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Report On

FCC Testing of the Vertex Telecom, Inc. DW33D Damai WiFi AC1750M
Dual Band Gigabit Router in accordance with FCC CFR 47 Part 15,
Subpart E

COMMERCIAL-IN-CONFIDENCE

FCC ID: 2AE7MRDW33D-E2

Document 57015092 Report 03 Issue 1

September 2015



Product Service

REPORT ON

FCC Testing of the
Vertex Telecom, Inc.
DW33D Damai WiFi AC1750M Dual Band Gigabit Router

Document 57015092 Report 03 Issue 1

September 2015

PREPARED FOR

Vertex Telecom, Inc.
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PREPARED BY

A handwritten signature in black ink, appearing to read "Zhao Guiying".

G Zhao
Engineer

APPROVED BY

A handwritten signature in black ink, appearing to read "Zhang Chengxin".

C Zhang
Manager

DATED

07 September 2015

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on one sample equipment to demonstrate limited compliance with FCC CFR 47 Part 15, Subpart E. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineer(s);

A handwritten signature in black ink, appearing to read "Zhao Guiying".

G Zhao



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SECTION 1

REPORT SUMMARY

FCC Testing of the Vertex Telecom, Inc.
DW33D Damai WiFi AC1750M Dual Band Gigabit Router
in accordance with FCC CFR 47 Part 15, Subpart E



Product Service

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Vertex Telecom, Inc. DW33D Damai WiFi AC1750M Dual Band Gigabit Router to the requirements of FCC CFR 47 Part 15 Subpart E.

Objective	To perform FCC Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Vertex Telecom, Inc.
Product Name	Damai WiFi AC1750M Dual Band Gigabit Router
Product Type	DW33D
Serial Number(s)	RDW33DI0121150400025
Software Version	00.00.00.01
Hardware Version	DW33D V1.0
Number of Samples Tested	1
Test Specification/Issue/Date	FCC CFR 47 Part 15, Subpart E: 2014
Start of Test	15 July 2015
Finish of Test	28 August 2015
Name of Engineer(s)	G Zhao



Product Service

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of results in accordance with FCC CFR 47 Part 15, Subpart E.

Test	Spec Clause	Test Description	Result
2.1	15.207, 15.407(b)(6)	Conducted Emission AC Power Port	Pass
2.2	KDB 789033 D02 II.B	Duty Cycle	-
2.3	15.407(a), 15.407(e)	99% Occupied Bandwidth 6dB and 26dB Emission Bandwidth	Pass
2.4	15.407(a)(3)	Maximum Conducted Output Power - Average	Pass
2.5	15.407(a)(3)	Power Spectral Density	Pass
2.6	15.407(g)	Frequency Stability	Pass
2.7	15.205, 15.209, 15.407(b)	Radiated Emissions and Band Edge	Pass



1.3 DECLARATION OF BUILD STATUS

MAIN EUT		
Manufacture	Vertex Telecom, Inc.	
Product Name	Damai WiFi AC1750M Dual Band Gigabit Router	
Product Type	DW33D	
Serial Number	RDW33DI0121150400025	
Radio Access Technology	WLAN	
Hardware Version	DW33D V1.0	
Software Version	00.00.00.01	
Operating Frequency	2400MHz to 2483.5MHz, 5725MHz to 5850MHz	
Transfer Rate	802.11b: 1Mbps, 2Mbps, 5.5Mbps, 11Mbps 802.11a/g: 6Mbps, 9Mbps, 12Mbps, 18Mbps, 24Mbps, 36Mbps, 48Mbps, 54Mbps 802.11n: up to 450Mbps 802.11ac: up to 1299.9Mbps	
Number of channel	For 2400MHz to 2483.5MHz 802.11b/g/n(20MHz): 11 802.11n(40MHz): 7	
	For 5725MHz to 5850MHz: 802.11a/11n(20MHz)/11ac(20MHz): 5 802.11n(40MHz)/11ac(40MHz): 2 802.11ac(80MHz): 1	
Modulation Type	802.11b: DSSS (CCK, DQPSK, DBPSK) 802.11a/g: OFDM (64QAM, 16QAM, QPSK, BPSK) 802.11n: OFDM (64QAM, 16QAM, QPSK, BPSK) 802.11ac: OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK)	
Maximum Output Power (dBm)	Band 2400MHz to 2483.5MHz: 25dBm Band 5725MHz to 5850MHz: 19dBm	
Antenna Gain (dBi)	Band 2400MHz to 2483.5MHz: 3dBi Band 5725MHz to 5850MHz: 5dBi	
Antenna Number	3	
FCC ID	2AE7MRDW33D-E2	
Environment temperature range(s)	Minimum	Maximum
	0 °C	+40 °C
DC Power source	12.0V	
TECHNICAL DESCRIPTION (a brief description of the intended use and operation)	This Damai WiFi AC1750M Dual Band Gigabit Router is an indoor access, which operates on the frequency band 2400MHz to 2483.5MHz and band 5725MHz to 5850MHz.	

No responsibility will be accepted by TÜV SÜD Certification and Testing (China) Co., Ltd. Beijing Branch as to the accuracy of the information declared in this document by the manufacturer.



Product Service

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) DW33D is Damai WiFi AC1750M Dual Band Gigabit Router from Vertex Telecom, Inc.

There is only one model with Damai WiFi AC1750M Dual Band Gigabit Router for approval, which is DW33D. This Damai WiFi AC1750M Dual Band Gigabit Router is an indoor access, which operates on the frequency band 2400MHz to 2483.5MHz and band 5725MHz to 5825MHz. Only the test results of frequency band 5725MHz to 5825MHz were shown in this report. A full technical description is held by Vertex Telecom, Inc.

The Equipment Under Test (EUT) is shown in the photograph below. A full technical description can be found in the Manufacturers documentation.



Equipment Under Test



1.4.2 Test Configuration

Configuration 1: 5GHz WLAN

The worst configurations were representative for all traffic scenarios after different data rates for each operating mode were measured. The settings of MIMO mode below were used for all measurements if not otherwise noted.

Frequency band IV: 5725MHz to 5850MHz	
Operating Mode	Data Rate / MCS
802.11a	54Mbps
802.11n(20)	MCS6
802.11n(40)	MCS6
802.11ac(20)	MCS8
802.11ac(40)	MCS9
802.11ac(80)	MCS5

Note : All the information below was used in this report.

802.11n(20) denotes 802.11n with 20MHz nominal channel bandwidth

802.11n(40) denotes 802.11n with 40MHz nominal channel bandwidth

802.11ac(20) denotes 802.11ac with 20MHz nominal channel bandwidth

802.11ac(40) denotes 802.11ac with 40MHz nominal channel bandwidth

802.11ac(80) denotes 802.11ac with 80MHz nominal channel bandwidth

The EUT was powered by a 12.0VDC power supply.

1.4.3 Test Frequencies

The frequencies for measurement are shown in the table below.

Frequency Band	Operating Mode	Frequencies (MHz) and Channel Number		
		Bottom(B)	Middle(M)	Top(T)
Band IV 5725MHz to 5850MHz	802.11a	5745 (149)	5785 (157)	5825 (165)
	802.11n(20)	5745 (149)	5785 (157)	5825 (165)
	802.11n(40)	5755 (151)	-	5795(159)
	802.11ac(20)	5745 (149)	5785 (157)	5825 (165)
	802.11ac(40)	5755 (151)	-	5795(159)
	802.11ac(80)	5775 (155)		

1.5 TEST CONDITIONS

For all tests the EUT was set up in accordance with the relevant test standard and to represent typical operating conditions. Tests were applied with the EUT situated in a shielded enclosure, test laboratories or an open test area as appropriate.

1.6 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.



Product Service

1.7 MODIFICATION RECORD

No modifications were made to the EUT during testing.

1.8 ALTERNATIVE TEST SITE

The testing was conducted at following site registrations:

FCC Accreditation 910917:

The State Radio Monitoring Center, No.80 Beilishi Road Xicheng District Beijing, China.



Product Service

SECTION 2

TEST DETAILS

FCC Testing of the Vertex Telecom, Inc.
DW33D Damai WiFi AC1750M Dual Band Gigabit Router
in accordance with FCC CFR 47 Part 15 Subpart E



Product Service

2.1 CONDUCTED EMISSIONS

2.1.1 Specification Reference

FCC CFR 47 Part 15, Clause 15.207, 15.407(b)(6)

2.1.2 Equipment Under Test

DW33D, S/N: RDW33DI0121150400025

2.1.3 Date of Test and Modification State

17 July 2015 – Modification State 0

2.1.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.5 Test Method

The test was applied in accordance with the test method requirements in clause 15.207 and 15.407 of FCC CFR 47 Part 15, Subpart E.

The test was performed in a shield room, and EUT was placed on a table, which was 0.8m above ground plane. The power line of the EUT was connected to the AC mains through a line Impedance Stabilization Network (LISN). The EUT was control to operate at traffic mode with maximum output power on MIMO mode.

A EMI test receiver was used to test the emissions from both sides of AC line. The conducted emission is scanned over the frequency from 150kHz to 30MHz with peak detector. A final measurement is performed with quasi-peak detector and average detector.

2.1.6 Environmental Conditions

Ambient Temperature 25.5°C

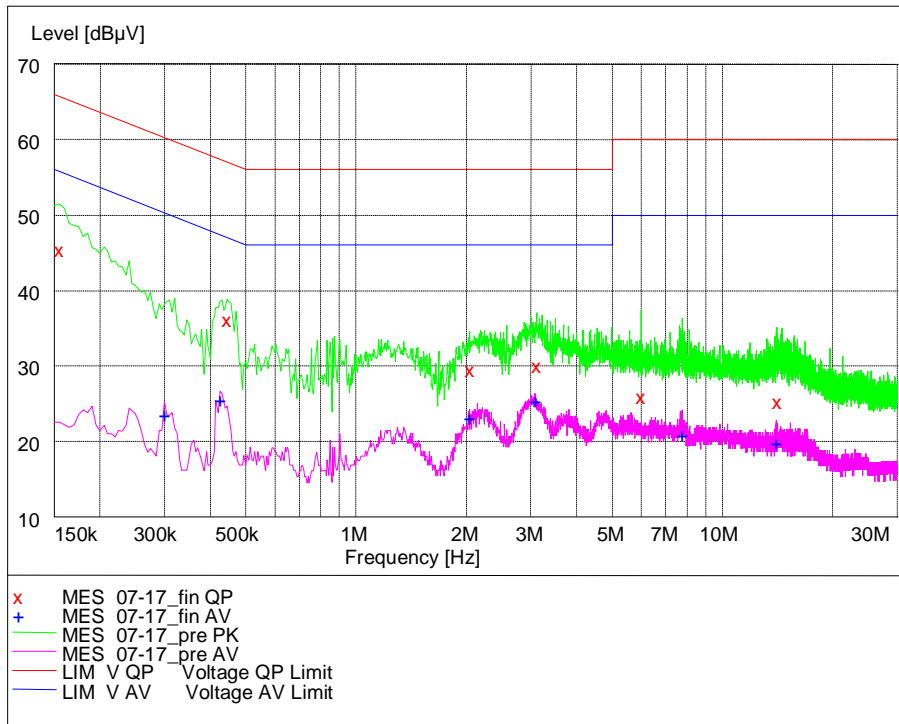
Relative Humidity 50.5%



2.1.7 Test Results

The test results are shown below.

L Line:

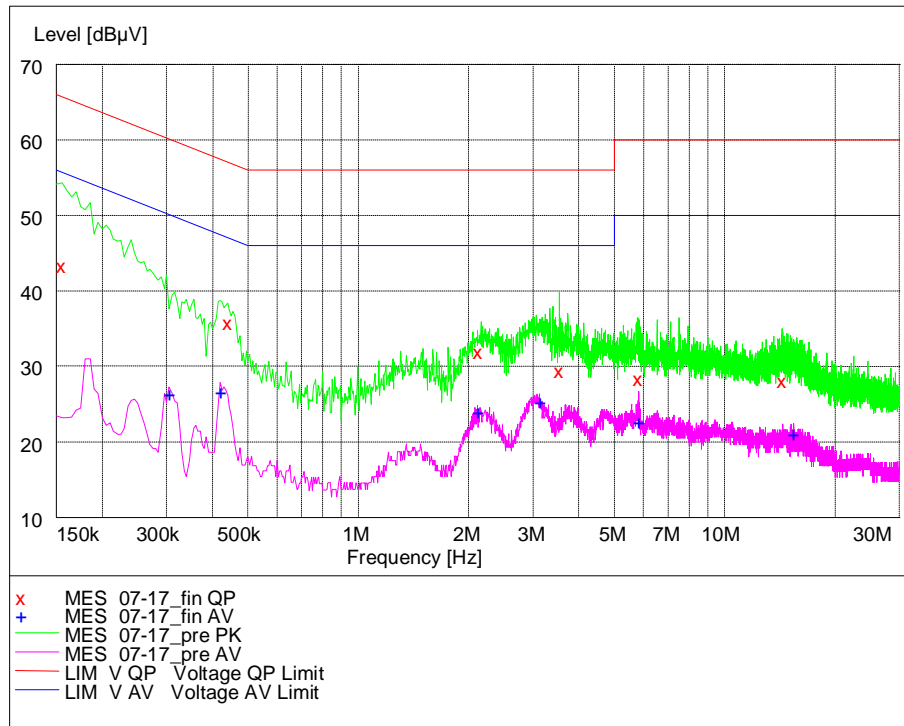


MEASUREMENT RESULT: "07-17_fin QP"

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB
0.155000	45.70	20.1	66	20.0
0.445000	36.40	20.1	57	20.6
2.045000	29.70	20.3	56	26.3
3.110000	30.30	20.3	56	25.7
6.005000	26.20	20.4	60	33.8
14.115000	25.50	20.7	60	34.5

MEASUREMENT RESULT: "07-17_fin AV"

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB
0.300000	23.90	20.2	50	26.4
0.425000	25.80	20.1	47	21.5
2.040000	23.50	20.3	46	22.5
3.085000	25.70	20.3	46	20.3
7.755000	21.10	20.5	50	28.9
14.025000	20.10	20.7	50	29.9

**N Line:****MEASUREMENT RESULT: "07-17_fin QP"**

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB
0.155000	43.60	20.1	66	22.2
0.440000	36.00	20.1	57	21.1
2.120000	32.20	20.3	56	23.8
3.540000	29.70	20.3	56	26.3
5.790000	28.70	20.4	60	31.3
14.355000	28.40	20.7	60	31.6

MEASUREMENT RESULT: "07-17_fin AV"

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB
0.305000	26.70	20.2	50	23.4
0.420000	27.00	20.1	47	20.4
2.120000	24.30	20.3	46	21.7
3.125000	25.60	20.3	46	20.4
5.825000	23.00	20.4	50	27.0
15.405000	21.40	20.7	50	28.6



Product Service

Frequency (MHz)	QP Limit (dB μ V)	AV Limit (dB μ V)
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

*Decreasing linearly with logarithm of the frequency

Remarks

The result of test did not exceed the limits at the measured frequencies.



Product Service

2.2 DUTY CYCLE

2.2.1 Specification Reference

FCC KDB 789033 D02 II.B

2.2.2 Equipment Under Test

DW33D, S/N: RDW33DI0121150400025

2.2.3 Date of Test and Modification State

03 and 04 August 2015 – Modification State 0

2.2.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.5 Test Method

The test was applied in accordance with the requirements in FCC KDB 789033 D02 Chapter II.B.

The EUT was connected to the spectrum analyzer via an RF cable, and was controlled to transmitting at its maximum output power. Test procedures refer to II.B of KDB 789033 D02. The analyzer was set to zero-span mode, and RBW and VBW were set to 10MHz. Only the duty cycle of ANT3 was measured and recorded.

The path loss was measured and entered as a reference level offset.

2.2.6 Environmental Conditions

Ambient Temperature 22.8 - 24.5°C

Relative Humidity 51.5 - 53.0%



2.2.7 Test Results

For the period of test the EUT met the requirements of FCC KDB 789033 D02 Chapter II.B for Duty Cycle.

The test results are shown below.

Band IV

Operating Mode	Data Rate	Frequency (MHz)	Duty Cycle (%)
11a	54Mbps	5745	79.08
11a	54Mbps	5785	79.90
11a	54Mbps	5825	79.90
11n(20)	MCS6	5745	77.11
11n(20)	MCS6	5785	79.90
11n(20)	MCS6	5825	80.00
11n(40)	MCS6	5755	67.97
11n(40)	MCS6	5795	67.97
11ac(20)	MCS8	5745	75.30
11ac(20)	MCS8	5785	75.76
11ac(20)	MCS8	5825	74.85
11ac(40)	MCS9	5755	63.06
11ac(40)	MCS9	5795	63.06
11ac(80)	MCS5	5775	53.41



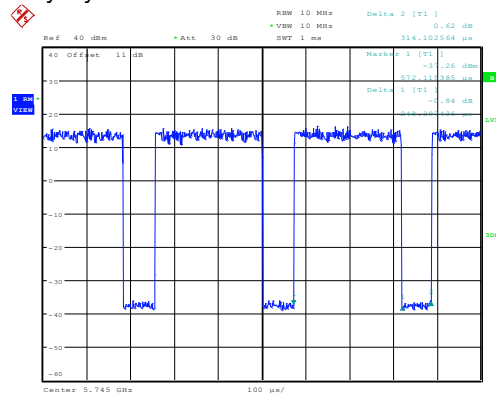
Product Service

The test plots are shown below

802.11a

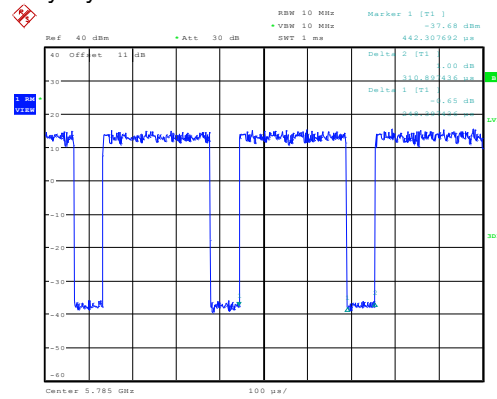
Configuration 1 - 5745MHz, 5785MHz and 5825MHz

Duty Cycle - 5745MHz



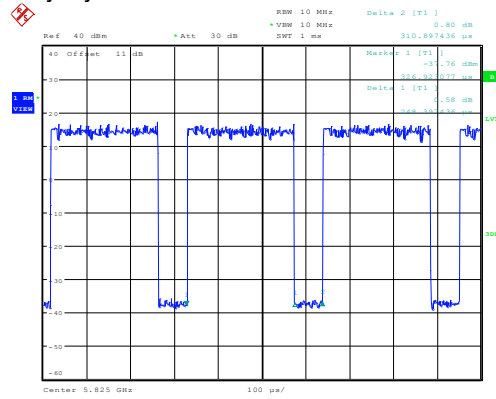
Date: 3.AUG.2015 14:39:48

Duty Cycle - 5785MHz



Date: 3.AUG.2015 15:45:57

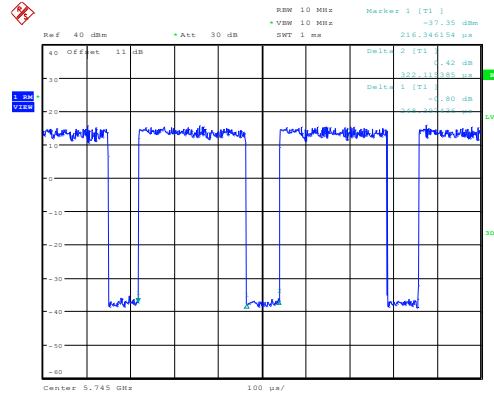
Duty Cycle - 5825MHz



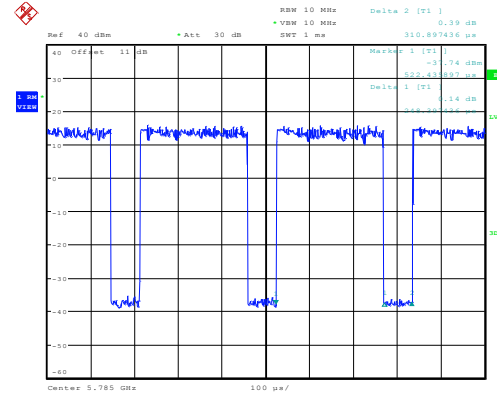
Date: 3.AUG.2015 15:20:55



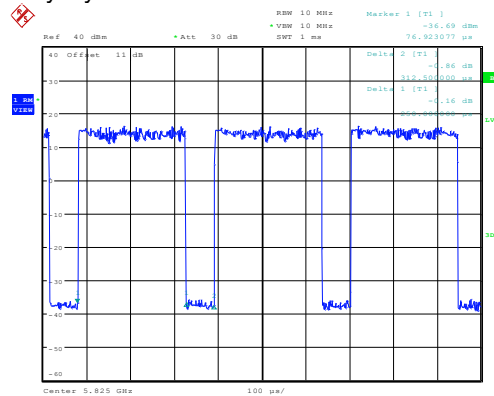
Product Service

802.11n(20)Configuration 1 - 5745MHz, 5785MHz and 5825MHz**Duty Cycle - 5745MHz**

Date: 3.AUG.2015 17:10:56

Duty Cycle - 5785MHz

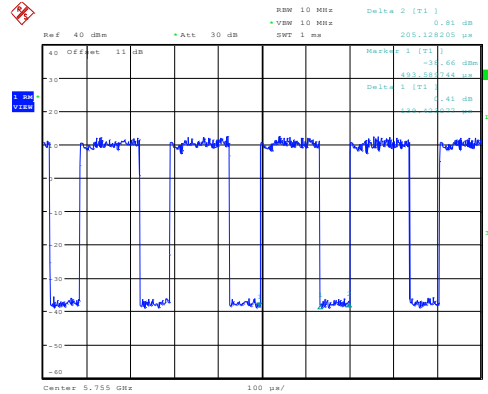
Date: 3.AUG.2015 16:15:38

Duty Cycle - 5825MHz

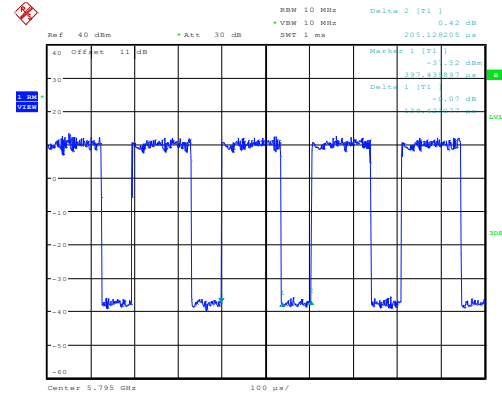
Date: 3.AUG.2015 17:19:16



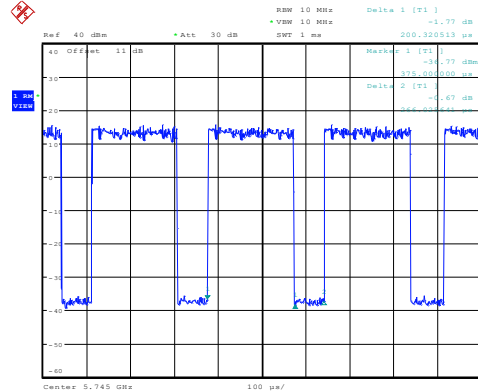
Product Service

802.11n(40)Configuration 1 - 5755MHz and 5795MHzDuty Cycle - 5755MHz

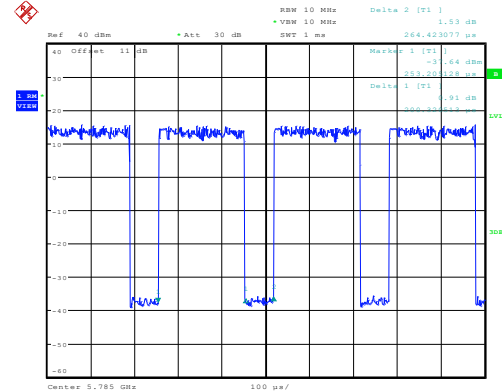
Date: 4.AUG.2015 10:29:29

Duty Cycle - 5795MHz

Date: 4.AUG.2015 10:46:57

802.11ac(20)Configuration 1 - 5745MHz, 5785MHz and 5825MHzDuty Cycle - 5745MHz

Date: 3.AUG.2015 19:23:30

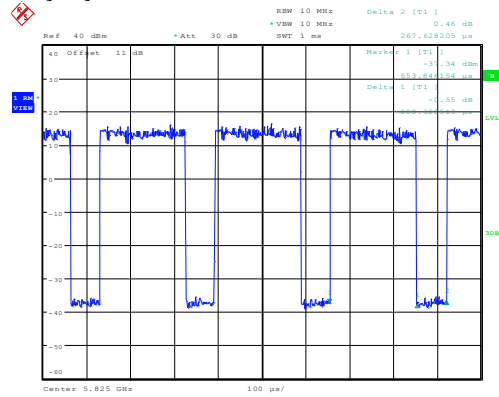
Duty Cycle - 5785MHz

Date: 3.AUG.2015 18:37:54



Product Service

Duty Cycle - 5825MHz

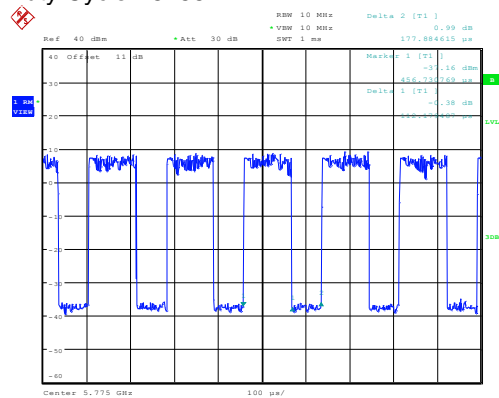


Date: 3.AUG.2015 18:35:27

802.11ac(40)

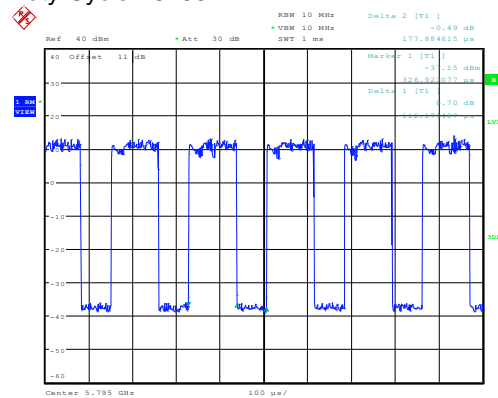
Configuration 1 - 5755MHz and 5795MHz

Duty Cycle - 5755MHz



Date: 4.AUG.2015 14:37:05

Duty Cycle - 5795MHz



Date: 4.AUG.2015 14:13:51

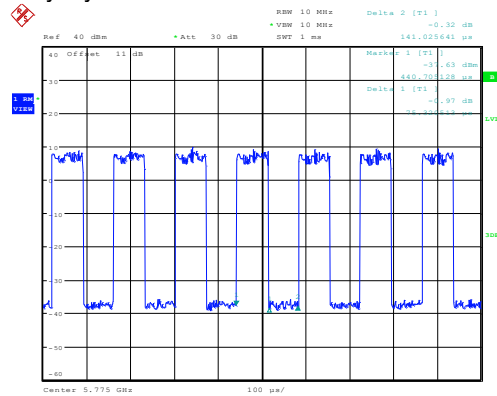


Product Service

802.11ac(80)

Configuration 1 - 5775MHz

Duty Cycle - 5775MHz



Date: 4.AUG.2015 16:09:09

Remarks

The duty cycles of EUT for each mode are lower than 98%.



Product Service

2.3 99% OCCUPIED BANDWIDTH, 6DB AND 26DB EMISSION BANDWIDTH**2.3.1 Specification Reference**

FCC CFR 47 Part 15, Clause 15.407(a), 15.407(e)

2.3.2 Equipment Under Test

DW33D, S/N: RDW33DI0121150400025

2.3.3 Date of Test and Modification State

03 and 04 August 2015 – Modification State 0

2.3.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.5 Test Method

The test was applied in accordance with the test method requirements in clause 15.407 of FCC CFR 47 Part 15 Subpart E.

The EUT was connected to the spectrum analyzer, and transmitting on its maximum output power.

For FCC requirement, outside of which all emissions are attenuated by at least X dB below the transmitter power, where the value of X is typically specified as 6 and 26. In addition, the 99% Occupied Bandwidth was measured. The limit for 6dBc bandwidth should be $\geq 500\text{kHz}$. Test procedures refer to Bandwidth Measurement in KDB 789033 D02. The peak detector was used for measurement.

The test was performed with the EUT in the following configurations and modes of operation:

2.3.6 Environmental Conditions

Ambient Temperature 22.8 - 24.5°C

Relative Humidity 51.5 - 53.0%



2.3.7 Test Results

For the period of test the EUT met the requirements of FCC CFR 47 Part 15 for Occupied Band width and Emission Bandwidth.

The test results are shown below.

99% Occupied Bandwidth

Band IV

Operating Mode	Data Rate	Frequency (MHz)	Test Result (MHz)		
			ANT1	ANT2	ANT3
11a	54Mbps	5745	16.83	16.73	16.73
11a	54Mbps	5785	16.78	16.78	16.78
11a	54Mbps	5825	16.78	16.73	16.83
11n(20)	MCS6	5745	17.88	17.88	17.88
11n(20)	MCS6	5785	17.88	17.88	17.88
11n(20)	MCS6	5825	17.88	17.93	17.88
11n(40)	MCS6	5755	36.73	36.73	36.73
11n(40)	MCS6	5795	36.73	36.83	36.83
11ac(20)	MCS8	5745	17.88	17.88	17.88
11ac(20)	MCS8	5785	17.88	17.93	17.88
11ac(20)	MCS8	5825	17.84	17.88	17.98
11ac(40)	MCS9	5755	36.73	36.73	36.73
11ac(40)	MCS9	5795	36.73	36.73	36.83
11ac(80)	MCS5	5775	76.73	76.73	76.73

26dB Emission Bandwidth

Band IV

Operating Mode	Data Rate	Frequency (MHz)	Test Result (MHz)		
			ANT1	ANT2	ANT3
11a	54Mbps	5745	22.84	22.79	23.51
11a	54Mbps	5785	23.17	23.89	24.23
11a	54Mbps	5825	23.89	23.85	25.48
11n(20)	MCS6	5745	23.32	23.37	23.56
11n(20)	MCS6	5785	23.80	24.18	23.56
11n(20)	MCS6	5825	23.94	23.99	24.28
11n(40)	MCS6	5755	45.29	46.06	45.96
11n(40)	MCS6	5795	45.77	46.15	46.25
11ac(20)	MCS8	5745	23.37	23.46	23.65
11ac(20)	MCS8	5785	23.61	24.04	24.28
11ac(20)	MCS8	5825	23.27	23.80	24.86
11ac(40)	MCS9	5755	45.58	45.10	45.29
11ac(40)	MCS9	5795	45.96	46.06	45.48
11ac(80)	MCS5	5775	95.00	94.62	93.85

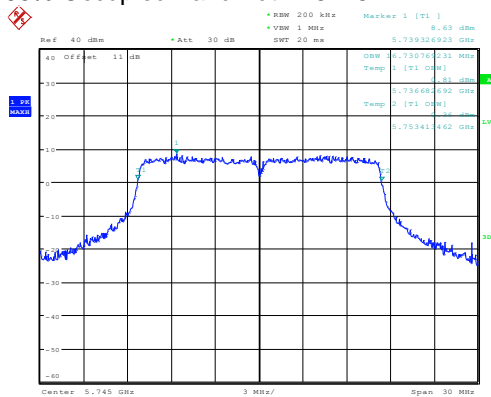


Product Service

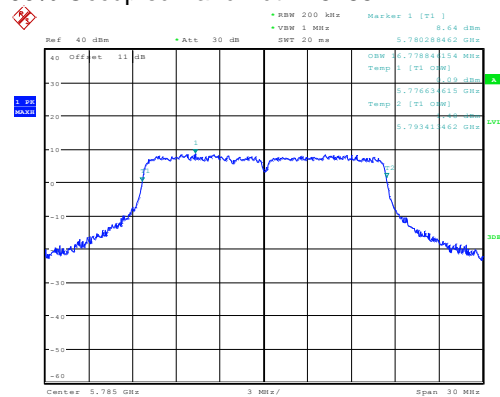
6dB Emission BandwidthBand IV

Operating Mode	Data Rate	Frequency (MHz)	Test Result (MHz)		
			ANT1	ANT2	ANT3
11a	54Mbps	5745	16.59	16.59	16.59
11a	54Mbps	5785	16.59	16.59	16.57
11a	54Mbps	5825	16.59	16.59	16.59
11n(20)	MCS6	5745	17.84	17.84	17.84
11n(20)	MCS6	5785	17.84	17.84	17.84
11n(20)	MCS6	5825	17.84	17.84	17.84
11n(40)	MCS6	5755	36.73	36.73	36.63
11n(40)	MCS6	5795	36.73	36.63	36.63
11ac(20)	MCS8	5745	17.84	17.84	17.84
11ac(20)	MCS8	5785	17.84	17.84	17.84
11ac(20)	MCS8	5825	17.84	17.84	17.84
11ac(40)	MCS9	5755	36.63	36.63	36.63
11ac(40)	MCS9	5795	36.73	36.63	36.63
11ac(80)	MCS5	5775	76.73	76.92	76.92

Only the test plots of ANT3 are shown below

802.11aConfiguration 1 - 5745MHz, 5785MHz and 5825MHz99% Occupied Bandwidth - 5745MHz

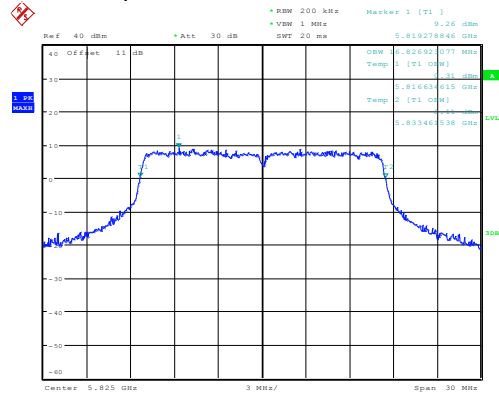
Date: 3.AUG.2015 14:42:13

99% Occupied Bandwidth - 5785MHz

Date: 3.AUG.2015 16:07:35

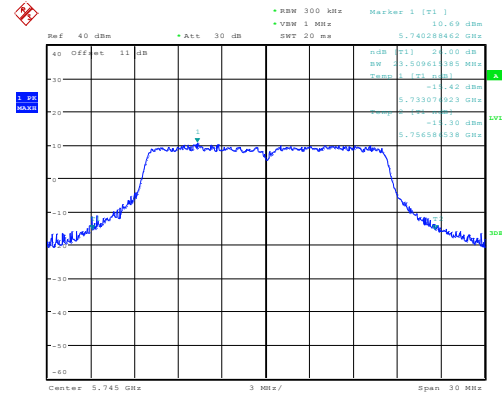


99% Occupied Bandwidth - 5825MHz



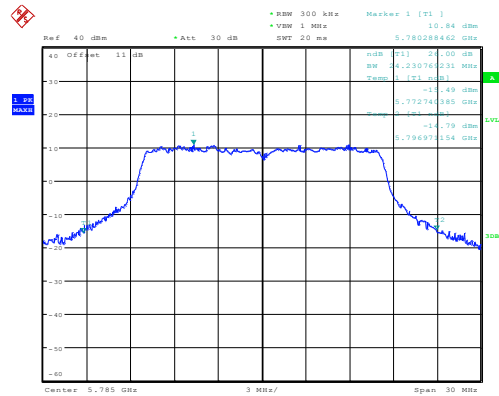
Date: 3.AUG.2015 15:09:47

26dB Emission Bandwidth - 5745MHz



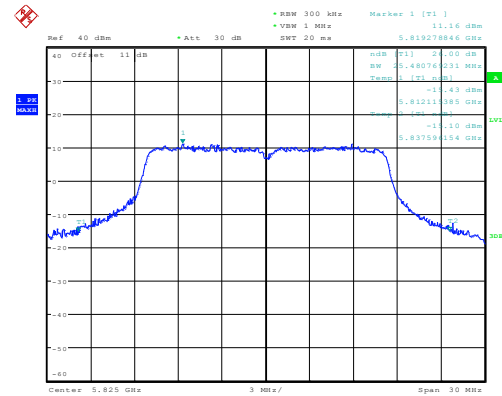
Date: 3.AUG.2015 14:43:27

26dB Emission Bandwidth - 5785MHz



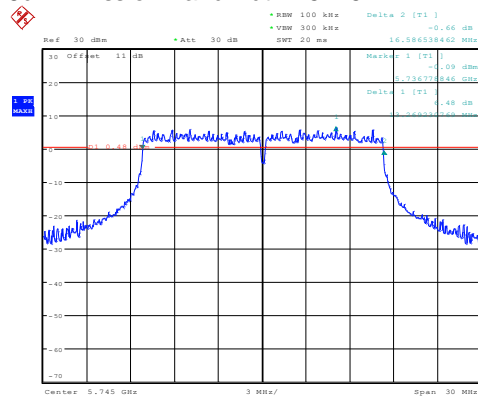
Date: 3.AUG.2015 16:09:02

26dB Emission Bandwidth - 5825MHz



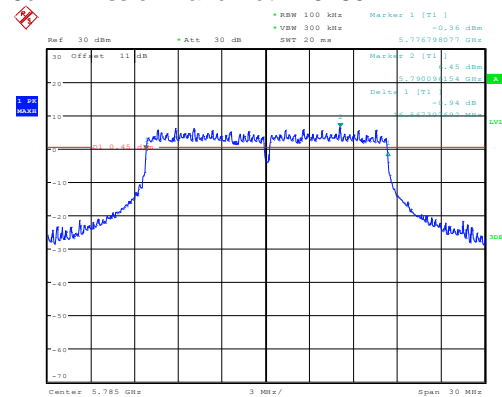
Date: 3.AUG.2015 15:05:24

6dB Emission Bandwidth - 5745MHz



Date: 3.AUG.2015 14:45:35

6dB Emission Bandwidth - 5785MHz

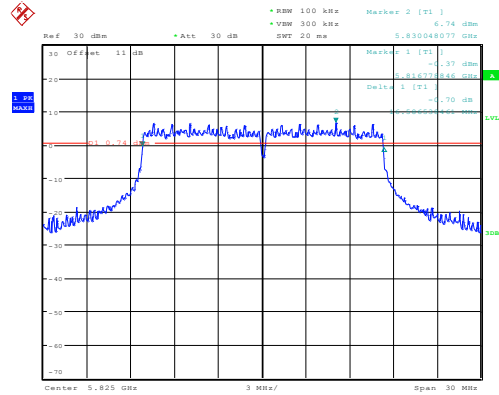


Date: 3.AUG.2015 16:10:47



Product Service

6dB Emission Bandwidth - 5825MHz

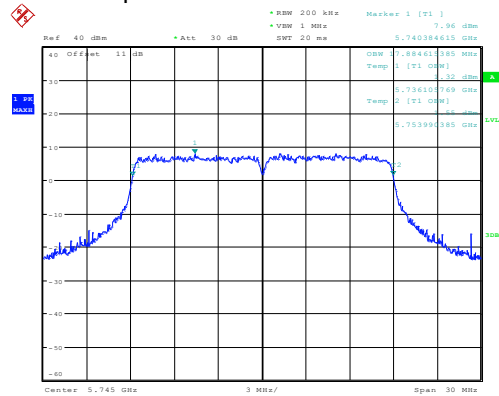


Date: 3.AUG.2015 15:11:13

802.11n(20)

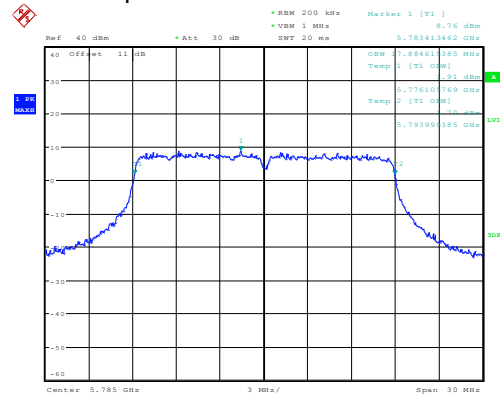
Configuration 1 - 5745MHz, 5785MHz and 5825MHz

99% Occupied Bandwidth - 5745MHz



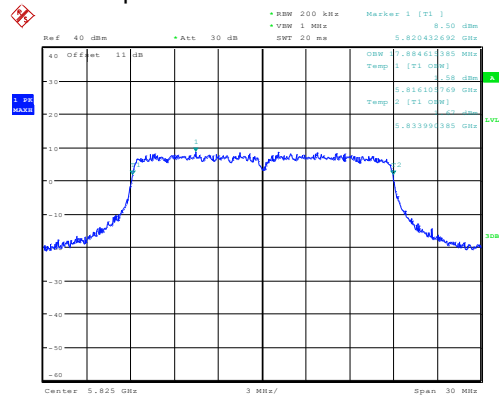
Date: 3.AUG.2015 17:05:13

99% Occupied Bandwidth - 5785MHz



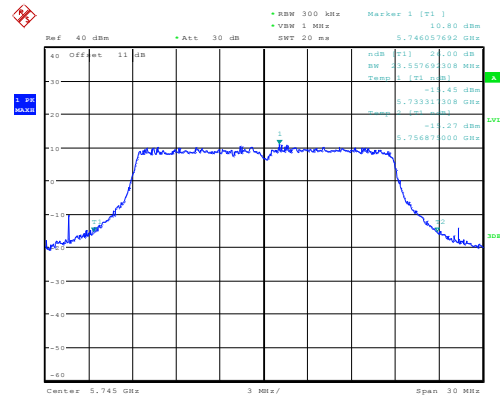
Date: 3.AUG.2015 16:18:12

99% Occupied Bandwidth - 5825MHz



Date: 3.AUG.2015 17:21:53

26dB Emission Bandwidth - 5745MHz

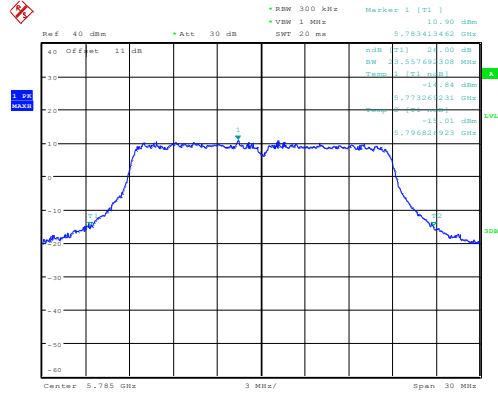


Date: 3.AUG.2015 17:03:40



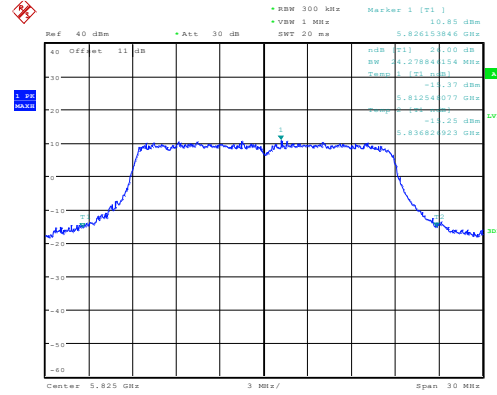
Product Service

26dB Emission Bandwidth - 5785MHz



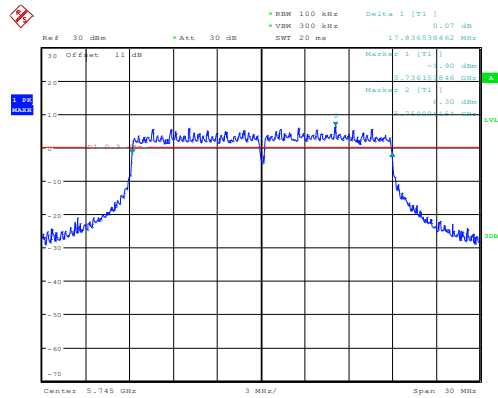
Date: 3.AUG.2015 16:20:15

26dB Emission Bandwidth - 5825MHz



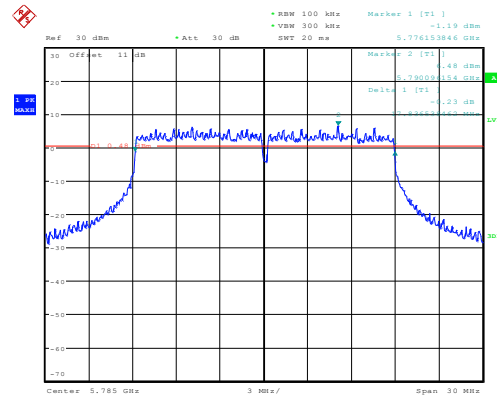
Date: 3.AUG.2015 17:21:21

6dB Emission Bandwidth - 5745MHz



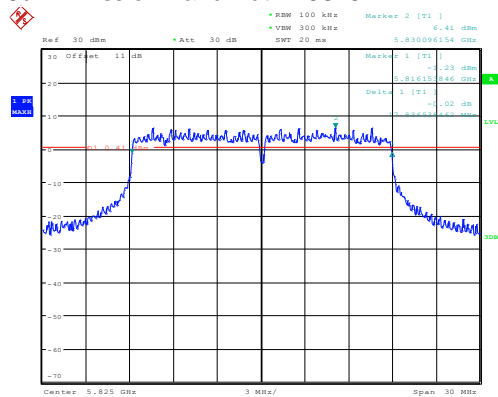
Date: 3.AUG.2015 17:06:25

6dB Emission Bandwidth - 5785MHz



Date: 3.AUG.2015 16:22:50

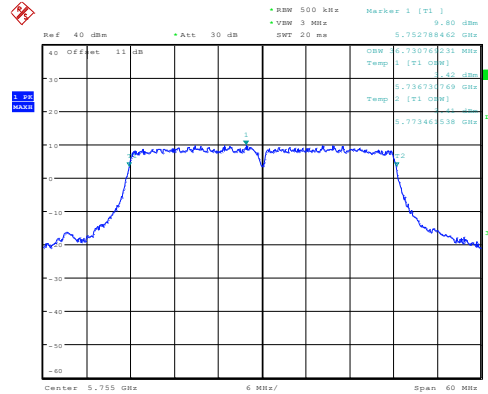
6dB Emission Bandwidth - 5825MHz



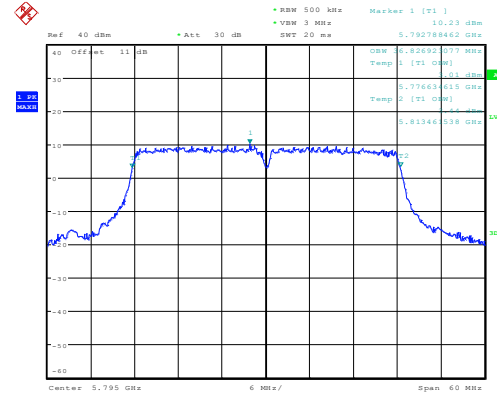
Date: 3.AUG.2015 17:23:42



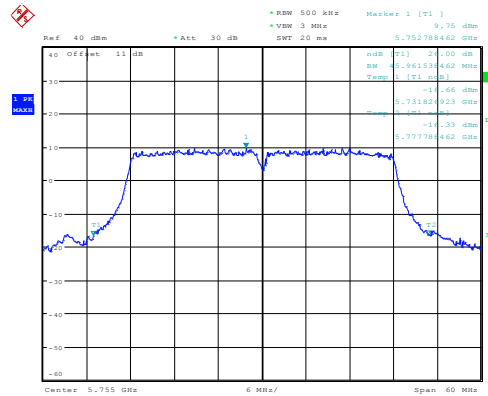
Product Service

802.11n(40)Configuration 1 - 5755MHz and 5795MHz**99% Occupied Bandwidth - 5755MHz**

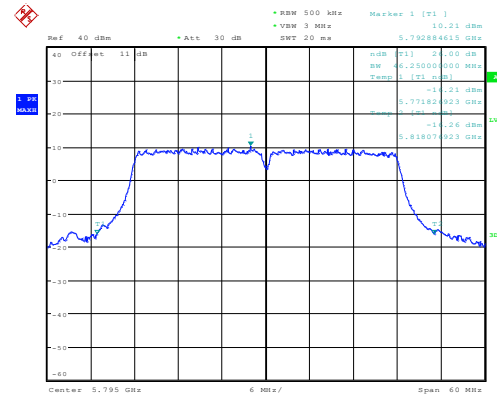
Date: 4.AUG.2015 10:21:58

99% Occupied Bandwidth - 5795MHz

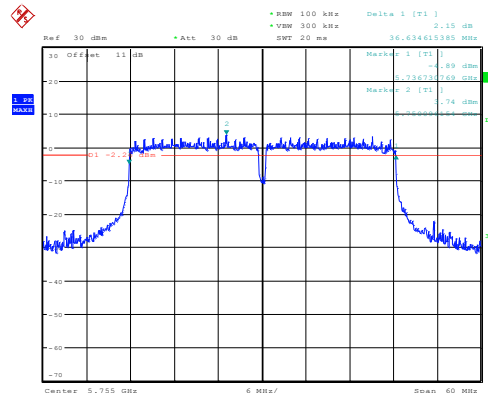
Date: 4.AUG.2015 10:50:44

26dB Emission Bandwidth - 5755MHz

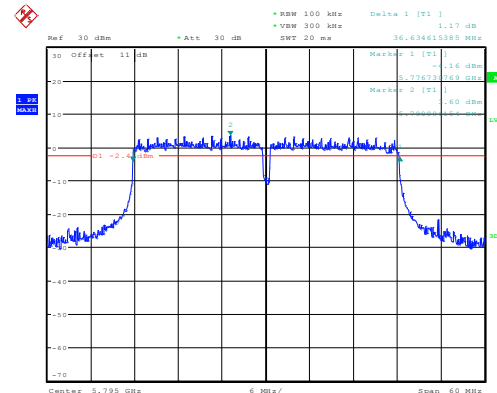
Date: 4.AUG.2015 10:19:48

26dB Emission Bandwidth - 5795MHz

Date: 4.AUG.2015 10:51:48

6dB Emission Bandwidth - 5755MHz

Date: 4.AUG.2015 10:24:17

6dB Emission Bandwidth - 5795MHz

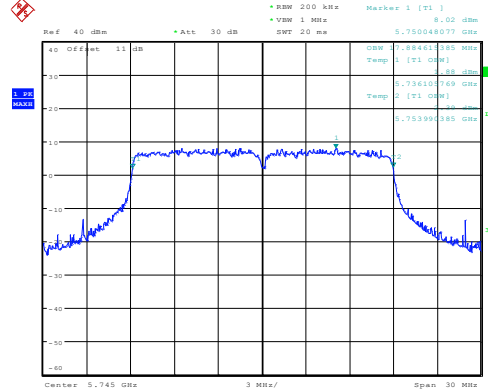
Date: 4.AUG.2015 10:54:39



Product Service

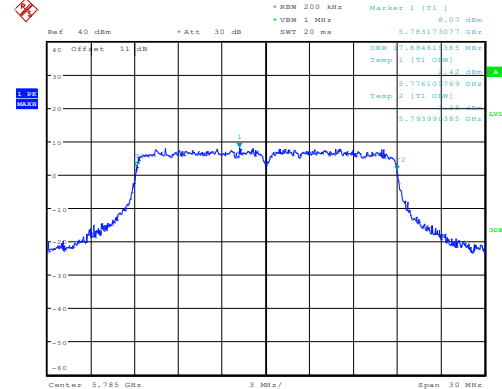
802.11ac(20)Configuration 1 - 5745MHz, 5785MHz and 5825MHz

99% Occupied Bandwidth - 5745MHz



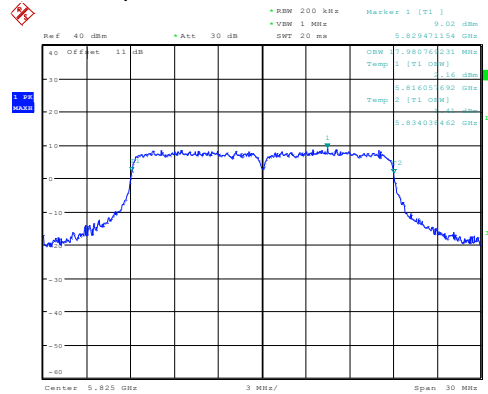
Date: 3.AUG.2015 19:27:03

99% Occupied Bandwidth - 5785MHz



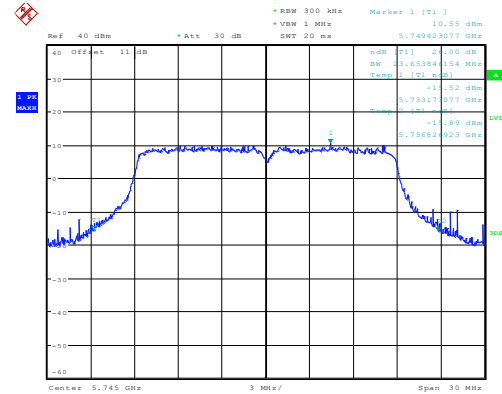
Date: 3.AUG.2015 18:52:43

99% Occupied Bandwidth - 5825MHz



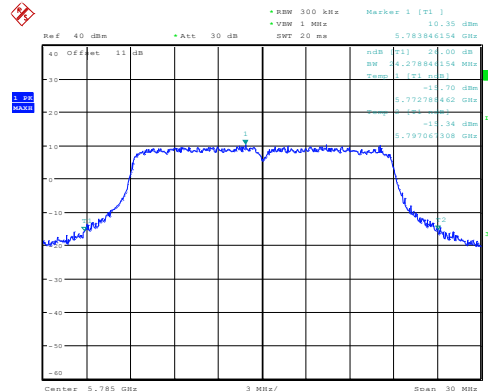
Date: 3.AUG.2015 18:26:56

26dB Emission Bandwidth - 5745MHz



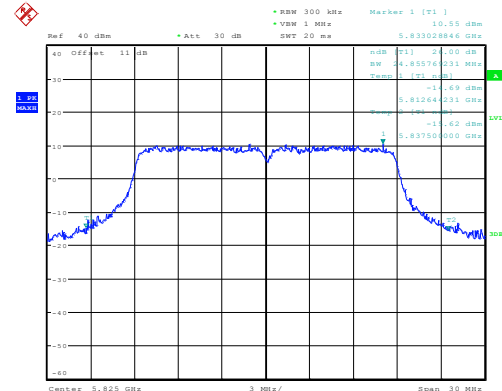
Date: 3.AUG.2015 19:25:48

26dB Emission Bandwidth - 5785MHz



Date: 3.AUG.2015 18:52:10

26dB Emission Bandwidth - 5825MHz

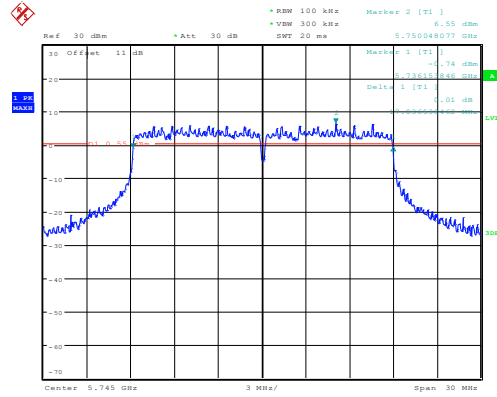


Date: 3.AUG.2015 18:25:57



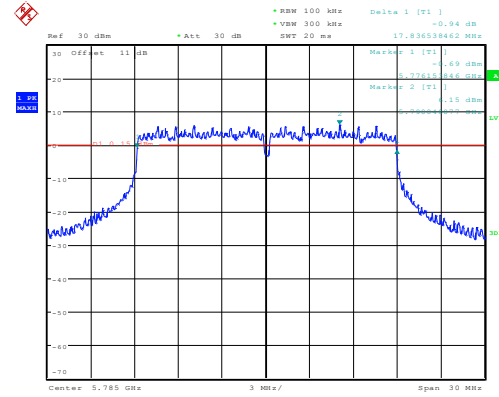
Product Service

6dB Emission Bandwidth - 5745MHz



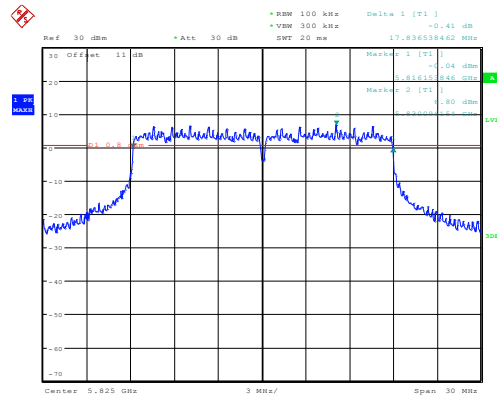
Date: 3.AUG.2015 19:34:08

6dB Emission Bandwidth - 5785MHz



Date: 3.AUG.2015 18:54:18

6dB Emission Bandwidth - 5825MHz

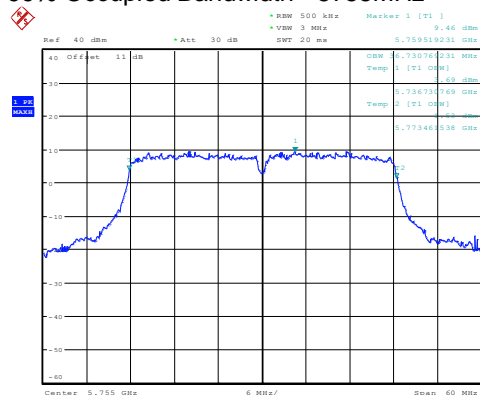


Date: 3.AUG.2015 18:28:57

802.11ac(40)

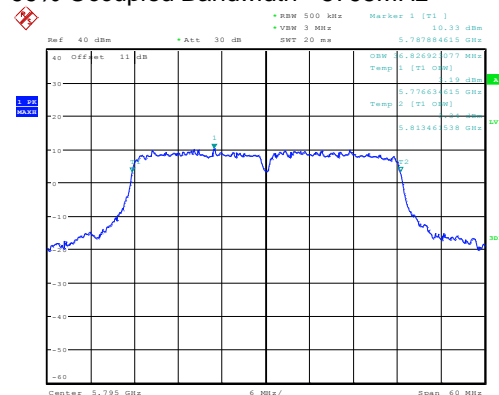
Configuration 1 - 5755MHz and 5795MHz

99% Occupied Bandwidth - 5755MHz



Date: 4.AUG.2015 14:24:17

99% Occupied Bandwidth - 5795MHz

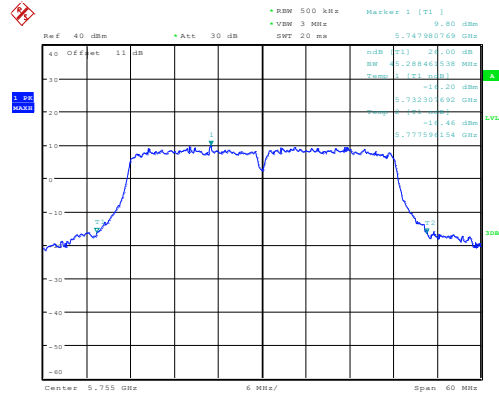


Date: 4.AUG.2015 14:19:27



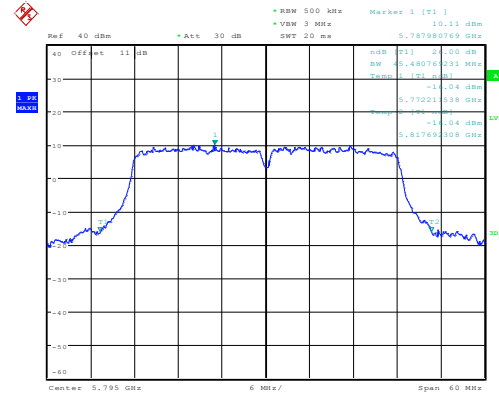
Product Service

26dB Emission Bandwidth - 5755MHz



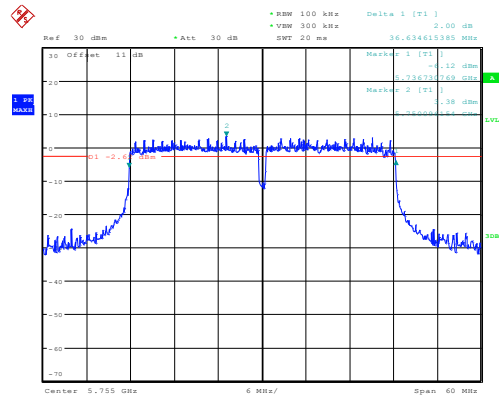
Date: 4.AUG.2015 14:25:56

26dB Emission Bandwidth - 5795MHz



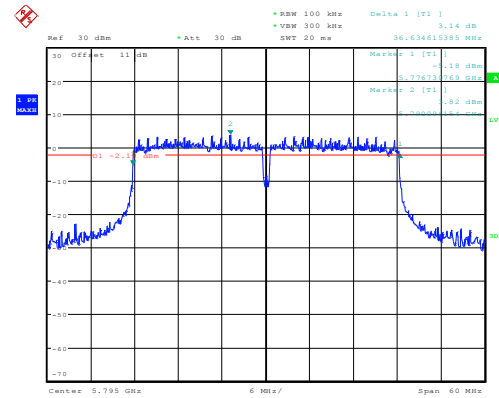
Date: 4.AUG.2015 14:17:35

6dB Emission Bandwidth - 5755MHz



Date: 4.AUG.2015 14:27:37

6dB Emission Bandwidth - 5795MHz

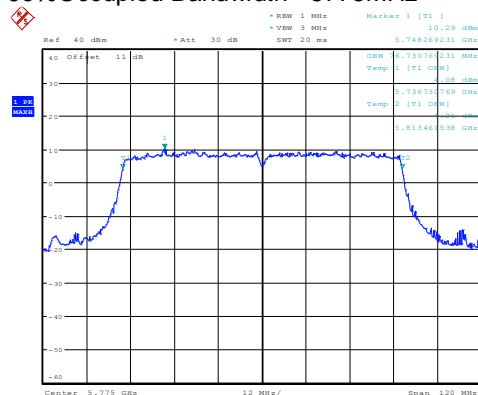


Date: 4.AUG.2015 14:21:02

802.11ac(80)

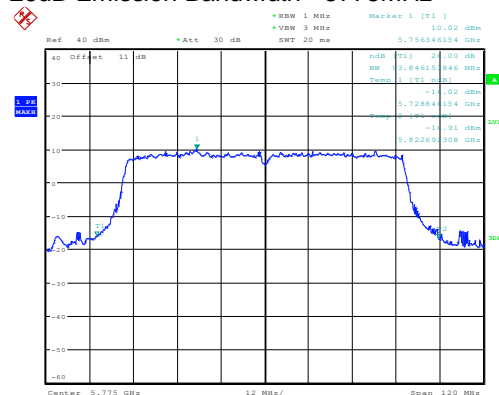
Configuration 1 - 5775MHz

99%Occupied Bandwidth - 5775MHz



Date: 4.AUG.2015 16:16:51

26dB Emission Bandwidth - 5775MHz

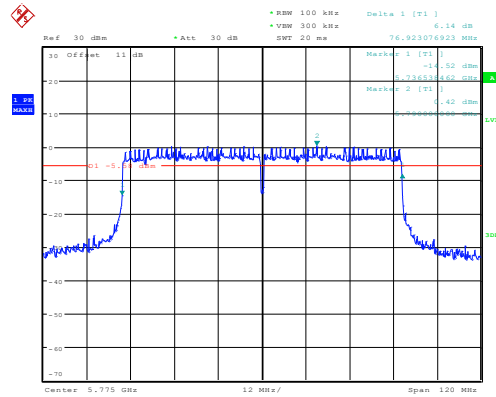


Date: 4.AUG.2015 16:15:39



Product Service

6dB Emission Bandwidth - 5775MHz



Date: 4.AUG.2015 16:19:00

6 dB Bandwidth Limit	≥ 500kHz
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Remarks

The results of test did not exceed the limits at the measured frequencies.



Product Service

2.4 MAXIMUM CONDUCTED OUTPUT POWER - AVERAGE

2.4.1 Specification Reference

FCC CFR 47 Part 15, Clause 15.407(a)(3)

2.4.2 Equipment Under Test

DW33D, S/N: RDW33DI0121150400025

2.4.3 Date of Test and Modification State

26 August 2015 – Modification State 0

2.4.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.4.5 Test Method

The test was applied in accordance with the requirements in clause 15.407 of FCC CFR 47 Part 15 Subpart E.

The EUT was connected to the spectrum analyzer via an RF cable. The path loss of the cable was measured and entered as an offset. The peak level was recorded and compared with the test limits. According to the duty cycle measurement, the test procedures refer to Method SA-3 of Maximum Conducted Output Power in KDB 789033 D02. The channel bandwidth was set as the 99% occupied bandwidth measured. The RMS detector was used for measurement.

The path loss was measured and entered as a reference level offset.

2.4.6 Environmental Conditions

Ambient Temperature 22.8°C

Relative Humidity 48.5%



2.4.7 Test Results

For the period of test the EUT met the requirements of FCC CFR 47 Part 15 for Maximum Conducted Output Power.

The test results are shown below.

Band IV

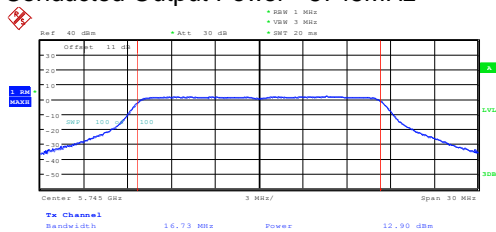
Operating Mode	Data Rate	Frequency (MHz)	Conducted Output Power				
			dBm				mW
			ANT1	ANT2	ANT3	Total	Total
11a	54Mbps	5745	12.01	12.43	12.90	17.23	52.88
11a	54Mbps	5785	13.90	13.38	14.16	18.60	72.39
11a	54Mbps	5825	13.75	13.28	13.74	18.37	68.65
11n(20)	MCS6	5745	12.07	12.36	12.86	17.21	52.64
11n(20)	MCS6	5785	13.82	13.35	14.03	18.51	71.02
11n(20)	MCS6	5825	13.66	13.16	13.71	18.29	67.43
11n(40)	MCS6	5755	11.50	11.42	11.81	16.35	43.16
11n(40)	MCS6	5795	12.78	11.91	12.64	17.23	52.86
11ac(20)	MCS8	5745	12.11	12.25	12.87	17.19	52.41
11ac(20)	MCS8	5785	14.02	13.18	14.03	18.53	71.32
11ac(20)	MCS8	5825	13.86	13.24	13.73	18.39	69.01
11ac(40)	MCS9	5755	11.52	11.36	11.80	16.34	43.00
11ac(40)	MCS9	5795	12.80	11.92	12.74	17.28	53.41
11ac(80)	MCS5	5775	8.50	7.92	8.40	13.05	20.19

Only the test plots of ANT3 are shown below

802.11a

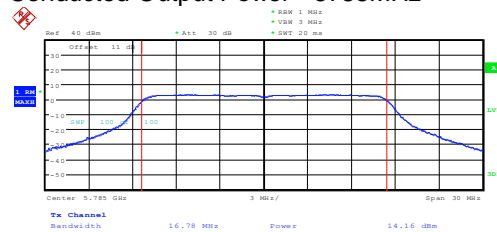
Configuration 1 - 5745MHz, 5785MHz and 5825MHz

Conducted Output Power - 5745MHz



Date: 26.AUG.2015 13:38:31

Conducted Output Power - 5785MHz

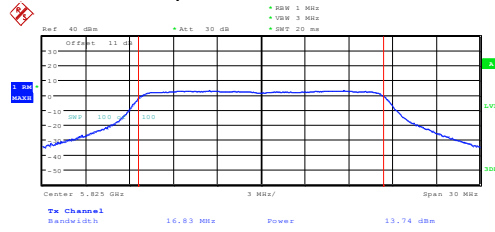


Date: 26.AUG.2015 13:36:53



Product Service

Conducted Output Power - 5825MHz

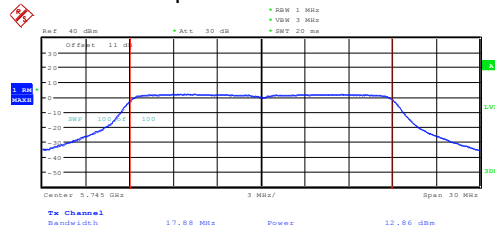


Date: 26.AUG.2015 13:34:24

802.11n(20)

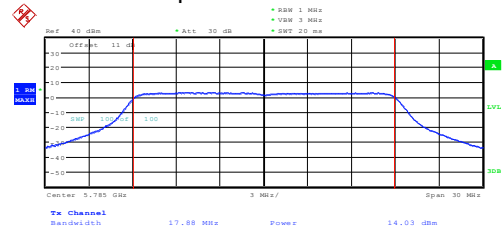
Configuration 1 - 5745MHz, 5785MHz and 5825MHz

Conducted Output Power - 5745MHz



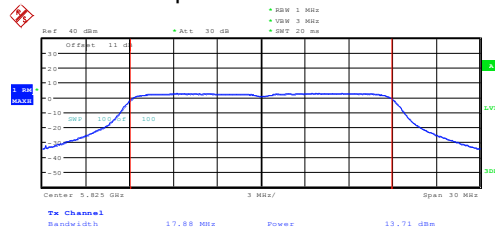
Date: 26.AUG.2015 13:40:16

Conducted Output Power - 5785MHz



Date: 26.AUG.2015 13:43:18

Conducted Output Power - 5825MHz



Date: 26.AUG.2015 13:49:20

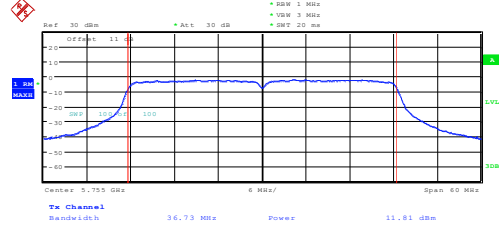


Product Service

802.11n(40)

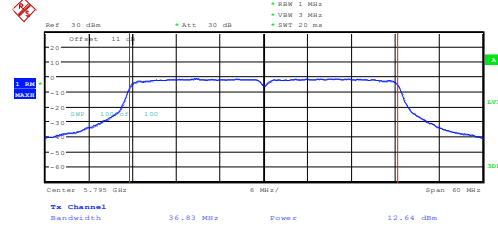
Configuration 1 - 5755MHz and 5795MHz

Conducted Output Power - 5755MHz



Date: 26.AUG.2015 14:05:31

Conducted Output Power - 5795MHz

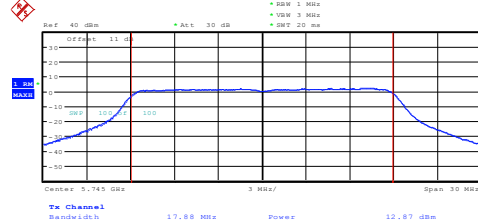


Date: 26.AUG.2015 14:07:44

802.11ac(20)

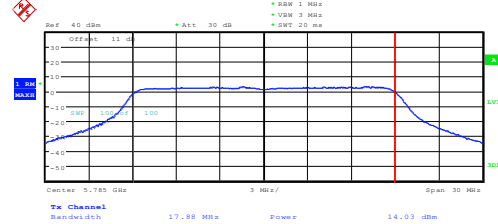
Configuration 1 - 5745MHz, 5785MHz and 5825MHz

Conducted Output Power - 5745MHz



Date: 26.AUG.2015 13:59:12

Conducted Output Power - 5785MHz

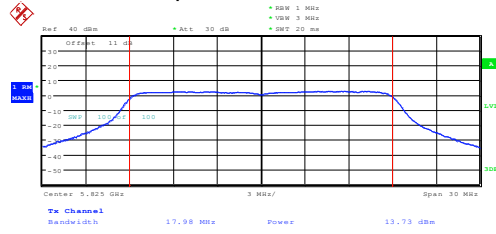


Date: 26.AUG.2015 13:56:52



Product Service

Conducted Output Power - 5825MHz

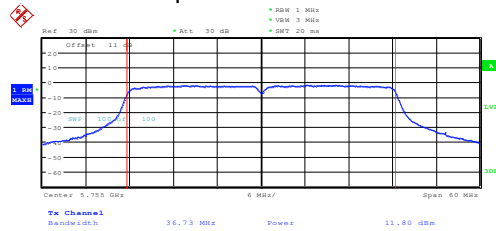


Date: 26.AUG.2015 13:53:37

802.11ac(40)

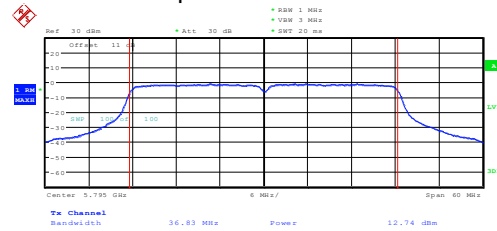
Configuration 1 - 5755MHz and 5795MHz

Conducted Output Power - 5755MHz



Date: 26.AUG.2015 14:13:40

Conducted Output Power - 5795MHz



Date: 26.AUG.2015 14:11:31

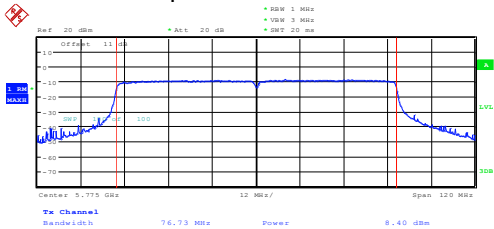


Product Service

802.11ac(80)

Configuration 1 - 5775MHz

Conducted Output Power - 5775MHz



Date: 26.AUG.2015 14:19:16

Limit	≤30dBm or ≤1000mW (Directional Antenna Gain ≤ 6dBi)
	≤26.2dBm* (Directional Antenna Gain> 6dBi)

*Note: The directional antenna gain = 5dBi+10log (3) =9.8dBi, so the limit = 30dBm-(9.8dBi-6dBi) = 26.2dBm.

Remarks

The maximum output power of EUT did not exceed the limit at the measured frequencies.



Product Service

2.5 POWER SPECTRAL DENSITY - AVERAGE

2.5.1 Specification Reference

FCC CFR 47 Part 15, Clause 15.407(a)(3)

2.5.2 Equipment Under Test

DW33D, S/N: RDW33DI0121150400025

2.5.3 Date of Test and Modification State

26 August 2015 – Modification State 0

2.5.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.5.5 Test Method

The test was applied in accordance with the requirements in clause 15.407 of FCC CFR 47 Part 15, Subpart E.

The EUT was connected to the spectrum analyzer via an RF cable, and controlled to transmit on its maximum output power. The peak level was recorded and compared with the test limits.

Test procedures refer to Method SA-3 of KDB 789033 D02, and the test span was set to 1.5*nominal bandwidth of each mode. The RMS detector was used for measurement.

The path loss was measured and entered as a reference level offset.

The test was performed with the EUT in the following configurations and modes of operation:

2.5.6 Environmental Conditions

Ambient Temperature 22.8°C

Relative Humidity 48.5%



2.5.7 Test Results

For the period of test the EUT met the requirements of FCC CFR 47 Part 15 for Power Spectral Density.

The test results are shown below.

Band IV

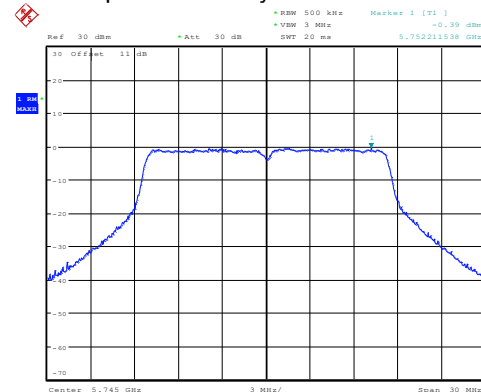
Operating Mode	Data Rate	Frequency (MHz)	Average Power Spectral Density				
			dBm/500kHz				mW/500k Hz
			ANT1	ANT2	ANT3	Total	Total
11a	54Mbps	5745	-0.58	-1.02	-0.39	4.12	2.58
11a	54Mbps	5785	0.81	0.21	0.96	5.44	3.50
11a	54Mbps	5825	0.70	0.05	0.35	5.15	3.27
11n(20)	MCS6	5745	-1.38	-1.17	-0.65	3.72	2.35
11n(20)	MCS6	5785	0.42	-0.07	0.42	5.03	3.19
11n(20)	MCS6	5825	0.22	-0.22	0.33	4.89	3.08
11n(40)	MCS6	5755	-4.85	-5.10	-4.55	-0.06	0.99
11n(40)	MCS6	5795	-3.58	-4.53	-3.75	0.84	1.21
11ac(20)	MCS8	5745	-1.18	-1.20	-0.62	3.78	2.39
11ac(20)	MCS8	5785	0.36	-0.48	0.70	4.99	3.16
11ac(20)	MCS8	5825	0.46	-0.12	0.07	4.91	3.10
11ac(40)	MCS9	5755	-4.71	-5.08	-4.59	-0.02	1.00
11ac(40)	MCS9	5795	-3.13	-4.39	-3.64	1.08	1.28
11ac(80)	MCS5	5775	-11.00	-11.62	-10.97	-6.42	0.23

Only the test plots of ANT3 are shown below

802.11a

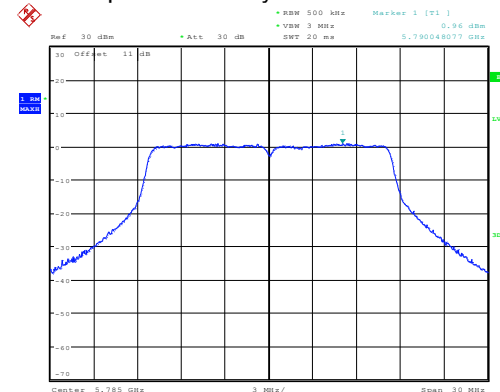
Configuration 1 - 5745MHz, 5785MHz and 5825MHz

Power Spectral Density - 5745MHz



Date: 26.AUG.2015 13:30:20

Power Spectral Density - 5785MHz

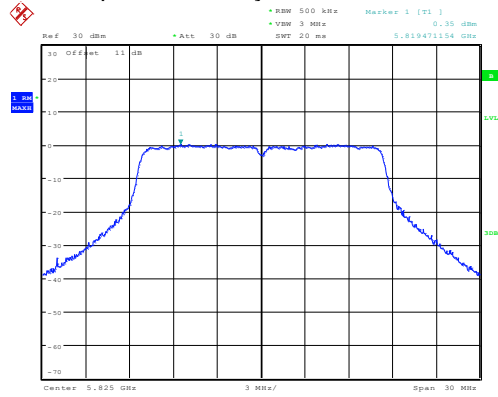


Date: 26.AUG.2015 13:25:26



Product Service

Power Spectral Density - 5825MHz

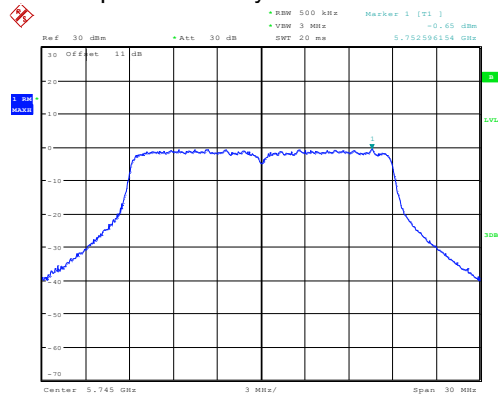


Date: 26.AUG.2015 13:34:59

802.11n(20)

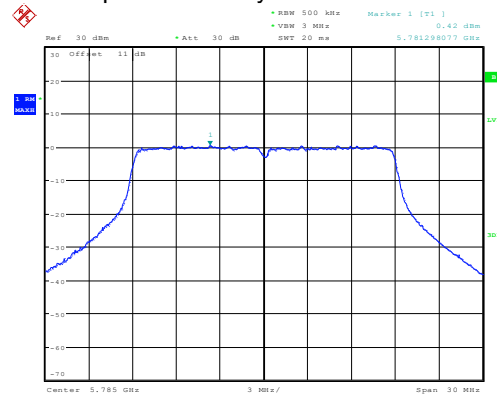
Configuration 1 - 5745MHz, 5785MHz and 5825MHz

Power Spectral Density - 5745MHz



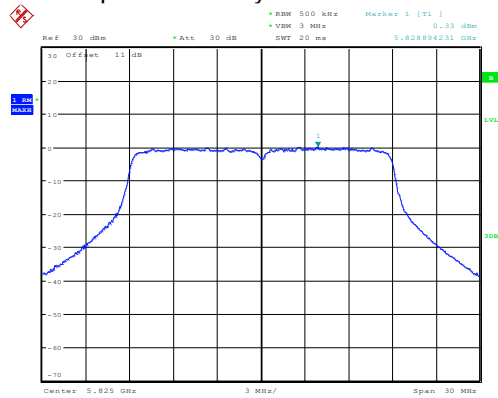
Date: 26.AUG.2015 13:40:51

Power Spectral Density - 5785MHz



Date: 26.AUG.2015 13:44:41

Power Spectral Density - 5825MHz



Date: 26.AUG.2015 13:46:15

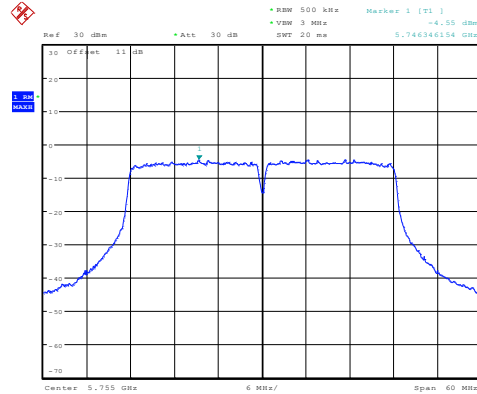


Product Service

802.11n(40)

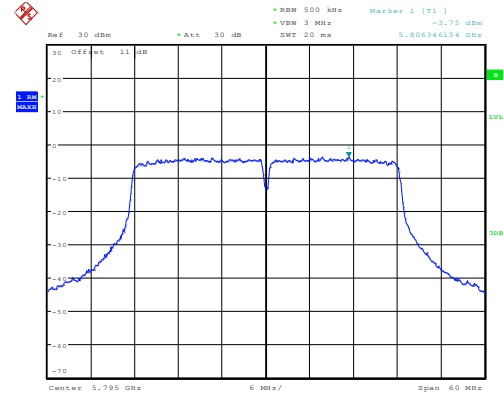
Configuration 1 - 5755MHz and 5795MHz

Power Spectral Density - 5755MHz



Date: 26.AUG.2015 14:02:50

Power Spectral Density - 5795MHz

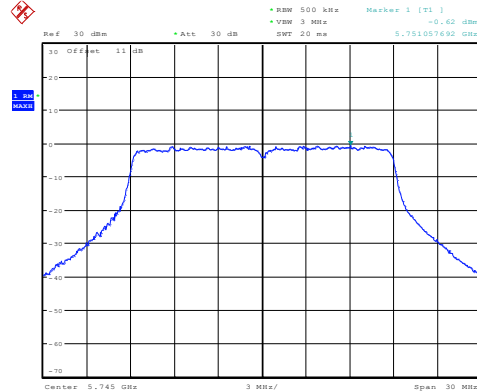


Date: 26.AUG.2015 14:08:23

802.11ac(20)

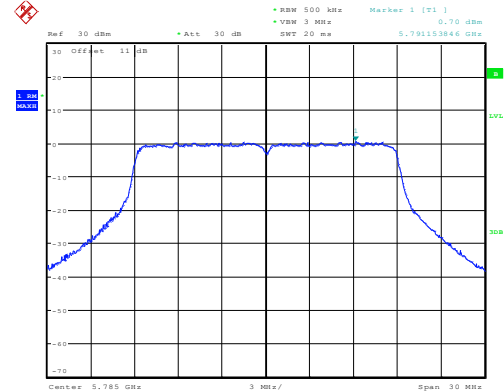
Configuration 1 - 5745MHz, 5785MHz and 5825MHz

Power Spectral Density - 5745MHz



Date: 26.AUG.2015 14:00:36

Power Spectral Density - 5785MHz

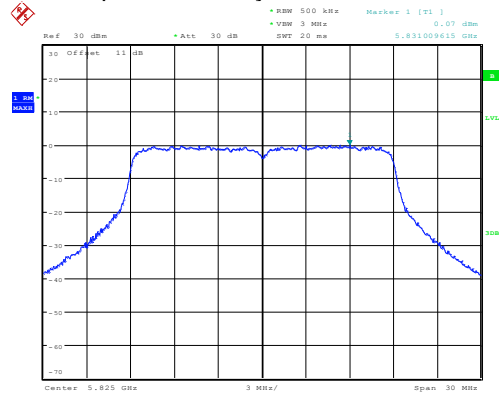


Date: 26.AUG.2015 13:55:10



Product Service

Power Spectral Density - 5825MHz

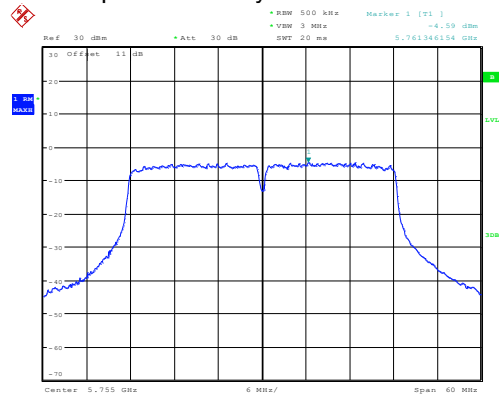


Date: 26.AUG.2015 13:54:15

802.11ac(40)

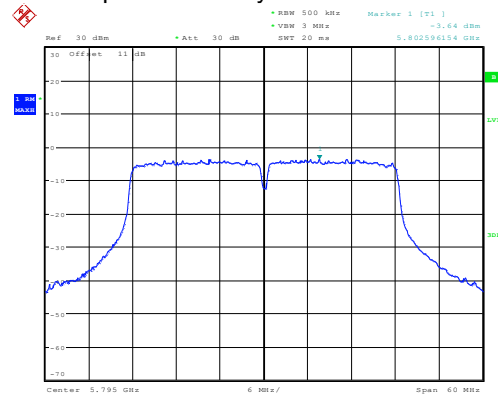
Configuration 1 - 5755MHz and 5795MHz

Power Spectral Density - 5755MHz



Date: 26.AUG.2015 14:14:33

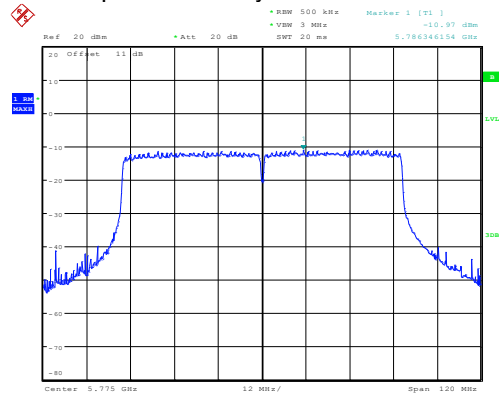
Power Spectral Density - 5795MHz



Date: 26.AUG.2015 14:09:50



Product Service

802.11ac(80)Configuration 1 - 5775MHzPower Spectral Density - 5775MHz

Date: 26.AUG.2015 14:16:23

Limit	≤30dBm/500kHz
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Remarks

The test results of EUT did not exceed the limit at all measured frequencies.



Product Service

2.6 FREQUENCY STABILITY MEASUREMENT

2.6.1 Specification Reference

FCC CFR 47 Part 15, Clause 15.407(g)

2.6.2 Equipment Under Test

DW33D, S/N: RDW33DI0121150400025

2.6.3 Date of Test and Modification State

15 July 2015 – Modification State 0

2.6.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.6.5 Test Method

The test was applied in accordance with the test requirements in clause 15.407 of FCC CFR 47 Part 15, Subpart E.

Frequency Stability – Temperature Variation

The EUT was tested over the temperature range -30°C to +50°C in 10°C steps with 120VAC Power Supply. At each temperature step, the EUT was configured to transmit at its maximum power on the lowest and highest channels of the operating band. After achieving thermal balance, the averages of 200 transmission bursts were measured and the result recorded.

Frequency Stability – Voltage Variation

The EUT was tested at the supplied voltages varied from 85 to 115 percent of the nominal values of 120VAC. At +20°C, the EUT was configured to transmit at its maximum power on the lowest and highest channels of the operating band. The average of 200 transmission bursts was measured and the result recorded.

The ANT3 of EUT was measured and recorded, whilst others were terminated.

2.6.6 Environmental Conditions

Ambient Temperature 24.5°C

Relative Humidity 57.0%



2.6.7 Test Results

For the period of test the EUT met the requirements of FCC CFR 47 Part 15 for Frequency Stability.

The test results are shown below.

Band IV

Frequency Stability – Temperature Variation

Supply Voltage AC (V)	Temperature	Frequency Stability			
		Lowest Frequency	Result (MHz)	Highest Frequency	Result (MHz)
120.0	-30°C	5745MHz	5745.03285	5825MHz	5825.03271
	-20°C		5745.06078		5825.06165
	-10°C		5745.07236		5825.07323
	0°C		5745.07467		5825.07583
	+10°C		5745.07033		5825.07091
	+20°C		5745.05962		5825.06078
	+30°C		5745.04573		5825.04689
	+40°C		5745.03415		5825.03473
	+50°C		5745.02894		5825.02923

Frequency Stability – Voltage Variation

Supply Voltage AC (V)	Temperature	Frequency Stability			
		Lowest Frequency	Result (MHz)	Highest Frequency	Result (MHz)
102.0	+20°C	5745MHz	5745.05991	5825MHz	5825 06049
120.0			5745.05962		5825.06078
138.0			5745.05962		5825 06049

Limit	Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user manual.
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Remarks

The test results of EUT did not exceed the limit at all measured frequencies.



Product Service

2.7 RADIATED EMISSIONS AND BAND EDGE

2.7.1 Specification Reference

FCC CFR 47 Part 15, Clause 15.205, 15.209, 15.407(b)

2.7.2 Equipment Under Test

DW33D, S/N: RDW33DI0121150400025

2.7.3 Date of Test and Modification State

17 July, 26 and 28 August 2015 – Modification State 0

2.7.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.7.5 Test Method

The test was applied in accordance with the requirements in clause 15.407 of FCC CFR 47 Part 15 Subpart E.

A preliminary profile of the Spurious Radiated Emissions was obtained by operating the EUT on a remotely controlled turntable within the chamber. Measurements of emissions from the EUT were obtained with the Measurement Antenna in both Horizontal and Vertical Polarisations.

Emissions identified within the range 30MHz – 40GHz were then formally measured using a Peak detector as the worst case.

In the frequency Range 30MHz – 40GHz, the measurement was performed with a resolution bandwidth of 1MHz.

The measurements were performed at a 3m distance unless otherwise stated.

The test was performed with the EUT in the following configurations and modes of operation:

2.7.6 Environmental Conditions

Ambient Temperature 22.8 - 25.5°C

Relative Humidity 48.5 - 53.0%



Product Service

2.7.7 Test Results

For the period of test the EUT met the requirements of FCC CFR 47 Part 15 Radiated Emissions and Band Edge.

Radiated Emissions

Note: Only the worst test results plots have been included as all of the unwanted emissions are below the limit. A set of plots have been included to show the measurement system noise floor.

The test results are shown below.

802.11a

Configuration 1 - 5785MHz

No unwanted emissions were detected beyond the limit.

802.11n(20)

Configuration 1 - 5785MHz

No unwanted emissions were detected beyond the limit.

802.11ac(20)

Configuration 1 - 5745MHz

No unwanted emissions were detected beyond the limit.

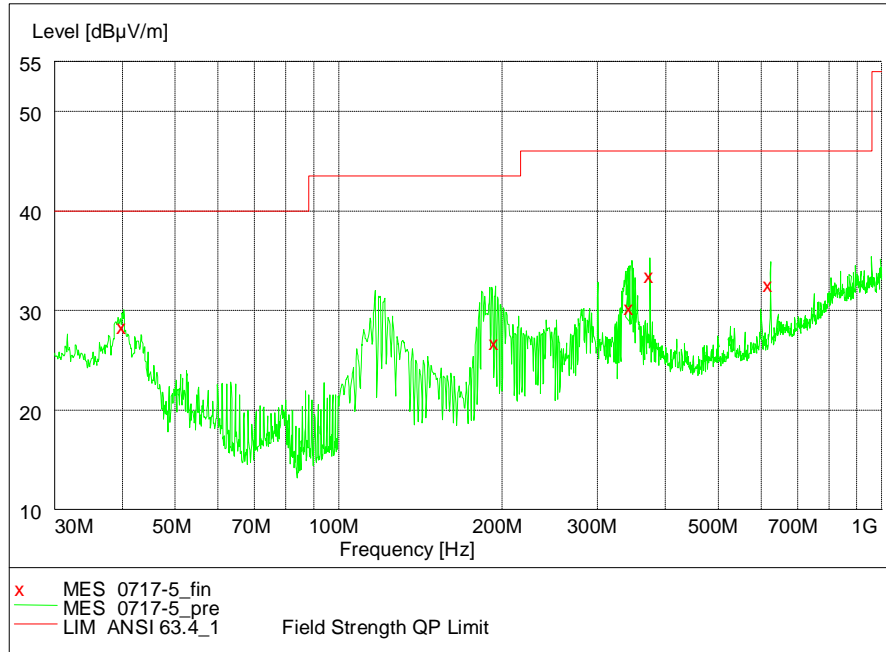
Configuration 1 - 5785MHz

No unwanted emissions were detected beyond the limit.

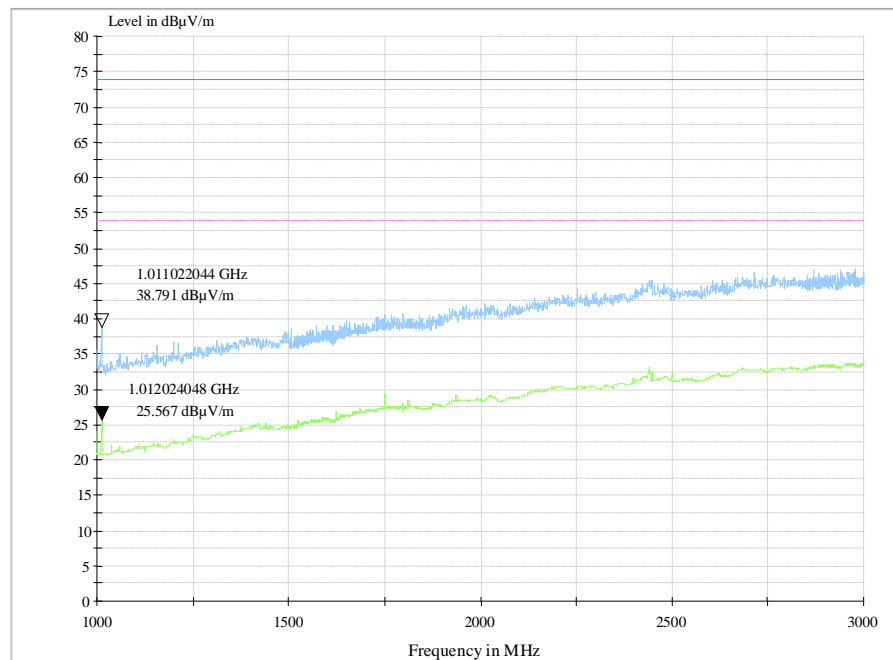


Configuration 1 - 5825MHz

30MHz – 1GHz

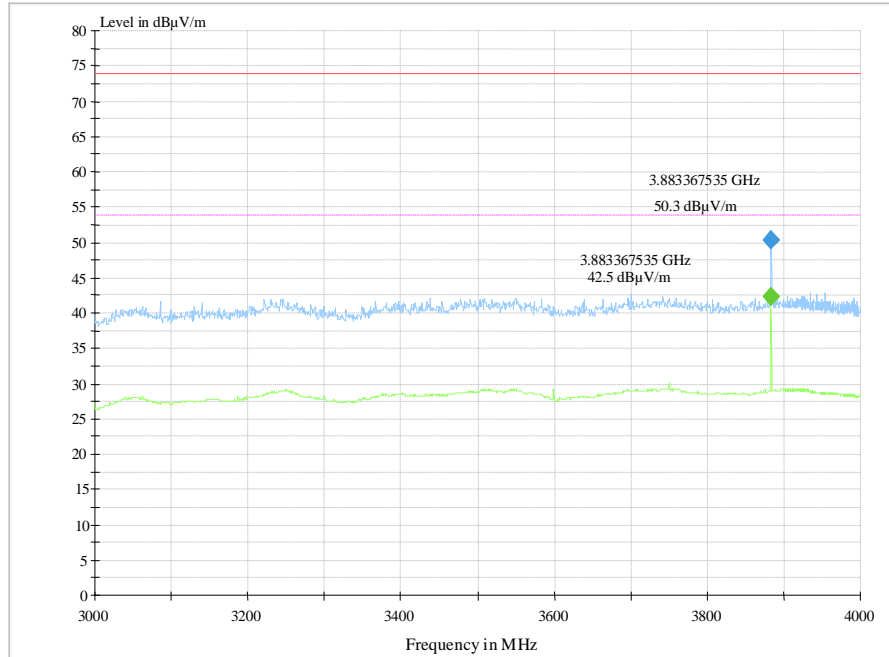


1GHz – 3GHz

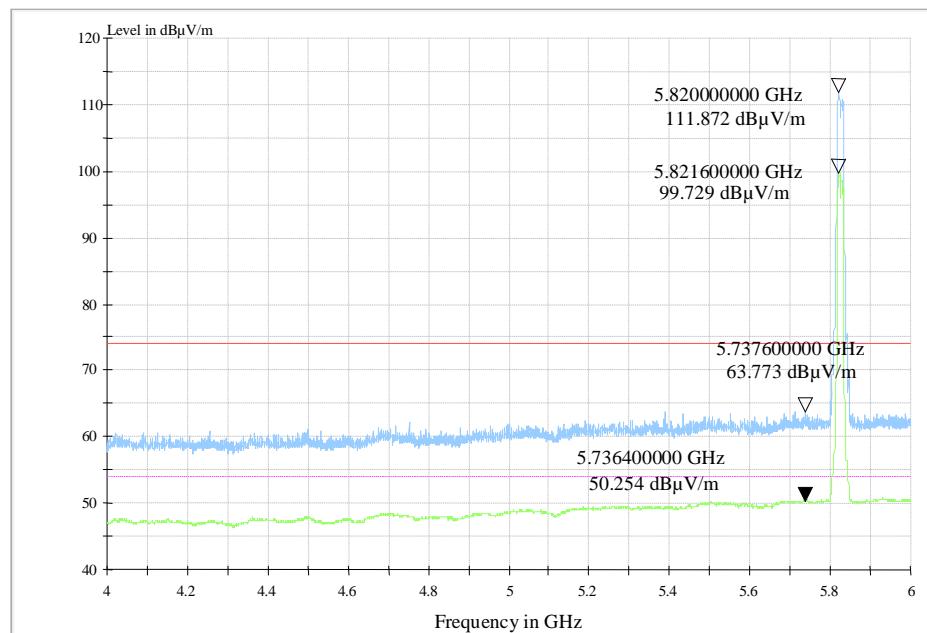




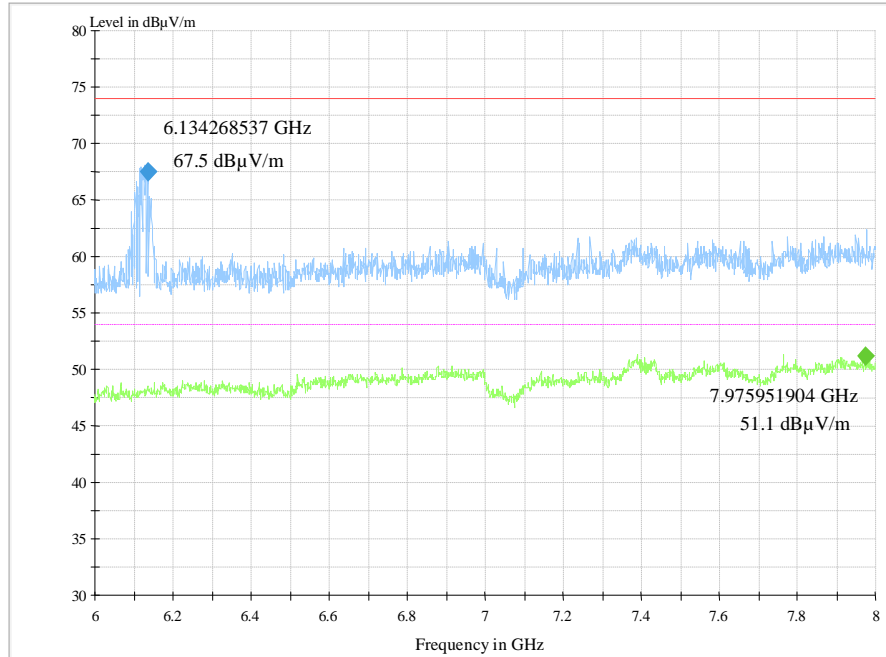
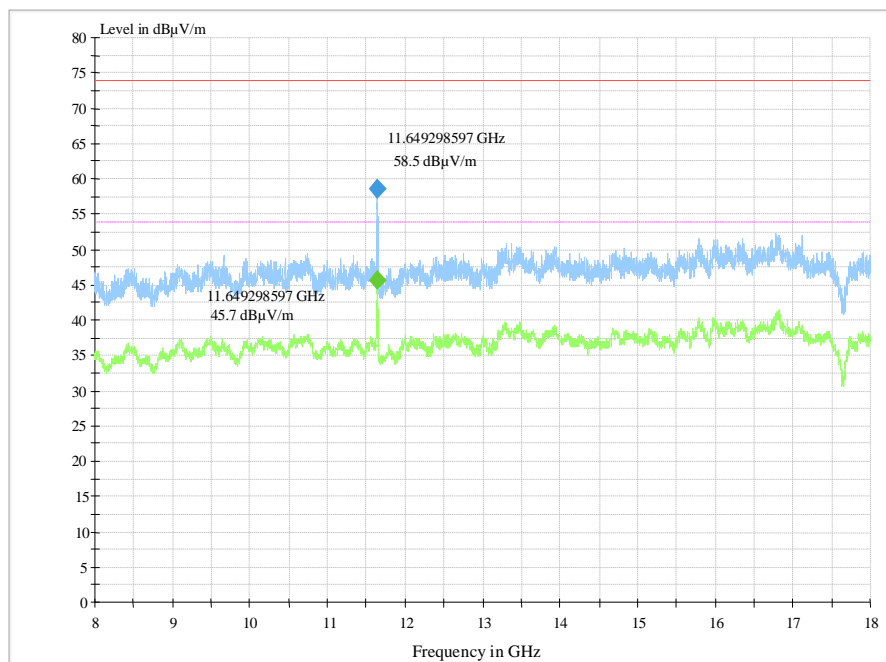
3GHz – 4GHz



4GHz – 6GHz

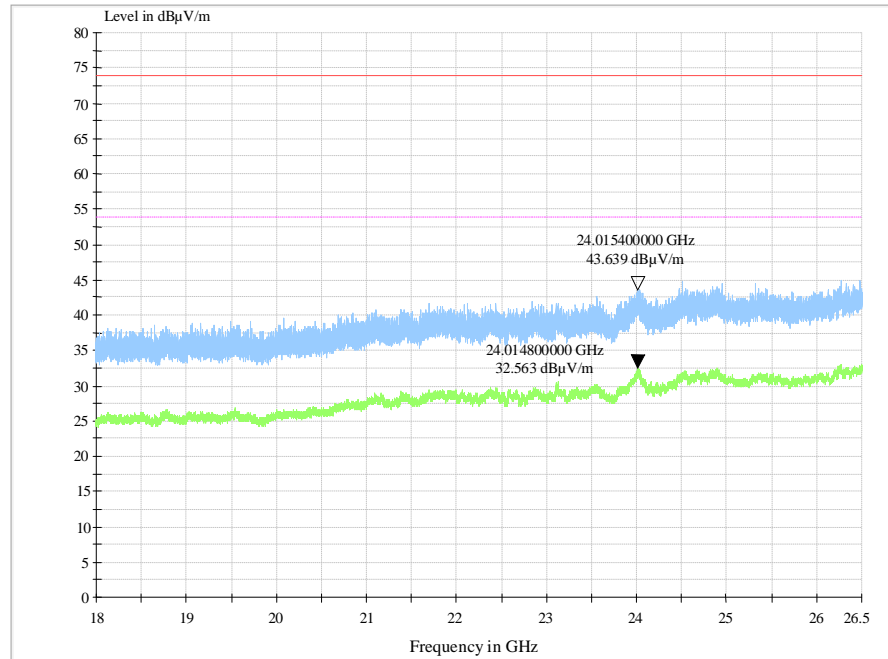


Note: The emission beyond the limit is the operating frequency.

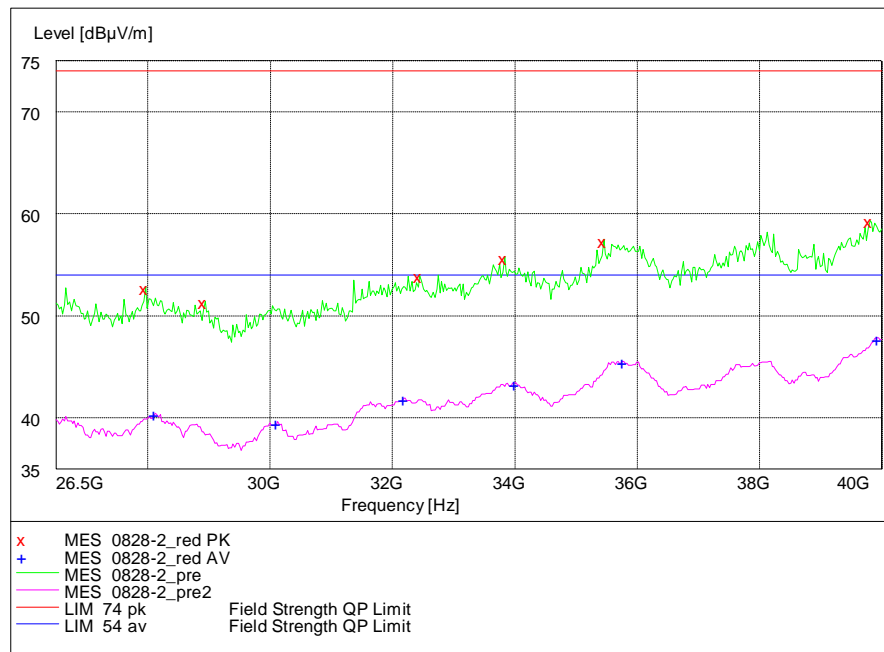
6GHz – 8GHz8GHz – 18GHz



18GHz – 26.5GHz



26.5GHz – 40GHz





Product Service

802.11n(40)

Configuration 1 - 5795MHz

No unwanted emissions were detected beyond the limit.

802.11ac(40)

Configuration 1 - 5755MHz

No unwanted emissions were detected beyond the limit.

Configuration 1 - 5795MHz

No unwanted emissions were detected beyond the limit.

802.11ac(80)

Configuration 1 - 5775MHz

No unwanted emissions were detected beyond the limit.

**Band Edge**

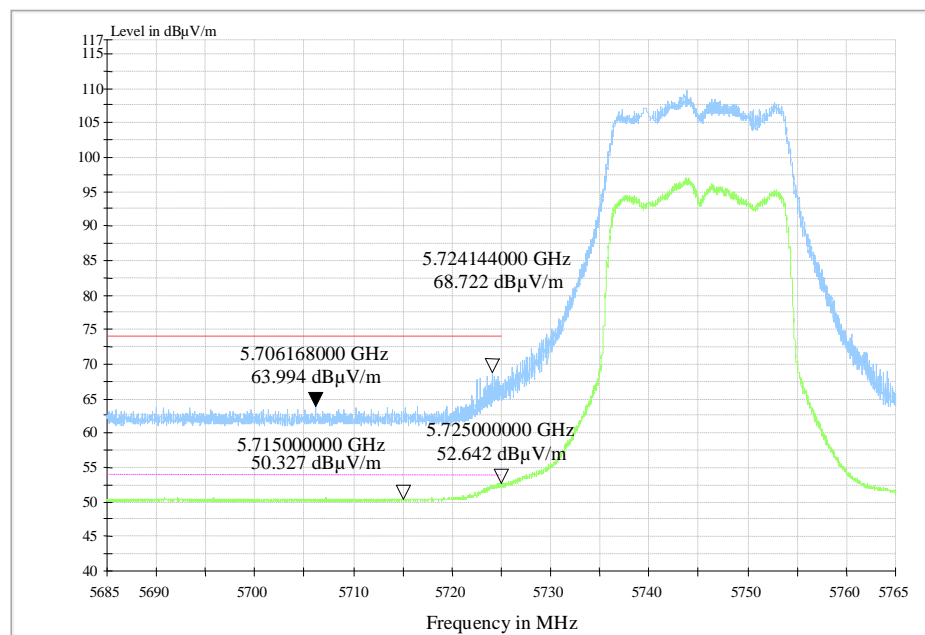
Note: Only the worst test results plots have been included as all of the unwanted emissions are below the limit.

The test results are shown below.

802.11ac(20)

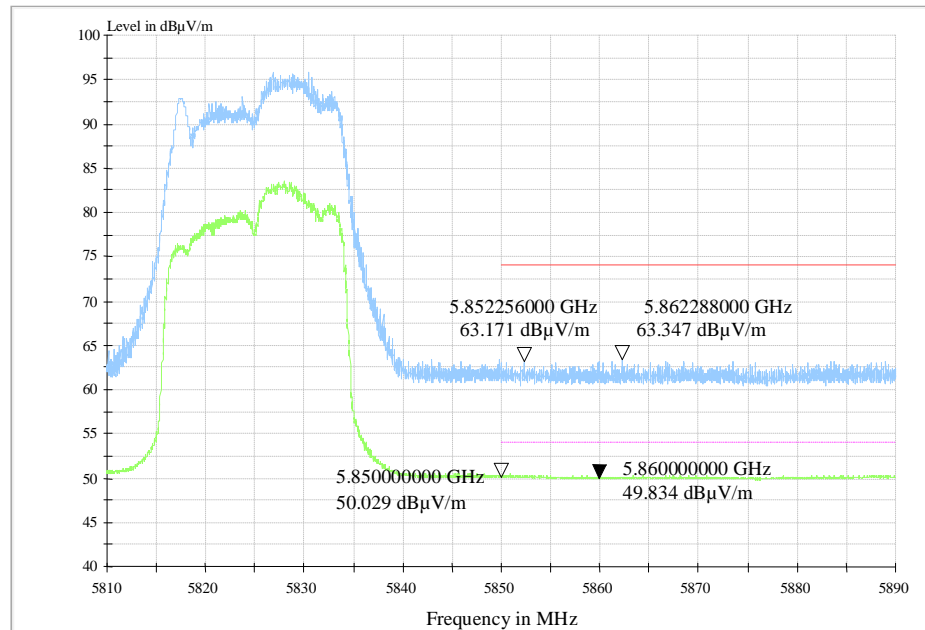
Configuration 1 - 5745MHz

RE-Power_5.685G-5.765GHz

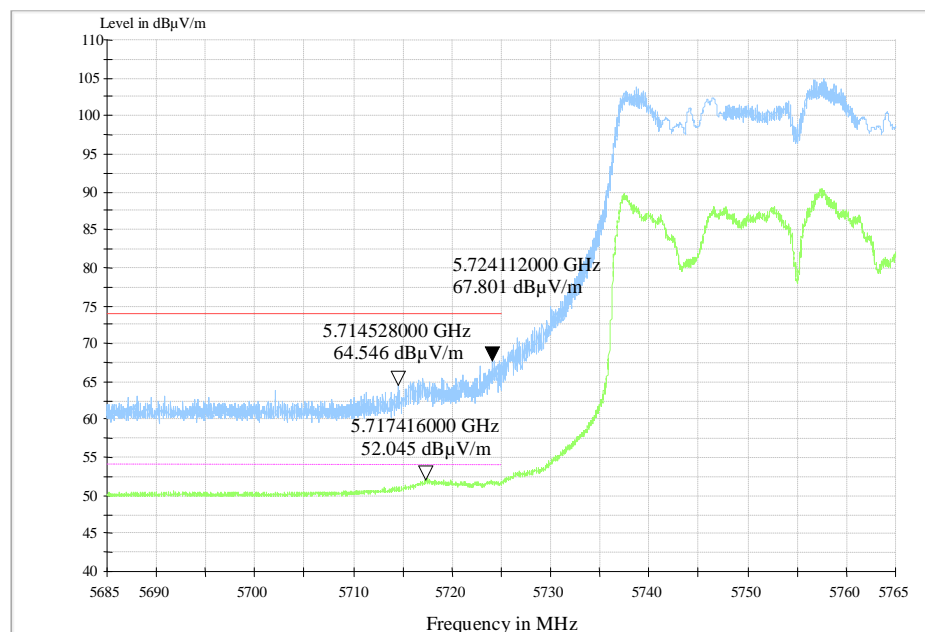


Configuration 1 - 5825MHz

RE-Power_5.810G-5.890GHz

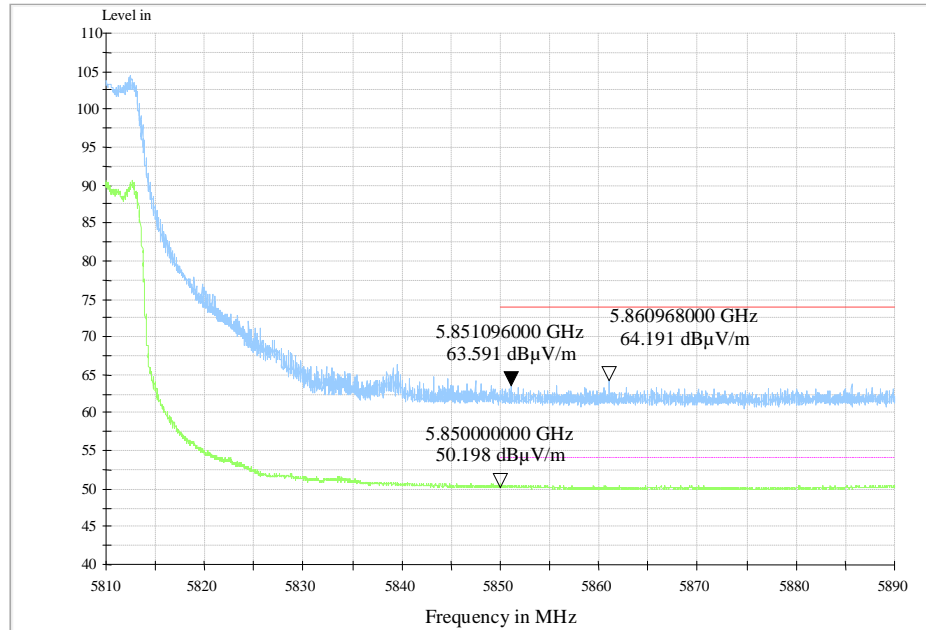
802.11ac(40)Configuration 1 - 5755MHz

RE-Power_5.685G-5.765GHz

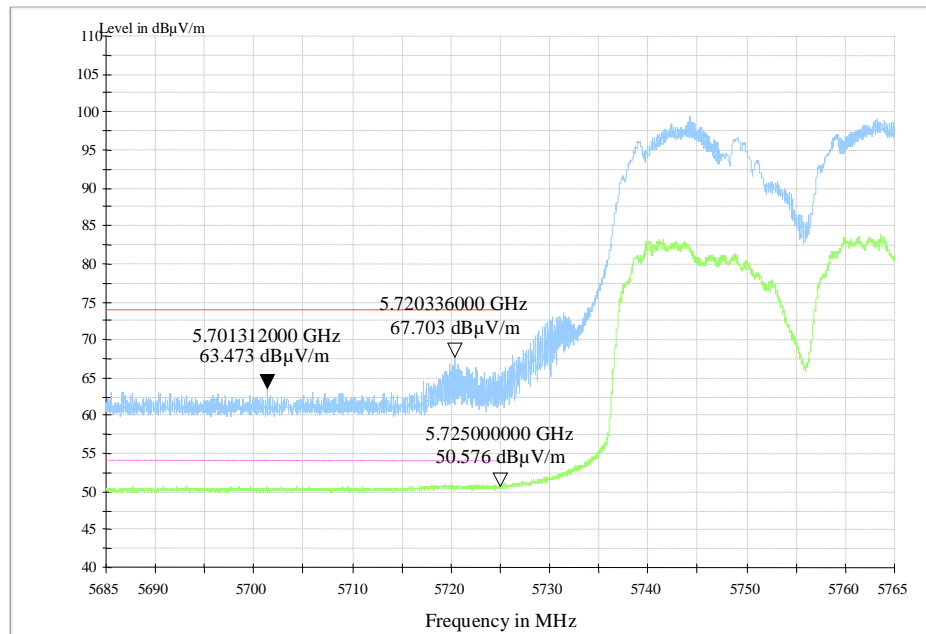


Configuration 1 - 5795MHz

RE-Power_5.810G-5.890GHz

802.11ac(80)Configuration 1 - 5775MHz

RE-Power_5.685G-5.765GHz





Requirement of Clause 15.209	
Frequency range	Limit
30 MHz to 88 MHz	40dB μ V/m
88 MHz to 216 MHz	43.5dB μ V/m
216 MHz to 960 MHz	46dB μ V/m
>960MHz	Average:54dB μ V/m, Peak:74dB μ V/m
Requirement of Clause 15.407 (b)(4)	
Frequency range	Limit
Frequencies 10 MHz or greater above or below the band edge	Peak: 68.2dB μ V/m
Frequency range from the band edge to 10 MHz above or below the band edge	Peak: 78.2dB μ V/m

Remarks

The test results of EUT did not exceed the limit during the test.



Product Service

SECTION 3

TEST EQUIPMENT USED



3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

Instrument	Manufacturer	Type No.	Serial No.	Calibration Period (months)	Calibration Due
Section 2.1 Conducted Emission					
EMI Receiver	Rohde & Schwarz	ESIB7	100280	12	15-Aug-2016
LISN	AFJ	LS16C	16011306281	12	01-Apr-2016
Digital Multimeter	FLUKE	179	91820401	12	14-Dec-2015
Thermo-hygrometer	AZ Instruments	8705	9151665	12	10-Dec-2015
Section 2.2, 2.3 2.4 and 2.5 – 6dB and 26dB Emission Bandwidth, Maximum Conducted Output Power-Peak, Band Edge Emissions and Conducted Spurious Emissions.					
Spectrum Analyzer	Rohde & Schwarz	FSV40	101065	12	19-Aug-2016
Power Meter	Agilent	E9327A	MY52420006	12	29-Feb-2016
Power Sensor	Agilent	E4416A	MY52370013	12	29-Feb-2016
Digital Multimeter	FLUKE	179	91820401	12	14-Dec-2015
Thermo-hygrometer	AZ Instruments	8705	9151665	12	10-Dec-2015
Section 2.5 – Radiated Spurious Emissions					
EMI Receiver	Rohde & Schwarz	ESI 40	100015	12	19-Aug-2016
Ultra log test antenna	Rohde & Schwarz	HL562	100167	12	19-Aug-2016
Double-Ridged Wave-guide Horn Antenna	Rohde & Schwarz	HF 906	100029	12	19-Aug-2016
Pyramidal Horn Antenna	EMCO	3160-09	-	-	-
Antenna master	Frankonia	MA 260	-	12	19-Aug-2016
Relay Switch Unit	Rohde & Schwarz	331.1601.31	338965002	-	TU
Semi Anechoic Chamber	Frankonia	23.18mx16.88 mx 9.60m	-	12	19-Aug-2016
Digital Multimeter	FLUKE	179	91820401	12	14-Dec-2015
Thermo-hygrometer	AZ Instruments	8705	9151665	12	10-Dec-2015

TU - Traceability Unscheduled.



3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:

Test Discipline	Frequency / Parameter	MU
Conducted RF Output Power	30MHz to 10GHz Amplitude	0.5dB*
Conducted Emissions	QP detector	3.34 dB
	AV detector	3.39 dB
Frequency Stability	30MHz to 6GHz	$<\pm 1 \times 10^{-7}$
Radiated Emissions, Bilog Antenna, AOATS	30MHz to 1GHz Amplitude	5.1dB*
Radiated Emissions, Horn Antenna, AOATS	1GHz to 40GHz Amplitude	6.3dB*
Worst case error for both Time and Frequency measurement 12 parts in 10^6		

* In accordance with CISPR 16-4



Product Service

SECTION 4

DISCLAIMERS AND COPYRIGHT



Product Service

4.1 DISCLAIMERS AND COPYRIGHT

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