WLAN ac-Mode; 40 MHz; MCS0; SISO

U-NII-Subband	Ch. No.	Freq. [MHz]	MPSD [dBm/500 kHz]	FCC Limit [dBm/500 kHz]	Margin [dB]	IC Limit [dBm/500 kHz]	Margin [dB]
1	38	5190	-5.9	17.0	22.9	N/A	N/A
	46	5230	-6.3	17.0	23.3	N/A	N/A
3	151	5755	-9.1	30.0	39.1	30.0	39.1
	159	5795	-7.6	30.0	37.6	30.0	37.6

WLAN ac-Mode; 80 MHz; MCS0; SISO

U-NII-Subband	Ch. No.	Freq. [MHz]	MPSD [dBm/500 kHz]	FCC Limit [dBm/500 kHz]	Margin [dB]	IC Limit [dBm/500 kHz]	Margin [dB]
1	42	5210	-7.6	17.0	24.6	N/A	N/A
3	155	5775	-12.1	30.0	42.1	30.0	42.1

WLAN n-Mode; 20 MHz; MCS0; MIMO

U-NII-Subband	Ch. No.	Freq. [MHz]	MPSD [dBm/500 kHz]	FCC Limit [dBm/500 kHz]	Margin [dB]	IC Limit [dBm/500 kHz]	Margin [dB]
1	36	5180	-1.0	17.0	18.0	N/A	N/A
	44	5220	-1.1	17.0	18.1	N/A	N/A
	48	5240	-1.0	17.0	18.0	N/A	N/A
3	149	5745	-5.5	30.0	35.5	30.0	35.5
	157	5785	-4.9	30.0	34.9	30.0	34.9
	165	5825	-5.1	30.0	35.1	30.0	35.1

WLAN n-Mode; 40 MHz; MCS0; MIMO

U-NII-Subband	Ch. No.	Freq. [MHz]	MPSD [dBm/500 kHz]	FCC Limit [dBm/500 kHz]	Margin [dB]	IC Limit [dBm/500 kHz]	Margin [dB]
1	38	5190	-1.4	17.0	18.4	N/A	N/A
	46	5230	-0.9	17.0	17.9	N/A	N/A
3	151	5755	-4.2	30.0	34.2	30.0	34.2
	159	5795	-4.5	30.0	34.5	30.0	34.5

WLAN ac-Mode; 20 MHz; MCS0; MIMO

U-NII-Subband	Ch. No.	Freq. [MHz]	MPSD [dBm/500 kHz]	FCC Limit [dBm/500 kHz]	Margin [dB]	IC Limit [dBm/500 kHz]	Margin [dB]
1	36	5180	-1.0	17.0	18.0	N/A	N/A
	44	5220	-1.2	17.0	18.2	N/A	N/A
	48	5240	-1.2	17.0	18.2	N/A	N/A
3	149	5745	-5.6	30.0	35.6	30.0	35.6
	157	5785	-5.1	30.0	35.1	30.0	35.1
	165	5825	-5.3	30.0	35.3	30.0	35.3

WLAN ac-Mode; 40 MHz; MCS0; MIMO

U-NII-Subband	Ch. No.	Freq. [MHz]	MPSD [dBm/500 kHz]	FCC Limit [dBm/500 kHz]	Margin [dB]	IC Limit [dBm/500 kHz]	Margin [dB]
1	38	5190	-1.4	17.0	18.4	N/A	N/A
	46	5230	-1.6	17.0	18.6	N/A	N/A
3	151	5755	-5.0	30.0	35.0	30.0	35.0
	159	5795	-4.3	30.0	34.3	30.0	34.3

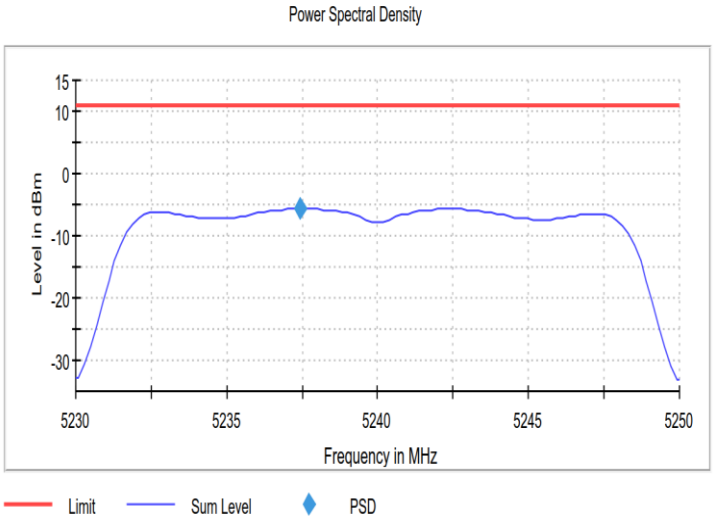
WLAN ac-Mode; 80 MHz; MCS0; MIMO

U-NII-Subband	Ch. No.	Freq. [MHz]	MPSD [dBm/500 kHz]	FCC Limit [dBm/500 kHz]	Margin [dB]	IC Limit [dBm/500 kHz]	Margin [dB]
1	42	5210	-3.4	17.0	20.4	N/A	N/A
3	155	5775	-8.2	30.0	38.2	30.0	38.2

Remark: Please see next sub-clause for the measurement plot.

5.5.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

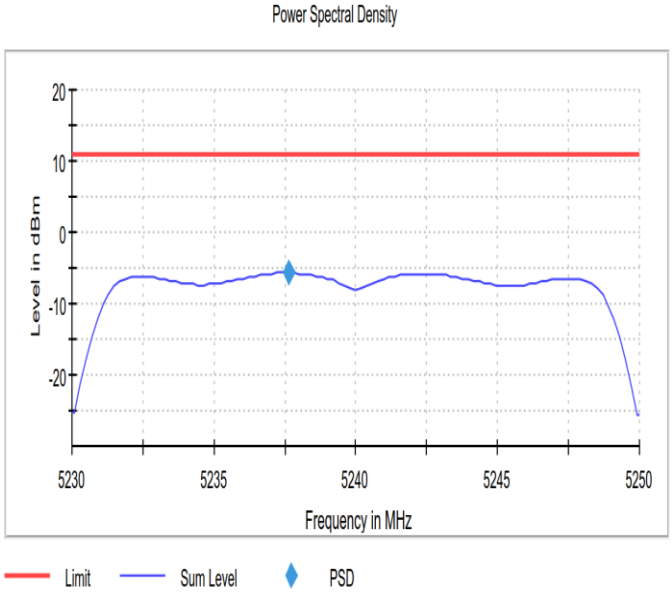
Radio Technology = WLAN a, Operating Frequency = high, Subband = U-NII-1 (S01_ah02)



Measurement

Setting	Instrument Value	Target Value
Start Frequency	5.23000 GHz	5.23000 GHz
Stop Frequency	5.25000 GHz	5.25000 GHz
Span	20.000 MHz	20.000 MHz
RBW	1.000 MHz	<= 1.000 MHz
VBW	3.000 MHz	>= 3.000 MHz
SweepPoints	101	~ 40
Sweeptime	505.000 ms	505.000 ms
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	RMS	RMS
SweepCount	119	119
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	4 / max. 15	max. 15
Stable	3 / 3	3
Max Stable Difference	0.03 dB	0.30 dB

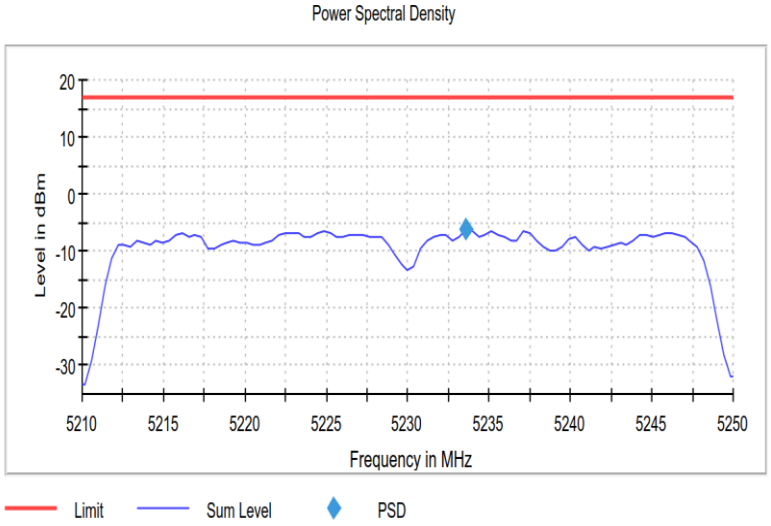
Radio Technology = WLAN n 20 MHz, Operating Frequency = high, Subband = U-NII-1 (S01_ah02)



Measurement

Setting	Instrument Value	Target Value
Start Frequency	5.23000 GHz	5.23000 GHz
Stop Frequency	5.25000 GHz	5.25000 GHz
Span	20.000 MHz	20.000 MHz
RBW	1.000 MHz	<= 1.000 MHz
VBW	3.000 MHz	>= 3.000 MHz
SweepPoints	101	~ 40
Sweeptime	505.000 ms	505.000 ms
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	RMS	RMS
SweepCount	119	119
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	4 / max. 15	max. 15
Stable	3 / 3	3
Max Stable Difference	0.02 dB	0.30 dB

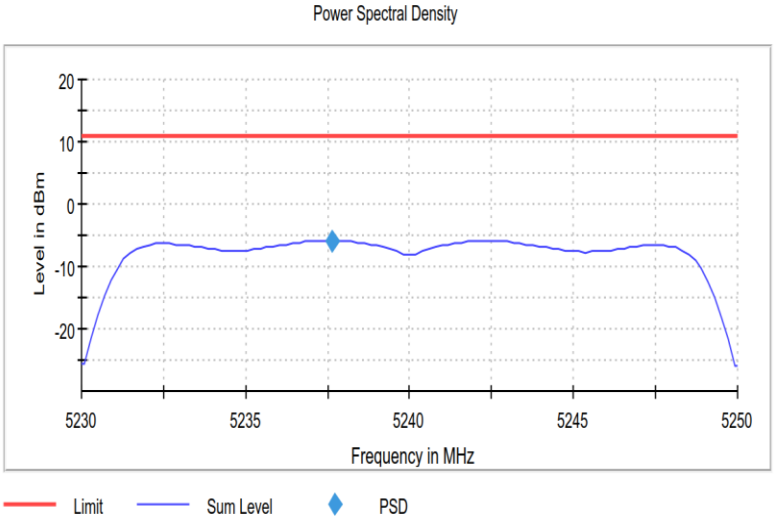
Radio Technology = WLAN n 40 MHz, Operating Frequency = high, Subband = U-NII-1 (S01_ah02)



Measurement

Setting	Instrument Value	Target Value
Start Frequency	5.21000 GHz	5.21000 GHz
Stop Frequency	5.25000 GHz	5.25000 GHz
Span	40.000 MHz	40.000 MHz
RBW	1.000 MHz	<= 1.000 MHz
VBW	3.000 MHz	>= 3.000 MHz
SweepPoints	101	~ 80
Sweeptime	11.000 µs	10.100 µs
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	RMS	RMS
SweepCount	0	5940595
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	15 / max. 15	max. 15
Stable	1 / 3	3
Max Stable Difference	0.00 dB	0.30 dB

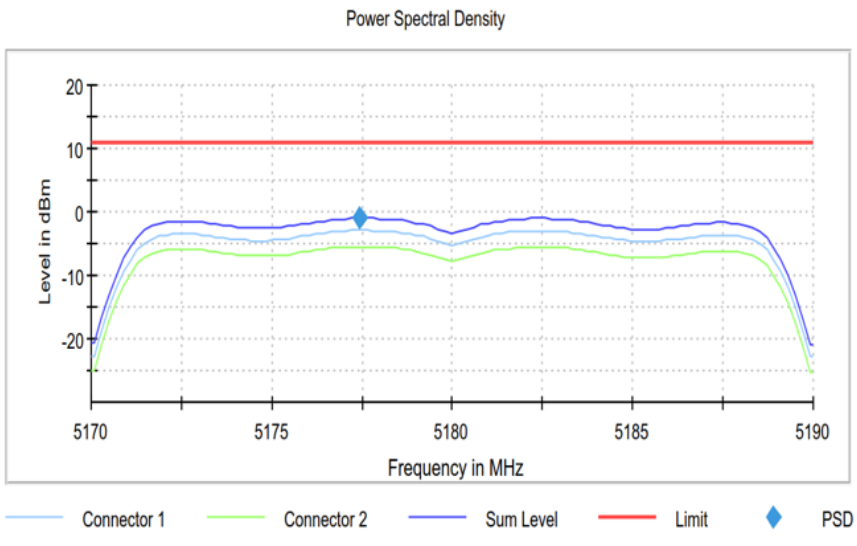
Radio Technology = WLAN ac 20 MHz, Operating Frequency = high, Subband = U-NII-1 (S01_ah02)



Measurement

Setting	Instrument Value	Target Value
Start Frequency	5.23000 GHz	5.23000 GHz
Stop Frequency	5.25000 GHz	5.25000 GHz
Span	20.000 MHz	20.000 MHz
RBW	1.000 MHz	<= 1.000 MHz
VBW	3.000 MHz	>= 3.000 MHz
SweepPoints	101	~ 40
Sweeptime	505.000 ms	505.000 ms
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	RMS	RMS
SweepCount	119	119
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	4 / max. 15	max. 15
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.30 dB

Radio Technology = WLAN ac 20 MHz MIMO, Operating Frequency = low, Subband = U-NII-1 (S01_ah02)

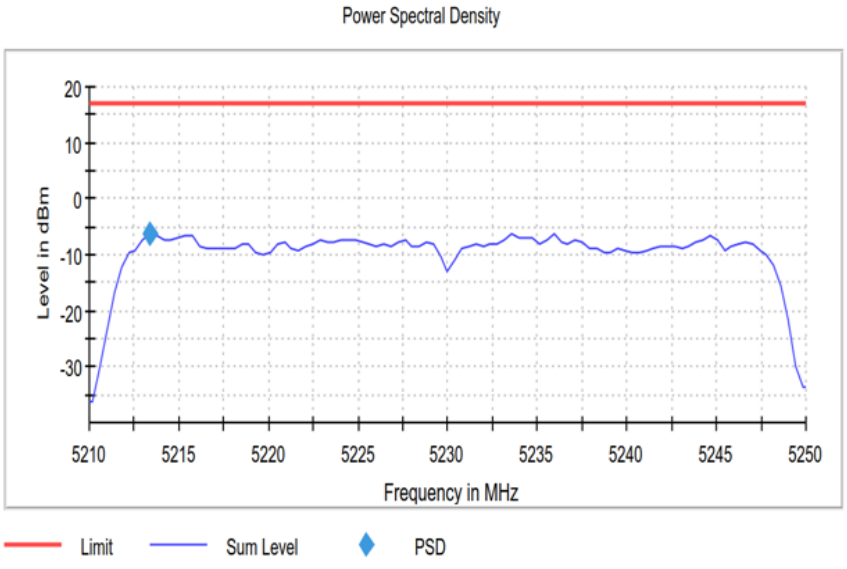


Measurement

Setting	Instrument Value	Target Value
Start Frequency	5.17000 GHz	5.17000 GHz
Stop Frequency	5.19000 GHz	5.19000 GHz
Span	20.000 MHz	20.000 MHz
RBW	1.000 MHz	<= 1.000 MHz
VBW	3.000 MHz	>= 3.000 MHz
SweepPoints	101	~ 40
Sweeptime	505.000 ms	505.000 ms
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	RMS	RMS
SweepCount	119	119
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	4 / max. 15	max. 15
Stable	3 / 3	3
Max Stable Difference	0.01 dB	0.30 dB

¶

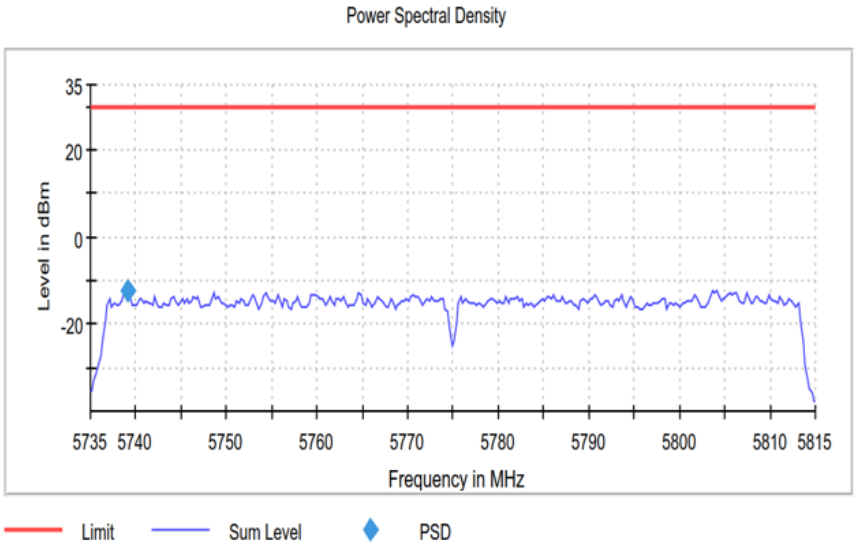
Radio Technology = WLAN ac 40 MHz, Operating Frequency = high, Subband = U-NII-1 (S01_ah02)



Measurement

Setting	Instrument Value	Target Value
Start Frequency	5.21000 GHz	5.21000 GHz
Stop Frequency	5.25000 GHz	5.25000 GHz
Span	40.000 MHz	40.000 MHz
RBW	1.000 MHz	<= 1.000 MHz
VBW	3.000 MHz	>= 3.000 MHz
SweepPoints	101	~ 80
Sweeptime	11.000 µs	10.100 µs
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	RMS	RMS
SweepCount	0	5940595
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	15 / max. 15	max. 15
Stable	2 / 3	3
Max Stable Difference	0.00 dB	0.30 dB

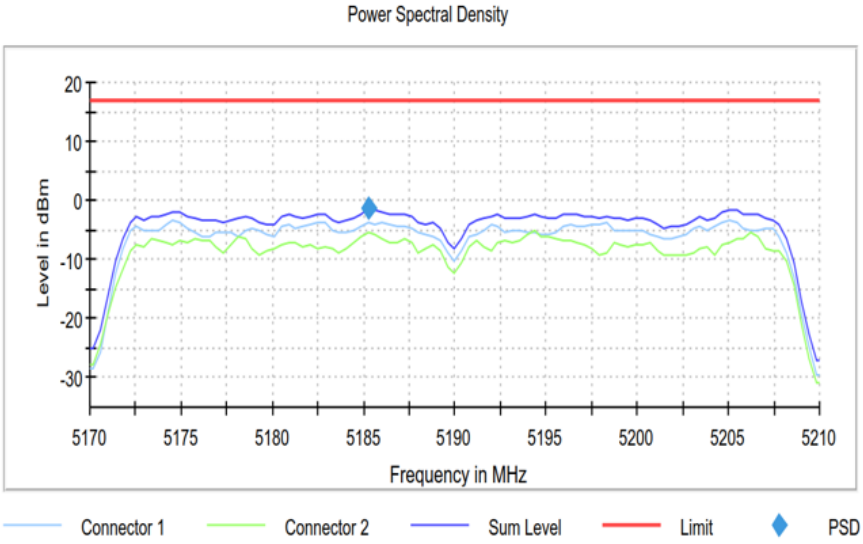
Radio Technology = WLAN ac 80 MHz, Operating Frequency = mid, Subband = U-NII-3 (S01_ah02)



Measurement

Setting	Instrument Value	Target Value
Start Frequency	5.73500 GHz	5.73500 GHz
Stop Frequency	5.81500 GHz	5.81500 GHz
Span	80.000 MHz	80.000 MHz
RBW	500.000 kHz	<= 500.000 kHz
VBW	2.000 MHz	>= 1.500 MHz
SweepPoints	320	~ 320
Sweeptime	32.000 µs	32.000 µs
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	RMS	RMS
SweepCount	0	1875001
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	13 / max. 15	max. 15
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.30 dB

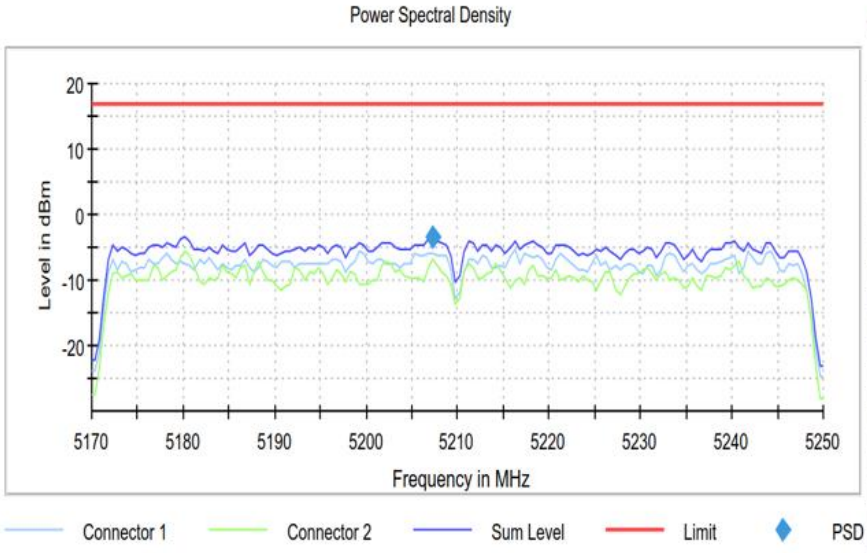
Radio Technology = WLAN ac 40 MHz MIMO, Operating Frequency = low, Subband = U-NII-1 (S01_ah02)



Measurement

Setting	Instrument Value	Target Value
Start Frequency	5.17000 GHz	5.17000 GHz
Stop Frequency	5.21000 GHz	5.21000 GHz
Span	40.000 MHz	40.000 MHz
RBW	1.000 MHz	<= 1.000 MHz
VBW	3.000 MHz	>= 3.000 MHz
SweepPoints	101	~ 80
Sweeptime	11.000 µs	10.100 µs
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	RMS	RMS
SweepCount	0	5940595
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	15 / max. 15	max. 15
Stable	2 / 3	3
Max Stable Difference	0.00 dB	0.30 dB

Radio Technology = WLAN ac 80 MHz MIMO, Operating Frequency = mid, Subband = U-NII-1 (S01_ah02)



Measurement

Setting	Instrument Value	Target Value
Start Frequency	5.17000 GHz	5.17000 GHz
Stop Frequency	5.25000 GHz	5.25000 GHz
Span	80.000 MHz	80.000 MHz
RBW	1.000 MHz	<= 1.000 MHz
VBW	3.000 MHz	>= 3.000 MHz
SweepPoints	160	~ 160
Sweeptime	16.000 µs	16.000 µs
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	RMS	RMS
SweepCount	0	3750001
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	15 / max. 15	max. 15
Stable	2 / 3	3
Max Stable Difference	0.00 dB	0.30 dB

5.5.5 TEST EQUIPMENT USED

- R&S TS8997

5.6 UNDESIRABLE EMISSIONS; GENERAL FIELD STRENGTH LIMITS

Standard **FCC Part 15 Subpart E**

The test was performed according to:
ANSI C63.10

5.6.1 TEST DESCRIPTION

The test set-up was made in accordance to the general provisions of ANSI C63.10 in a typical installation configuration. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m² in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.
The measurement procedure is implemented into the EMI test software EMC32 from R&S.
Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is also performed at 3 axes.
A pre-check is performed while the EUT is powered from a DC power source.

1. Measurement up to 30 MHz
The Loop antenna HFH2-Z2 is used.

Step 1: pre measurement
- Anechoic chamber
- Antenna distance: 3 m
- Detector: Peak-Maxhold
- Frequency range: 0.009 - 0.15 MHz and 0.15 – 30 MHz
- Frequency steps: 0.05 kHz and 2.25 kHz
- IF–Bandwidth: 0.2 kHz and 9 kHz
- Measuring time / Frequency step: 100 ms (FFT-based)

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: final measurement
For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is to find the maximum emission level.
- Open area test side
- Antenna distance: according to the Standard
- Detector: Quasi-Peak
- Frequency range: 0.009 – 30 MHz
- Frequency steps: measurement at frequencies detected in step 1
- IF–Bandwidth: 0.2 - 10 kHz
- Measuring time / Frequency step: 1 s

2. Measurement above 30 MHz and up to 1 GHz

Step 1: Preliminary scan
This is a preliminary test to identify the highest amplitudes relative to the limit.
Settings for step 1:
- Antenna distance: 3 m
- Detector: Peak-Maxhold / Quasipeak (FFT-based)
- Frequency range: 30 – 1000 MHz
- Frequency steps: 30 kHz
- IF–Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 ms

- Turntable angle range: –180° to 90°
- Turntable step size: 90°
- Height variation range: 1 – 3 m
- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: Adjustment measurement

In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.

For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will slowly vary by ± 45° around this value. During this action, the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position, the antenna height will also slowly vary by ± 100 cm around the antenna height determined. During this action, the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: ± 45 ° around the determined value
- Height variation range: ± 100 cm around the determined value
- Antenna Polarisation: max. value determined in step 1

Step 3: Final measurement with QP detector

With the settings determined in step 3, the final measurement will be performed:

EMI receiver settings for step 4:

- Detector: Quasi-Peak (< 1 GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

3. Measurement above 1 GHz

The following modifications apply to the measurement procedure for the frequency range above 1 GHz:

Step 1:

The Equipment Under Test (EUT) was set up on a non-conductive support (tilt device) at 1.5 m height in the fully-anechoic chamber.

All steps were performed with one height (1.5 m) of the receiving antenna only.

The EUT is turned during the preliminary measurement across the elevation axis, with a step size of 90 °.

The turn table step size (azimuth angle) for the preliminary measurement is 45 °.

Above 26 GHz the measurement distance is reduced to 1 m.

Step 2:

Due to the fact, that in this frequency range the test is performed in a fully anechoic room, the height scan of the receiving antenna instep 2 is omitted. Instead of this, a maximum search with a step size ± 45° for the elevation axis is performed.

The turn table azimuth will slowly vary by ± 22.5°.

The elevation angle will slowly vary by ± 45°

EMI receiver settings (for all steps):
- Detector: Peak, Average
- IF Bandwidth = 1 MHz

Step 3:
Spectrum analyser settings for step 3:
- Detector: Peak / Average
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 1 MHz
- Measuring time: 1 s

5.6.2 TEST REQUIREMENTS / LIMITS

A) FCC

FCC Part 15 Subpart E, §15.407 (b)(1)
For transmitters operating in the 5150–5250 MHz band:
Limit: –27 dBm/MHz EIRP outside of the band 5150–5350 MHz.

FCC Part 15 Subpart E, §15.407 (b)(2)
For transmitters operating in the 5250–5350 MHz band:
Limit: –27 dBm/MHz EIRP outside of the band 5150–5350 MHz.

FCC Part 15 Subpart E, §15.407 (b)(3)
For transmitters operating in the 5470–5725 MHz band:
Limit: –27 dBm/MHz EIRP outside of the band 5470–5725 MHz.

FCC Part 15 Subpart E, §15.407 (b)(4)
For transmitters operating in the 5725–5850 MHz band:
Limit: –27 dBm/MHz EIRP outside of the band 5715–5860 MHz and additionally
Limit: –17 dBm/MHz EIRP within the frequency ranges 5715–5725 and 5850–5860 MHz.

B) IC
Different frequency bands and limits apply, as compared to the FCC requirements.

RSS-247, 6.2.1 (2), Emissions outside the band 5150-5250 MHz, indoor operation only:
Limit: –27 dBm/MHz EIRP outside of the band 5150–5250 MHz.

RSS-247, 6.2.2 (2), Emissions outside the band 5250-5350 MHz:
Limit: –27 dBm/MHz EIRP outside of the band 5250–5350 MHz.

RSS-247, 6.2.3 (2), Emissions outside the bands 5470-5600 MHz and 5650-5725 MHz:
Limit: –27 dBm/MHz EIRP outside of the band 5470–5725 MHz.
Note: No operation is permitted for the frequency range 5600–5650 MHz.

RSS-247, 6.2.4 (2), Emissions outside the band 5725-5825 MHz:
Limit: –27 dBm/MHz EIRP outside of the band 5715–5835 MHz and additionally
Limit: –17 dBm/MHz EIRP within the frequency ranges 5715–5725 and 5825–5835 MHz.

C) FCC & IC

FCC Part 15 Subpart E, §15.405
The provisions of §§ 15.203 and 15.205 are included.

§15.407 (b)(6)
Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209.

§15.407 (b)(7)
The provisions of §15.205 apply to intentional radiators operating under this section

FCC Part 15, Subpart C, §15.209, Radiated Emission Limits

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limits (dBµV/m)
0.009 – 0.49	2400/F(kHz)@300m	3	(48.5 – 13.8)@300m
0.49 – 1.705	24000/F(kHz)@30m	3	(33.8 – 23.0)@30m
1.705 – 30	30@30m	3	29.5@30m

The measured values are corrected with an inverse linear distance extrapolation factor (40 dB/decade) according FCC 15.31 (2).

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limits (dBµV/m)
30 – 88	100@3m	3	40.0@3m
88 – 216	150@3m	3	43.5@3m
216 – 960	200@3m	3	46.0@3m
960 - 26000	500@3m	3	54.0@3m
26000 - 40000	500@3m	1	54.0@3m

The measured values above 26 GHz are corrected with an inverse linear distance extrapolation factor (20 dB/decade).

§15.35(b) ..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....

Used conversion factor:
- Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)
- Limit (dBµV/m) = EIRP [dBm] – 20 log (d [m]) + 104.8

Limit types (in result tables on next page):
RB – Emissions falls into a "Restricted Band" according FCC §§15.205 and 15.209 *)
UE – "Undesirable Emission Limit" according FCC §15.407
BE-RB – Band Edge Limit basing on "Restricted Band Limits"
BE-UE – Band Edge Limit basing on "Undesirable Emission Limit"
*) Below 1 GHz the limits of §15.209 are applied for all frequencies.

5.6.3 TEST PROTOCOL

Ambient temperature: 24 °C
Air Pressure: 1025 hPa
Humidity: 34 %

WLAN a-Mode; 20 MHz; 6 Mbit/s

Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type
36	5180	15602.2	42.2	AV	1000	54.0	11.8	RB
36	5180	15604.3	55.5	PEAK	1000	74.0	18.5	RB
36	5180	17775.8	57.8	PEAK	1000	74.0	16.2	RB
36	5180	17793.9	45.6	AV	1000	54.0	8.4	RB
44	5220	133.4	15.3	QP	120	43.5	28.2	RB
44	5220	240.3	5.4	QP	120	46.0	40.6	RB
44	5220	463.2	20.5	QP	120	46.0	25.5	RB
44	5220	882.1	17.9	QP	120	46.0	28.1	RB
157	5785	926.4	23.7	QP	120	46.0	22.3	RB

WLAN n-Mode; 20 MHz; MCS0; SISO

Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type
36	5180	5148.9	57.4	PEAK	1000	74.0	16.6	RB
36	5180	5148.9	44.8	AV	1000	54.0	9.2	RB
44	5220	-	-	-	-	-	> 20	-
157	5785	-	-	-	-	-	> 20	-

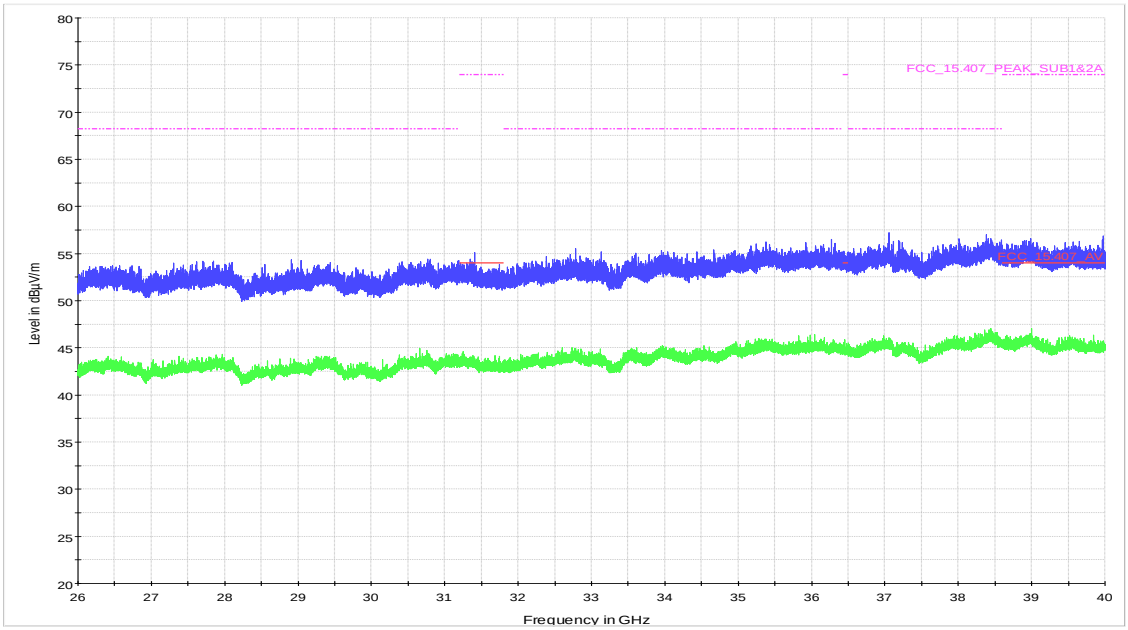
WLAN ac-Mode; 40 MHz; MCS0; SISO

Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type
151	5755	1065.5	43.1	Peak	1000	74.0	30.9	RB
151	5755	1753.7	46.6	Peak	1000	68.2	21.6	UE
151	5755	5718.7	60.4	Peak	1000	68.2	7.8	UE
151	5755	5720.2	62.1	Peak	1000	68.2	6.1	UE
151	5755	11509.7	48.7	Peak	1000	74.0	25.3	RB
151	5755	11510.1	40.6	AV	1000	54.0	13.4	RB
159	5795	5852.3	58.0	Peak	1000	68.2	10.2	UE

Remark: Please see next sub-clause for the measurement plot.

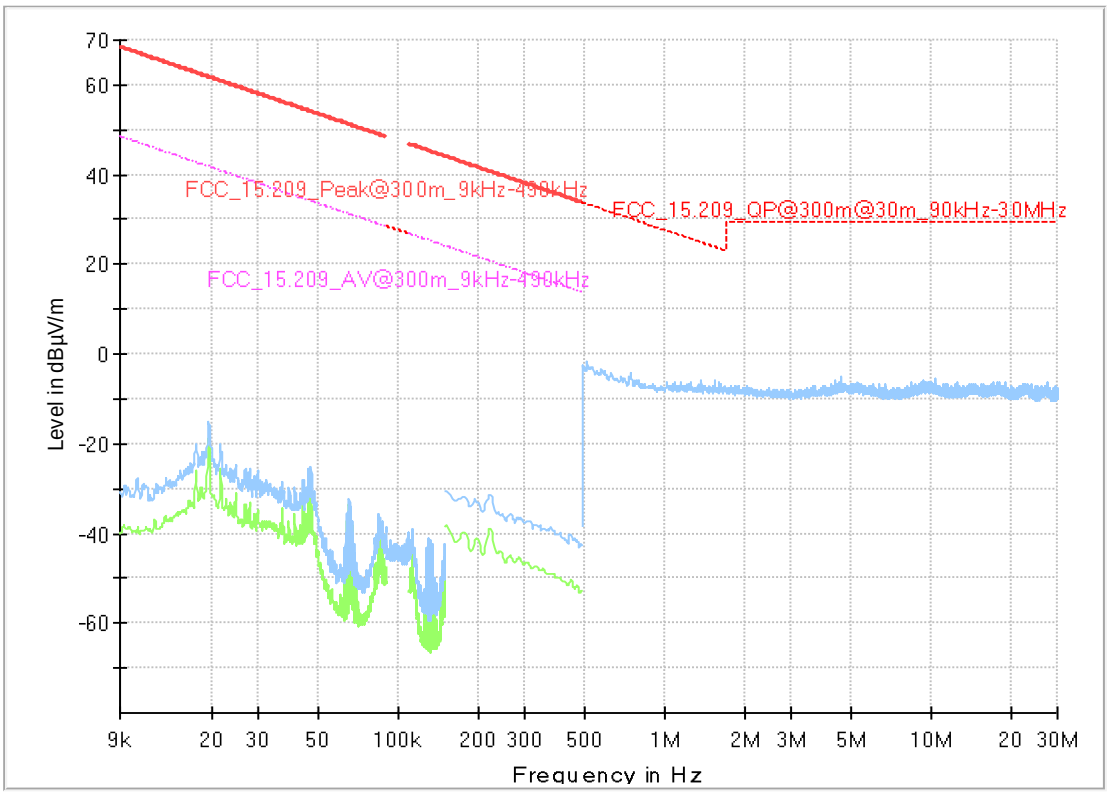
5.6.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

Radio Technology = WLAN a, Operating Frequency = mid, Measurement range = 26GHz - 40GHz, Subband = U-NII-1
(S01_ai02)

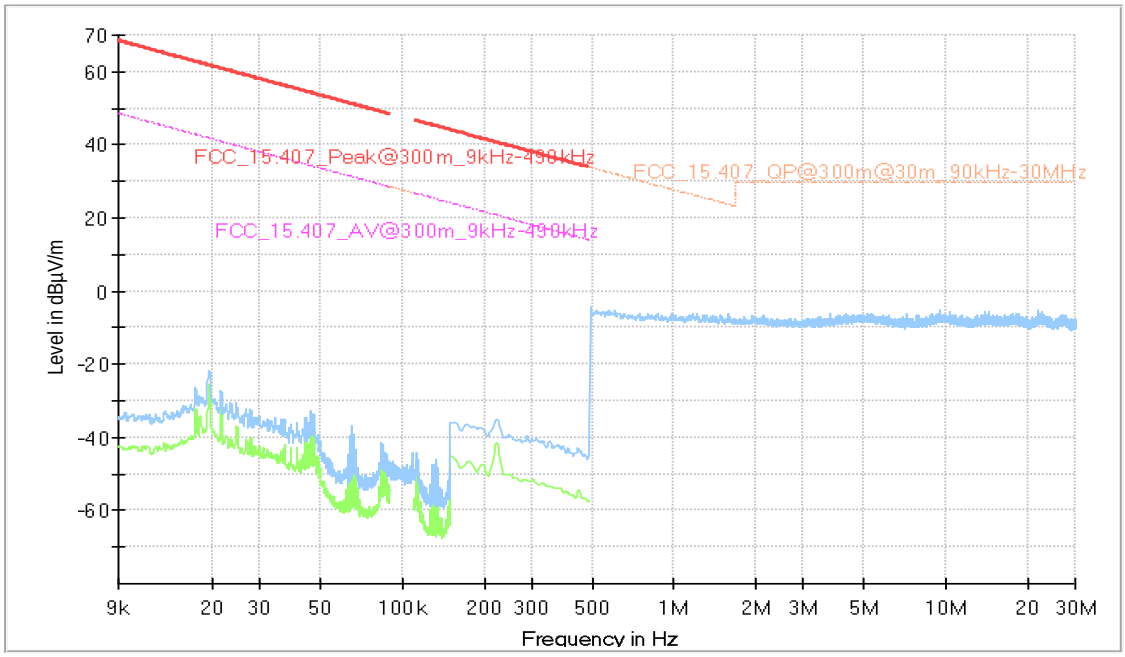


Radio Technology = WLAN a, Operating Frequency = mid, Measurement range = 9kHz - 30MHz, Subband = U-NII-1
(S01_ai02)

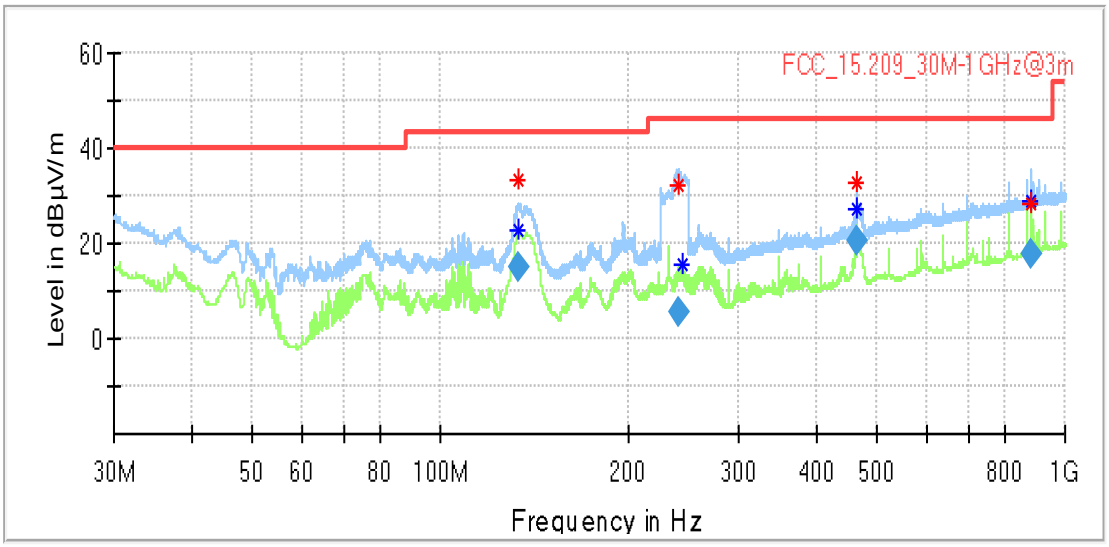
XY-Axis



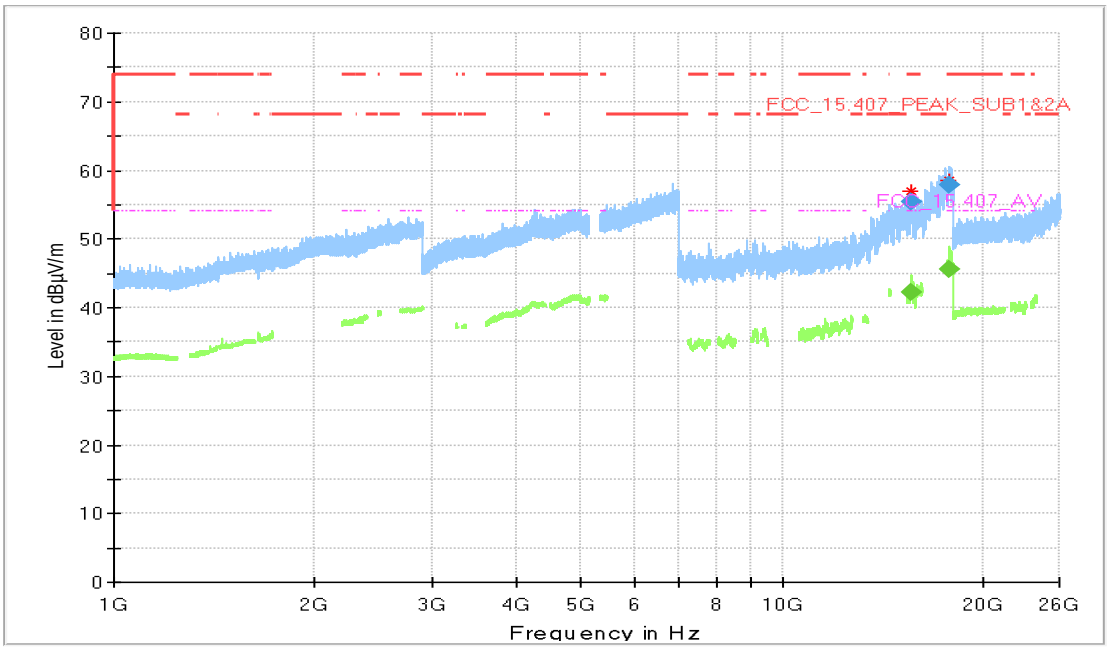
Z-Axis



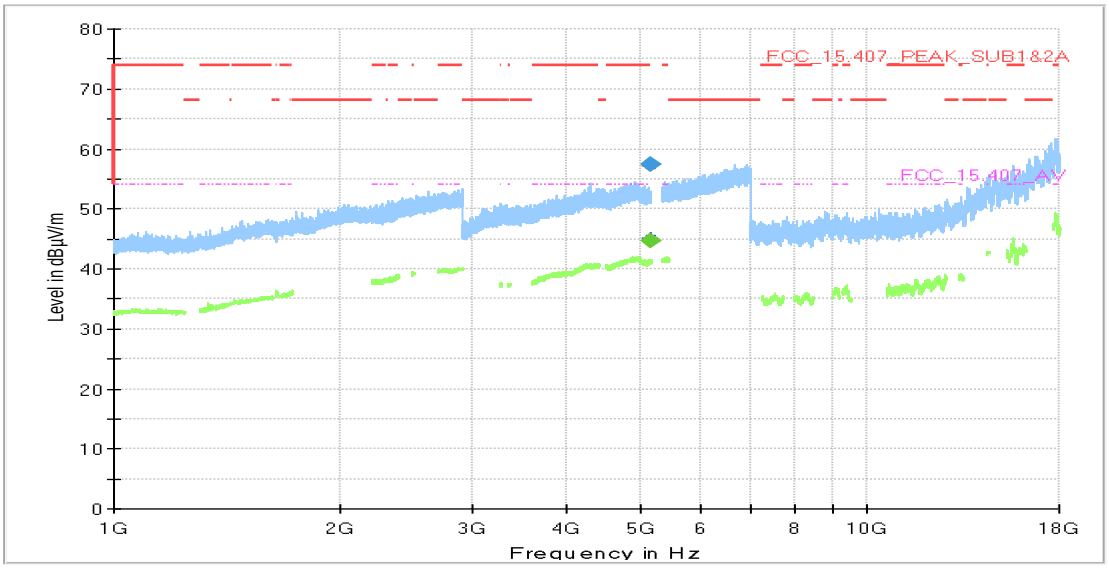
Radio Technology = WLAN a, Operating Frequency = mid, Measurement range = 30MHz - 1GHz, Subband = U-NII-1
(S01_ai02)



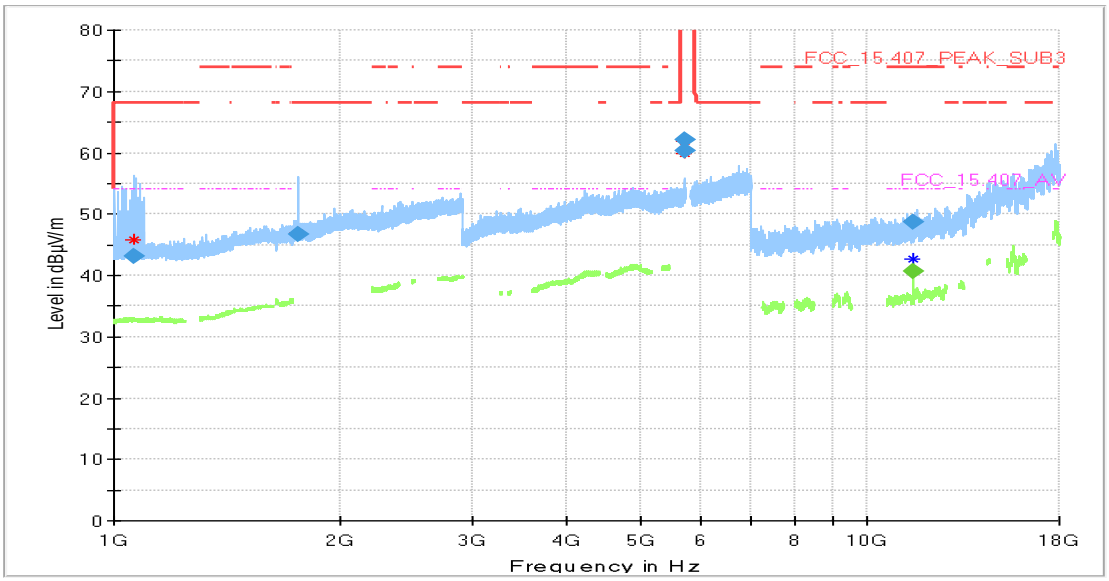
Radio Technology = WLAN a, Operating Frequency = low, Measurement range = 1GHz - 26GHz, Subband = U-NII-1
(S01_ai02)



Radio Technology = WLAN n 20 MHz, Operating Frequency = low, Measurement range = 1GHz - 26GHz, Subband = U-NII-1
(S01_ai02)



Radio Technology = WLAN ac 40 MHz, Operating Frequency = low, Measurement range = 1GHz - 26GHz, Subband = U-NII-3
(S01_ai02)



5.6.5 TEST EQUIPMENT USED

- Radiated Emissions

5.7 BAND EDGE

Standard **FCC Part 15 Subpart E**

The test was performed according to:
ANSI C63.10

5.7.1 TEST DESCRIPTION

Please see test description for the test case "Spurious Radiated Emissions"

5.7.2 TEST REQUIREMENTS / LIMITS

For band edges connected to a restricted band, the limits are specified in Section 15.209(a)

FCC Part 15, Subpart C, §15.209, Radiated Emission Limits

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limits (dBµV/m)
0.009 – 0.49	2400/F(kHz)@300m	3	(48.5 – 13.8)@300m
0.49 – 1.705	24000/F(kHz)@30m	3	(33.8 – 23.0)@30m
1.705 – 30	30@30m	3	29.5@30m

The measured values are corrected with an inverse linear distance extrapolation factor (40 dB/decade) according FCC 15.31 (2).

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limits (dBµV/m)
30 – 88	100@3m	3	40.0@3m
88 – 216	150@3m	3	43.5@3m
216 – 960	200@3m	3	46.0@3m
960 - 26000	500@3m	3	54.0@3m
26000 - 40000	500@3m	1	54.0@3m

The measured values above 26 GHz are corrected with an inverse linear distance extrapolation factor (20 dB/decade).

§15.35(b) ..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....

Used conversion factor: Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)

5.7.3 TEST PROTOCOL

Ambient temperature: 22 - 24 °C
Air Pressure: 1008 - 1025 hPa
Humidity: 31 - 34 %

WLAN a-Mode; 20 MHz; 6 Mbit/s

U-NII-Subband	Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type	FCC /IC?
1	36	5180	5150.0	57.5	PEAK	1000	74.0	16.5	BE-RB	FCC&IC
	36	5180	5150.0	44.7	AV	1000	54.0	9.3	BE-RB	FCC&IC
3	149	5745	5725.0	56.7	PEAK	1000	68.2	11.5	BE-UE	FCC&IC
	165	5825	5850.0	58.1	PEAK	1000	68.2	10.1	BE-UE	FCC&IC

WLAN n-Mode; 20 MHz; MCS0; SISO

U-NII-Subband	Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type	FCC /IC?
1	36	5180	5150.0	57.4	PEAK	1000	74.0	16.6	BE-RB	FCC&IC
	36	5180	5150.0	44.8	AV	1000	54.0	9.2	BE-RB	FCC&IC
3	149	5745	5725.0	57.5	PEAK	1000	68.2	10.7	BE-UE	FCC&IC
	165	5825	5850.0	58.2	PEAK	1000	68.2	10.0	BE-UE	FCC&IC

WLAN n-Mode; 40 MHz; MCS0; SISO

U-NII-Subband	Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type	FCC /IC?
1	38	5190	5150.0	62.1	PEAK	1000	74.0	11.9	BE-RB	FCC&IC
	38	5190	5150.0	46.7	AV	1000	54.0	7.3	BE-RB	FCC&IC
3	151	5755	5725.0	64.8	PEAK	1000	68.2	3.4	BE-UE	FCC&IC
	159	5795	5850.0	58.0	PEAK	1000	68.2	10.2	BE-UE	FCC&IC

WLAN ac-Mode; 20 MHz; MCS0; SISO

U-NII-Subband	Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type	FCC /IC?
1	36	5180	5150.0	56.7	PEAK	1000	74.0	17.3	BE-RB	FCC&IC
	36	5180	5150.0	44.4	AV	1000	54.0	9.6	BE-RB	FCC&IC
3	149	5745	5725.0	57.7	PEAK	1000	68.2	10.5	BE-UE	FCC&IC
	165	5825	5850.0	57.4	PEAK	1000	68.2	10.8	BE-UE	FCC&IC

WLAN ac-Mode; 40 MHz; MCS0; SISO

U-NII-Subband	Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type	FCC /IC?
1	38	5190	5150.0	63.7	PEAK	1000	74.0	10.3	BE-RB	FCC&IC
	38	5190	5150.0	47.8	AV	1000	54.0	6.2	BE-RB	FCC&IC
3	151	5755	5725.0	62.1	PEAK	1000	68.2	6.1	BE-UE	FCC&IC
	159	5795	5850.0	58.0	PEAK	1000	68.2	10.2	BE-UE	FCC&IC

WLAN ac-Mode; 80 MHz; MCS0; SISO

U-NII-Subband	Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type	FCC /IC?
1	42	5210	5150.0	61.9	PEAK	1000	74.0	12.1	BE-RB	FCC&IC
	42	5210	5150.0	45.2	AV	1000	54.0	8.8	BE-RB	FCC&IC
3	155	5775	5725.0	56.9	PEAK	1000	68.2	11.3	BE-UE	FCC&IC
	155	5775	5850.0	57.7	PEAK	1000	68.2	10.5	BE-UE	FCC&IC

WLAN n-Mode; 20 MHz; MCS0; MIMO

U-NII-Subband	Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type	FCC /IC?
1	36	5180	5150.0	62.2	PEAK	1000	74.0	11.8	BE-RB	FCC&IC
	36	5180	5150.0	45.8	AV	1000	54.0	8.2	BE-RB	FCC&IC
3	165	5825	5850.0	57.4	PEAK	1000	68.2	10.8	BE-UE	FCC&IC

WLAN n-Mode; 40 MHz; MCS0; MIMO

U-NII-Subband	Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type	FCC /IC?
1	38	5190	5150.0	66.0	PEAK	1000	74.0	8.0	BE-RB	FCC&IC
	38	5190	5150.0	51.9	AV	1000	54.0	2.1	BE-RB	FCC&IC
3	151	5755	5725.0	65.6	PEAK	1000	68.2	2.6	BE-UE	FCC&IC

WLAN ac-Mode; 20 MHz; MCS0; MIMO

U-NII-Subband	Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type	FCC /IC?
1	36	5180	5150.0	59.3	PEAK	1000	74.0	14.7	BE-RB	FCC&IC
	36	5180	5150.0	46.0	AV	1000	54.0	8.0	BE-RB	FCC&IC
3	149	5745	5725.0	60.7	PEAK	1000	68.2	7.5	BE-UE	FCC&IC

WLAN ac-Mode; 40 MHz; MCS0; MIMO

U-NII-Subband	Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type	FCC /IC?
1	38	5190	5150.0	70.5	PEAK	1000	74.0	3.5	BE-RB	FCC&IC
	38	5190	5150.0	51.8	AV	1000	54.0	2.2	BE-RB	FCC&IC
3	151	5755	5725.0	65.7	PEAK	1000	68.2	2.5	BE-UE	FCC&IC

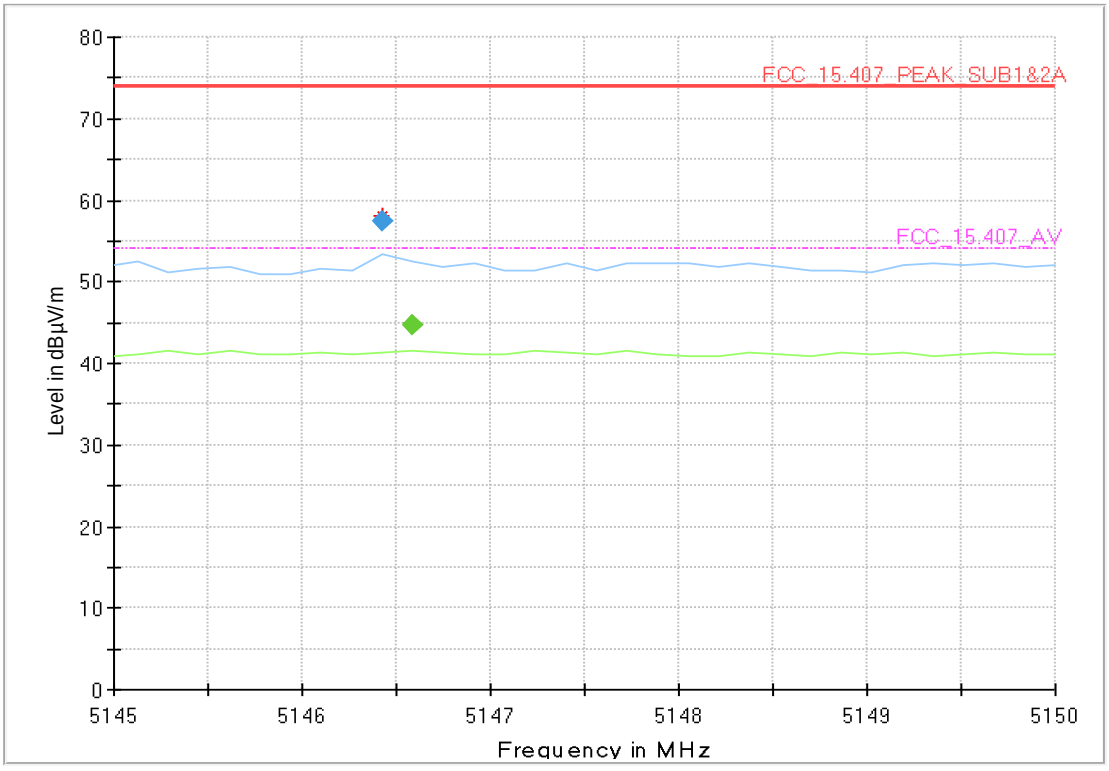
WLAN ac-Mode; 80 MHz; MCS0; MIMO

U-NII-Subband	Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type	FCC /IC?
1	42	5210	5150.0	68.2	PEAK	1000	74.0	5.8	BE-RB	FCC&IC
	42	5210	5150.0	52.0	AV	1000	54.0	2.0	BE-RB	FCC&IC
	155	5775	5850.0	67.1	PEAK	1000	68.2	1.1	BE-UE	FCC&IC

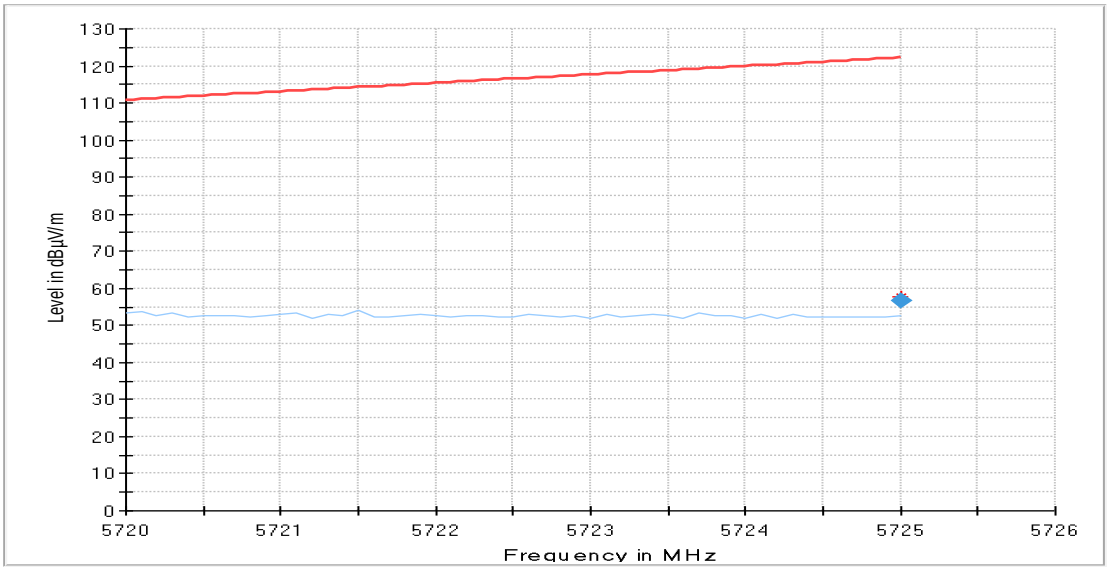
Remark: Please see next sub-clause for the measurement plot.

5.7.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

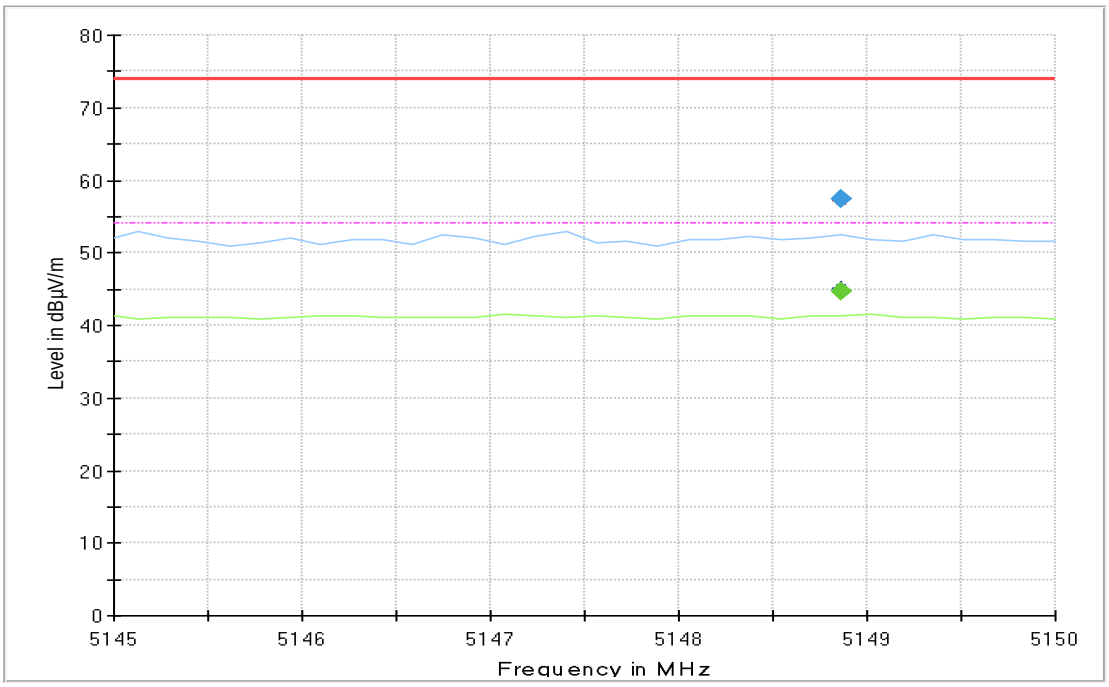
Radio Technology = WLAN a, Operating Frequency = low, Subband = U-NII-1 (S01_ai02)



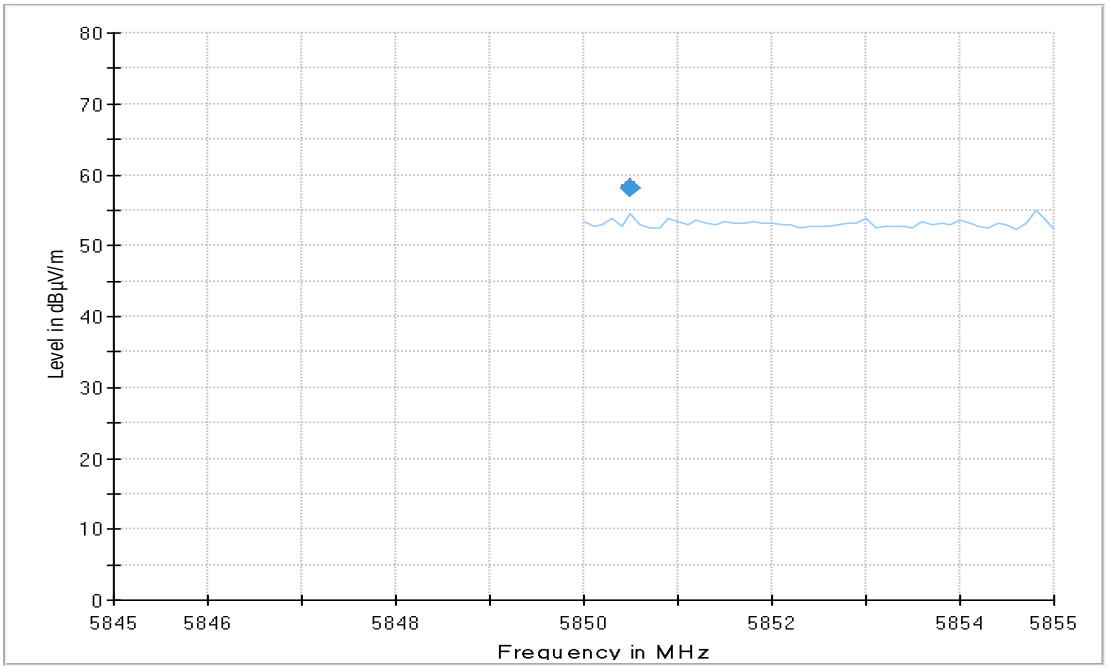
Radio Technology = WLAN a, Operating Frequency = low, Subband = U-NII-3 (S01_ai02)



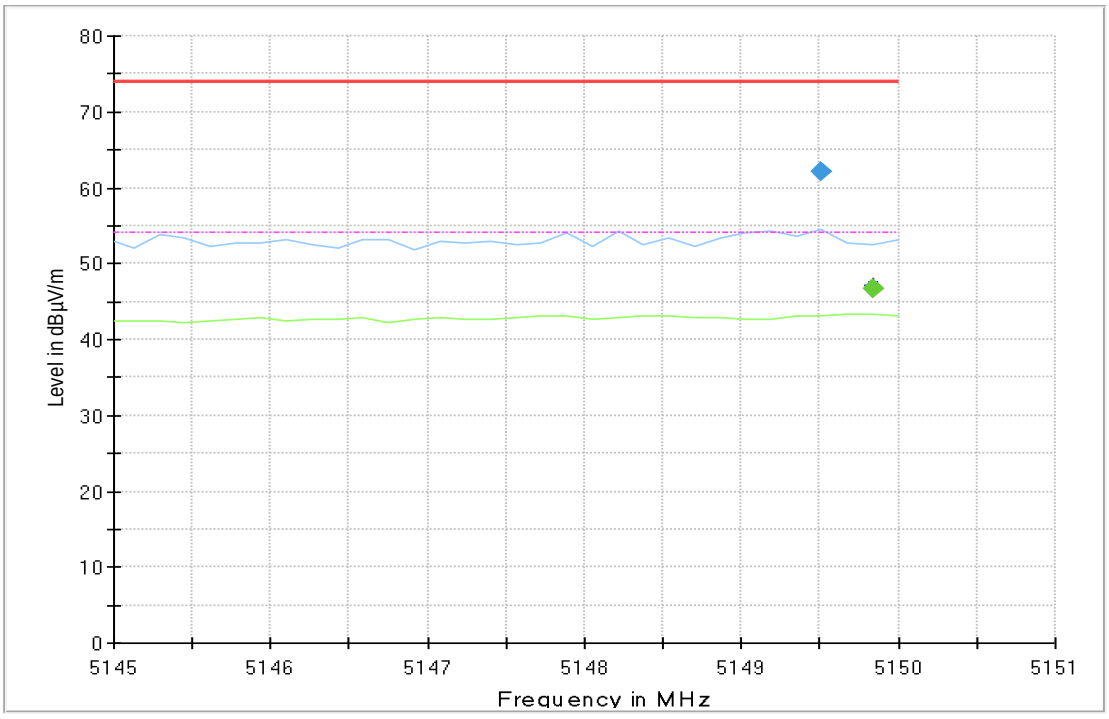
Radio Technology = WLAN n 20 MHz, Operating Frequency = low, Subband = U-NII-1 (S01_ai02)



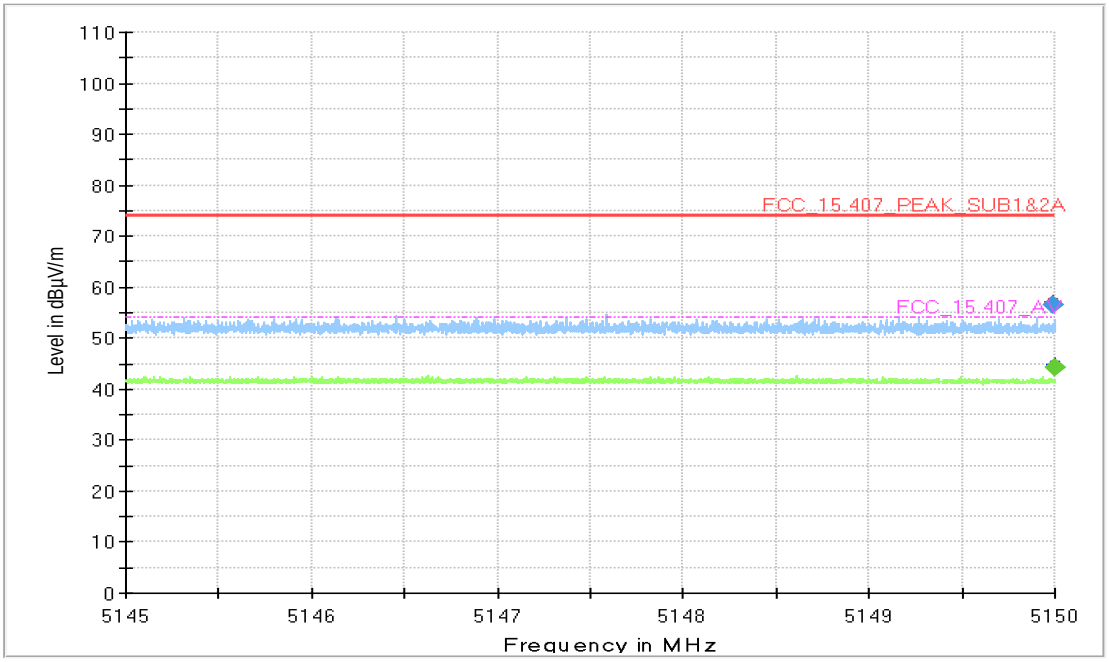
Radio Technology = WLAN n 20 MHz, Operating Frequency = high, Subband = U-NII-3 (S01_ai02)



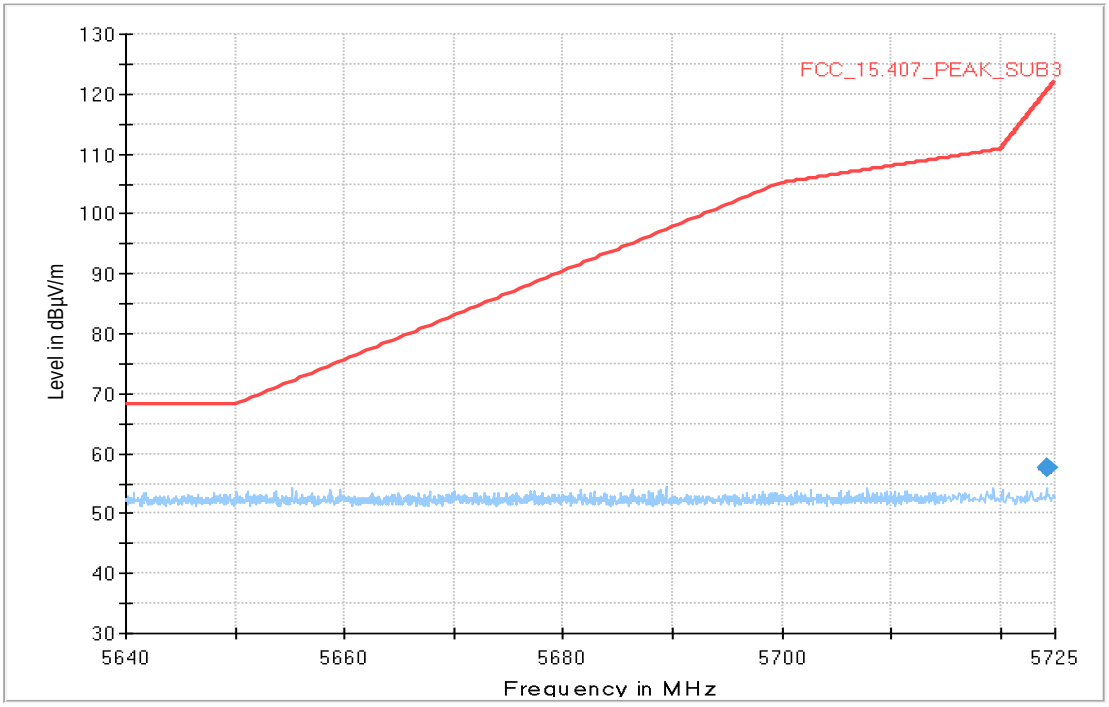
Radio Technology = WLAN n 40 MHz, Operating Frequency = low, Subband = U-NII-1 (S01_ai02)



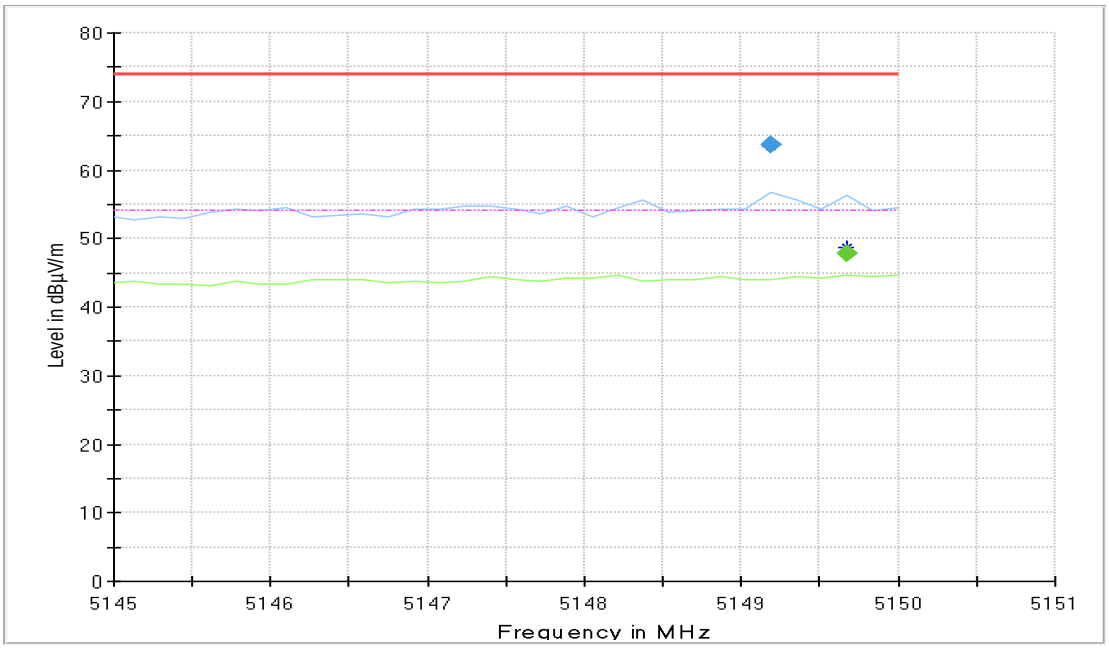
Radio Technology = WLAN ac 20 MHz, Operating Frequency = low, Subband = U-NII-1 (S01_ai02)



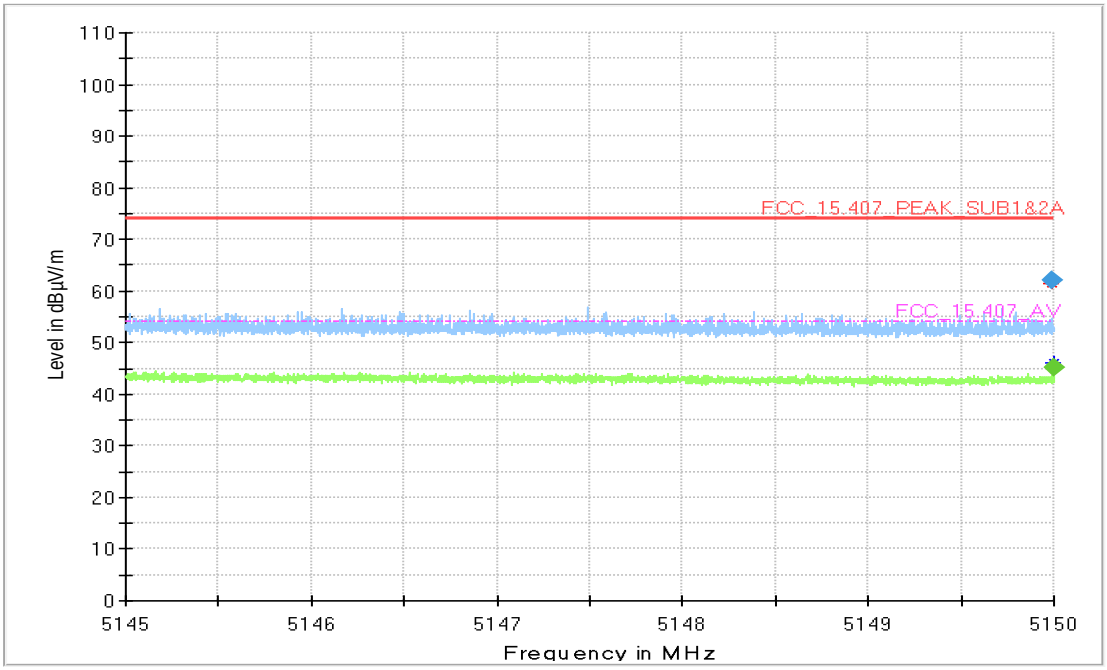
Radio Technology = WLAN ac 20 MHz, Operating Frequency = low, Subband = U-NII-3 (S01_ai02)



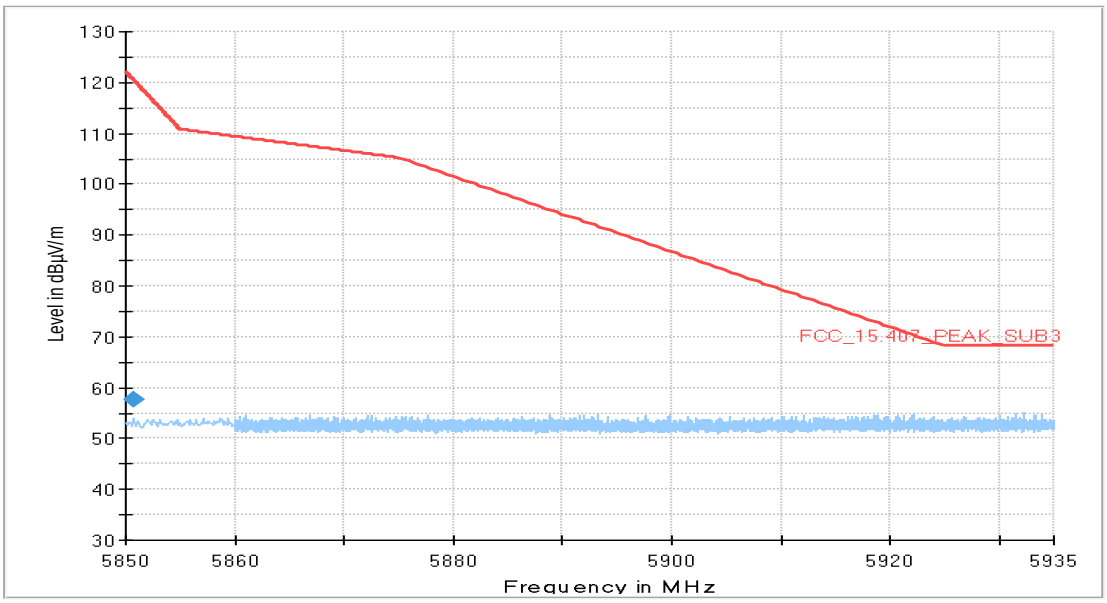
Radio Technology = WLAN ac 40 MHz, Operating Frequency = low, Subband = U-NII-1 (S01_ai02)



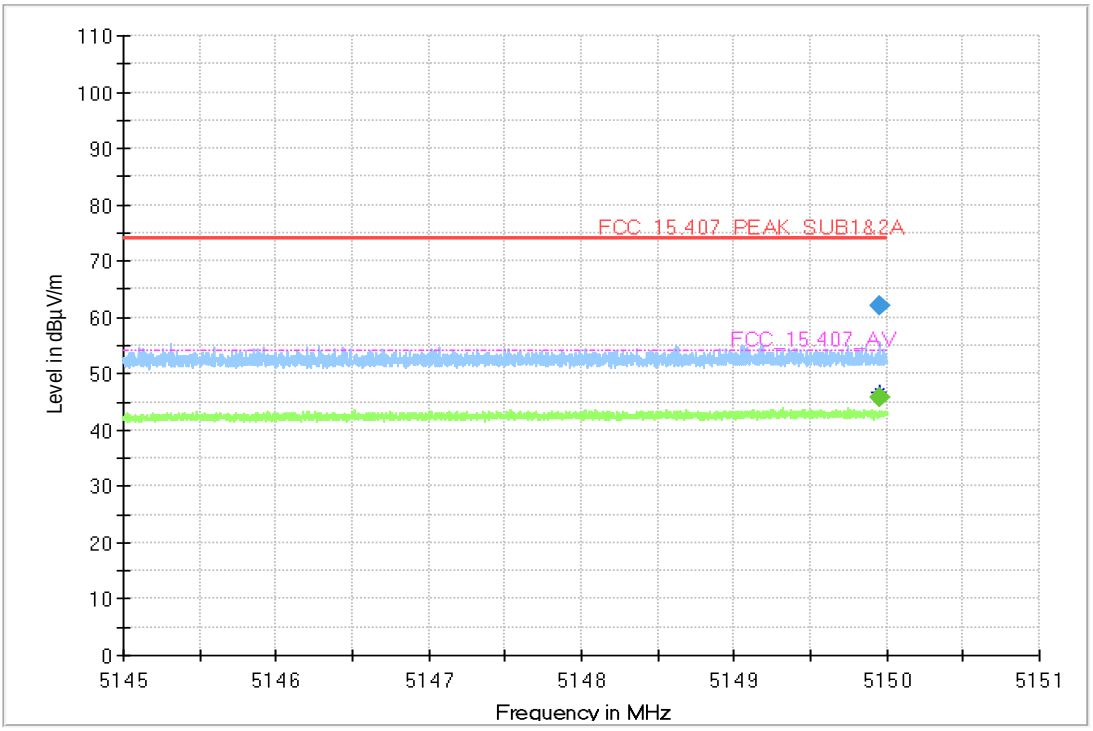
Radio Technology = WLAN ac 80 MHz, Operating Frequency = mid, Subband = U-NII-1 (S01_ai02)



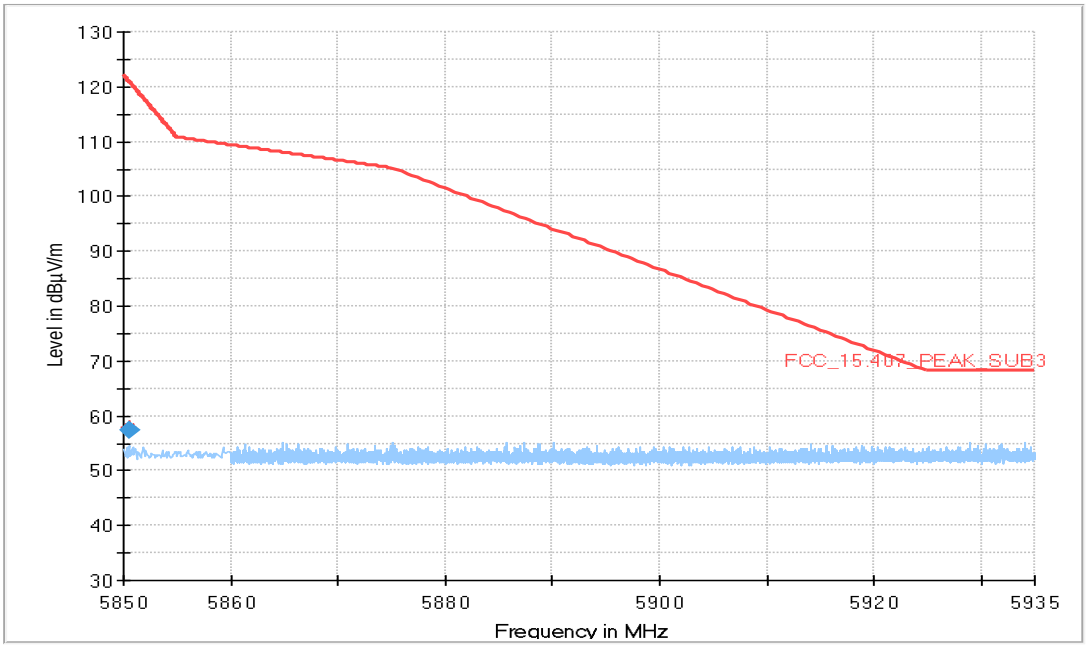
Radio Technology = WLAN ac 80 MHz, Operating Frequency = mid, Subband = U-NII-3 (S01_ai02)



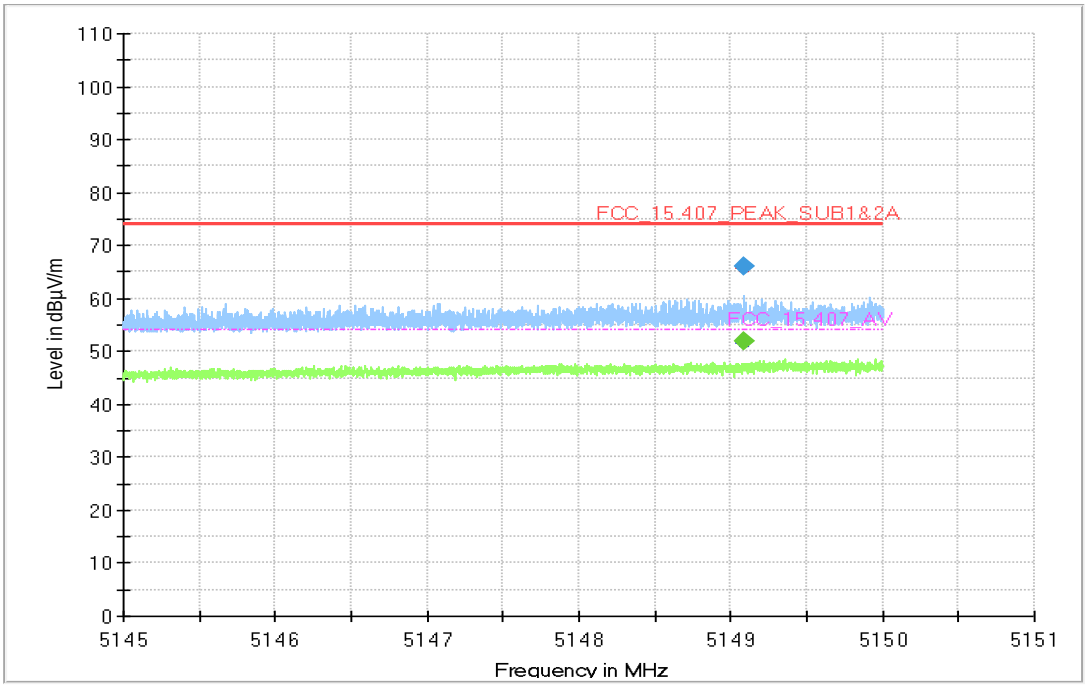
Radio Technology = WLAN n 20 MHz MIMO, Operating Frequency = low, Subband = U-NII-1 (S01_ai02)



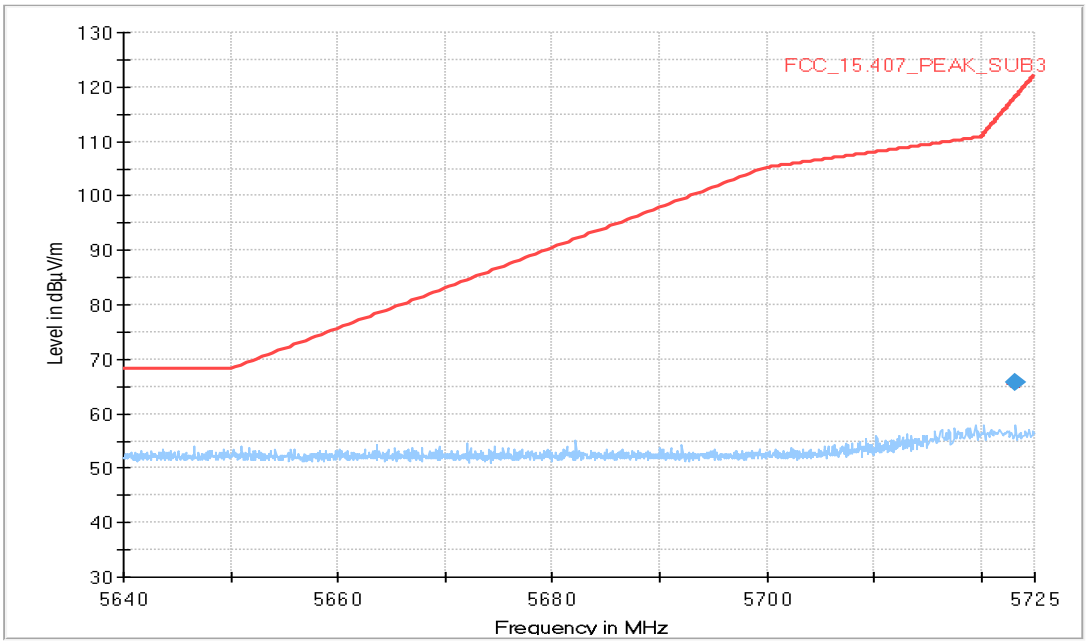
Radio Technology = WLAN n 20 MHz MIMO, Operating Frequency = high, Subband = U-NII-3 (S01_ai02)



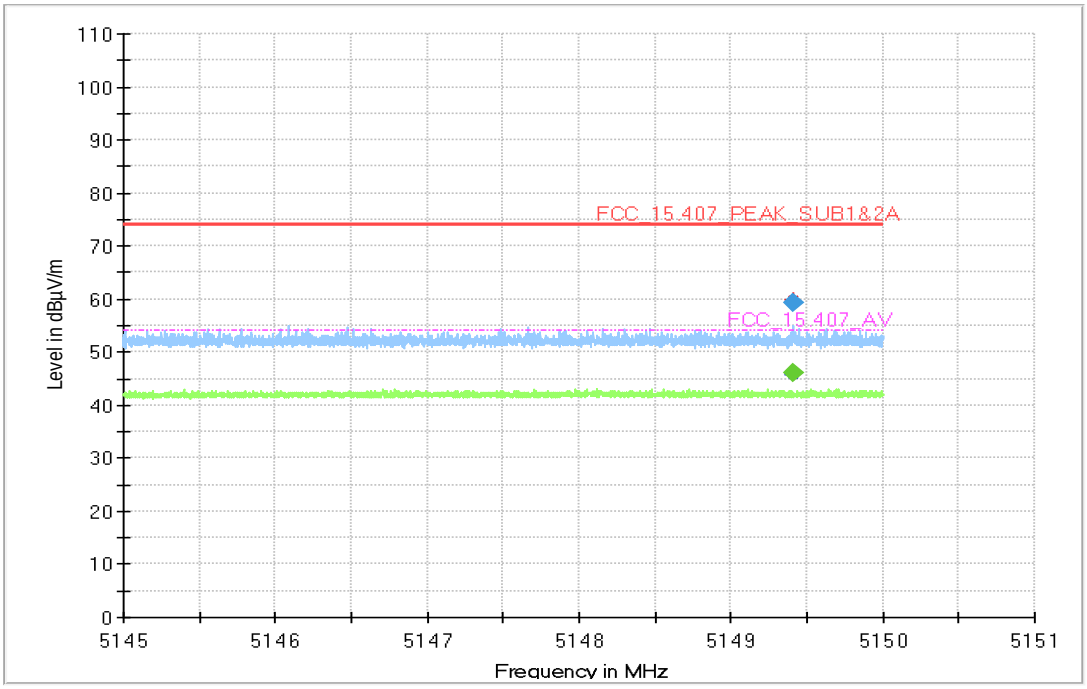
Radio Technology = WLAN n 40 MHz MIMO, Operating Frequency = low, Subband = U-NII-1 (S01_ai02)



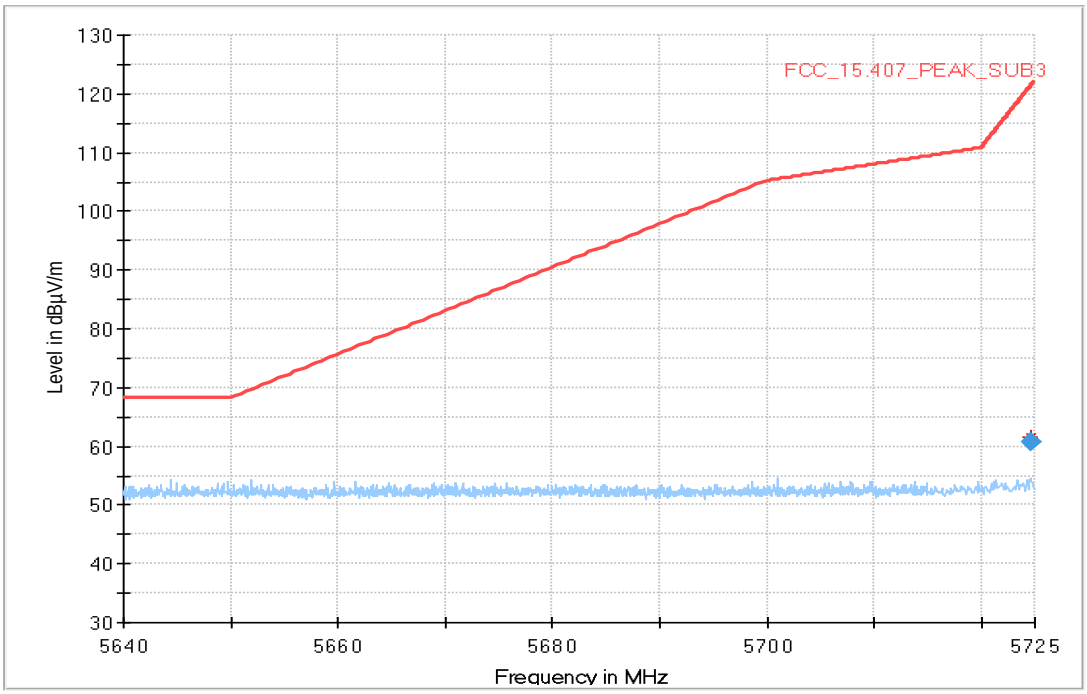
Radio Technology = WLAN n 40 MHz MIMO, Operating Frequency = low, Subband = U-NII-3 (S01_ai02)



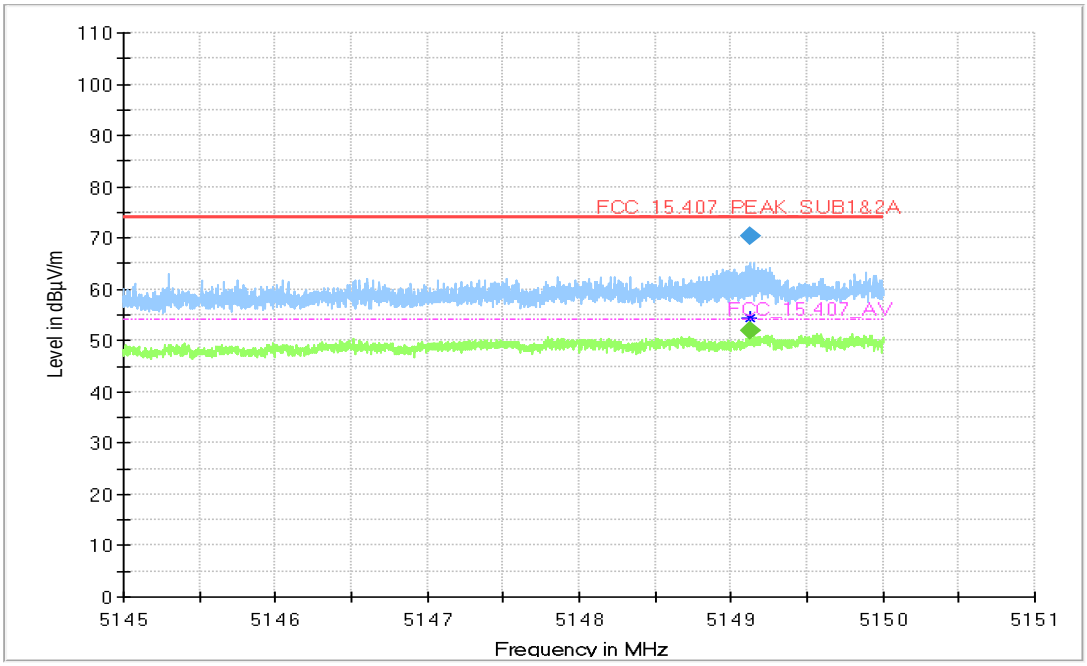
Radio Technology = WLAN ac 20 MHz MIMO, Operating Frequency = low, Subband = U-NII-1 (S01_ai02)



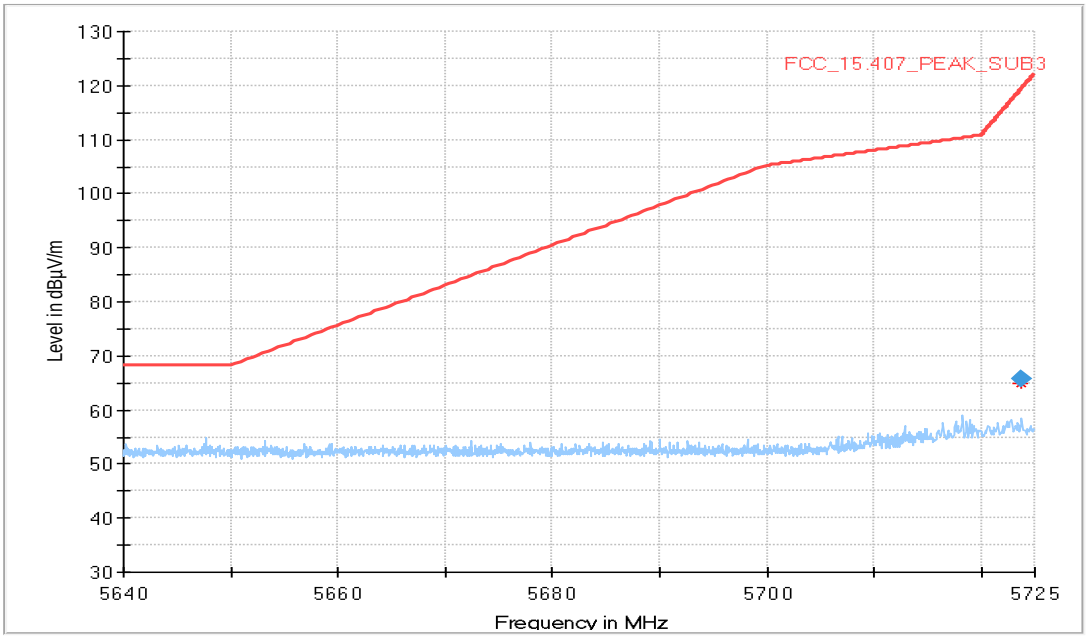
Radio Technology = WLAN ac 20 MHz MIMO, Operating Frequency = low, Subband = U-NII-3 (S01_ai02)



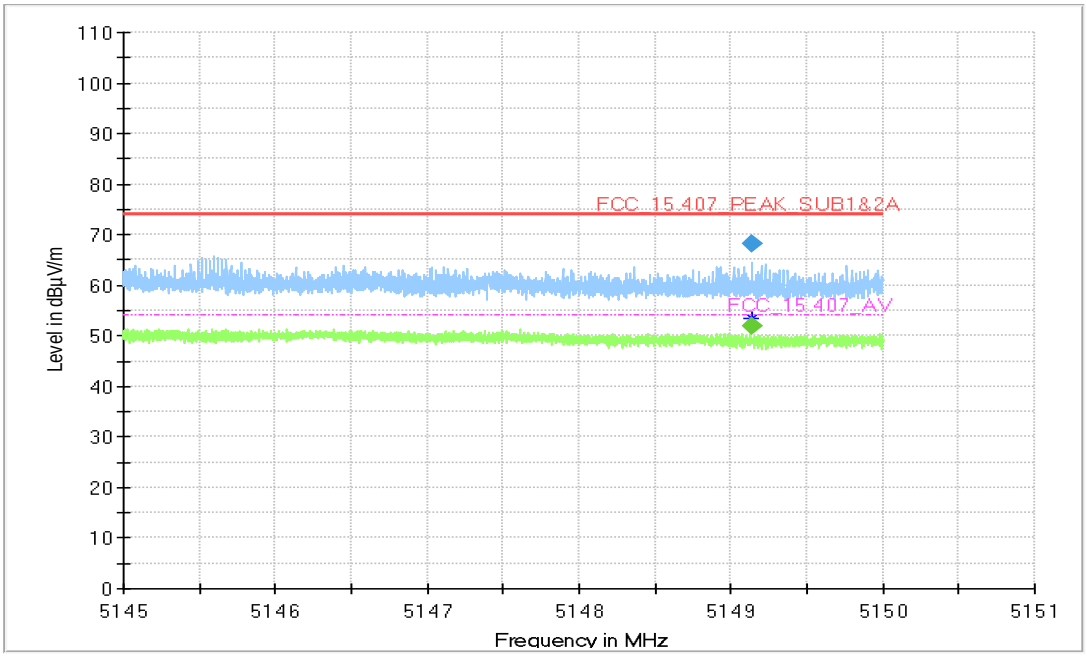
Radio Technology = WLAN ac 40 MHz MIMO, Operating Frequency = low, Subband = U-NII-1 (S01_ai02)



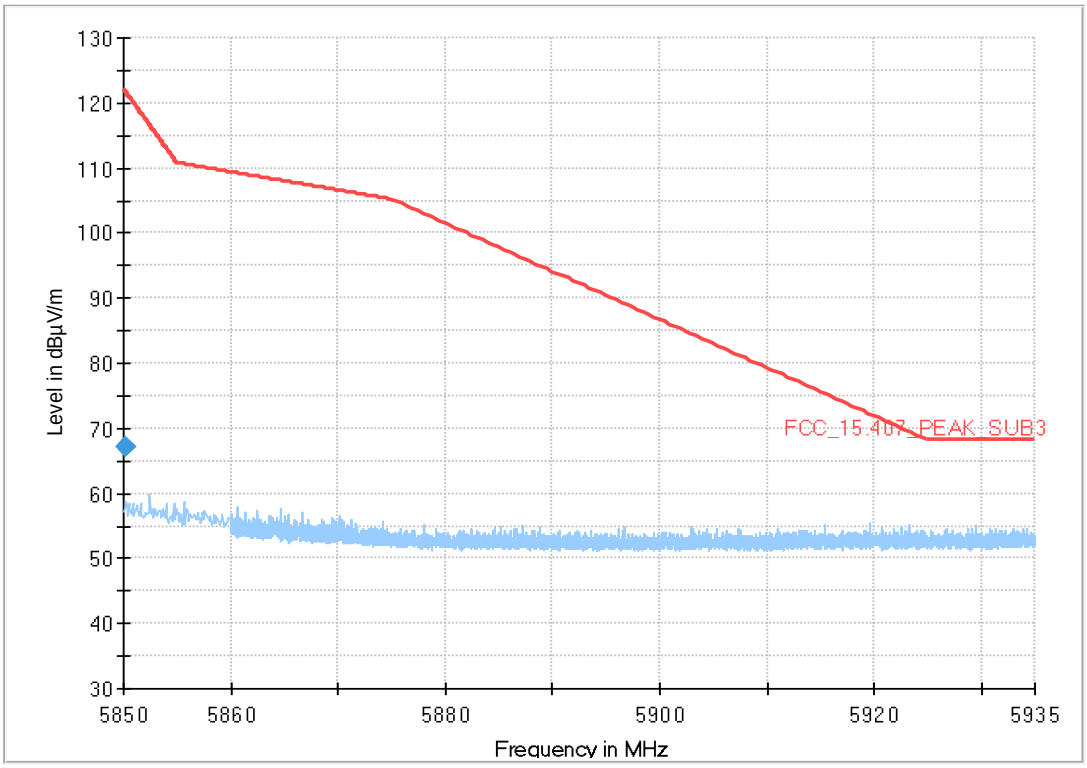
Radio Technology = WLAN ac 40 MHz MIMO, Operating Frequency = low, Subband = U-NII-3 (S01_ai02)



Radio Technology = WLAN ac 80 MHz MIMO, Operating Frequency = mid, Subband = U-NII-1 (S01_ai02)



Radio Technology = WLAN ac 80 MHz MIMO, Operating Frequency = mid, Subband = U-NII-3 (S01_ai02)



5.7.5 TEST EQUIPMENT USED

- Radiated Emissions

6 TEST EQUIPMENT

1 R&S TS8997
EN300328/301893 Test Lab

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.1	SMBV100A	Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz	107695	2017-07	2020-07
1.2	FSV30	Signal Analyzer 10 Hz - 30 GHz	Rohde & Schwarz	103005	2018-04	2020-04
1.3	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2018-04	2020-04
1.4	Temperature Chamber VT 4002	Temperature Chamber Vötsch 03	Vötsch	58566002150010	2018-04	2020-04
1.5	A8455-4	4 Way Power Divider (SMA)		-		
1.6	Opus10 THI (8152.00)	T/H Logger 03	Lufft Mess- und Regeltechnik GmbH	7482	2019-06	2021-06
1.7	UNI-T UT195E	True RMS Digital Multimeter	UNI-T UNI-TREND TECHNOLOGY (CHINA) CO., LTD.	C190729561		
1.8	SMBV100A	Vector Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz	259291	2019-11	2022-11
1.9	OSP120	Switching Unit with integrated power meter	Rohde & Schwarz	101158	2018-05	2021-05
1.10	Temperature Chamber VT 4002	Temperature Chamber Vötsch 05	Vötsch	58566080550010	2018-04	2020-04

2 Radiated Emissions
Lab to perform radiated emission tests

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.1	MFS	Rubidium Frequency Normal MFS	Datum GmbH	002	2019-10	2020-10
2.2	N5000/NP	Filter for EUT, 2 Lines, 250 V, 16 A	ETS-LINDGREN	241515		
2.3	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2019-05	2021-05
2.4	ESW44	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	101603	2019-12	2021-12
2.5	Anechoic Chamber 01	SAC/FAR, 10.58 m x 6.38 m x 6.00 m	Frankonia	none	2018-06	2020-06

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.6	HL 562 ULTRALOG	Biconical-log-per antenna (30 MHz - 3 GHz) with HL 562E biconicals	Rohde & Schwarz GmbH & Co. KG	830547/003	2018-07	2021-07
2.7	AMF-7D00101800-30-10P-R	Broadband Amplifier 100 MHz - 18 GHz	Miteq			
2.8	5HC2700/12750-1.5-KK	High Pass Filter	Trilithic	9942012		
2.9	ASP 1.2/1.8-10 kg	Antenna Mast	Maturo GmbH	-		
2.10	Anechoic Chamber 03	FAR, 8.80m x 4.60m x 4.05m (l x w x h)	Albatross Projects	P26971-647-001-PRB	2018-06	2020-06
2.11	SMBV100A	Vector Signal Generator 9 kHz - 3.2 GHz (GNSS / Broadcast Signalling Unit)	Rohde & Schwarz GmbH & Co. KG	260001	2018-01	2021-01
2.12	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2018-04	2020-04
2.13	WRD1920/1980-5/22-5EESD	Tunable Band Reject Filter	Wainwright Instruments GmbH	11		
2.14	TDS 784C	Digital Oscilloscope [SA2] (Aux)	Tektronix	B021311		
2.15	foRS232 Unit 2	Fibre optic link RS232	PONTIS Messtechnik GmbH	4031516037		
2.16	PONTIS Con4101	PONTIS Camera Controller		6061510370		
2.17	NRVD	Power Meter	Rohde & Schwarz GmbH & Co. KG	828110/016	2019-08	2020-08
2.18	OLS-1 R	Fibre optic link USB 1.1	Ingenieurbüro Scheiba	018		
2.19	HF 906	Double-ridged horn	Rohde & Schwarz	357357/002	2018-09	2021-09
2.20	JS4-18002600-32-5P	Broadband Amplifier 18 GHz - 26 GHz	Miteq	849785		
2.21	FSW 43	Spectrum Analyzer	Rohde & Schwarz	103779	2019-02	2021-02
2.22	3160-09	Standard Gain / Pyramidal Horn Antenna 26.5 GHz	EMCO Elektronic GmbH	00083069		
2.23	foRS232 Unit 1	Fibre optic link RS232	PONTIS Messtechnik GmbH	4021516036		
2.24	FSP3	Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	836722/011		
2.25	WHKX 7.0/18G-8SS	High Pass Filter	Wainwright Instruments GmbH	09		

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.26	DS 420S	Turn Table 2 m diameter	HD GmbH	420/573/99		
2.27	4HC1600/12750-1.5-KK	High Pass Filter	Trilithic	9942011		
2.28	foUSB-M Converter 2	Fibre optic link USB 2.0	PONTIS Messtechnik GmbH	4471520061		
2.29	WRCD1879.8-0.2/40-10EE	Notch Filter Ultra Stable	Wainwright Instruments GmbH	16		
2.30	SMBV100A	Signal Generator 100 kHz - 40 GHz	Rohde & Schwarz Vertriebs-GmbH	181486	2019-11	2021-11
2.31	JS4-00102600-42-5A	Broadband Amplifier 30 MHz - 26 GHz	Miteq	619368		
2.32	TT 1.5 WI	Turn Table	Maturo GmbH	-		
2.33	HL 562 ULTRALOG	Biconical-log-per Antenna (30 MHz - 3 GHz)	Rohde & Schwarz GmbH & Co. KG	100609	2019-05	2022-05
2.34	HF 906	Double-ridged horn	Rohde & Schwarz	357357/001	2018-03	2021-03
2.35	foCAN (v 4.0)	Fibre optic link CAN	Audivo GmbH (PONTIS EMC)	492 1607 014		
2.36	FS-Z325	Harmonic Mixer 220 - 325 GHz	Rohde & Schwarz Messgerätebau GmbH	101006	2017-03	2020-03
2.37	CMW500	CMW500 Callbox OIL-RE, SUW	Rohde & Schwarz GmbH & Co. KG	155999-Ei	2019-09	2022-09
2.38	CMU 200	"CMU1" Universal Radio Communicatio n Tester	Rohde & Schwarz GmbH & Co. KG	102366	2017-12	2020-12
2.39	MA4985-XP-ET	Bore Sight Antenna Mast	innco systems GmbH	none		
2.40	CBT	Bluetooth Tester "CBT-02" incl. BLE-Option	Rohde & Schwarz	100302	2018-03	2021-03
2.41	CMW500	CMW500 Callbox OIL-RE, SUW	Rohde & Schwarz GmbH & Co. KG	163529-bw	2017-07	2020-07
2.42	A8455-4	4 Way Power Divider (SMA)		-		
2.43	JUN-AIR Mod. 6-15	Air Compressor	JUN-AIR Deutschland GmbH	612582		
2.44	foEthernet_M	Fibre optic link Ethernet / Gb-LAN	PONTIS Messtechnik GmbH	4841516023		
2.45	5HC3500/18000-1.2-KK	High Pass Filter	Trilithic	200035008		
2.46	OLS-1 M	Fibre optic link USB 1.1	Ingenieurbüro Scheiba	018		
2.47	HFH2-Z2	Loop Antenna	Rohde & Schwarz	829324/006	2018-01	2021-01
2.48	Voltcraft M-3860M	Digital Multimeter 01 (Multimeter)	Conrad	IJ096055		

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.49	CMW 500	callbox, 2G, 3G, LTE, WLAN, BT, Audio	Rohde & Schwarz GmbH & Co. KG	149268-Qf	2018-04	2021-04
2.50	Opus10 THI (8152.00)	T/H Logger 12	Lufft Mess- und Regeltechnik GmbH	12482	2019-06	2021-06
2.51	ESR 7	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz	101424	2019-01	2021-01
2.52	UNI-T UT195E	True RMS Digital Multimeter	UNI-T UNI-TREND TECHNOLOGY (CHINA) CO., LTD.	C190729561		
2.53	foEthernet_M	Fibre optic link Ethernet / Gb-LAN	PONTIS Messtechnik GmbH	4841516022		
2.54	JS4-00101800-35-5P	Broadband Amplifier 30 MHz - 18 GHz	Miteq	896037		
2.55	AS 620 P	Antenna Mast (pneumatic polarisation)	HD GmbH	620/37		
2.56	6005D (30 V / 5 A)	Laboratory Power Supply 120 V 60 Hz	Peaktech	81062045		
2.57	TD1.5-10kg	EUT Tilt Device (Rohacell)	Maturo GmbH	TD1.5-10kg/024/3790709		
2.58	ESIB 26	Spectrum Analyzer	Rohde & Schwarz	830482/004	2018-01	2020-01
2.59	Innco Systems CO3000	Controller for bore sight mast SAC	innco systems GmbH	CO3000/967/39371016/L		
2.60	NRV-Z1	Sensor Head B	Rohde & Schwarz GmbH & Co. KG	827753/006	2019-08	2020-08
2.61	HF 907-2	Double-ridged horn	Rohde & Schwarz	102817	2019-04	2022-04
2.62	foCAN (v 4.0)	Fibre optic link CAN	Audivo GmbH (PONTIS EMC)	492 1607 013		
2.63	PAS 2.5 - 10 kg	Antenna Mast	Maturo GmbH	-		
2.64	AFS42-00101800-25-S-42	Broadband Amplifier 25 MHz - 18 GHz	Miteq	2035324		
2.65	WRCA800/960-0.2/40-6EEK	Tunable Notch Filter	Wainwright Instruments GmbH	20		
2.66	AM 4.0	Antenna Mast 4 m	Maturo GmbH	AM4.0/180/11920513		
2.67	HF 907	Double-ridged horn	Rohde & Schwarz	102444	2018-07	2021-07
2.68	E4408B	Spectrum Analyser (9 kHz to 26.5 GHz)	Agilent Technologies Deutschland GmbH	MY45103714		

The calibration interval is the time interval between “Last Calibration” and “Calibration Due”

7 ANTENNA FACTORS, CABLE LOSS AND SAMPLE CALCULATIONS

This chapter contains the antenna factors with their corresponding path loss of the used measurement path for all antennas as well as the insertion loss of the LISN.

7.1 LISN R&S ESH3-Z5 (150 KHZ – 30 MHZ)

Frequency		Corr.	LISN insertion loss ESH3-Z5	cable loss (incl. 10 dB atten-uator)
MHz		dB	dB	dB
0.15		10.1	0.1	10.0
5		10.3	0.1	10.2
7		10.5	0.2	10.3
10		10.5	0.2	10.3
12		10.7	0.3	10.4
14		10.7	0.3	10.4
16		10.8	0.4	10.4
18		10.9	0.4	10.5
20		10.9	0.4	10.5
22		11.1	0.5	10.6
24		11.1	0.5	10.6
26		11.2	0.5	10.7
28		11.2	0.5	10.7
30		11.3	0.5	10.8

Sample calculation

U_{LISN} (dB µV) = U (dB µV) + Corr. (dB)
U = Receiver reading
LISN Insertion loss = Voltage Division Factor of LISN
Corr. = sum of single correction factors of used LISN, cables, switch units (if used)
Linear interpolation will be used for frequencies in between the values in the table.

7.2 ANTENNA R&S HFH2-Z2 (9 KHZ – 30 MHZ)

Frequency	AF HFH-Z2)	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-40 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
0.009	20.50	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.01	20.45	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.015	20.37	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.02	20.36	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.025	20.38	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.03	20.32	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.05	20.35	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.08	20.30	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.1	20.20	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.2	20.17	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.3	20.14	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.49	20.12	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.490001	20.12	-39.6	0.1	0.1	0.1	0.1	-40	30	3
0.5	20.11	-39.6	0.1	0.1	0.1	0.1	-40	30	3
0.8	20.10	-39.6	0.1	0.1	0.1	0.1	-40	30	3
1	20.09	-39.6	0.1	0.1	0.1	0.1	-40	30	3
2	20.08	-39.6	0.1	0.1	0.1	0.1	-40	30	3
3	20.06	-39.6	0.1	0.1	0.1	0.1	-40	30	3
4	20.05	-39.5	0.2	0.1	0.1	0.1	-40	30	3
5	20.05	-39.5	0.2	0.1	0.1	0.1	-40	30	3
6	20.02	-39.5	0.2	0.1	0.1	0.1	-40	30	3
8	19.95	-39.5	0.2	0.1	0.1	0.1	-40	30	3
10	19.83	-39.4	0.2	0.1	0.2	0.1	-40	30	3
12	19.71	-39.4	0.2	0.1	0.2	0.1	-40	30	3
14	19.54	-39.4	0.2	0.1	0.2	0.1	-40	30	3
16	19.53	-39.3	0.3	0.1	0.2	0.1	-40	30	3
18	19.50	-39.3	0.3	0.1	0.2	0.1	-40	30	3
20	19.57	-39.3	0.3	0.1	0.2	0.1	-40	30	3
22	19.61	-39.3	0.3	0.1	0.2	0.1	-40	30	3
24	19.61	-39.3	0.3	0.1	0.2	0.1	-40	30	3
26	19.54	-39.3	0.3	0.1	0.2	0.1	-40	30	3
28	19.46	-39.2	0.3	0.1	0.3	0.1	-40	30	3
30	19.73	-39.1	0.4	0.1	0.3	0.1	-40	30	3

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = -40 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values

7.3 ANTENNA R&S HL562 (30 MHZ – 1 GHZ)

(d_{Limit} = 3 m)

Frequency	AF R&S HL562	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-20 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
30	18.6	0.6	0.29	0.04	0.23	0.02	0.0	3	3
50	6.0	0.9	0.39	0.09	0.32	0.08	0.0	3	3
100	9.7	1.2	0.56	0.14	0.47	0.08	0.0	3	3
150	7.9	1.6	0.73	0.20	0.59	0.12	0.0	3	3
200	7.6	1.9	0.84	0.21	0.70	0.11	0.0	3	3
250	9.5	2.1	0.98	0.24	0.80	0.13	0.0	3	3
300	11.0	2.3	1.04	0.26	0.89	0.15	0.0	3	3
350	12.4	2.6	1.18	0.31	0.96	0.13	0.0	3	3
400	13.6	2.9	1.28	0.35	1.03	0.19	0.0	3	3
450	14.7	3.1	1.39	0.38	1.11	0.22	0.0	3	3
500	15.6	3.2	1.44	0.39	1.20	0.19	0.0	3	3
550	16.3	3.5	1.55	0.46	1.24	0.23	0.0	3	3
600	17.2	3.5	1.59	0.43	1.29	0.23	0.0	3	3
650	18.1	3.6	1.67	0.34	1.35	0.22	0.0	3	3
700	18.5	3.6	1.67	0.42	1.41	0.15	0.0	3	3
750	19.1	4.1	1.87	0.54	1.46	0.25	0.0	3	3
800	19.6	4.1	1.90	0.46	1.51	0.25	0.0	3	3
850	20.1	4.4	1.99	0.60	1.56	0.27	0.0	3	3
900	20.8	4.7	2.14	0.60	1.63	0.29	0.0	3	3
950	21.1	4.8	2.22	0.60	1.66	0.33	0.0	3	3
1000	21.6	4.9	2.23	0.61	1.71	0.30	0.0	3	3

(d_{Limit} = 10 m)

30	18.6	-9.9	0.29	0.04	0.23	0.02	-10.5	10	3
50	6.0	-9.6	0.39	0.09	0.32	0.08	-10.5	10	3
100	9.7	-9.2	0.56	0.14	0.47	0.08	-10.5	10	3
150	7.9	-8.8	0.73	0.20	0.59	0.12	-10.5	10	3
200	7.6	-8.6	0.84	0.21	0.70	0.11	-10.5	10	3
250	9.5	-8.3	0.98	0.24	0.80	0.13	-10.5	10	3
300	11.0	-8.1	1.04	0.26	0.89	0.15	-10.5	10	3
350	12.4	-7.9	1.18	0.31	0.96	0.13	-10.5	10	3
400	13.6	-7.6	1.28	0.35	1.03	0.19	-10.5	10	3
450	14.7	-7.4	1.39	0.38	1.11	0.22	-10.5	10	3
500	15.6	-7.2	1.44	0.39	1.20	0.19	-10.5	10	3
550	16.3	-7.0	1.55	0.46	1.24	0.23	-10.5	10	3
600	17.2	-6.9	1.59	0.43	1.29	0.23	-10.5	10	3
650	18.1	-6.9	1.67	0.34	1.35	0.22	-10.5	10	3
700	18.5	-6.8	1.67	0.42	1.41	0.15	-10.5	10	3
750	19.1	-6.3	1.87	0.54	1.46	0.25	-10.5	10	3
800	19.6	-6.3	1.90	0.46	1.51	0.25	-10.5	10	3
850	20.1	-6.0	1.99	0.60	1.56	0.27	-10.5	10	3
900	20.8	-5.8	2.14	0.60	1.63	0.29	-10.5	10	3
950	21.1	-5.6	2.22	0.60	1.66	0.33	-10.5	10	3
1000	21.6	-5.6	2.23	0.61	1.71	0.30	-10.5	10	3

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

7.4 ANTENNA R&S HF907 (1 GHZ – 18 GHZ)

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay + cable inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit, atten-uator & pre-amp)	cable loss 4 (to receiver)		
MHz	dB (1/m)	dB	dB	dB	dB	dB		
1000	24.4	-19.4	0.99	0.31	-21.51	0.79		
2000	28.5	-17.4	1.44	0.44	-20.63	1.38		
3000	31.0	-16.1	1.87	0.53	-19.85	1.33		
4000	33.1	-14.7	2.41	0.67	-19.13	1.31		
5000	34.4	-13.7	2.78	0.86	-18.71	1.40		
6000	34.7	-12.7	2.74	0.90	-17.83	1.47		
7000	35.6	-11.0	2.82	0.86	-16.19	1.46		

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay inside chamber)	cable loss 2 (inside chamber)	cable loss 3 (outside chamber)	cable loss 4 (switch unit, atten-uator & pre-amp)	cable loss 5 (to receiver)	used for FCC 15.247
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	
3000	31.0	-23.4	0.47	1.87	0.53	-27.58	1.33	
4000	33.1	-23.3	0.56	2.41	0.67	-28.23	1.31	
5000	34.4	-21.7	0.61	2.78	0.86	-27.35	1.40	
6000	34.7	-21.2	0.58	2.74	0.90	-26.89	1.47	
7000	35.6	-19.8	0.66	2.82	0.86	-25.58	1.46	

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay inside chamber)	cable loss 2 (High Pass)	cable loss 3 (pre-amp)	cable loss 4 (inside chamber)	cable loss 5 (outside chamber)	cable loss 6 (to receiver)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	dB
7000	35.6	-57.3	0.56	1.28	-62.72	2.66	0.94	1.46
8000	36.3	-56.3	0.69	0.71	-61.49	2.84	1.00	1.53
9000	37.1	-55.3	0.68	0.65	-60.80	3.06	1.09	1.60
10000	37.5	-56.2	0.70	0.54	-61.91	3.28	1.20	1.67
11000	37.5	-55.3	0.80	0.61	-61.40	3.43	1.27	1.70
12000	37.6	-53.7	0.84	0.42	-59.70	3.53	1.26	1.73
13000	38.2	-53.5	0.83	0.44	-59.81	3.75	1.32	1.83
14000	39.9	-56.3	0.91	0.53	-63.03	3.91	1.40	1.77
15000	40.9	-54.1	0.98	0.54	-61.05	4.02	1.44	1.83
16000	41.3	-54.1	1.23	0.49	-61.51	4.17	1.51	1.85
17000	42.8	-54.4	1.36	0.76	-62.36	4.34	1.53	2.00
18000	44.2	-54.7	1.70	0.53	-62.88	4.41	1.55	1.91

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

7.5 ANTENNA EMCO 3160-09 (18 GHZ – 26.5 GHZ)

Frequency	AF EMCO 3160-09	Corr.	cable loss 1 (inside chamber)	cable loss 2 (pre-amp)	cable loss 3 (inside chamber)	cable loss 4 (switch unit)	cable loss 5 (to receiver)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB
18000	40.2	-23.5	0.72	-35.85	6.20	2.81	2.65
18500	40.2	-23.2	0.69	-35.71	6.46	2.76	2.59
19000	40.2	-22.0	0.76	-35.44	6.69	3.15	2.79
19500	40.3	-21.3	0.74	-35.07	7.04	3.11	2.91
20000	40.3	-20.3	0.72	-34.49	7.30	3.07	3.05
20500	40.3	-19.9	0.78	-34.46	7.48	3.12	3.15
21000	40.3	-19.1	0.87	-34.07	7.61	3.20	3.33
21500	40.3	-19.1	0.90	-33.96	7.47	3.28	3.19
22000	40.3	-18.7	0.89	-33.57	7.34	3.35	3.28
22500	40.4	-19.0	0.87	-33.66	7.06	3.75	2.94
23000	40.4	-19.5	0.88	-33.75	6.92	3.77	2.70
23500	40.4	-19.3	0.90	-33.35	6.99	3.52	2.66
24000	40.4	-19.8	0.88	-33.99	6.88	3.88	2.58
24500	40.4	-19.5	0.91	-33.89	7.01	3.93	2.51
25000	40.4	-19.3	0.88	-33.00	6.72	3.96	2.14
25500	40.5	-20.4	0.89	-34.07	6.90	3.66	2.22
26000	40.5	-21.3	0.86	-35.11	7.02	3.69	2.28
26500	40.5	-21.1	0.90	-35.20	7.15	3.91	2.36

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

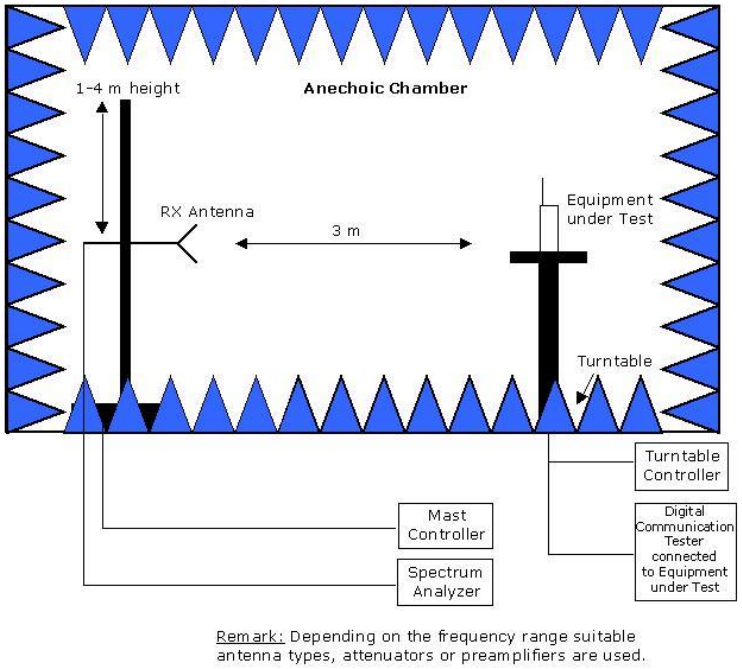
7.6 ANTENNA EMCO 3160-10 (26.5 GHZ – 40 GHZ)

Frequency	AF EMCO 3160-10	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-20 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
GHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
26.5	43.4	-11.2	4.4				-9.5	3	1.0
27.0	43.4	-11.2	4.4				-9.5	3	1.0
28.0	43.4	-11.1	4.5				-9.5	3	1.0
29.0	43.5	-11.0	4.6				-9.5	3	1.0
30.0	43.5	-10.9	4.7				-9.5	3	1.0
31.0	43.5	-10.8	4.7				-9.5	3	1.0
32.0	43.5	-10.7	4.8				-9.5	3	1.0
33.0	43.6	-10.7	4.9				-9.5	3	1.0
34.0	43.6	-10.6	5.0				-9.5	3	1.0
35.0	43.6	-10.5	5.1				-9.5	3	1.0
36.0	43.6	-10.4	5.1				-9.5	3	1.0
37.0	43.7	-10.3	5.2				-9.5	3	1.0
38.0	43.7	-10.2	5.3				-9.5	3	1.0
39.0	43.7	-10.2	5.4				-9.5	3	1.0
40.0	43.8	-10.1	5.5				-9.5	3	1.0

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

8 SETUP DRAWINGS

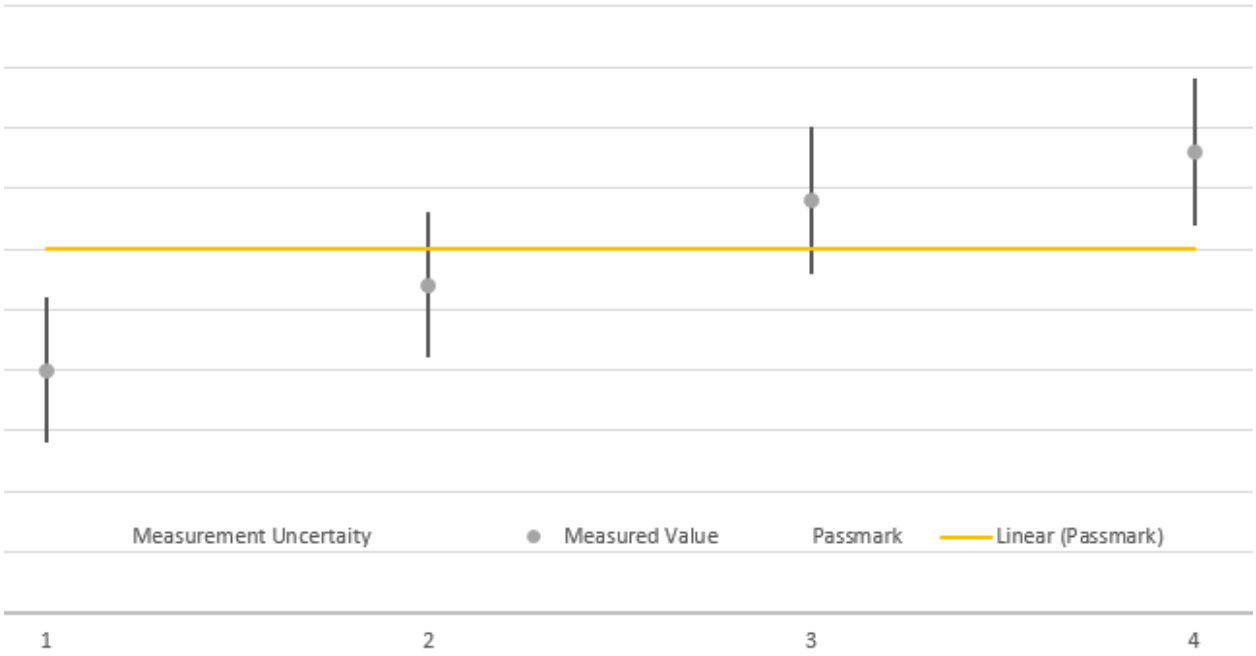


Drawing 1: Setup in the Anechoic chamber. For measurements below 1 GHz the ground was replaced by a conducting groundplane.

9 MEASUREMENT UNCERTAINTIES

Test Case	Parameter	Uncertainty
AC Power Line	Power	± 3.4 dB
Field Strength of spurious radiation	Power	± 5.5 dB
6 dB / 26 dB / 99% Bandwidth	Power Frequency	± 2.9 dB ± 11.2 kHz
Conducted Output Power	Power	± 2.2 dB
Band Edge Compliance	Power Frequency	± 2.2 dB ± 11.2 kHz
Frequency Stability	Frequency	± 25 Hz
Power Spectral Density	Power	± 2.2 dB

The measurement uncertainties for all parameters are calculated with an expansion factor (coverage factor) k = 1.96. This means, that the true value is in the corresponding interval with a probability of 95 %.



The verdicts in this test report are given according the above diagram:

Case	Measured Value	Uncertainty Range	Verdict
1	below pass mark	below pass mark	Passed
2	below pass mark	within pass mark	Passed
3	above pass mark	within pass mark	Failed
4	above pass mark	above pass mark	Failed

That means, the laboratory applies, as decision rule (see ISO/IEC 17025:2017), the so called shared risk principle.

10 PHOTO REPORT

Please see separate photo report.