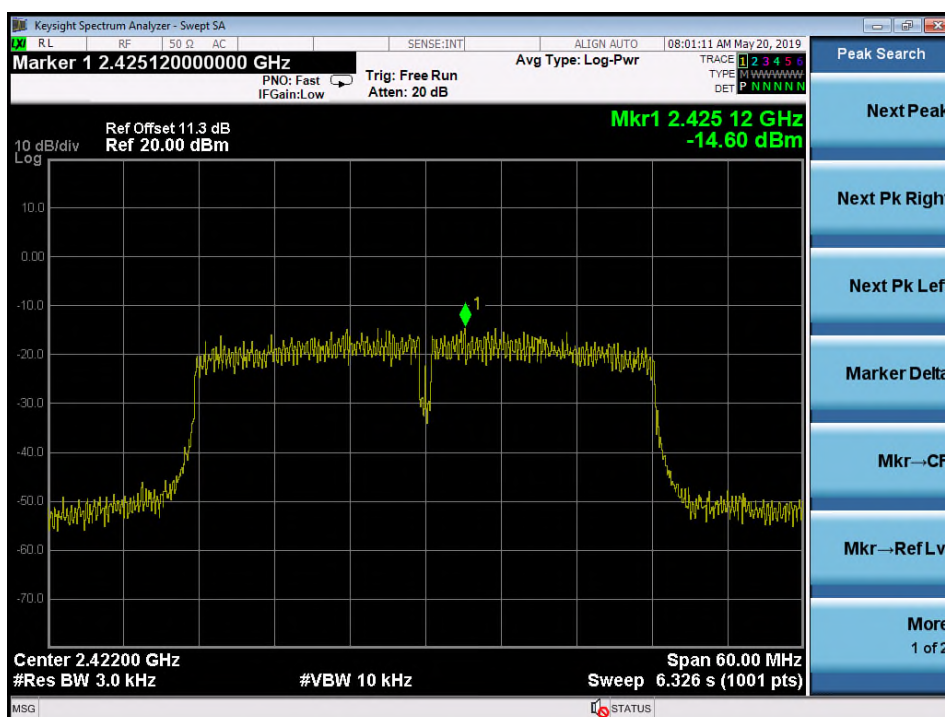
802.11n20

Low Channel

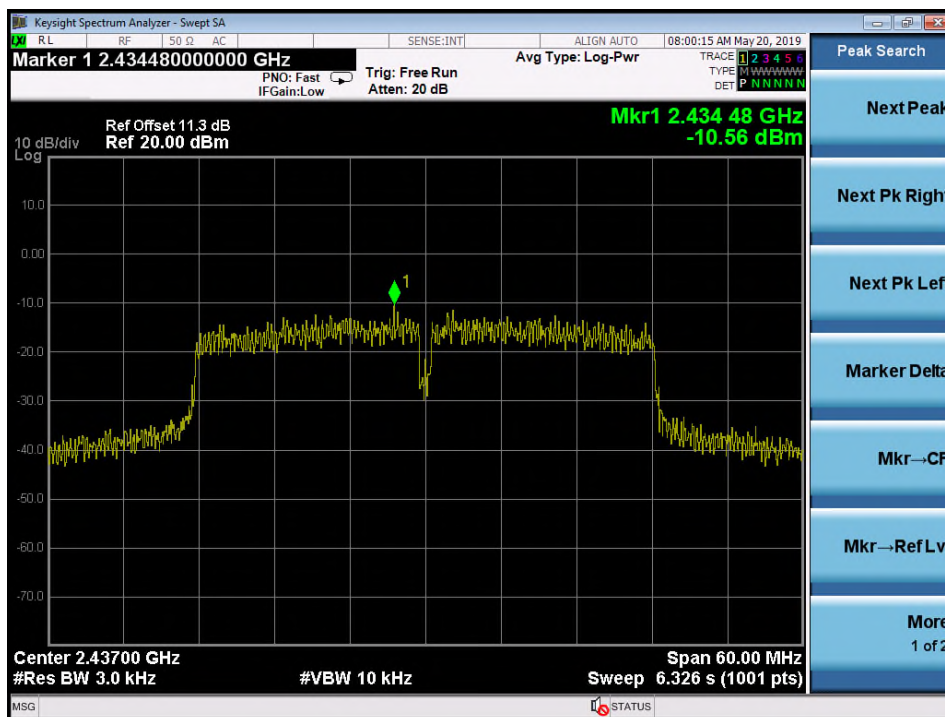


Middle Channel

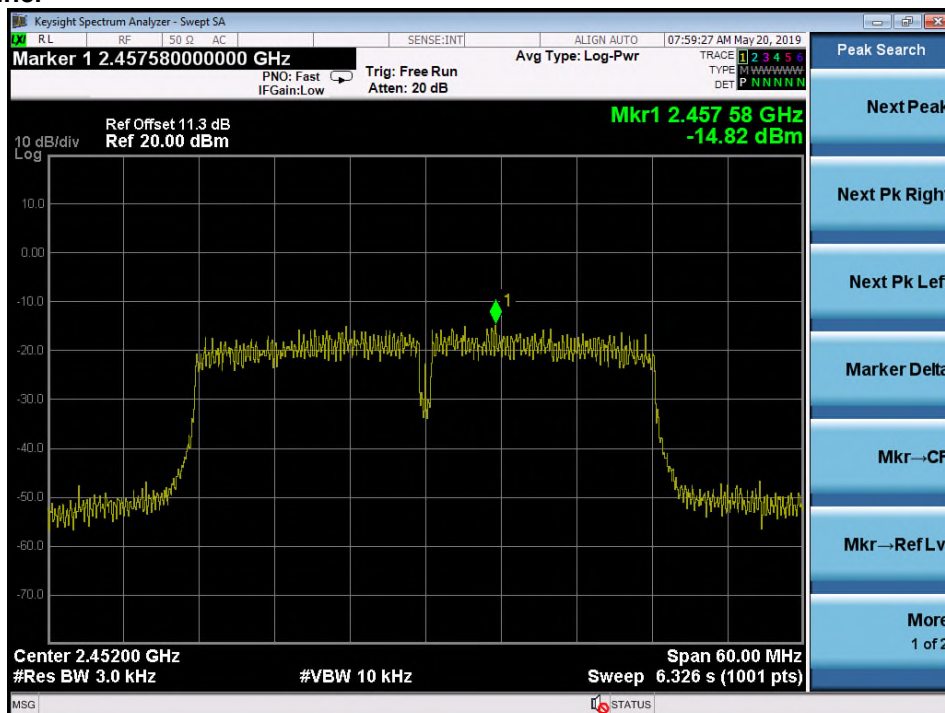


High Channel

802.11n40
Low Channel


Middle Channel



High Channel



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

RESULT:**Passed**

Test standard	:	LP0002(2018): 3.10.1.5
Basic standard	:	ANSI C63.10 (2013)
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/ Middle/ High for Conducted Spurious Emissions Low/ High for Frequency Band Edge
Operation Mode	:	A
Ambient temperature	:	20-24°C
Relative humidity	:	50-65%
Atmospheric pressure	:	100-103 kPa

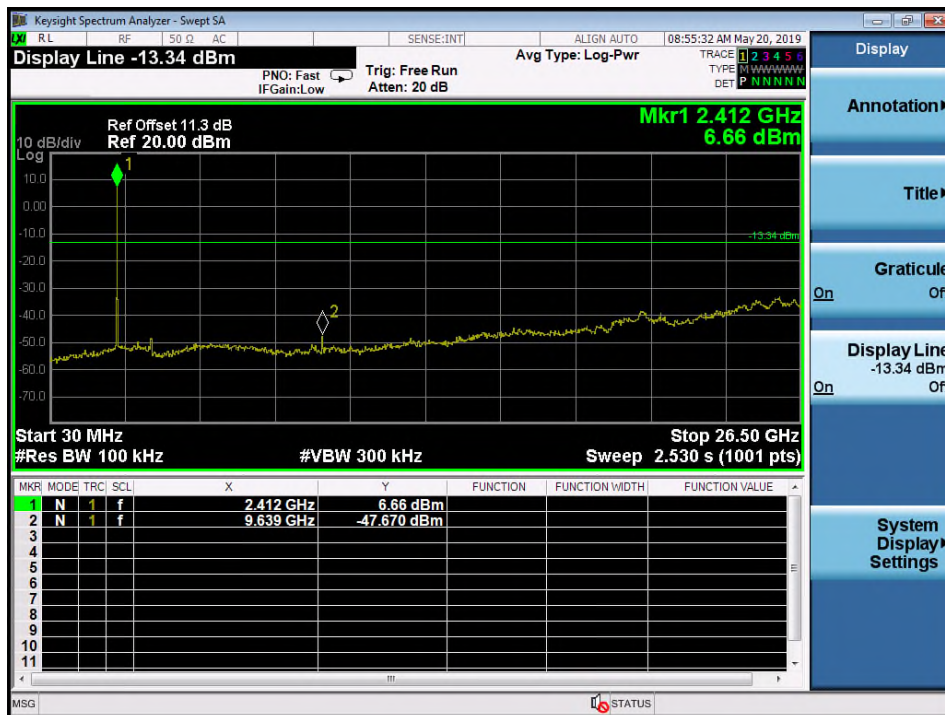
All emissions are more than 20dB below fundamental, details refer to following test plot, and compliance is achieved as well.

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.

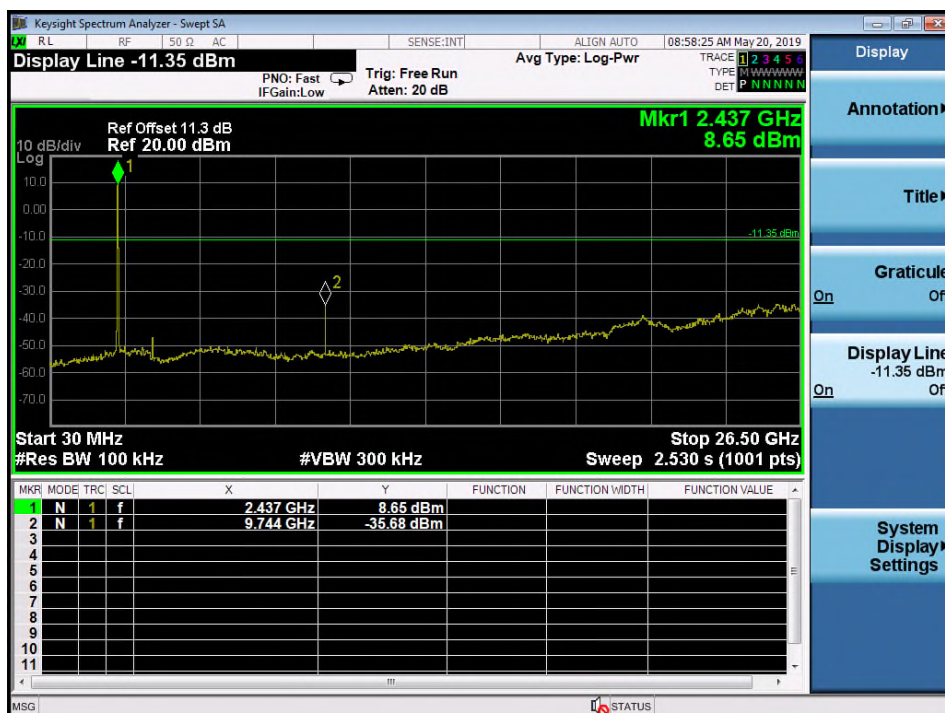
Test Plot 100kHz Conducted Emissions

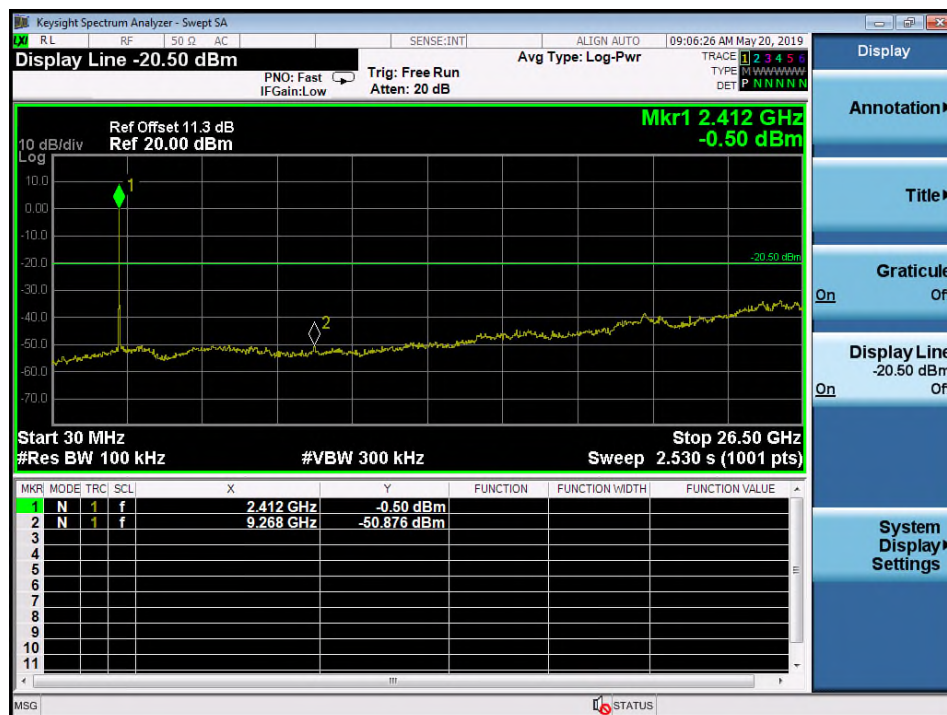
802.11b

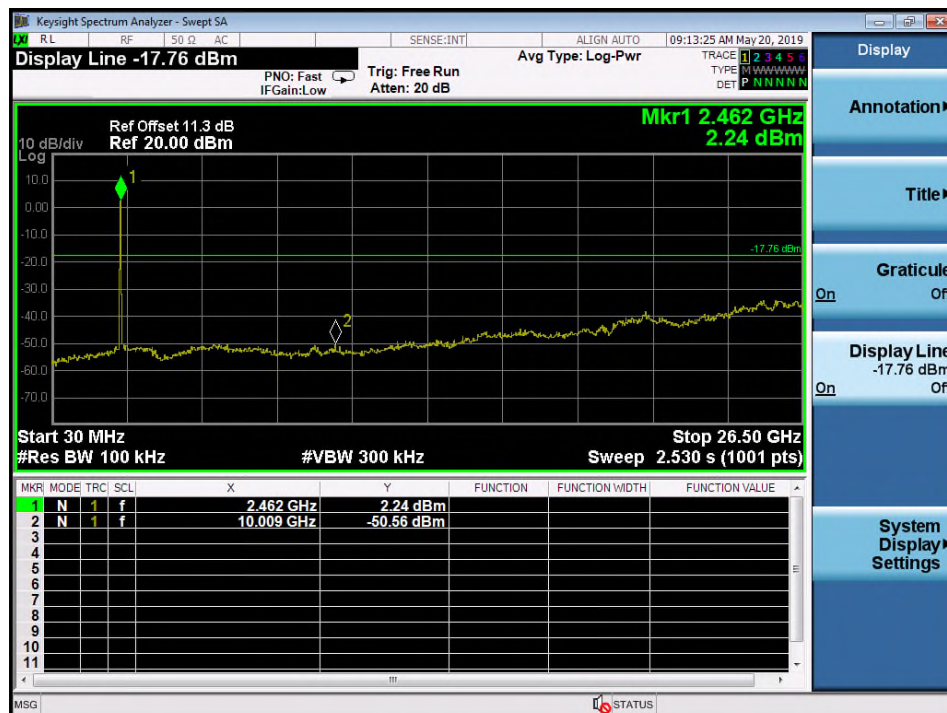
Low Channel

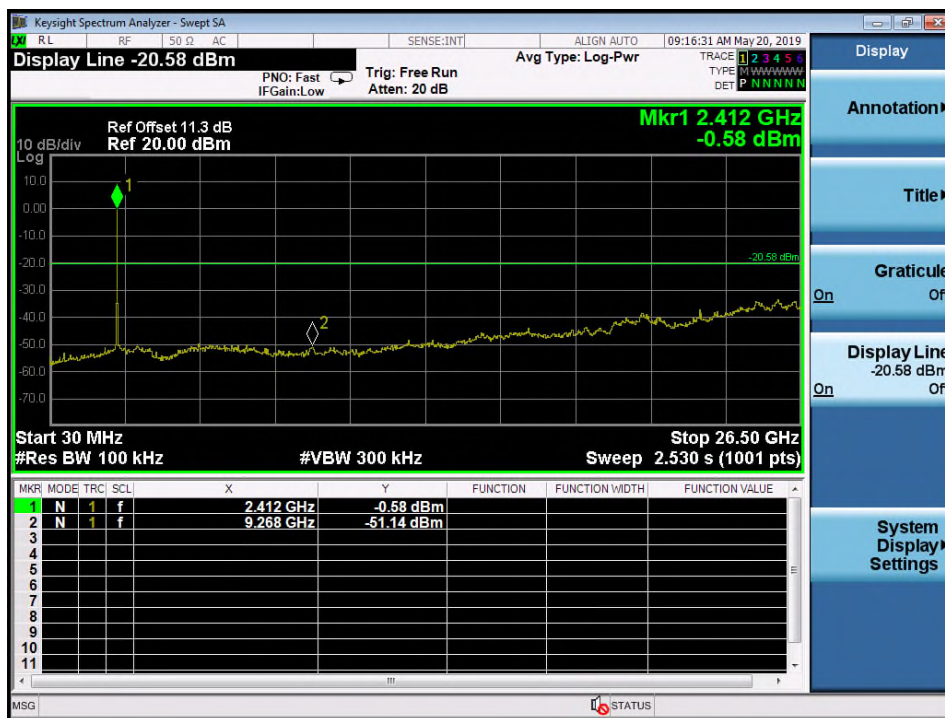
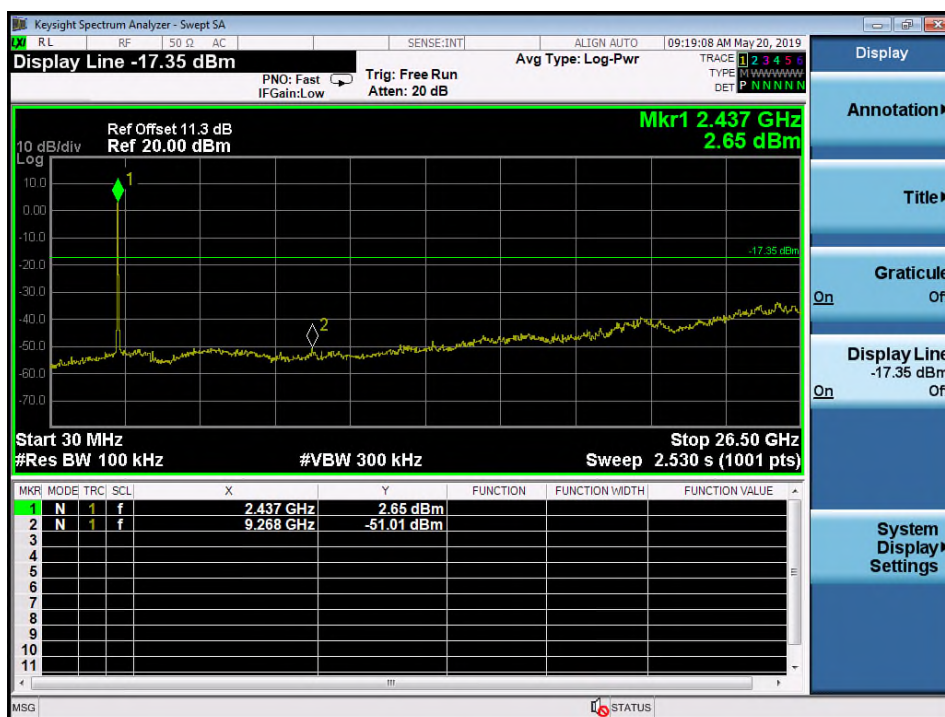


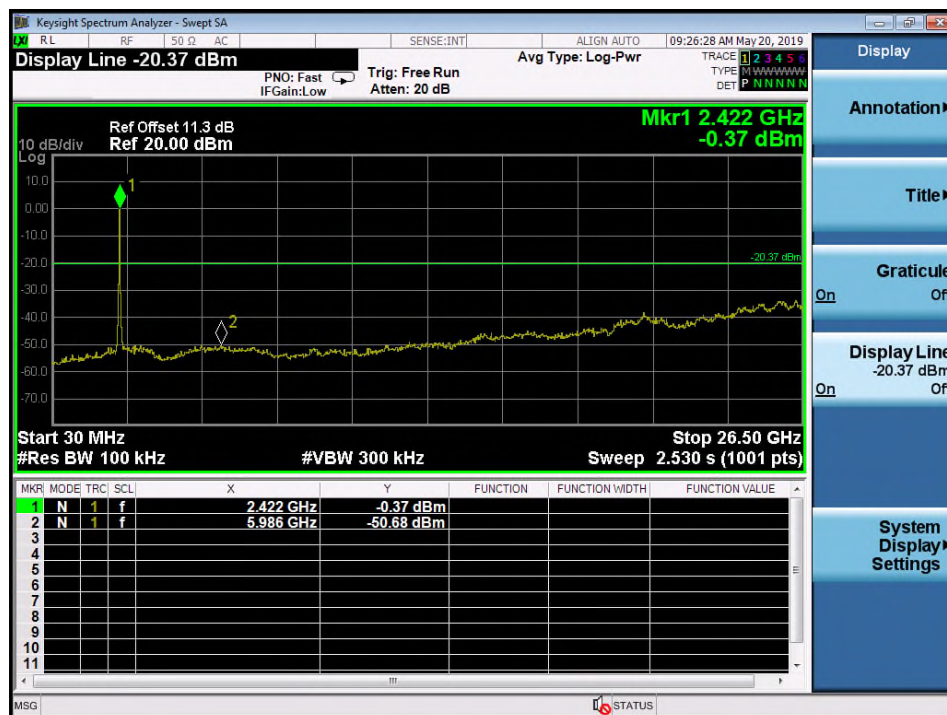
Middle Channel

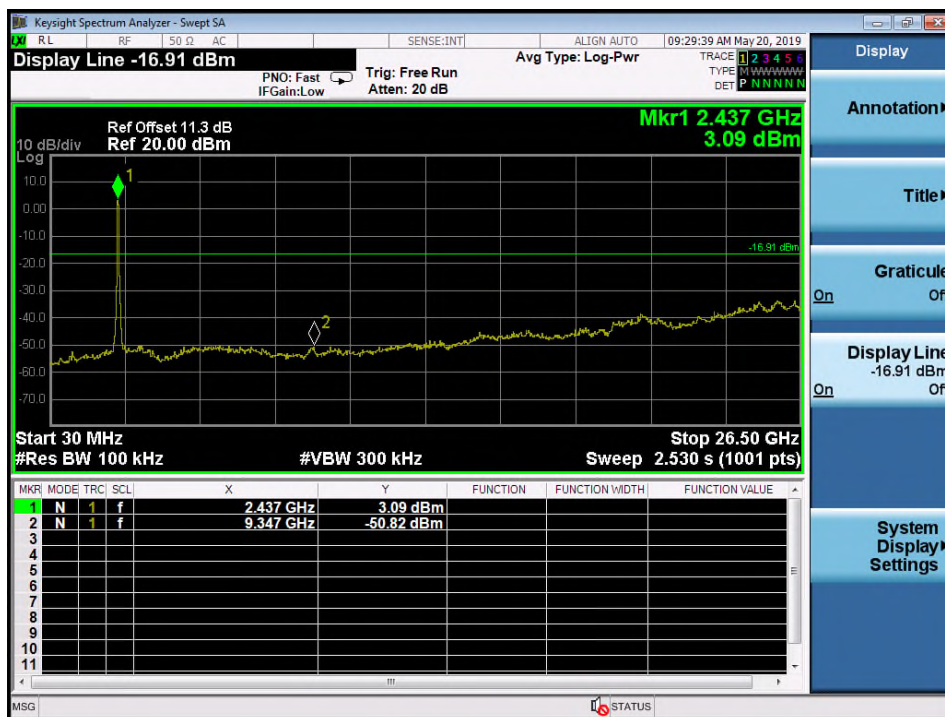
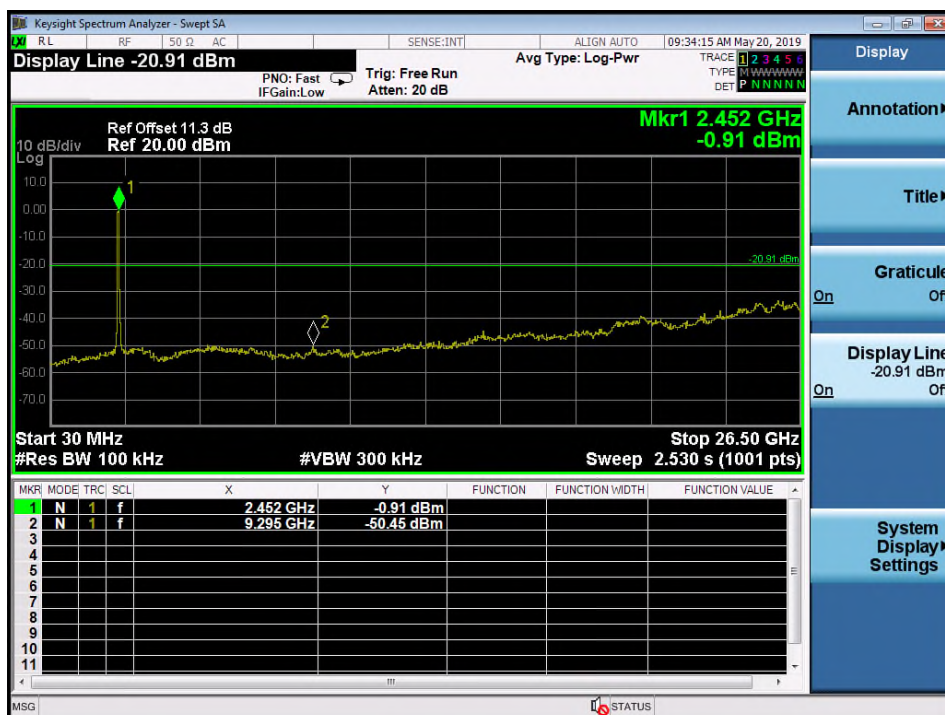






802.11n20
Low Channel

Middle Channel




Middle Channel

High Channel


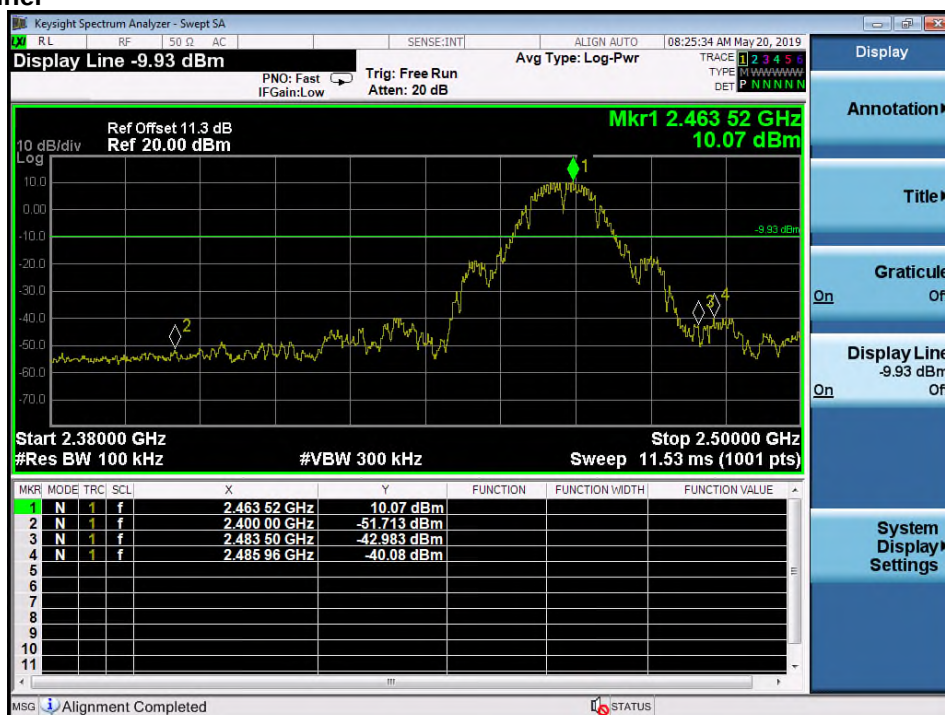
Test Plot 100kHz RBW of Band Edge

802.11b

Low Channel

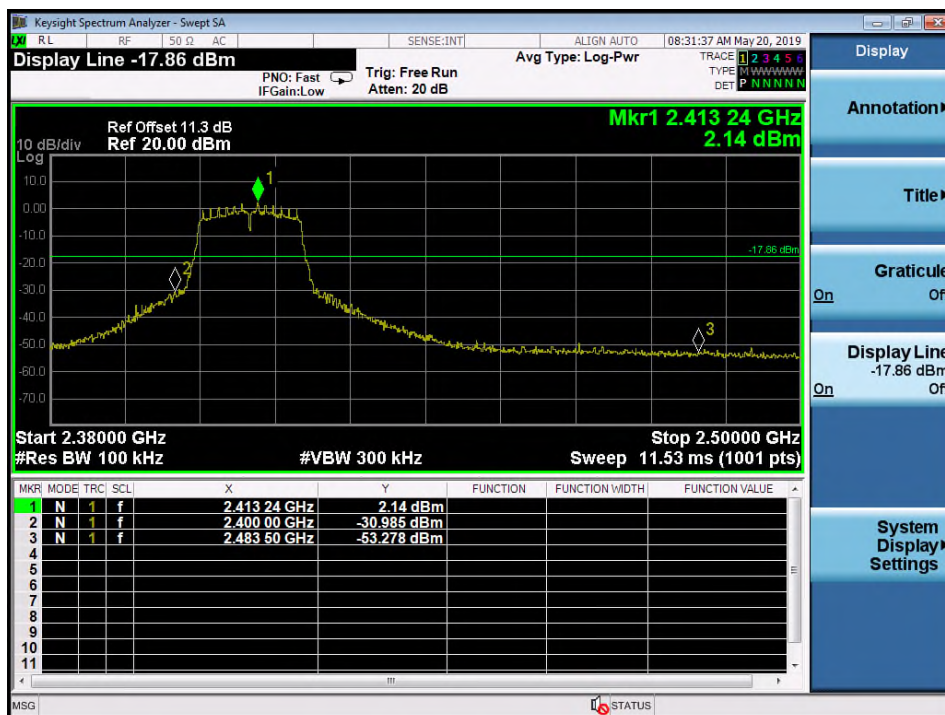


High Channel

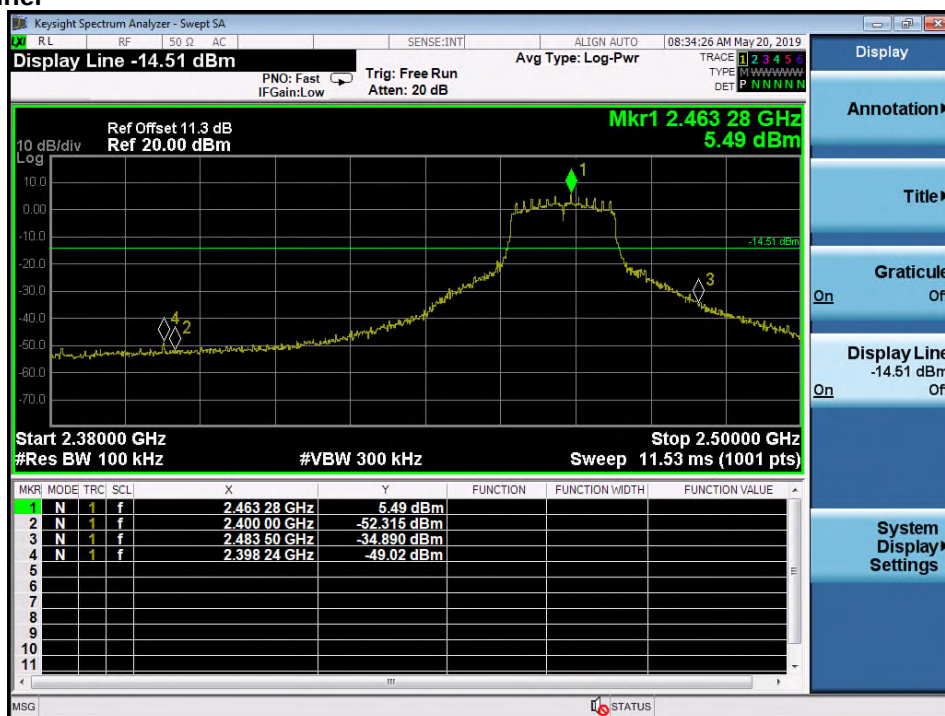


802.11g

Low Channel

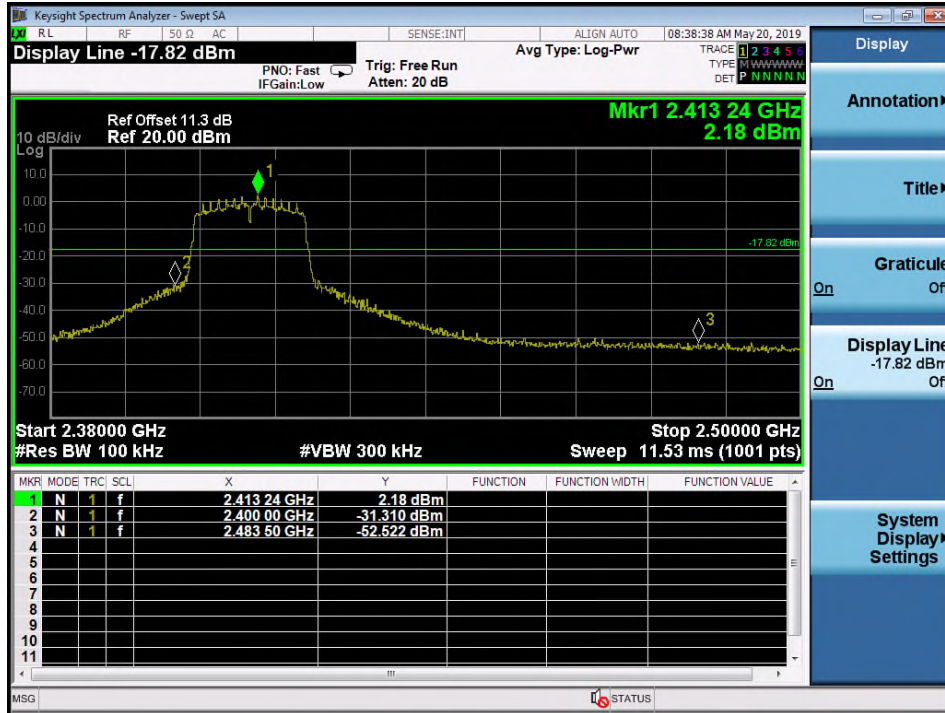


High Channel

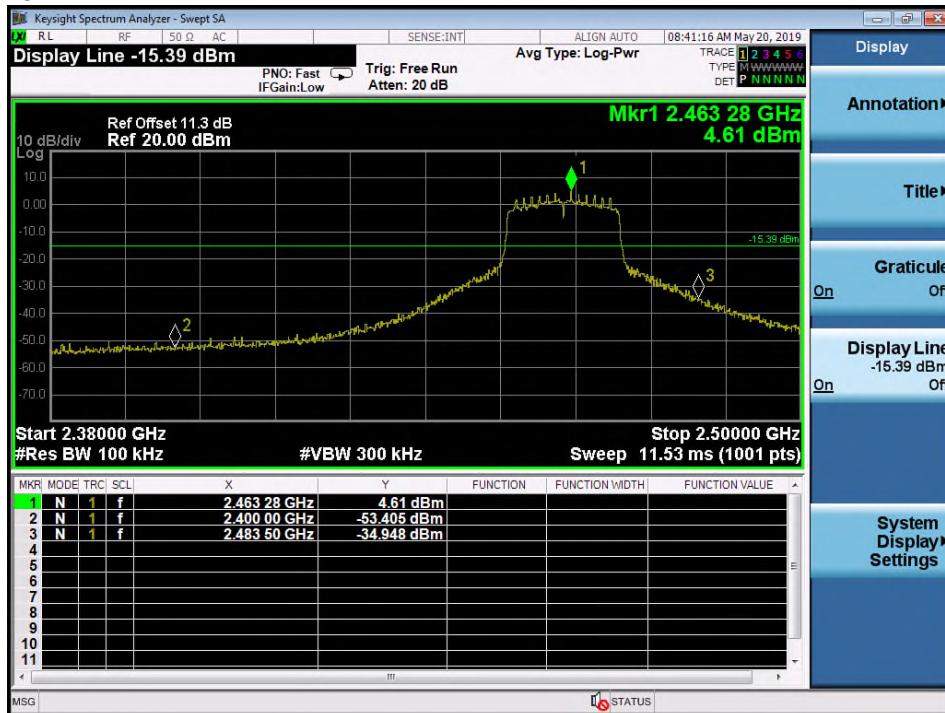


802.11n20

Low Channel



High Channel



802.11n40

Low Channel



High Channel



5.1.6 Spurious Emission

RESULT:**Passed**

Test standard	:	LP0002(2018): 3.10.1.5, (2)
Basic standard	:	ANSI C63.10 (2013)
Limits	:	Radiated emissions which fall in the restricted bands, as defined in LP0002(2018): 2.7 , must comply with the radiated emission limits specified in LP0002(2018): 2.8 Emission radiated outside the specified frequency bands must comply with the radiated emission limits specified in LP0002(2018): 2.8
Kind of test site	:	3m Semi-Anechoic Chamber

Test setup

Test Channel	:	Low/ Middle/ High
Operation mode	:	A,B

Testing was carried out within frequency range 9kHz 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 worst-case Axis orientation is recorded in this test report.

5.2 Mains Emissions

5.2.1 Mains Conducted Emissions

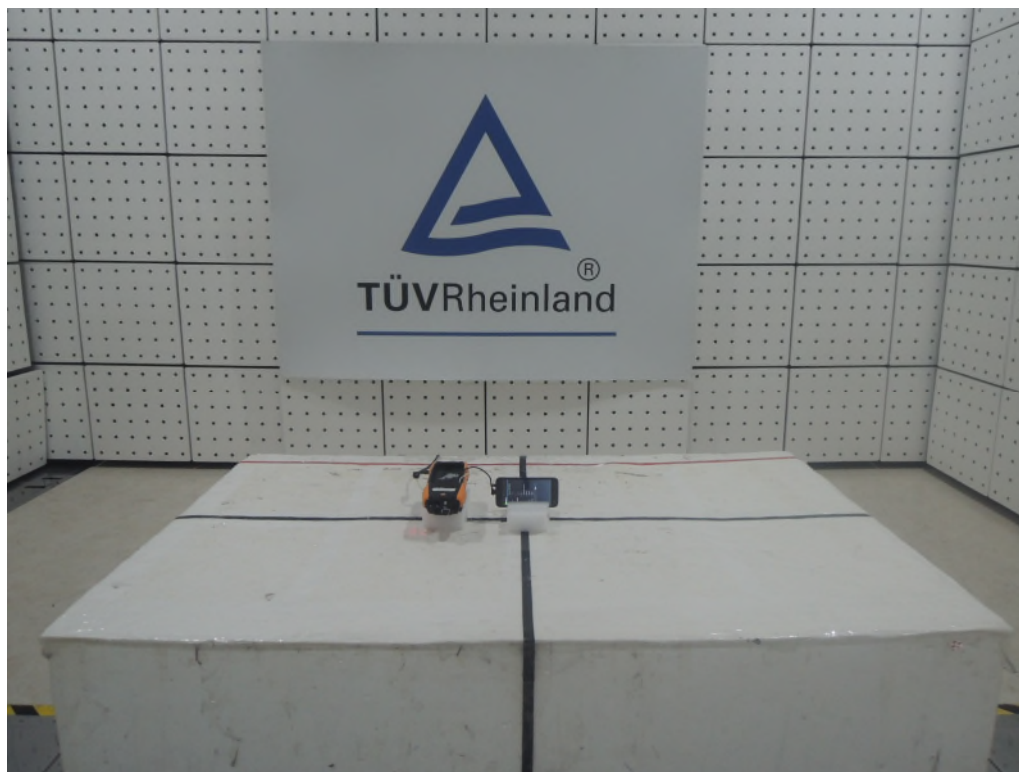
RESULT:**Passed**

Test standard	:	LP0002(2018): 2.3
Limits	:	Mains Conducted emissions as defined in above test standards must comply with the mains conducted emission limits specified
Kind of test site	:	Shielded Room
Test setup		
Test Channel	:	Middle
Operation mode	:	A
Ambient temperature	:	20-24°C
Relative humidity	:	50-65%
Atmospheric pressure	:	100-103 kPa

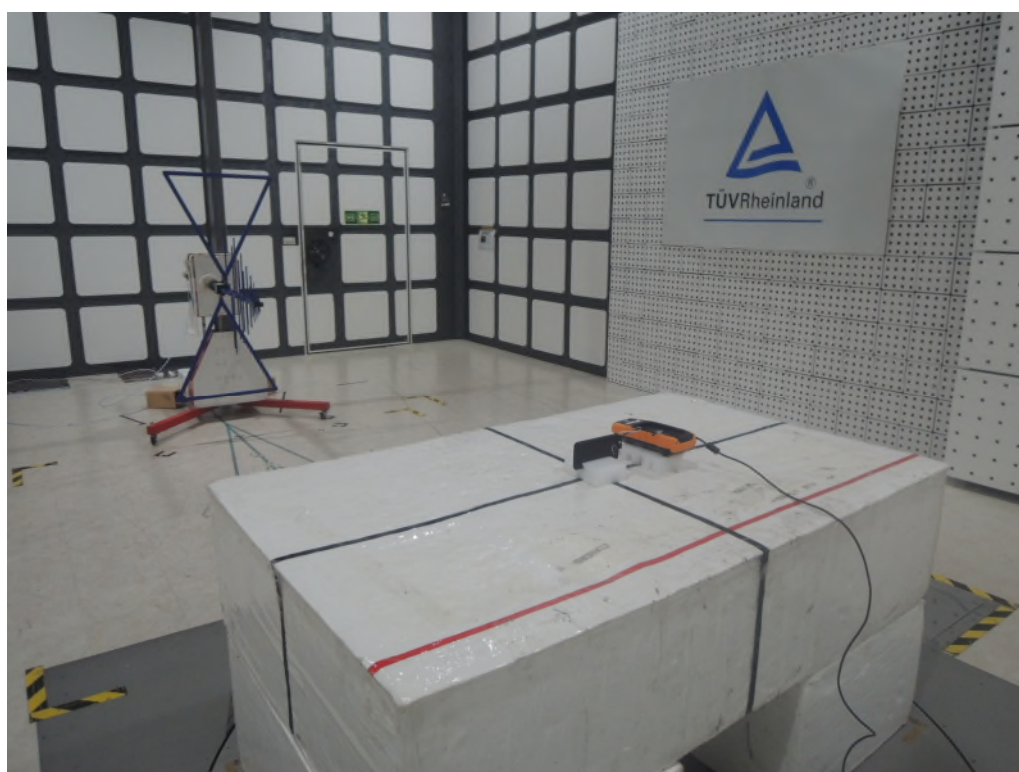
Remark: For details refer to Appendix D.

6. Photographs of the Test Set-Up

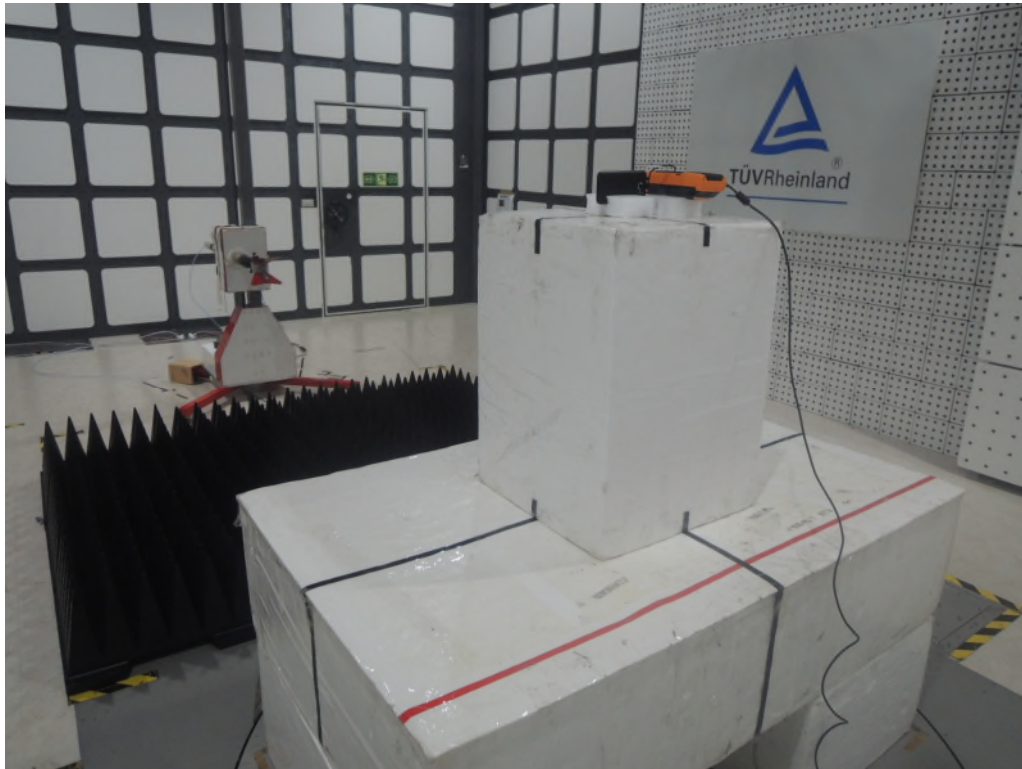
Photograph 1: Set-up for Spurious Emissions (Front View)



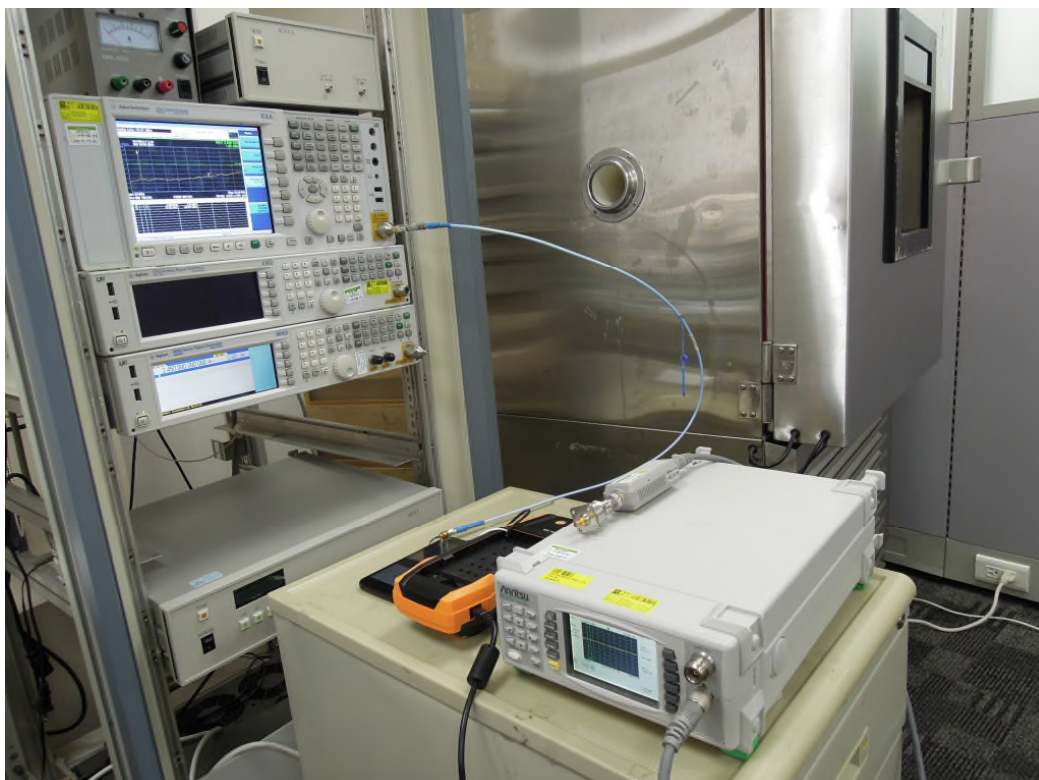
Photograph 2: Set-up for Spurious Emissions (Back View 1)



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



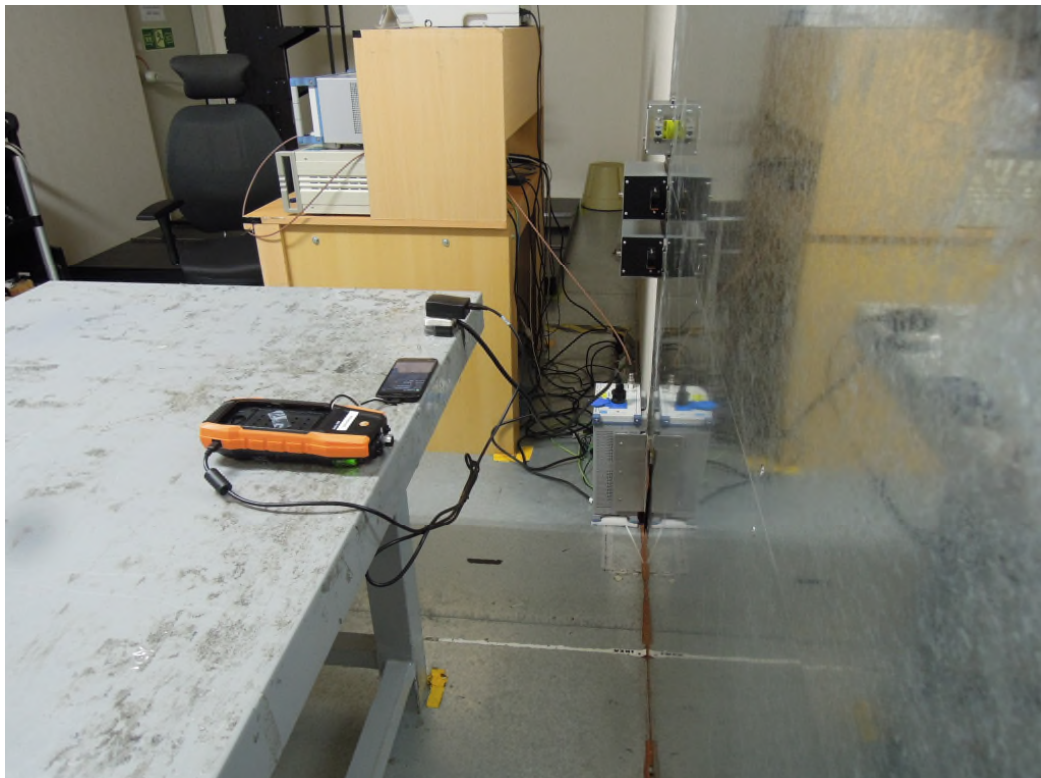
Photograph 4: Set-up for Conducted testing



Photograph 5: Set-up for AC Mains (Front View)



Photograph 6: Set-up for AC Mains (Back View)



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