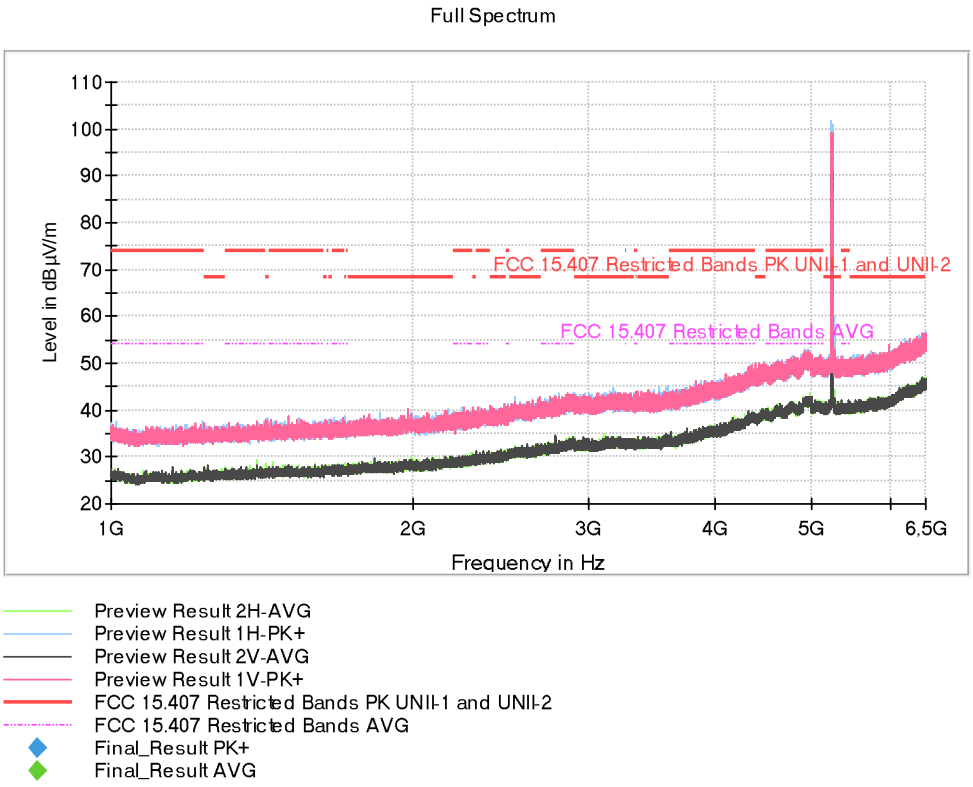
- High Channel:

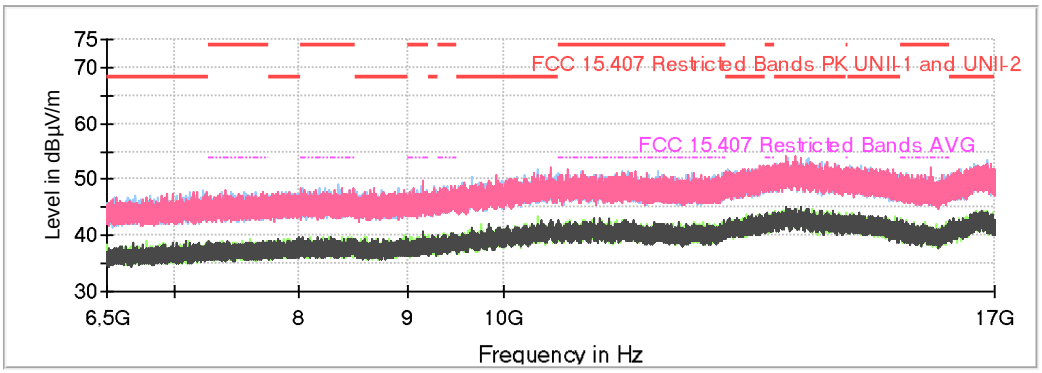


The peak shown on the plot above the limit is the carrier frequency.

FREQUENCY RANGE 6.5 - 17 GHz

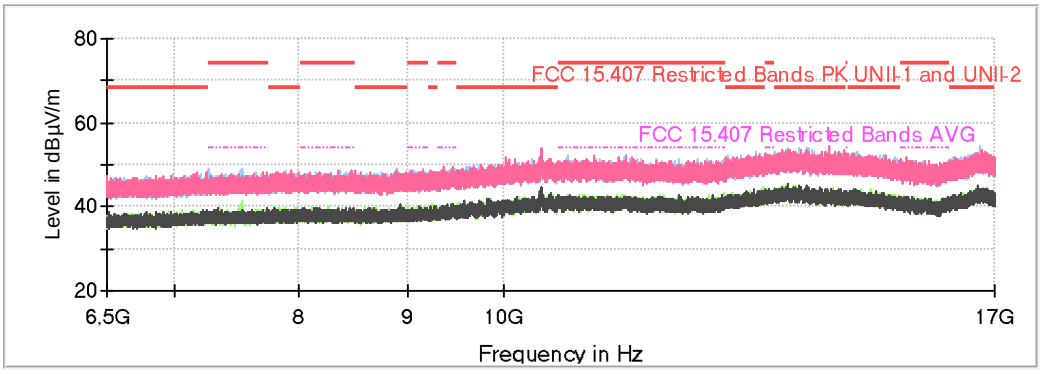
U-NII-1 FCC (5150-5250 MHz)

- Low Channel:



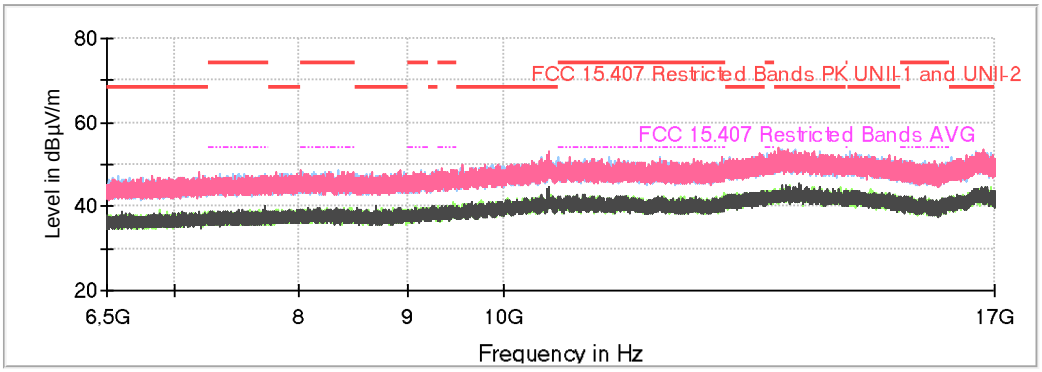
Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

- Channel 40:



Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

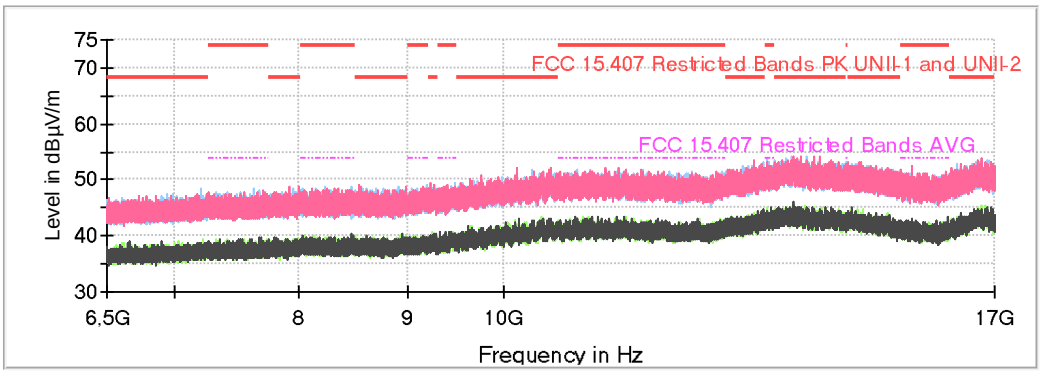
- High Channel:



Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

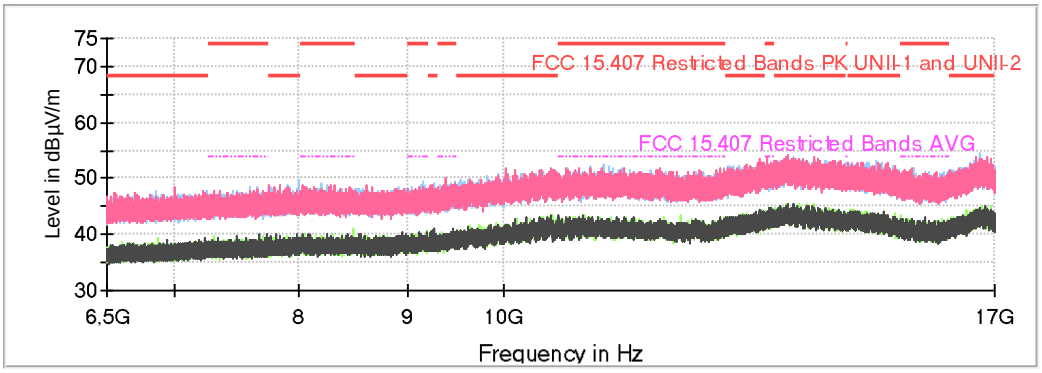
U-NII-1 RSS (5150-5250 MHz)

- Low Channel:



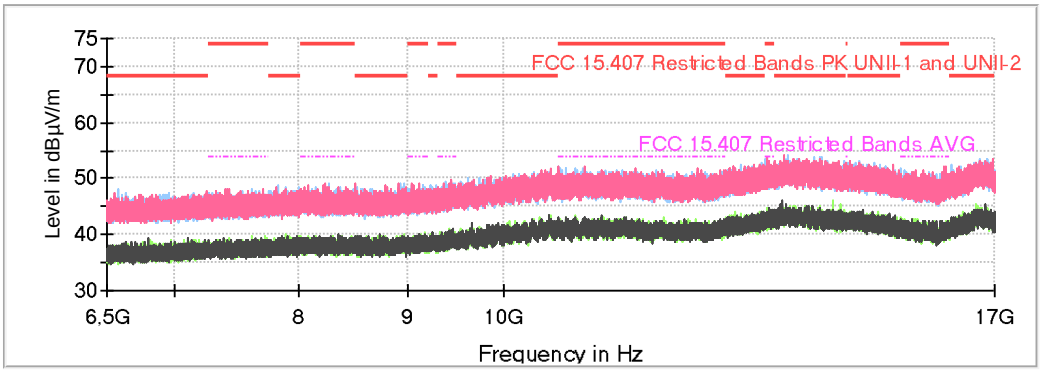
Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

- Channel 40:



Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

- High Channel:

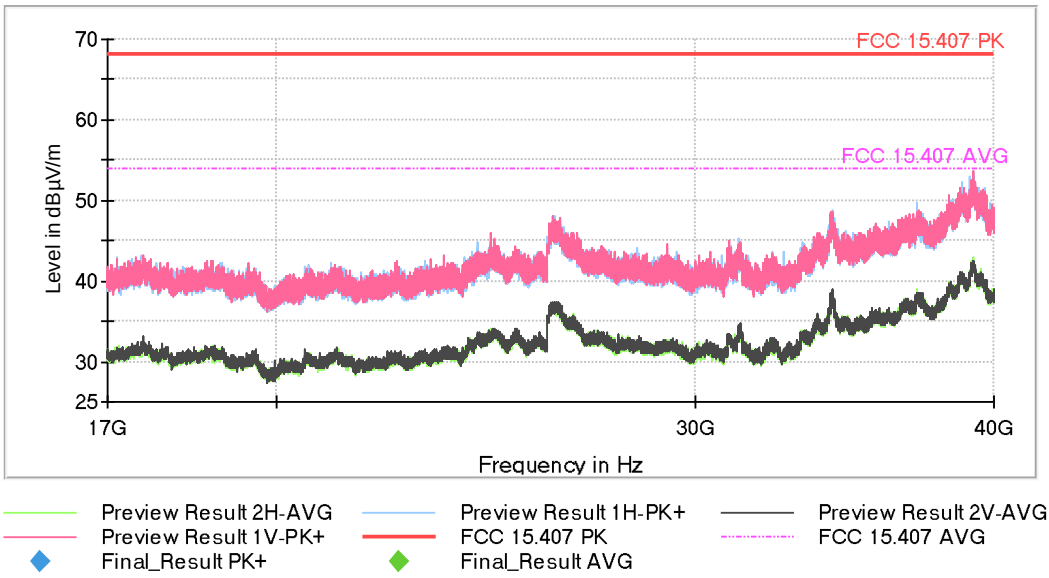


Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

FREQUENCY RANGE 17 - 40 GHz

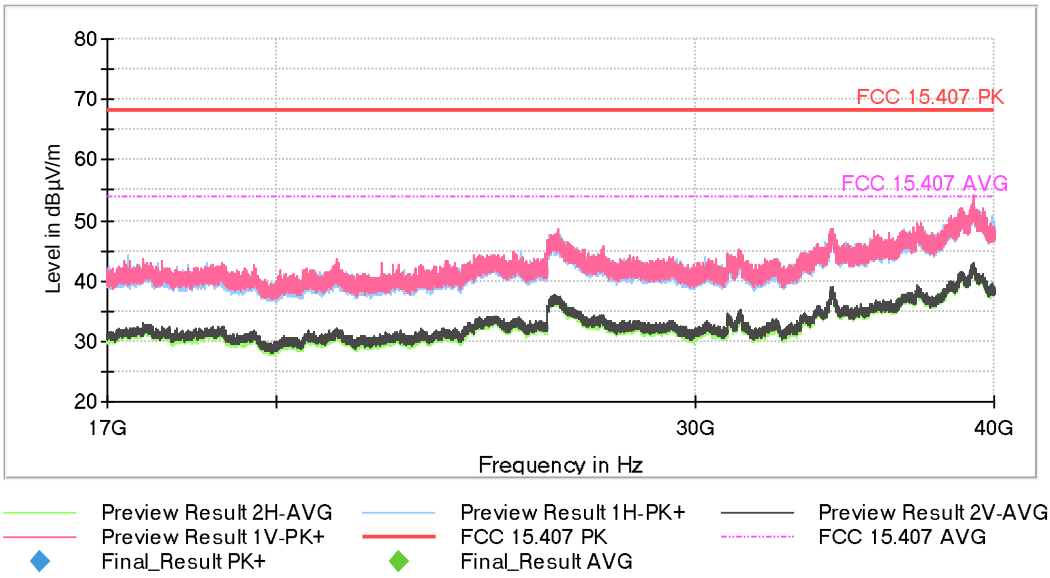
U-NII-1 FCC (5150-5250 MHz)

This plot is valid for Low, Middle and High Channels and all the modulation modes and bandwidths.



U-NII-1 RSS (5150-5250 MHz)

This plot is valid for Low, Middle and High Channels and all the modulation modes and bandwidths.



FCC 15.407 (b)(1) / RSS-247 6.2.1.2
Transmitter Band Edge Radiated Emissions

Limits

For transmitters with operating frequencies in the band 5150-5250 MHz, all emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p (68.23 dBµV/m at 3 m distance).

Any unwanted emissions that fall into the band 5250-5350 MHz shall be attenuated below the channel power by at least 26 dB, when measured using a resolution bandwidth between 1 and 5% of the occupied bandwidth (i.e. 99% bandwidth), above 5250 MHz.

Radiated emissions which fall in the restricted bands, as defined in FCC §15.205(a), must also comply with the radiated emission limits specified in FCC §15.209(a) (see §15.205(c)):

Frequency Range (MHz)	Magnetic field strength (µA/m)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009 - 0.490	6.37/F (F in kHz)	--	-	300
0.490 - 1.705	63.7/F (F in kHz)	--	-	30
1.705 - 30.000	0.08	--	-	30
30 - 88	--	100	40	3
88 - 216	--	150	43.5	3
216 - 960	--	200	46	3
Above 960	--	500	54	3

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table specified when measuring with peak detector function.

RSS-247:

Attenuation below the general field strength limits specified in RSS-Gen is not required.

Results

The field strength is calculated by adding a correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

All emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27dBm/MHz. There are restricted bands of operation below lower band edge at 5.15 GHz and also above the upper band edge at 5.35 GHz therefore the provisions of FCC Part 15.205 and RSS-Gen Section 8.9 apply in these restricted bands.

Field strength measurements using peak and average detectors performed in the restricted bands 4.5-5.15 GHz and 5.35-5.46 GHz.
Spurious frequencies falling inside the restricted bands with peak levels above the average limit (54 dBµV/m at 3 m) are measured with an average detector for checking compliance with the average limit.

Frequency range 5250-5350 MHz is also measured (with peak detector) in order to ensure any unwanted emission falling inside this frequency range is attenuated below the channel power by at least 26 dB, when using a RBW between 1 and 5% of the 99% Occupied Bandwidth.

U-NII-1 FCC (5150-5250 MHz)

BAND EDGE EMISSIONS – Restricted Bands:

The Lower Band Edge and the Upper Band Edge were tested for all modes.

- **SISO 802.11 a20:**

- Low Channel.

  - Lower Band Edge. Spurious emissions found inside the Restricted Band 4.50-5.15 GHz:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
5147.400000	56.77	H	Peak
	36.66		Average

- High Channel.

  - Upper Band Edge. No spurious emissions found inside the Restricted Band 5.35-5.46 GHz.

- **SISO 802.11 n20:**

- Low Channel.

  - Lower Band Edge. Spurious emissions found inside the Restricted Band 4.50-5.15 GHz:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
5149.600000	55.29	H	Peak
	35.53		Average

- High Channel.

  - Upper Band Edge. No spurious found emissions inside the Restricted Band 5.35-5.46 GHz.

- **SISO 802.11 ac20:**

- Low Channel.

  - Lower Band Edge. Spurious emissions found inside the Restricted Band 4.50-5.15 GHz:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
5148.800000	58.85	H	Peak
	38.32		Average

- High Channel.

  - Upper Band Edge. No spurious emissions found inside the Restricted Band 5.35-5.46 GHz.

- **SISO 802.11 n40:**

- Low Channel.

  - Lower Band Edge. Spurious emissions found inside the Restricted Band 4.50-5.15 GHz:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
5148.800000	68.24	H	Peak
	51.49		Average

- High Channel.

  - Upper Band Edge. No spurious emissions found inside the Restricted Band 5.35-5.46 GHz.

- **SISO 802.11 ac40:**

- Low Channel.

  - Lower Band Edge. Spurious emissions found inside the Restricted Band 4.50-5.15 GHz:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
5149.600000	67.94	H	Peak
	51.26		Average

- High Channel.

  - Upper Band Edge. No spurious emissions found inside the Restricted Band 5.35-5.46 GHz.

- **SISO 802.11 ac80:**

- Single Channel.

  - Lower Band Edge. Spurious emissions inside the Restricted Band 4.50-5.15 GHz:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Duty Cycle Correction (dB)	Corrected Emission Level (dBµV/m)	Polarization	Detector
5147.400000	64.86	--	--	H	Peak
	50.21	0.21	50.42		Average

  - Upper Band Edge. No spurious emissions inside the Restricted Band 5.35-5.46 GHz.

Measurement Uncertainty (dB) < ±4.32

Verdict

Pass

U-NII-1 RSS (5150-5250 MHz)

BAND EDGE EMISSIONS – Restricted Bands:

The Lower Band Edge and the Upper Band Edge were tested for all modes.

- **SISO 802.11 a20:**

- Low Channel.

  - Lower Band Edge. No spurious emissions found inside the Restricted Band 4.50-5.15 GHz.

- High Channel.

  - Upper Band Edge. No spurious emissions found inside the Restricted Band 5.35-5.46 GHz.

- **SISO 802.11 n20:**

- Low Channel.

  - Lower Band Edge. No spurious emissions found inside the Restricted Band 4.50-5.15 GHz:

- High Channel.

  - Upper Band Edge. No spurious found emissions inside the Restricted Band 5.35-5.46 GHz.

- **SISO 802.11 ac20:**

- Low Channel.

  - Lower Band Edge. No spurious emissions found inside the Restricted Band 4.50-5.15 GHz:

- High Channel.

  - Upper Band Edge. No spurious emissions found inside the Restricted Band 5.35-5.46 GHz.

- **SISO 802.11 n40:**

- Low Channel.

  - Lower Band Edge. Spurious emissions found inside the Restricted Band 4.50-5.15 GHz:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
5148.300000	56.78	PH	Peak
	41.82		Average

- High Channel.

  - Upper Band Edge. No spurious emissions found inside the Restricted Band 5.35-5.46 GHz.

- **SISO 802.11 ac40:**

- Low Channel.

  - Lower Band Edge. Spurious emissions found inside the Restricted Band 4.50-5.15 GHz:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
5149.700000	54.59	H	Peak
	37.82		Average

- High Channel.

  - Upper Band Edge. No spurious emissions found inside the Restricted Band 5.35-5.46 GHz.

- **SISO 802.11 ac80:**

- Single Channel.

  - Lower Band Edge. Spurious emissions inside the Restricted Band 4.50-5.15 GHz:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Duty Cycle Correction (dB)	Corrected Emission Level (dBµV/m)	Polarization	Detector
5121.600000	57.02	--	--	H	Peak
	43.33	0.21	37.93		Average

  - Upper Band Edge. No spurious emissions inside the Restricted Band 5.35-5.46 GHz.

Measurement Uncertainty (dB) < ±4.32

Verdict

Pass

BAND EDGE EMISSIONS – Band 5250-5350 MHz:

The Upper Channel was tested for all modes in the frequency range 5250-5350 MHz.

- **SISO 802.11 a20:**

- High Channel.

  - Emissions in the frequency range 5250-5350 MHz:

In-band Peak level (dBm)	Maximum emission level in band 5250-5350 MHz (dBm)	Measured Frequency (GHz)	Limit (dBm)	Polarization	Detector
5.20	-21.97	5.250058	-20.80	H	Peak

- **SISO 802.11 n20:**

- High Channel.

  - Emissions in the frequency range 5250-5350 MHz:

In-band Peak level (dBm)	Maximum emission level in band 5250-5350 MHz (dBm)	Measured Frequency (GHz)	Limit (dBm)	Polarization	Detector
4.98	-22.67	5.250190	-21.02	H	Peak

- **SISO 802.11 ac20:**

- High Channel.

  - Emissions in the frequency range 5250-5350 MHz:

In-band Peak level (dBm)	Maximum emission level in band 5250-5350 MHz (dBm)	Measured Frequency (GHz)	Limit (dBm)	Polarization	Detector
4.82	-21.82	5.250022	-21.18	H	Peak

- **SISO 802.11 n40:**

- High Channel.

  - Emissions in the frequency range 5250-5350 MHz:

In-band Peak level (dBm)	Maximum emission level in band 5250-5350 MHz (dBm)	Measured Frequency (GHz)	Limit (dBm)	Polarization	Detector
1.93	-24.44	5.250355	-24.07	H	Peak

- **SISO 802.11 ac40:**

- High Channel.

  - Emissions in the frequency range 5250-5350 MHz:

In-band Peak level (dBm)	Maximum emission level in band 5250-5350 MHz (dBm)	Measured Frequency (GHz)	Limit (dBm)	Polarization	Detector
2.43	-24.03	5.250481	-23.57	H	Peak

- **SISO 802.11 ac80:**

- Single Channel.

  - Emissions in the frequency range 5250-5350 MHz:

In-band Peak level (dBm)	Maximum emission level in band 5250-5350 MHz (dBm)	Measured Frequency (GHz)	Limit (dBm)	Polarization	Detector
2.30	-26.15	5.251063	-23.70	H	Peak

Measurement Uncertainty (dB) < ±4.32

Verdict

Pass

Attachments

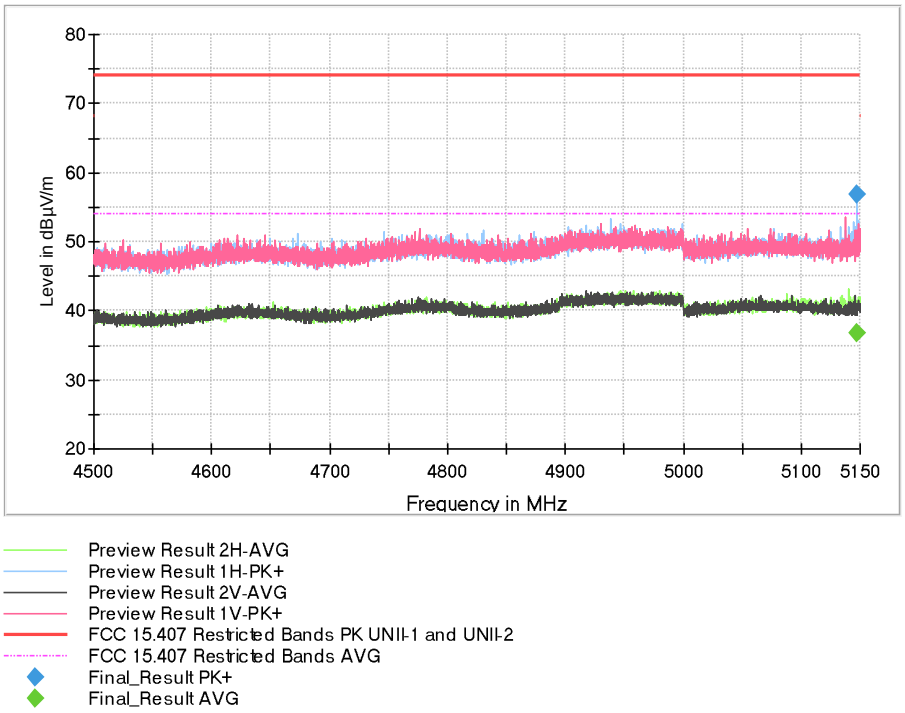
Settings for measurements in Restricted Bands:

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44]					
1 GHz - 6,5 GHz	100 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

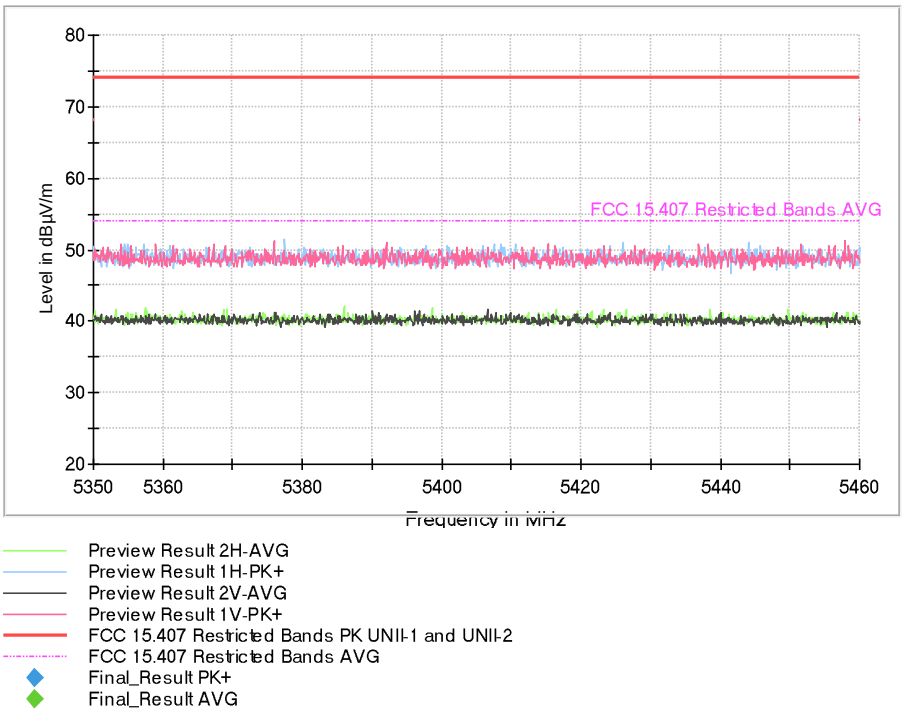
U-NII-1 FCC (5150-5250 MHz)

SISO 802.11 a20

- Lower Band Edge – Low Channel:

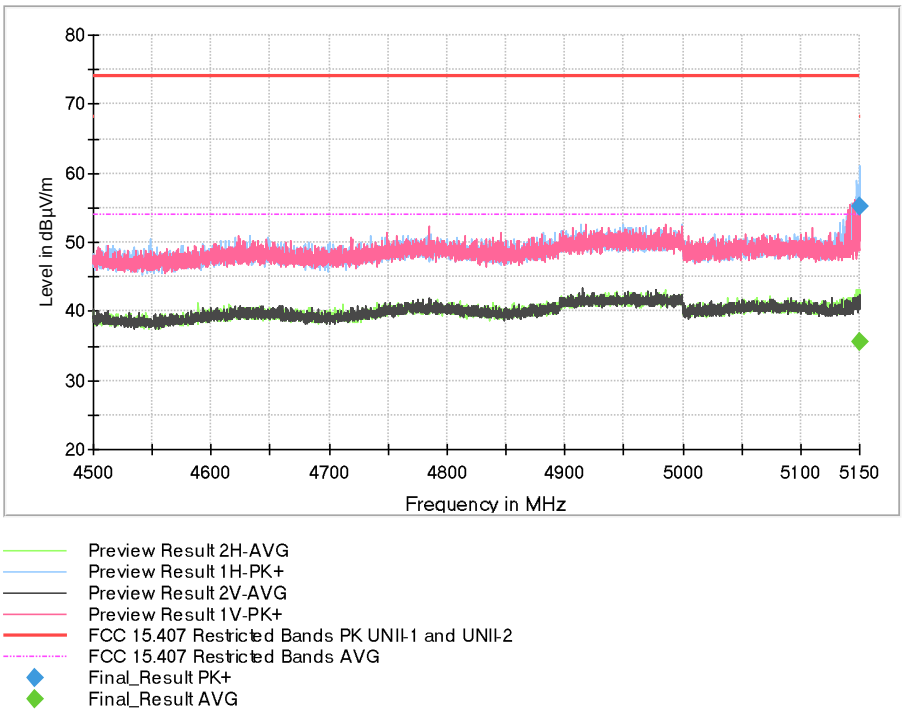


- Upper Band Edge - High Channel:

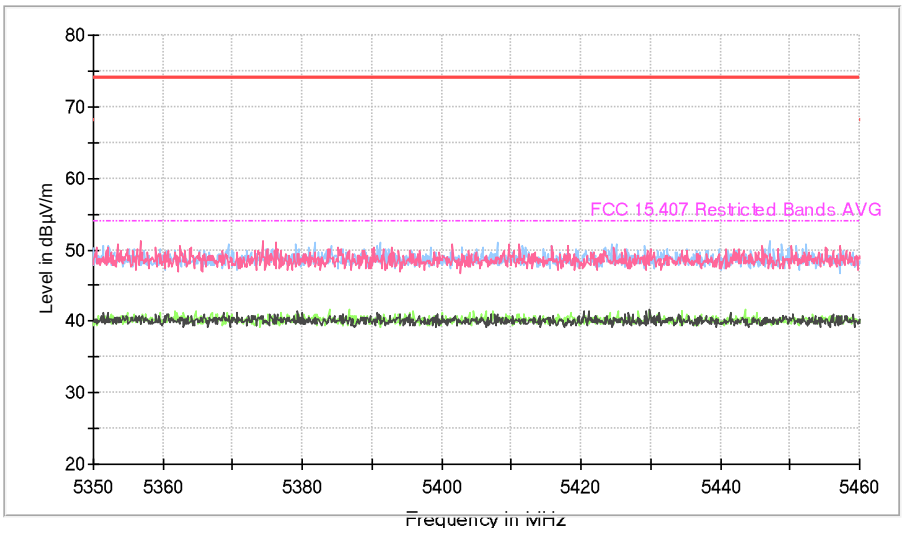


SISO 802.11 n20

- Lower Band Edge – Low Channel:

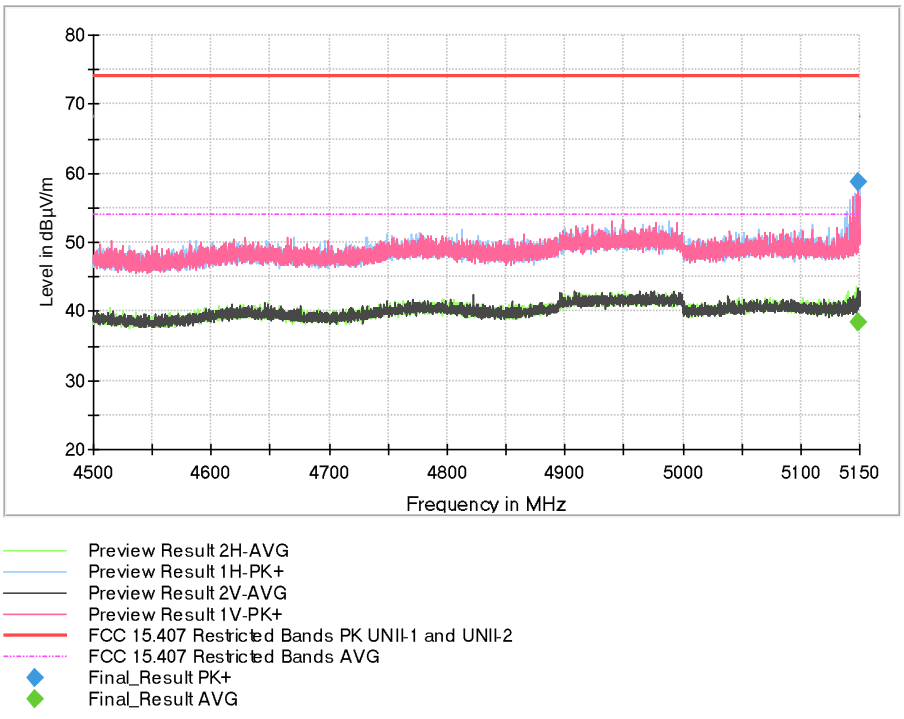


- Upper Band Edge - High Channel:

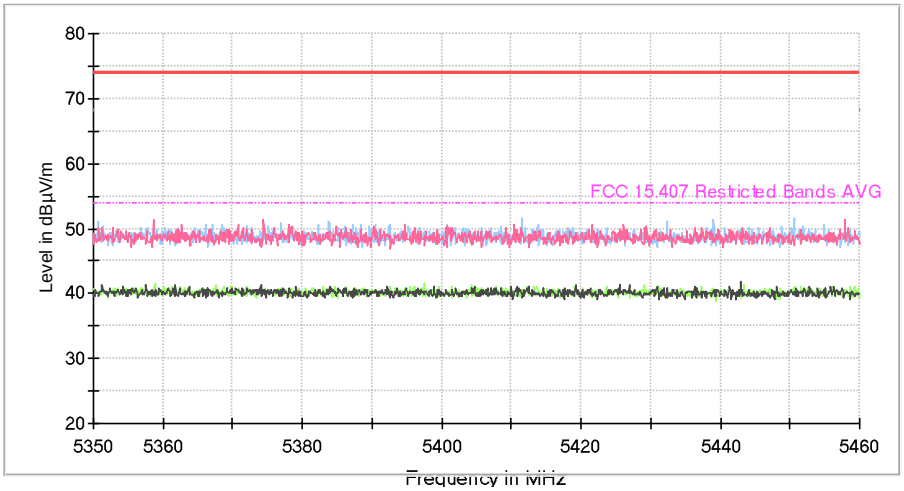


SISO 802.11 ac20

- Lower Band Edge – Low Channel:



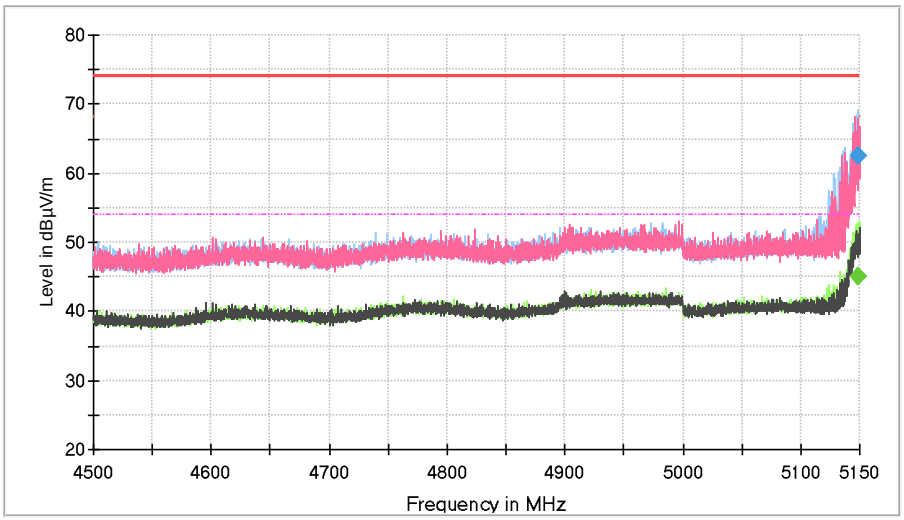
- Upper Band Edge – High Channel:



Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
PK+
AVG
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

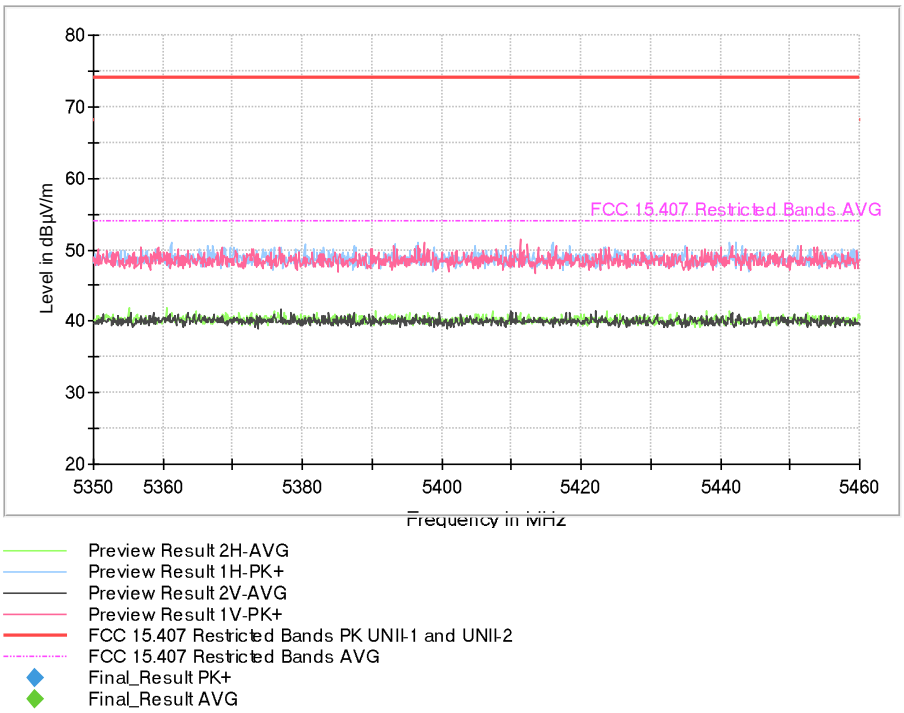
SISO 802.11 n40

- Lower Band Edge – Low Channel:



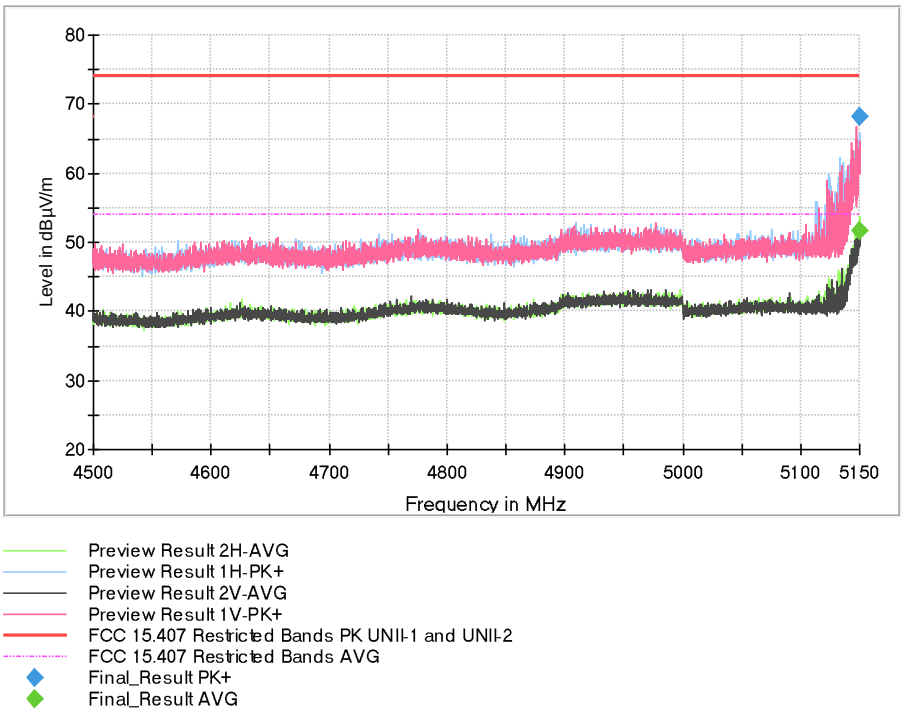
Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

- Upper Band Edge – High Channel:

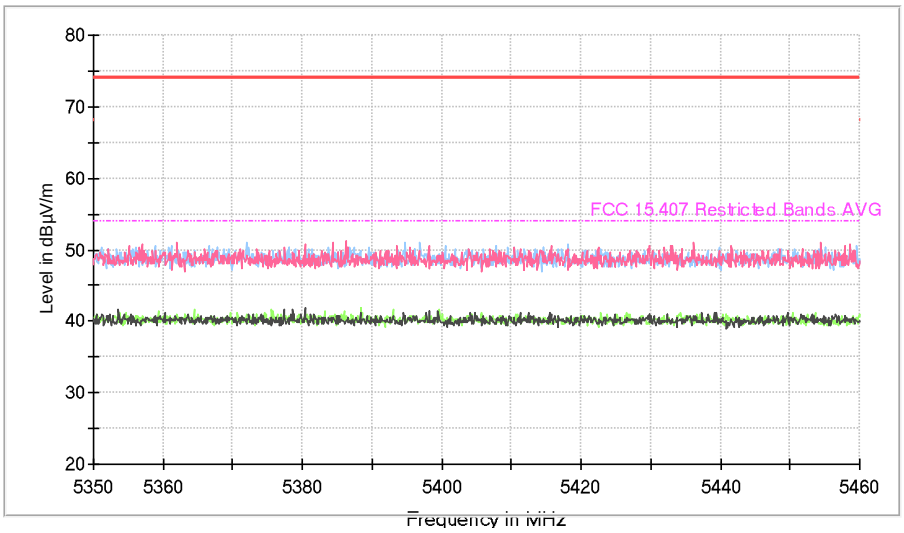


SISO 802.11 ac40

- Lower Band Edge – Low Channel:

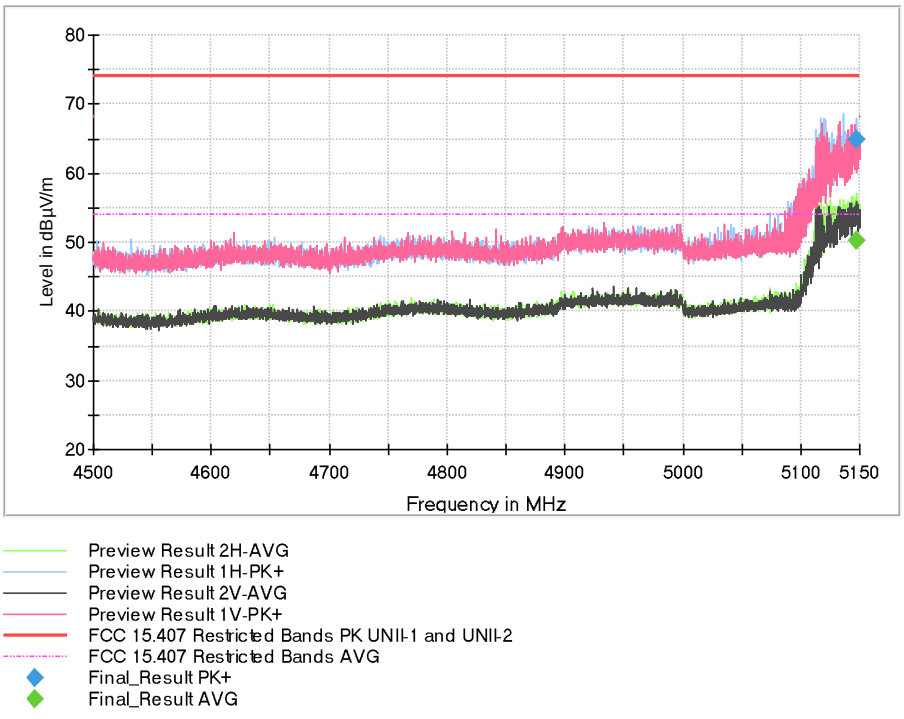


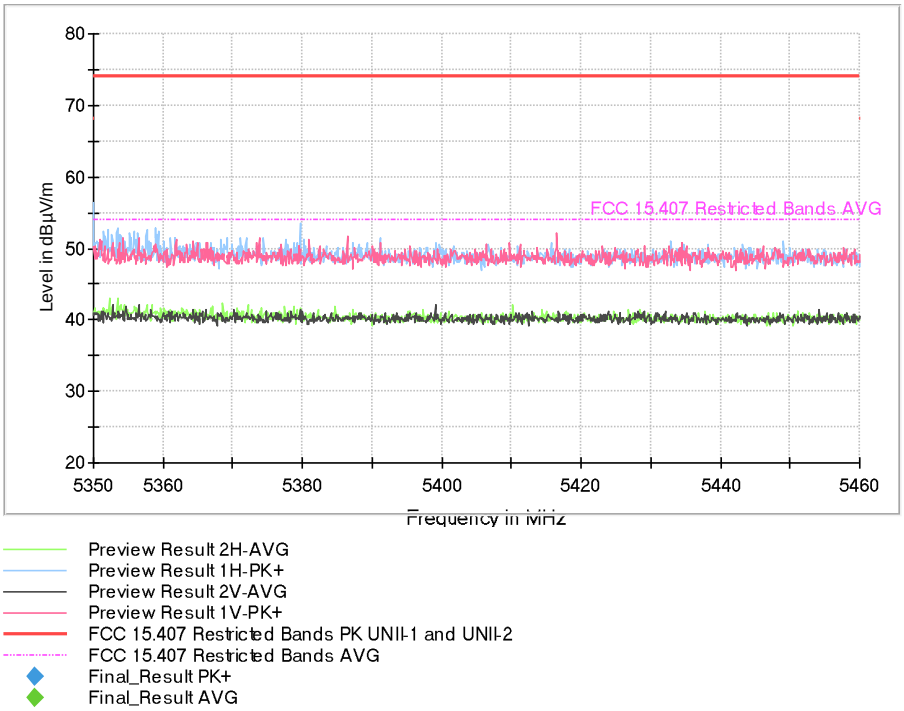
- Upper Band Edge – High Channel:



SISO 802.11 ac80

- Lower Band Edge and Upper Band Edge – Single Channel (Restricted Bands):

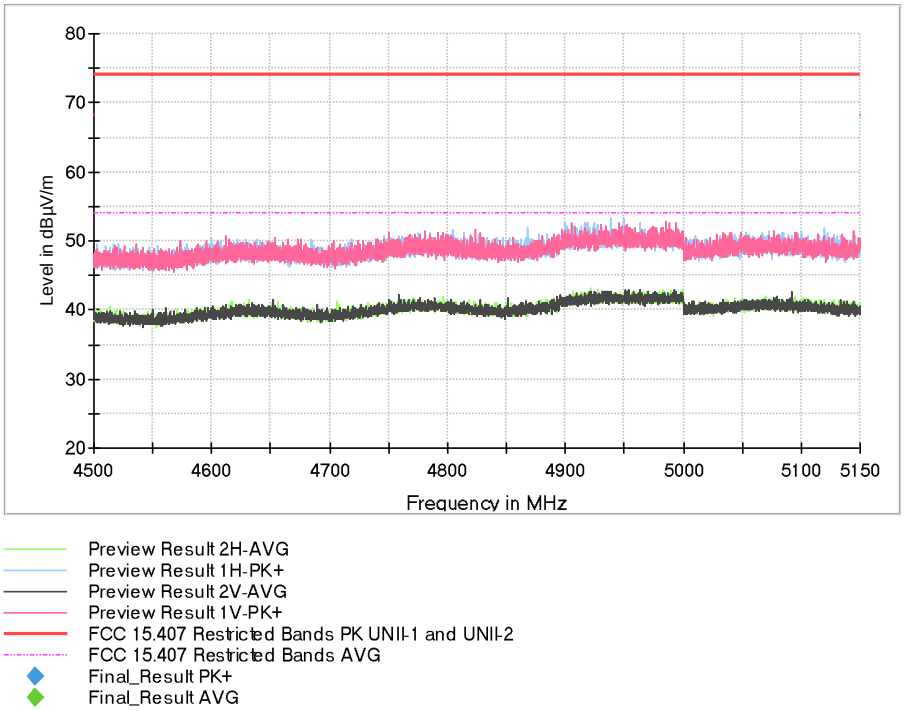



80
70
60
50
40
30
20
Level in dBµV/m
FCC 15.407 Restricted Bands AVG
5350
5360
5380
5400
5420
5440
5460
Frequency in MHz
Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

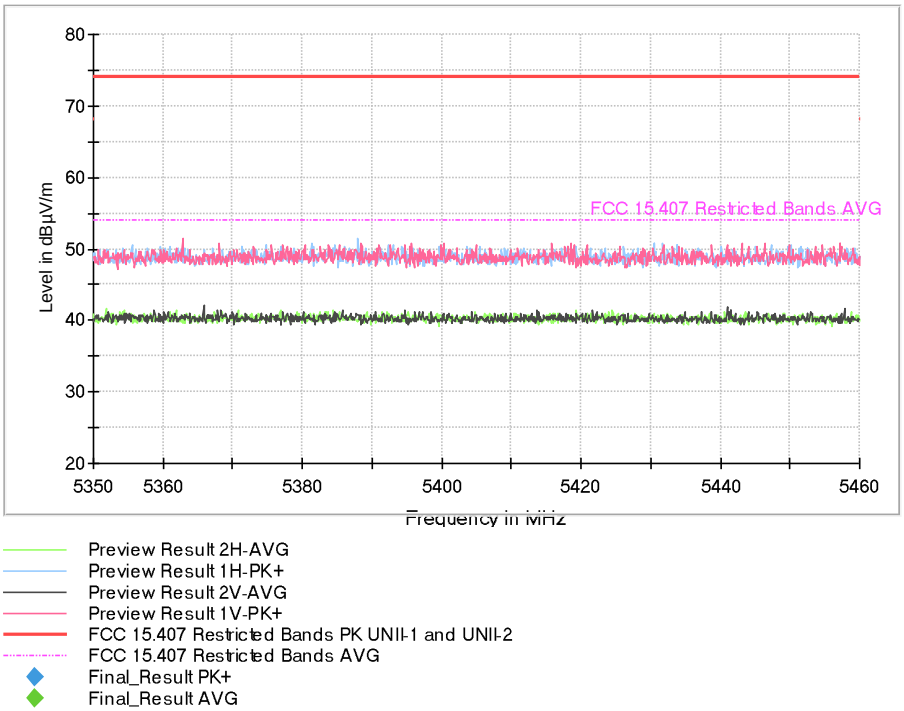
U-NII-1 RSS (5150-5250 MHz)

SISO 802.11 a20

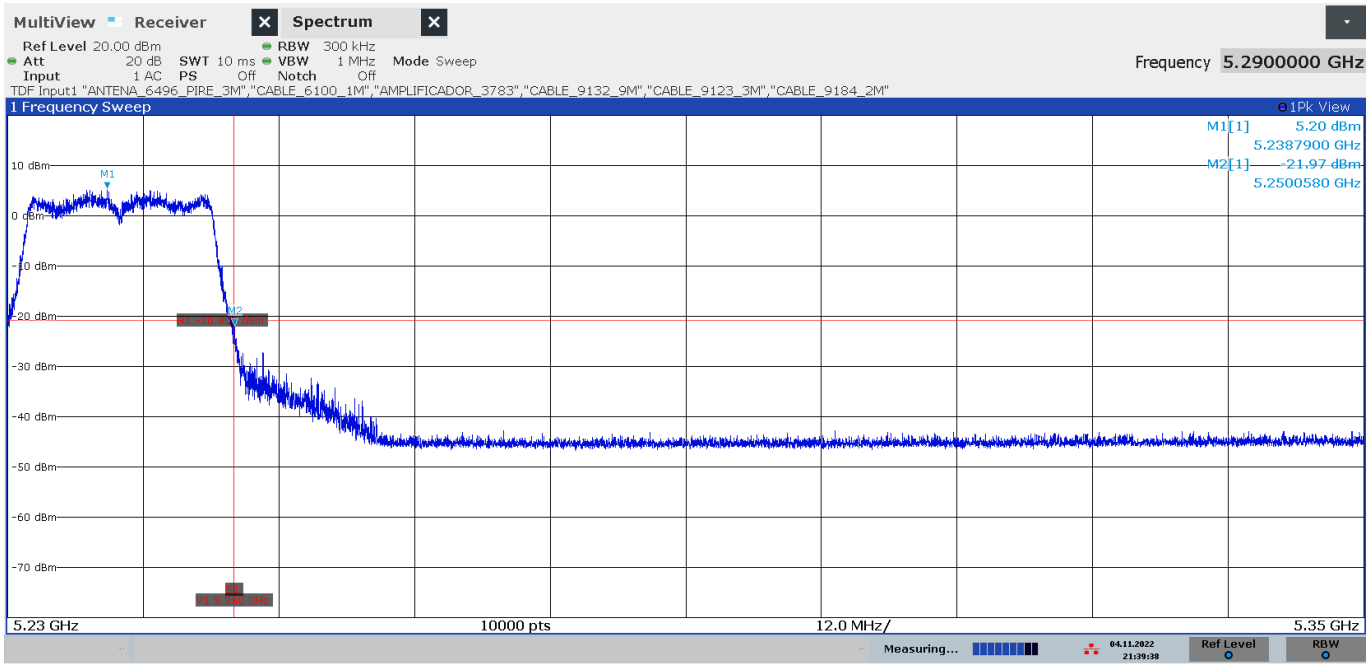
- Lower Band Edge – Low Channel (Restricted Band):



- Upper Band Edge - High Channel (Restricted Band):

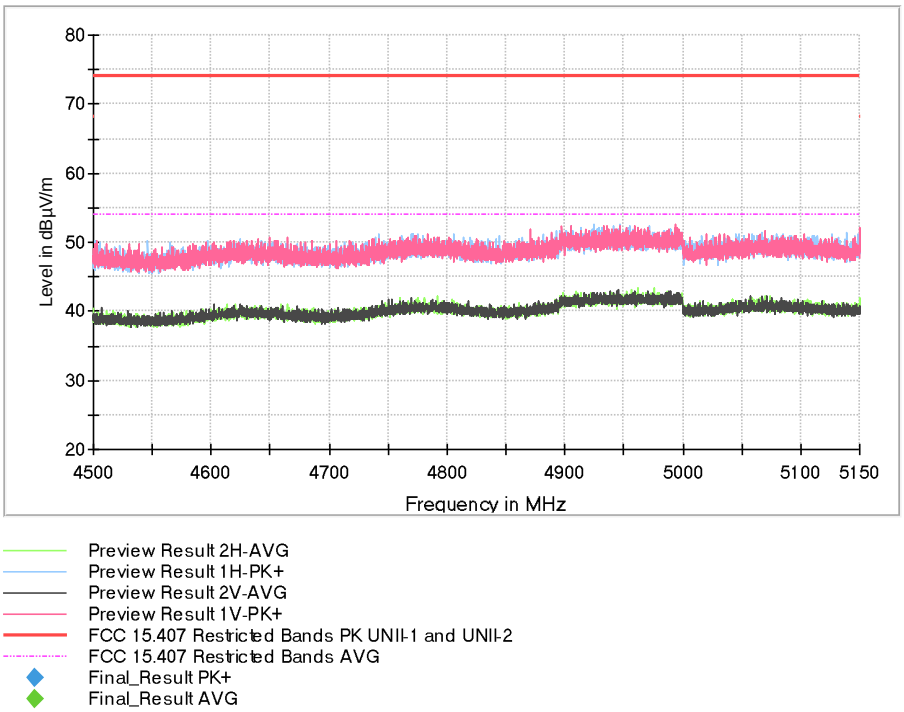


- Frequency range 5250-5350 MHz - High Channel:

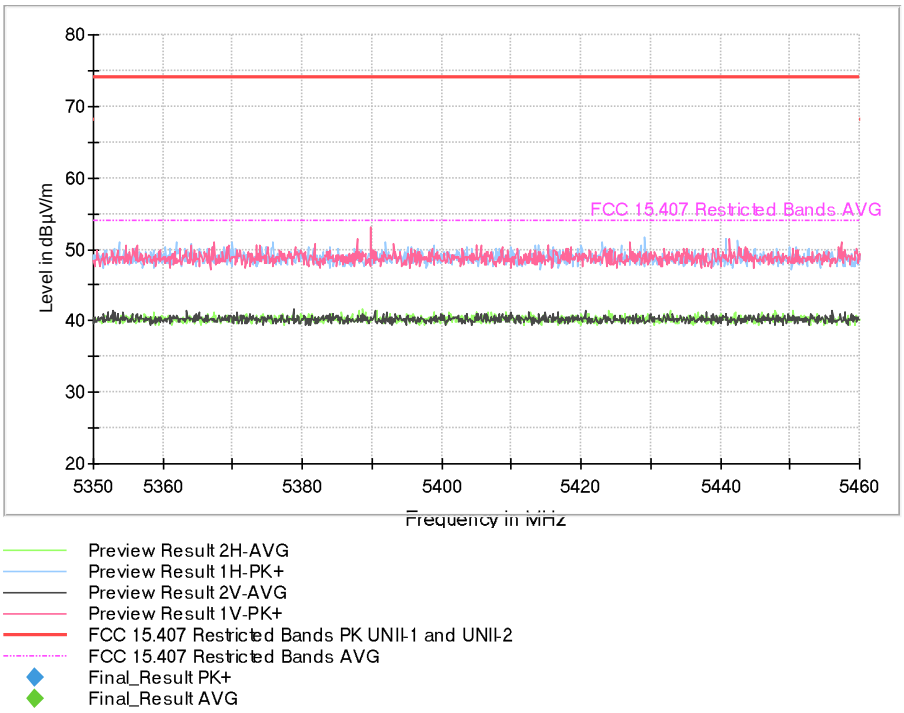


SISO 802.11 n20

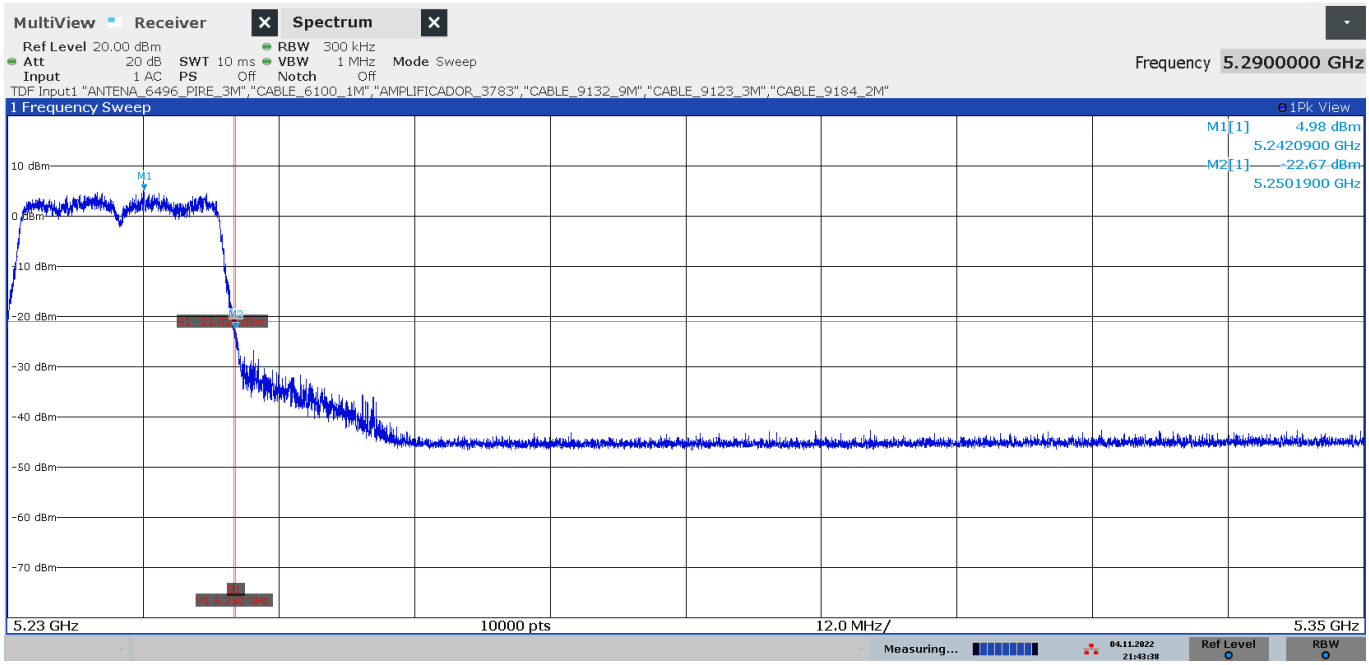
- Lower Band Edge – Low Channel (Restricted Band):



- Upper Band Edge - High Channel (Restricted Band):

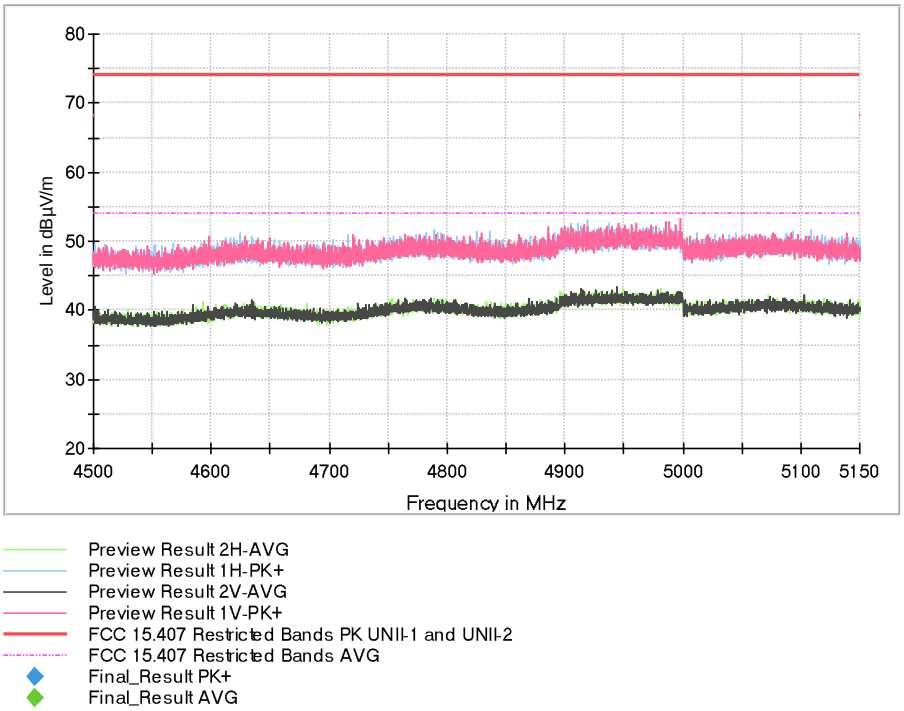


- Frequency range 5250-5350 MHz - High Channel:

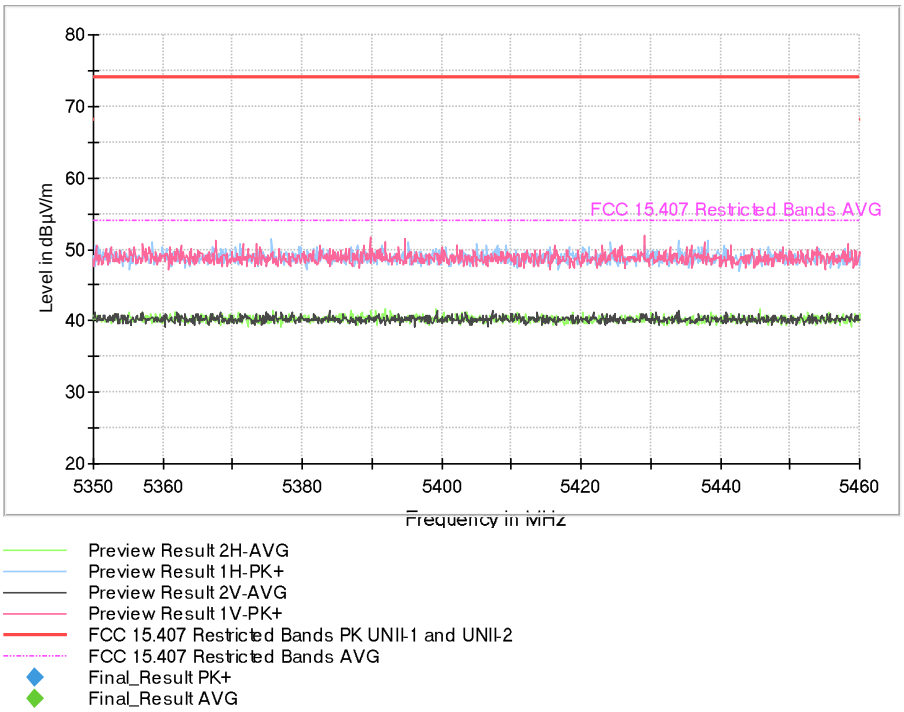


SISO 802.11 ac20

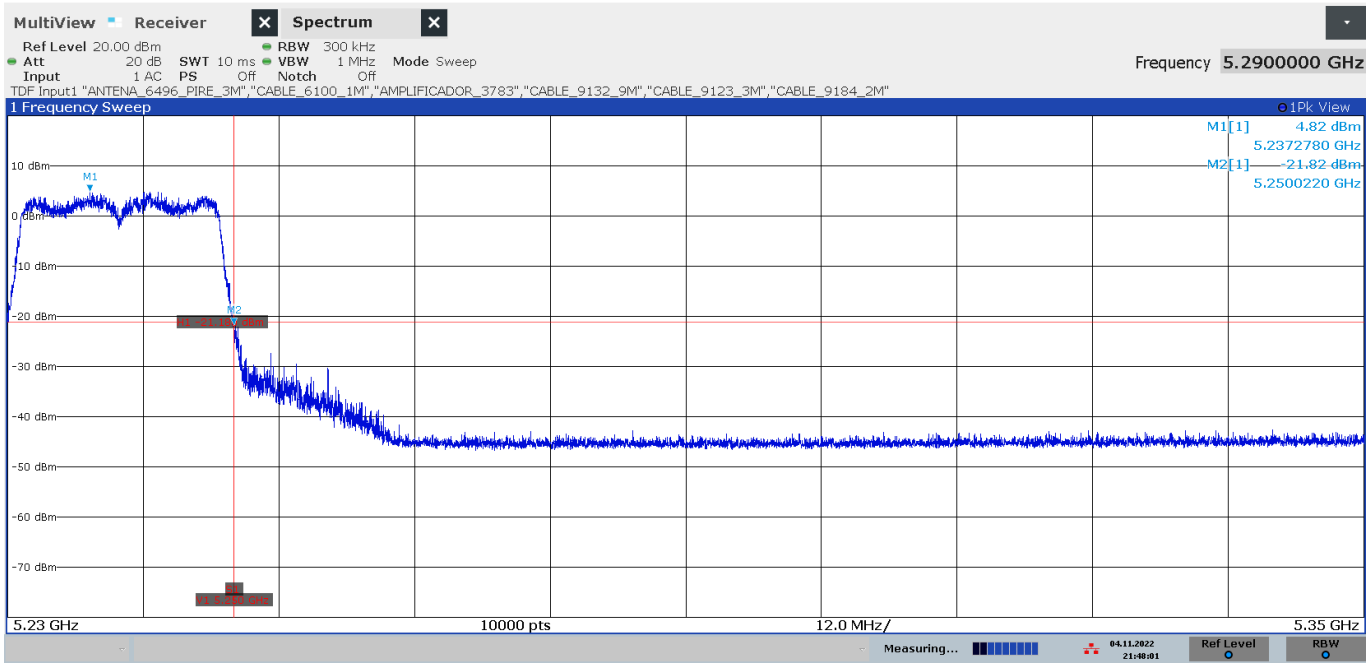
- Lower Band Edge – Low Channel (Restricted Band):



- Upper Band Edge – High Channel (Restricted Band):

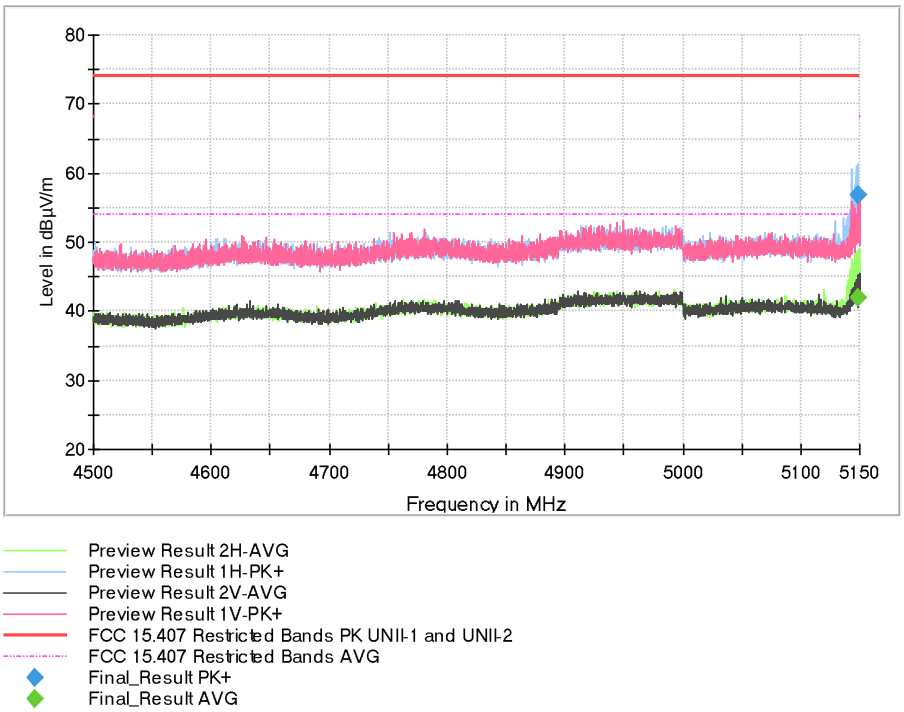


- Frequency range 5250-5350 MHz - High Channel:

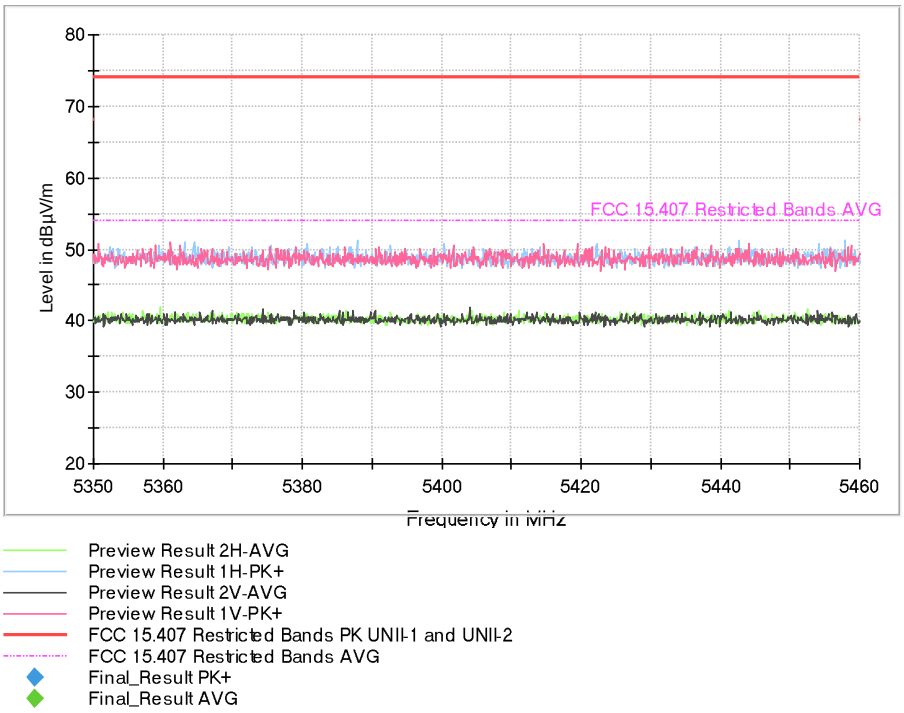


SISO 802.11 n40

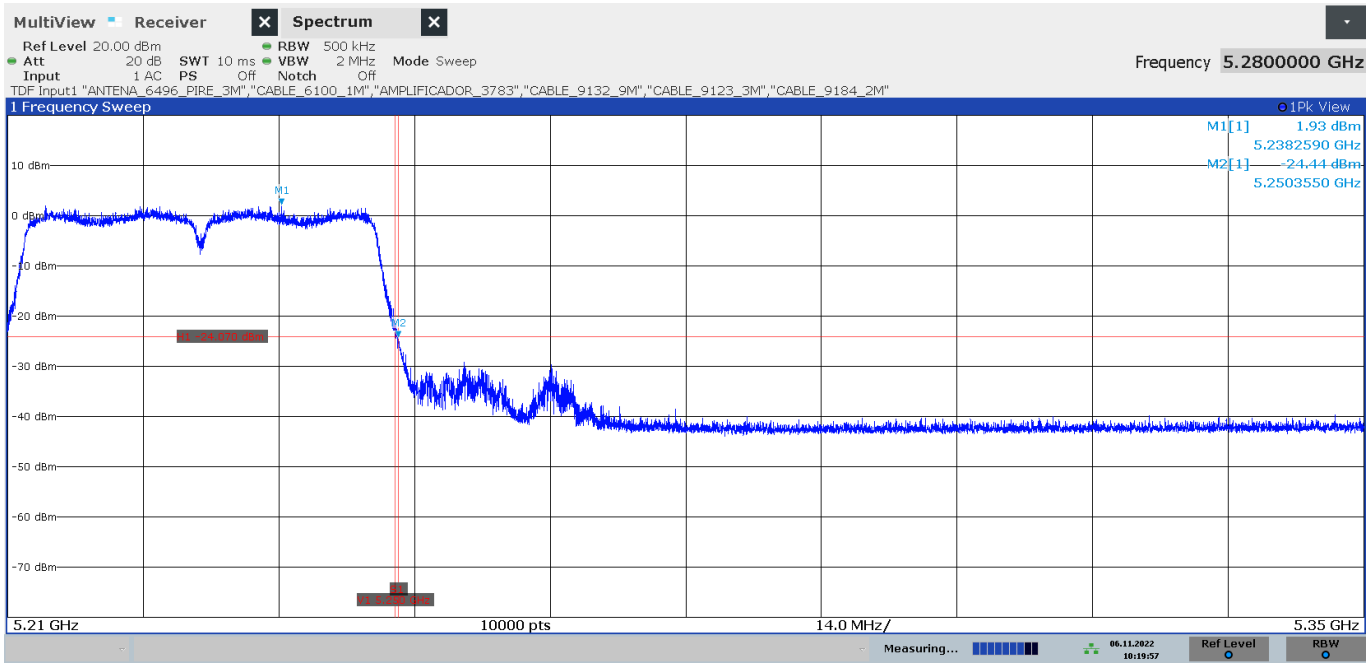
- Lower Band Edge – Low Channel (Restricted Band):



- Upper Band Edge – High Channel (Restricted Band):

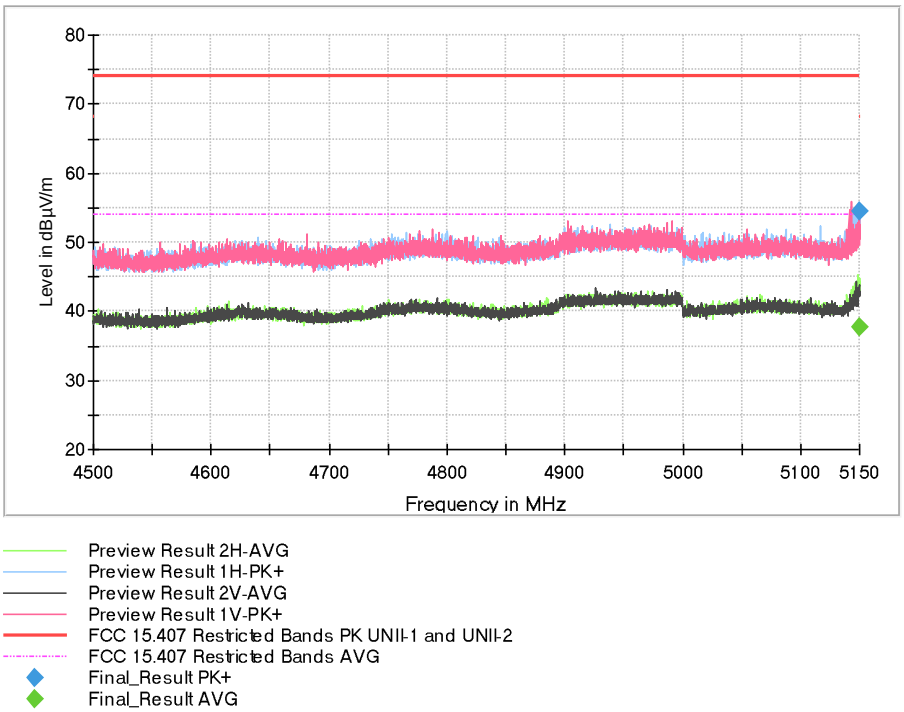


- Frequency range 5250-5350 MHz - High Channel:

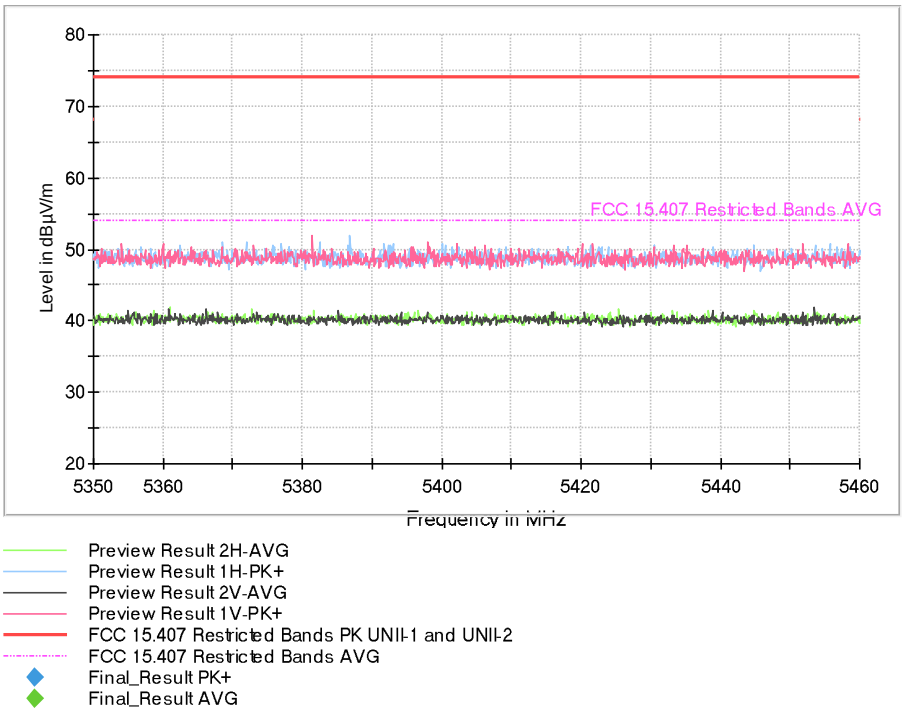


SISO 802.11 ac40

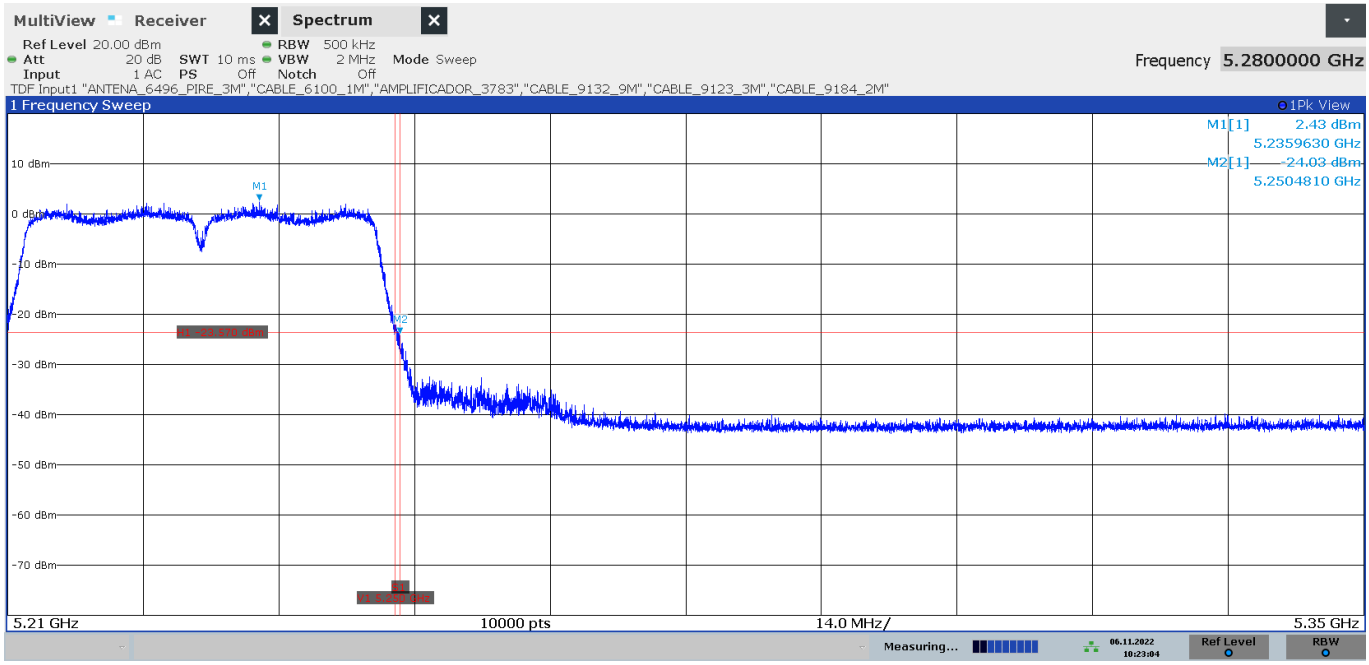
- Lower Band Edge – Low Channel (Restricted Band):



- Upper Band Edge – High Channel (Restricted Band):

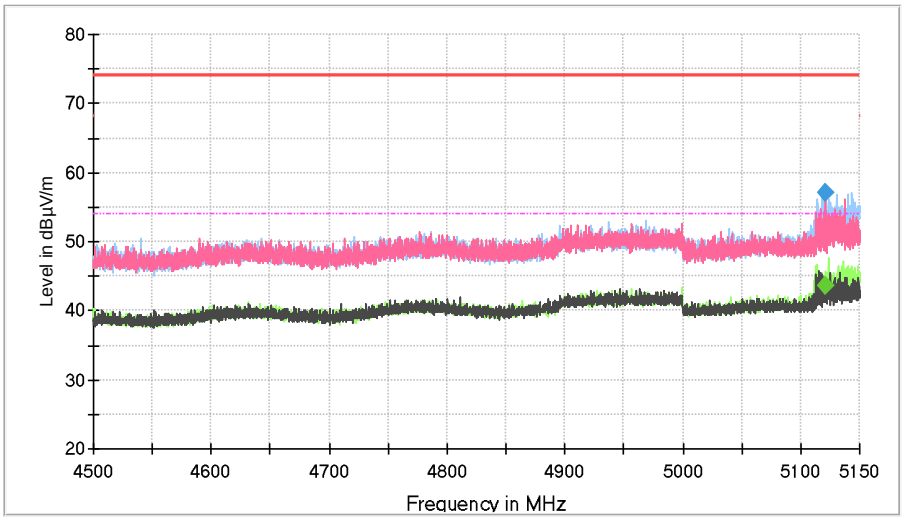


- Frequency range 5250-5350 MHz - High Channel:

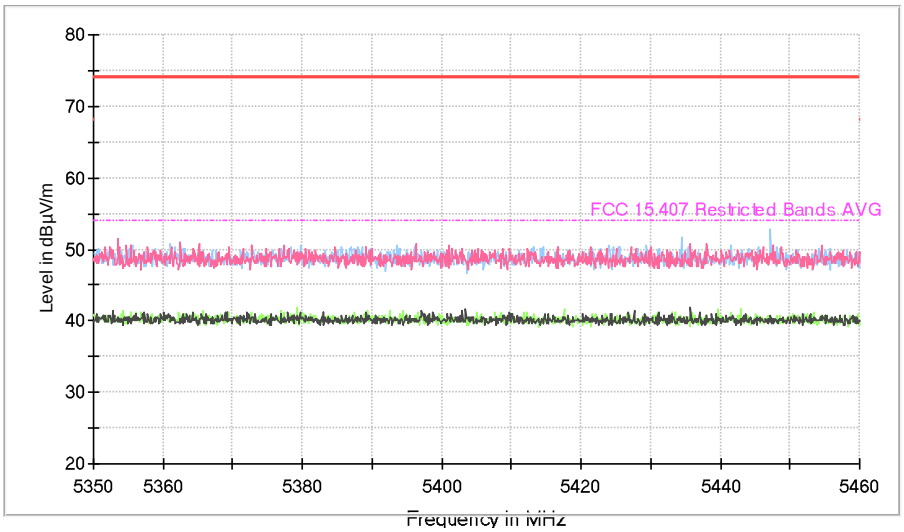


SISO 802.11 ac80

- Lower Band Edge and Upper Band Edge – Single Channel (Restricted Bands):

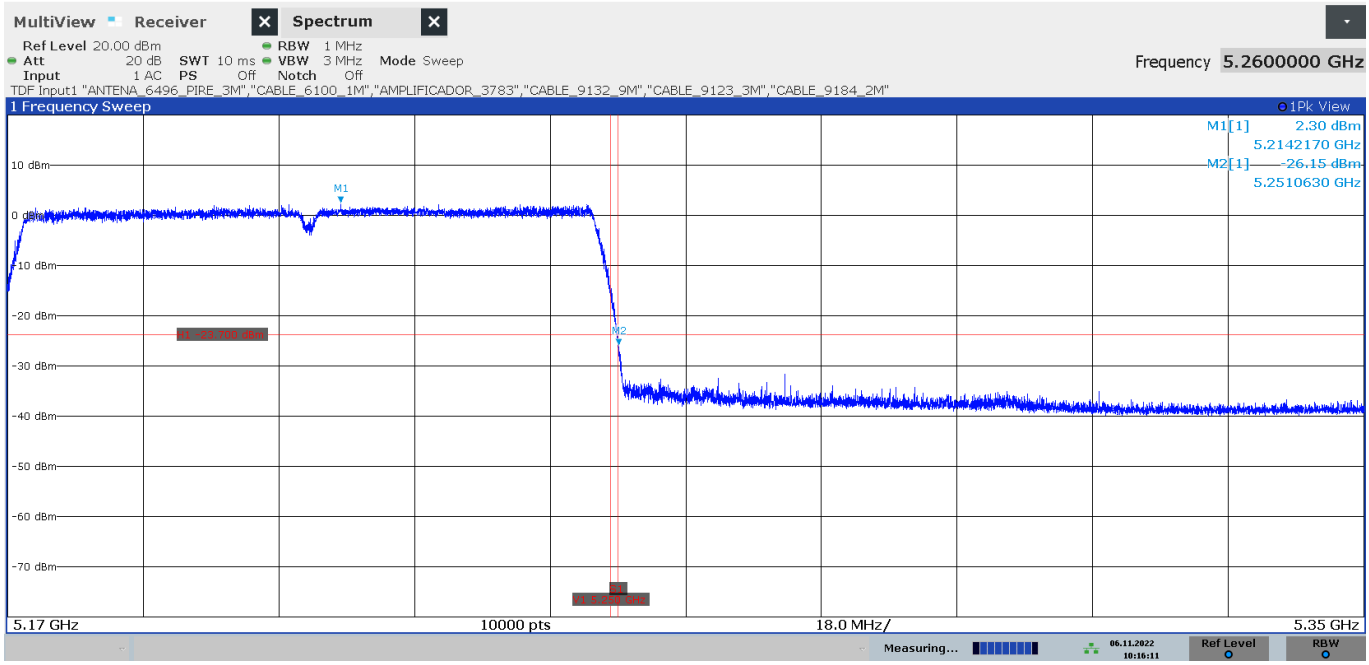


Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG



Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

- Frequency range 5250-5350 MHz - High Channel:



Appendix C: Tests results for U-NII-3: 5.725 GHz – 5.85 GHz Band

INDEX

TEST CONDITIONS

(*) Declared by the Client.

POWER SUPPLY (*):

Vnominal:	12 Vdc
Type of Power Supply:	External DC (Vehicle Battery).

ANTENNA (*):

Type of Antenna:	External.
Maximum Declared Antenna Gain U-NII-3:	+2.38 dBi

Technology Tested:	WLAN (IEEE 802.11 a20 / n2040 / ac204080 1x1) U-NII-3	
Modes:	802.11a: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps (SISO, with CDD)	
	802.11n HT20: MCS0 to MCS23 (SISO, 1 spatial stream)	
	802.11n HT40: MCS0 to MCS23 (SISO, 1 spatial stream)	
	802.11ac VHT20: MCS0 to MCS9 (SISO, 1 spatial stream)	
	802.11ac VHT40: MCS0 to MCS9 (SISO, 1 spatial stream)	
	802.11ac VHT80: MCS0 to MCS9 (SISO, 1 spatial stream)	
Setting of cores / ports:	One.	
Beamforming:	No.	
Frequency Range:	5725 MHz to 5850 MHz	
Operating Channel Bandwidth:	20 MHz	
Transmission Channels:	Channel	Channel Frequency (MHz)
	Low (149)	5745
	Middle (157)	5785
	High (165)	5825
Operating Channel Bandwidth:	40 MHz	
Transmission Channels:	Channel	Channel Frequency (MHz)
	Low (151)	5755
	High (159)	5795
Operating Channel Bandwidth:	80 MHz	
Transmission Channels:	Single (155)	5775

POWER SETTINGS (*):

The next power settings were used to configure the sample for the tests.

U-NII-3. FCC and RSS:

Channel	Frequency	a	n	ac
149	5745 MHz	17	17	17
157	5785 MHz	17	17	17
165	5825 MHz	19	19	19
151	5755 MHz		17	17
159	5795 MHz		17	17
165	5775 MHz			17

The test set-up was made in accordance to the general provisions of FCC Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec 14, 2017.

The EUT was tested in the following operating mode:

- Continuously transmitting with a modulated carrier at maximum power in all required channels using the supported data rates/modulations types.

The field strength at the band edges was evaluated for each mode on the lowest and highest channels at the rated power for the channel under test.

For all modes, the EUT was configured in test mode using a software application. The application was used to enable a continuous transmission and to select the test channels as required. The client supplied instructions to configure the EUT. The customer supplied a document containing the setup instructions.

The worst cases for testing were identified for output power and spurious levels at the band edges which were selected based on preliminary testing. They correspond to the next data rates:

- 802.11a: 6 Mbps SISO 1Tx.
- 802.11n HT20: MCS0 SISO 1Tx.
- 802.11n HT40: MCS0 SISO 1Tx.
- 802.11ac VHT20: MCS0 SISO 1Tx.
- 802.11ac VHT40: MCS0 SISO 1Tx.
- 802.11ac VHT80: MCS0 SISO 1Tx.

CONDUCTED MEASUREMENTS:

The equipment under test was set up in a shielded room and connected to the spectrum analyzer using a low-loss RF cable. The reading in the spectrum analyzer is corrected taking into account the internal and external RF cable loss.

For all modes:

RADIATED MEASUREMENTS:

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range from 30 MHz to 1000 MHz) and 1 GHz-18 GHz Double ridge horn antenna is situated at a distance of 3 m and a distance of 1.5 m for the frequency range 17 GHz-40 GHz (18 GHz-40 GHz horn antenna).

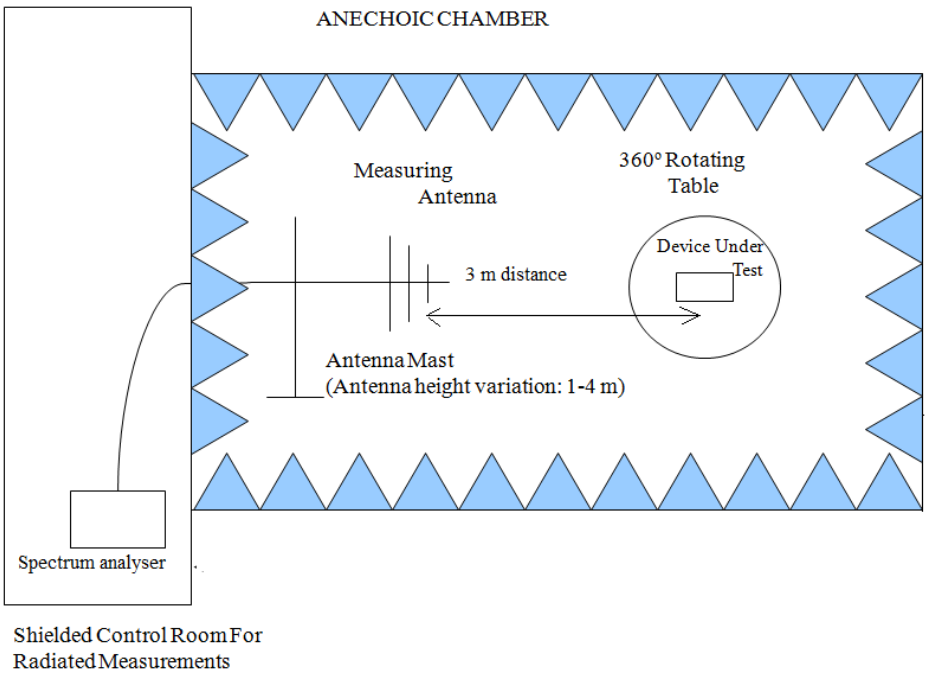
For radiated emissions in the range 17 GHz-40 GHz performed at a distance closer than the distance specified in the standard, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The equipment under test was set up on a non-conductive platform above the ground plane and its situation and orientation were varied to find the maximum radiated emission. It was also rotated 360º and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find the maximum radiated emission (up to 17 GHz).

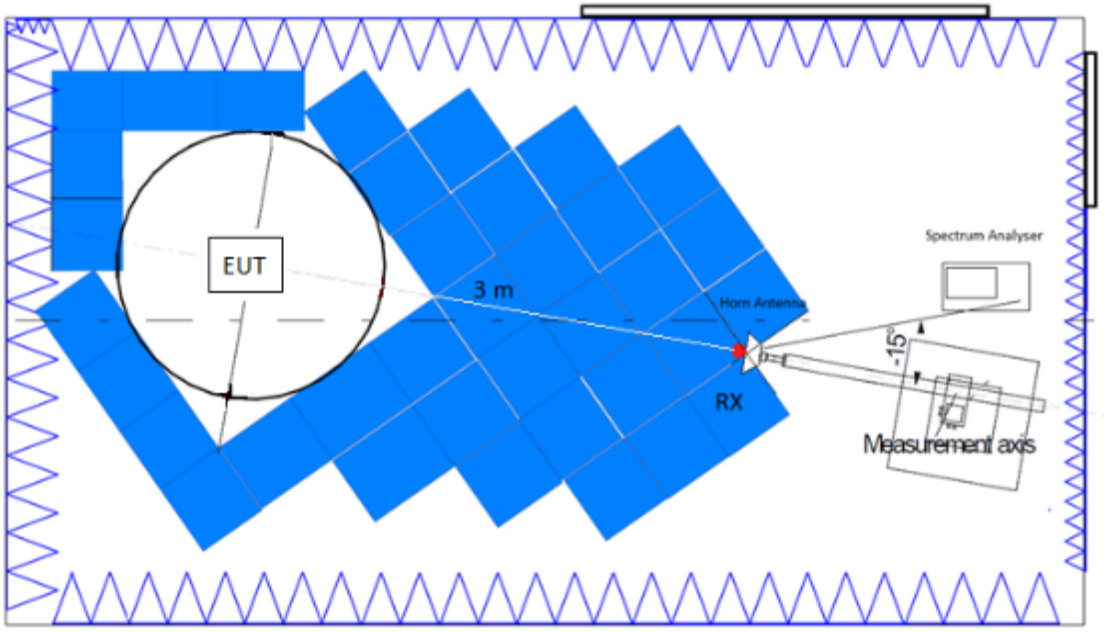
Measurements were made in both horizontal and vertical planes of polarization.

A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

Radiated measurements setup f < 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup f > 17 GHz: