26 dB bandwidth measurements according to KDB 789033 D02 General UNII Test Procedures New Rules v02r01 Dec. 14, 2017 II.C.1. / RSS-Gen 6.7

Date	Temperature	Humidity
2019-04-03	22 °C ± 3 °C	29 % ± 5 %

Test setup and procedure

The measurements were performed according to ANSI C63.10 cl. 12.4.1/6.9.2 and KDB 789033 D02 General UNII Test Procedures New Rules v02r01 Dec. 14, 2017 II.C.1.
Conducted measurements were performed on units with the temporary antenna connectors, with transmission between 94.3% and 99.3% of duty cycle and with normal modulation.

Test set-up photos during the tests can be found in the report annex, "8P07436 - F2 photos".

Measurement equipment	RISE number
Test site Marconi	15:121
Spectrum analyser R&S FSQ 26	BX50694
Coaxial cable	BX81424
Coaxial cable	BX81436
Coaxial cable	BX50685
120 V AC/60 Hz AC Power source HP 6813B	503 091
DC power supply HP E3632A	503 170
Multimeter Fluke 85 III	503 418
Temperature and humidity meter Testo 625	503 498

Results

SISO 2 (chain 2 – 6 dBi antenna gain)		802.11ac			
T_{nom} 20°C, V_{nom} 120 V AC					
f [MHz]	BW [MHz]	EBW left [MHz]	EBW right [MHz]	EBW [MHz]	RBW [MHz]
5260	20	5244.2	5277.4	33.2	0.3
5280	20	5263.1	5297.6	34.5	0.3
5320	20	5304.9	5337.5	32.6	0.3
5500	20	5483.9	5518.0	34.1	0.3
5580	20	5562.7	5597.7	35.0	0.3
5720	20	5700.4	5737.4	37.0	0.3

SISO 2 (chain 2 – 6 dBi antenna gain)		802.11ac			
T_{nom} 20°C, V_{nom} 120 V AC					
f [MHz]	BW [MHz]	EBW left [MHz]	EBW right [MHz]	EBW [MHz]	RBW [MHz]
5270	40	5238.9	5303.0	64.1	0.5
5310	40	5281.4	5343.1	61.7	0.5
5510	40	5478.0	5548.4	70.4	0.5
5550	40	5517.2	5584.8	67.6	0.5
5710	40	5673.1	5745.4	72.2	0.5

SISO 2 (chain 2 – 6 dBi antenna gain)		802.11ac			
T_{nom} 20°C, V_{nom} 120 V AC					
f [MHz]	BW [MHz]	EBW left [MHz]	EBW right [MHz]	EBW [MHz]	RBW [MHz]
5290	80	5234.4	5357.5	123.0	1.0
5530	80	5464.1	5600.6	136.5	1.0
5610	80	5550.9	5670.0	119.1	1.0
5690	80	5621.3	5757.4	136.0	1.0

The 26 dB BW measurements can be found in the diagrams below:

Diagram 1:	5260 MHz 20 MHz BW, 26 dB EBW
Diagram 2:	5280 MHz 20 MHz BW, 26 dB EBW
Diagram 3:	5320 MHz 20 MHz BW, 26 dB EBW
Diagram 4:	5270 MHz 40 MHz BW, 26 dB EBW
Diagram 5:	5310 MHz 40 MHz BW, 26 dB EBW
Diagram 6:	5290 MHz 80 MHz BW, 26 dB EBW

Diagram 7:	5500 MHz 20 MHz BW, 26 dB EBW
Diagram 8:	5580 MHz 20 MHz BW, 26 dB EBW
Diagram 9:	5720 MHz 20 MHz BW, 26 dB EBW
Diagram 10:	5510 MHz 40 MHz BW, 26 dB EBW
Diagram 11:	5550 MHz 40 MHz BW, 26 dB EBW
Diagram 12:	5710 MHz 40 MHz BW, 26 dB EBW
Diagram 13:	5530 MHz 80 MHz BW, 26 dB EBW
Diagram 14:	5610 MHz 80 MHz BW, 26 dB EBW
Diagram 15:	5690 MHz 80 MHz BW, 26 dB EBW

Limits

No limits specified in the §15.407 or RSS-247.

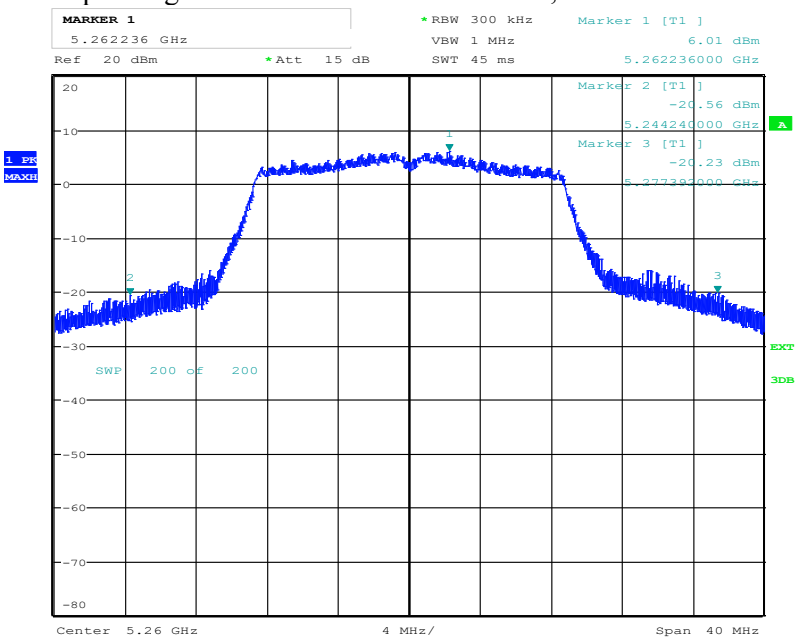
Note: There is not particular requirement, but information is needed for configuration of instruments and for assessment if operating channel is inside allowed frequency band.

Test engineer: Markel Bertilsson

Complies?	N/A

Diagram 1

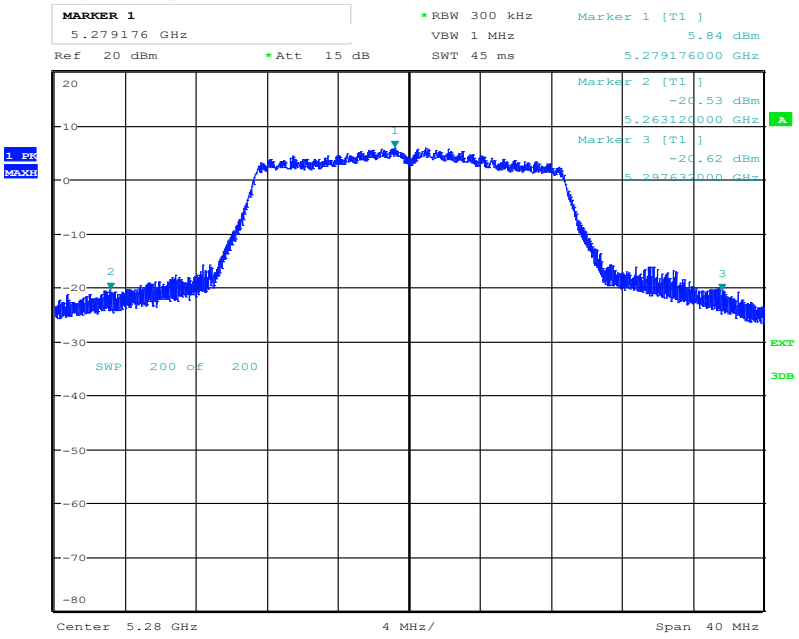
DUT operating at 5260 MHz and 20 MHz BW; 26 dB EBW



Date: 3.APR.2019 13:12:33

Diagram 2

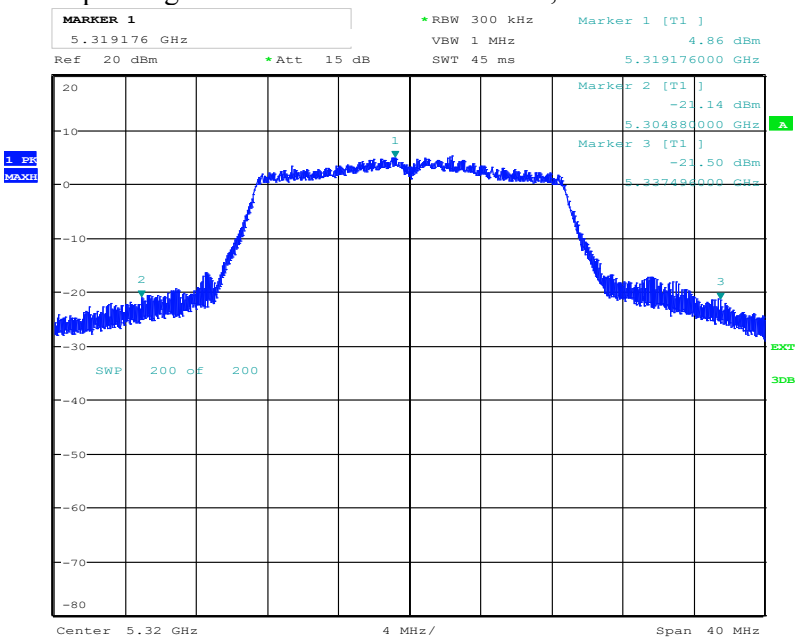
DUT operating at 5280 MHz and 20 MHz BW; 26 dB EBW



Date: 3.APR.2019 13:28:42

Diagram 3

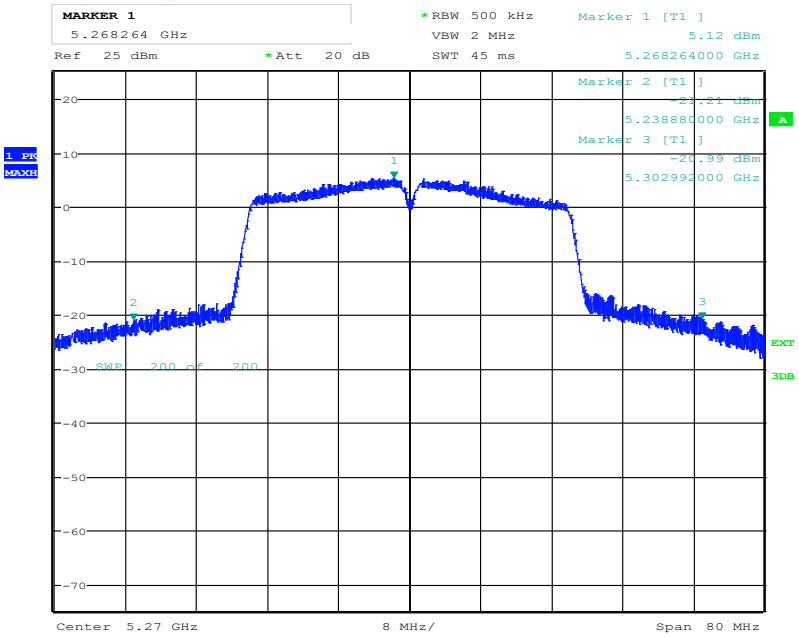
DUT operating at 5320 MHz and 20 MHz BW; 26 dB EBW



Date: 3.APR.2019 13:46:38

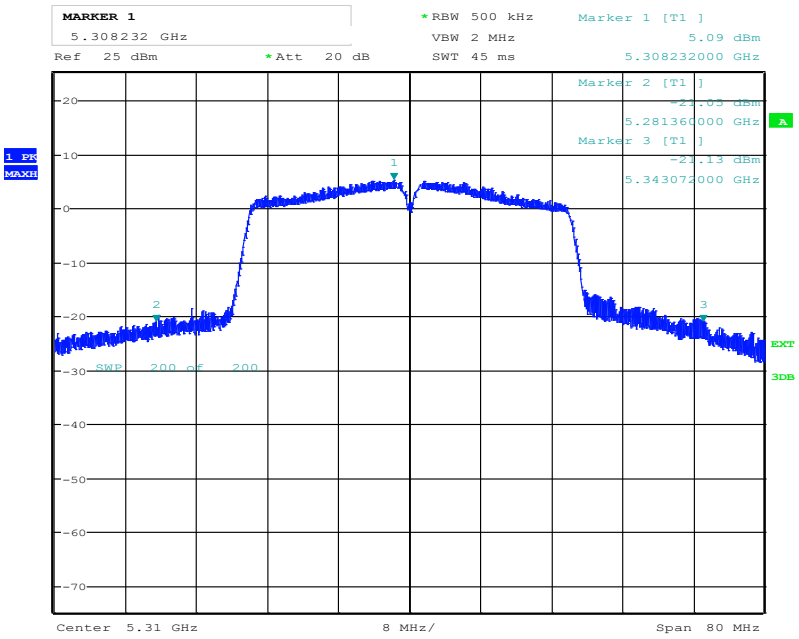
Diagram 4

DUT operating at 5270 MHz and 40 MHz BW; 26 dB EBW



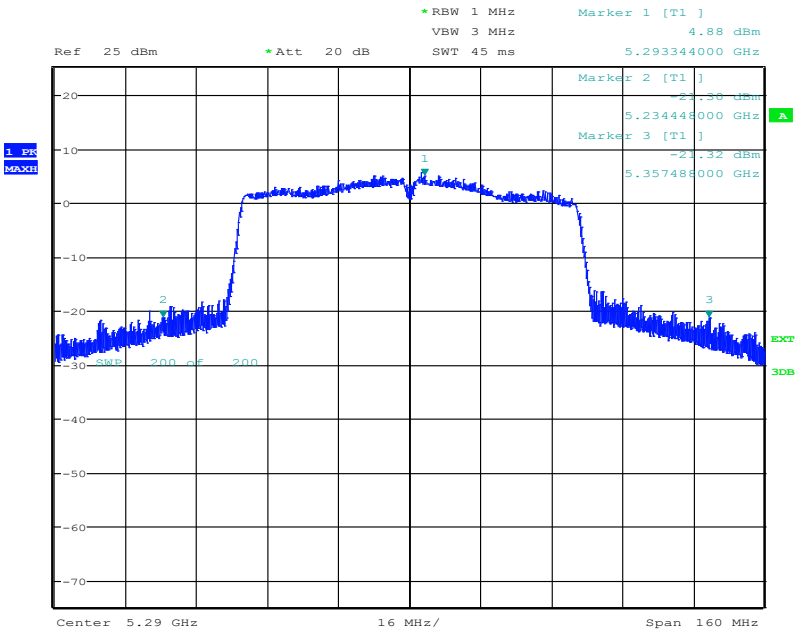
Date: 3.APR.2019 14:39:30

Diagram 5
DUT operating at 5310 MHz and 40 MHz BW; 26 dB EBW



Date: 3.APR.2019 15:04:41

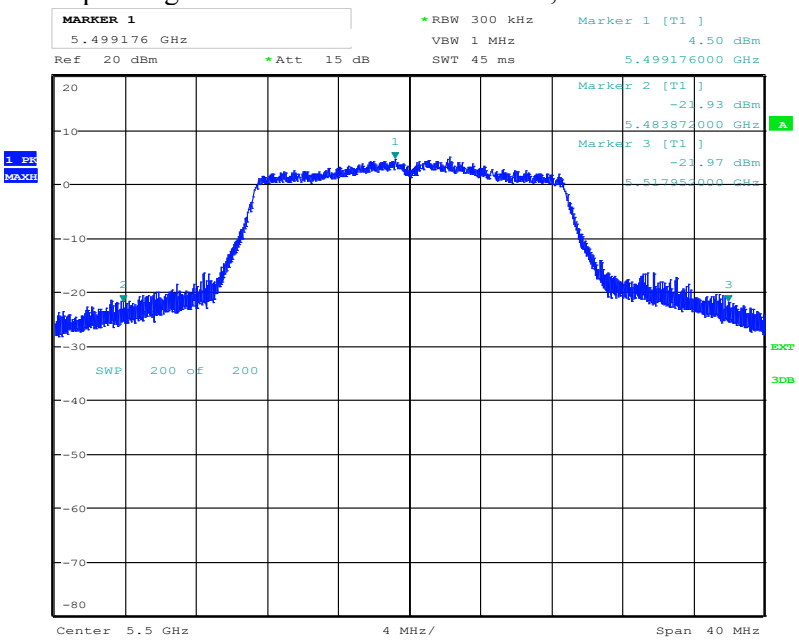
Diagram 6
DUT operating at 5290 MHz and 80 MHz BW; 26 dB EBW



Date: 3.APR.2019 15:35:52

Diagram 7

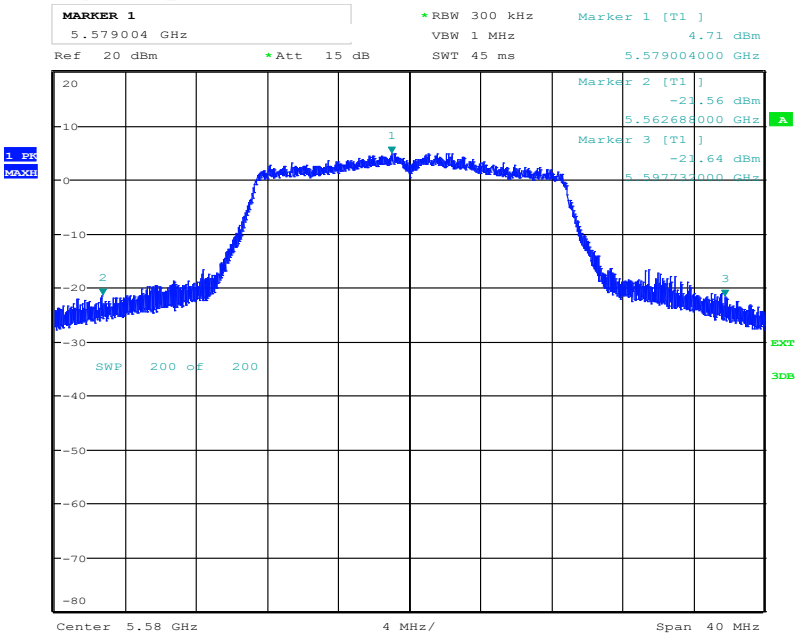
DUT operating at 5500 MHz and 20 MHz BW; 26 dB EBW



Date: 3.APR.2019 13:58:04

Diagram 8

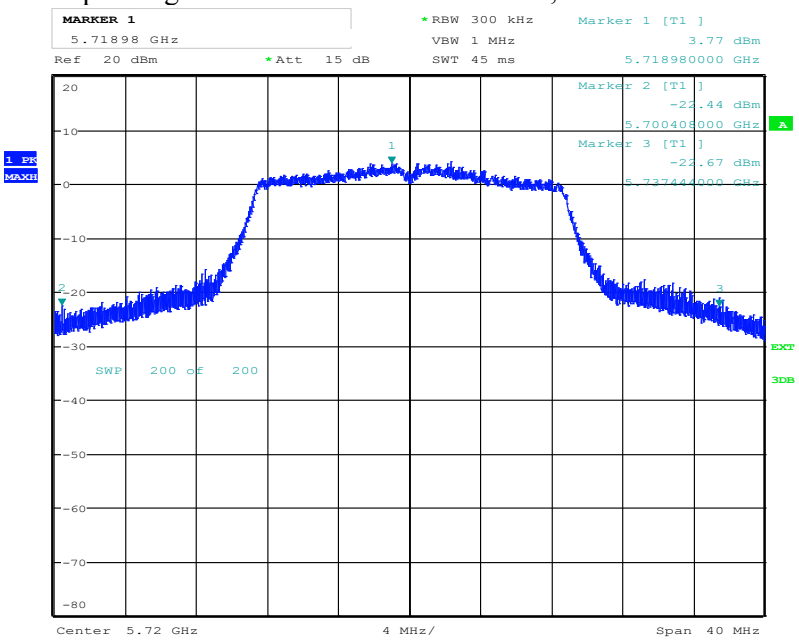
DUT operating at 5580 MHz and 20 MHz BW; 26 dB EBW



Date: 3.APR.2019 14:06:29

Diagram 9

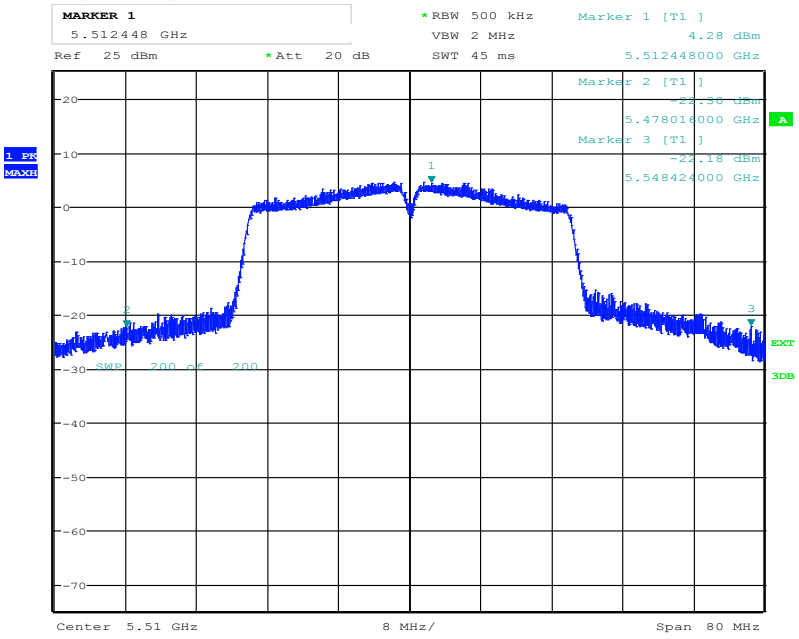
DUT operating at 5720 MHz and 20 MHz BW; 26 dB EBW



Date: 3.APR.2019 14:13:20

Diagram 10

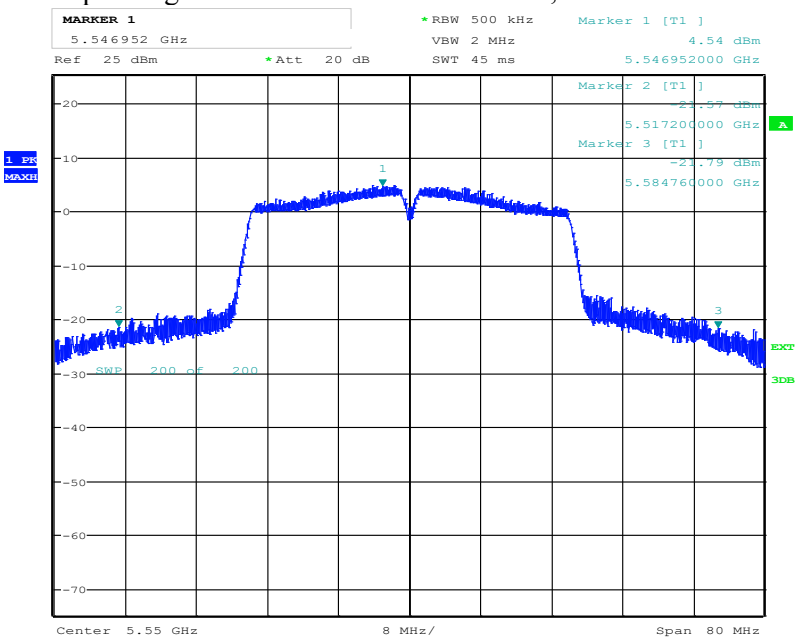
DUT operating at 5510 MHz and 40 MHz BW; 26 dB EBW



Date: 3.APR.2019 15:10:30

Diagram 11

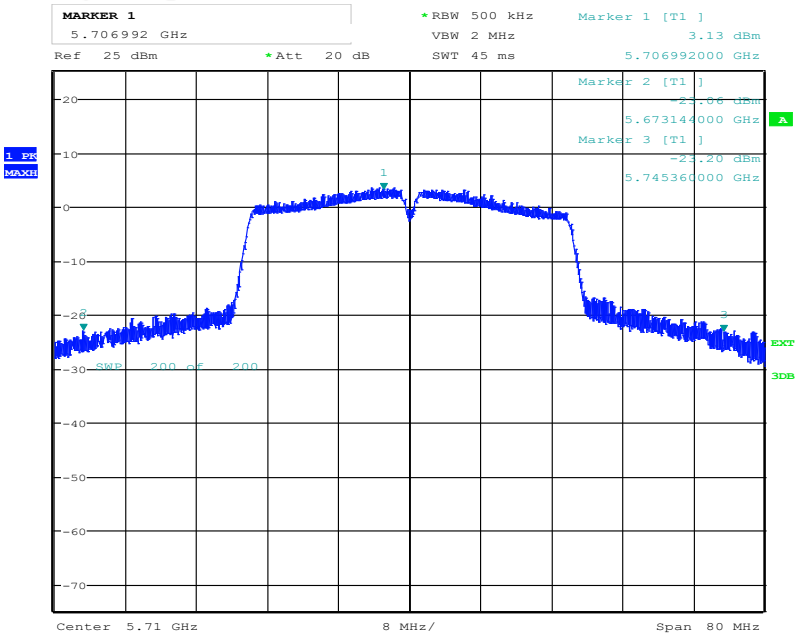
DUT operating at 5550 MHz and 40 MHz BW; 26 dB EBW



Date: 3.APR.2019 15:16:57

Diagram 12

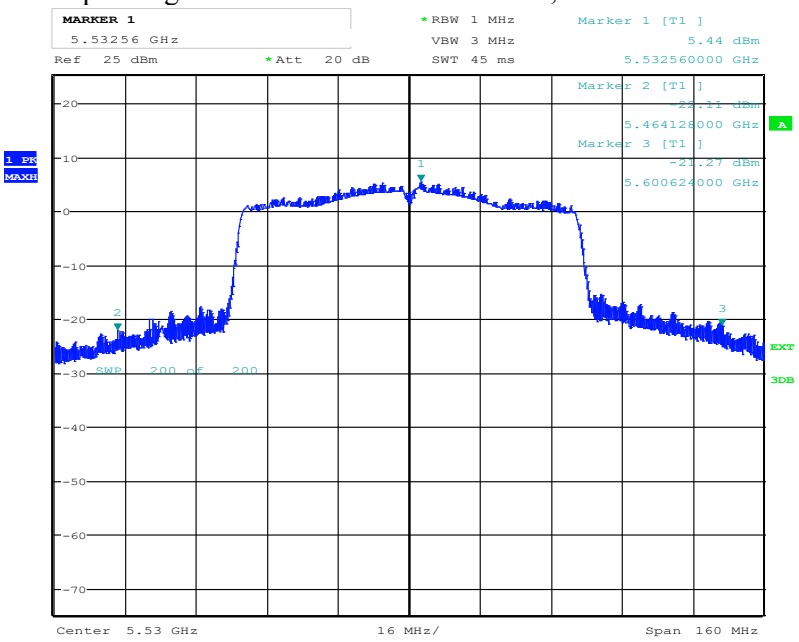
DUT operating at 5710 MHz and 40 MHz BW; 26 dB EBW



Date: 3.APR.2019 15:29:18

Diagram 13

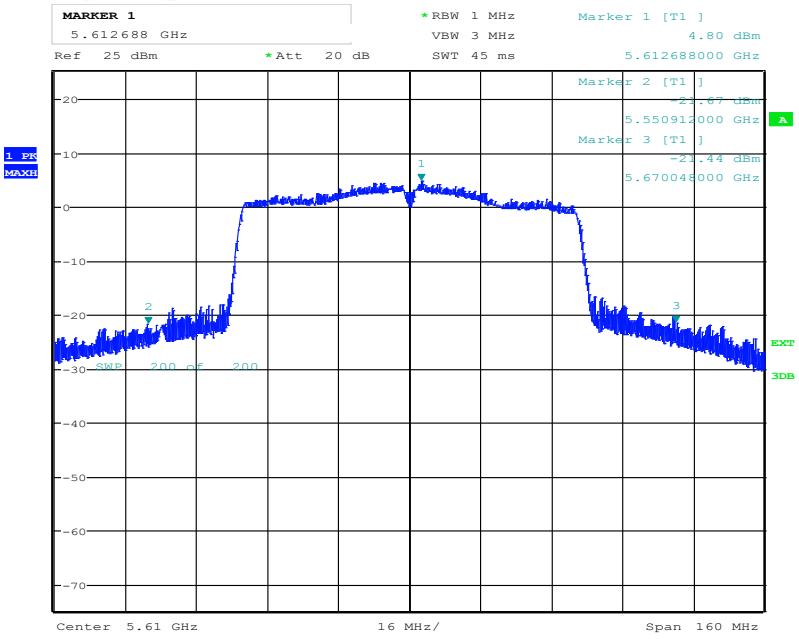
DUT operating at 5530 MHz and 80 MHz BW; 26 dB EBW



Date: 3.APR.2019 15:51:39

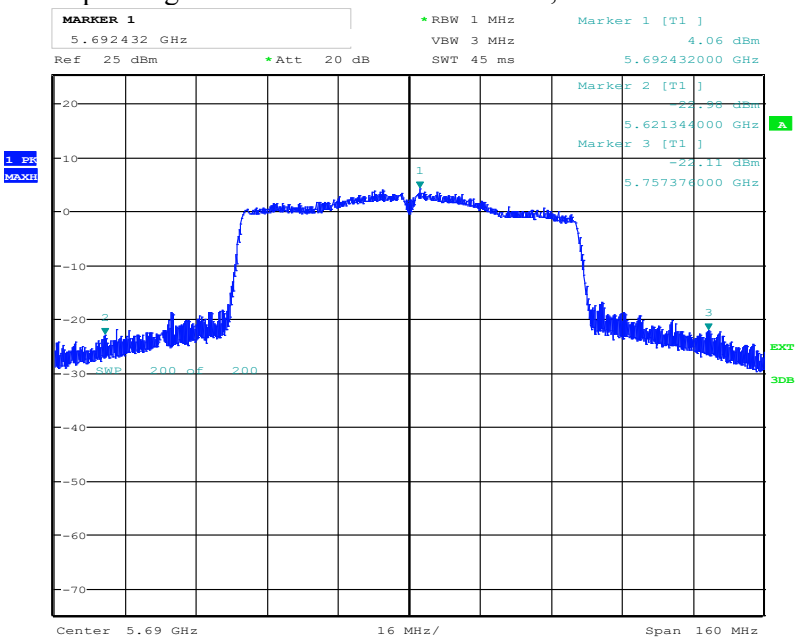
Diagram 14

DUT operating at 5610 MHz and 80 MHz BW; 26 dB EBW



Date: 3.APR.2019 15:57:23

Diagram 15
DUT operating at 5690 MHz and 80 MHz BW; 26 dB EBW



Date: 3.APR.2019 16:07:58

99% occupied bandwidth - OBW measurements according to 47CFR 2.1049/RSS-Gen 6.7

Date	Temperature	Humidity
2019-04-04	22 °C ± 3 °C	29 % ± 5 %

Test setup and procedure

The measurements were performed according to ANSI C63.10, clause 12.4.2/6.9.3 and KDB 789033 D02 General UNII Test Procedures New Rules v02r01 Dec. 14, 2017 II.D

Conducted measurements were performed on units with the temporary antenna connectors, with transmission between 94.3% and 99.3% of duty cycle and with normal modulation.

The test was performed with max peak detector.

Test set-up photos during the tests can be found in the report annex, "8P07436 - F2 photos".

Measurement equipment	RISE number
Test site Marconi	15:121
Spectrum analyser R&S FSQ 26	BX50694
Coaxial cable	BX81424
Coaxial cable	BX81436
Coaxial cable	BX50685
120 V AC/60 Hz AC Power source HP 6813B	503 091
DC power supply HP E3632A	503 170
Multimeter Fluke 85 III	503 418
Temperature and humidity meter Testo 625	503 498

Results

SISO 2 (chain 2 – 6 dBi antenna gain)		802.11ac			
T_{nom} 20°C, V_{nom} 120 V AC					
f [MHz]	BW [MHz]	OBW left [MHz]	OBW right [MHz]	OBW [MHz]	RBW [MHz]
5260	20	5251.0	5269.0	18.0	0.2
5280	20	5270.9	5289.1	18.3	0.2
5320	20	5311.0	5329.0	18.0	0.2
5500	20	5491.0	5509.0	18.0	0.2
5580	20	5571.0	5589.0	18.1	0.2
5720	20	5710.9	5729.1	18.2	0.2

SISO 2 (chain 2 – 6 dBi antenna gain)		802.11ac			
T_{nom} 20°C, V_{nom} 120 V AC					
f [MHz]	BW [MHz]	OBW left [MHz]	OBW right [MHz]	OBW [MHz]	RBW [MHz]
5270	40	5251.7	5288.3	36.5	0.5
5310	40	5291.7	5328.3	36.5	0.5
5510	40	5491.8	5528.4	36.6	0.5
5550	40	5531.7	5568.3	36.7	0.5
5710	40	5691.5	5728.6	37.1	0.5

SISO 2 (chain 2 – 6 dBi antenna gain)		802.11ac			
T_{nom} 20°C, V_{nom} 120 V AC					
f [MHz]	BW [MHz]	OBW left [MHz]	OBW right [MHz]	OBW [MHz]	RBW [MHz]
5290	80	5252.0	5327.9	76.0	1.0
5530	80	5492.0	5568.0	76.0	1.0
5610	80	5572.0	5647.9	75.9	1.0
5690	80	5651.9	5728.1	76.2	1.0

The 99% OBW measurements can be found in the diagrams below:

Diagram 1:	5260 MHz 20 MHz BW, 99% OBW
Diagram 2:	5280 MHz 20 MHz BW, 99% OBW
Diagram 3:	5320 MHz 20 MHz BW, 99% OBW
Diagram 4:	5270 MHz 40 MHz BW, 99% OBW
Diagram 5:	5310 MHz 40 MHz BW, 99% OBW
Diagram 6:	5290 MHz 80 MHz BW, 99% OBW

Diagram 7:	5500 MHz 20 MHz BW, 99% OBW
Diagram 8:	5580 MHz 20 MHz BW, 99% OBW
Diagram 9:	5720 MHz 20 MHz BW, 99% OBW
Diagram 10:	5510 MHz 40 MHz BW, 99% OBW
Diagram 11:	5550 MHz 40 MHz BW, 99% OBW
Diagram 12:	5710 MHz 40 MHz BW, 99% OBW
Diagram 13:	5530 MHz 80 MHz BW, 99% OBW
Diagram 14:	5610 MHz 80 MHz BW, 99% OBW
Diagram 15:	5690 MHz 80 MHz BW, 99% OBW

Limits

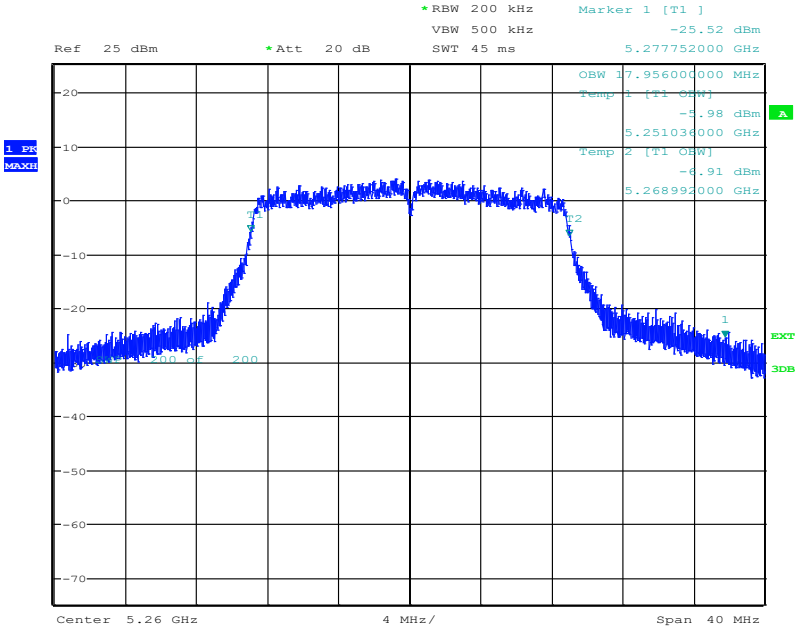
No limits specified in the §15.407.
No limits specified in RSS-247.

Test engineer: Markel Bertilsson

Complies?	Yes

Diagram 1

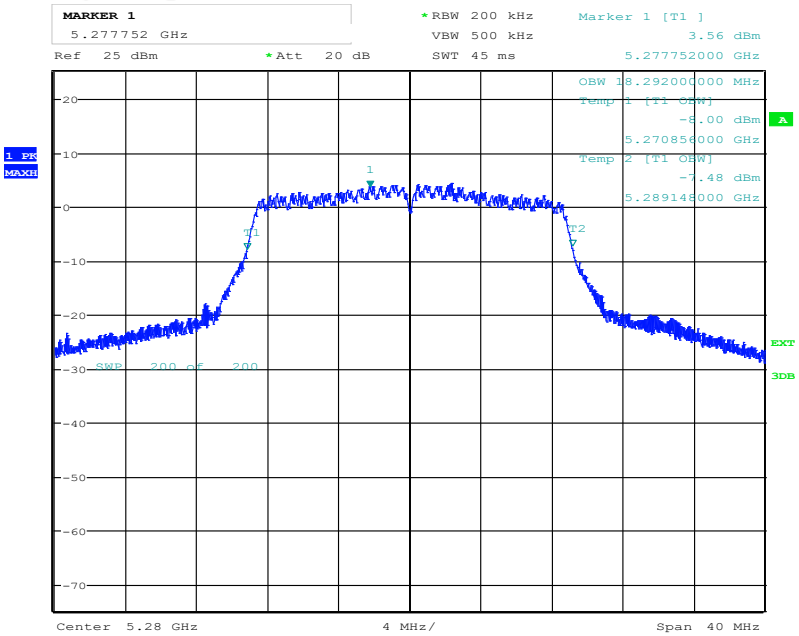
DUT operating at 5260 MHz and 20 MHz BW; 99% OBW



Date: 4.APR.2019 11:15:17

Diagram 2

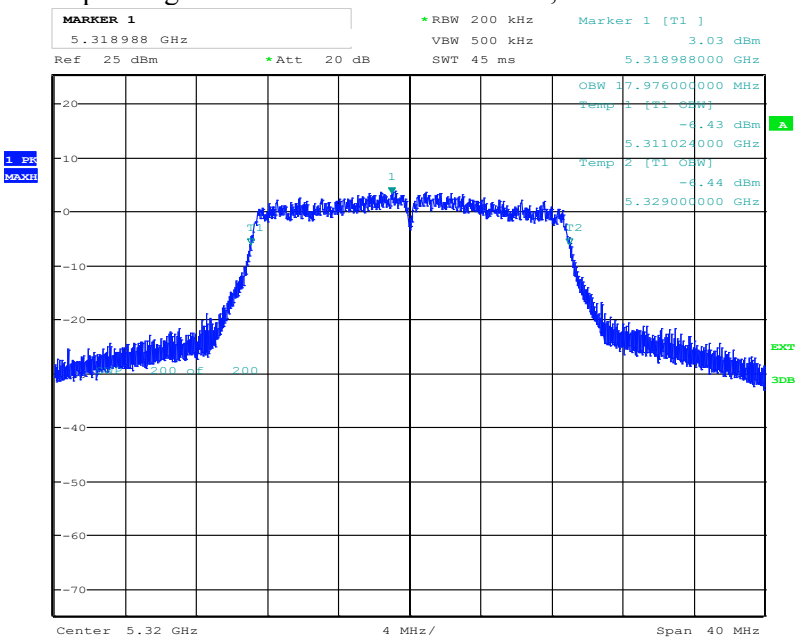
DUT operating at 5280 MHz and 20 MHz BW; 99% OBW



Date: 4.APR.2019 11:13:32

Diagram 3

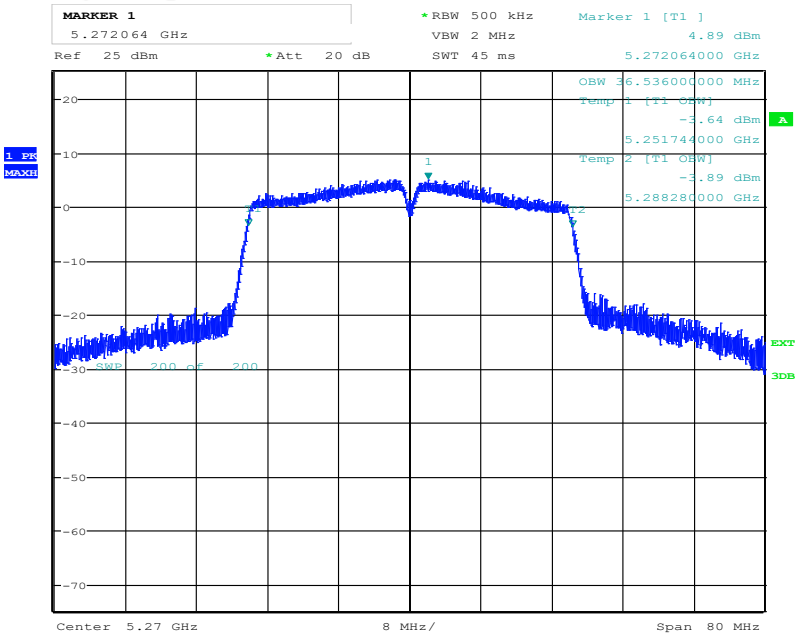
DUT operating at 5320 MHz and 20 MHz BW; 99% OBW



Date: 4.APR.2019 10:25:49

Diagram 4

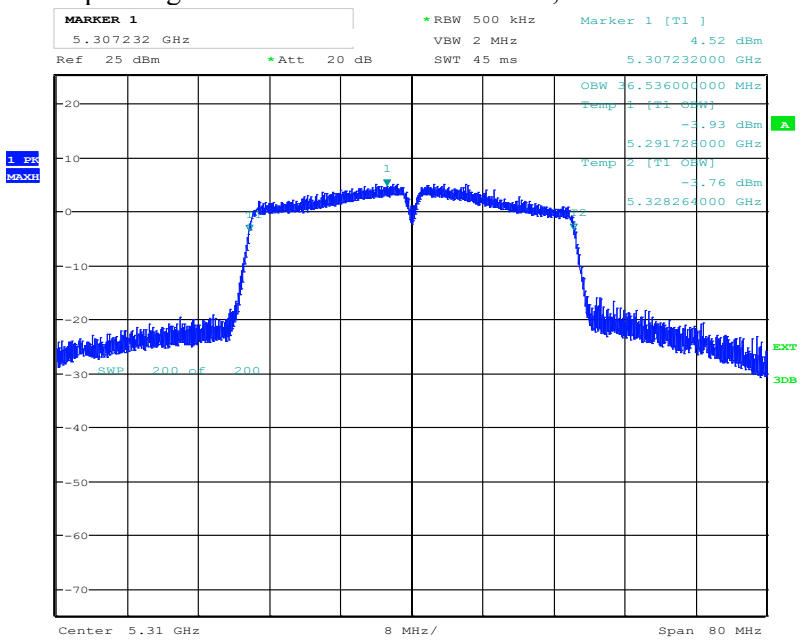
DUT operating at 5270 MHz and 40 MHz BW; 99% OBW



Date: 4.APR.2019 10:16:27

Diagram 5

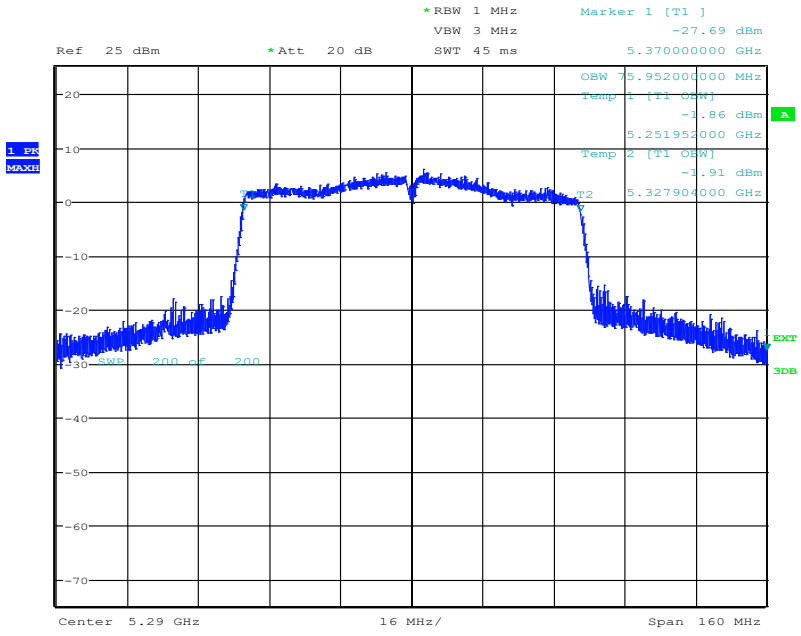
DUT operating at 5310 MHz and 40 MHz BW; 99% OBW



Date: 4.APR.2019 10:14:36

Diagram 6

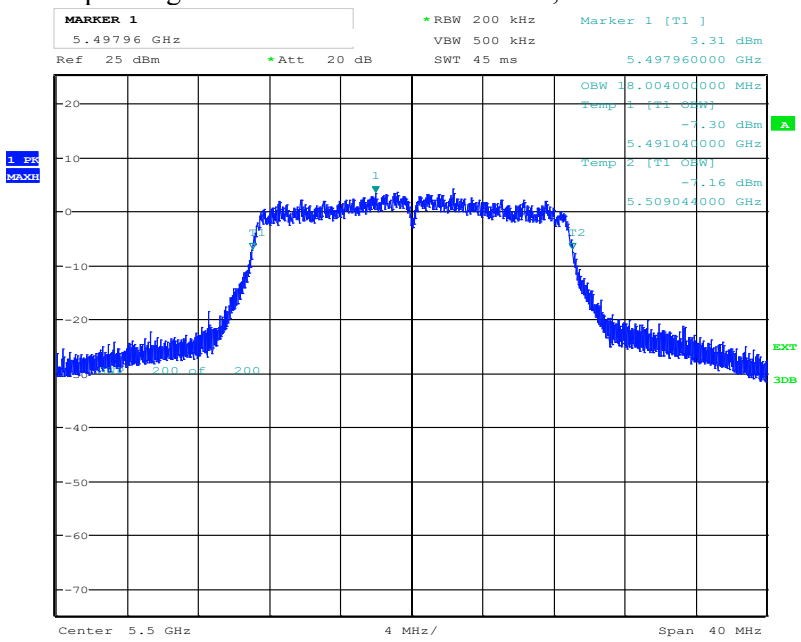
DUT operating at 5290 MHz and 80 MHz BW; 99% OBW



Date: 4.APR.2019 09:19:20

Diagram 7

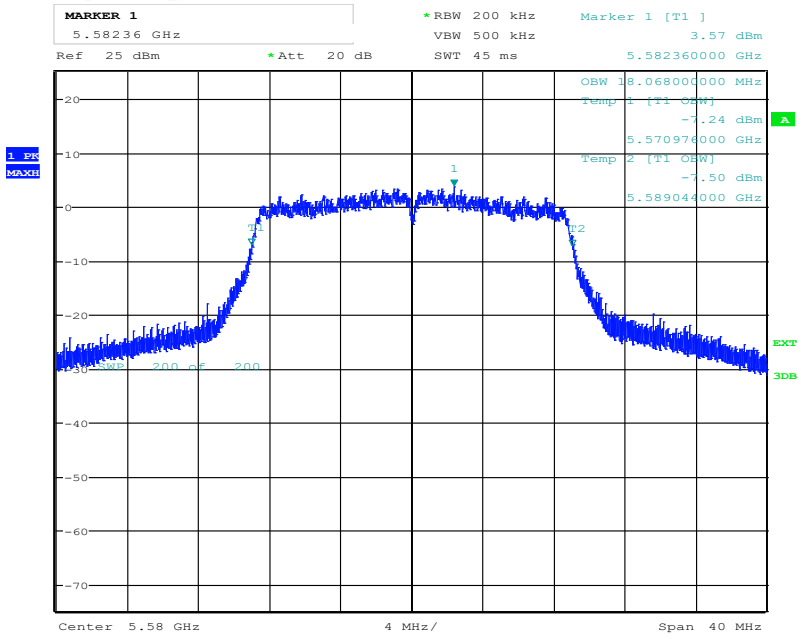
DUT operating at 5500 MHz and 20 MHz BW; 99% OBW



Date: 4.APR.2019 10:23:46

Diagram 8

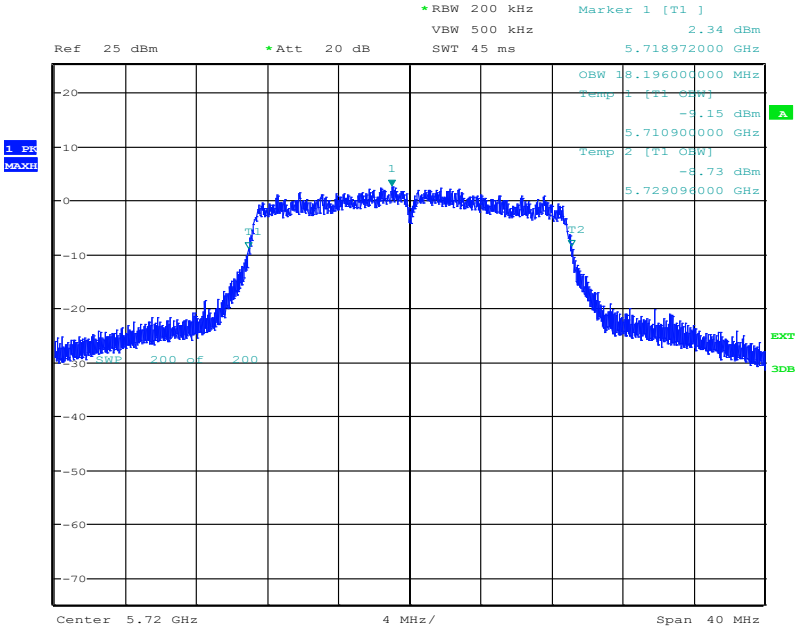
DUT operating at 5580 MHz and 20 MHz BW; 99% OBW



Date: 4.APR.2019 10:21:40

Diagram 9

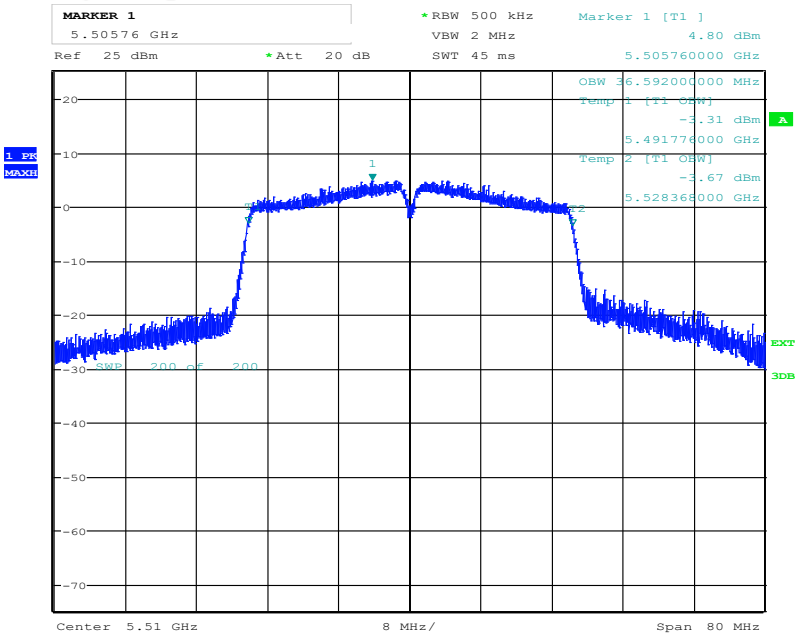
DUT operating at 5720 MHz and 20 MHz BW; 99% OBW



Date: 4.APR.2019 10:19:19

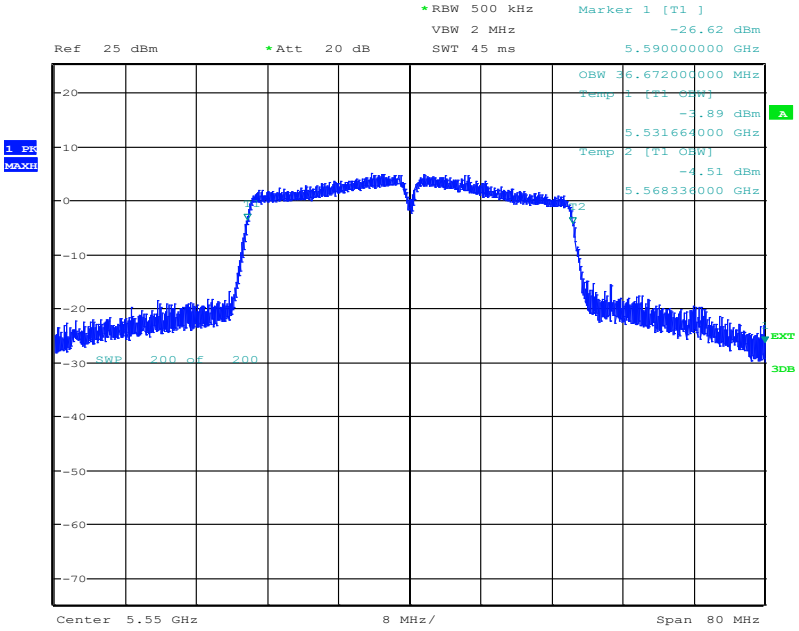
Diagram 10

DUT operating at 5510 MHz and 40 MHz BW; 99% OBW



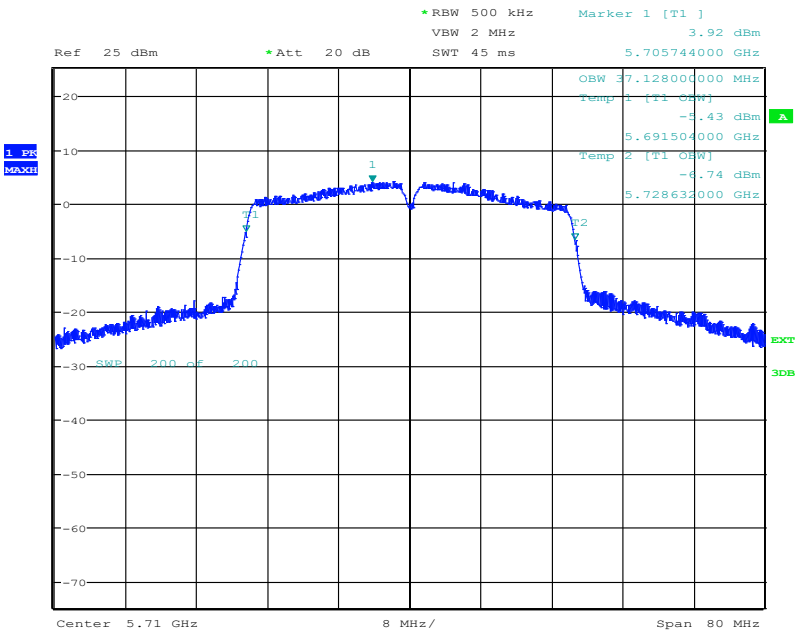
Date: 4.APR.2019 10:12:53

Diagram 11
DUT operating at 5550 MHz and 40 MHz BW; 99% OBW



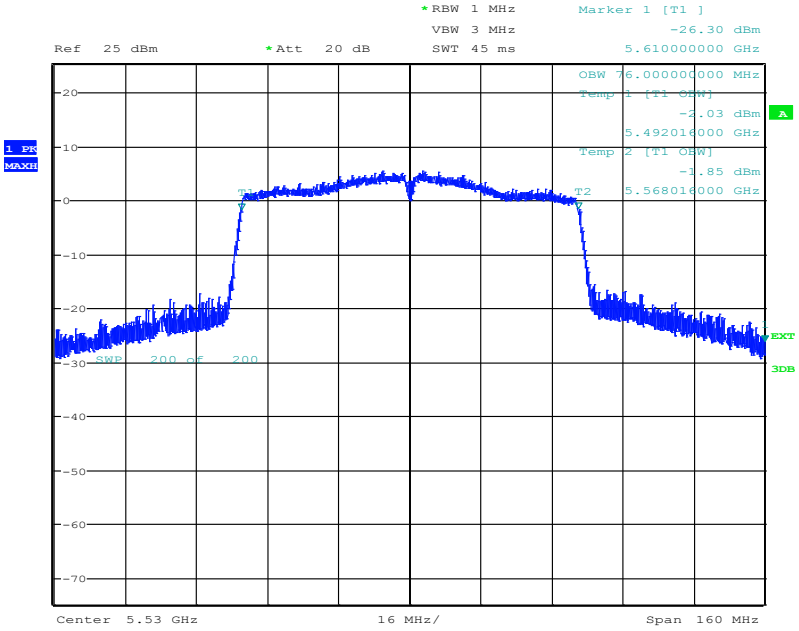
Date: 4.APR.2019 10:10:53

Diagram 12
DUT operating at 5710 MHz and 40 MHz BW; 99% OBW



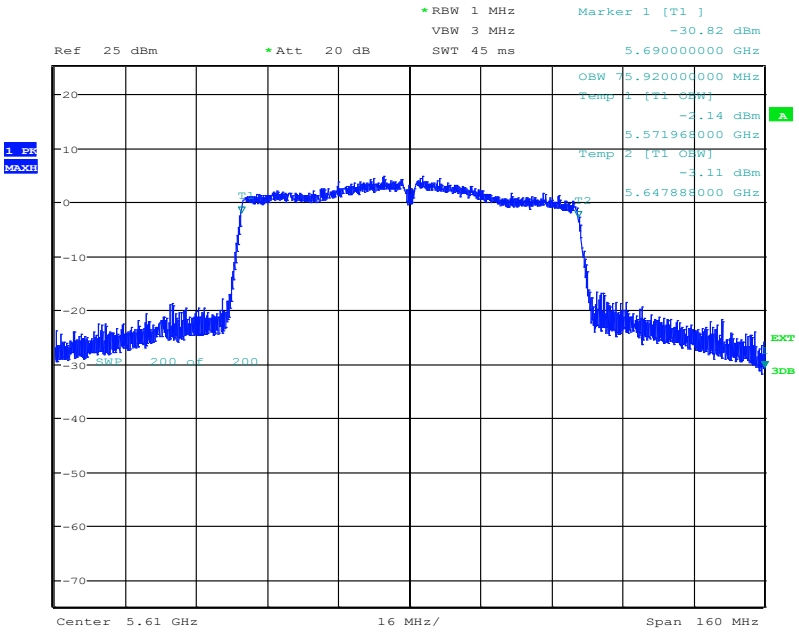
Date: 4.APR.2019 10:08:37

Diagram 13
DUT operating at 5530 MHz and 80 MHz BW; 99% OBW



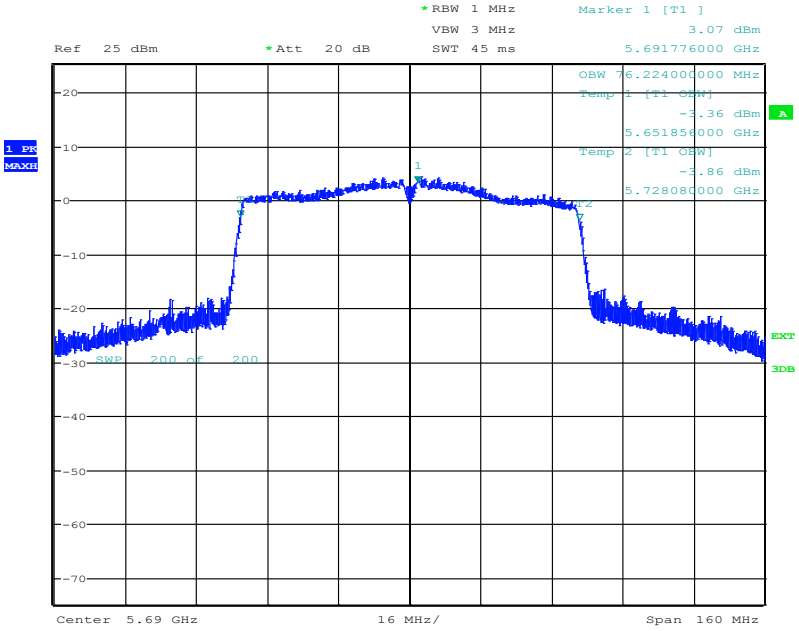
Date: 4.APR.2019 09:16:20

Diagram 14
DUT operating at 5610 MHz and 80 MHz BW; 99% OBW



Date: 4.APR.2019 09:13:41

Diagram 15
DUT operating at 5690 MHz and 80 MHz BW; 99% OBW



Date: 4.APR.2019 09:02:01

Band edge measurements according to 47CFR 2.1049 / RSS-247 6.2.2.2 and RSS-247 6.2.3.2

Date	Temperature	Humidity
2018-10-19	22 °C ± 3 °C	34 % ± 5 %
2018-10-20	21 °C ± 3 °C	31 % ± 5 %
2019-03-17	22 °C ± 3 °C	28 % ± 5 %
2019-04-01	22 °C ± 3 °C	32 % ± 5 %

Test setup and procedure

The measurements were performed according to ANSI C63.10-2013, clause 12.7.4.4. and KDB 789033 D02 General UNII Test Procedures New Rules v02r01 Dec. 14, 2017 II.G.3.d.(ii), II.G.5, II.G.6, III.B.2.a(ii), III.B.2.b(i) and III.B.2.b(iii).

Radiated measurements were performed on units with the integrated antennas with transmission between 94.3% and 99.3% of duty cycle and with normal modulation. The presented results of peak and average power in the table below are measured results with applied correction for duty cycle. The results in the diagrams are not corrected for duty cycle.

Test set-up photos during the tests can be found in the report annex, "8P07436 - F2 photos".

Measurement equipment	RISE number
Semi anechoic chamber, Edison	504114
Computer Lenovo ThinkCentre	-
Software R&S EMC32, ver.9.15.00	503889
EMI test receiver R&S ESU 26	902210
Antenna ETS-Lindgren 3115	902175
Step attenuator Narda743-60	BX41644
Coaxial cable	BX50672
Coaxial cable	504102
Coaxial cable	504103
Coaxial cable	504104
Multimeter Fluke 83	501522
Temperature and humidity meter Testo 625	504117

Results

Operation band:
5250-5350 MHz
5470-5725 MHz

Applicable restricted bands:
4500 – 5150 MHz
5350 – 5460 MHz
7250 - 7750 MHz

Operation band 5250-5350 MHz, low edge:
Test of emission at edge 5150 MHz is not done for device operating in 5250-5350 MHz band because the emission is expected to be no higher than emission level at this edge from device operating in the band 5150-5250 MHz which was verified and reported in the report Equipment Authorization measurement on 5150-5250 MHz RLAN as compliant.

Operation band 5250-5350 MHz

MIMO		802.11ac					
T_{nom} 20°C V_{nom} 120 V AC		5350 MHz - edge					
f [MHz]	BW [MHz]	Peak [dBm]	Peak Limit [dBm]	Peak Margin [dB]	CAV [dBm]	CAV Limit [dBm]	CAV Margin [dB]
Ch 64, 5320 MHz; 10 dBm/p10	20	-27.1	-21.2	5.9	-56.1	-41.2	14.9
Ch 62, 5310 MHz; 9 dBm/p9	40	-26.1	-21.2	4.9	-55.5	-41.2	14.3
Ch 58, 5290 MHz; 9 dBm/p9	80	-24.5	-21.2	3.1	-51.8	-41.2	10.6

Operation band 5470-5725 MHz

MIMO		802.11ac					
T_{nom} 20°C V_{nom} 120 V AC		5470 MHz - edge			5460 MHz - edge		
f [MHz]	BW [MHz]	Peak [dBm]	Peak Limit [dBm]	Peak Margin [dB]	CAV [dBm]	CAV Limit [dBm]	CAV Margin [dB]
Ch 100, 5500 MHz; 6 dBm/p6	20	-28.7	-27.0	1.7	-47.5	-41.2	6.3
Ch 102, 5510 MHz; 4 dBm/p4	40	-30.5	-27.0	3.5	-43.0	-41.2	1.8
Ch 106, 5530 MHz; 5 dBm/p5	80	-31.5	-27.0	4.5	-51.3	-41.2	10.1

Operation band 5470-5725 MHz

MIMO			802.11ac	
T_{nom} 20°C V_{nom} 120 V AC		5850 MHz - edge		
f [MHz]	BW [MHz]	Peak [dBm]	Peak Limit [dBm]	Peak Margin [dB]
Ch 144, 5720 MHz; 13 dBm/p13	20	-38.1	-27.0	11.1
Ch 142, 5710 MHz; 13 dBm/p13	40	-36.5	-27.0	9.5
Ch 138, 5690 MHz; 13 dBm/p13	80	-34.8	-27.0	7.8

In the restricted bands peak limit is 20 dB higher than CAV limit.
The limit of -27 dBm/MHz according KDB 789033 D02 General UNII Test Procedures New Rules v02r01 Dec. 14, 2017 III.B.2.a)(i) at the edge 5350 MHz and just over is not applicable due to the restricted band.

Outside restricted bands, peak limit of -27 dBm is applied.

Note: Peak and CAV values in the upper table are corrected for duty cycle according following table:

Operating frequency, f and bandwidth, BW	Duty cycle [%]	Correction [dB]
5290 MHz, 80 MHz	94.3	0.26
5310 MHz, 40 MHz	97.1	0.13
5320 MHz, 20 MHz	98.5	0.06
5500 MHz, 20 MHz	99.3	0.03
5510 MHz, 40 MHz	97.1	0.13
5530 MHz, 80 MHz	94.3	0.26
5690 MHz, 80 MHz	94.3	0.26
5710 MHz, 40 MHz	97.1	0.13
5720 MHz, 20 MHz	99.3	0.03

The band edge measurements can be found in the diagrams below:

Diagram 1:	Ch 64, 5320 MHz 20 MHz BW, 10 dBm/p10, 5350 MHz-Band edge
Diagram 2:	Ch 62, 5310 MHz 40 MHz BW, 9 dBm/p9, 5350 MHz-Band edge
Diagram 3:	Ch 58, 5290 MHz 80 MHz BW, 9 dBm/p9, 5350 MHz-Band edge
Diagram 4:	Ch 100, 5500 MHz 20 MHz BW, 6 dBm/p6, 5470 MHz-Band edge
Diagram 5:	Ch 102, 5510 MHz 40 MHz BW, 4 dBm/p4, 5470 MHz-Band edge
Diagram 6:	Ch 106, 5530 MHz 80 MHz BW, 5 dBm/p5, 5470 MHz-Band edge
Diagram 7:	Ch 144, 5720 MHz 20 MHz BW, 13 dBm/p13, 5850 MHz-Band edge
Diagram 8:	Ch 142, 5710 MHz 40 MHz BW, 13 dBm/p13, 5850 MHz-Band edge
Diagram 9:	Ch 138, 5690 MHz 80 MHz BW, 13 dBm/p13, 5850 MHz-Band edge

Note: The results in the diagrams are not corrected for duty cycle. The highest level after correction for duty cycle can be seen in the tables on the top of this chapter: Band edge.

Limits

According to 47CFR 15.407(b), e.i.r.p. of the emission produced by the intentional radiator shall be below -27 dBm outside the frequency band in which the 5 GHz WiFi radiator is operating for frequencies over 1 GHz and except restricted bands defined in §15.205 as shown in paragraph 15.407(b)(7).
Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits based on the field strength, specified in Section 15.209(a).

According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01 Dec. 14, 2017 III.B.2.a) (ii) for devices operating in the 5.25-5.25 GHz band, the -27 dBm/MHz peak EIRP limit applies outside of the lower pair of U-NII bands. i.e., 5.15-5.35.

According to RSS-247 6.2.2.2 for transmitters with operating frequencies in the band 5250-5350 MHz, all emissions outside the band 5250-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. All emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. and its power shall comply with the power spectral density requirement for operation within the band 5150-5250 MHz.

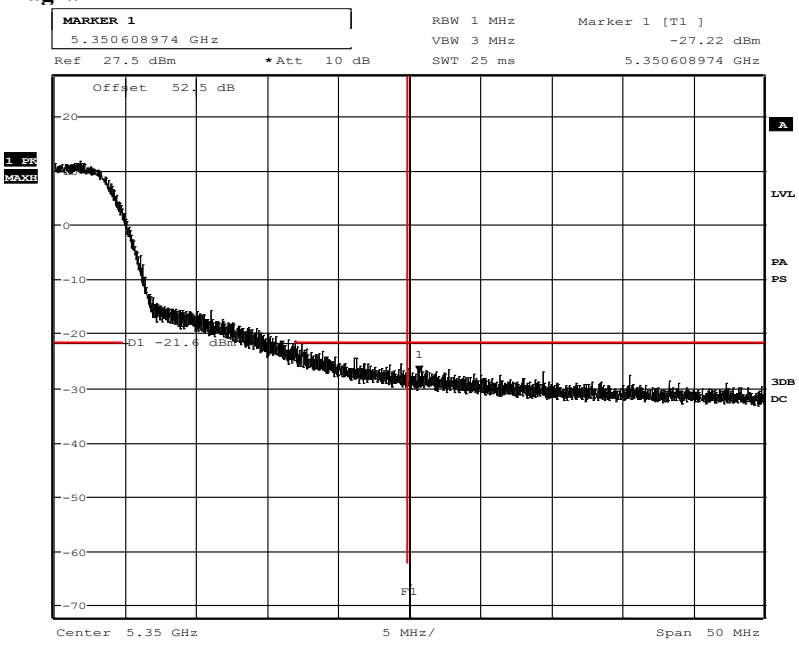
According to RSS-247 6.2.3.2 for transmitters with operating frequencies in the band 5470-5725 MHz, all emissions outside the band 5470-5725 MHz shall not exceed -27 dBm/MHz e.i.r.p. However, devices with bandwidth overlapping the band edge of 5725 MHz can meet the emission limit of -27 dBm/MHz e.i.r.p. at 5850 MHz instead of 5725 MHz.

Radiated emissions that fall in the restricted bands specified in RSS-Gen 8.10 shall comply with field strength limits shown in table 5 in RSS-Gen 8.9.

Test engineer: Ermin Pasalic and Markel Bertilsson

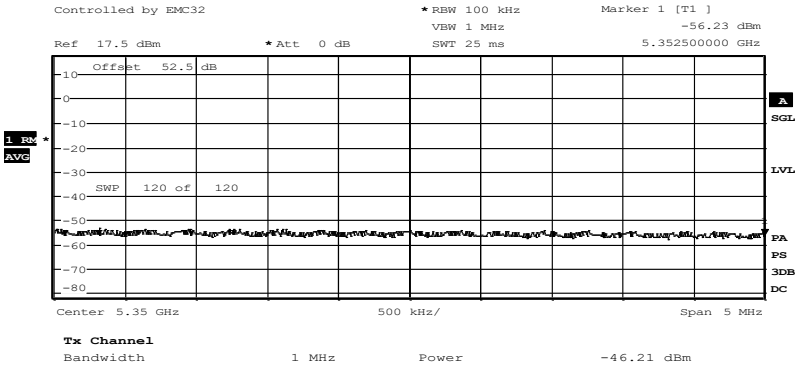
Complies?	Yes

Diagram 1



Date: 19.OCT.2018 12:40:31

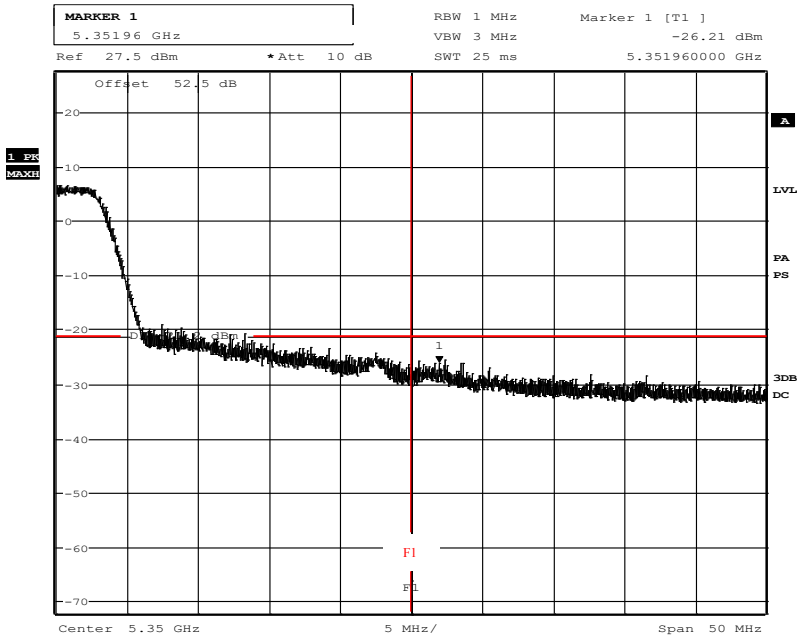
Note: the highest level for frequencies 5.35 GHz, (red line F1), and higher shall be after correction for duty cycle below limit, -21.2 dBm.



Date: 20.OCT.2018 13:27:36

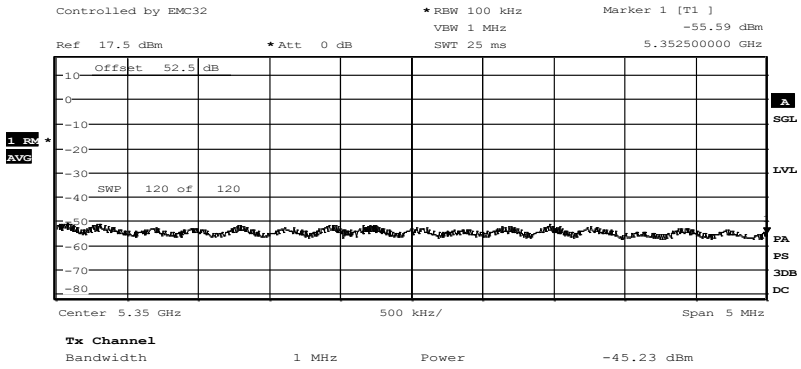
Ch 64, 5320 MHz 20 MHz BW, 10 dBm/p10, 5350 MHz-Band edge
Requirement is based on Average RMS power and peak power.

Diagram 2



Date: 20.OCT.2018 13:18:23

Note: the highest level for frequencies 5.35 GHz, (red line F1), and higher shall be after correction for duty cycle below limit, -21.2 dBm.

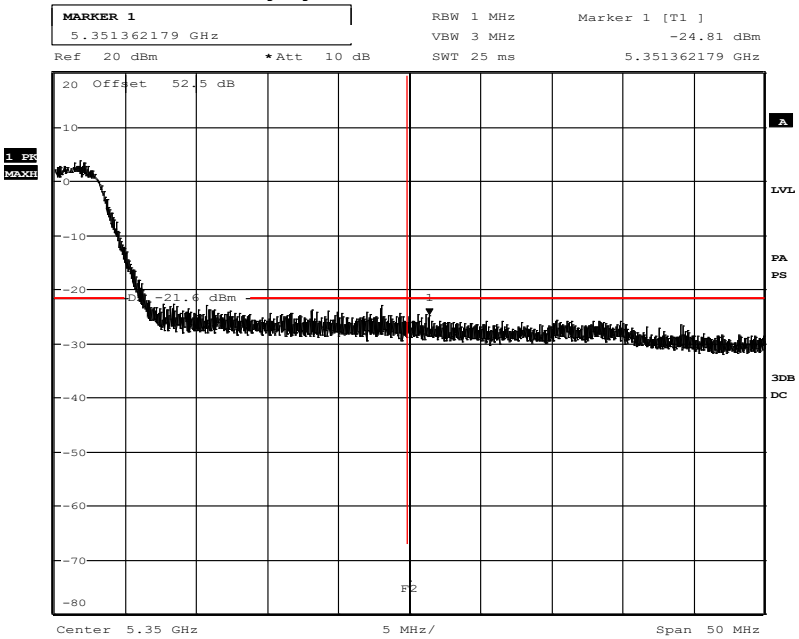


Date: 19.OCT.2018 15:46:48

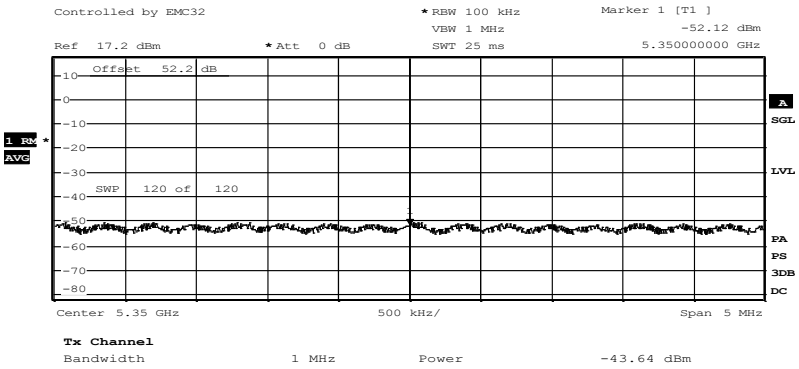
Ch 62, 5310 MHz 40 MHz BW, 9 dBm/p9, 5350 MHz-Band edge
Requirement is based on Average RMS power and peak power

Diagram 3

Note: the highest level for frequencies 5.35 GHz, (red line F1), and higher shall be after correction for duty cycle below limit, -21.2 dBm.



Date: 19.OCT.2018 12:53:47

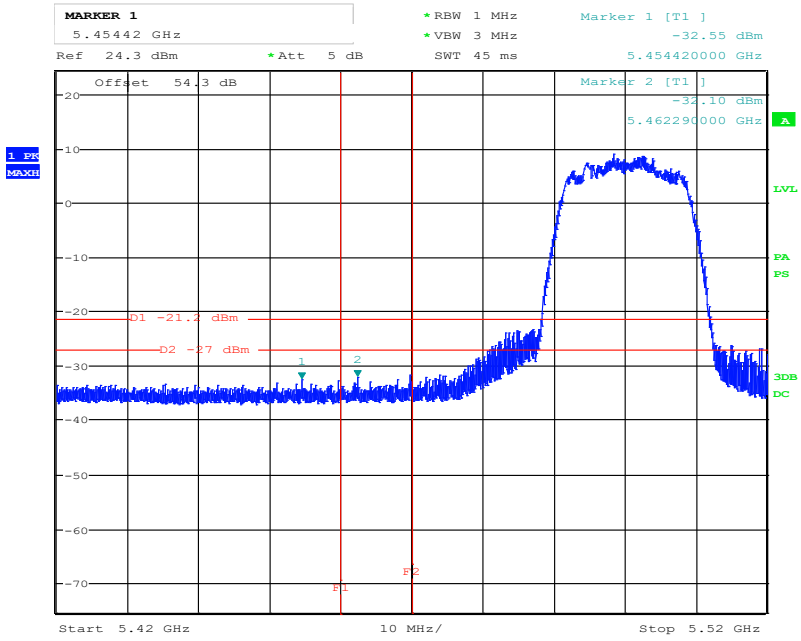


Date: 19.OCT.2018 12:56:50

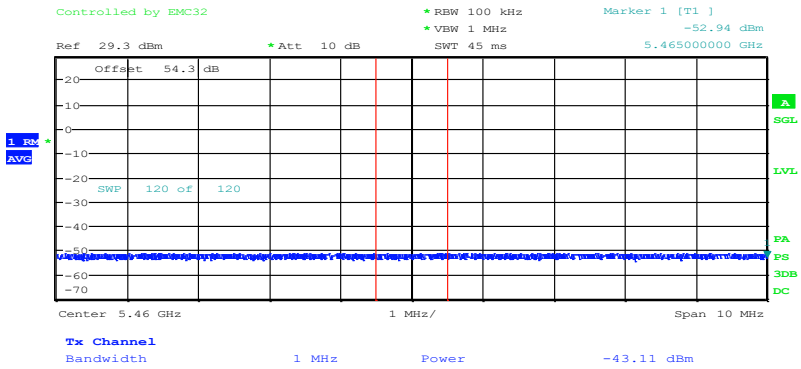
Ch 58, 5290 MHz 80 MHz BW, 9 dBm/p9, 5350 MHz-Band edge
Requirement is based on Average RMS power and peak power

Diagram 4

Note: the highest level for frequencies 5.47 GHz, (red line F2), and lower shall be after correction for duty cycle below limit D2, -27 dBm.



Date: 17.MAR.2019 12:06:57

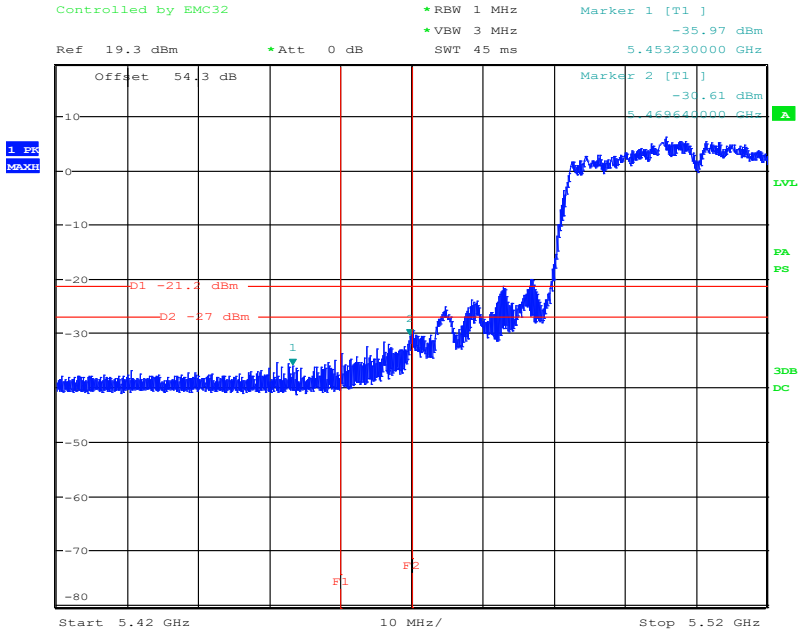


Date: 17.MAR.2019 12:24:39

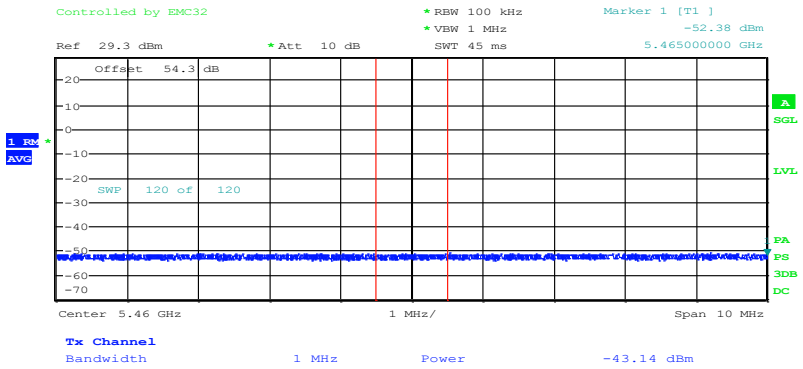
Ch 100, 5500 MHz 20 MHz BW, 6 dBm/p6, 5470 MHz-Band edge
Requirement is based on Average RMS power and peak power

Diagram 5

Note: the highest level for frequencies 5.47 GHz, (red line F2), and lower shall be after correction for duty cycle below limit D2, -27 dBm.



Date: 17.MAR.2019 12:43:48

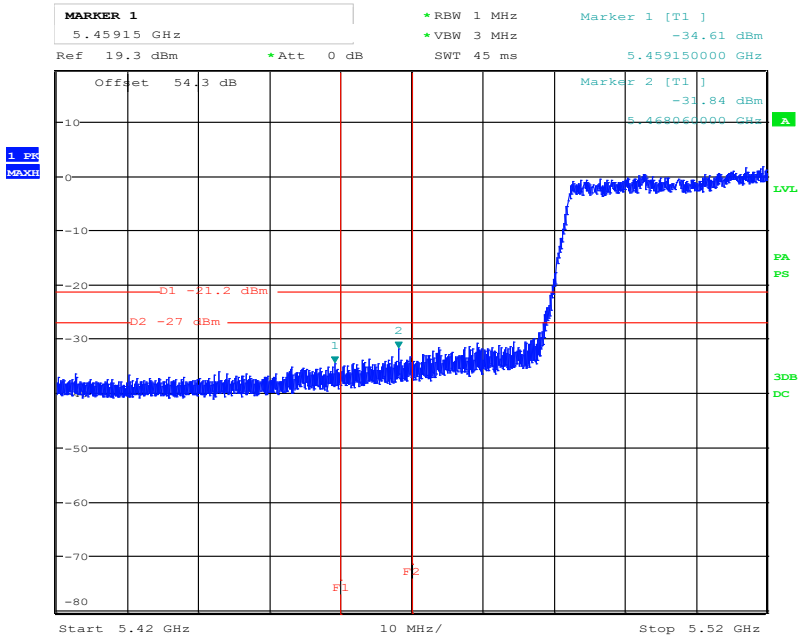


Date: 17.MAR.2019 12:46:13

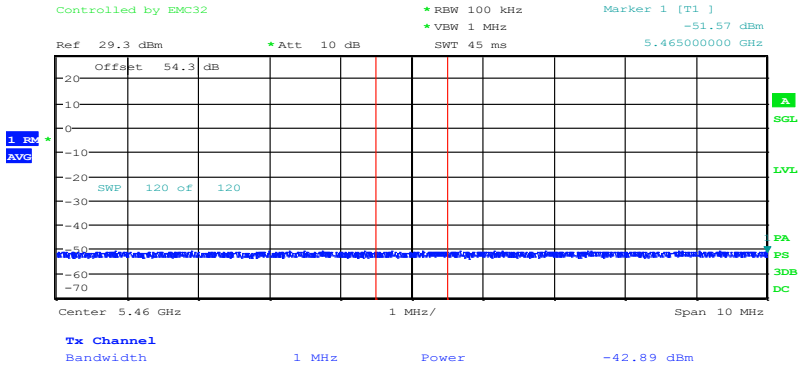
Ch 102, 5510 MHz 40 MHz BW, 4 dBm/p4, 5470 MHz-Band edge
Requirement is based on Average RMS power and peak power

Diagram 6

Note: the highest level for frequencies 5.47 GHz, (red line F2), and lower shall be after correction for duty cycle below limit D2, -27 dBm.



Date: 17.MAR.2019 13:17:14

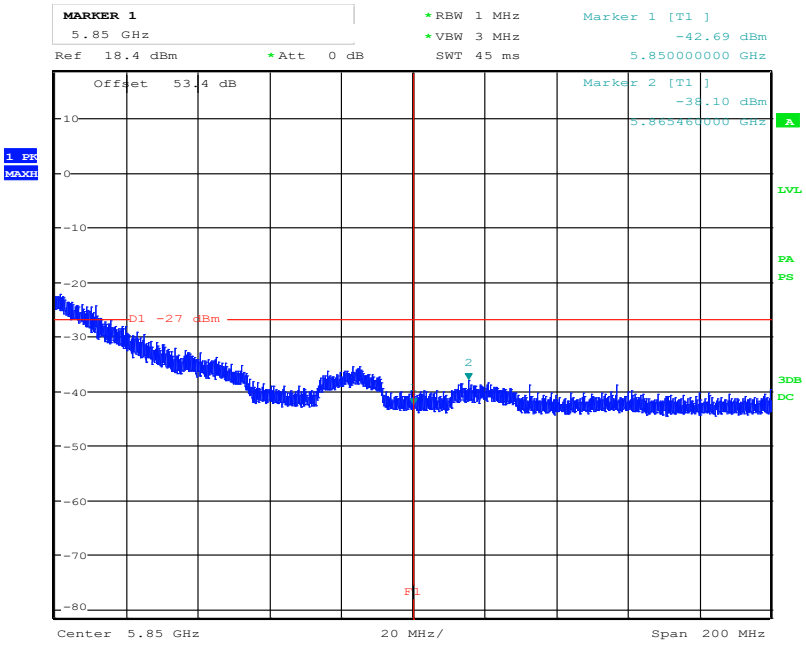


Date: 17.MAR.2019 13:19:39

Ch 106, 5530 MHz 80 MHz BW, 5 dBm/p5, 5470 MHz-Band edge
Requirement is based on Average RMS power and peak power.

Diagram 7

Note: the highest level for frequencies 5.85 GHz, (red line F1), and higher shall be after correction for duty cycle below limit D1, -27 dBm.

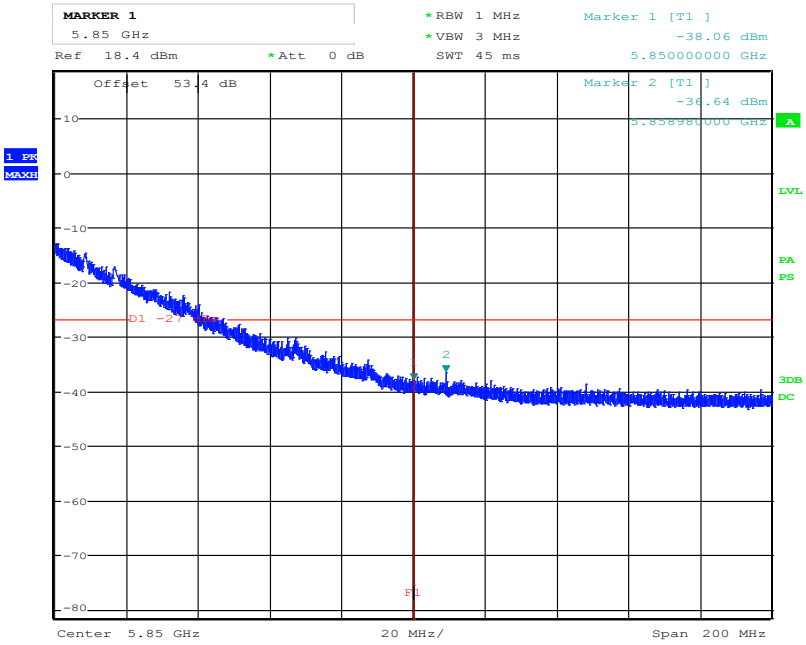


Date: 1.APR.2019 15:44:02

Ch 144, 5720 MHz 20 MHz BW, 13 dBm/p13, 5850 MHz-Band edge
Requirement is based on peak power

Diagram 8

Note: the highest level for frequencies 5.85 GHz, (red line F1), and higher shall be after correction for duty cycle below limit D1, -27 dBm.

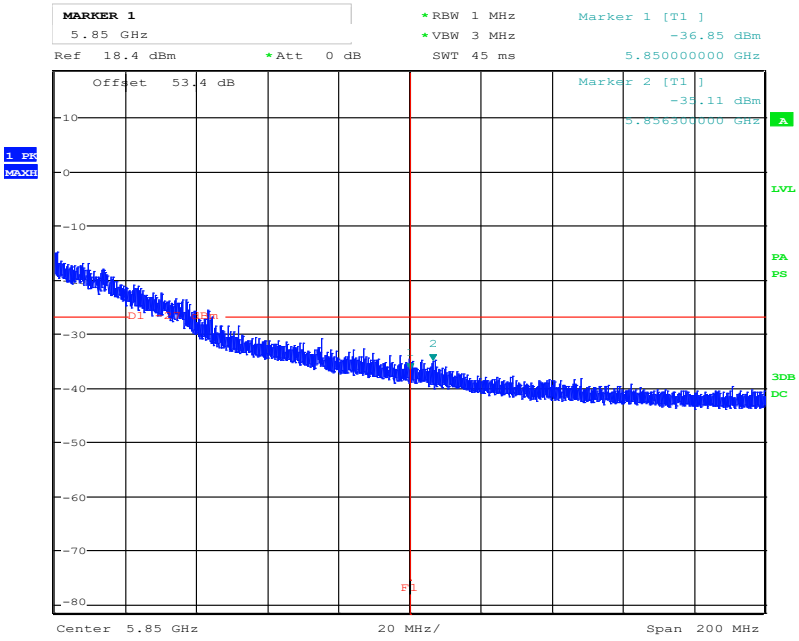


Date: 1.APR.2019 14:33:28

Ch 142, 5710 MHz 40 MHz BW, 13 dBm/p13, 5850 MHz-Band edge
Requirement is based on peak power

Diagram 9

Note: the highest level for frequencies 5.85 GHz, (red line F1), and higher shall be after correction for duty cycle below limit D1, -27 dBm.



Date: 1.APR.2019 15:40:29

Ch 138, 5690 MHz 80 MHz BW, 13 dBm/p13, 5850 MHz-Band edge
Requirement is based on peak power

DFS test for U-NII client devices without radar detection capability according to FCC 47 CFR part 15.407 (h) (2) /RSS-247 6.3

Date	Temperature	Humidity
2019-03-27	23 °C ± 3 °C	26 % ± 5 %
2019-03-28	24 °C ± 3 °C	23 % ± 5 %

Test setup and procedure

The measurements were performed according to KDB 905462 D03 Client Without DFS New Rules v01r02 and KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02

U-NII device description

The device is specified to operate in 5250-5350 MHz (U-NII-2A band) and 5470-5725 MHz (U-NII-2C band). In the U-NII-2C band, 5470 -5725 MHz, the device works only as client without radar detection. It does not operate as a bridge or mesh device.
Router Asus RT-AC2900, FCC Id:MSQ-RTACHN00 was used as master during the DFS test.
The highest EiRP in MIMO mode is 23.5 dBm. The highest EiRP in SISO mode is 22.0 dBm. The lowest EiRP in the band is 12 dBm.
Output power will not be varied dynamically, but it will vary between channels as noted in the chapter Operational test mode

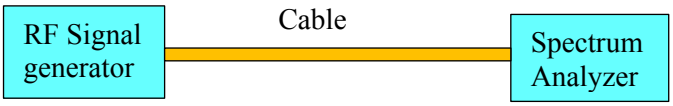
The list of the antennas can be seen in the Test object. Return loss of antenna in the chain 1 at test frequency 5530 MHz is 15 dB and mismatch losses are considered negligible. Return loss of antenna in the chain 2 at test frequency 5530 MHz is 7.5 dB and mismatch losses on this chain is 0.9 dB. The impedance on the antenna connectors is 50 Ω for both chains.

Video file wildlife.mp4 was played and captured by the Airtame Application to initiate a stream from the Master device to the Client device (DUT). The stream quality was 1080p according to the resolution of the display connected to the DUT, which is maximum officially supported resolution.
Initiating a stream in this way is the intended use-case of the Airtame device. The video file is used in order to guarantee a variation in data sent from Master Device to Slave Device.

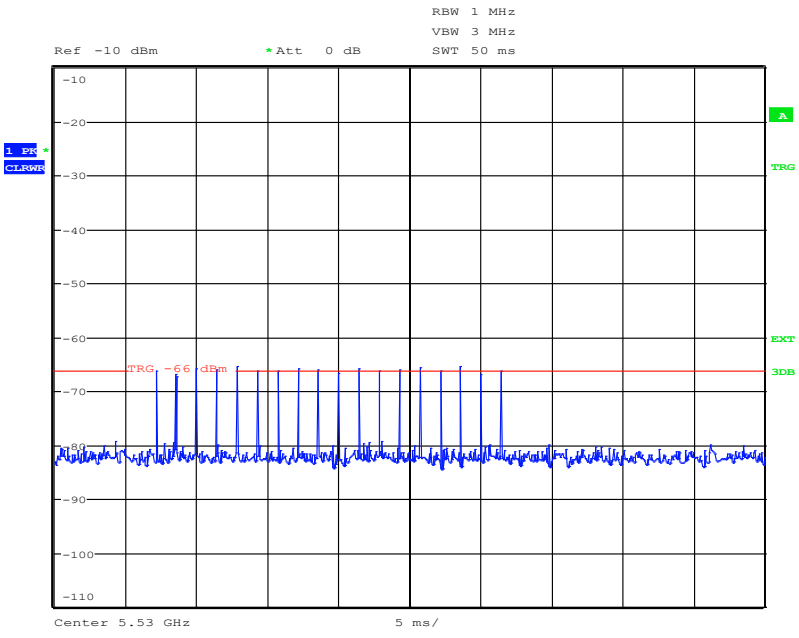
Transmit Power Control functionality is not implemented in the product.
The DUT is load based wireless device supporting 802.11b/g/n/a/ac.
According the manufacturer, the information regarding the parameters of the detected Radar Waveforms is not available to the end user.

Radar waveform calibration

Test system inclusive all cables in the test setup was calibrated. Internal calibration of the switching and controlling unit OSP-B157W8 as well as system cables is done annually by supplier Rohde Schwarz. Saved calibration data are used during the measurement of different radio parameters. External calibration including DUT and companion cables is done annually by RISE using instruments of the test system and procedure described by Rohde Schwarz:

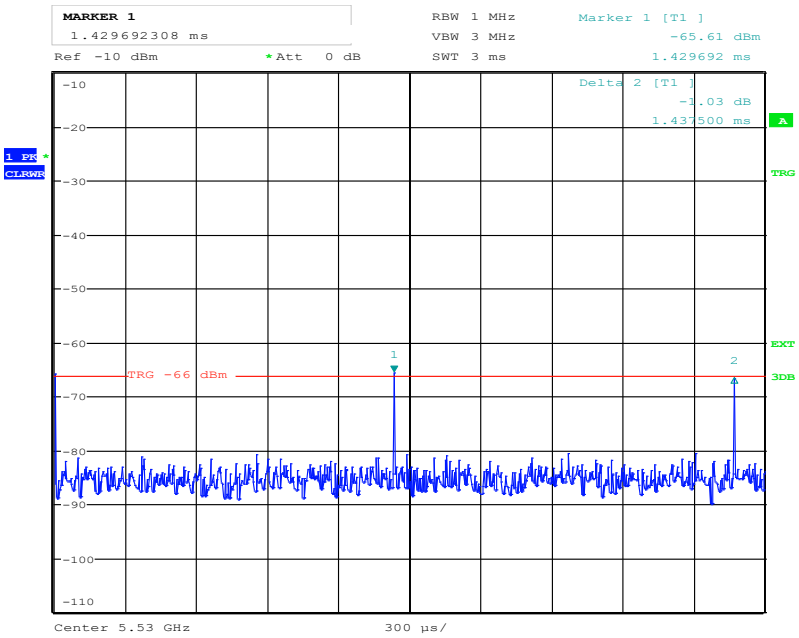


Calibration step 1: RF signal of practical level, i.e. 0 dBm, from signal generator is swept in the frequency range of interest and measured by spectrum analyser connected to signal generator with normalization cable. Measured power level is saved.
Calibration step 2: Normalization cable is replaced with DUT cable and the procedure in step 1 is repeated.
The result of step two is subtracted from the result of step 1 to get losses of DUT cable.
This procedure is repeated for another DUT cables, companion cable and other cables if needed.
Radar type 0 was used during the test. Radar pulses from the vector signal generator was verified before DFS test, see diagrams bellow.



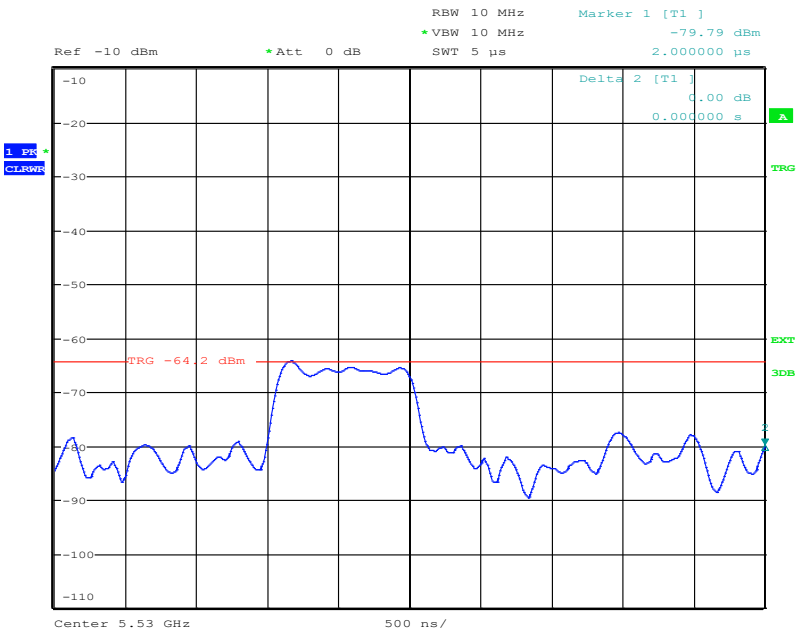
Date: 5.APR.2019 16:03:22

Radar type 0, Serie of 18 pulses



Date: 5.APR.2019 16:08:26

Radar type 0, PRI = 1428 µs

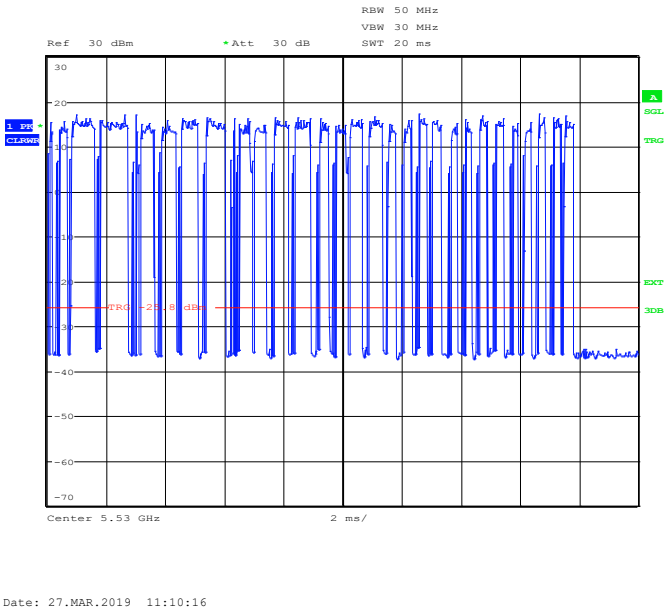


Date: 5.APR.2019 16:13:31

Radar type 0, Pulse Width = 1 µs

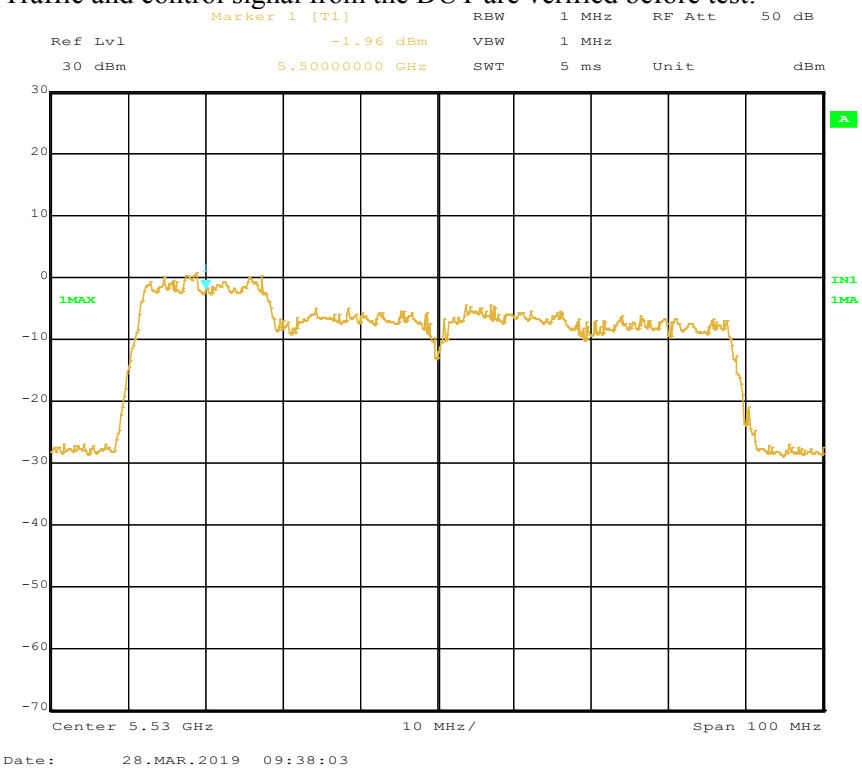
DFS Detection Threshold level for Master Devices and Client Devices with radar detection, TL requirement according table 3 in KDB 905462 D02 is not applied for test of client without radar detection.
It was verified that Master switch of transmission on the test channel with DFS Detection Threshold level of -62 dBm applied on the imput.

Channel loading was verified before the test. It variated very hard during the time – from 0 % up to ca 17 % measured in time interval of 100 ms. We could not control channel loading and don't know how much it was at test time.

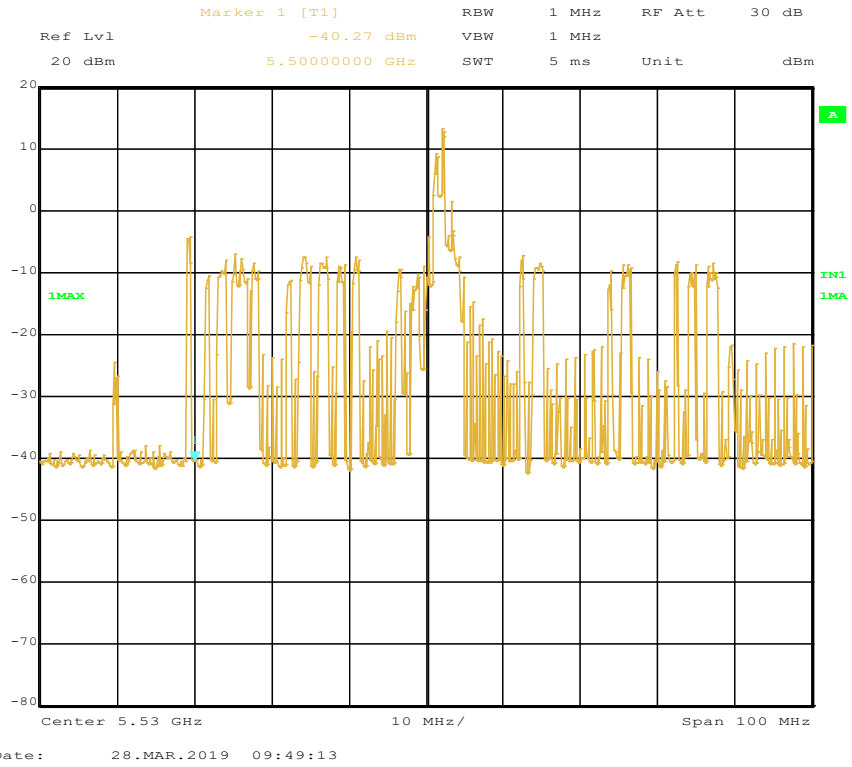


Channel loading in 20 ms interval - example

Traffic and control signal from the DUT are verified before test:



DUT operating at 5530 MHz, BW=80 MHz, chain 2



Control signal from DUT at chain 2; (No data transfere)
(max hold during a few minutes)

Power level at the input of the master was verified to be -62 dBm.

Test procedure

The device was tested in Client without radar detection mode.
Only In-service monitoring test including channel closing transmission time, channel move time and non-occupancy period is required for the devices operating as client without radar detection.
The test was done in conducted mode with test system TS8997 by Rohde Schwarz.
The test is completely automatized based on device configuration including information about DUT, hardware setup including information about all instrument needed for test case, internal losses for all paths in the actual test setup, external losses for all cables between instruments, DUT and companion.

The test was performed on the unit with the temporary antenna connectors.
Test was done on channel 106, f=5530 MHz, BW=80 MHz in MIMO mode with antenna gain of 2.5 dBi on chain 1 and 6 dBi on chain 2.

Block diagram of the test setup for DFS test of device operating as client without radar detection is same as suggested in the KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02:

7.2.2 Setup for Client with injection at the Master

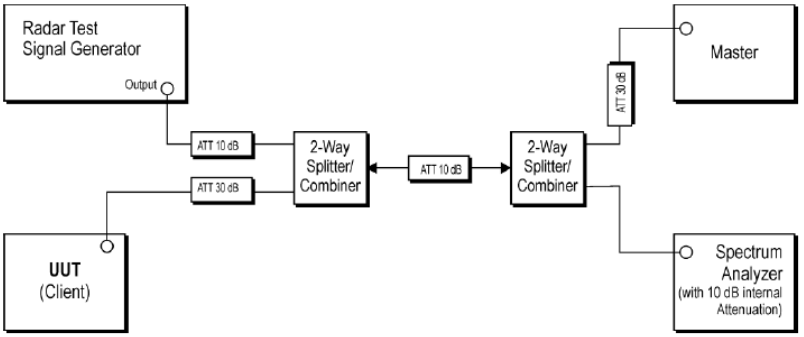


Figure 3: Example Conducted Setup where UUT is a Client and Radar Test Waveforms are injected into the Master

Conducted DFS Detection Threshold level during the test was -62 dBm. It was based on maximum declared power of 13 dBm per chain.

Test set-up photos during the tests can be found in the report annex, "8P07436 - F2 photos".

Measurement equipment	RISE number
Test site Marconi	15:121
Computer Lenovo ThinkCentre	-
Software R&S WMS32, ver.10.40.10	-
Switching box with RF power meters R&S OSP120 with OSP-B157W8	BX60313
Spectrum analyser R&S FSQ 26	BX50694
Vector signal generator R&S SMBV100A	BX62243
Coaxial cable	BX81424
Coaxial cable	BX81436
Coaxial cable	BX50685
Temperature and humidity meter Testo 625	504 117
120 V AC/60 Hz AC Power source HP 6813B	503 091
Multimeter Fluke 85 III	503 418
Temperature and humidity meter Testo 625	503 498

The diagram with results can be find below:

Diagram 1	In-Service Monitoring Channel Move Time
Diagram 2	In-Service Monitoring Channel Move Time, GPIB shot
Diagram 3	In-Service Monitoring Channel Move Time first 200 ms
Diagram 4	In-Service Monitoring Non-occupancy period
Diagram 5	In-Service Monitoring Non-occupancy period, GPIB shot

Results

Channel Move time - CMT

DUT Frequency (MHz)	Radar Type No.	CMT Tx Time (s)	CMT Limit (s)	CMT Result
5530	0	0.000	10.00	PASS

Comment: Tx Time value is the last trailing edge found within sweep. See note 1 in the table below.

Channel Closing Transmission time - CCTT

DUT Frequency (MHz)	Radar Type No.	CCTT Type of Value	CCTT No. of pulses found	CCTT Tx Time (ms)	CCTT Tx Limit	CCTT Result
5530	0	First 200 ms	0	0.0	200.0	PASS
5530	0	Remaining 10 s period	0	0.0	60.0	PASS

Comment: see note 1 in the table below.

Non-occupancy period - NOP

DUT Frequency (MHz)	Radar Type No.	NOP No. of Pulses found	NOP No. of Pulses limit	NOP Tx Time (s)
5530	0	0	0	0.0

Non-occupancy period – NOP, continuous

DUT Frequency (MHz)	NOP Tx Time limit (s)	NOP Result
5530	0.0	PASS

Remark

Additional information

Note	Description
Note 1	Because of radar pulse event at the beginning, the investigation of the trace begins with an offset of 26.7 ms conforming to the end of the Radar burst.
Note 2	Channel move time (CMT) and channel closing transmission time (CCTT) measurement was done with high resolution video sweep using OSP DAQ channel.
Note 3	Because of the substantially higher sampling rate of the video signal the results for CCTT and CMT are more accurate than in the graphics visible. Reached timing accuracy of the video trace: approx. 4 µs.
Note 4	The Non-occupancy period trace starts at the end of the channel move time trace (20.0 s). Labelling of the x-axis (time) is relative to its beginning (0 s).

Limits

According to the KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02 5.1.2 it is required for client device without radar detection:

a) A client device will not transmit before having received appropriate control signal from a master device
b) A client device will stop all its transmissions whenever instructed by a master device to switch it is associated and will meet the channel move time and channel closing transmission time requirements. The client device will not resume any transmissions until it has again received control signal from a master device.
c) N/A for client device without radar detection
d) N/A for client device without radar detection
e) The client test frequency must be monitored to ensure no transmission of any type has occurred for 30 minutes. Note: if the client moves with the master, the device is considered compliant if nothing appears in the client non-occupancy period test. For devices that shut down (rather than moving channels), no beacons should appear.

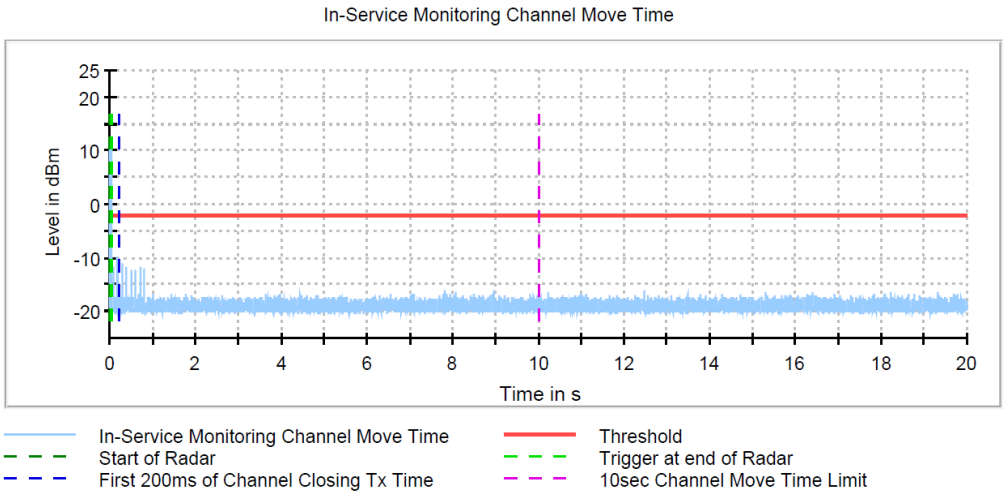
DFS Response Requirement Values – Client without radar detection

Parameter	**Value**
Non-occupancy period	Minimum 30 minutes
Channel Move Time	10 seconds
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 seconds period. See Notes 1 and 2.
Note 1: Channel Move Time and Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst. Note 2: The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus any additional intermittent control signals required to facilitate a Channel move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.	

Test engineers: Markel Bertilsson and Ermin Pasalic

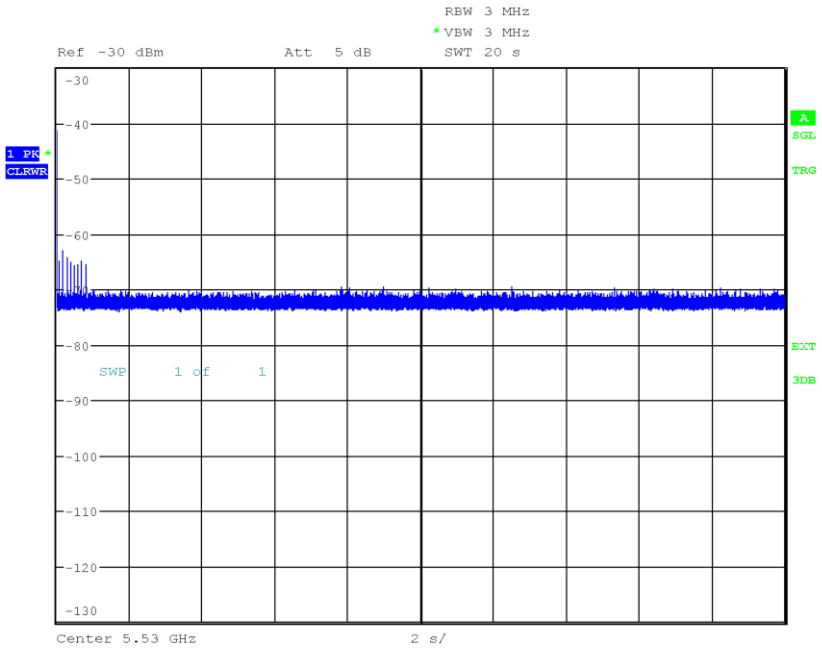
Complies?	Yes

Diagram 1



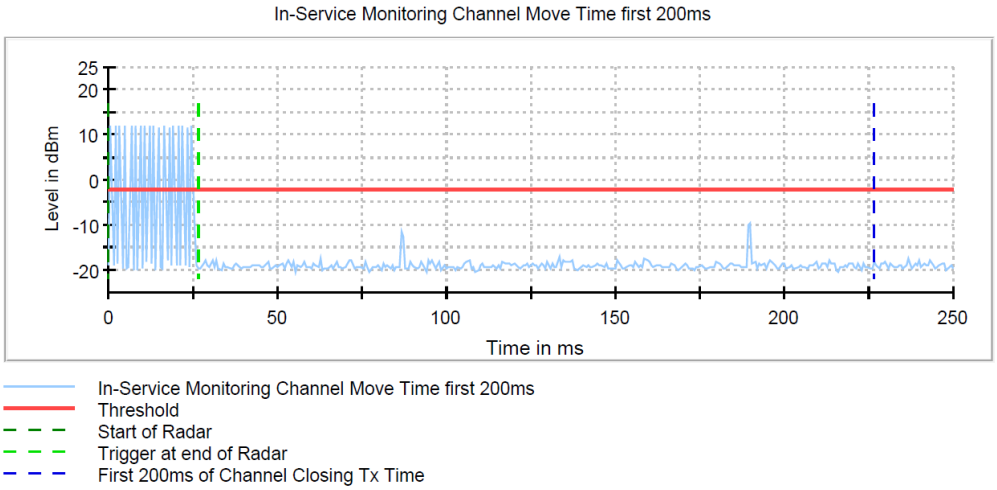
In-Service Monitoring Channel Move Time, after correction for losses

Diagram 2



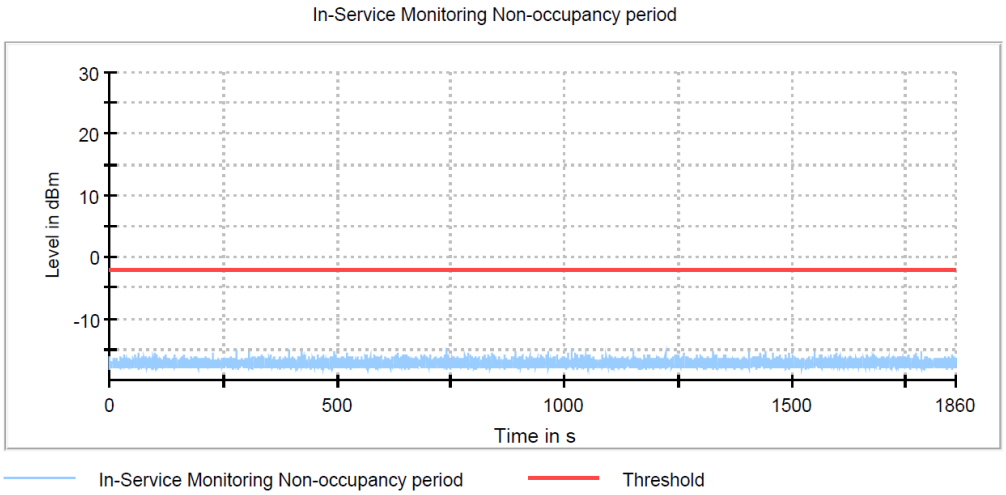
In-Service Monitoring Channel Move Time, GPIB shot

Diagram 3



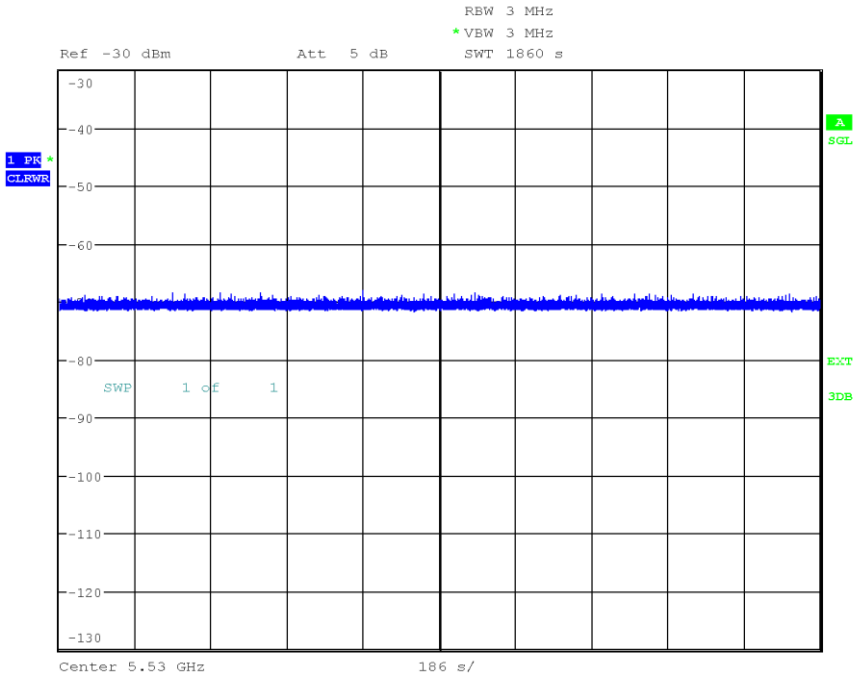
In-Service Monitoring Channel Move Time first 200 ms

Diagram 4



In-Service Monitoring Non-occupancy period, after correction for losses

Diagram 5



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In-Service Monitoring Non-occupancy period, GPIB shot