

FCC REPORT

(UNII)

Applicant: LigoWave LLC

Address of Applicant: 138 Mountain Brook Dr Canton, GA 30115 United States

Equipment Under Test (EUT)

Product Name: Broadband Digital Transmission System

Model No.: LigoDLB 5-15ac, LigoDLB 5-20ac

FCC ID: V2V-FWBD3200

Applicable standards: FCC CFR Title 47 Part 15 Subpart E Section 15.407

Date of sample receipt: 18 Mar., 2016

Date of Test: 18 Mar., to 25 Apr., 2016

Date of report issued: 25 Apr., 2016

Test Result: PASS*

* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:



Bruce Zhang
Laboratory Manager

This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product and does not permit the use of the CCIS product certification mark. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards.

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2 Version

Version No.	Date	Description
00	25 Apr., 2016	Original

Tested by:

YT Yang

Date:

25 Apr., 2016

Test Engineer

Reviewed by:

Carrey Chen

Date:

25 Apr., 2016

Project Engineer

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4 Test Summary

Test Item	Section in CFR 47	Result
Antenna requirement	15.203/15.407 (g)	Pass
AC Power Line Conducted Emission	15.207	Pass
Conducted Peak Output Power	15.407 (a)	Pass
26dB Occupied Bandwidth	15.407 (a)	Pass
6dB Emission Bandwidth	15.407(e)	Pass
Power Spectral Density	15.407 (a)	Pass
Band Edge	15.407(b)	Pass
Spurious Emission	15.205/15.209	Pass
Frequency Stability	15.407(g)	Pass

Pass: The EUT complies with the essential requirements in the standard.

5 General Information

5.1 Client Information

Applicant:	LigoWave LLC
Address of Applicant:	138 Mountain Brook Dr Canton, GA 30115 United States
Manufacturer/ Factory:	LigoWave LLC
Address of Manufacture/Factory:	138 Mountain Brook Dr Canton, GA 30115 United States

5.2 General Description of E.U.T.

Product Name:	Broadband Digital Transmission System
Model No.:	LigoDLB 5-15ac, LigoDLB 5-20ac
Operation Frequency:	Band 1: 802.11a/802.11n20: 5180-5240 MHz 802.11n40: 5190-5230 MHz 802.11ac80: 5210 MHz Band 4: 802.11a/802.11n20: 5745-5825 MHz 802.11n40: 5755-5795 MHz 802.11ac80: 5775 MHz
Operation mode:	Fixed point-to-point operation ; Professional install
Channel numbers:	Band 1: 802.11a/802.11n20: 4,802.11n40: 2, 802.11ac80: 1 Band 4: 802.11a/802.11n20: 5,802.11n40: 2, 802.11ac80: 1
Channel separation:	802.11a/802.11n20:20MHz, 802.11n40:40MHz, 802.11ac80 : 80MHz
Modulation technology: (IEEE 802.11a)	BPSK,QPSK,16-QAM,64-QAM
Modulation technology: (IEEE 802.11n)	BPSK,QPSK,16-QAM,64-QAM
Modulation technology: (IEEE 802.11ac)	BPSK,QPSK,16-QAM, 64-QAM, 256-QAM
Data speed(IEEE 802.11a)	6Mbps, 9Mbps,12Mbps,18Mbps,24Mbps,36Mbps,48Mbps,54Mbps
Data speed (IEEE 802.11n20):	MCS0: 6.5Mbps,MCS1:13Mbps,MCS2:19.5Mbps,MCS3:26Mbps, MCS4:39Mbps,MCS5:52Mbps,MCS6:58.5Mbps,MCS7:65Mbps
Data speed (IEEE 802.11n40):	MCS0:15Mbps,MCS1:30Mbps,MCS2:45Mbps,MCS3:60Mbps, MCS4:90Mbps,MCS5:120Mbps,MCS6:135Mbps,MCS7:150Mbps
Data speed (IEEE 802.11ac80):	Up to 866.7Mbps
Technology:	MIMO (2 antenna)
Power supply:	DC 24V
AC adapter :	(1) Model: G0720-240-050 Input:100-240V AC,50/60Hz 0.75A Output:24V DC MAX 0.5A (2) Model: GRT-P0E20-240100A Input:100-240V AC,50/60Hz 0.5A Output:24V DC MAX 1.0A
Remark:	Item No.: LigoDLB 5-15ac , LigoDLB 5-20ac were identical inside, the electrical circuit design, layout, components used and internal

	wiring, with only difference being as below: 1. antenna gain : LigoDLB 5-15ac used 15dBi antenna, LigoDLB 5-20ac used 20dBi antenna. 2. Plastic enclosure: LigoDLB 5-15ac enclosure smaller than LigoDLB 5-20ac
Antenna type 1:	Panel antenna (2 MIMO antenna) , 15dBi , directional gain= $15+10\log 2=18.01\text{dBi}$
Antenna type 2:	Panel antenna (2 MIMO antenna) , 20dBi , directional gain= $20+10\log 2=23.01\text{dBi}$

Operation Frequency each of channel

Band 1					
802.11a/802.11n20		802.11n40		802.11ac80	
Channel	Frequency	Channel	Frequency	Channel	Frequency
36	5180MHz	38	5190MHz	42	5210MHz
40	5200MHz	46	5230MHz		
44	5220MHz				
48	5240MHz				
Band 4					
802.11a/802.11n20		802.11n40		802.11ac80	
Channel	Frequency	Channel	Frequency	Channel	Frequency
149	5745MHz	151	5755MHz	155	5775MHz
153	5765MHz	159	5795MHz		
157	5785MHz				
161	5805MHz				
165	5825MHz				

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Band 1					
802.11a/802.11n20		802.11n40		802.11ac80	
Channel	Frequency	Channel	Frequency	Channel	Frequency
The lowest channel	5180MHz	The lowest channel	5190MHz	Middle channel	5210MHz
The middle channel	5200MHz	The highest channel	5230MHz		
The highest channel	5240MHz				
Band 4					
802.11a/802.11n20		802.11n40		802.11ac80	
Channel	Frequency	Channel	Frequency	Channel	Frequency
The lowest channel	5745MHz	The lowest channel	5755MHz	Middle channel	5775MHz
The middle channel	5785MHz	The highest channel	5795MHz		
The highest channel	5825MHz				

5.3 Test environment and mode

Operating Environment:	
Temperature:	24.0 °C
Humidity:	54 % RH
Atmospheric Pressure:	1010 mbar
Test mode:	
Continuously transmitting mode	Keep the EUT in 100% duty cycle MIMO transmitting with modulation.
Note:	LigoDLB 5-15ac with 15dBi antenna and LigoDLB 5-20ac with 20dBi antenna are electrically identical ,only antenna gain is different ,for Conducted emission and Radiated emission all have been tested ,only worse case LigoDLB 5-20ac with 20dBi antenna is reported.

We have verified the construction and function in typical operation. All the test modes were carried out with the EUT in transmitting operation, which was shown in this test report and defined as follows:

Per-scan all kind of data rate in lowest channel, and found the follow list which it was worst case.

Mode	Data rate
802.11a	6Mbps
802.11n20	6.5Mbps
802.11n40	13Mbps
802.11ac80	29.3Mbps

Final Test Mode:

According to ANSI C63.4 standards, the test results are both the “worst case” and “worst setup” 6Mbps for 802.11a, 6.5 Mbps for 802.11n20, 13 Mbps for 802.11n40 and 29.3 Mbps for 802.11ac80. All test items for 802.11a, 802.11n and 802.11ac were performed with duty cycle above 98%, meet the requirements of KDB789033.

5.4 Description of Support Units

Manufacturer	Description	Model	Serial Number	FCC ID/DoC
DELL	PC	OPTIPLEX745	N/A	DoC
DELL	MONITOR	E178FPC	N/A	DoC
DELL	KEYBOARD	SK-8115	N/A	DoC
DELL	MOUSE	MOC5UO	N/A	DoC

5.5 Laboratory Facility

The test facility is recognized, certified, or accredited by the following organizations:

• **FCC- Registration No.: 817957**

Shenzhen Zhongjian Nanfang Testing Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 817957, February 27, 2012.

• **IC - Registration No.: 10106A-1**

The 3m Semi-anechoic chamber of Shenzhen Zhongjian Nanfang Testing Co., Ltd. has been Registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 10106A-1.

• **CNAS - Registration No.: CNAS L6048**

Shenzhen Zhongjian Nanfang Testing Co., Ltd. is accredited to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration laboratories for the competence of testing. The Registration No. is CNAS L6048.

5.6 Laboratory Location

Shenzhen Zhongjian Nanfang Testing Co., Ltd.
Address: No. B-C, 1/F., Building 2, Laodong No.2 Industrial Park, Xixiang Road,
Bao'an District, Shenzhen, Guangdong, China
Tel: +86-755-23118282
Fax: +86-755-23116366

5.7 Measurement Uncertainty

Items	Expanded Uncertainty (Confidence of 95%)
Conducted Emission (9kHz ~ 30MHz)	2.14 dB (k=2)
Radiated Emission (9kHz ~ 30MHz)	4.24 dB (k=2)
Radiated Emission (30MHz ~ 1000MHz)	4.35 dB (k=2)
Radiated Emission (1GHz ~ 18GHz)	4.44 dB (k=2)
Radiated Emission (18GHz ~ 26.5GHz)	4.56 dB (k=2)

5.8 Test Instruments list

Radiated Emission:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. Date (mm-dd-yy)	Cal. Due date (mm-dd-yy)
1	3m SAC	SAEMC	9(L)*6(W)* 6(H)	CCIS0001	08-23-2014	08-22-2017
2	BiConiLog Antenna	SCHWARZBECK	VULB9163	CCIS0005	03-25-2015	03-25-2016
	BiConiLog Antenna	SCHWARZBECK	VULB9163	CCIS0005	03-25-2016	03-25-2017
3	Horn Antenna	SCHWARZBECK	BBHA9120D	CCIS0006	03-25-2015	03-25-2016
	Horn Antenna	SCHWARZBECK	BBHA9120D	CCIS0006	03-25-2016	03-25-2017
4	Pre-amplifier (10kHz-1.3GHz)	HP	8447D	CCIS0003	03-25-2015	03-25-2016
	Pre-amplifier (10kHz-1.3GHz)	HP	8447D	CCIS0003	03-25-2016	03-25-2017
5	Pre-amplifier (1GHz-18GHz)	Compliance Direction Systems Inc.	PAP-1G18	CCIS0011	03-25-2015	03-25-2016
	Pre-amplifier (1GHz-18GHz)	Compliance Direction Systems Inc.	PAP-1G18	CCIS0011	03-25-2016	03-25-2017
6	Pre-amplifier (18-40GHz)	A.H System	PAM-1840	GTS219	04-01-2015	03-31-2016
	Pre-amplifier (18-40GHz)	A.H System	PAM-1840	GTS219	04-01-2016	03-31-2017
7	Horn Antenna	ETS-LINDGREN	3160	GTS217	04-01-2015	03-31-2016
	Horn Antenna	ETS-LINDGREN	3160	GTS217	04-01-2016	03-31-2017
8	Spectrum analyzer 9k-30GHz	Rohde & Schwarz	FSP30	CCIS0023	03-28-2015	03-28-2016
	Spectrum analyzer 9k-30GHz	Rohde & Schwarz	FSP30	CCIS0023	03-28-2016	03-28-2017
9	EMI Test Receiver	Rohde & Schwarz	ESRP7	CCIS0167	04-01-2015	03-31-2016
	EMI Test Receiver	Rohde & Schwarz	ESRP7	CCIS0167	04-01-2016	03-31-2017
10	Loop antenna	Laplace instrument	RF300	EMC0701	04-01-2015	03-31-2016

	Loop antenna	Laplace instrument	RF300	EMC0701	04-01-2016	03-31-2017
11	Spectrum Analyzer	HP	8564E	CCIS0150	05-24-2015	05-23-2016
12	EMI Test Software	AUDIX	E3	N/A	N/A	N/A

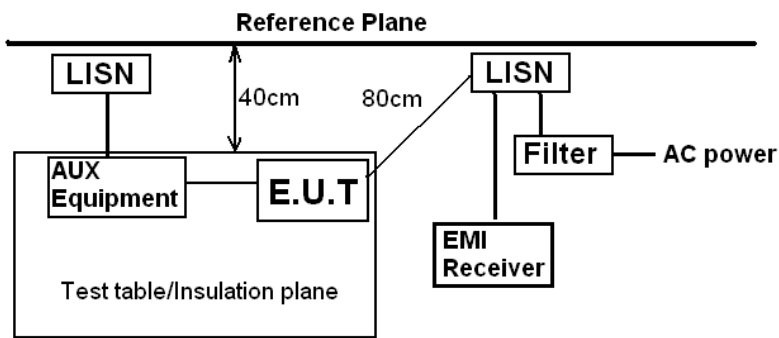
Conducted Emission:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. Date (mm-dd-yy)	Cal. Due date (mm-dd-yy)
1	Shielding Room	ZhongShuo Electron	11.0(L)x4.0(W)x3.0(H)	CCIS0061	11-10-2013	11-09-2016
2	EMI Test Receiver	Rohde & Schwarz	ESCI	CCIS0002	03-24-2015	03-24-2016
	EMI Test Receiver	Rohde & Schwarz	ESCI	CCIS0002	03-24-2016	03-24-2017
3	LISN	CHASE	MN2050D	CCIS0074	03-26-2015	03-26-2016
	LISN	CHASE	MN2050D	CCIS0074	03-26-2016	03-26-2017
4	Coaxial Cable	CCIS	N/A	CCIS0086	04-01-2015	03-31-2016
	Coaxial Cable	CCIS	N/A	CCIS0086	04-01-2016	03-31-2017
5	EMI Test Software	AUDIX	E3	N/A	N/A	N/A

6 Test results and Measurement Data

6.1 Antenna requirement

Standard requirement:	FCC Part15 E Section 15.203 /407(a)
15.203 requirement: <i>An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.</i> <i>This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, § 15.213, § 15.217, § 15.219, or § 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.</i>	
E.U.T Antenna:	<i>The antenna of EUT is an integral antenna, which cannot be replaced by end-user. And the antenna gain is 20 dBi.(directional gain=23dBi)</i> 

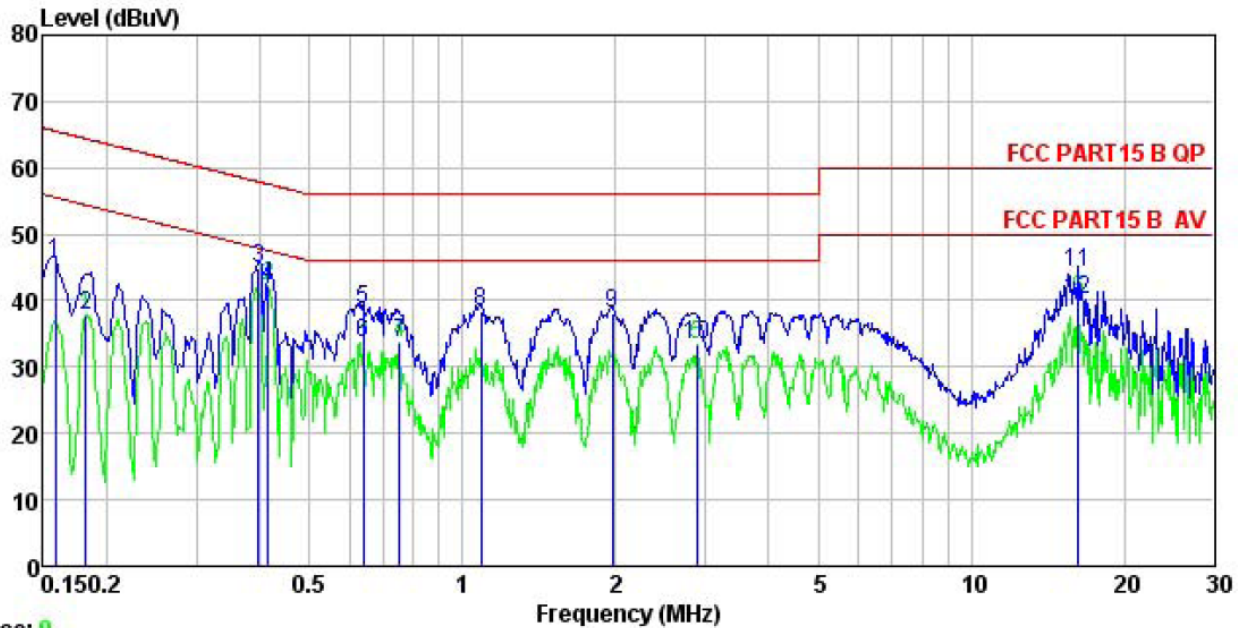
6.2 Conducted Emission

Test Requirement:	FCC Part15 C Section 15.207		
Test Method:	ANSI C63.4: 2014		
TestFrequencyRange:	150kHz to 30MHz		
Class / Severity:	Class B		
Receiver setup:	RBW=9kHz, VBW=30kHz		
Limit:©	Frequency range (MHz)	Limit (dBuV)	
		Quasi-peak	Average
	0.15-0.5	66 to 56*	56 to 46*
	0.5-5	56	46
	5-30	60	50
	* Decreases with the logarithm of the frequency.		
Test procedure	1. The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). It provides a 50ohm/50uH coupling impedance for the measuring equipment. 2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). 3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10: 2013 on conducted measurement.		
Test setup:	 Remark: E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m		
Test Instruments:	Refer to section 5.8 for details		
Test mode:	Refer to section 5.3 for details.		
Test results:	Passed		

Measurement Data:

Adapter (1)

Line:

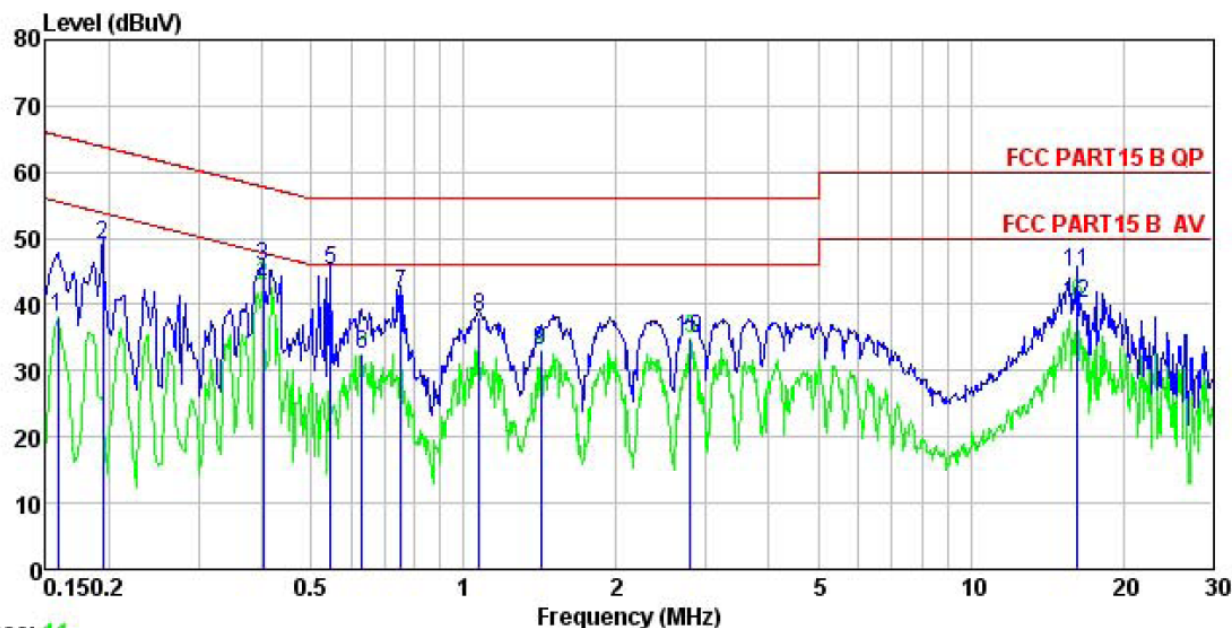


Trace: 9

Site : CCIS Shielding Room
 Condition : FCC PART15 B QP LISN LINE
 EUT : Broadband Digital Transmission System
 Model : LigoDLB 5-20ac
 Test Mode : 5Gwifi mode
 Power Rating : AC 120/60Hz
 Environment : Temp: 23 °C Humi:56% Atmos:101KPa
 Test Engineer: YT
 Remark : G0720-240-050

	Freq	Read Level	LISN Factor	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dB	dBuV	dBuV	dB	
1	0.158	34.66	0.26	10.78	45.70	65.56	-19.86	QP
2	0.182	26.78	0.26	10.77	37.81	54.42	-16.61	Average
3	0.398	33.85	0.26	10.72	44.83	57.90	-13.07	QP
4	0.415	31.13	0.26	10.73	42.12	47.55	-5.43	Average
5	0.637	27.77	0.27	10.77	38.81	56.00	-17.19	QP
6	0.637	22.66	0.27	10.77	33.70	46.00	-12.30	Average
7	0.751	22.49	0.28	10.79	33.56	46.00	-12.44	Average
8	1.088	27.21	0.29	10.88	38.38	56.00	-17.62	QP
9	1.970	26.73	0.32	10.96	38.01	56.00	-17.99	QP
10	2.884	22.13	0.35	10.92	33.40	46.00	-12.60	Average
11	16.226	32.46	0.85	10.91	44.22	60.00	-15.78	QP
12	16.226	28.31	0.85	10.91	40.07	50.00	-9.93	Average

Neutral:



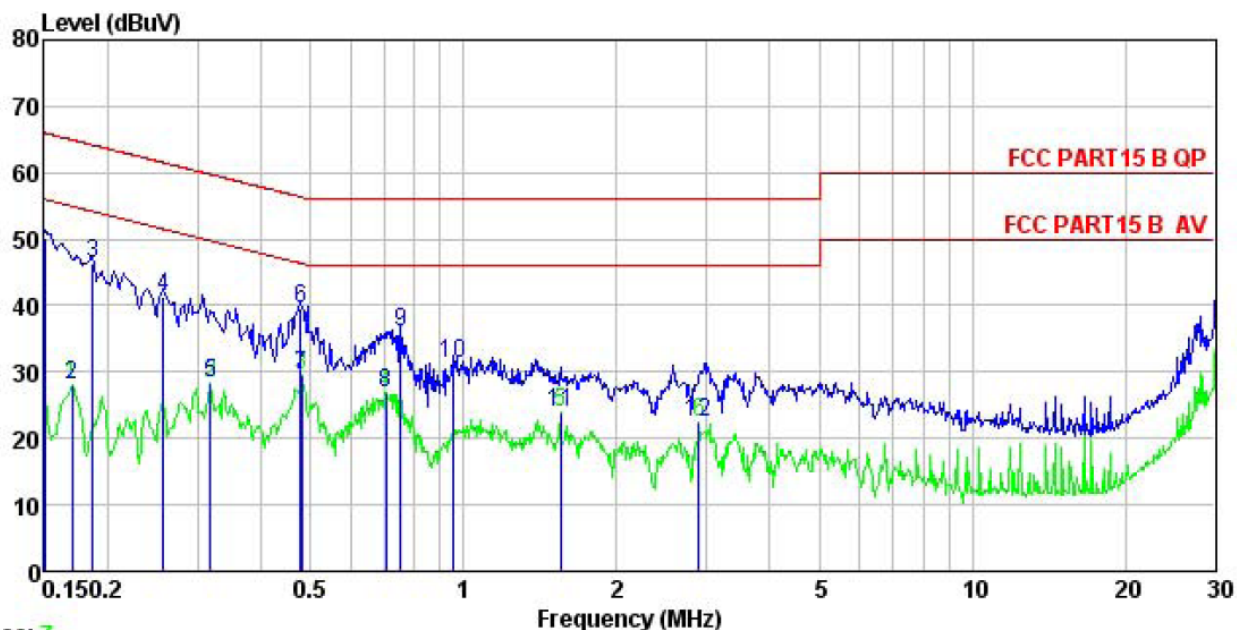
Trace: 11

Site : CCIS Shielding Room
 Condition : FCC PART15 B QP LISN NEUTRAL
 EUT : Broadband Digital Transmission System
 Model : LigoDLB 5-20ac
 Test Mode : 5Gwifi mode
 Power Rating : AC 120/60Hz
 Environment : Temp: 23 °C Humi:56% Atmos:101KPa
 Test Engineer: YT
 Remark : G0720-240-050

	Read	LISN	Cable		Limit	Over	
Freq	Level	Factor	Loss	Level	Line	Limit	Remark
-----	-----	-----	-----	-----	-----	-----	-----
MHz	dBuV	dB	dB	dBuV	dBuV	dB	
1	0.158	27.18	0.17	10.78	38.13	55.56	-17.43 Average
2	0.194	38.18	0.16	10.76	49.10	63.84	-14.74 QP
3	0.402	34.86	0.16	10.72	45.74	57.81	-12.07 QP
4	0.402	32.00	0.16	10.72	42.88	47.81	-4.93 Average
5	0.546	34.13	0.16	10.76	45.05	56.00	-10.95 QP
6	0.630	21.62	0.17	10.77	32.56	46.00	-13.44 Average
7	0.751	30.75	0.18	10.79	41.72	56.00	-14.28 QP
8	1.071	27.02	0.18	10.88	38.08	56.00	-17.92 QP
9	1.418	21.83	0.19	10.92	32.94	46.00	-13.06 Average
10	2.794	23.58	0.22	10.93	34.73	46.00	-11.27 Average
11	16.226	33.38	0.60	10.91	44.89	60.00	-15.11 QP
12	16.226	28.72	0.60	10.91	40.23	50.00	-9.77 Average

Adapter (2)

Line:

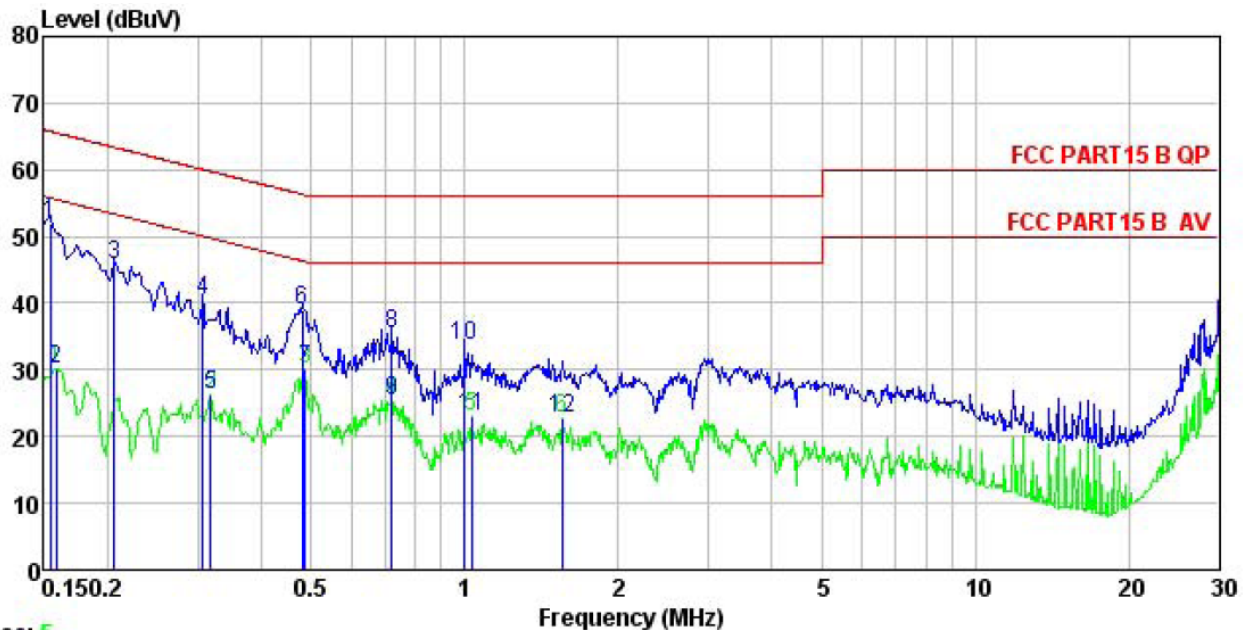


Trace: 7

Site : CCIS Shielding Room
 Condition : FCC PART15 B QP LISN LINE
 EUT : Broadband Digital Transmission System
 Model : LigoDLB 5-20ac
 Test Mode : 5Gwifi mode
 Power Rating : AC 120/60Hz
 Environment : Temp: 23 °C Humi:56% Atmos:101KPa
 Test Engineer: YT
 Remark : GRT-POE20-240100A

	Read	LISN	Cable	Limit	Over	
Freq	Level	Factor	Loss	Line	Limit	Remark
-----	-----	-----	-----	-----	-----	-----
MHz	dBuV	dB	dB	dBuV	dB	
1	0.150	39.19	0.26	10.78	50.23	66.00 -15.77 QP
2	0.170	17.01	0.26	10.77	28.04	54.94 -26.90 Average
3	0.186	35.25	0.26	10.76	46.27	64.20 -17.93 QP
4	0.258	30.45	0.26	10.75	41.46	61.51 -20.05 QP
5	0.318	17.38	0.26	10.74	28.38	49.75 -21.37 Average
6	0.479	28.50	0.27	10.75	39.52	56.36 -16.84 QP
7	0.481	18.40	0.27	10.75	29.42	46.32 -16.90 Average
8	0.705	15.93	0.28	10.77	26.98	46.00 -19.02 Average
9	0.751	24.95	0.28	10.79	36.02	56.00 -19.98 QP
10	0.953	20.18	0.29	10.86	31.33	56.00 -24.67 QP
11	1.552	12.56	0.30	10.93	23.79	46.00 -22.21 Average
12	2.900	11.05	0.35	10.92	22.32	46.00 -23.68 Average

Neutral:



Trace: 5

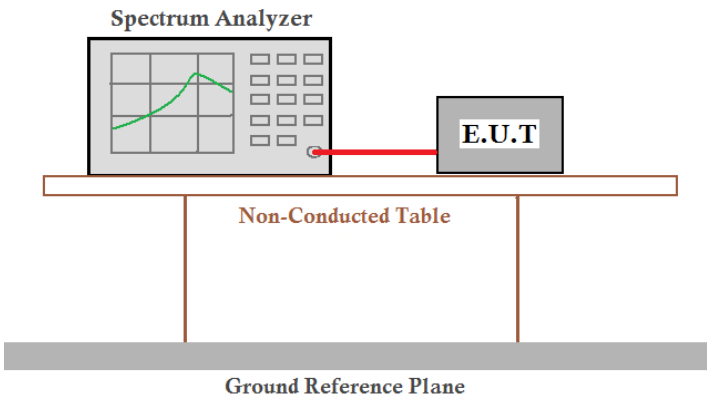
Site : CCIS Shielding Room
 Condition : FCC PART15 B QP LISN NEUTRAL
 EUT : Broadband Digital Transmission System
 Model : LigoDLB 5-20ac
 Test Mode : 5Gwifi mode
 Power Rating : AC 120/60Hz
 Environment : Temp: 23 °C Humi:56% Atmos:101KPa
 Test Engineer: YT
 Remark : GRT-POE20-240100A

	Freq	Read	LISN	Cable	Level	Limit	Over	
	MHz	Level	Factor	Loss	dBuV	Line	Limit	Remark
	MHz	dBuV	dB	dB	dBuV	dBuV	dB	
1	0.154	41.07	0.17	10.78	52.02	65.78	-13.76	QP
2	0.158	19.27	0.17	10.78	30.22	55.56	-25.34	Average
3	0.206	34.72	0.16	10.76	45.64	63.36	-17.72	QP
4	0.307	29.41	0.16	10.74	40.31	60.06	-19.75	QP
5	0.318	15.49	0.16	10.74	26.39	49.75	-23.36	Average
6	0.481	28.03	0.16	10.75	38.94	56.32	-17.38	QP
7	0.486	19.29	0.16	10.76	30.21	46.23	-16.02	Average
8	0.720	24.39	0.17	10.78	35.34	56.00	-20.66	QP
9	0.720	14.44	0.17	10.78	25.39	46.00	-20.61	Average
10	1.000	22.47	0.17	10.87	33.51	56.00	-22.49	QP
11	1.032	11.92	0.17	10.87	22.96	46.00	-23.04	Average
12	1.552	11.66	0.19	10.93	22.78	46.00	-23.22	Average

Notes:

1. An initial pre-scan was performed on the live and neutral lines with peak detector.
2. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
3. Final Level = Receiver Read level + LISN Factor + Cable Loss

6.3 Conducted Output Power

Test Requirement:	FCC Part15 E Section 15.407 (a) (1) (ii) & (a) (3)
Test Method:	ANSI C63.10: 2013, KDB789033
Limit:	Band 1: 1 W (For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power is required for each 1 dB of antenna gain in excess of 23 dBi); Band 4: 1W (For fixed point-to-point UNII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power).
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected to an E.U.T. (Equipment Under Test) via a red cable. Both the Spectrum Analyzer and the E.U.T. are placed on a Non-Conducted Table. The table is supported by two vertical legs and sits on a Ground Reference Plane.
Test Instruments:	Refer to section 5.8 for details
Test mode:	Refer to section 5.3 for details
Test results:	Passed

Measurement Data:

Band 1:

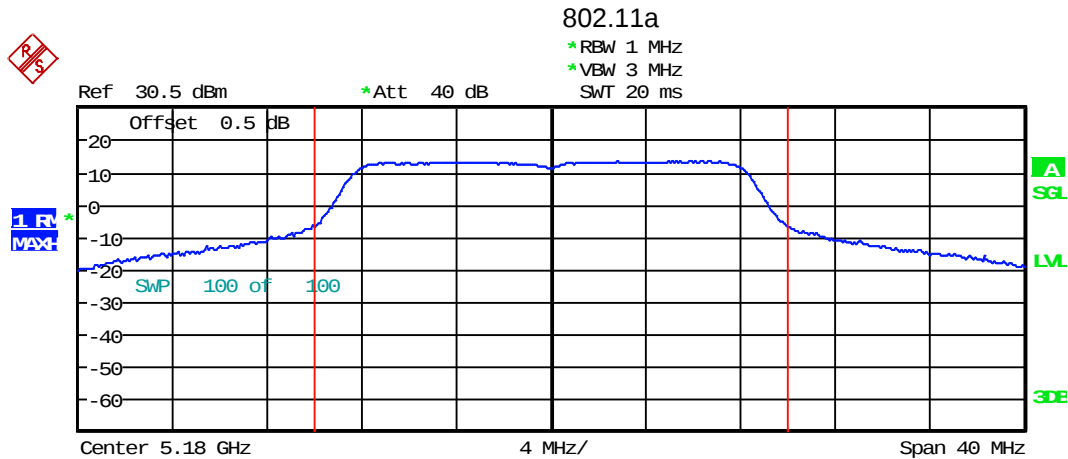
Mode	Test CH	Ant. Port	Conducted Output power (dBm)	Total power (dBm)	Limit (dBm)	Result
802.11a	Lowest	TX0	24.64	27.76	30.00	Pass
		TX1	24.85			
	Middle	TX0	24.25	27.49	30.00	Pass
		TX1	24.70			
	Highest	TX0	24.01	27.34	30.00	Pass
		TX1	24.62			
802.11n20	Lowest	TX0	24.63	27.67	30.00	Pass
		TX1	24.68			
	Middle	TX0	24.25	27.44	30.00	Pass
		TX1	24.61			
	Highest	TX0	24.01	27.28	30.00	Pass
		TX1	24.51			
802.11n40	Lowest	TX0	23.78	26.78	30.00	Pass
		TX1	23.76			
	Highest	TX0	23.41	26.65	30.00	Pass
		TX1	23.85			
802.11ac80	Middle	TX0	23.40	26.60	30.00	Pass
		TX1	23.77			

Band 4:

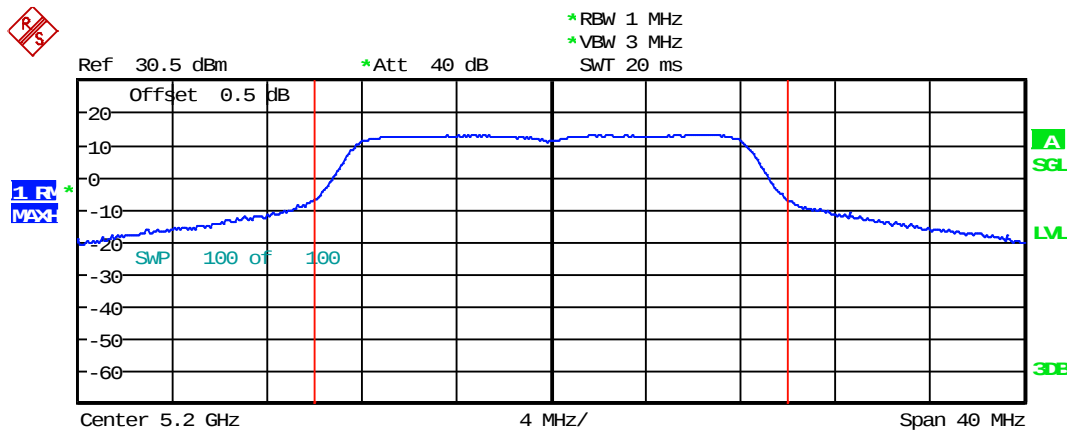
Mode	Test CH	Ant. Port	Conducted Output power (dBm)	Total power (dBm)	Limit (dBm)	Result
802.11a	Lowest	TX0	26.70	29.74	30.00	Pass
		TX1	26.76			
	Middle	TX0	26.37	29.60	30.00	Pass
		TX1	26.79			
	Highest	TX0	25.81	28.90	30.00	Pass
		TX1	25.96			
802.11n20	Lowest	TX0	26.21	29.50	30.00	Pass
		TX1	26.75			
	Middle	TX0	25.58	28.91	30.00	Pass
		TX1	26.19			
	Highest	TX0	25.29	28.36	30.00	Pass
		TX1	25.41			
802.11n40	Lowest	TX0	26.07	29.21	30.00	Pass
		TX1	26.33			
	Highest	TX0	25.52	28.71	30.00	Pass
		TX1	25.88			
802.11ac80	Middle	TX0	22.76	25.95	30.00	Pass
		TX1	23.11			

Test plot as follows:

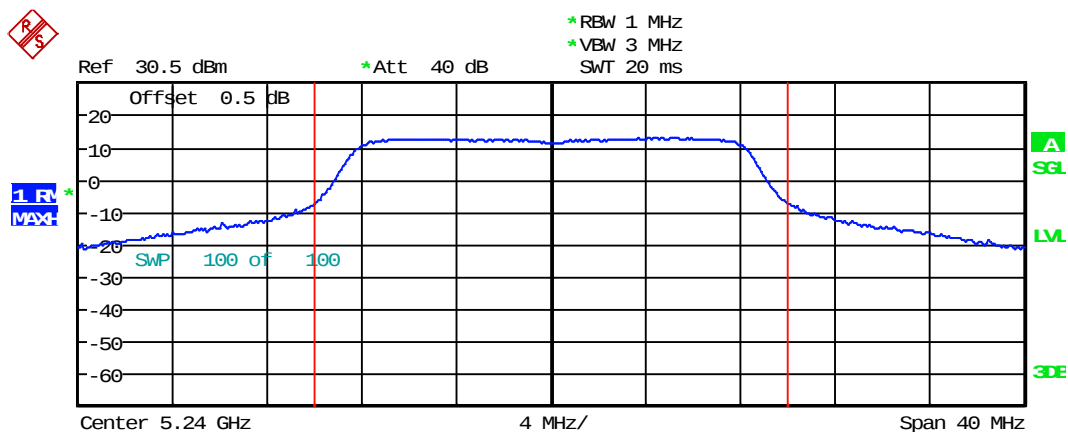
Band 1: TX0



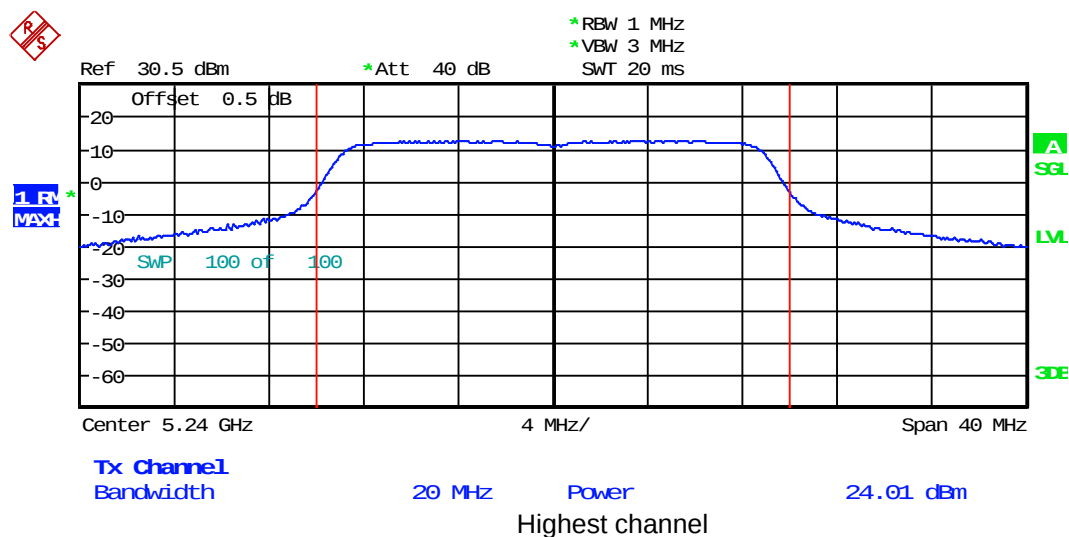
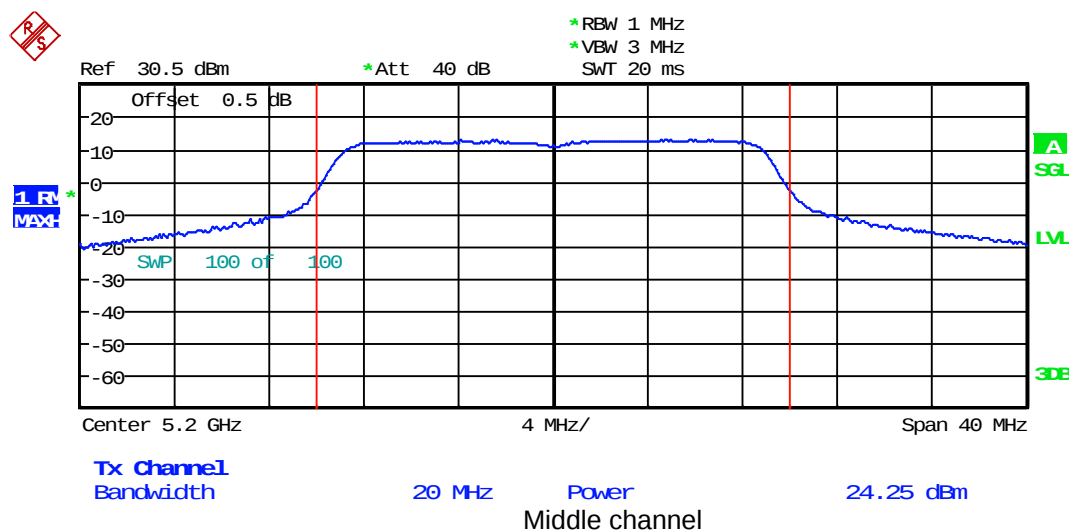
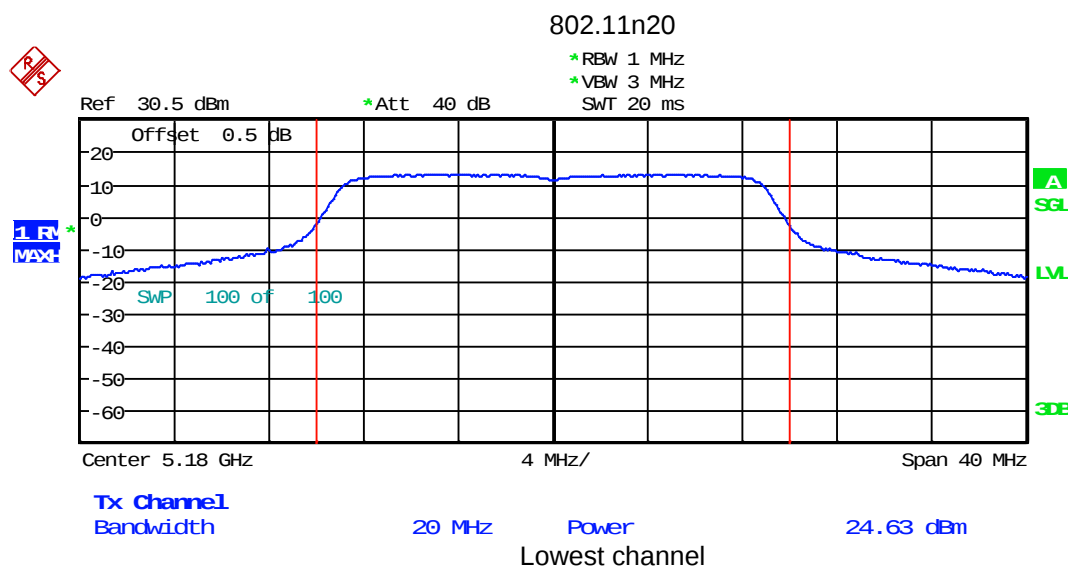
Tx Channel
Bandwidth 20 MHz Power 24.64 dBm
Lowest channel

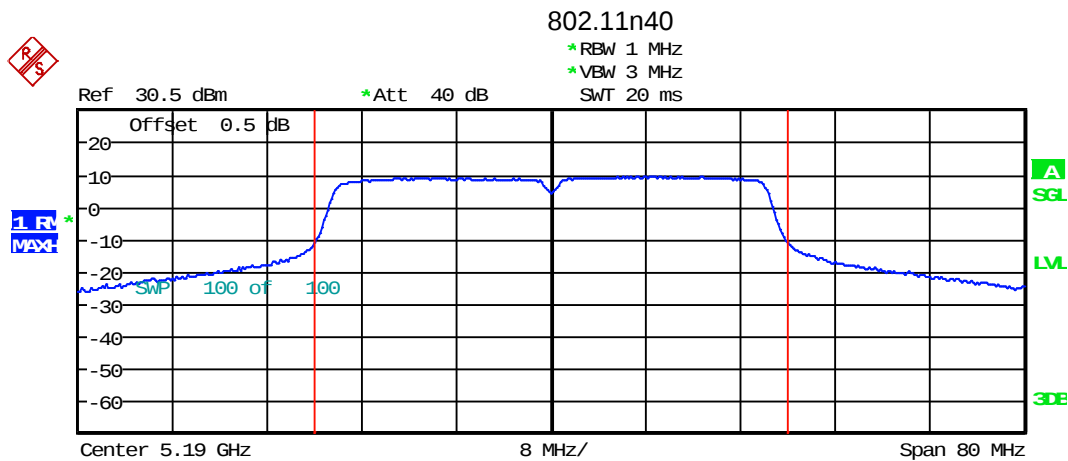


Tx Channel
Bandwidth 20 MHz Power 24.25 dBm
Middle channel

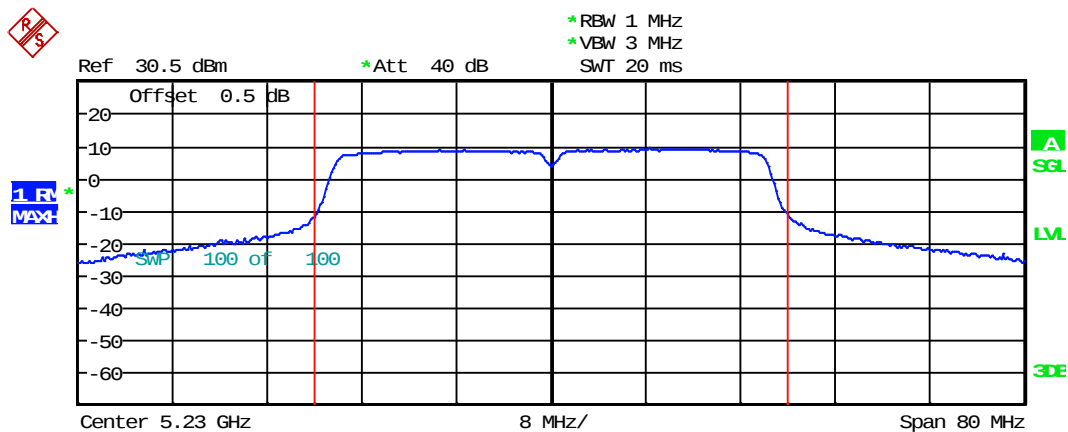


Tx Channel
Bandwidth 20 MHz Power 24.01 dBm
Highest channel

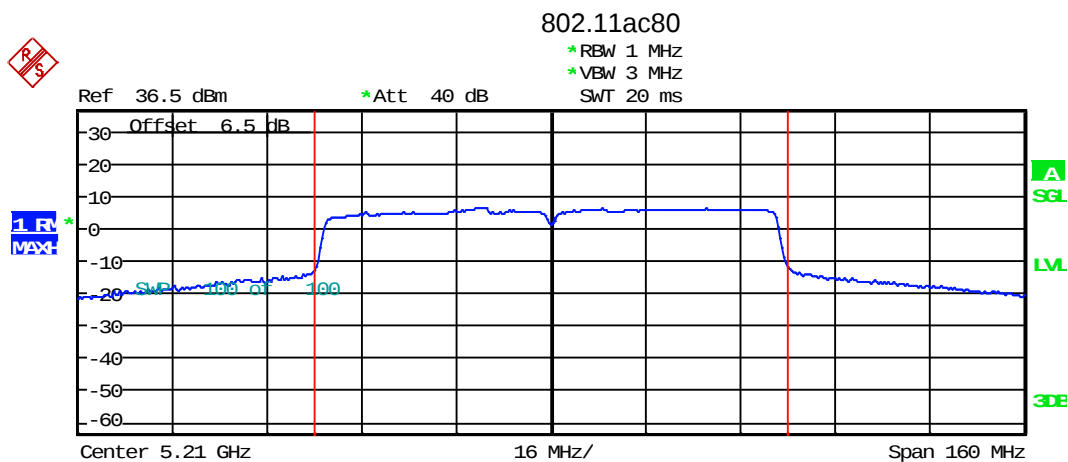




Tx Channel
Bandwidth 40 MHz Power 23.78 dBm
Lowest channel

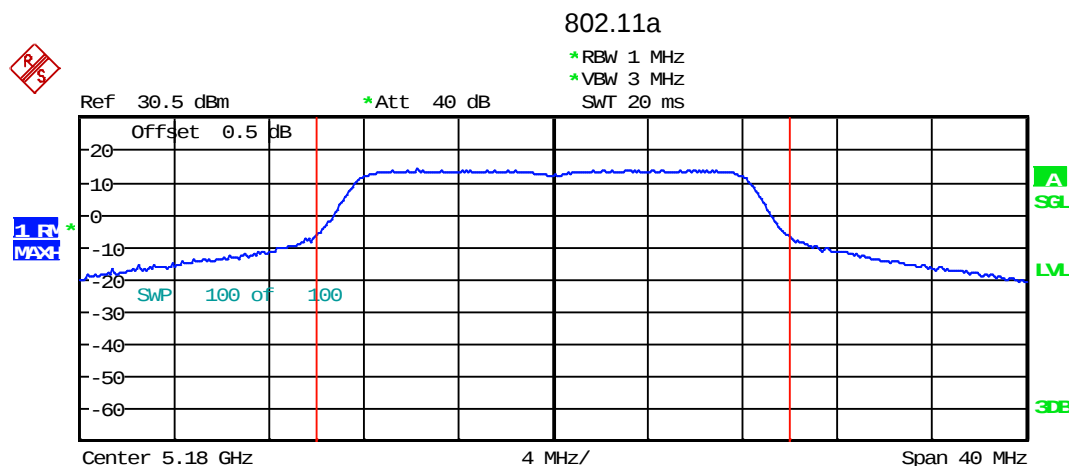


Tx Channel
Bandwidth 40 MHz Power 23.41 dBm
Highest channel



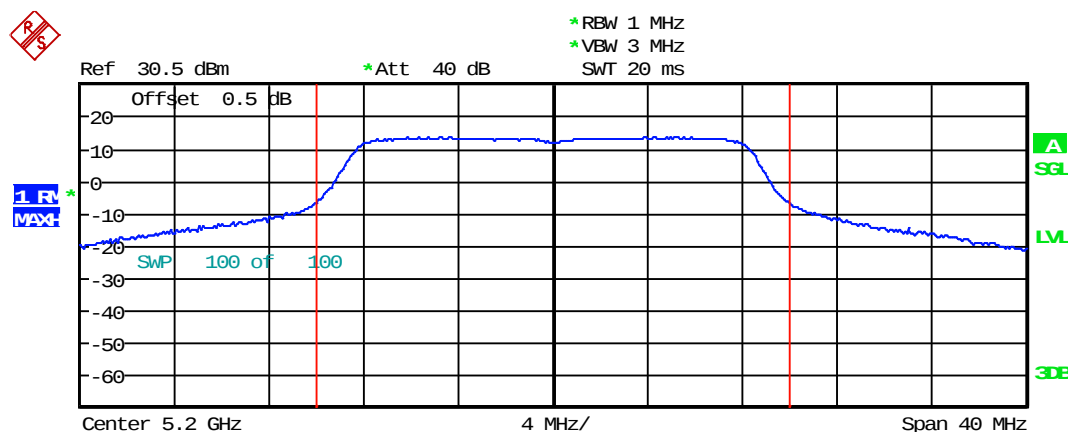
Tx Channel
Bandwidth 80 MHz Power 23.40 dBm
Middle channel

TX1



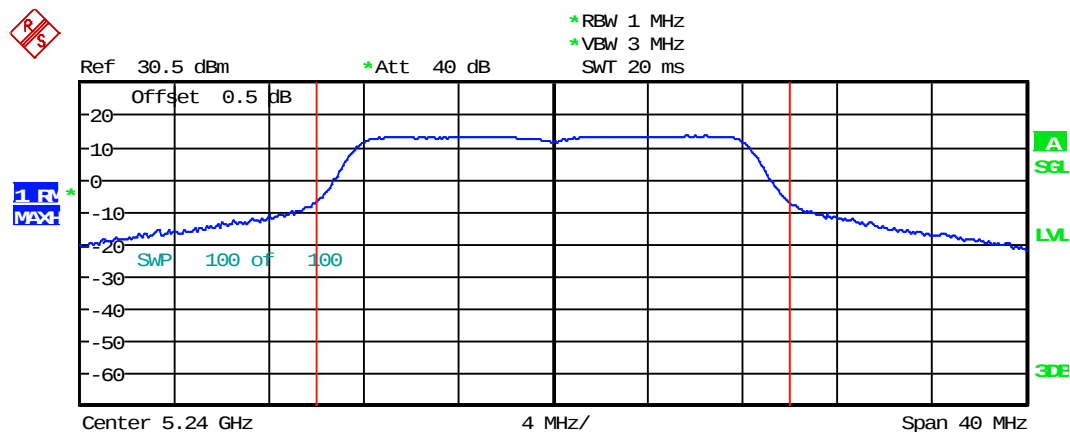
Tx Channel
Bandwidth 20 MHz Power 24.85 dBm

Lowest channel



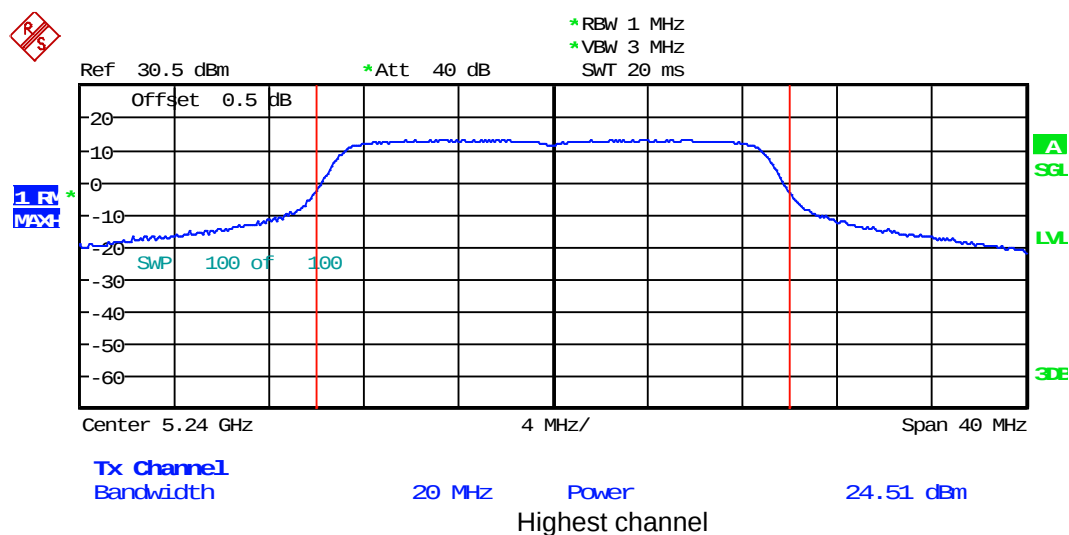
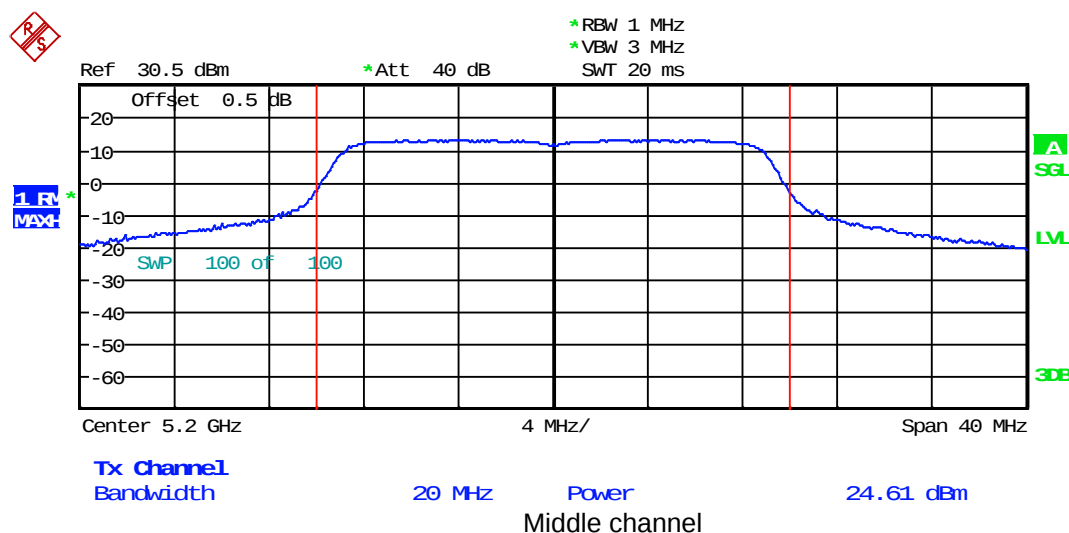
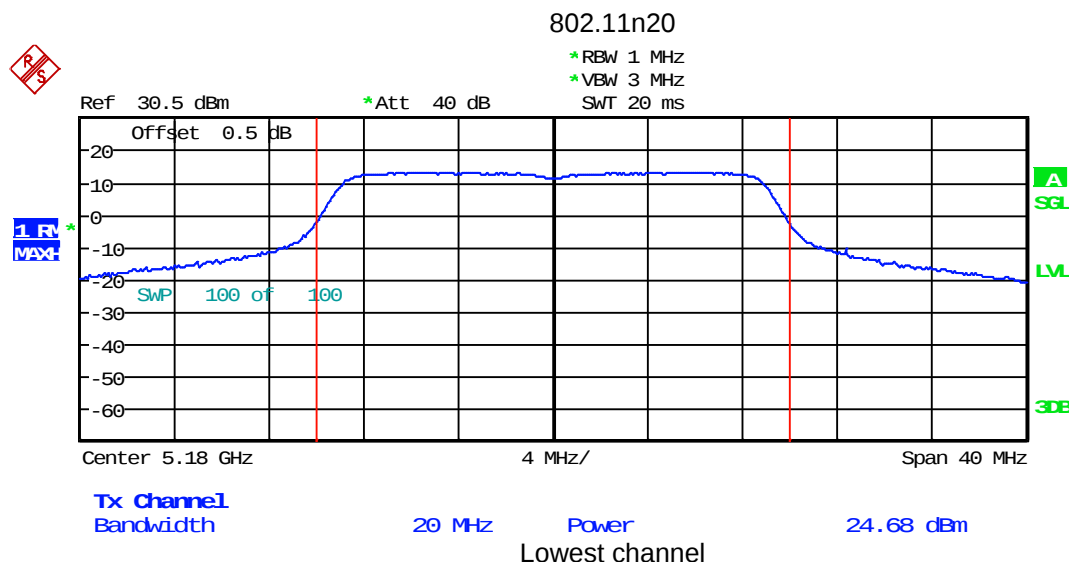
Tx Channel
Bandwidth 20 MHz Power 24.70 dBm

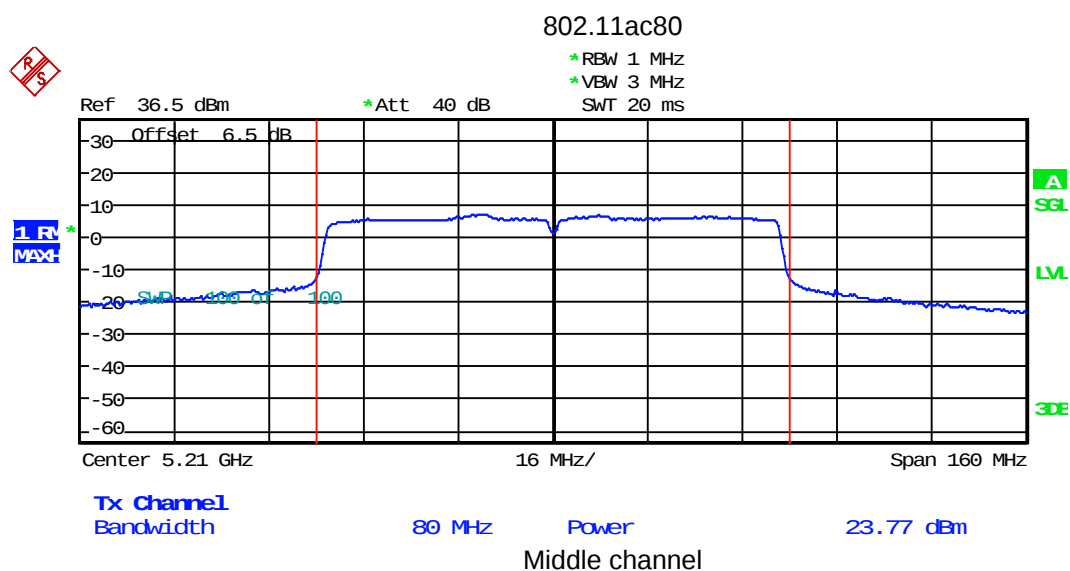
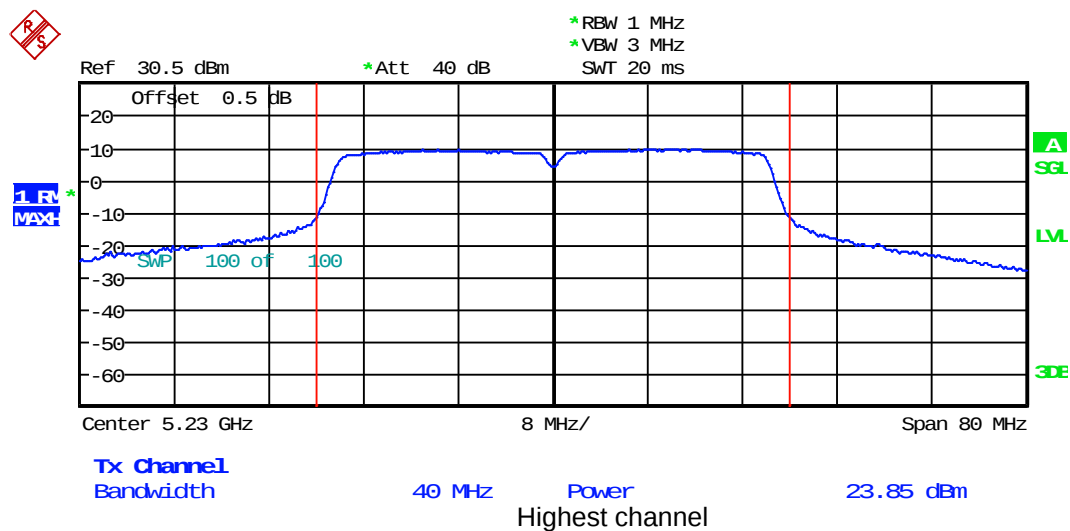
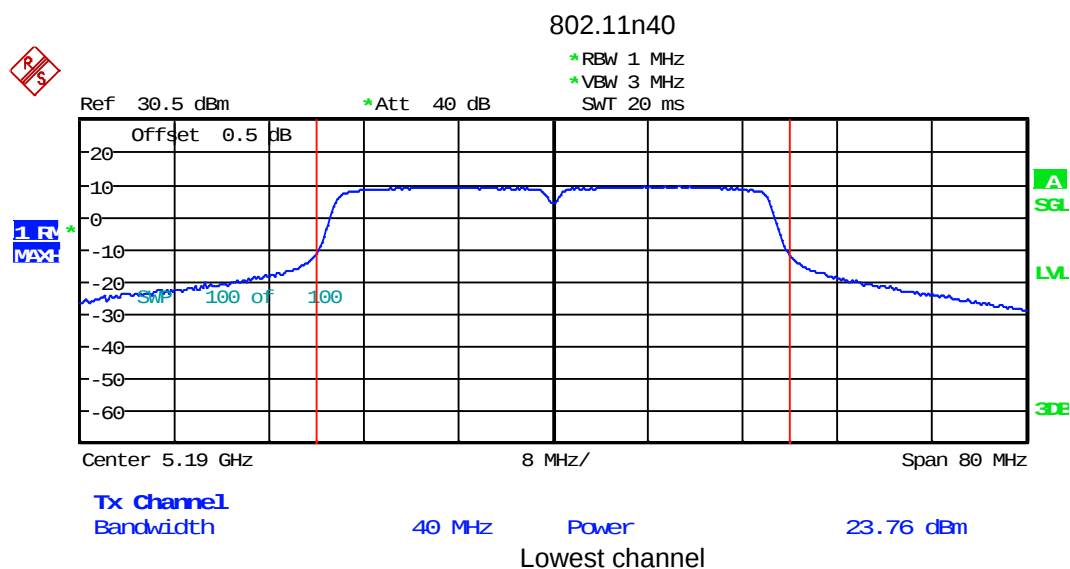
Middle channel



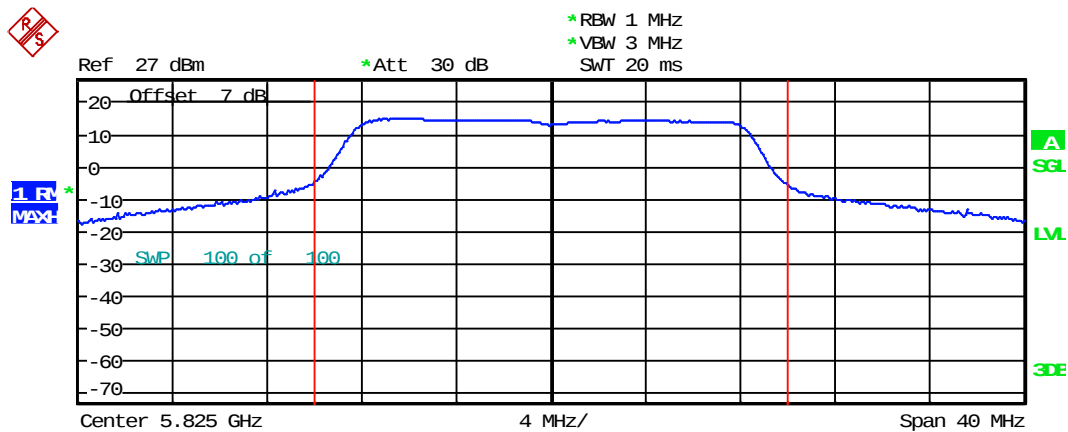
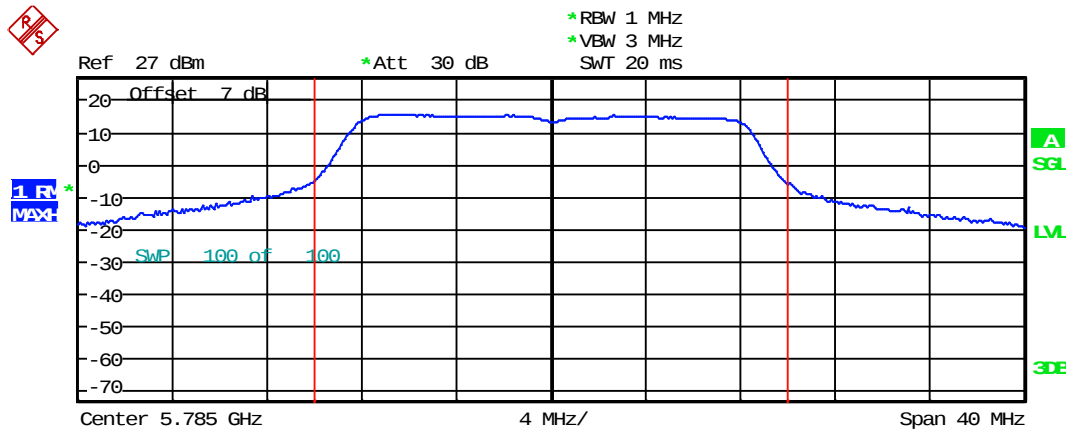
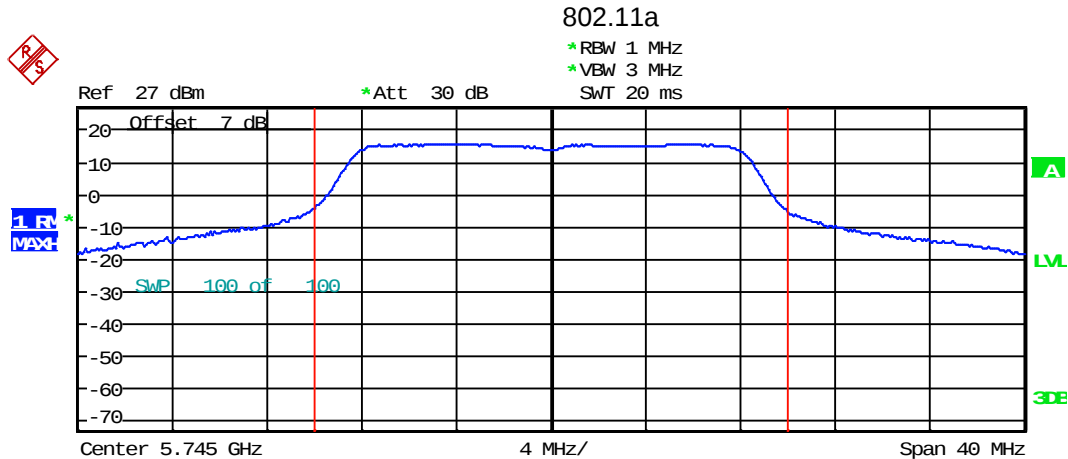
Tx Channel
Bandwidth 20 MHz Power 24.62 dBm

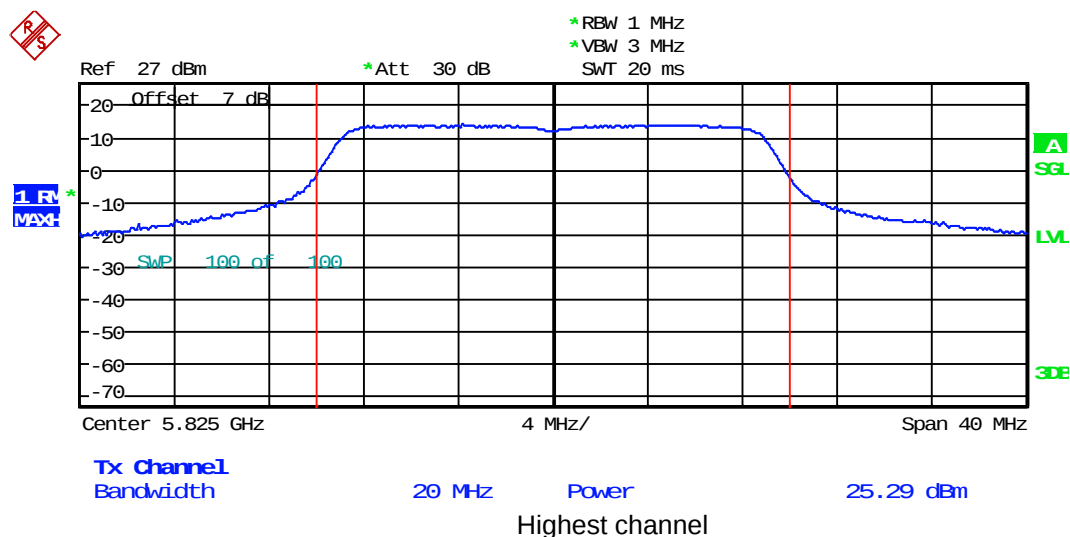
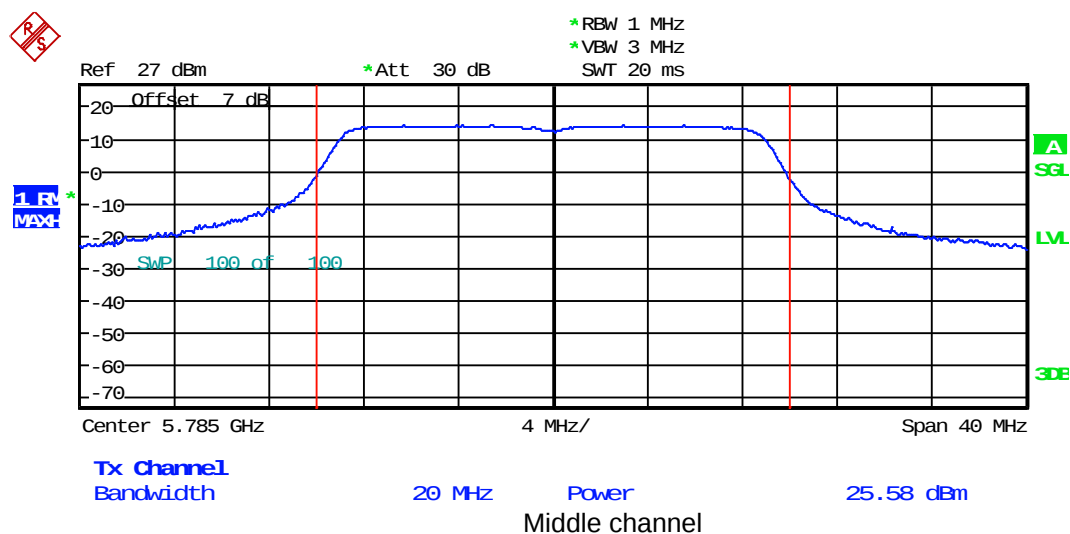
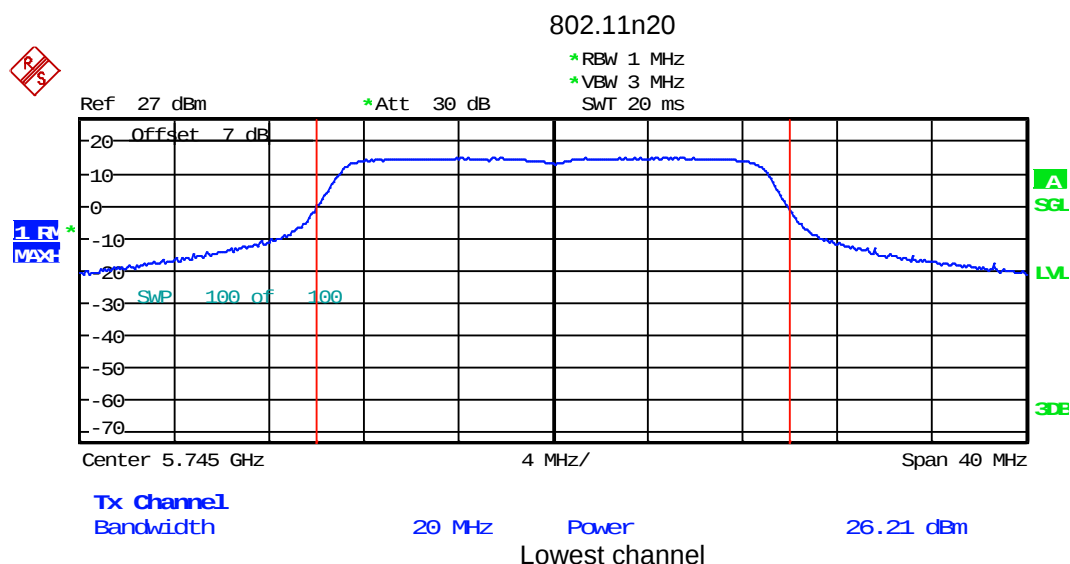
Highest channel

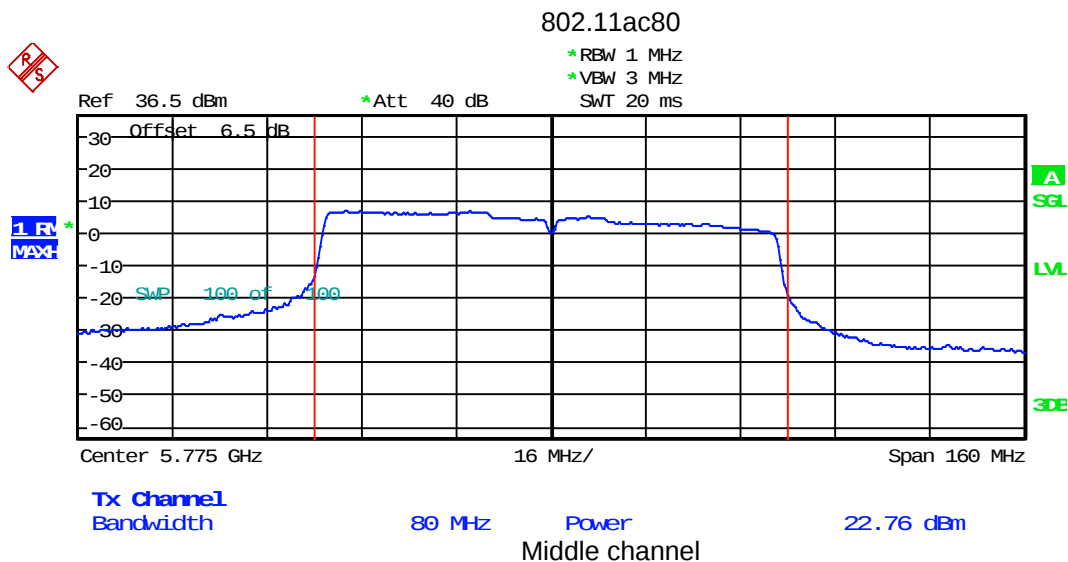
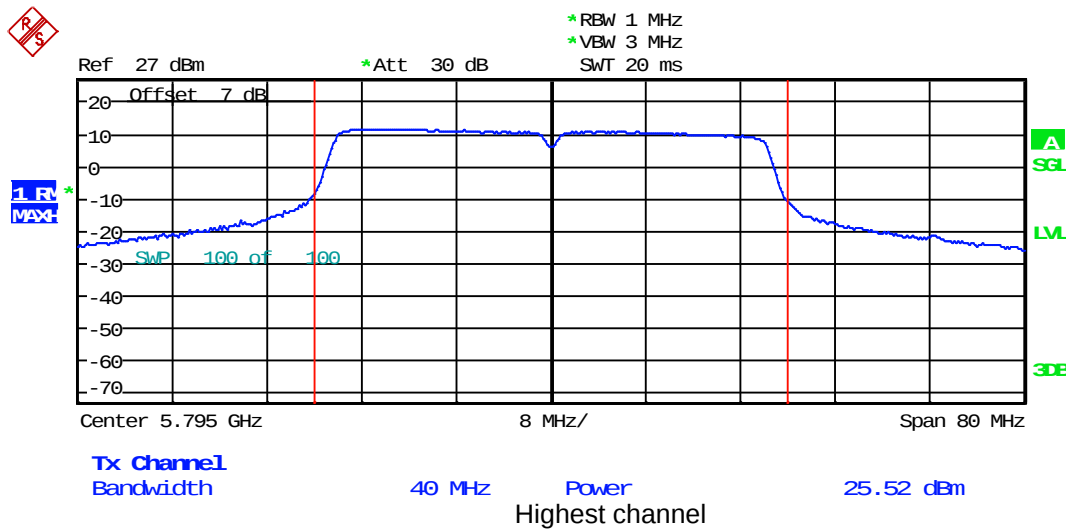
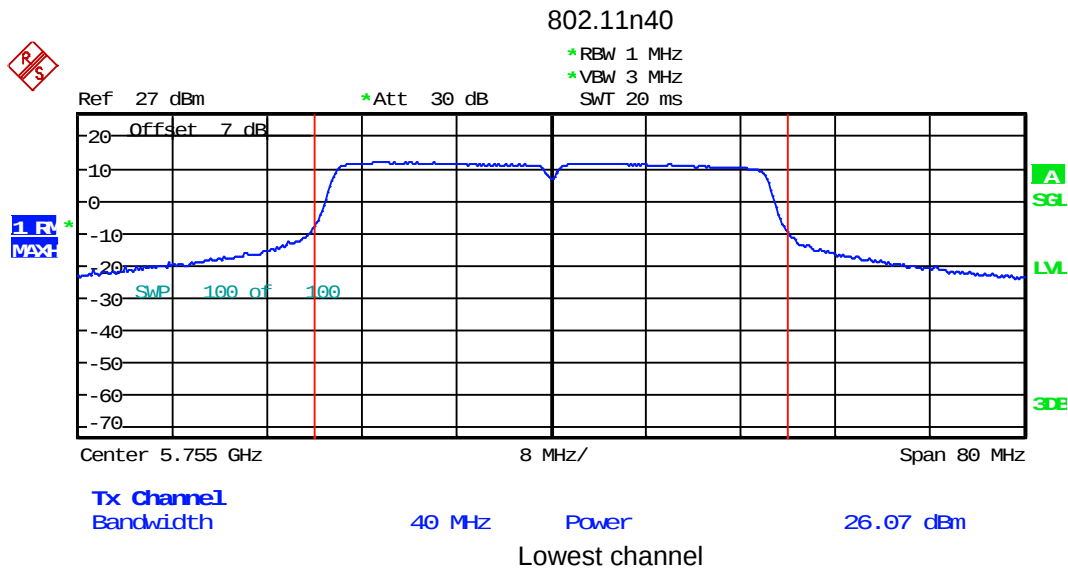




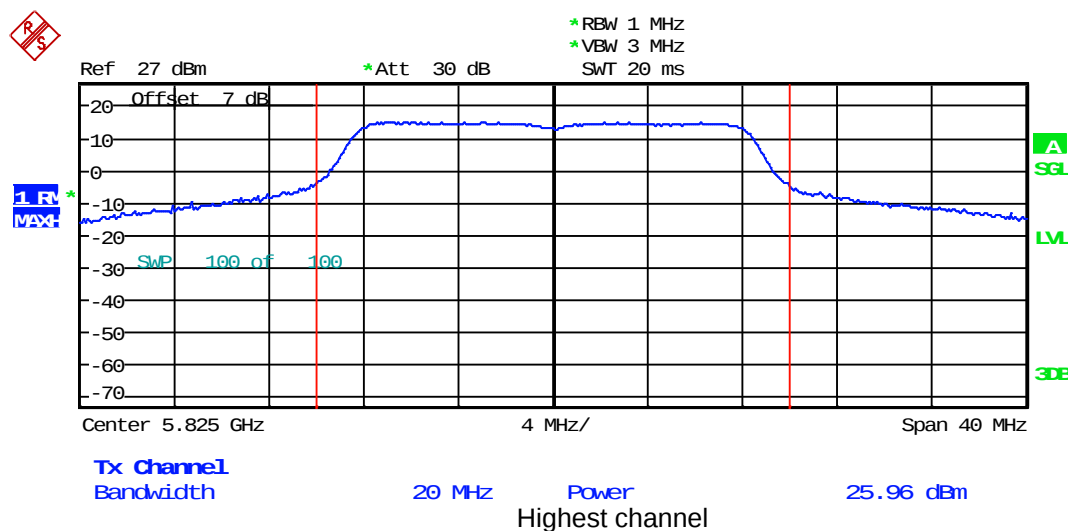
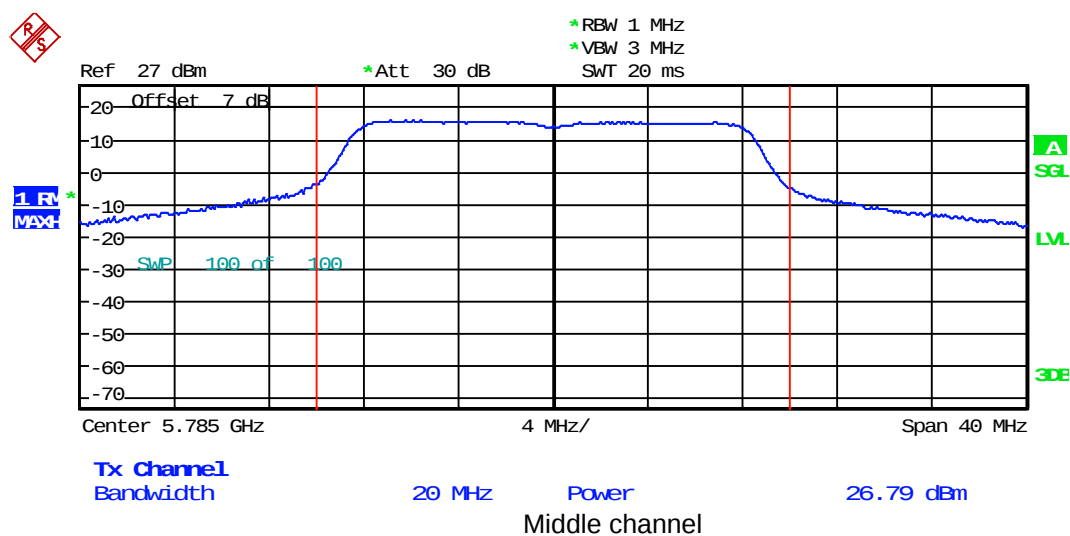
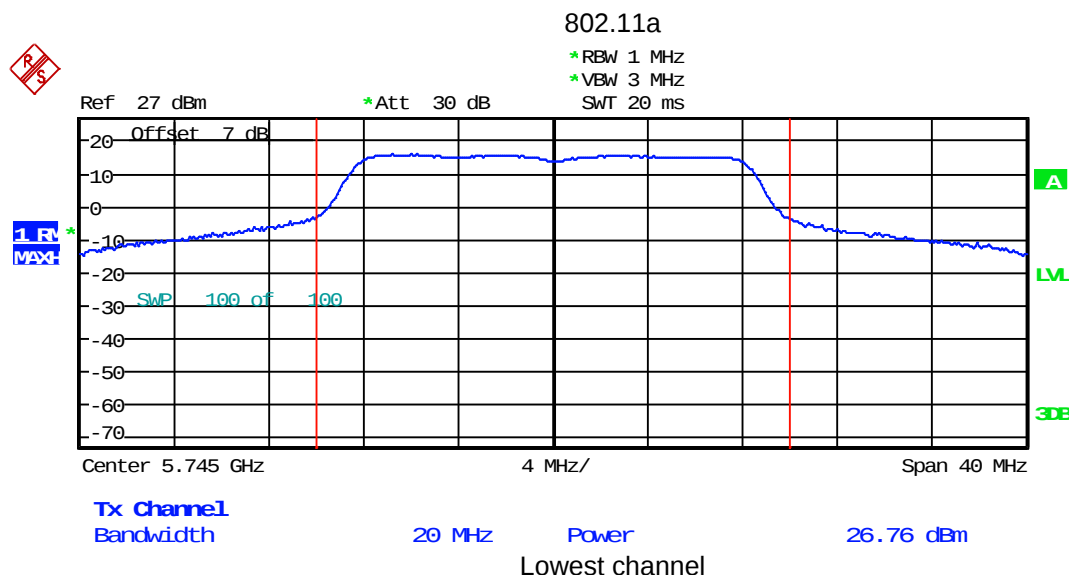
Band 4: TX0

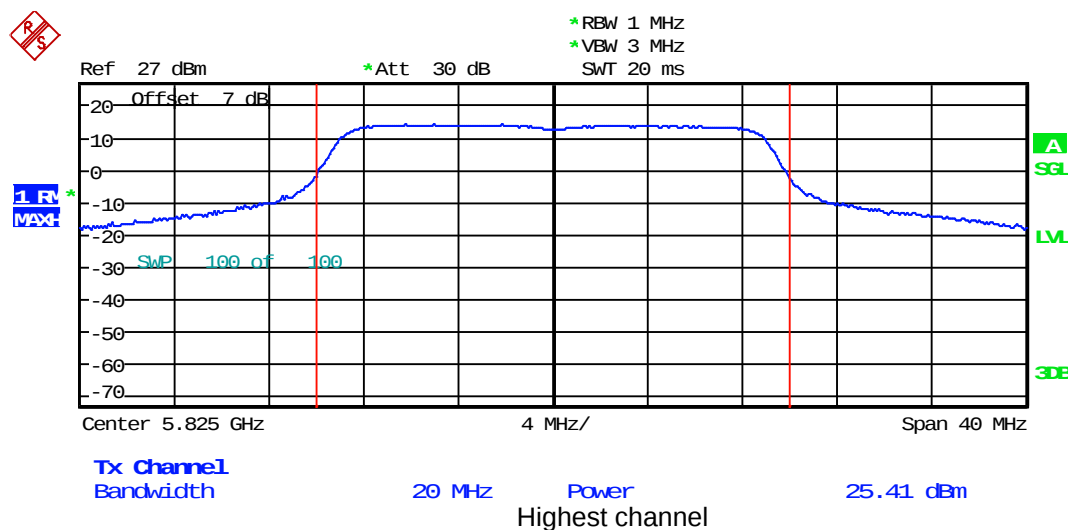
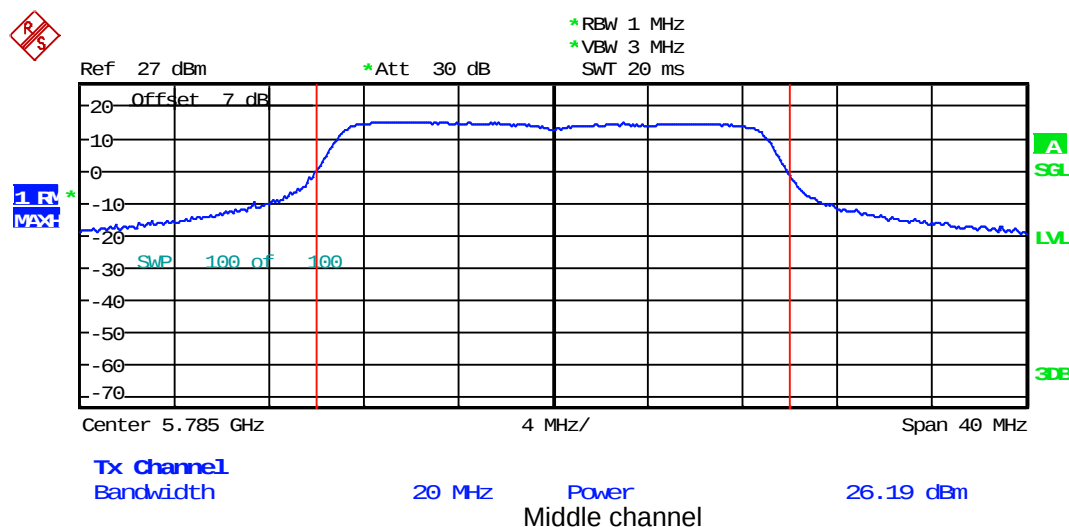
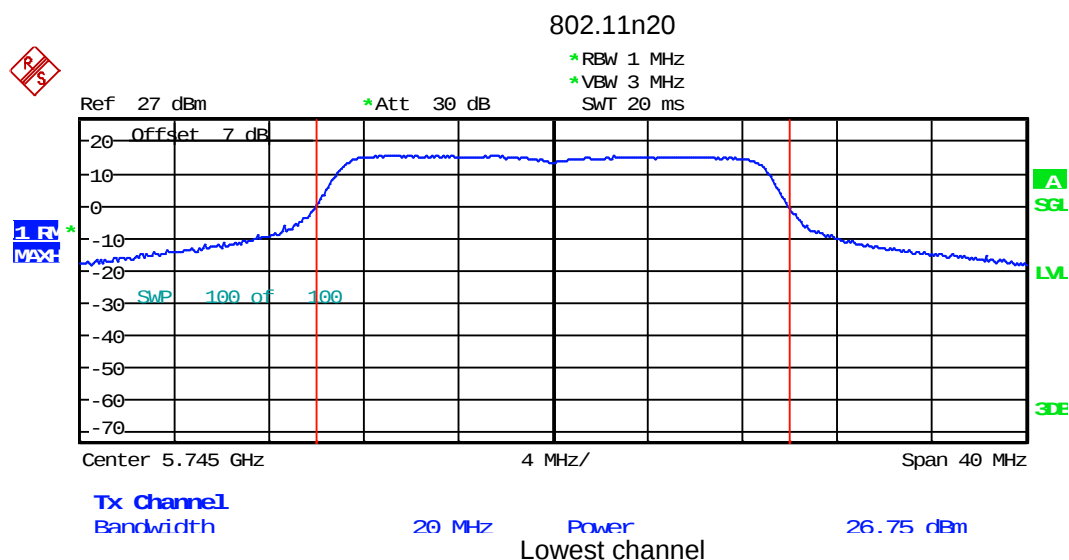


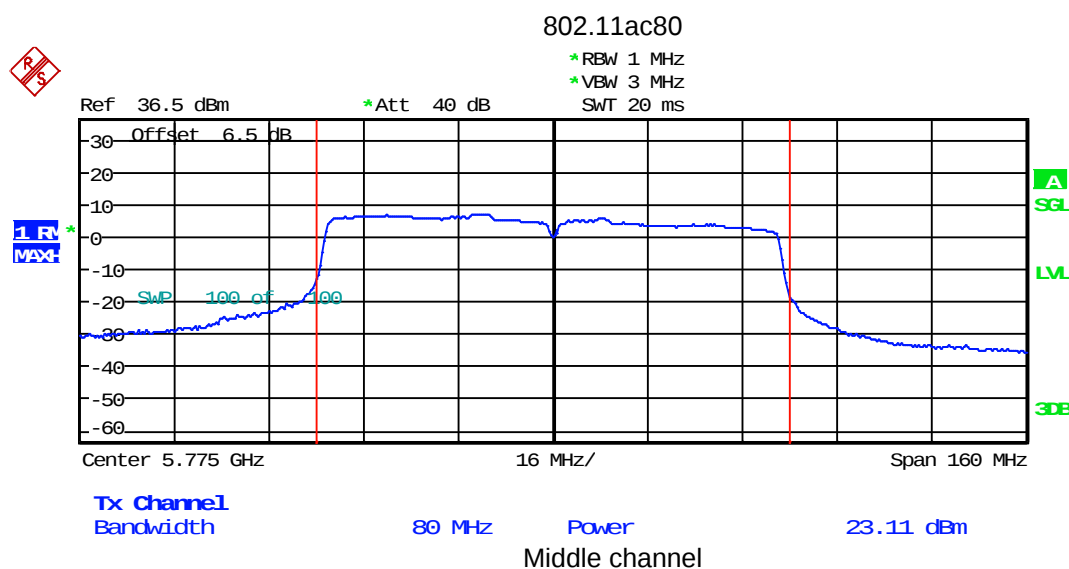
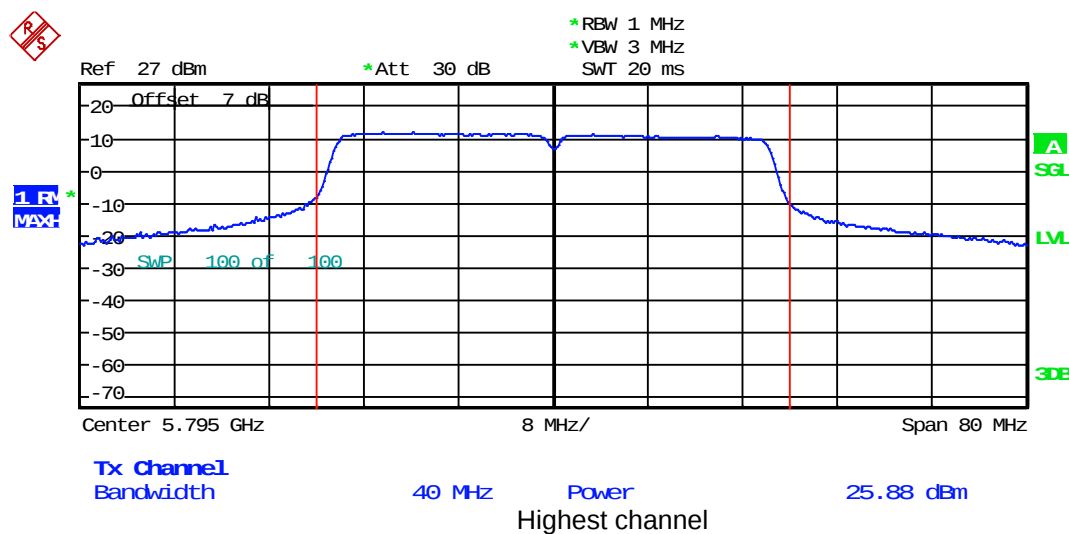
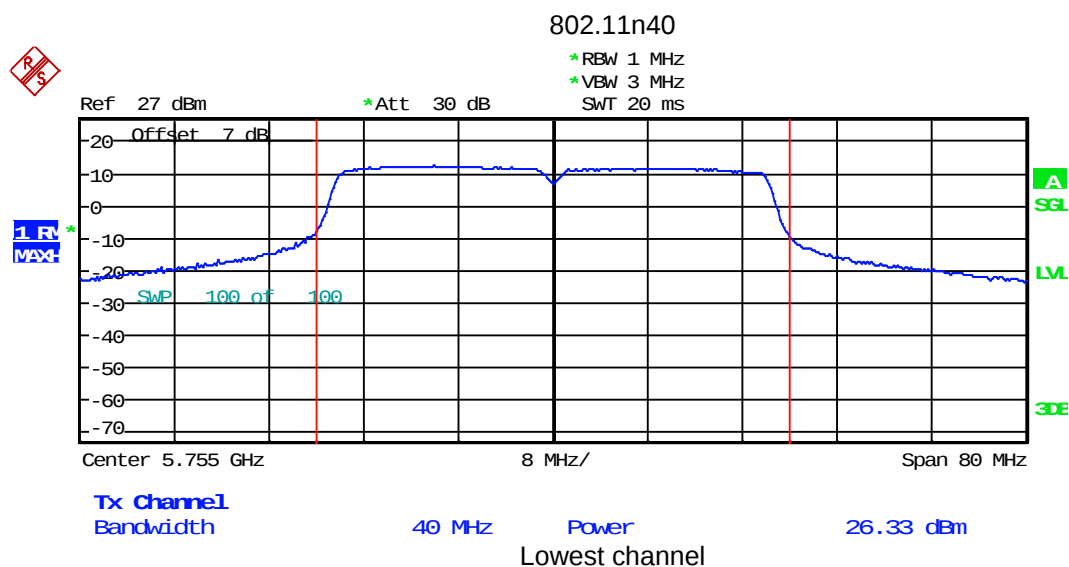




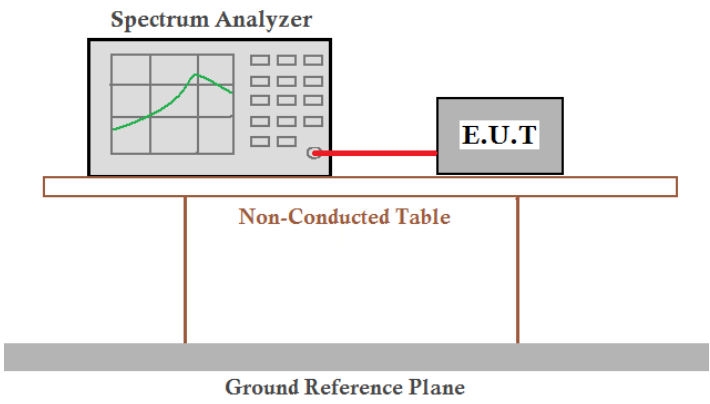
TX1







6.4 Occupy Bandwidth

Test Requirement:	FCC Part15 E Section 15.407 (a) (5) and Section 15.407 (e)
Test Method:	ANSI C63.10:2013 and KDB 789033
Limit:	Band 1: N/A(26dB Emission Bandwidth and 99% Occupy Bandwidth) Band 4: N/A(26dB Emission Bandwidth and 99% Occupy Bandwidth) Band 4: >500kHz(6dB Bandwidth)
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected to an E.U.T (Equipment Under Test) via a red cable. Both the Spectrum Analyzer and the E.U.T are placed on a Non-Conducted Table. Below the table is a Ground Reference Plane.
Test Instruments:	Refer to section 5.8 for details
Test mode:	Refer to section 5.3 for details
Test results:	Passed

Measurement Data:

Band 1:

Test Channel	26dB Emission Bandwidth (MHz)				Limit	Result
	802.11a	802.11n20	802.11n40	802.11ac80		
Lowest	24.40	24.56	44.32	---	N/A	N/A
Middle	24.32	24.40	---	101.44		
Highest	24.16	24.24	44.80	---		
Test Channel	99% Occupy Bandwidth (MHz)				Limit	Result
	802.11a	802.11n20	802.11n40	802.11ac80		
Lowest	17.20	18.24	36.48		N/A	N/A
Middle	17.12	18.16	---	79.04		
Highest	17.12	18.08	36.48			

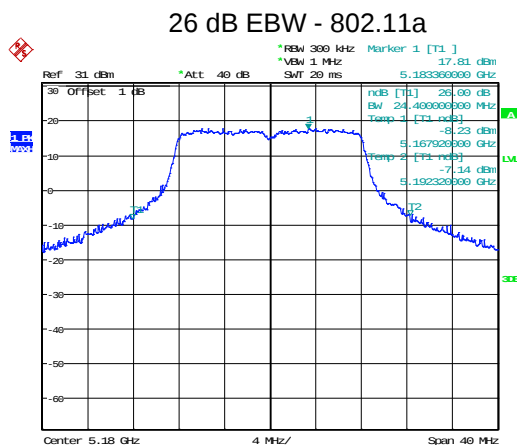
Band 4:

Test Channel	26dB Emission Bandwidth (MHz)				Limit	Result
	802.11a	802.11n20	802.11n40	802.11ac80		
Lowest	27.76	26.00	47.84	---	N/A	N/A
Middle	26.64	23.68	---	85.12		
Highest	28.32	26.80	45.28	---		
Test Channel	99% Occupy Bandwidth (MHz)				Limit	Result
	802.11a	802.11n20	802.11n40	802.11ac80		
Lowest	17.60	18.32	36.64	---	N/A	N/A
Middle	17.36	18.24	---	75.84		
Highest	17.68	18.32	36.48	---		
Test Channel	6dB Emission Bandwidth (MHz)				Limit	Result
	802.11a	802.11n20	802.11n40	802.11ac80		
Lowest	16.48	17.76	36.80	---	>500kHz	N/A
Middle	16.56	17.76	---	72.00		
Highest	16.48	17.76	36.80	---		

Note: TX 1 and TX 0 port all have been tested , only worse case is reported

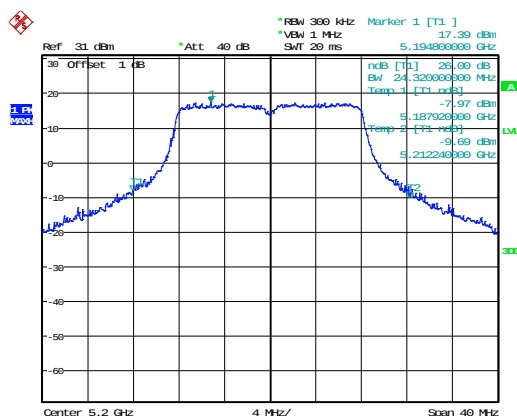
Test plot as follows:

Band 1



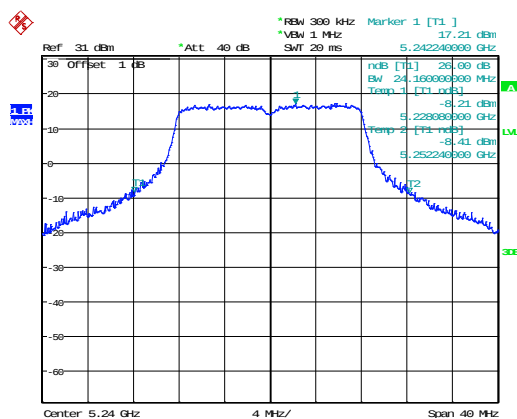
Date: 22.MAR.2016 06:04:42

Lowest channel



Date: 22.MAR.2016 06:05:23

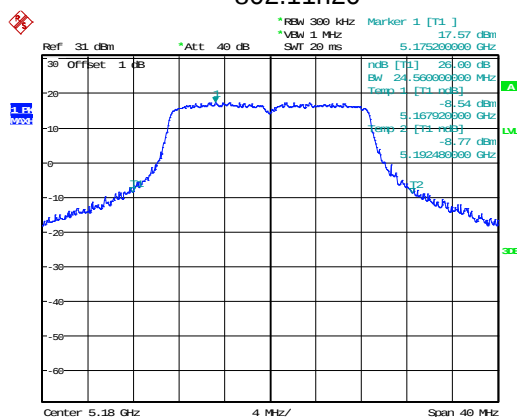
Middle channel



Date: 22.MAR.2016 06:05:46

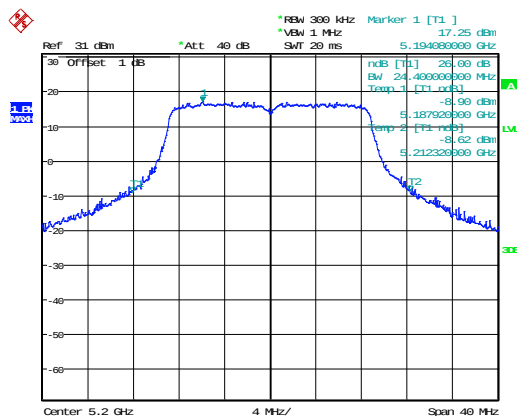
Highest channel

802.11n20



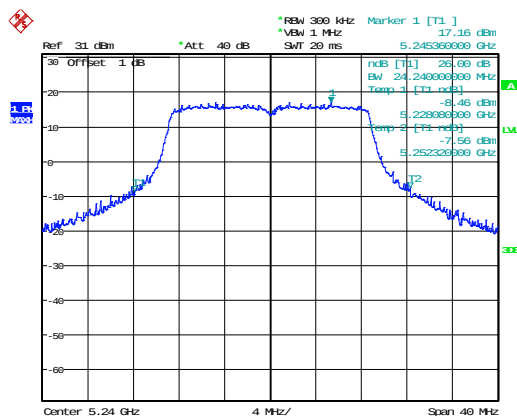
Date: 22.MAR.2016 06:06:33

Lowest channel



Date: 22.MAR.2016 06:06:55

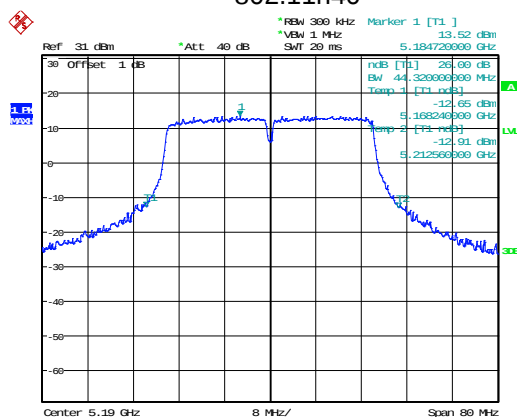
Middle channel



Date: 22.MAR.2016 06:07:33

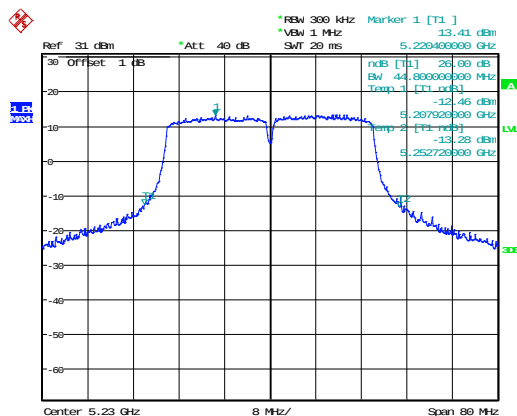
Highest channel

802.11n40



Date: 22.MAR.2016 06:04:06

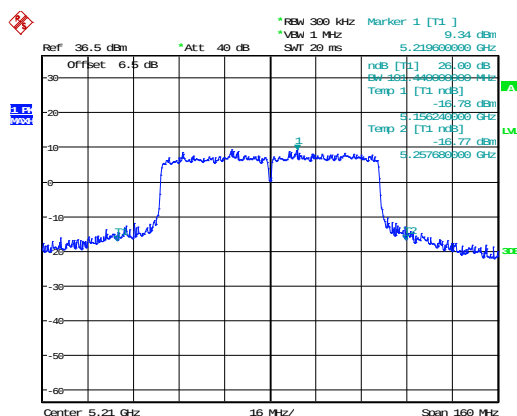
Lowest channel



Date: 22.MAR.2016 06:03:21

Highest channel

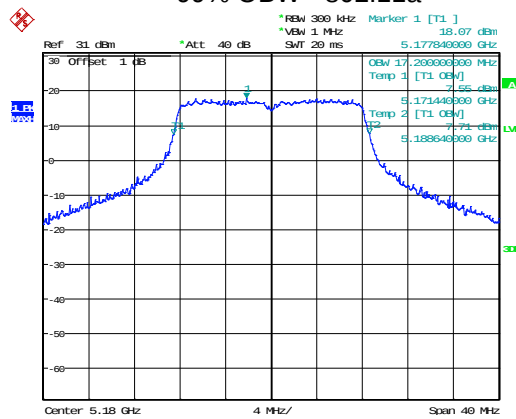
802.11ac80



Date: 15.APR.2016 19:35:37

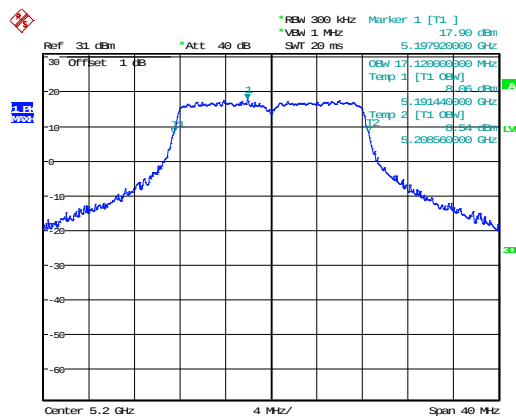
Middle channel

99% OBW - 802.11a



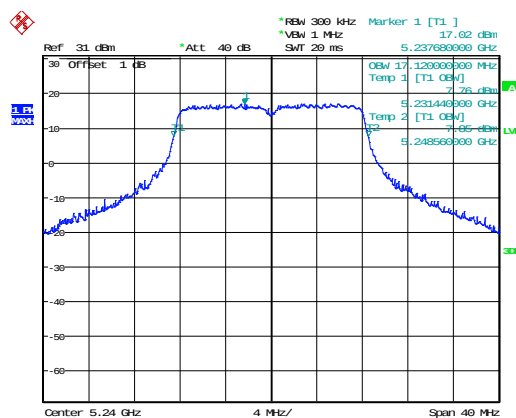
Date: 22.MAR.2016 06:04:53

Lowest channel



Date: 22.MAR.2016 06:05:14

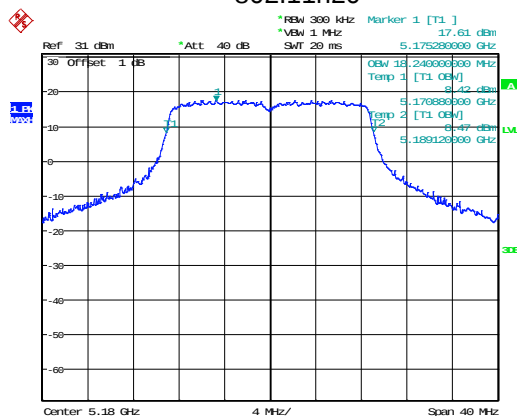
Middle channel



Date: 22.MAR.2016 06:05:59

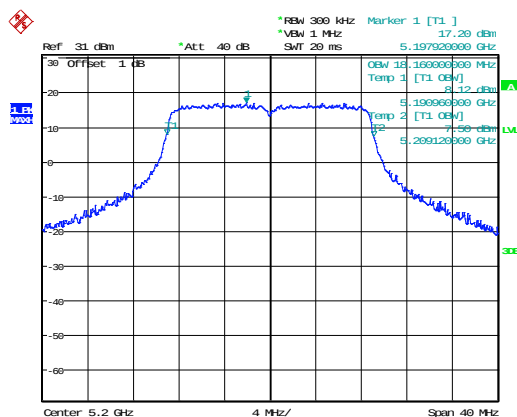
Highest channel

802.11n20



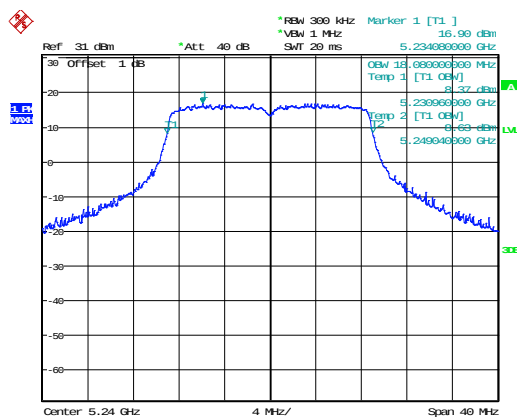
Date: 22.MAR.2016 06:06:24

Lowest channel



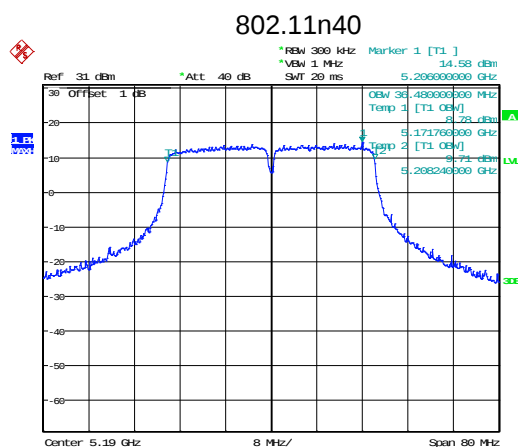
Date: 22.MAR.2016 06:07:04

Middle channel



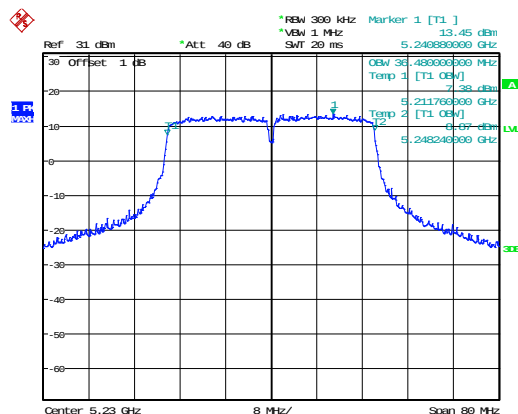
Date: 22.MAR.2016 06:07:24

Highest channel



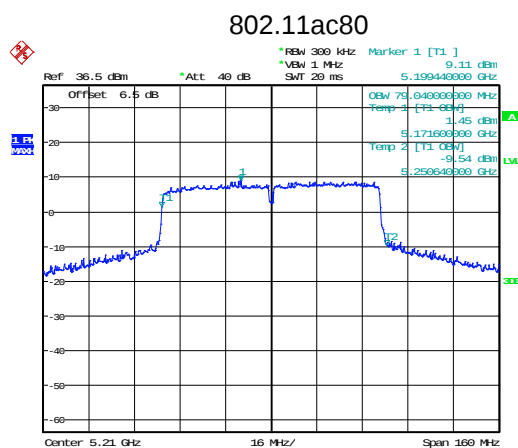
Date: 22.MAR.2016 06:03:57

Lowest channel



Date: 22.MAR.2016 06:03:31

Highest channel

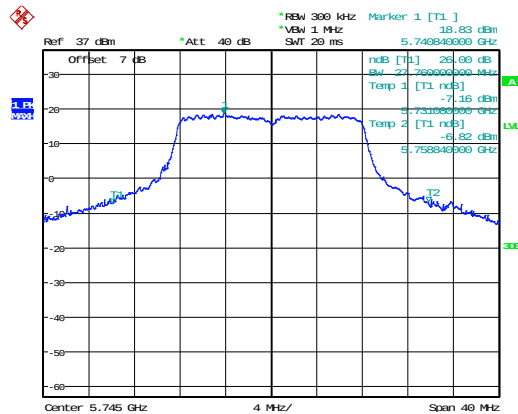


Date: 21.APR.2016 17:38:59

Middle channel

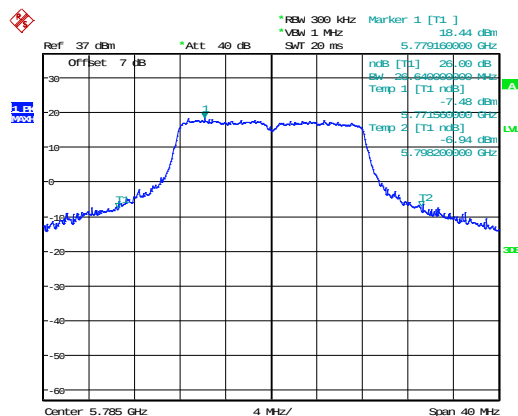
Band 4:

26 dB EBW - 802.11a



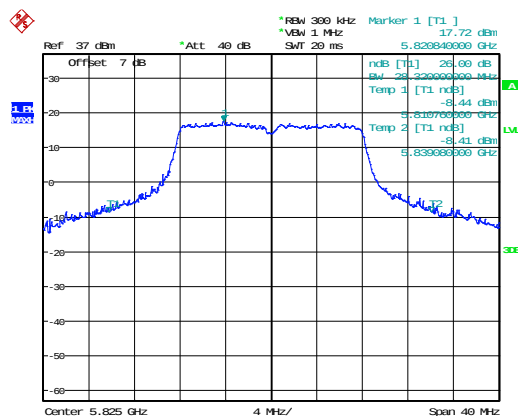
Date: 30.MAR.2016 19:03:35

Lowest channel



Date: 30.MAR.2016 19:04:09

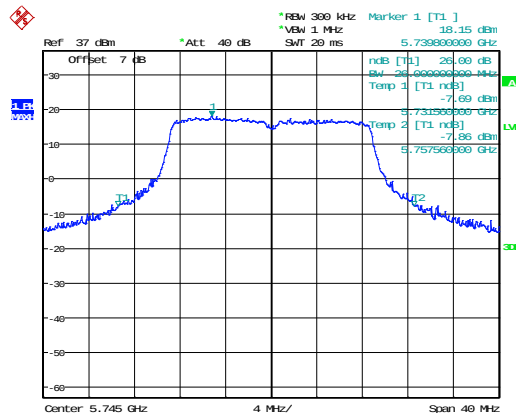
Middle channel



Date: 30.MAR.2016 19:04:37

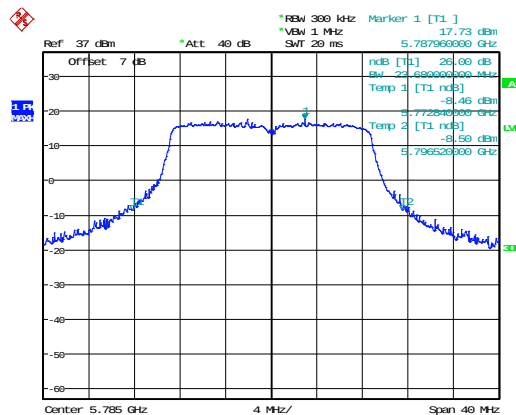
Highest channel

802.11n20



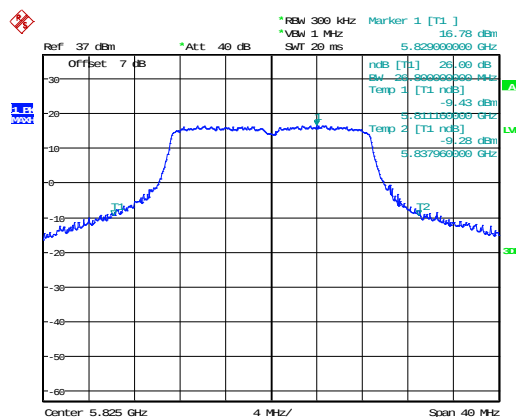
Date: 30.MAR.2016 19:05:27

Lowest channel



Date: 30.MAR.2016 19:05:51

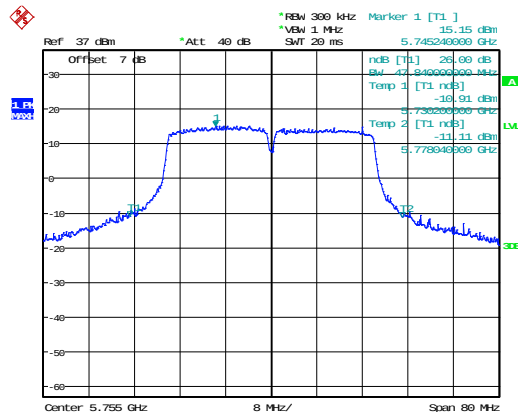
Middle channel



Date: 30.MAR.2016 19:06:30

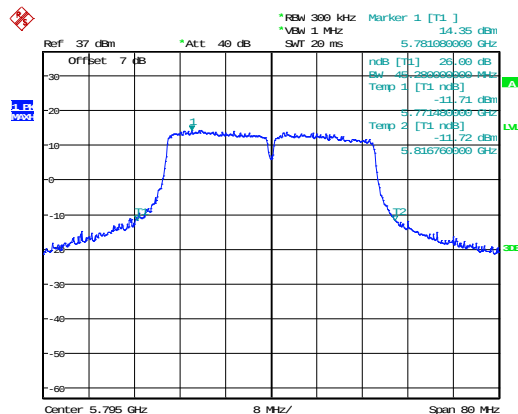
Highest channel

802.11n40



Date: 30.MAR.2016 19:07:28

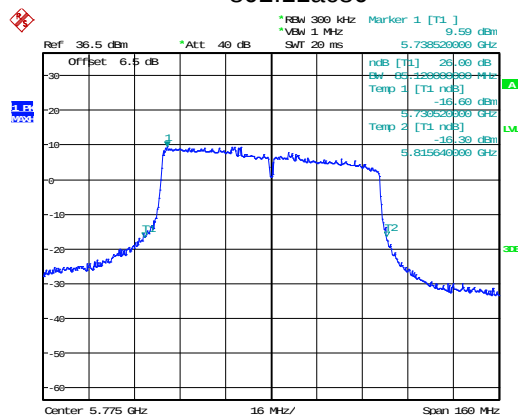
Lowest channel



Date: 30.MAR.2016 19:07:55

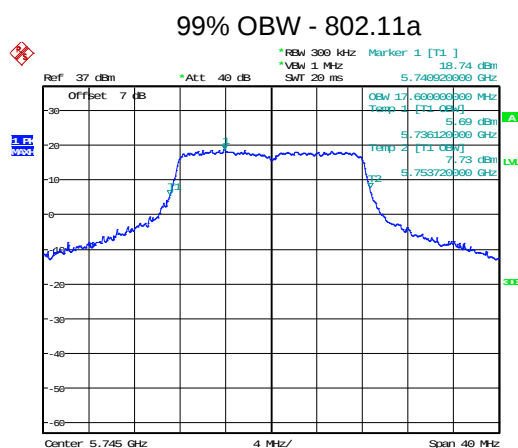
Highest channel

802.11ac80



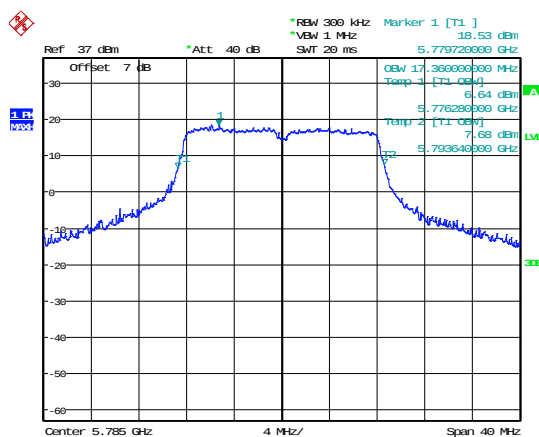
Date: 15.APR.2016 19:49:18

Middle channel



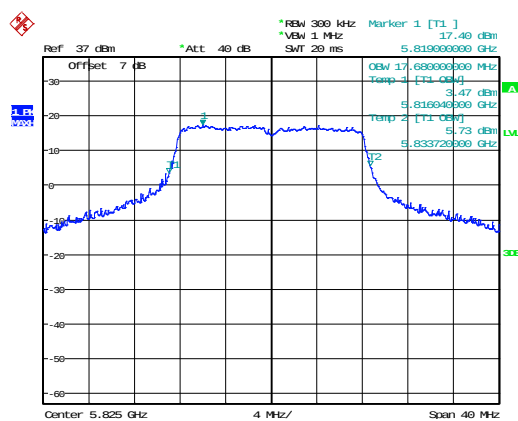
Date: 30.MAR.2016 19:12:37

Lowest channel



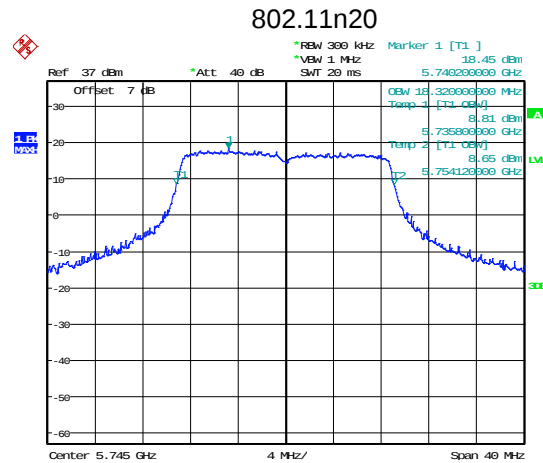
Date: 30.MAR.2016 19:12:55

Middle channel



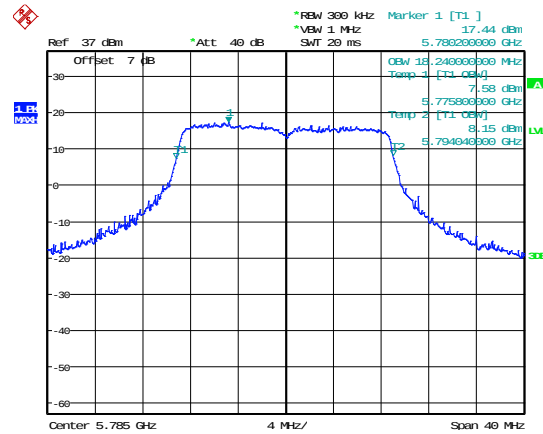
Date: 30.MAR.2016 19:13:17

Highest channel



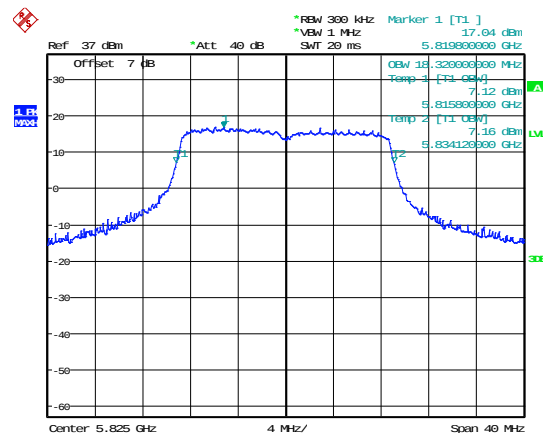
Date: 30.MAR.2016 19:13:59

Lowest channel



Date: 30.MAR.2016 19:14:10

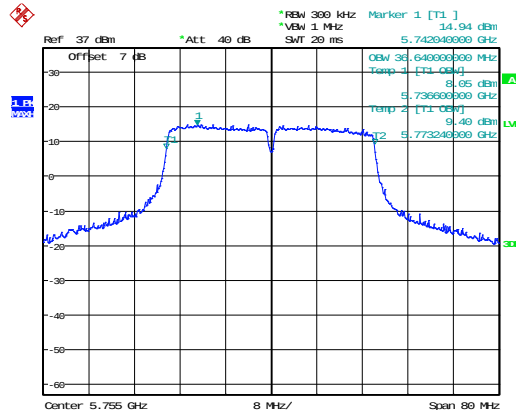
Middle channel



Date: 30.MAR.2016 19:14:31

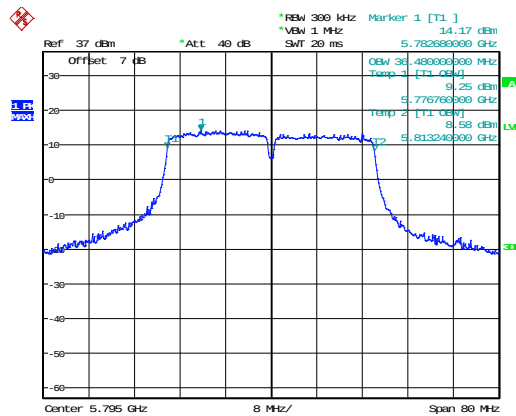
Highest channel

802.11n40



Date: 30.MAR.2016 19:15:14

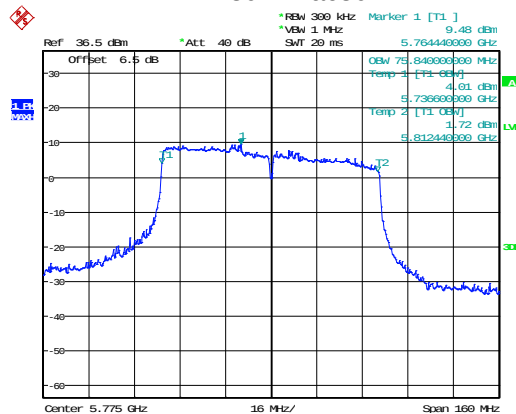
Lowest channel



Date: 30.MAR.2016 19:15:37

Highest channel

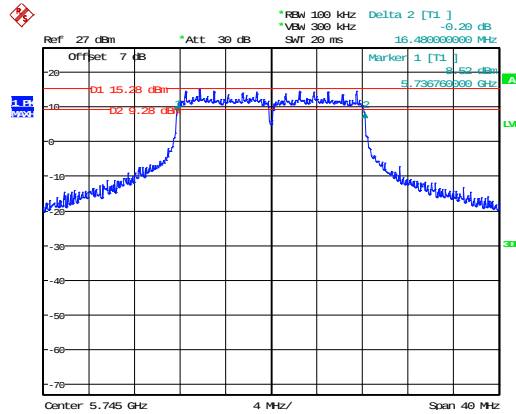
802.11ac80



Date: 15.APR.2016 19:49:30

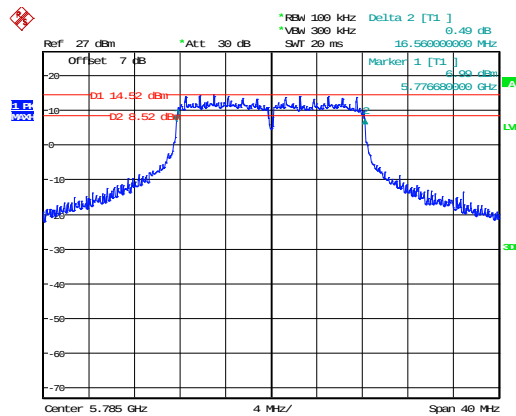
Middle channel

6 dB BW - 802.11a



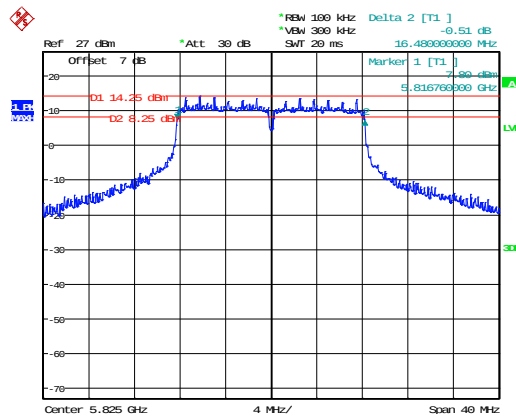
Date: 30.MAR.2016 19:20:26

Lowest channel



Date: 30.MAR.2016 19:22:19

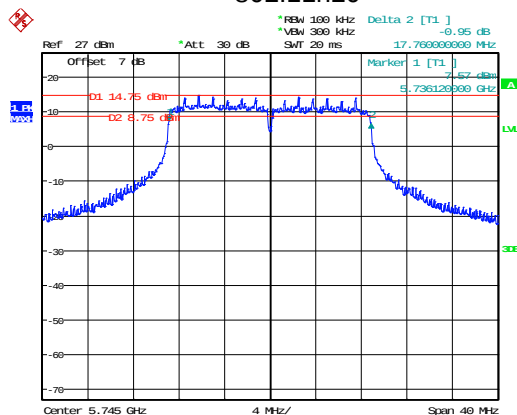
Middle channel



Date: 30.MAR.2016 19:23:36

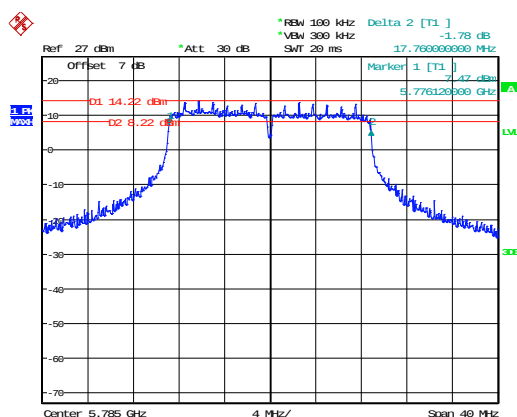
Highest channel

802.11n20



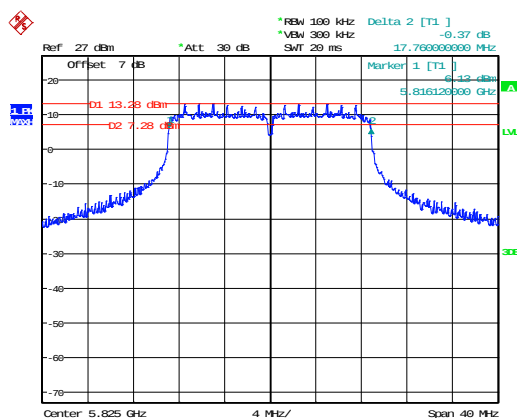
Date: 30.MAR.2016 19:25:51

Lowest channel



Date: 30.MAR.2016 19:26:47

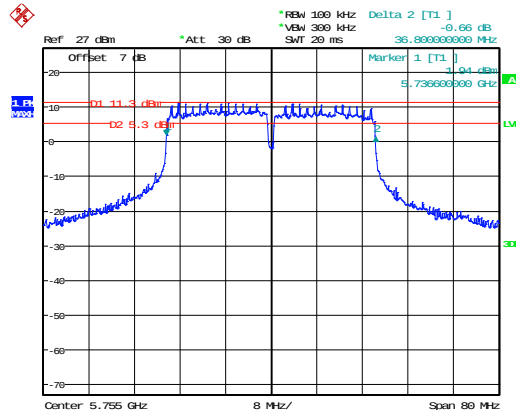
Middle channel



Date: 30.MAR.2016 19:27:55

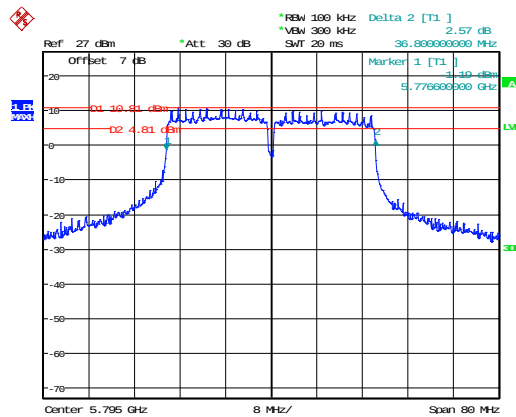
Highest channel

802.11n40



Date: 30.MAR.2016 19:29:08

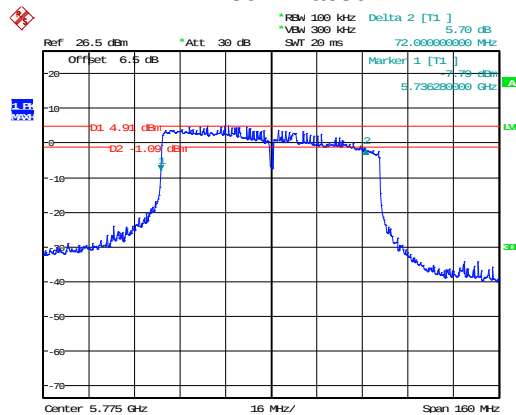
Lowest channel



Date: 30.MAR.2016 19:30:13

Highest channel

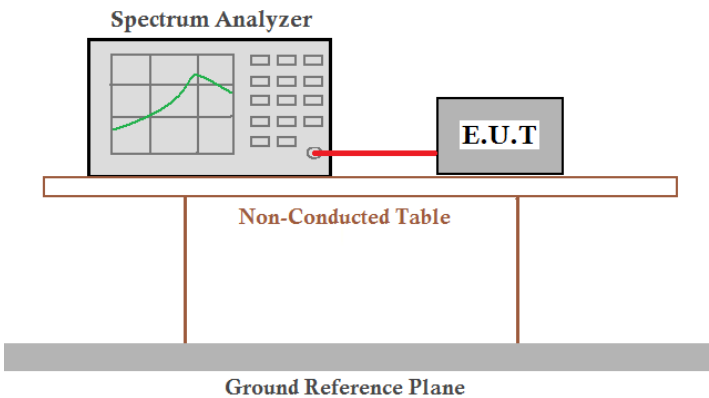
802.11ac80



Date: 15.APR.2016 19:52:32

Middle channel

6.5 Power Spectral Density

Test Requirement:	FCC Part15 E Section 15.407 (a) (1) (ii) &(a) (3)
Test Method:	ANSI C63.10:2013, KDB 789033
Limit:	Band 1: 17 dBm/MHz (For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi); Band 4: 30dBm/500kHz(For fixed point-to-point UNII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power).
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer, shown with a green trace on its screen, is connected to an E.U.T (Equipment Under Test) box by a red cable. Both the Spectrum Analyzer and the E.U.T are positioned on a 'Non-Conducted Table'. This table is supported by two vertical legs and rests on a 'Ground Reference Plane', which is represented by a thick grey horizontal bar at the bottom of the setup.
Test Instruments:	Refer to section 5.8 for details
Test mode:	Refer to section 5.3 for details
Test results:	Passed

Measurement Data:**Band 1:**

Mode	Test Channel	Ant. Port	PSD (dBm)	Total PSD (dBm)	Limit (dBm)	Result
802.11a	Lowest	TX0	13.82	16.91	17.00	Pass
		TX1	13.98			
	Middle	TX0	13.51	16.70	17.00	Pass
		TX1	13.86			
	Highest	TX0	13.26	16.53	17.00	Pass
		TX1	13.76			
802.11n 20	Lowest	TX0	13.67	16.64	17.00	Pass
		TX1	13.58			
	Middle	TX0	13.27	16.49	17.00	Pass
		TX1	13.68			
	Highest	TX0	12.86	16.23	17.00	Pass
		TX1	13.56			
802.11n 40	Lowest	TX0	9.71	12.85	17.00	Pass
		TX1	9.96			
	Highest	TX0	9.26	12.44	17.00	Pass
		TX1	9.59			
802.11ac 80	Middle	TX0	6.48	9.63	17.00	Pass
		TX1	6.75			

Band 4:

Mode	Test Channel	Ant. Port	PSD (dBm)	Total PSD (dBm)	Limit (dBm)	Result
802.11a	Lowest	TX0	19.17	23.12	30.00	Pass
		TX1	20.89			
	Middle	TX0	18.71	22.34	30.00	Pass
		TX1	19.87			
	Highest	TX0	18.62	22.40	30.00	Pass
		TX1	20.05			
802.11n 20	Lowest	TX0	18.70	22.57	30.00	Pass
		TX1	20.28			
	Middle	TX0	18.13	21.34	30.00	Pass
		TX1	18.52			
	Highest	TX0	17.47	20.84	30.00	Pass
		TX1	18.16			
802.11n 40	Lowest	TX0	15.85	18.78	30.00	Pass
		TX1	15.69			
	Highest	TX0	15.41	18.59	30.00	Pass
		TX1	15.75			
802.11ac 80	Middle	TX0	7.03	10.13	30.00	Pass
		TX1	7.21			
Remark:	For 802.11ac 80 , though set RBW to 100KHz , but add Factor=10log (500 kHz/100kHz) =7 to calculate result of 500kHz , 7+0.03=7.03; 7+0.21=7.21					