Prüfbericht-Nr.: *Test Report No.:*	**50085645 001**	**Auftrags-Nr.:** *Order No.:*	114062897	**Seite 1 von 43** *Page 1 of 43*
Kunden-Referenz-Nr.: *Client Reference No.:*	N/A	**Auftragsdatum:** *Order date:*	03-Mar-2017	
Auftraggeber: *Client:*	Beijing TPCast Technologies Limited Company., Room 301-09, 3rd Floor, No. 22 Building, No.1 Yard, 1st Street of Wuliqiao, Chaoyang District, Beijing, P.R. China.			
Prüfgegenstand: *Test item:*	Power Box			
Bezeichnung / Typ-Nr.: *Identification / Type No.:*	AD-1			
Auftrags-Inhalt: *Order content:*	FCC Part15E/ RSS-247 / NCC Test report			
Prüfgrundlage: *Test specification:*	FCC 47CFR Part 15: Subpart E Section 15.407 RSS-247 (02-2017) NCC Low-power Radio-frequency Devices Technical Regulations LP0002(2016)			
Wareneingangsdatum: *Date of receipt:*	27-Apr-2017			
Prüfmuster-Nr.: *Test sample No.:*	A000523085-001 A000523085-002			
Prüfzeitraum: *Testing period:*	22-May-2017 - 02-Jun-2017			
Ort der Prüfung: *Place of testing:*	EMC/RF Laboratory Taipei			
Prüflaboratorium: *Testing laboratory:*	TUV Rheinland Taiwan Ltd.			
Prüfergebnis*: *Test result*:*	Pass			

Repoet Date / *tested by:*			**kontrolliert von** / *reviewed by:*		
2017-07-25	Amy S.R.Hsu/Engineer		2017-07-25	René Charton/Senior Project Manager	
Datum *Date*	**Name / Stellung** *Name / Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name / Stellung** *Name / Position*	**Unterschrift** *Signature*

Sonstiges / *Other:*

Zustand des Prüfgegenstandes bei Anlieferung: Prüfmuster vollständig und unbeschädigt
Condition of the test item at delivery: *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.
V04

TEST SUMMARY

5.1.1 ANTENNA REQUIREMENT
RESULT: Passed

5.1.2 26 dB BANDWIDTH AND 99% BANDWIDTH
RESULT: Passed

5.1.3 6 dB BANDWIDTH
RESULT: Passed

5.1.4 TRANSMIT OUTPUT POWER
RESULT: Passed

5.1.5 POWER SPECTRAL DENSITY
RESULT: Passed

5.1.6 SPURIOUS EMISSION
RESULT: Passed

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1. General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix P: Photo Documentation internal view
(File Name: 50085645APPENDIX P)
Appendix D: Test Result of Radiated Emissions
(File Name: 50085645APPENDIX D)

Test Specifications

The following standards were applied:

Table 1: Applied Standard and Test Levels

Radio
FCC CFR47 Part 15 Subpart E
RSS-247 issue 2, Feb 2017
RSS-Gen, Issue 4, November 2014
ANSI C63.10:2013
FCC KDB-789033
FCC KDB-662911 D01
FCC KDB-644545
NCC Low-power Radio-frequency Devices Technical Regulations LP0002(2016)

2. Test Sites

2.1 Test Facility

TUV Rheinland Taiwan Ltd.
Taipei Office

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

FCC Registration No.: 340738
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

TAF
Testing Laboratory
0759

2.2 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	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	2017/05/02	2018/05/01
Spectrum Analyzer	Agilent	N9010A	MY53470241	2017/04/23	2018/04/22
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	201918	2016/08/12	2017/08/12
Horn Antenna (18GHz~40GHz)	COM-POWER	AH840	101029	2016/10/11	2017/10/11
Loop Antenna	Schwarzbeck	FMZB 1513	1513-076	2016/06/11	2017/06/10
EMI Test Receiver	R&S	ESCI7	100797	2016/12/30	2017/12/30
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	R&S	ENV216	101262	2016/06/16	2017/06/16
Test Software	Audix	e3	Ver. 9	N/A	N/A
Test Software	Agilent	300328 testsystem	V1.9.1	N/A	N/A
Power sensor	Agilent	U2021XA	MY54020001	2017/03/08	2018/03/07

2.3 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.

2.4 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.

2.5 Measurement Uncertainty

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

Table 3: Emission Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	± 1 x 10^{-7}
RF power, conducted	± 1.5 dB
Adjacent channel power	± 3 dB
Radiated emission of transmitter, valid up to 40 GHz	± 6 dB
Radiated emission of receiver, valid up to 40 GHz	± 6 dB
Temperature	± 2 ºC
Humidity	± 10 %

3. General Product Information

3.1 Product Function and Intended Use

PC transmitter transfers audio and video signal of PC through TPCAST wireless high-definition transfer protocol to wireless signals which is transmitted to HMD receiver.
HMD receiver accepts wireless signals from PC transmitter, through TPCAST wireless high-definition transfer protocol to restore to audio and video signal which is transmitted to helmet display.
Power box adjusts voltage and current output from power bank to the used value for HMD Receiver and HMD, and offer power supply for the both. At the same time, it transfers the positioning information from the helmet and interactive information into wireless signal, and pass back to PC for operation.
For details refer to the User Guide, Data Sheet and Circuit Diagram.

3.2 Ratings and System Details

Table 4: Technical Specification of EUT

Technical Specification	Value
Kind of Equipment	Power Box
FCC ID	2AL8N-AD001
IC ID	22801-AD001
HVIN	F3
Brand name	TPCAST
Type Designation	AD-1
Operating Frequency	5180 - 5240MHz, 5745 MHz - 5825 MHz
Operation Voltage	5Vdc
Modulation	802.11n HT20 MHz Mode: OFDM 802.11 ac HT20 MHz Mode: OFDM
Antenna gain	-3.48dBi
Antenna Type	PCB Antenna

Table 5: Test Channel Frequency information

	CH	Frequency (MHz)
802.11n (HT20) Band I	36	5180
802.11n (HT20) Band I	40	5200
802.11n (HT20) Band I	44	5220
802.11n (HT20) Band I	48	5240
802.11ac (HT20) Band I	36	5180
802.11ac (HT20) Band I	40	5200
802.11ac (HT20) Band I	44	5220
802.11ac (HT20) Band I	48	5240
802.11n (HT20) Band IV	149	5745
802.11n (HT20) Band IV	157	5785
802.11n (HT20) Band IV	165	5825
802.11ac (HT20) Band IV	149	5745
802.11ac (HT20) Band IV	157	5785
802.11ac (HT20) Band IV	165	5825

3.3 Independent Operation Modes

The 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

- Circuit Diagram
- Instruction Manual
- 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: 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 2.3 as appropriate. The samples were used as follows:

Conducted: A000523085-001
Radiation: A000523085-002

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

U-NII-1:

IEEE 802.11n HT20 mode for 5180 ~ 5240MHz:

Channel Low (5180MHz), Channel Mid (5200MHz) and Channel High (5240MHz) with 6.5Mbps data rate were chosen for full testing.

IEEE 802.11ac HT20 MHz mode for 5180 ~ 5240MHz:

Channel Low (5180MHz), Channel Mid (5200MHz) and Channel High (5240MHz) with 6.5Mbps data rate were chosen for full testing.

U-NII-3:

IEEE 802.11n HT20 mode for 5745 MHz ~ 5825 MHz:

Channel Low (5745MHz), Channel Mid (5785MHz) and Channel High (5825MHz) with 6.5Mbps data rate were chosen for full testing.

IEEE 802.11ac HT20 MHz mode for 5745 MHz ~ 5825 MHz:

Channel Low(5745MHz), Channel Mid(5785MHz) and Channel High(5825MHz) with 6.5Mbps 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.
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

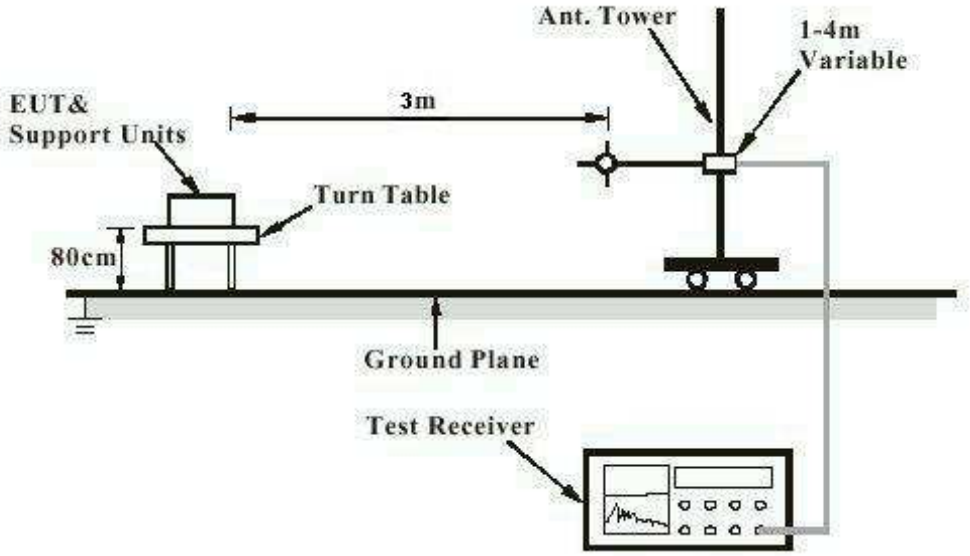


Diagram of Measurement Equipment Configuration for Mains Conduction Measurement

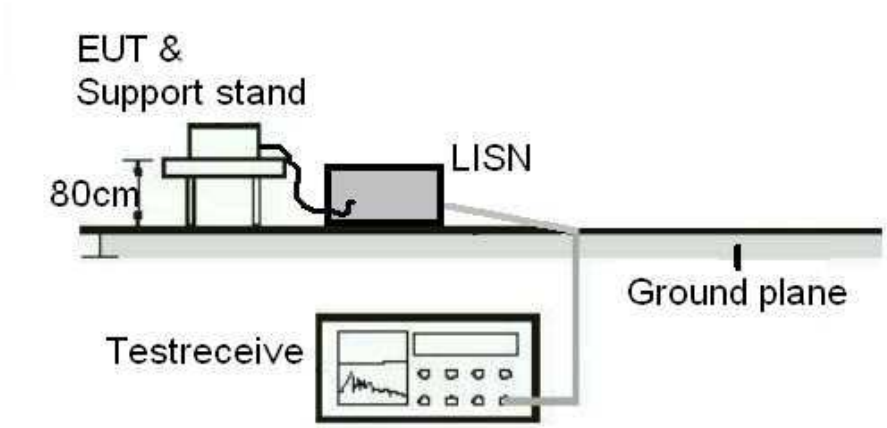
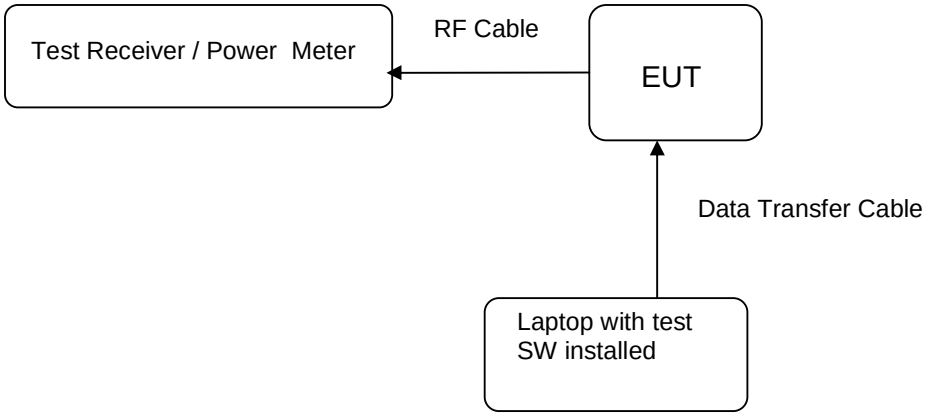


Diagram of Measurement Equipment Configuration for Conducted Transmitter Measurement



5. Antenna Port Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT: **Passed**

Test standard	:	LP0002(2016): 4.7.8 FCC Part 15.407(a), Part 15.203 and RSS-Gen 7.1.4
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 -3.48dBi. The antenna is PCB 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 26 dB Bandwidth and 99% Bandwidth

RESULT: **Passed**

Test standard	:	LP0002(2016):4.7.3 FCC Part 15.407(a), RSS-247 issue2 6.2.1
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 26dB/99% Bandwidth 802.11n HT20

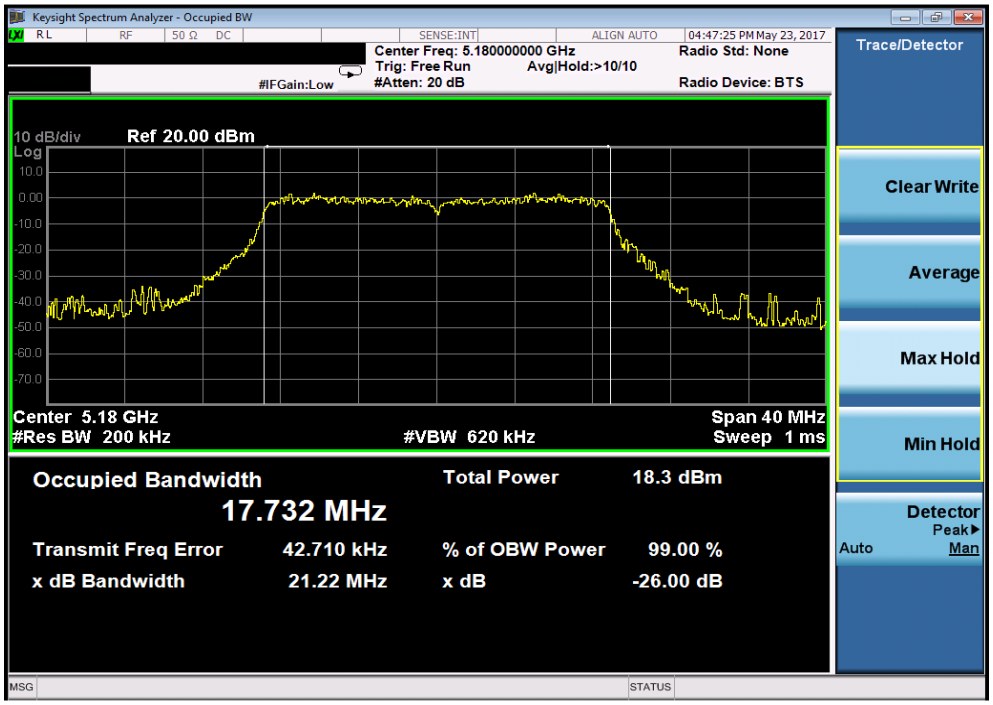
Channel	Channel Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low Channel	5180	21.22	17.732
Mid Channel	5200	21.25	17.729
Mid Channel	5220	21.49	17.768
High Channel	5240	21.32	17.699

Table 7: Test result of 26dB/99% Bandwidth 802.11ac HT20

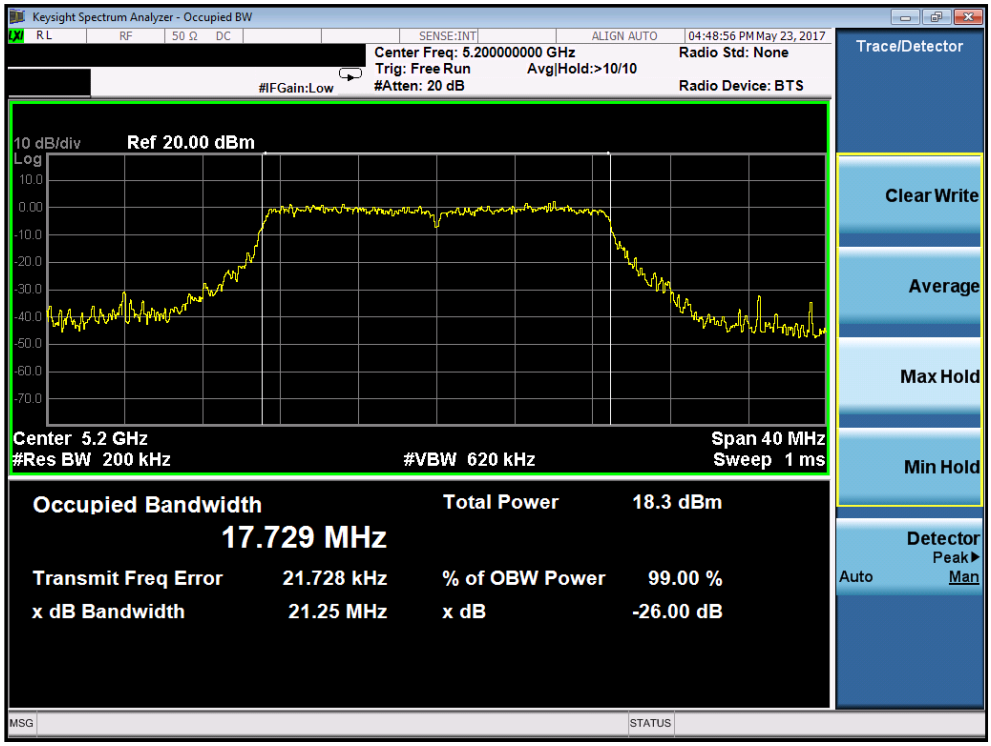
Channel	Channel Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low Channel	5180	20.88	17.724
Mid Channel	5200	21.75	17.768
Mid Channel	5220	21.36	17.691
High Channel	5240	20.72	17.713

Test Plot of 26dB Bandwidth 802.11n HT20

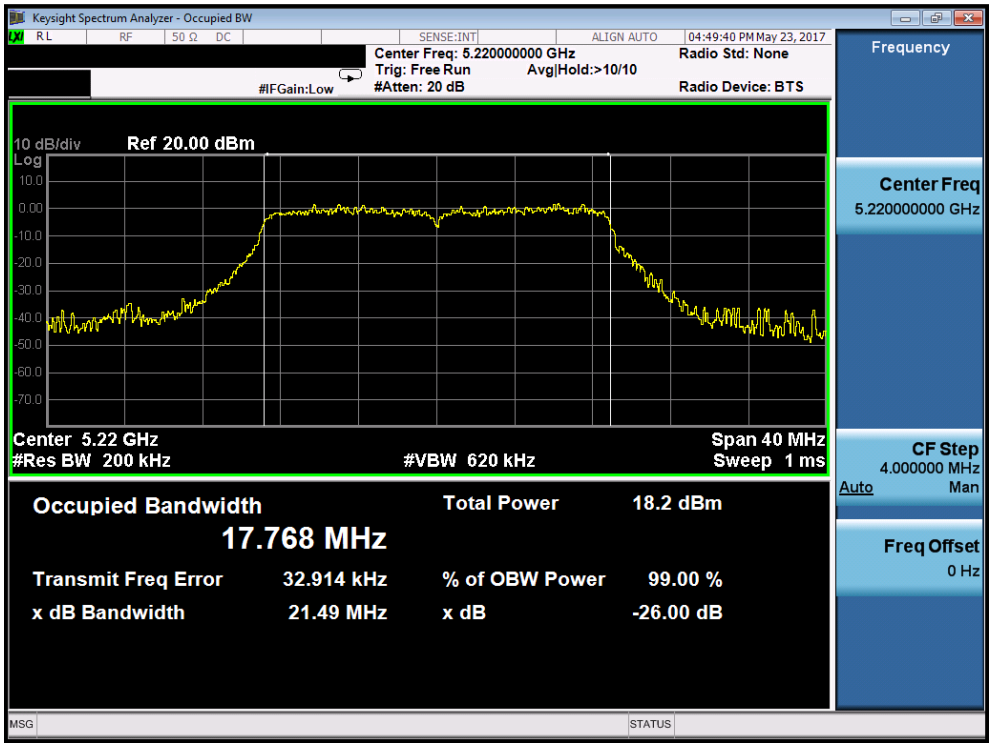
Low Channel



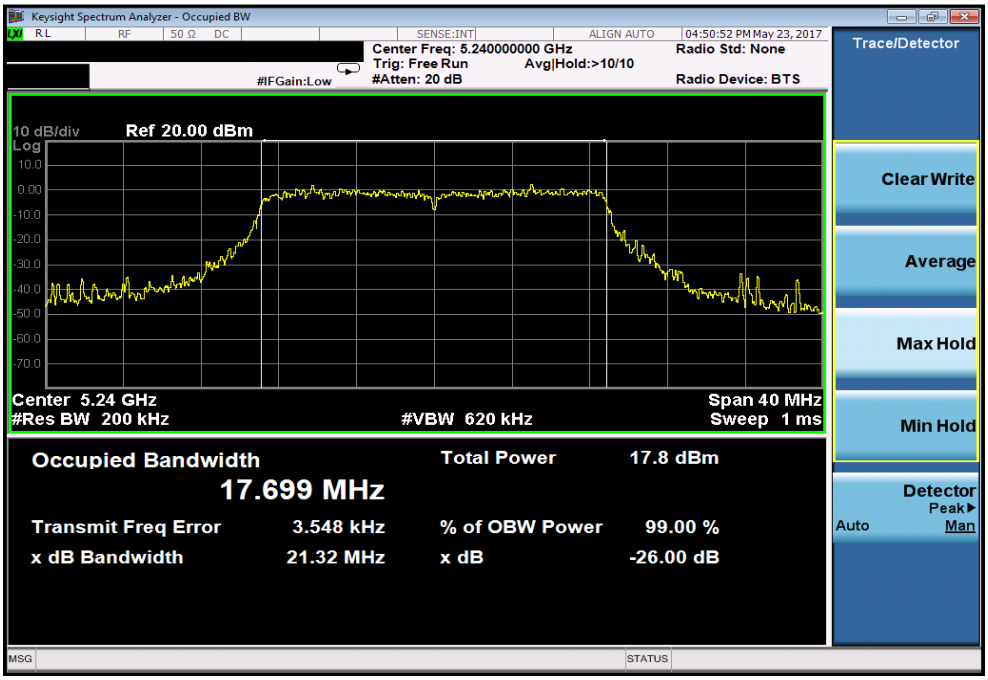
Mid Channel



Mid Channel

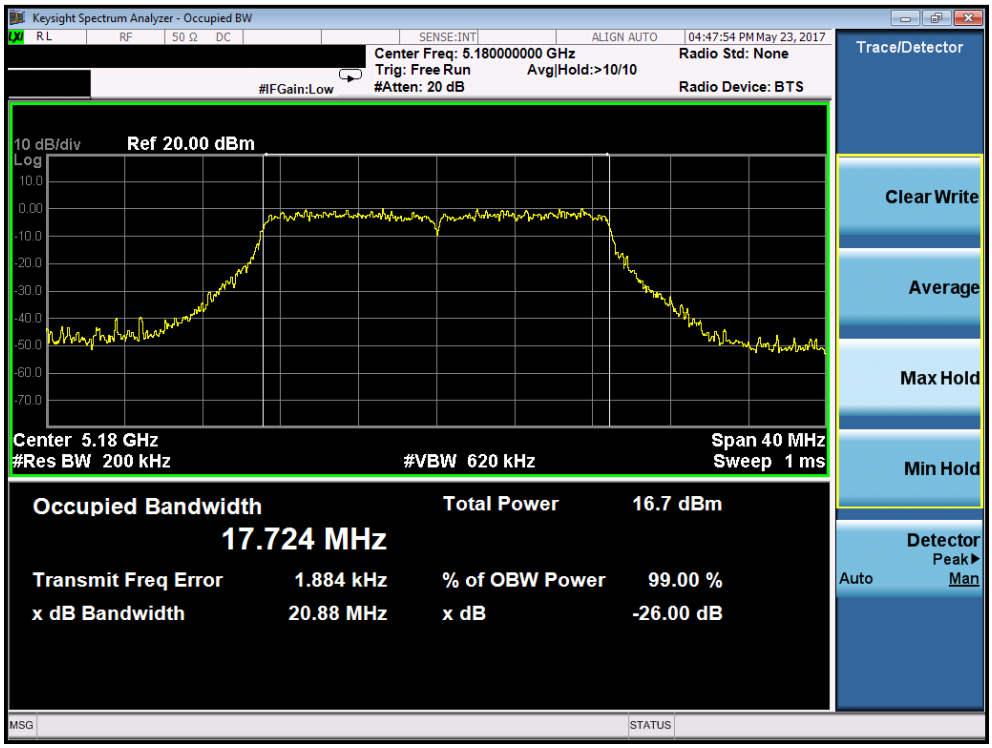


High Channel

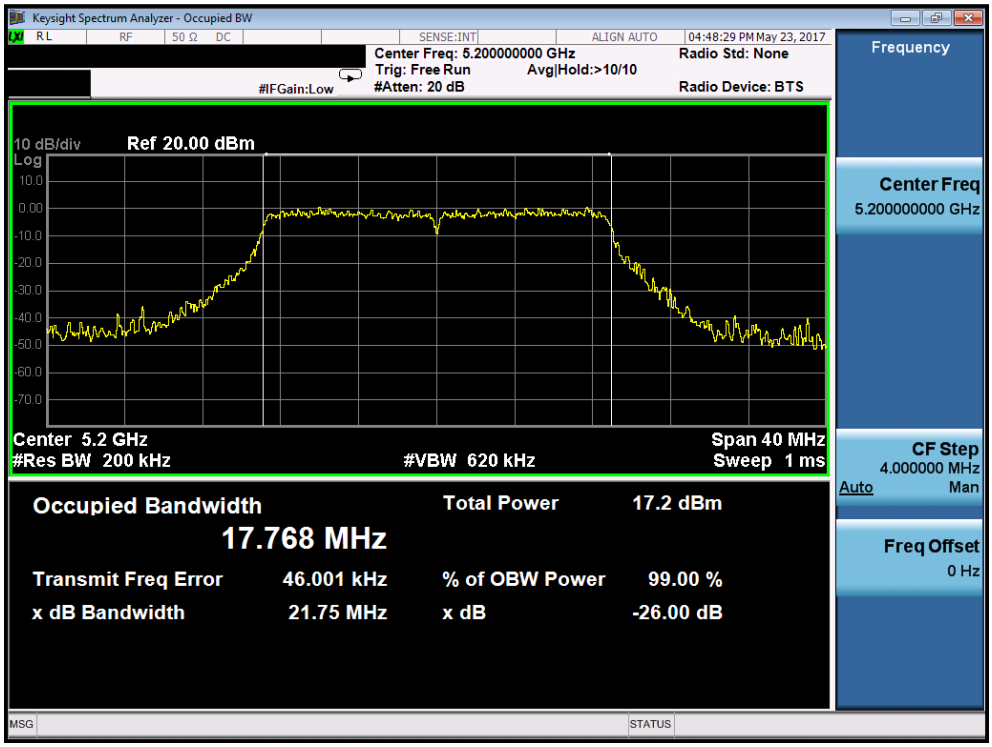


Test Plot of 26dB Bandwidth 802.11ac HT20

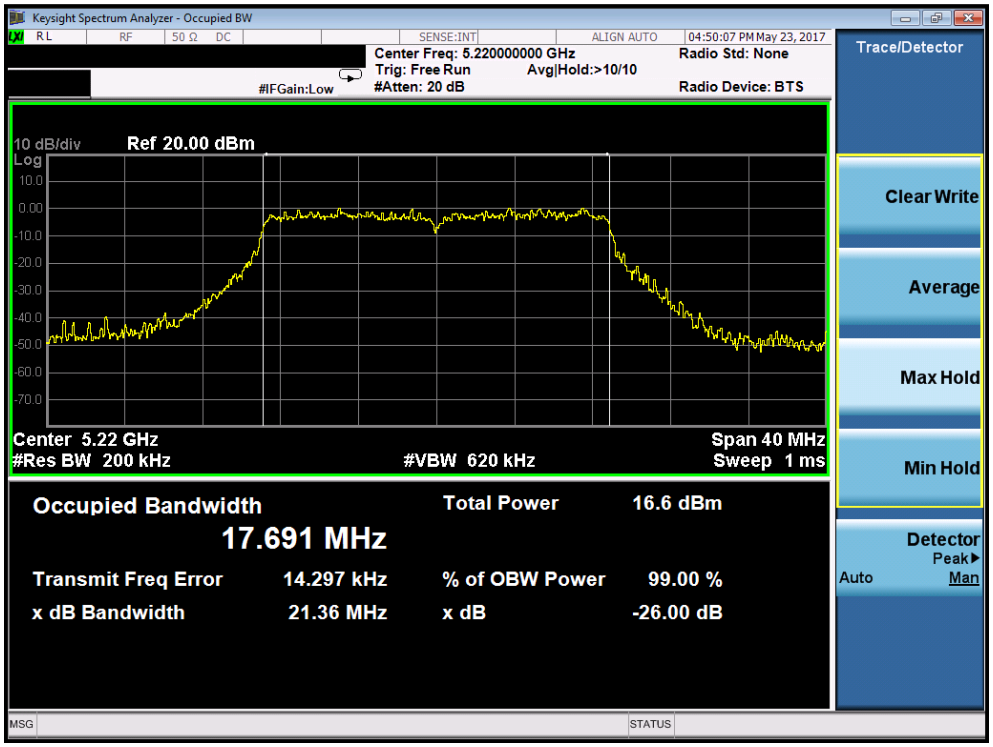
Low Channel



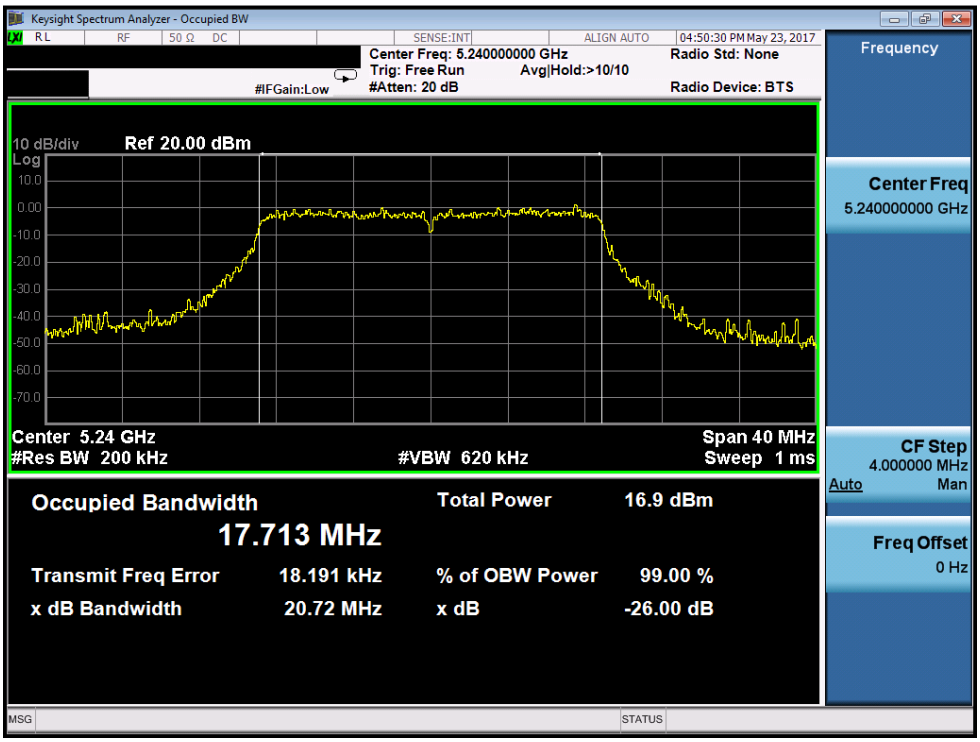
Mid Channel



Mid Channel



High Channel



5.1.3 6 dB Bandwidth

RESULT: **Passed**

Test standard	:	LP0002(2016):4.7.(5) FCC Part 15.407(a), RSS-247 issue2 6.2.4
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 8: Test result of 6dB Bandwidth 802.11n HT20

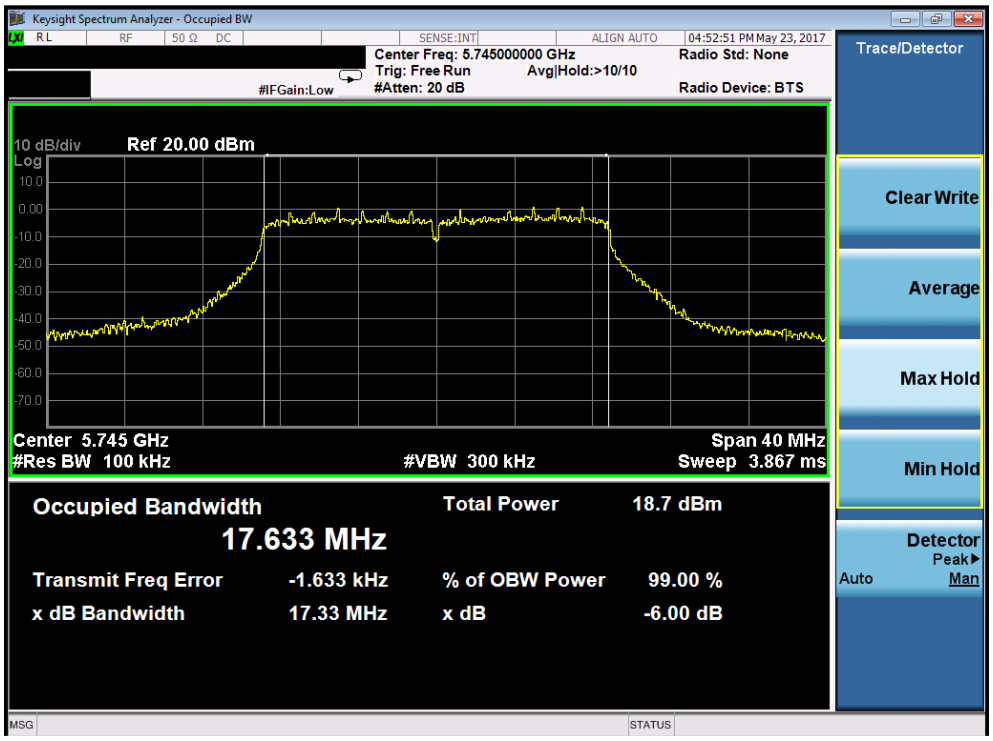
Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)
Low Channel	5745	17.33	> 0.5
Mid Channel	5785	17.14	> 0.5
High Channel	5825	17.33	> 0.5

Table 9: Test result of 6dB Bandwidth 802.11ac HT20

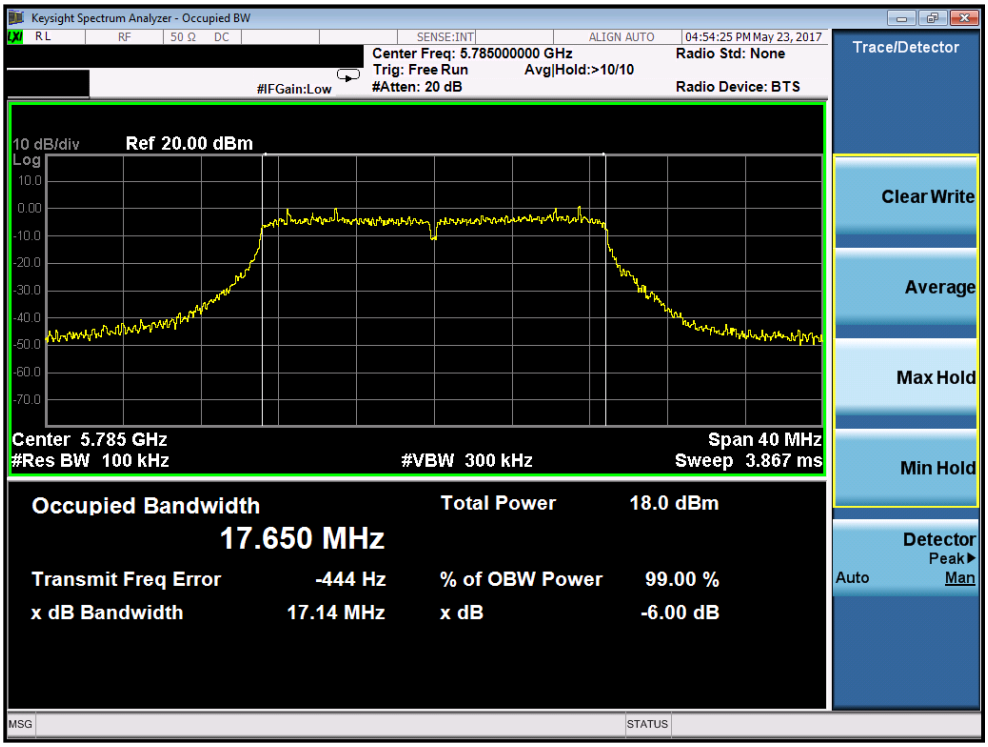
Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)
Low Channel	5745	17.21	> 0.5
Mid Channel	5785	16.97	> 0.5
High Channel	5825	17.33	> 0.5

Test Plot of 6dB Bandwidth 802.11n HT20

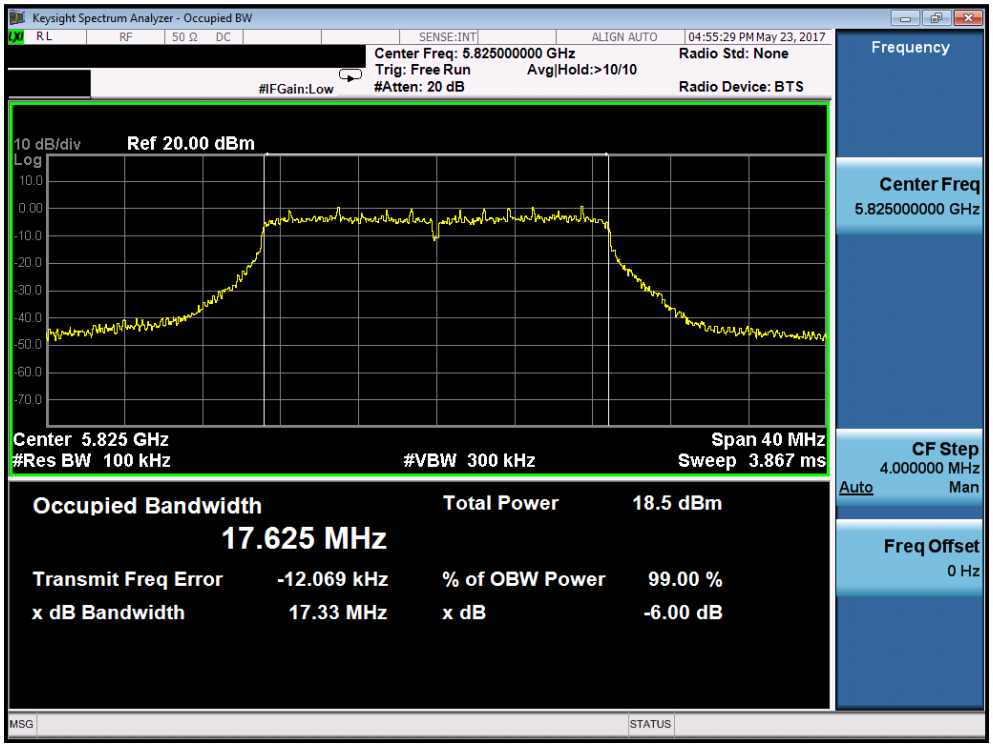
Low Channel



Mid Channel

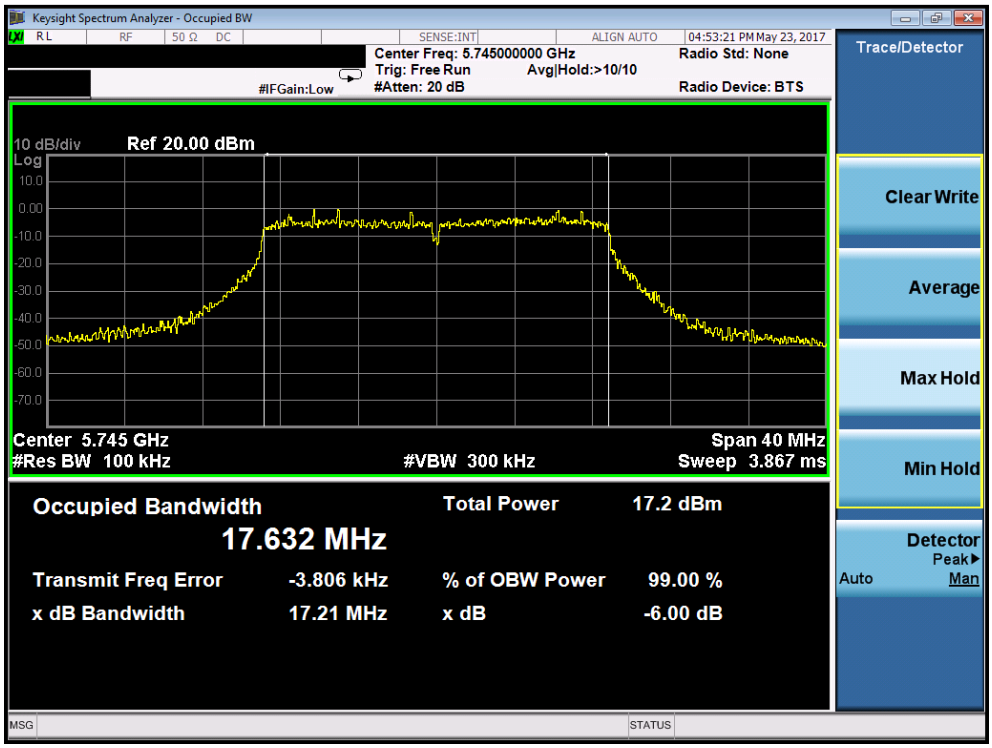


High Channel

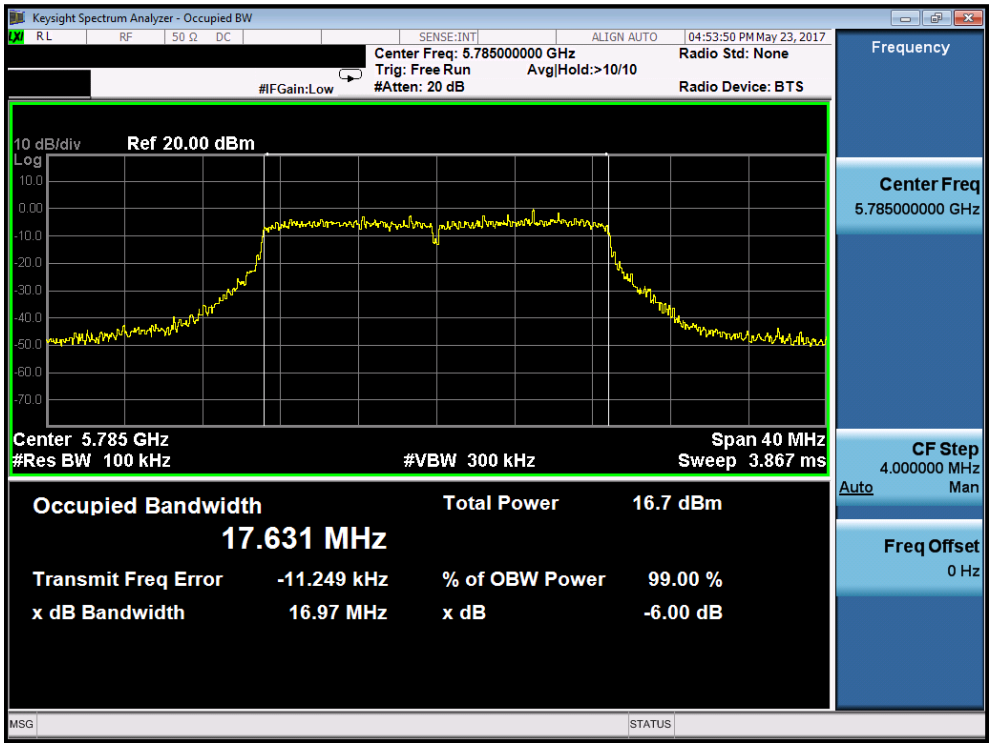


Test Plot of 6dB Bandwidth 802.11ac HT20

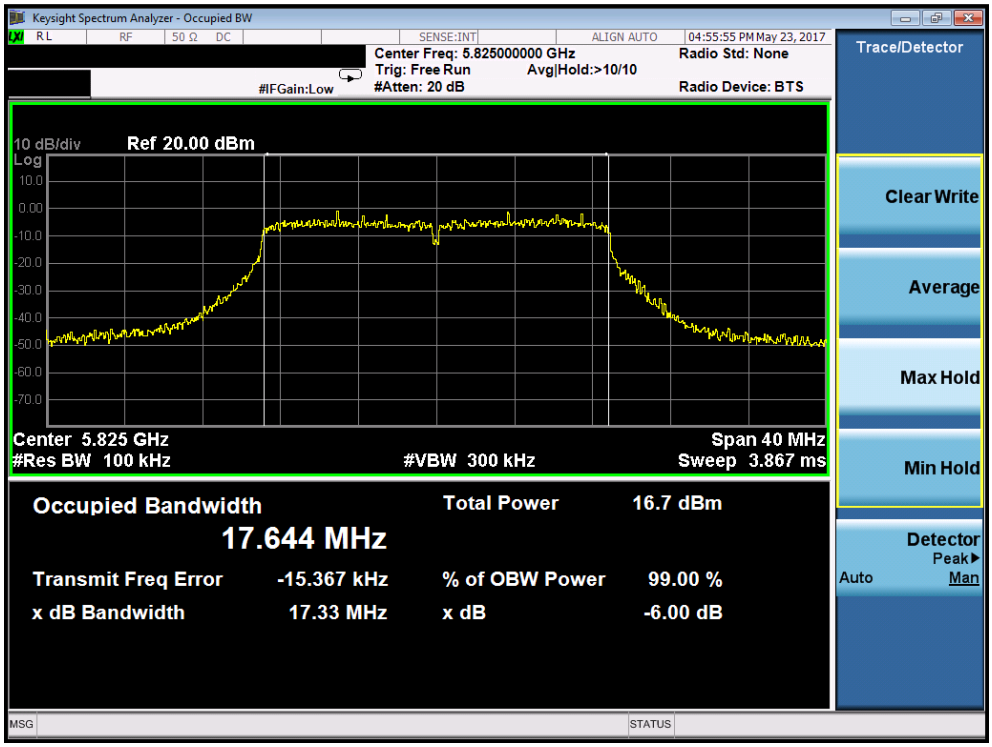
Low Channel



Mid Channel



High Channel



5.1.4 Transmit Output Power

RESULT: **Passed**

Test standard	:	LP0002(2016):4.7.3 FCC Part 15.407(a), RSS-247 issue2 6.2.1, 6.2.4
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

15.407 General technical requirements.

(a) Power limits:

For the band 5.15–5.25 GHz.:
(iv) For mobile and portable client devices in the 5.15–5.25 GHz. band, the maximum **conducted** output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi.

In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
---
(3)For the band 5.725 - 5.85 GHz,
the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

In addition, the maximum power spectral density shall not exceed 30 dBm in any 500kHz band.

If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

==========

Table 10: Test result of Transmit Power 802.11n HT20

5150-5250MHz:

Channel	Channel Frequency (MHz)	Power (dBm)	Power (mW)	Limit (mW)	Result
Low Channel	5180	15.2	33.11	250	Pass
Mid Channel	5200	15.3	33.88	250	Pass
Mid Channel	5220	15.2	33.11	250	Pass
High Channel	5240	15.2	33.11	250	Pass

5725-5850MHz:

Channel	Channel Frequency (MHz)	Power(dBm)	Power (mW)	Limit (mW)	Result
Low Channel	5745	15.4	34.67	1000	Pass
Mid Channel	5785	15.2	33.11	1000	Pass
High Channel	5825	15.2	33.11	1000	Pass

Table 11: Test result of Transmit Power 802.11ac HT20

5150-5250MHz:

Channel	Channel Frequency (MHz)	Power (dBm)	Power (mW)	Limit (mW)	Result
Low Channel	5180	14.1	25.70	250	Pass
Mid Channel	5200	14.3	26.92	250	Pass
Mid Channel	5220	14.2	26.30	250	Pass
High Channel	5240	14.2	26.30	250	Pass

5725-5850MHz:

Channel	Channel Frequency (MHz)	Power(dBm)	Power (mW)	Limit (mW)	Result
Low Channel	5745	11.53	14.40	1000	Pass
Mid Channel	5785	10.83	14.10	1000	Pass
High Channel	5825	11.14	14.20	1000	Pass

5.1.5 Power Spectral Density

RESULT: **Passed**

Test standard	:	LP0002(2016):4.7.3 FCC Part 15.407(a)(1),(5) RSS-247 issue2 6.2.1, 6.2.4
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 Spectral Density 802.11n HT20

5150-5250MHz:

Channel	Channel Frequency (MHz)	Peak Power Density (dBm)	Limit (dBm/MHz)	Result
Low Channel	5180	6.20	11	Pass
Mid Channel	5200	7.34	11	Pass
Mid Channel	5220	6.14	11	Pass
High Channel	5240	6.63	11	Pass

5725-5850MHz:

Channel	Channel Frequency (MHz)	Peak Power Density (dBm)	Limit (dBm/MHz)	Result
Low Channel	5745	5.18	30	Pass
Mid Channel	5785	5.10	30	Pass
High Channel	5825	5.37	30	Pass

Table 13: Test result of Power Spectral Density 802.11ac HT20

5150-5250MHz:

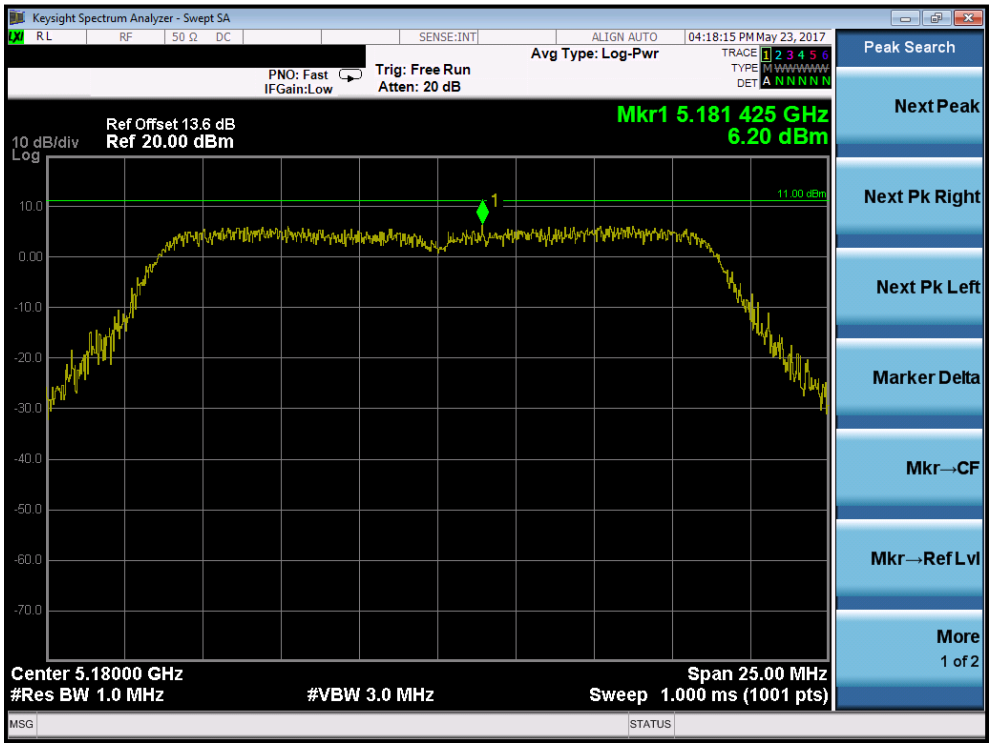
Channel	Channel Frequency (MHz)	Peak Power Density (dBm)	Limit (dBm/MHz)	Result
Low Channel	5180	5.56	11	Pass
Mid Channel	5200	5.76	11	Pass
Mid Channel	5220	5.24	11	Pass
High Channel	5240	5.76	11	Pass

5725-5850MHz:

Channel	Channel Frequency (MHz)	Peak Power Density (dBm)	Limit (dBm/MHz)	Result
Low Channel	5745	3.68	30	Pass
Mid Channel	5785	3.49	30	Pass
High Channel	5825	3.66	30	Pass

Test Plot of Power Density 802.11n HT20 (5150-5250MHz)

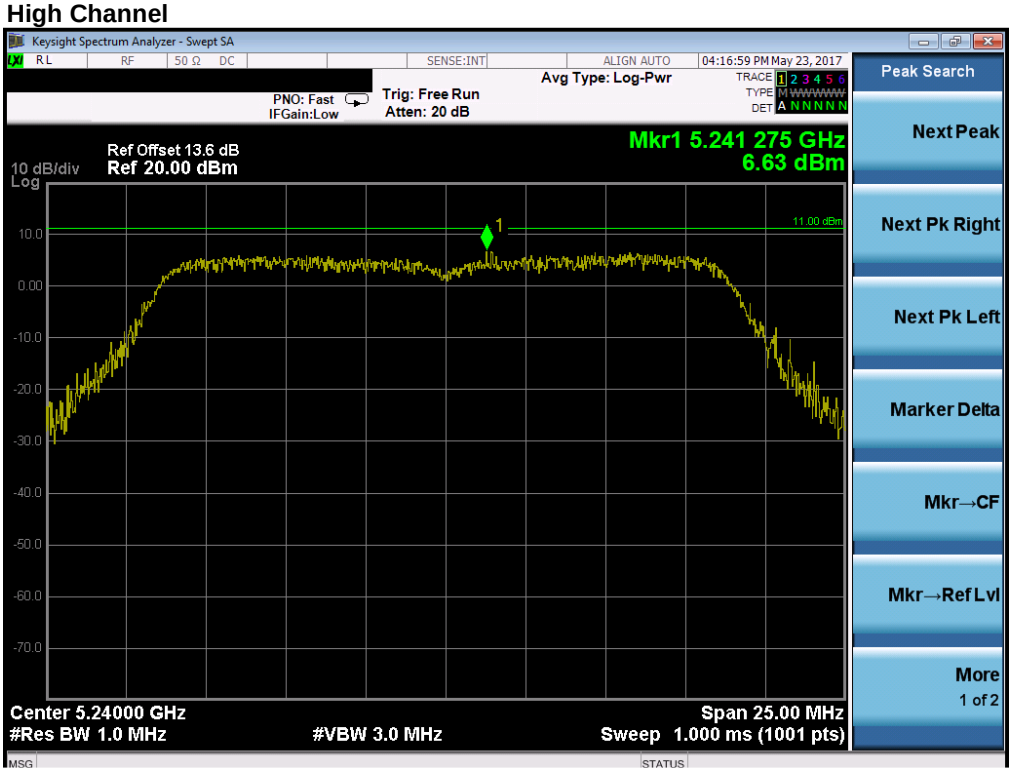
Low Channel



Middle Channel

Middle Channel

High Channel

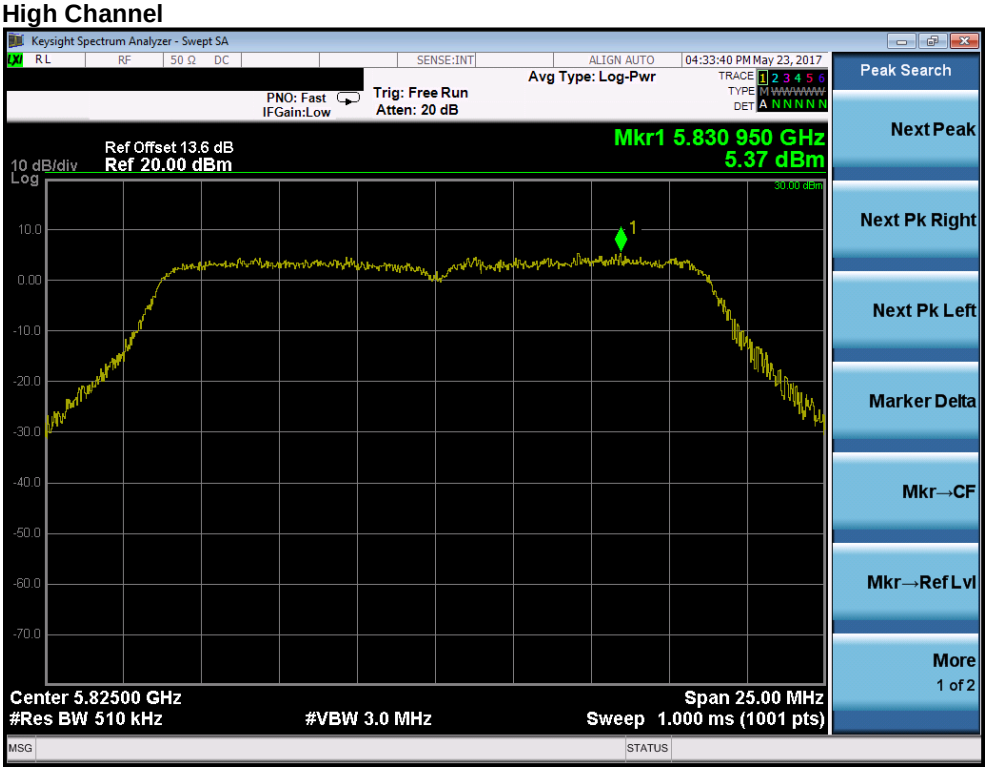


Test Plot of Power Density 802.11n HT20 (5725-5850MHz)

Low Channel

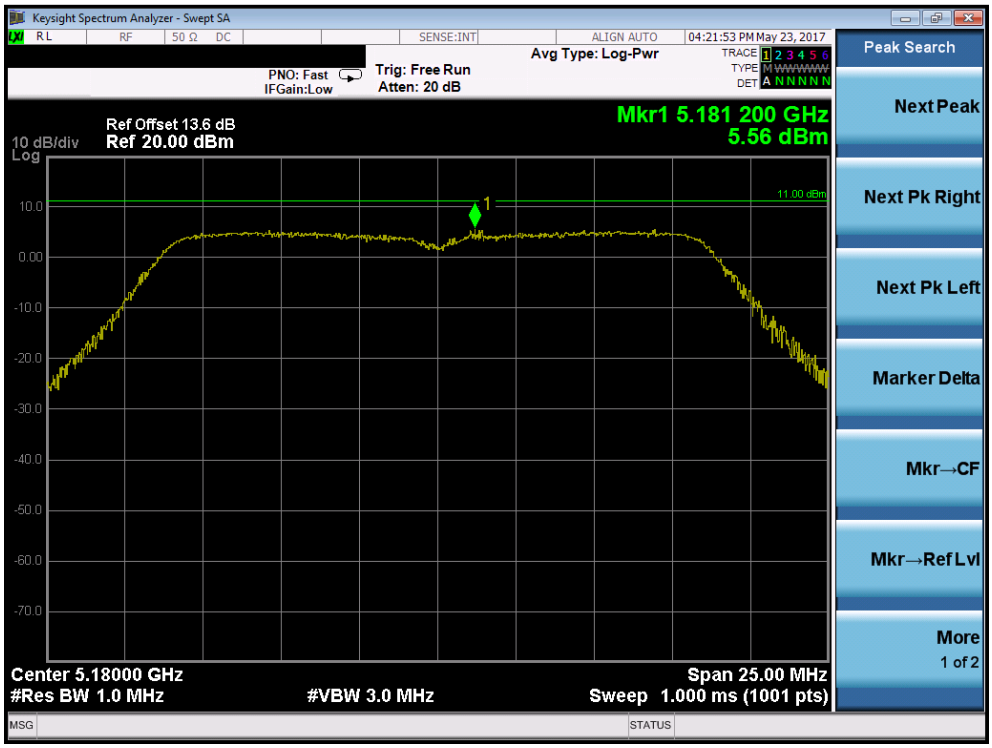
Middle Channel

High Channel



Test Plot of Power Density 802.11ac HT20 (5150-5250MHz)

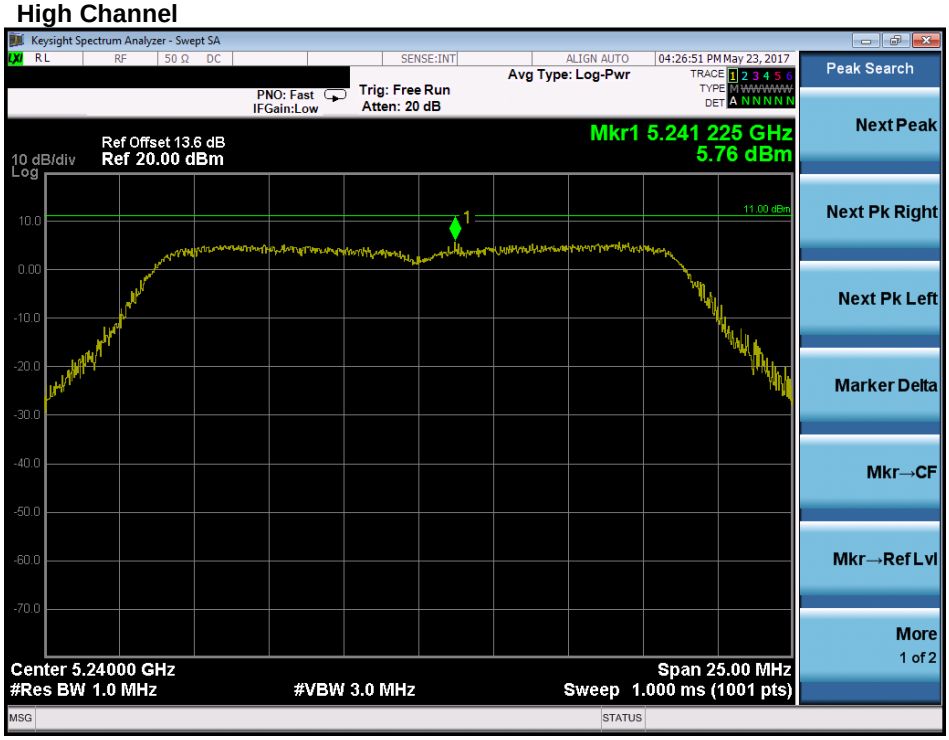
Low channel



Middle Channel

Middle Channel

High Channel

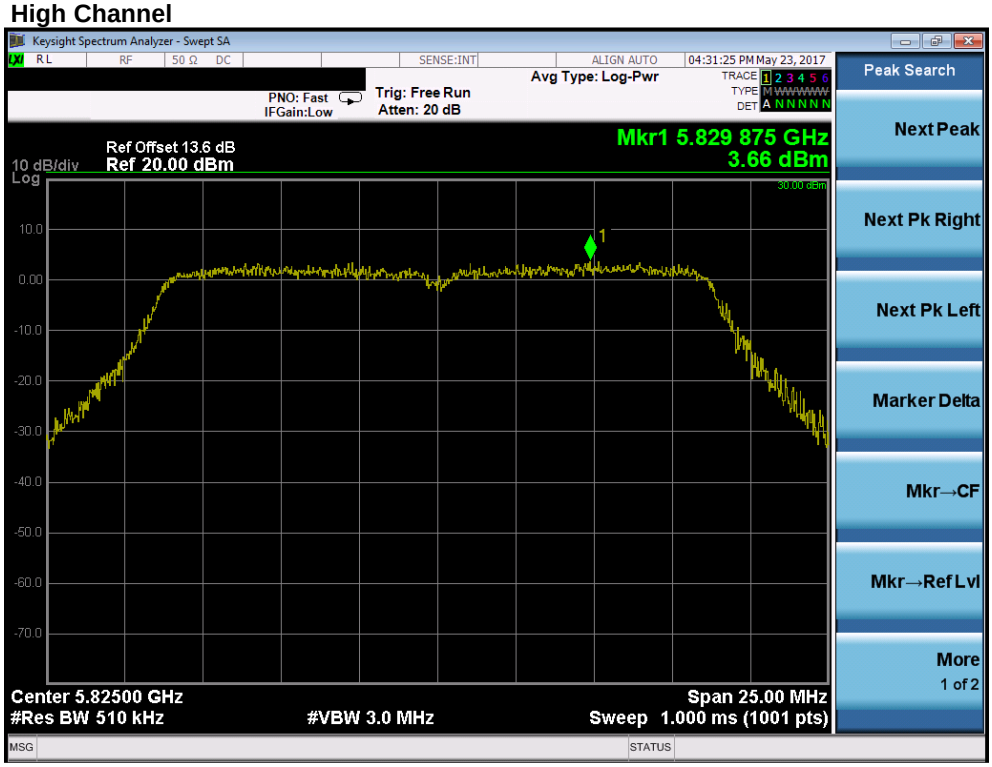


Test Plot of Power Density 802.11ac HT20 (5725-5850MHz)

Low Channel

Middle Channel

High Channel



5.1.6 Spurious Emission

RESULT: **Passed**

Test standard	:	LP0002(2016):4.7.4 FCC 15.205, FCC 15.209, RSS-247 issue2, and RSS-Gen 7.2.1
Basic standard	:	ANSI C63.10: 2009
Limits	:	Radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a) and RSS-210 2.7 (Table 1), must comply with the radiated emission limits specified in FCC 15.209(a) and RSS-210 2.7 (Table 2 and 3). 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-210 2.7 (Table 2 and 3) and RSS-210 A2.9(a). LP0002(2016): 4.7.4
Kind of test site	:	3m Semi-Anechoic Chamber

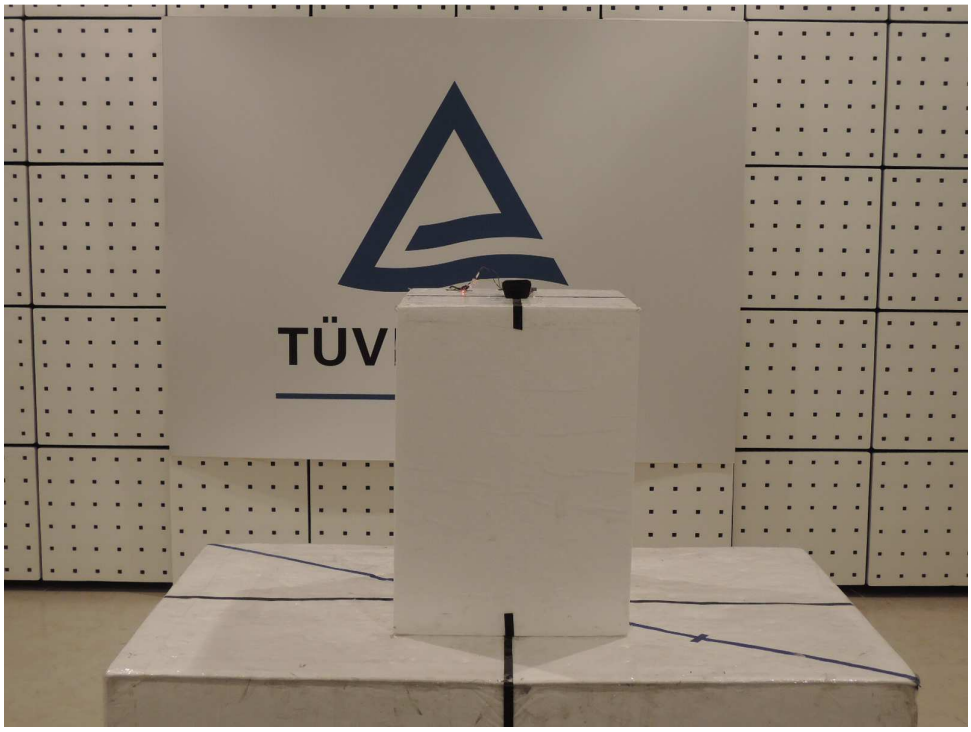
Test setup

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

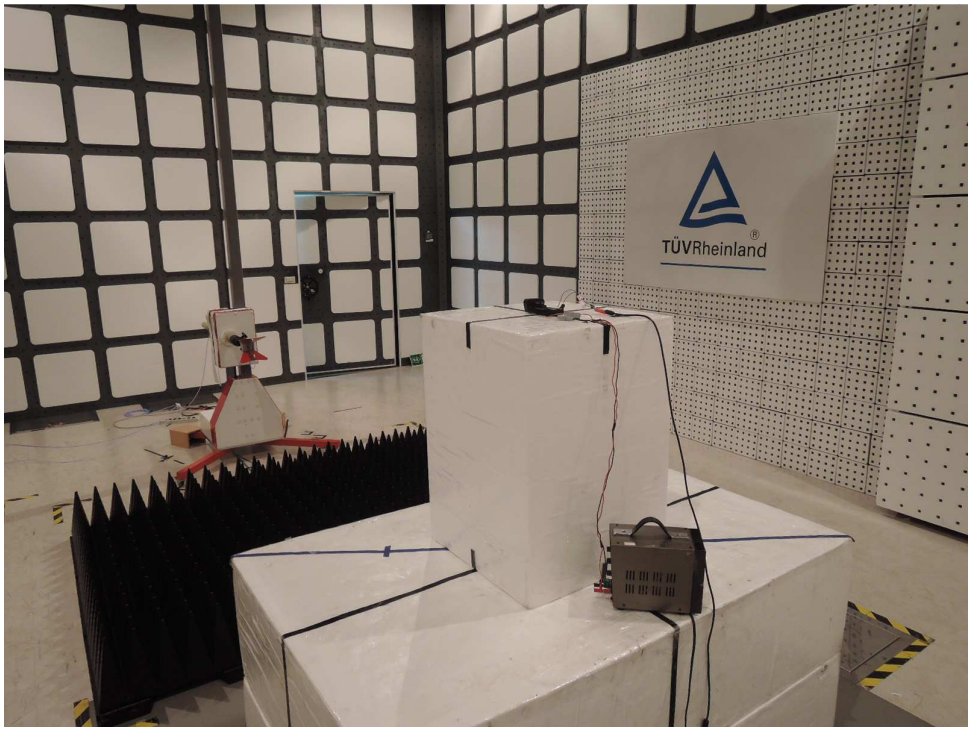
Remark: Testing was carried out within frequency range 30MHz to the tenth harmonic. For details refer to Appendix D. The Radiated Emissions testing was performed in the X, Y and Z axis orientation. The Z Axis orientation is the worst-case and recorded in this test report.

Photographs of the Test Set-Up

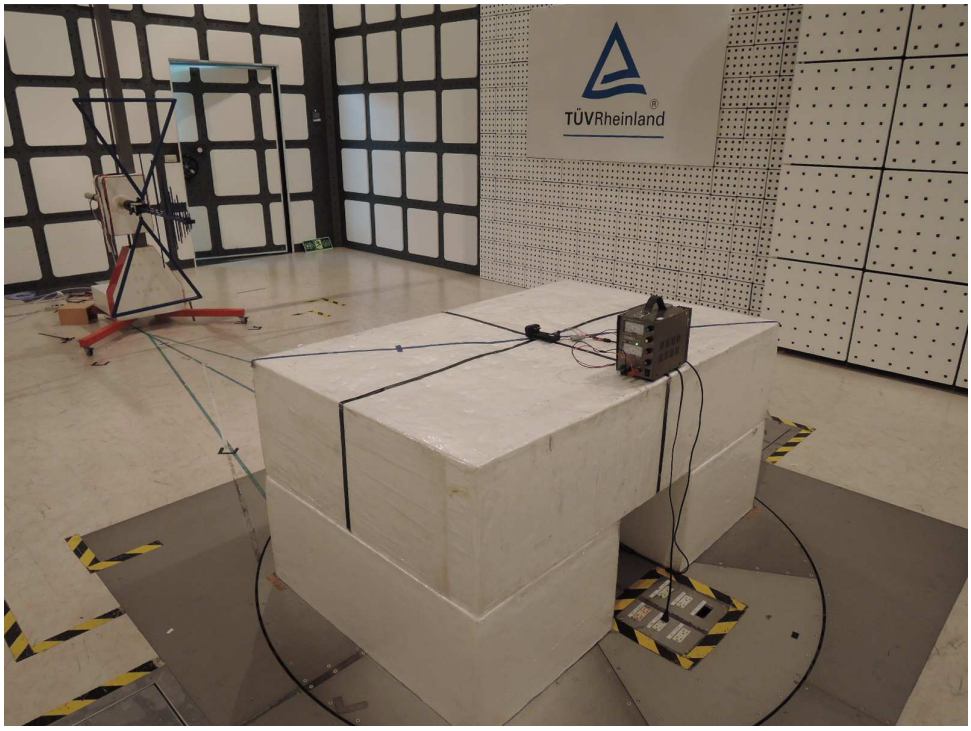
Photograph 1: Set-up for Spurious Emissions TX (Front View)



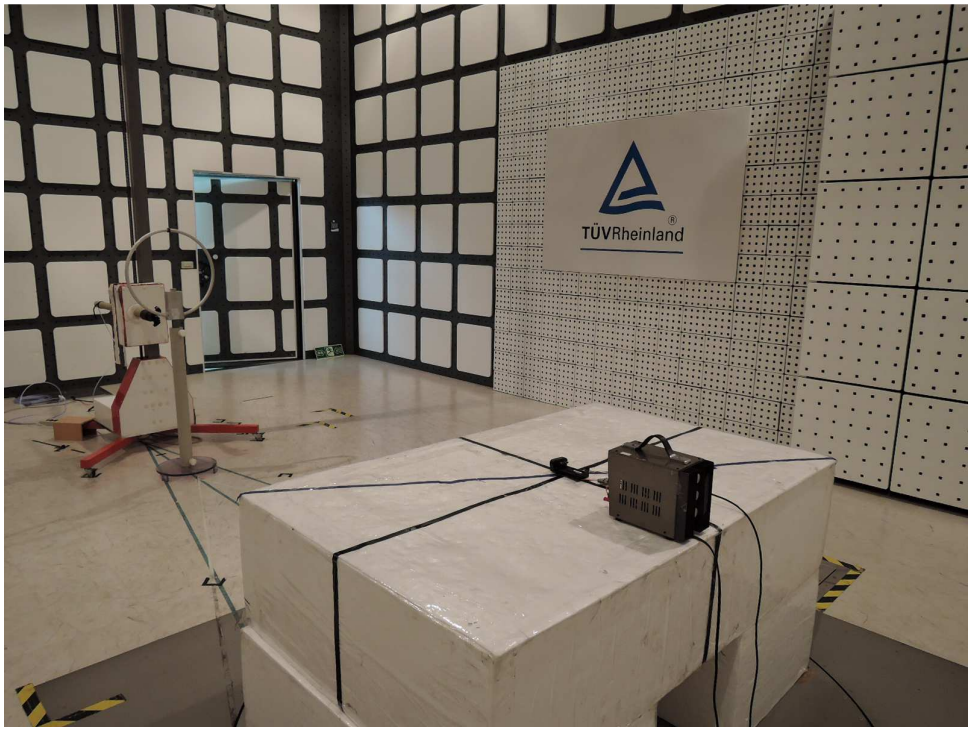
Photograph 2: Set-up for Spurious Emissions TX (Back View 1)



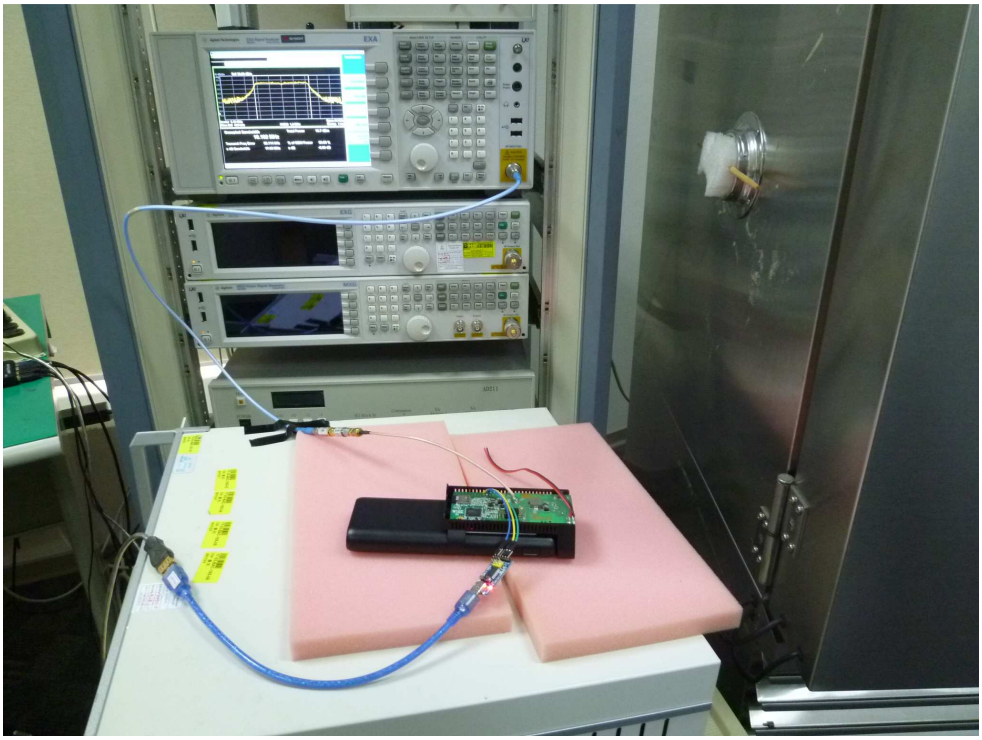
Photograph 3: Set-up for Spurious Emissions TX (Back View 2)



Photograph 4: Set-up for Spurious Emissions TX (Back View 3)



Photograph 5: Set-up for Conducted testing



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