

Prüfbericht-Nr.: Test Report No.:	50271749 001	Auftrags-Nr.: Order No.:	114083434	Seite 1 on 52 Page 1 of 52
Kunden-Referenz-Nr.: Client Reference No.:	N/A	Auftragsdatum: Order date:	24-Oct-2018	
Auftraggeber: Client:	安儀精密儀器有限公司 臺北市大同區天水路 46 號 1 樓			
Prüfgegenstand: Test item:	GIS 資料蒐集器			
Bezeichnung / Typ-Nr.: Identification / Type No.:	Zeno 20			
Auftrags-Inhalt: Order content:	NCC LP0002 Test report			
Prüfgrundlage: Test specification:	NCC Low-power Radio-frequency Devices Technical Regulations LP0002(2018) Section 3.10.1			
Wareneingangsdatum: Date of receipt:	30-Oct-2018			
Prüfmuster-Nr.: Test sample No.:	A000830237-006(Conducted) A000830237-007(Radiated)			
Prüfzeitraum: Testing period:	03-Jul-2019 – 16-Jul-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: 22-Jul-2019 Brenda Chen/Senior Project Manager Datum Name / Stellung Unterschrift Date(Report Date) Name / Position Signature		kontrolliert von / reviewed by: 22-Jul-2019 Arvin Ho/Vice General Manager 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. 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.				

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 100 kHz 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: 50271749 001 APPENDIX P)

Appendix D: Test Result of Radiated Emissions

(File Name: 50271749 001 APPENDIX D)

Test Specifications

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

Table 1: Applied Standard and Test Levels

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

1.2 Decision Rule of conformity

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.
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.)

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	101514	2019/02/07	2020/02/07
EXA Signal Analyzer	KEYSIGHT	N9010A	MY53470241	2019/02/15	2020/02/15
Preamplifier (30MHz -1GHz)	HP	8447D	2944A09270	2018/08/31	2019/08/31
Preamplifier (18 GHz -40 GHz)	EMC Instruments	EMC184045SE	980652	2019/02/25	2020/02/25
Pre-Amplifier (1GHz~18GHz)	EM Electronics	EM01G18G	060649	2018/08/24	2019/08/24
Bilog Antenna	TESEQ	CBL 6111D	29802	2018/08/22	2019/08/22
Horn Antenna	ETS-Lindgren	3117	00201918	2018/08/23	2019/08/23
Horn Antenna (18GHz~40GHz)	COM-POWER	AH-840	101029	2018/12/22	2019/12/22
Loop Antenna	Schwarzbeck	FMZB 1513	1513-076	2019/07/11	2020/07/11
Two-Line V-Network	R&S	ENV216	101243	2019/06/23	2020/06/23
EMI Test Receiver	R&S	ESCI 7	100797	2019/01/16	2020/01/16

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 basis 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	$\pm 1.5 \text{ dB}$
Adjacent channel power	$\pm 3 \text{ dB}$
Radiated emission of transmitter, valid up to 26 GHz	$\pm 6 \text{ dB}$
Radiated emission of receiver, valid up to 26 GHz	$\pm 6 \text{ dB}$
Temperature	$\pm 2 \text{ }^{\circ}\text{C}$
Humidity	$\pm 10 \text{ } \%$

3. General Product Information

3.1 Product Function and Intended Use

The EUT is a GIS collector. 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 Circuit Diagram.

3.2 System Details and Ratings

Table 4: Basic Information of EUT

Item	EUT information
Kind of Equipment	GIS 資料蒐集器
Type Designation	Zeno 20
Brand Name	Leica

Table 5: Technical Specification of EUT

Technical Specification	Value
Operating Frequencies	802.11b/g/n HT20 : 2412 MHz ~ 2462 MHz
Channel Spacing	802.11b/g/n HT20 : 5MHz
Channel number	802.11b/g/n HT20 : 11
Operation Voltage	3.7 Vdc
Modulation	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Antenna gain	3.33 dBi

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 | - Circuit Diagram |
| - PCB Layout | - Instruction Manual |
| - Photo Document | - Rating Label |
| - Technical Description | |

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: The Test samples are provided with an application used to enable the operation modes listed in section 3.3 as appropriate.

The samples were used as follows:
Conducted sample: A000830237-006
Radiation sample: A000830237-007

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 MCS0 data rate were chosen for full testing.

4.3 Special Accessories and Auxiliary Equipment

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

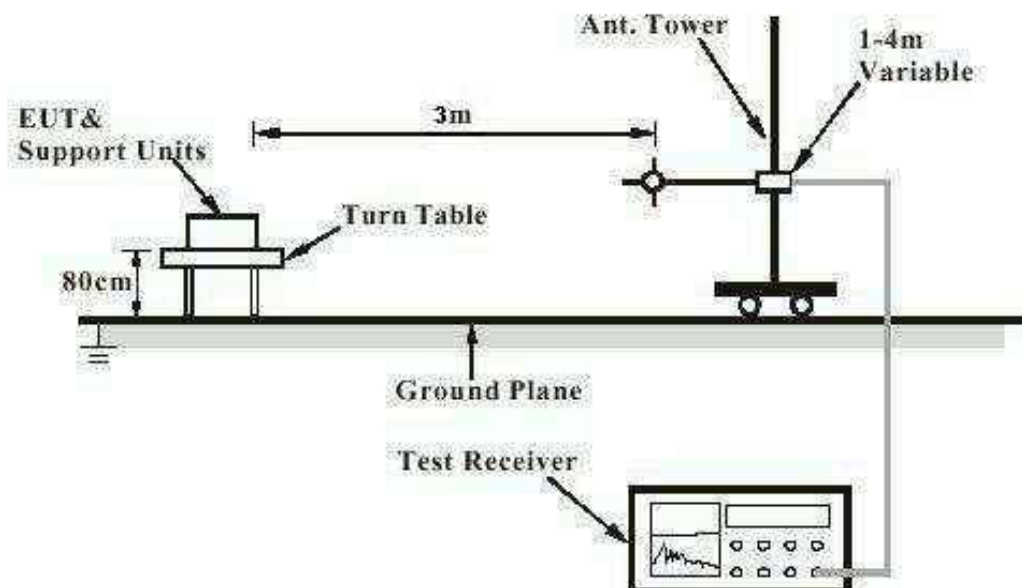
Description	Manufacturer	Model No.	Serial No.
Test application	-	WiFi_FCC_Certification_Test_v1.2.cab	-
Adapter for AC mains	Apple	A1401	-

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)

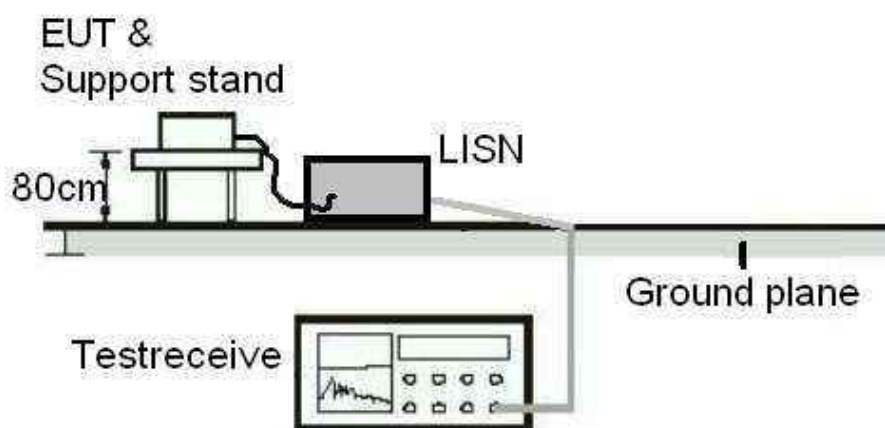
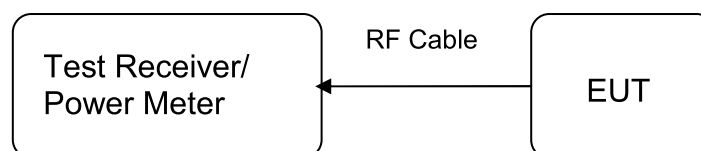


Diagram of Measurement Equipment Configuration for Conducted Transmitter Measurement



5. Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT:**Passed**

Test standard : LP0002(2018): 2.2, 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 only one antenna(1T1R) with a directional gain of 1.57dBi .The antenna is a Carrier 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.

5.1.2 Peak Output Power

RESULT:**Passed**

Test standard	:	LP0002(2018): 3.10.1.2(1)(C)
Basic standard	:	ANSI C63.10:2013, KDB558074, LP0002(2018) Appendix II
Limit	:	1 Watt
Kind of test site	:	Shielded room

Test setup

Test Channel	:	Low/ Middle/ High
Operation Mode	:	A
Ambient temperature	:	22-26 °C
Relative humidity	:	50-65 %
Atmospheric pressure	:	100-103 kPa

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

Channel	Channel Frequency (MHz)	Output Power		Limit
		(dBm)	(W)	(W)
Low Channel	2412	17.23	0.05284	1
Middle Channel	2437	16.83	0.04819	1
High Channel	2462	16.38	0.04345	1

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

Channel	Channel Frequency (MHz)	Output Power		Limit
		(dBm)	(W)	(W)
Low Channel	2412	24.65	0.29174	1
Middle Channel	2437	24.69	0.29444	1
High Channel	2462	24.63	0.29040	1

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

Channel	Channel Frequency (MHz)	Output Power		Limit
		(dBm)	(W)	(W)
Low Channel	2412	22.06	0.16069	1
Middle Channel	2437	24.61	0.28907	1
High Channel	2462	24.62	0.28973	1

5.1.3 6dB Bandwidth

RESULT:**Passed**

Test standard : LP0002(2018): 3.10.1.6(2)(A)
Basic standard : ANSI C63.10:2013, KDB558074,
LP0002(2018) Appendix II
Kind of test site : Shielded room

Test setup

Test Channel : Low/ Middle/ High
Operation Mode : A

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

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

Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
Low Channel	2412	9.102	0.5	Pass
Mid Channel	2437	9.093	0.5	Pass
High Channel	2462	9.094	0.5	Pass

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

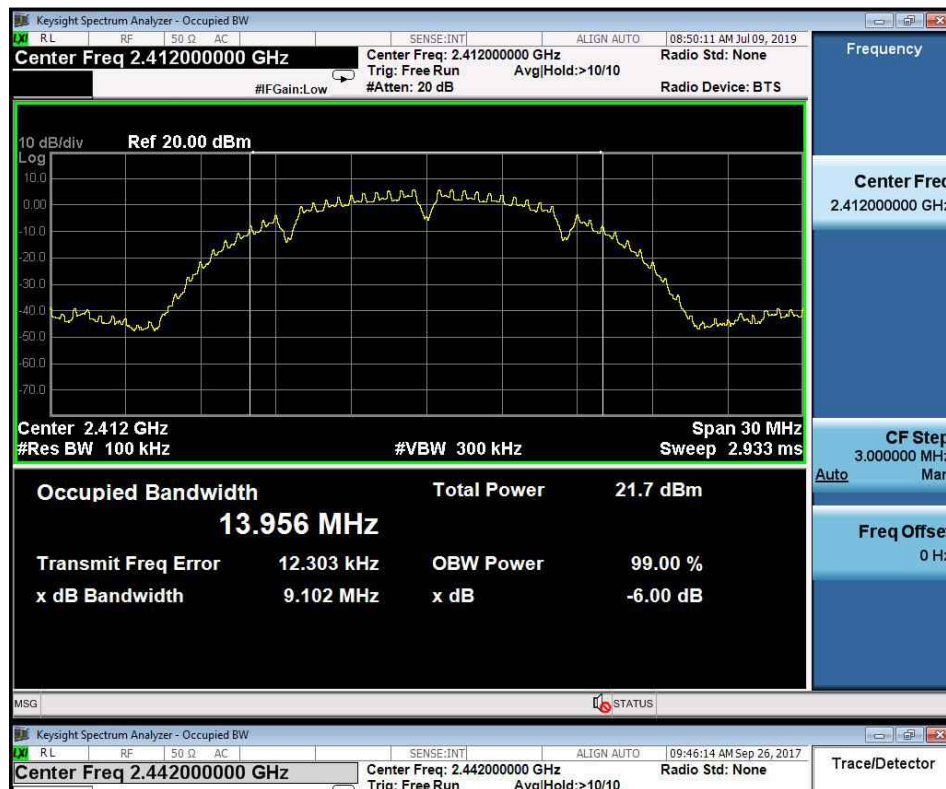
Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
Low Channel	2412	15.17	0.5	Pass
Mid Channel	2437	15.17	0.5	Pass
High Channel	2462	15.35	0.5	Pass

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

Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
Low Channel	2412	15.33	0.5	Pass
Mid Channel	2437	15.36	0.5	Pass
High Channel	2462	15.17	0.5	Pass

Test Plot of 6dB Bandwidth (802.11b)

Low Channel



Middle Channel



High Channel



Test Plot of 6dB Bandwidth (802.11g)

Low Channel



Middle Channel

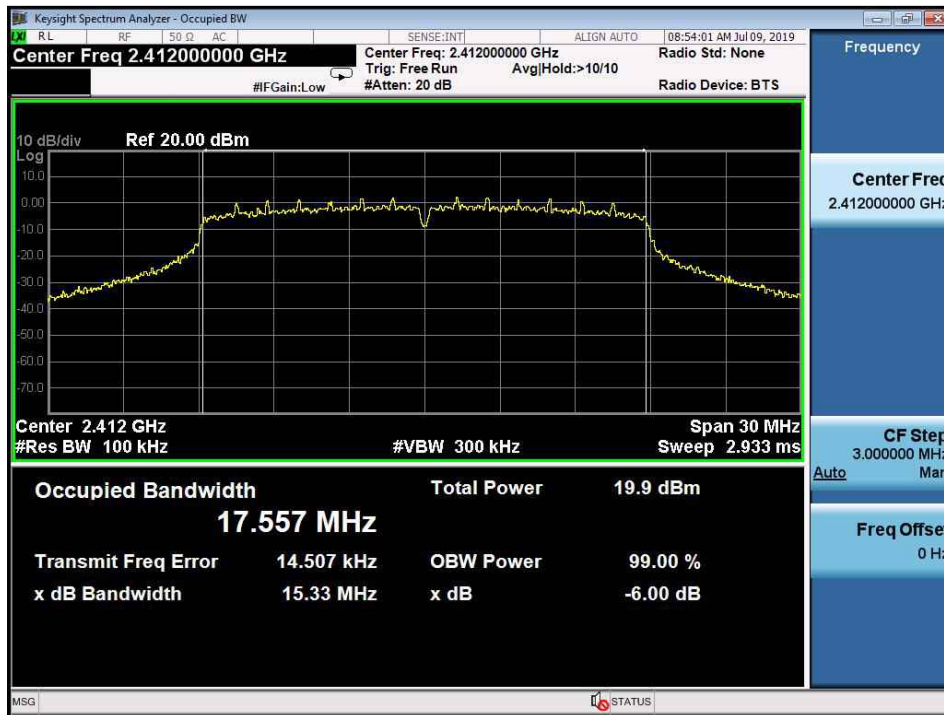


High Channel

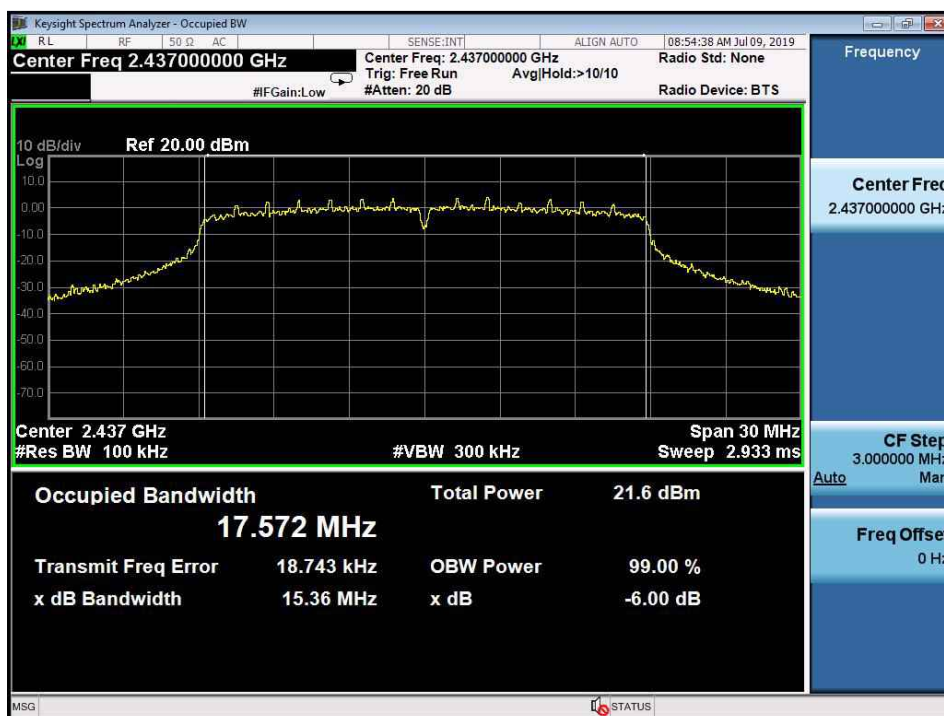


Test Plot of 6dB Bandwidth (802.11n HT20)

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, KDB558074,
LP0002(2018) Appendix II
Kind of test site : Shielded room

Test setup

Test Channel : Low/ Middle/ High
Operation Mode : A
Ambient temperature : 22-26°C
Relative humidity : 50-65%
Atmospheric pressure : 100-103 kPa

Table 12: Test result of Power Density (802.11b)

Channel	Channel Frequency (MHz)	Power Density	Limit
		(dBm)	(dBm)
Low Channel	2412	-8.5	8
Middle Channel	2437	-8.88	8
High Channel	2462	-8.96	8

Table 13: Test result of Power Density (802.11g)

Channel	Channel Frequency (MHz)	Power Density	Limit
		(dBm)	(dBm)
Low Channel	2412	-11.46	8
Middle Channel	2437	-10.22	8
High Channel	2462	-10.87	8

Table 14: Test result of Power Density (802.11n HT20)

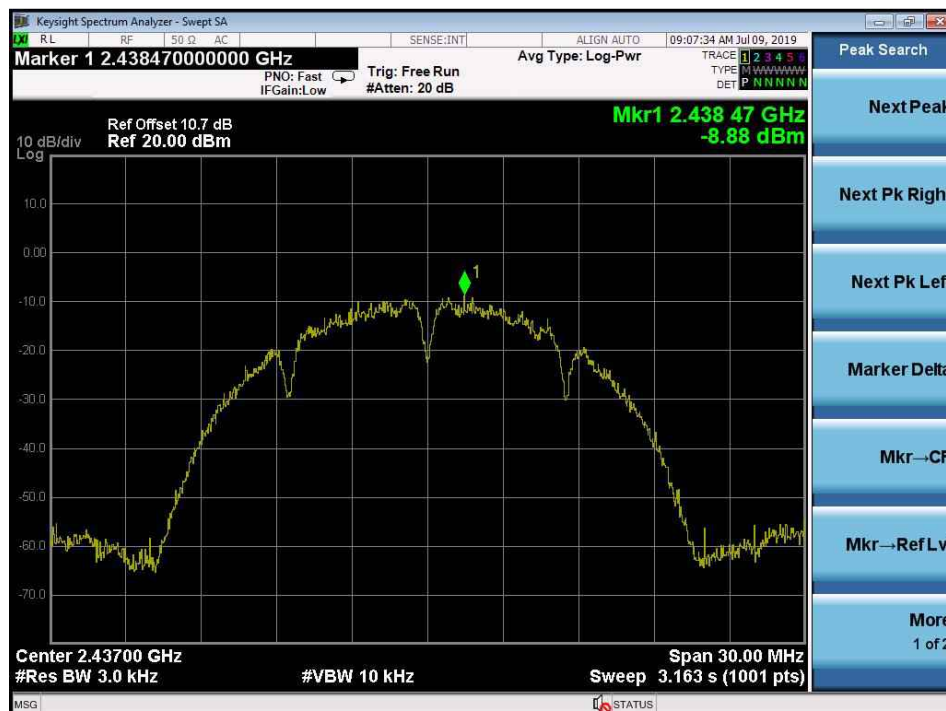
Channel	Channel Frequency (MHz)	Power Density	Limit
		(dBm)	(dBm)
Low Channel	2412	-12.49	8
Middle Channel	2437	-10.67	8
High Channel	2462	-10.34	8

Test Plot of Power Density (802.11b)

Low Channel



Middle Channel

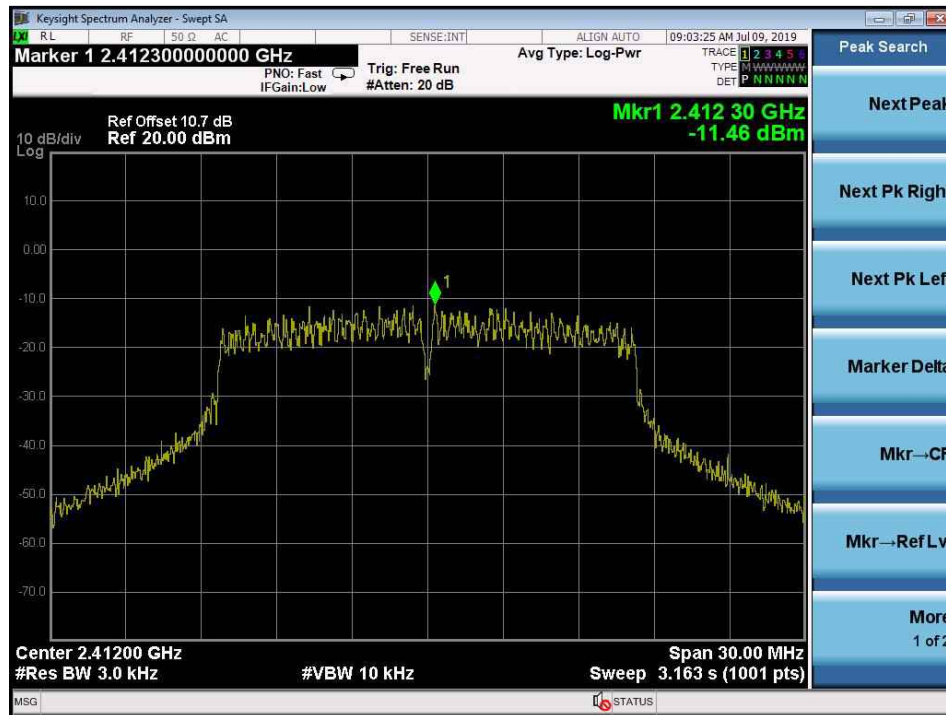


High Channel

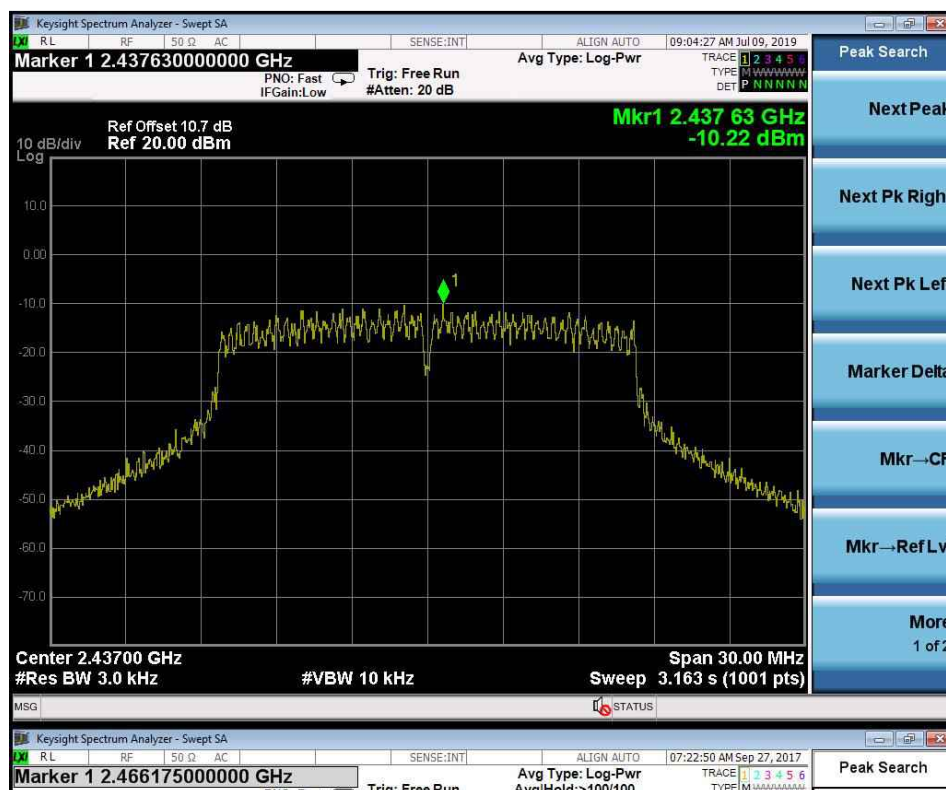


Test Plot of Power Density (802.11g)

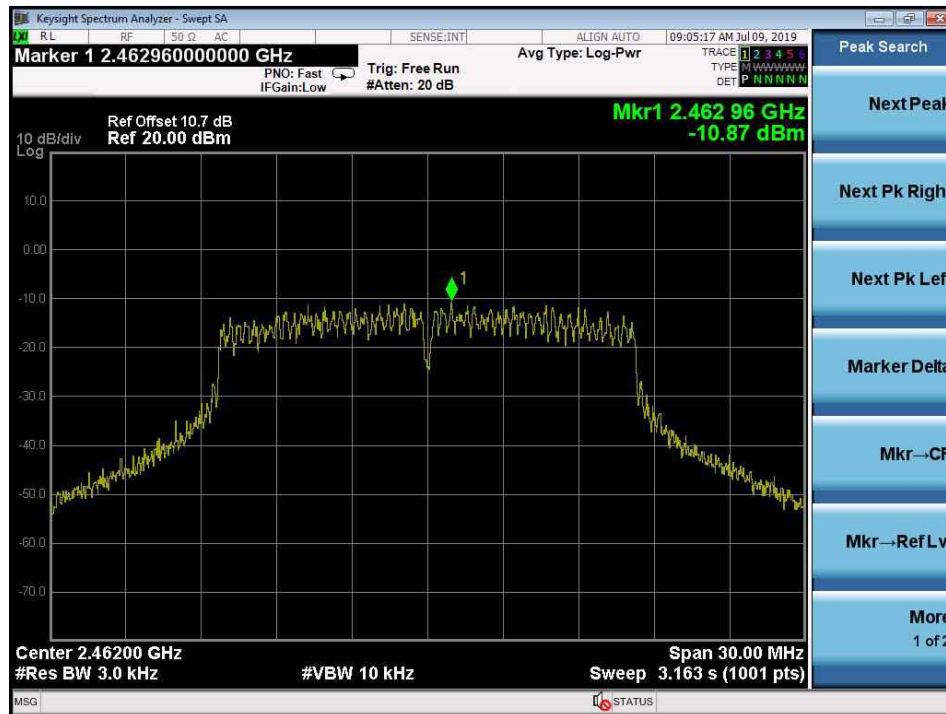
Low Channel



Middle Channel

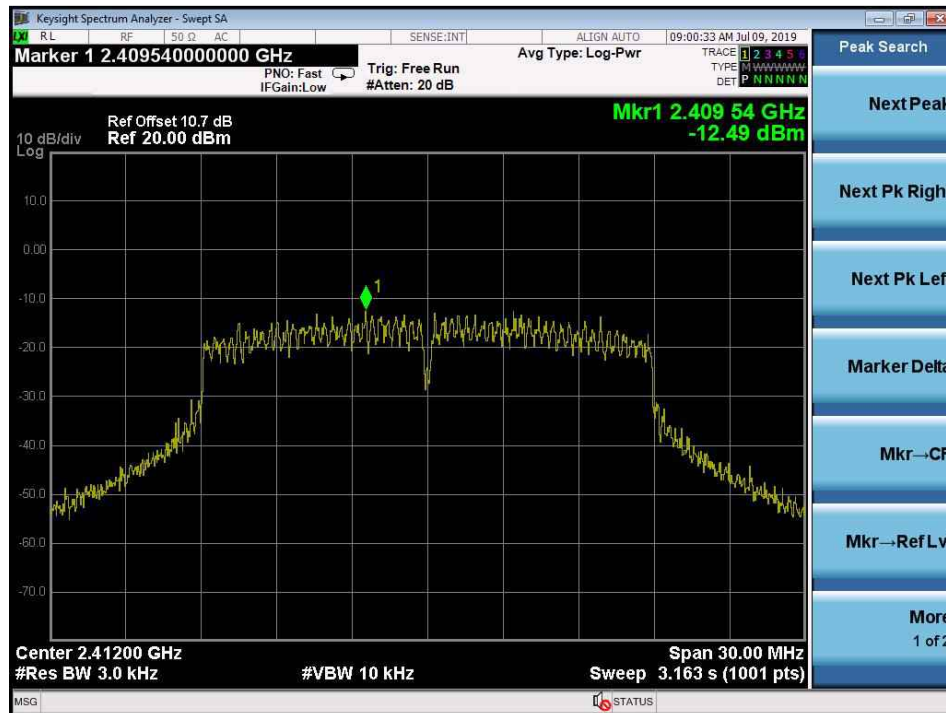


High Channel

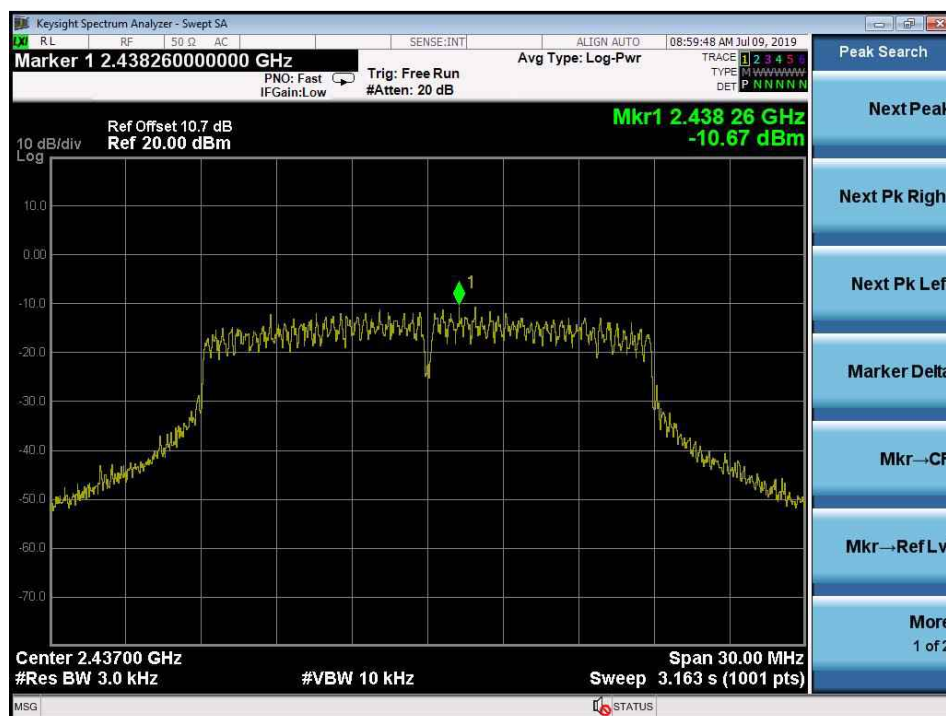


Test Plot of Power Density (802.11n HT20)

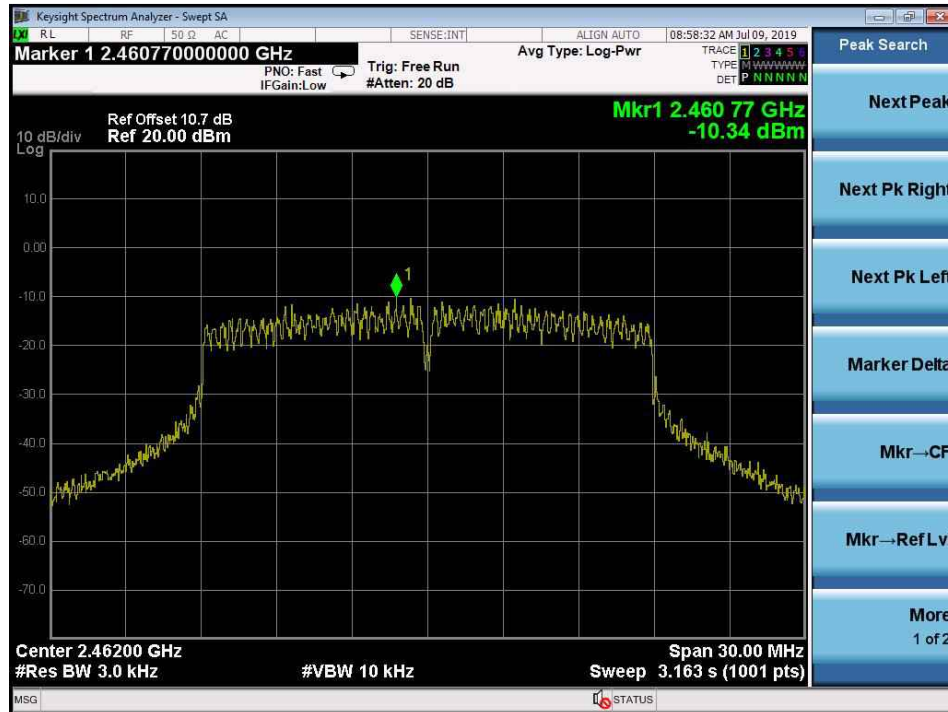
Low Channel



Middle Channel



High Channel



5.1.5 Conducted spurious emissions and Frequency Band Edge measured in 100 kHz Bandwidth**RESULT:****Passed**

Test standard	:	LP0002(2018): 3.10.1.5
Basic standard	:	ANSI C63.10:2013, KDB558074, LP0002(2018) Appendix II
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/ Mid/ High for spurious, Low/ High for Band Edge
Operation mode	:	A
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 achieved as well.

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

Test Plot 100kHz Conducted Emissions (802.11b)

Low Channel



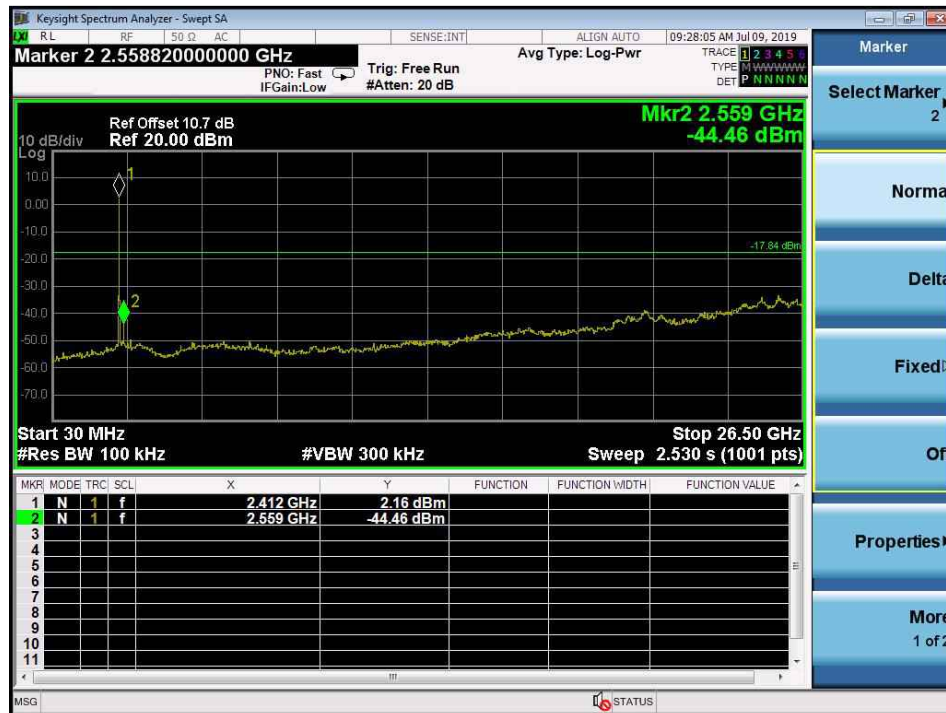
Middle Channel





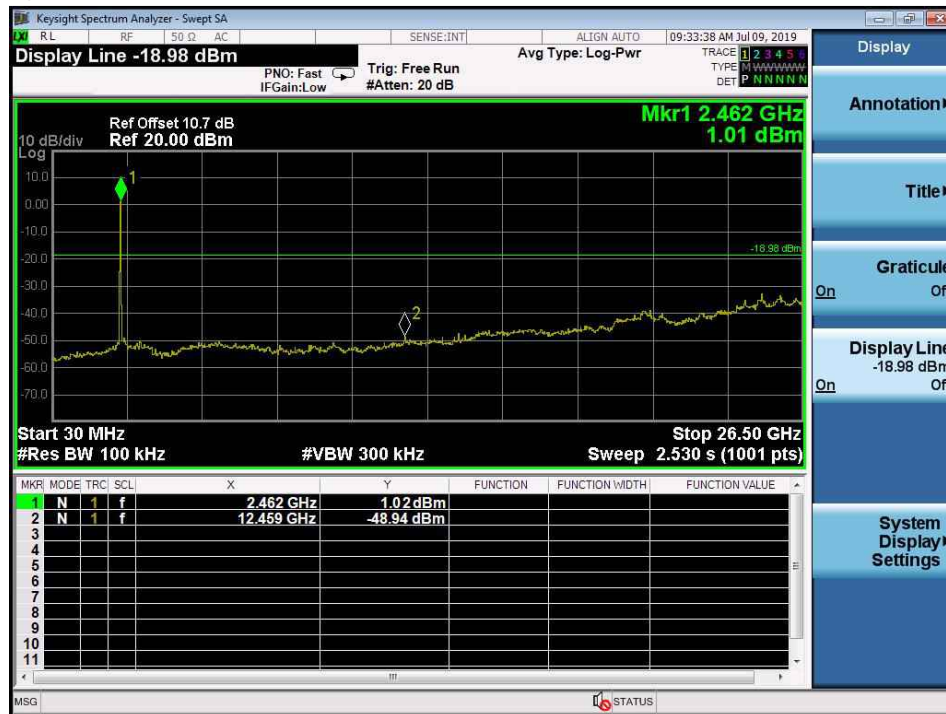
Test Plot 100kHz Conducted Emissions (802.11g)

Low Channel



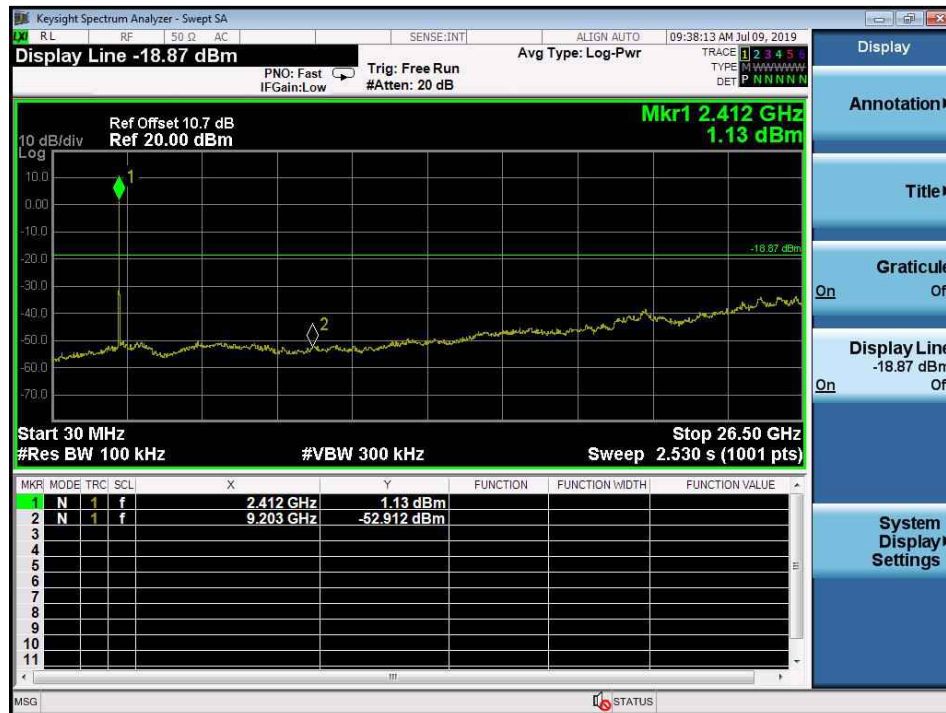
Middle Channel





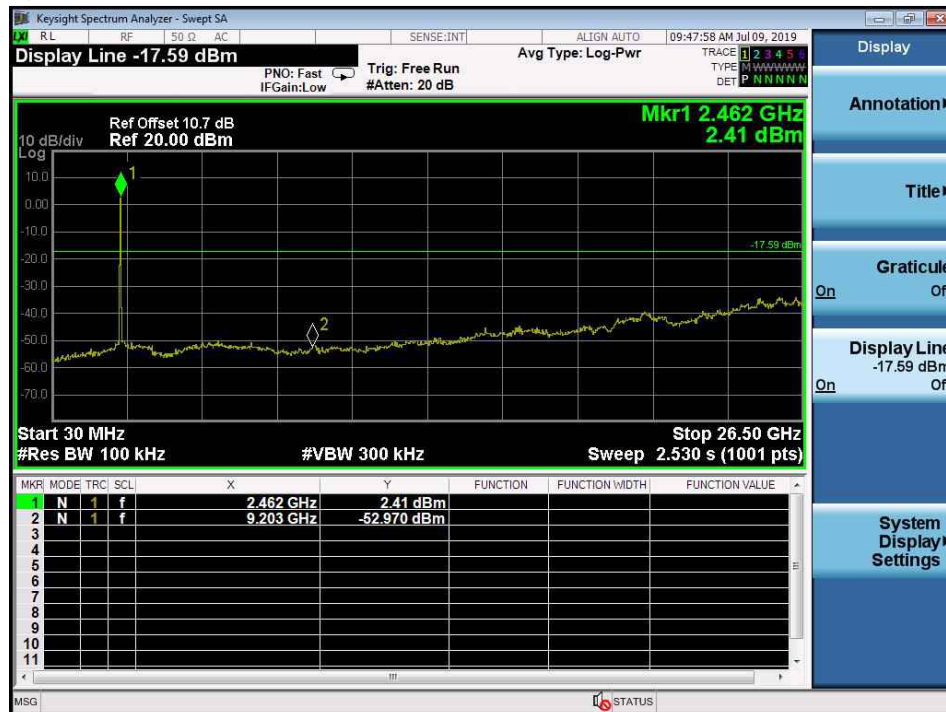
Test Plot 100kHz Conducted Emissions (802.11n HT20)

Low Channel



Middle Channel



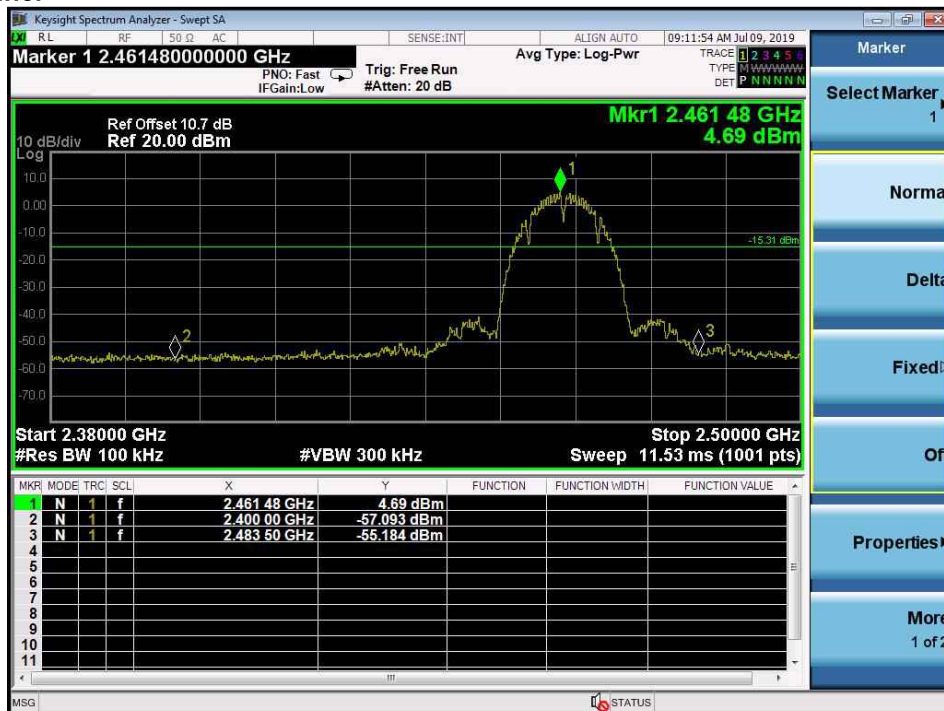


Test Plot 100kHz RBW of Band Edge (802.11b)

Low Channel

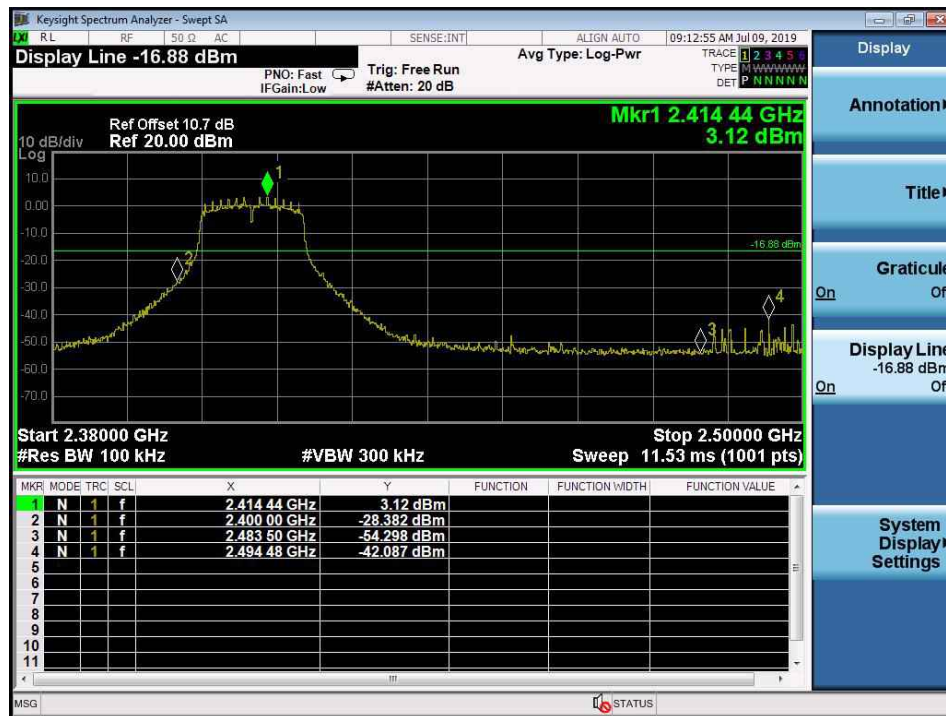


High Channel

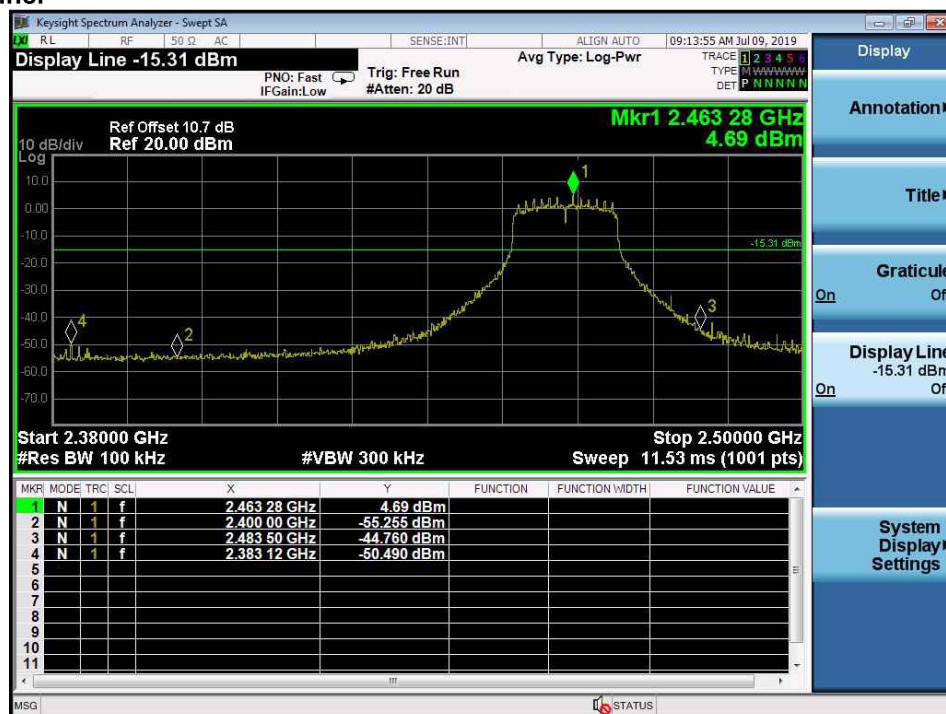


Test Plot 100kHz RBW of Band Edge (802.11g)

Low Channel

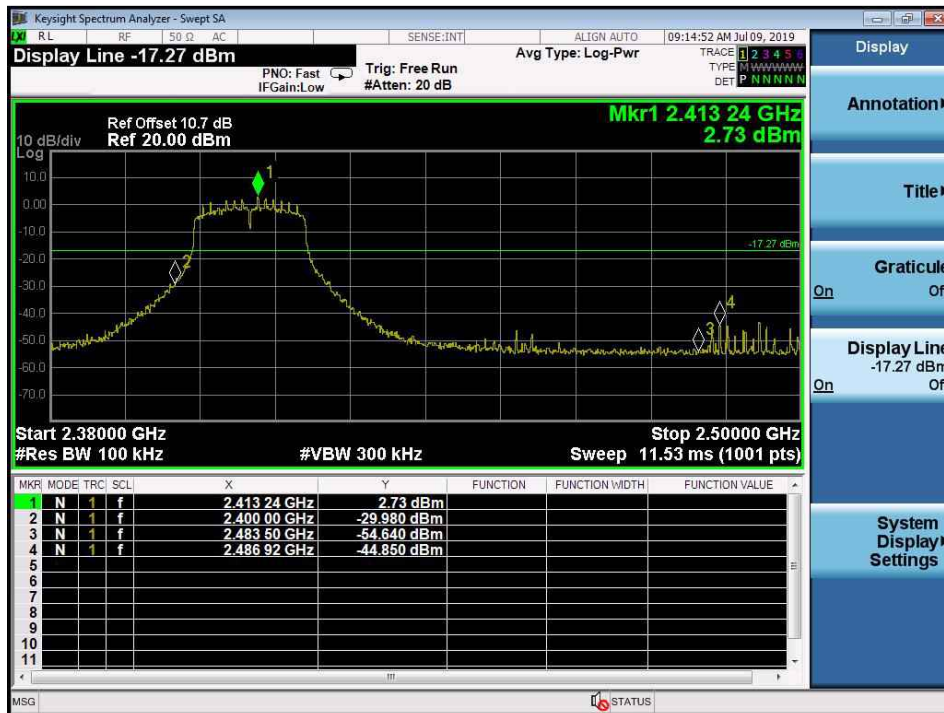


High Channel

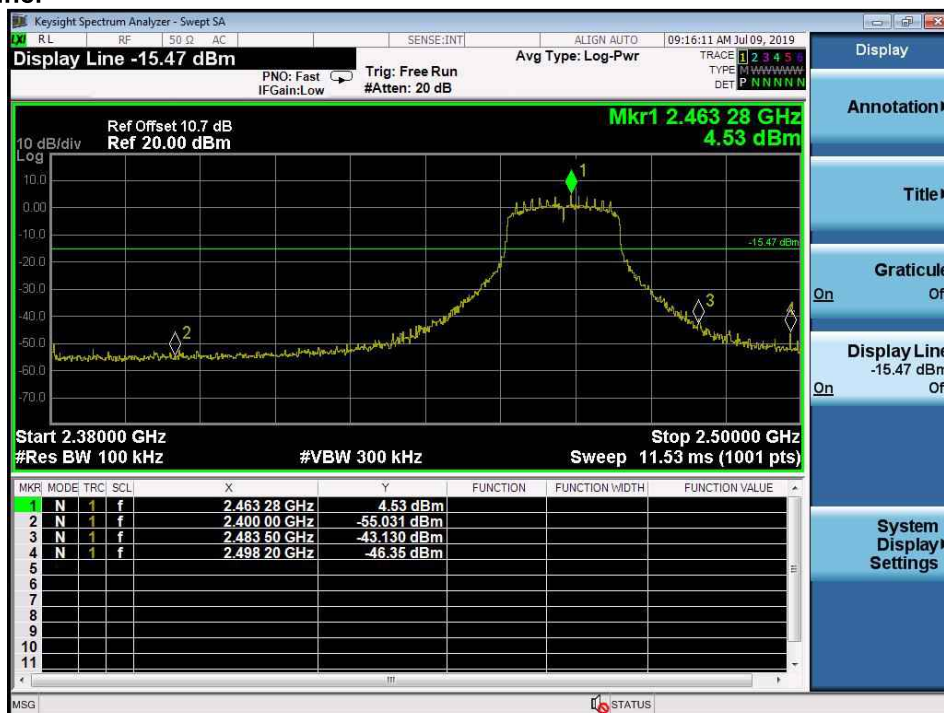


Test Plot 100kHz RBW of Band Edge (802.11n HT20)

Low Channel



High Channel



5.1.6 Spurious Emission

RESULT:**Passed**

Test standard	:	LP0002(2018): 3.10.1.5
Basic standard	:	ANSI C63.10: 2013, LP0002(2018) Appendix II
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

For details refer to Appendix D.

The Radiated Emissions testing was performed in the X, Y and Z axis orientation.

Factor (dB/m)=Antenna Factor(dB/m)+Cable loss (dB)

Level(dBuV/m)=Reading(dBuV)+ Factor(dB/m)

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 standards
Kind of test site : Shielded Room

Test setup

Test Channel : Middle
Operation mode : A

Remark: For details refer to Appendix D.

6. Safety Human exposure

6.1 Radio Frequency Exposure Compliance

6.1.1 Electromagnetic Fields

RESULT:**Passed**

Test standard : LP0002(2018) 5.20.2.2

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

Maximum Exposure:

Power to Antenna (mW)	294.4422 mW
Power to Antenna (dBm)	24.7 dBm
Antenna Gain	1.57 dBi
Power+Ant Gain	422.7 mW
Distance	20 cm
S=	0.084 mW/cm ²

NCC:

0.3-1.34 MHz	(100) mW/cm ²
1.34-30 MHz	(180/f ²) mW/cm ²
30-300 MHz	0.2 mW/cm ²
300-1500 MHz f/1500	mW/cm ²
1500-100,000 MHz	1.0 mW/cm ²

---End---

7. Photographs of the Test Set-Up

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



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



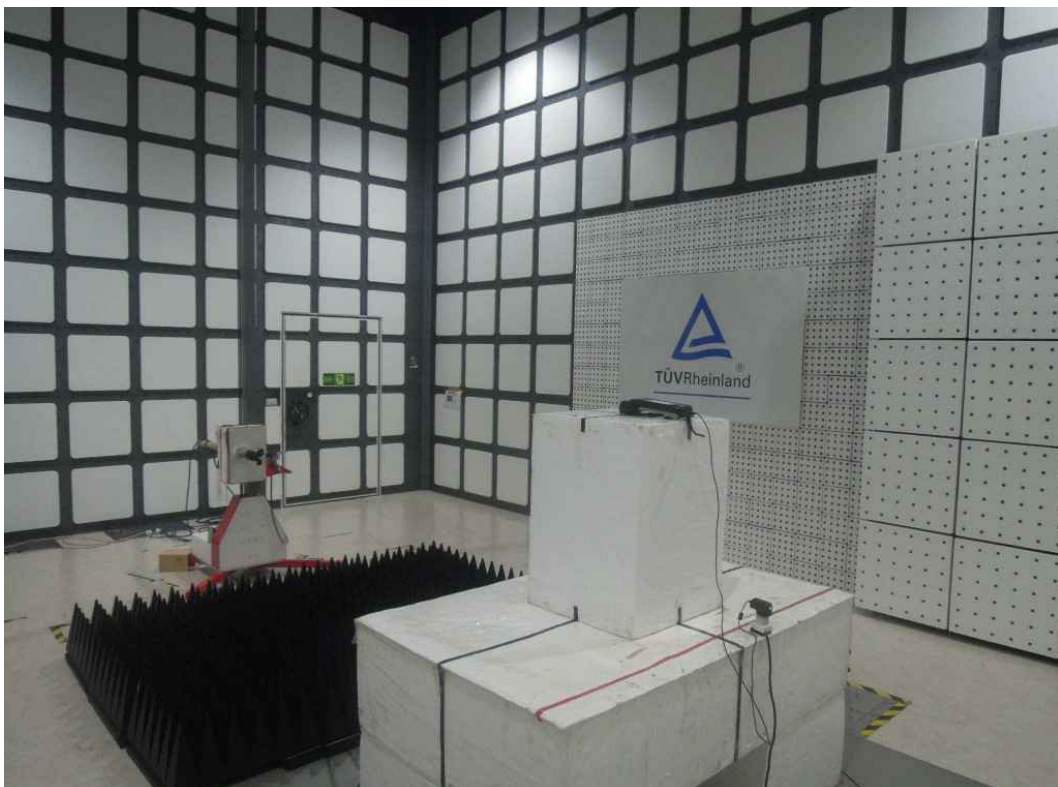
Photograph 3: Set-up for Spurious Emissions (Back View 1)



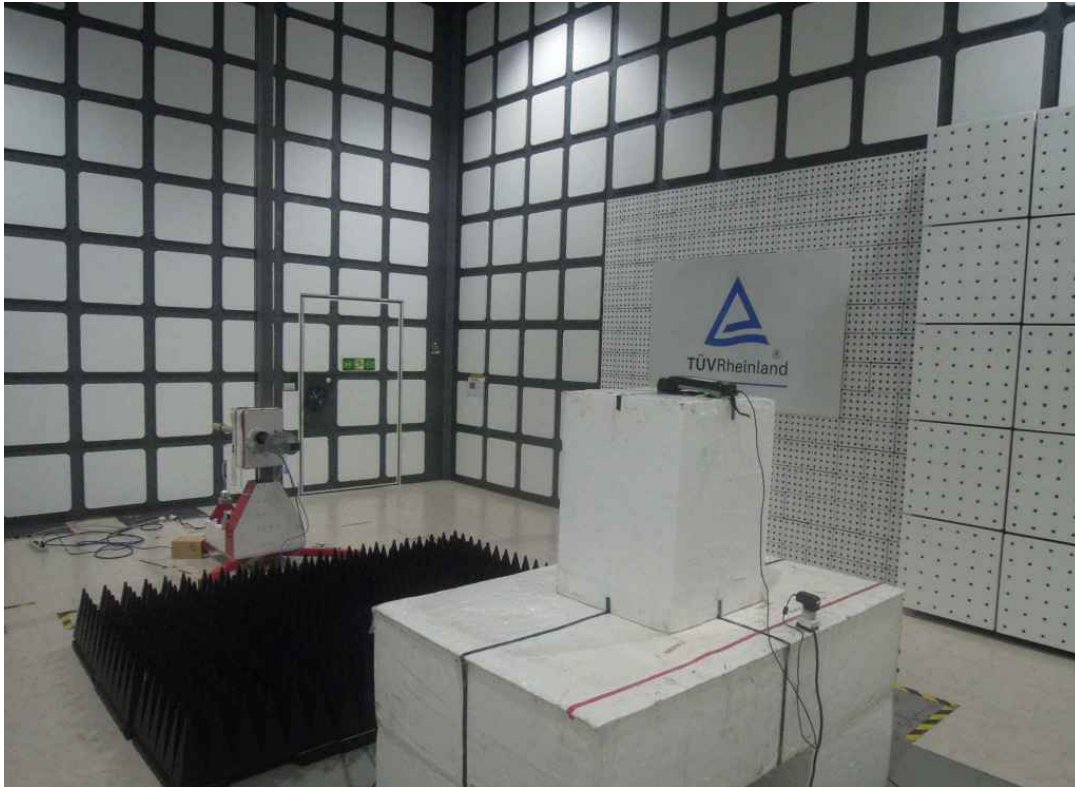
Photograph 4: Set-up for Spurious Emissions (Back View 2)



Photograph 5: Set-up for Spurious Emissions (Back View 3)



Photograph 6: Set-up for Spurious Emissions (Back View 4)



Photograph 7: Set-up for Conducted testing



Photograph 8: Set-up for Conducted testing



Photograph 9: Set-up for Mains Conducted testing Back



Photograph 10: Set-up for Mains Conducted testing Front



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