Plot 7-143. BANDWIDTH Plot – ANT2 - CH.9 – SP1 – Preamble 32

Plot 7-144. BANDWIDTH Plot – ANT2 - CH.9 – SP3 – Preamble 32

7.3 Cessation Time

§15.519(a)(1)

Test Overview and Limit

§15.519(a)(1) A UWB device operating under the provisions of this section shall transmit only when it is sending information to an associated receiver. The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgment from the associated receiver that its transmission is being received an acknowledgment of reception must continue to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting.

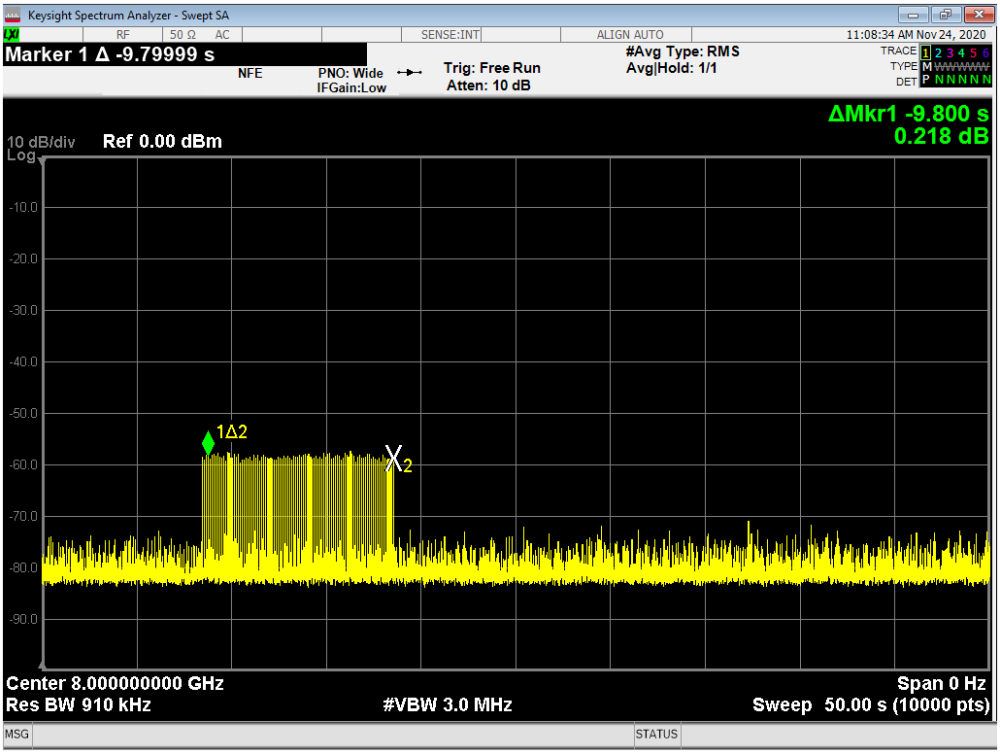
Test Settings

1. RBW = 1MHz
2. VBW = 3MHz
3. Span = 0 Span Mode
4. Sweep time shall be sufficient to demonstrate EUTs compliance with the rule part.
5. Vertical Markers are placed to indicate the point in which the receiver ceases acknowledging the EUT and the point 10s after.

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

Figure 7-2. Test Instrument and Measurement Setup



Plot 7-145. Cessation Time Plot

7.4 Peak Power and Maximum Average Emissions

§15.519(e), §15.519(c)

Test Overview and Limit

15.519 (3)(e) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, fM. That limit is 0 dBm EIRP.

15.519 (3)(c) The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency in MHz	EIRP in dBm
3100 - 10600	-41.3

Test Procedures Used

ANSI C63.10-2013

Test Settings

Peak:

1. Analyzer frequency set to the frequency of the radiated spurious emission of interest
2. RBW = 50MHz, VBW = 80MHz
3. Detector = Peak
4. Sweep time = 2s
5. Trace mode = max hold
6. Trace was allowed to stabilize

Average:

1. Analyzer frequency set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz, VBW = 3MHz
3. Detector = Average-RMS (for Average)
4. Sweep time = 2s
5. Sweep Points = 2001 (1ms integration period per measurement bin)
6. Trace mode = max hold
7. Trace was allowed to stabilize

RESULTS – BPRF

ANT	CH	MODE	Preamble	Meas. Ant.	FM [GHz]	Peak Power (dBm/50MHz)	Peak Limit (dBm/50MHz)	Margin [dB]
1	5	SP0	9	H	6.487	-1.62	0	-1.62
2	5	SP0	9	H	6.487	-9.16	0	-9.16
1	9	SP1	9	V	7.997	-4.35	0	-4.35
2	9	SP1	9	V	7.997	-8.03	0	-8.03

Table 7-4. BPRF Highest Peak Power Results

ANT	CH	MODE	Preamble	Meas. Ant.	FM [GHz]	Average Power (dBm)	Average Limit (dBm)	Margin [dB]
1	5	SP3	11	H	6.664	-42.82	-41.3	-1.52
2	5	SP3	10	H	6.695	-42.90	-41.3	-1.60
1	9	SP3	11	V	7.839	-42.85	-41.3	-1.55
2	9	SP3	11	V	7.839	-42.88	-41.3	-1.58

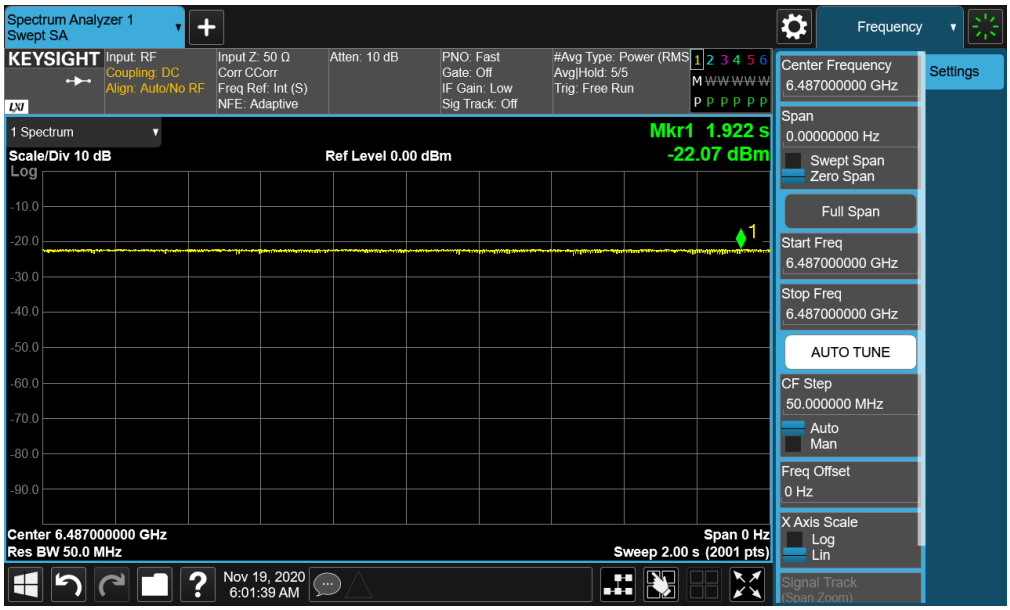
Table 7-5. BPRF Highest Average Power Results

Sample Calculation:

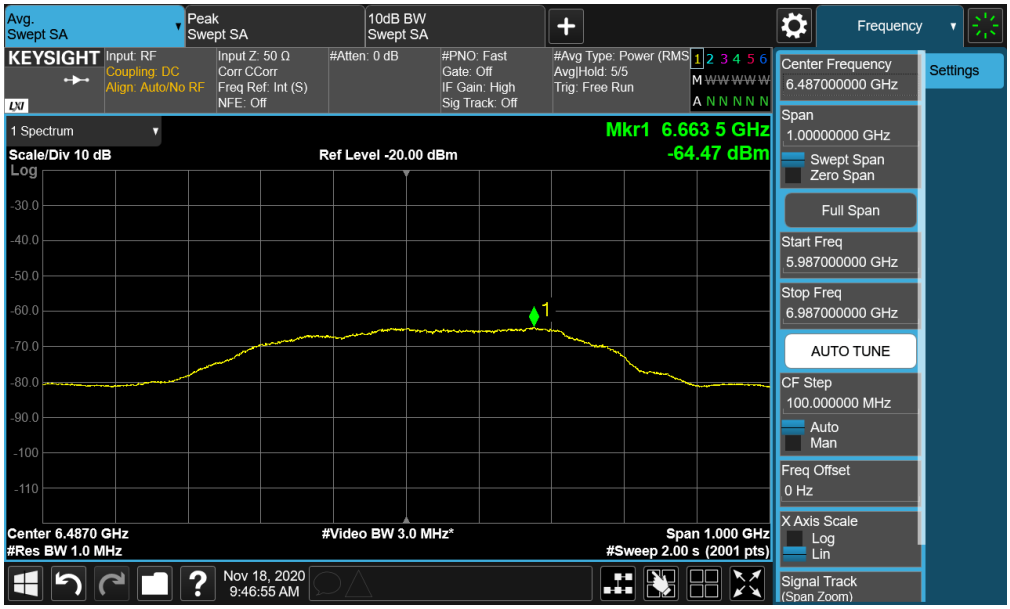
The raw radiated spurious level is converted to field strength in dBuV/m. Then, the EIRP level is calculated by applying the additional factors shown below for a test distance of 3 meter

.

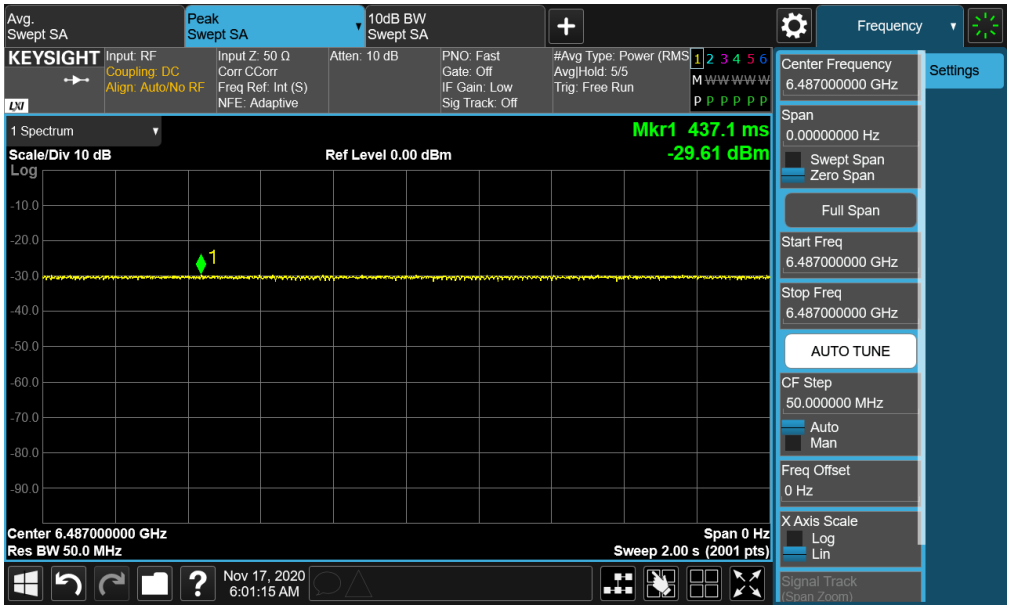
RSE EIRP (dBm) = Analyzer Level (dBm) + 107 + AFCL (dB/m) + 20Log(Dm) – 104.8



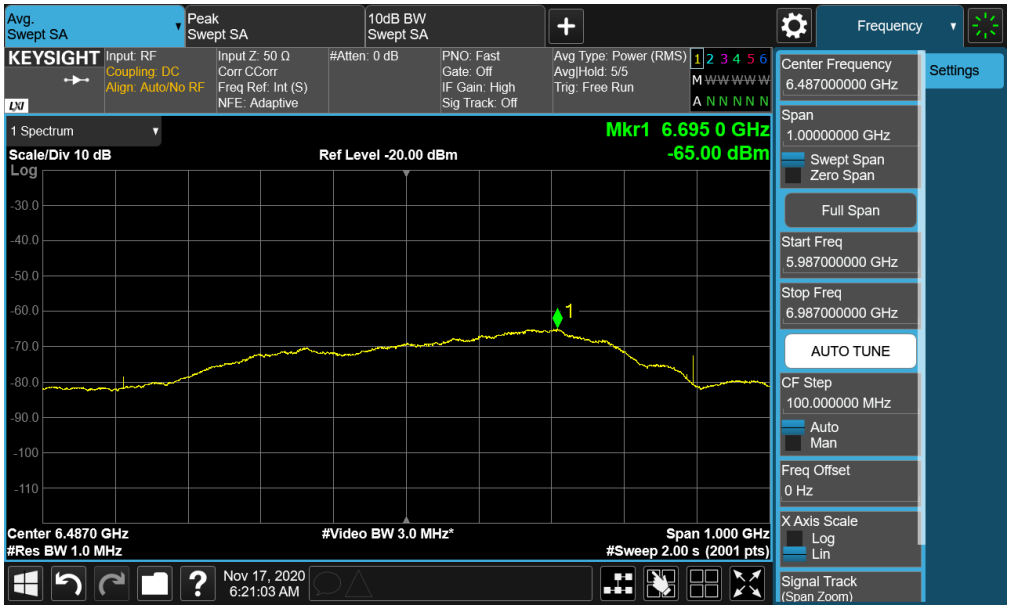
Plot 7-146. UWB Peak Power Measurement - ANT 1 - CH.5 – SP0 – BPRF



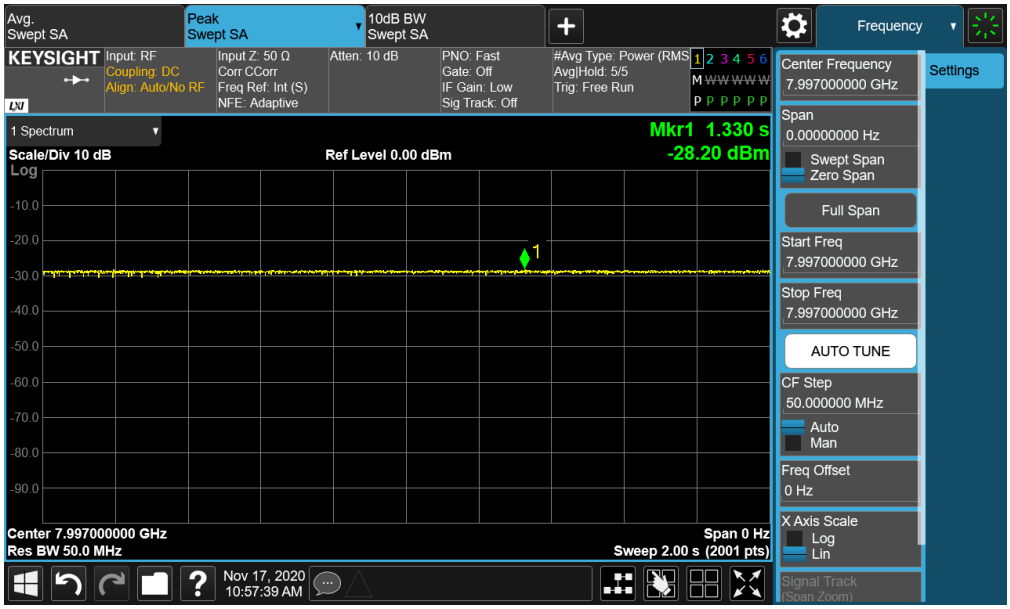
Plot 7-147. UWB Average Power Measurement - ANT 1 - CH.5 – SP3 – BPRF



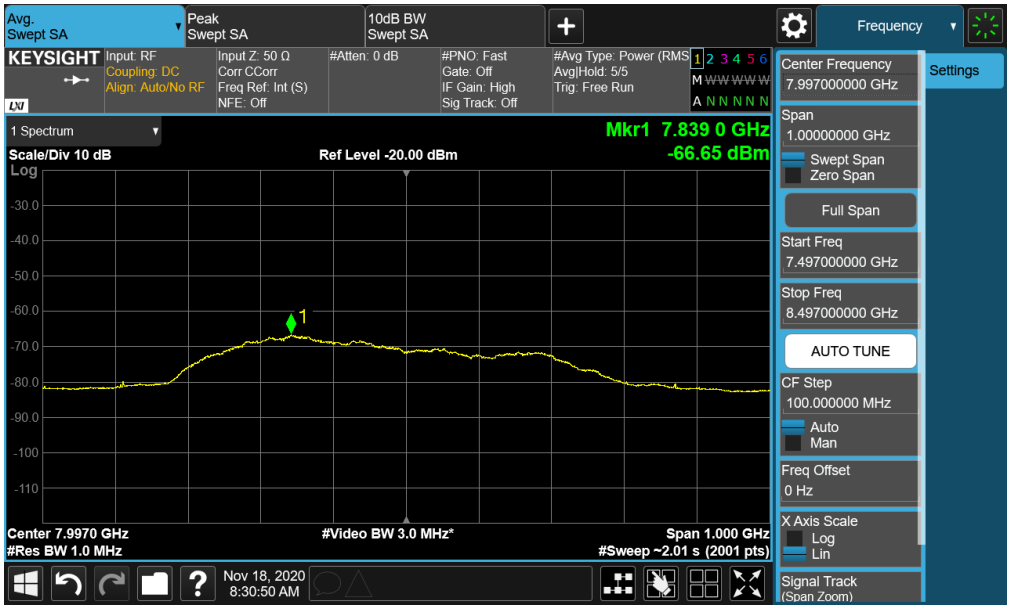
Plot 7-148. UWB Peak Power Measurement - ANT 2 - CH.5 – SP0 – BPRF



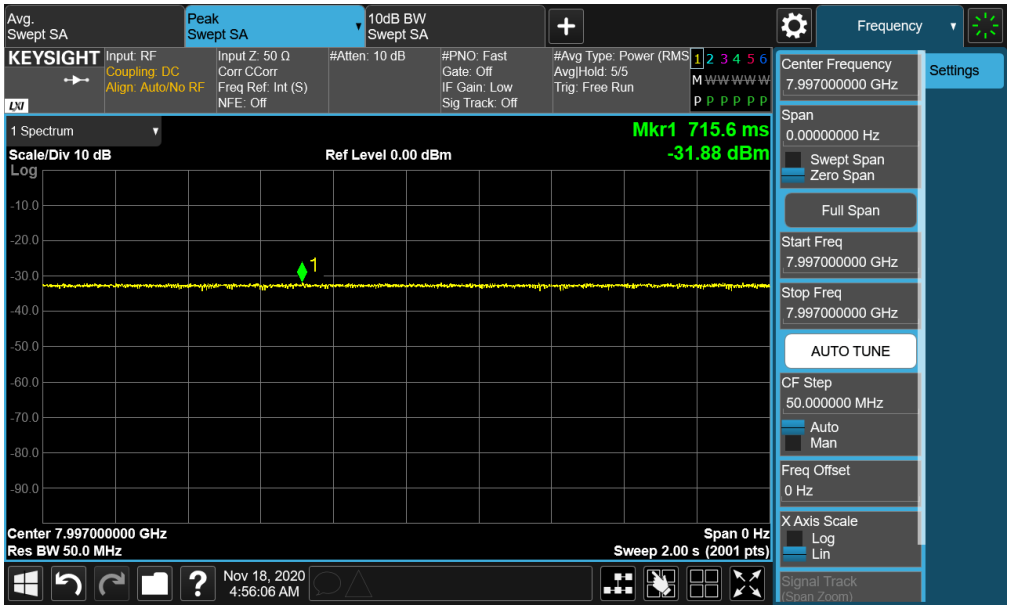
Plot 7-149. UWB Average Power Measurement - ANT 2 - CH.5 – SP3 - BPRF



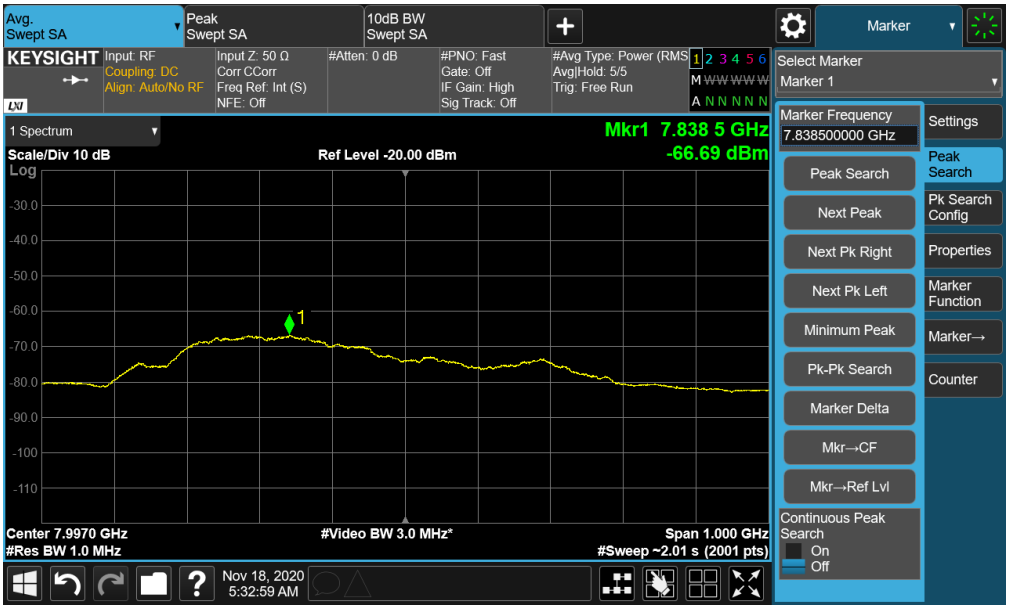
Plot 7-150. UWB Peak Power Measurement - ANT 1 - CH.9 – SP1 – BPRF



Plot 7-151. UWB Average Power Measurement - ANT 1 - CH.9 – SP3 - BPRF



Plot 7-152. UWB Peak Power Measurement - ANT 2 - CH.9 – SP1 – BPRF



Plot 7-153. UWB Average Power Measurement - ANT 2 - CH.9 – SP3 - BPRF

RESULTS – HPRF

ANT	CH	MODE	Preamble	Meas. Ant.	FM [GHz]	Peak Power (dBm/50MHz)	Peak Limit (dBm/50MHz)	Margin [dB]
1	5	SP0	31	H	6.487	-7.10	0	-7.10
2	5	SP0	26	H	6.487	-6.38	0	-6.38
1	9	SP0	30	V	7.997	-3.61	0	-3.61
2	9	SP0	28	V	7.997	-5.59	0	-5.59

Table 7-6. HPRF Highest Peak Power Results

ANT	CH	MODE	Preamble	Meas. Ant.	FM [GHz]	Average Power (dBm)	Average Limit (dBm)	Margin [dB]
1	5	SP3	32	H	6.661	-42.82	-41.3	-1.52
2	5	SP3	26	V	6.690	-42.82	-41.3	-1.52
1	9	SP3	28	V	7.835	-42.84	-41.3	-1.54
2	9	SP3	31	V	7.850	-43.00	-41.3	-1.70

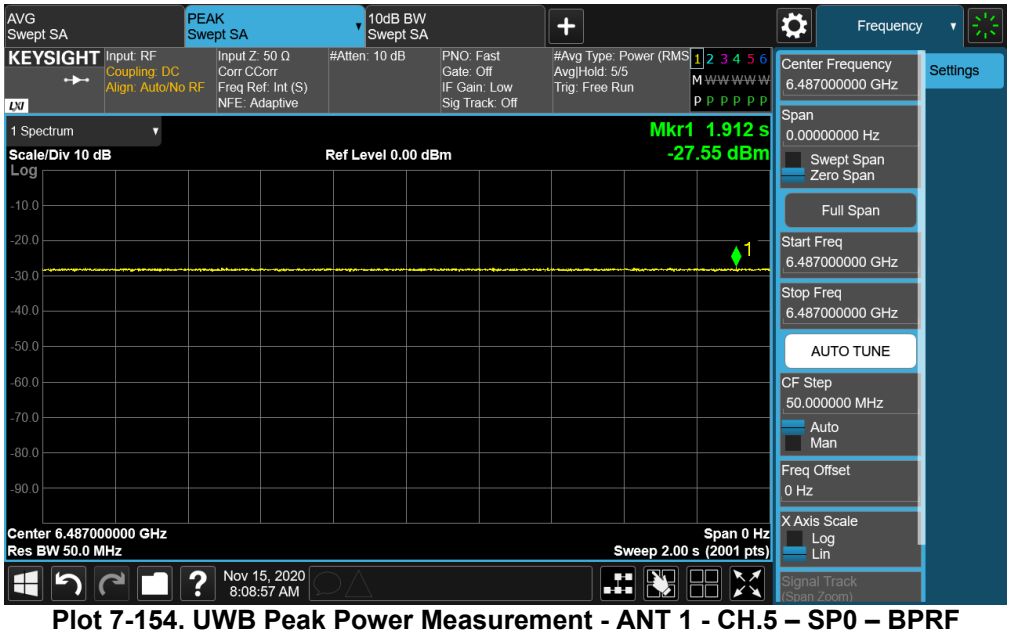
Table 7-7. HPRF Highest Average Power Results

Sample Calculation

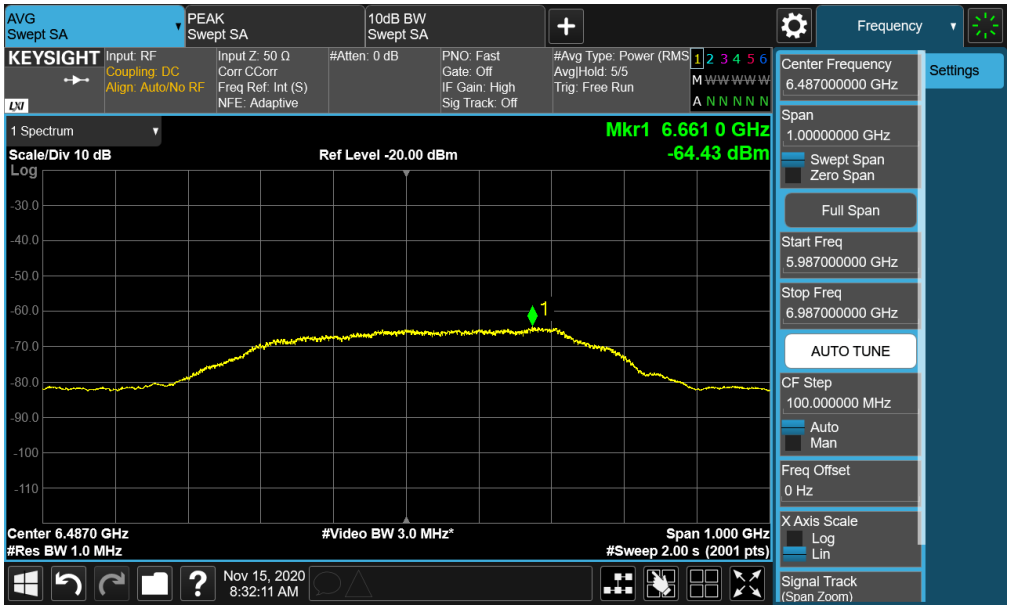
The raw radiated spurious level is converted to field strength in dBuV/m. Then, the EIRP level is calculated by applying the additional factors shown below for a test distance of 3 meter

.

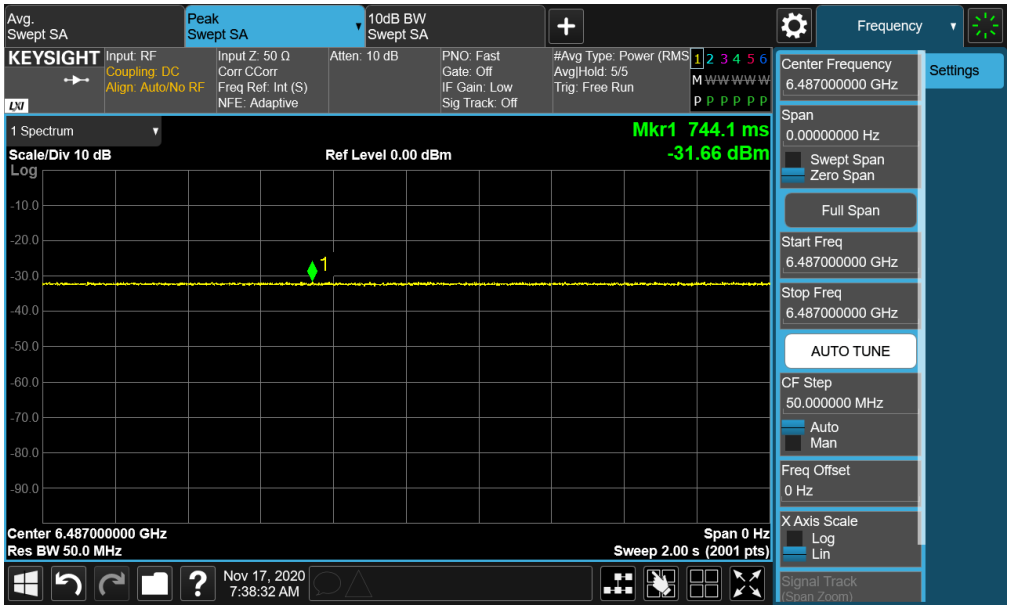
RSE EIRP (dBm) = Analyzer Level (dBm) + 107 + AFCL (dB/m) + 20Log(Dm) – 104.8



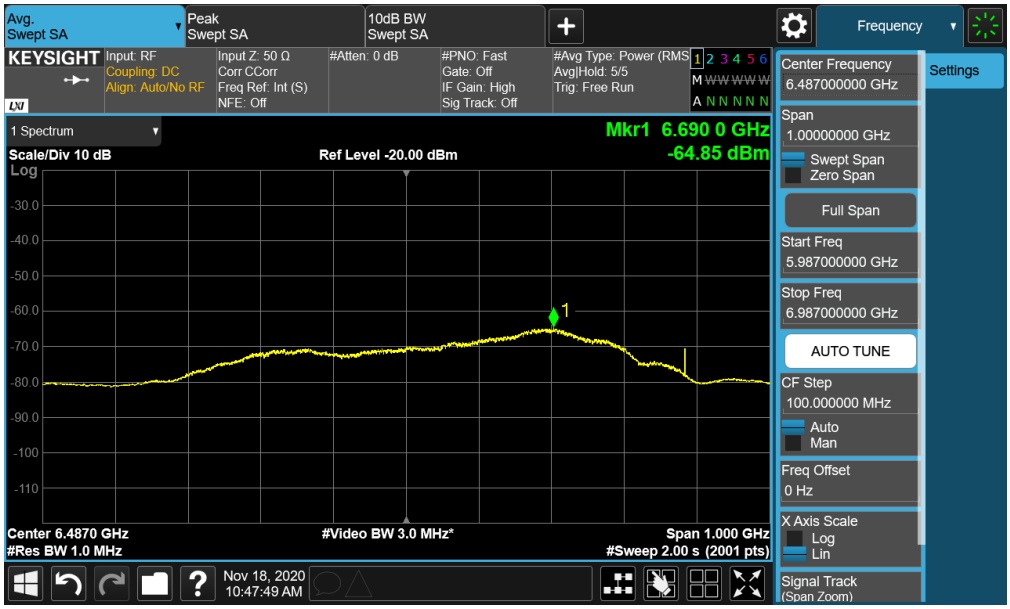
Plot 7-154. UWB Peak Power Measurement - ANT 1 - CH.5 – SP0 – BPRF



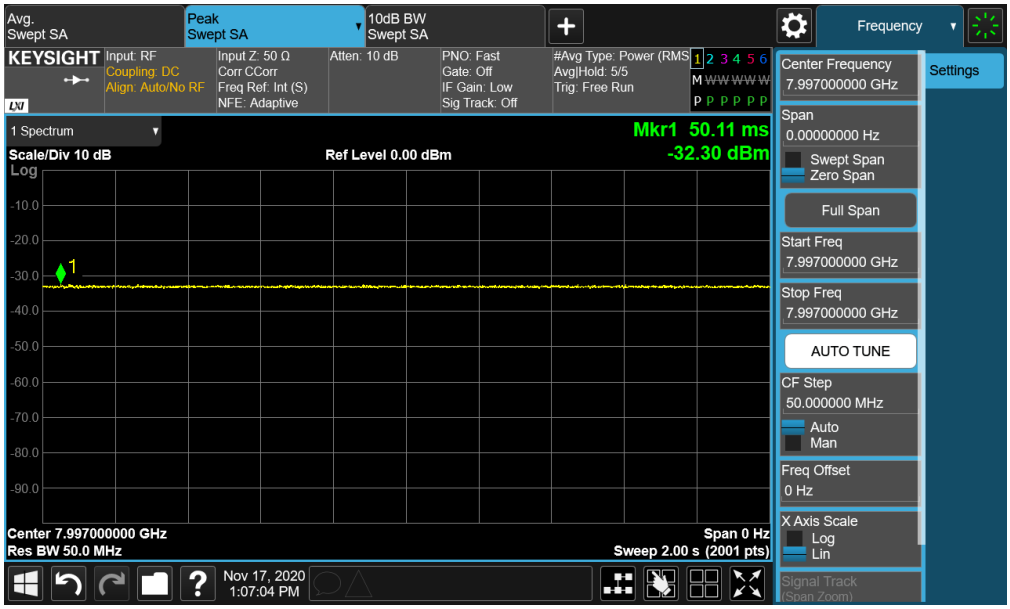
Plot 7-155. UWB Average Power Measurement - ANT 1 - CH.5 – SP3 – BPRF



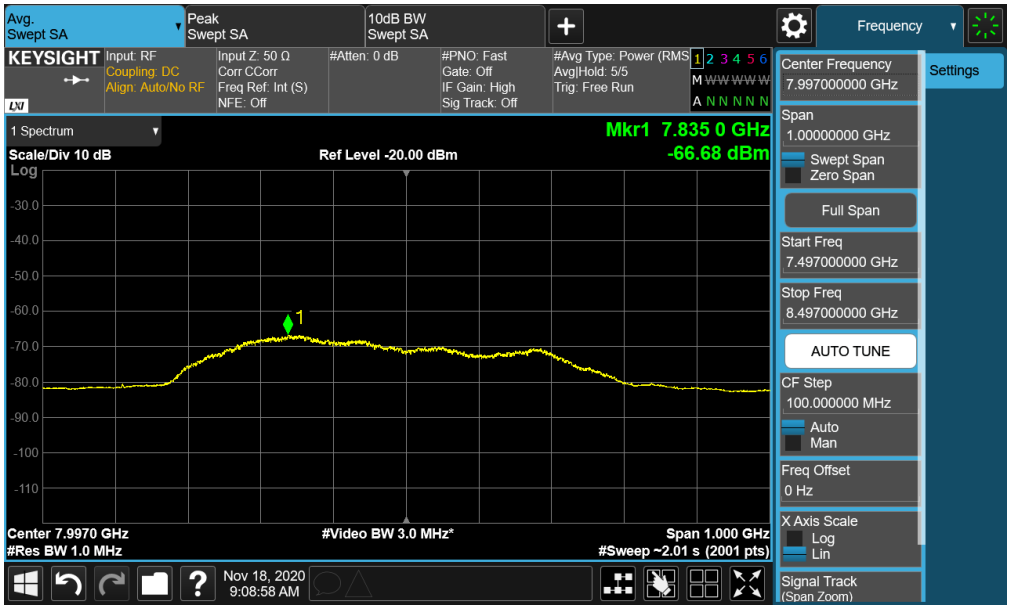
Plot 7-156. UWB Peak Power Measurement - ANT 2 - CH.5 – SP0 – BPRF



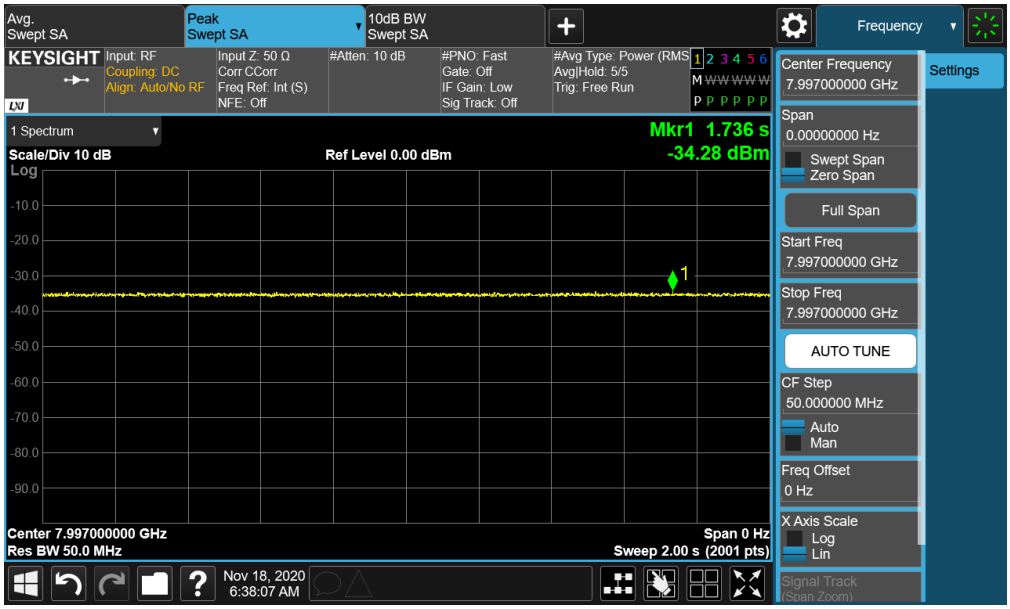
Plot 7-157. UWB Average Power Measurement - ANT 2 - CH.5 – SP3 - BPRF



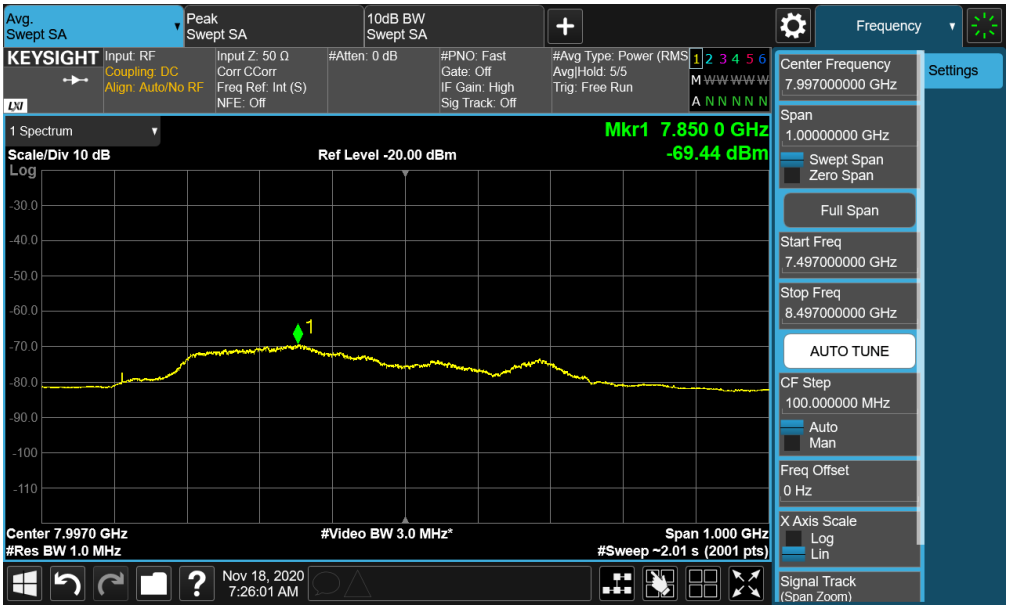
Plot 7-158. UWB Peak Power Measurement - ANT 1 - CH.9 – SP0 – BPRF



Plot 7-159. UWB Average Power Measurement - ANT 1 - CH.9 – SP3 - BPRF



Plot 7-160. UWB Peak Power Measurement - ANT 2 - CH.9 – SP0 – BPRF



Plot 7-161. UWB Average Power Measurement - ANT 2 - CH.9 – SP3 - BPRF

7.5 Radiated Measurement Data above 960MHz

§15.519 (c), §15.519(d), §15.209(a)

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at maximum power and at the appropriate frequencies. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

§15.519(c)

Frequency in MHz	EIRP in dBm
960-1610	-75.3
1610-1990	-63.3
1990-3100	-61.3
3100-10600	-41.3
Above 10600	-61.3

Table 7-8. Above 960MHz Average Limits

§15.519(d)

Frequency in MHz	EIRP in dBm
1164-1240	-85.3
1559-1610	-85.3

Table 7-9. Above 960MHz Average Limits

Test Procedures Used

ANSI C63.10-2013

Test Settings

Average EIRP Measurements

1. Analyzer frequency set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz (3kHz for emissions in the GPS bands)
3. VBW = 3MHz (30kHz for the emissions in the GPS bands)
4. Detector = RMS
5. Sweep time = auto couple
6. Trace mode = trace averaging
7. Trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown test setup photos provided.

Test Notes

1. All modes of operation and settings (Preamble, Packet Type, etc) were investigated and the worst-case emissions are reported.
2. The RBW for measurements in the GPS Bands were reduced to 3kHz in order to show compliance.
3. Pre-scan plots that are included are not corrected for antenna factors, cable losses, or pre-amplifier gains. The plots are only for the purpose of spurious emission identification.
4. All readings are calibrated by a signal generator with accuracy traceable to the National Institute of Standards and Technology (NIST).
5. AFCL (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB)

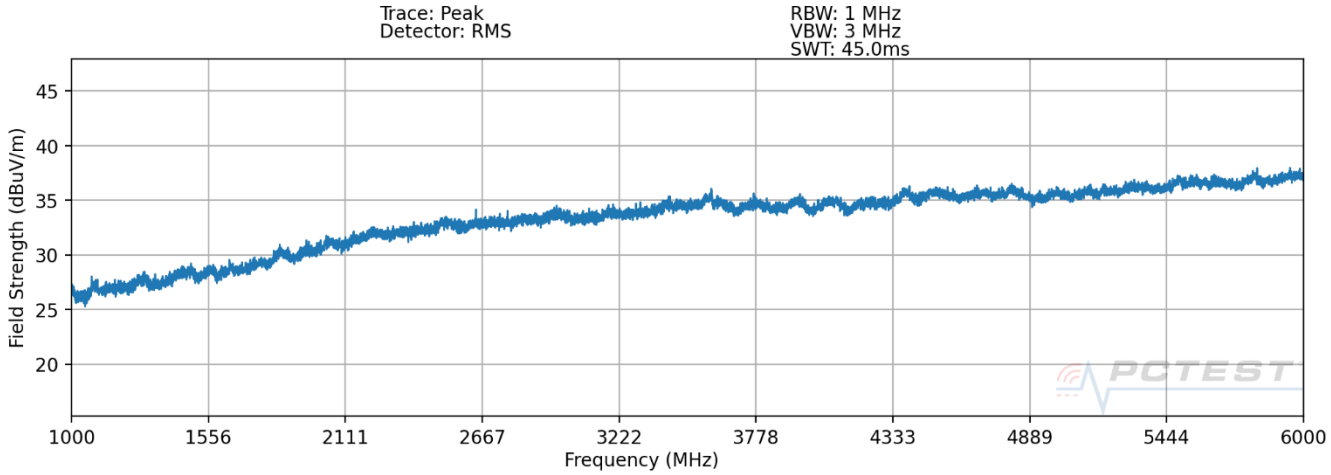
Sample Calculation

The raw radiated spurious level is converted to field strength in dBuV/m. Then, the EIRP RSE level is calculated by applying the additional factors shown below for a test distance of 3 meter

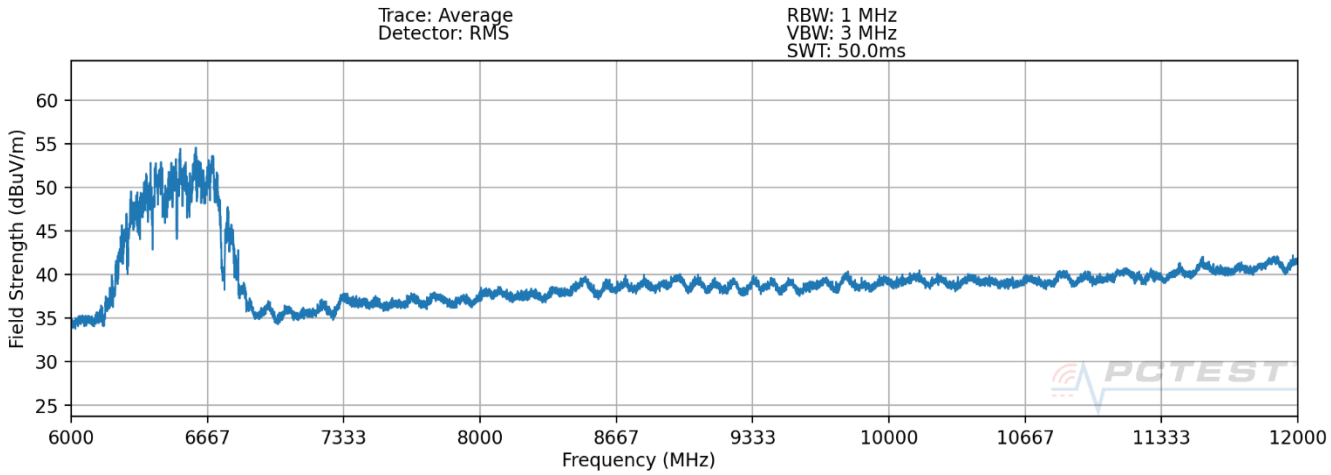
.

RSE EIRP (dBm) = Analyzer Level (dBm) + 107 + AFCL (dB/m) + 20Log(Dm) – 104.8

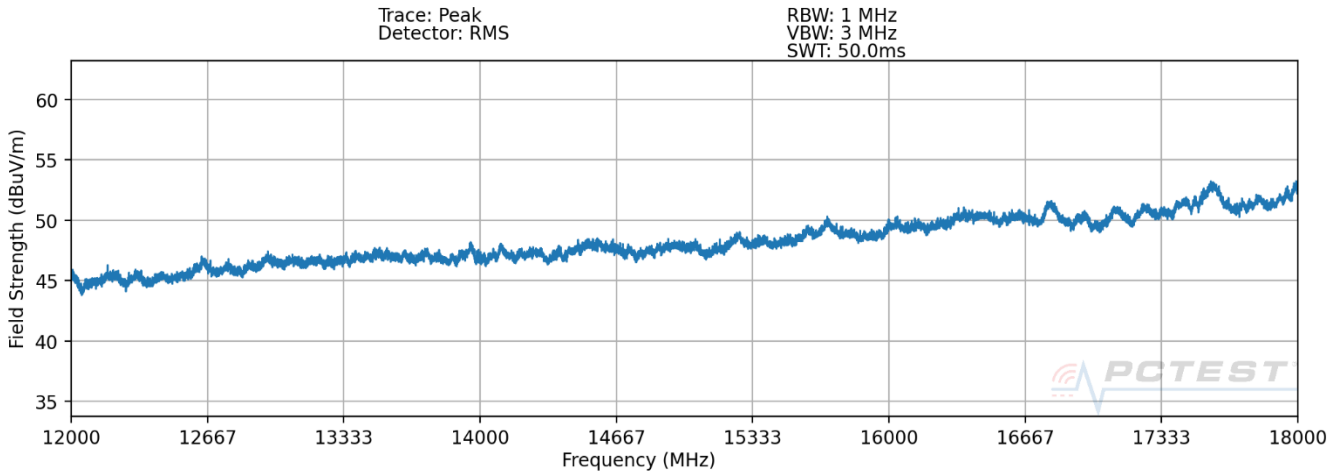
Channel 5 ANTENNA 1:



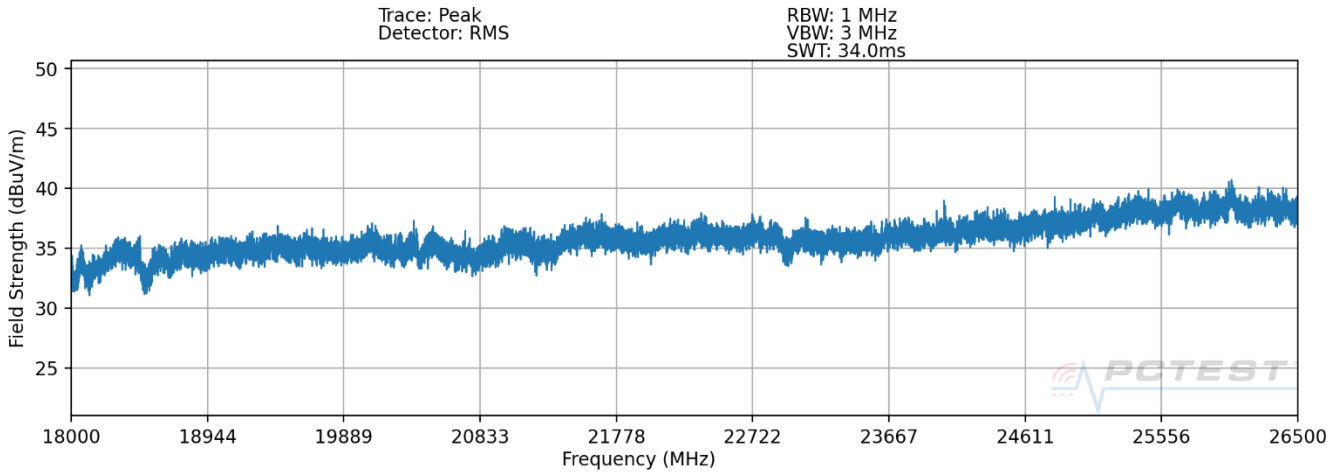
Plot 7-162. Radiated Spurious Pre-Scan 960 - 6000 MHz - CH.5 - ANT 1



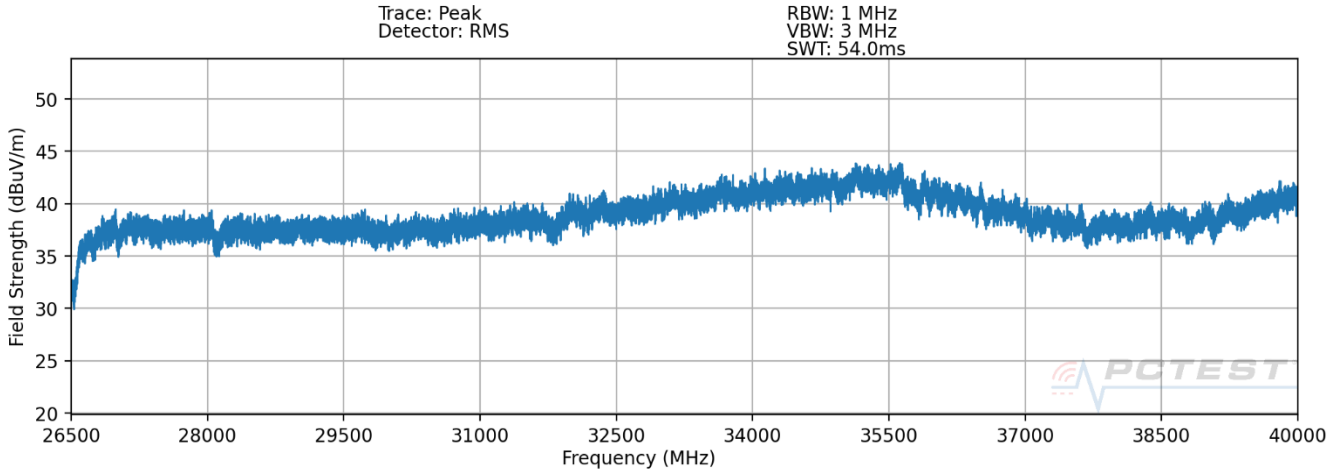
Plot 7-163. Radiated Spurious Pre-Scan 6000 - 12000 MHz - CH.5 - ANT 1



Plot 7-164. Radiated Spurious Pre-Scan 12000 - 18000 MHz - CH.5 - ANT 1



Plot 7-165. Radiated Spurious Pre-Scan 18 – 26.5 GHz - CH.5 - ANT 1

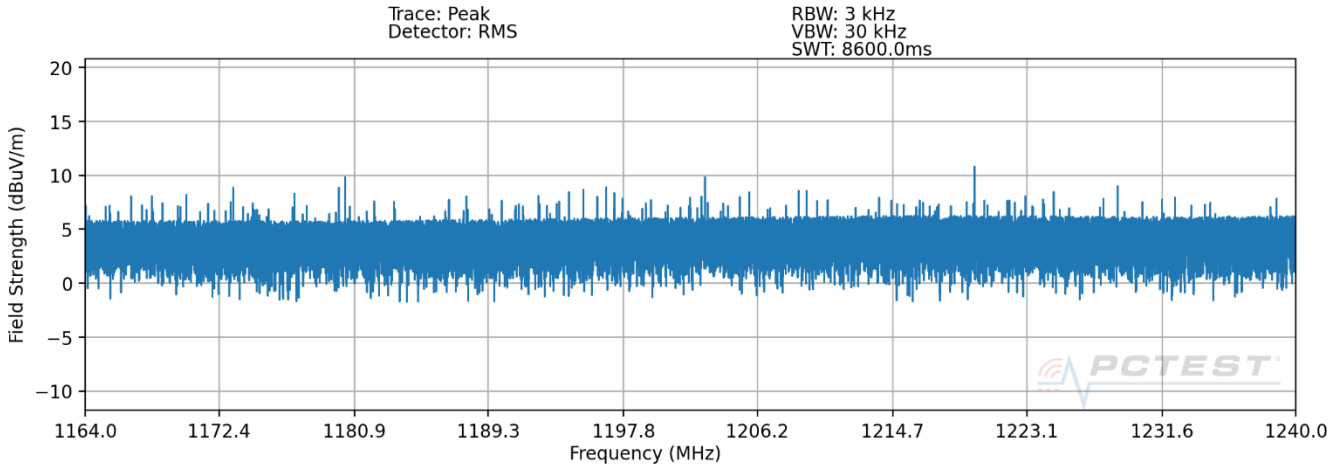


Plot 7-166. Radiated Spurious Pre-Scan 26.5 – 40.0 GHz - CH.5 - ANT 1

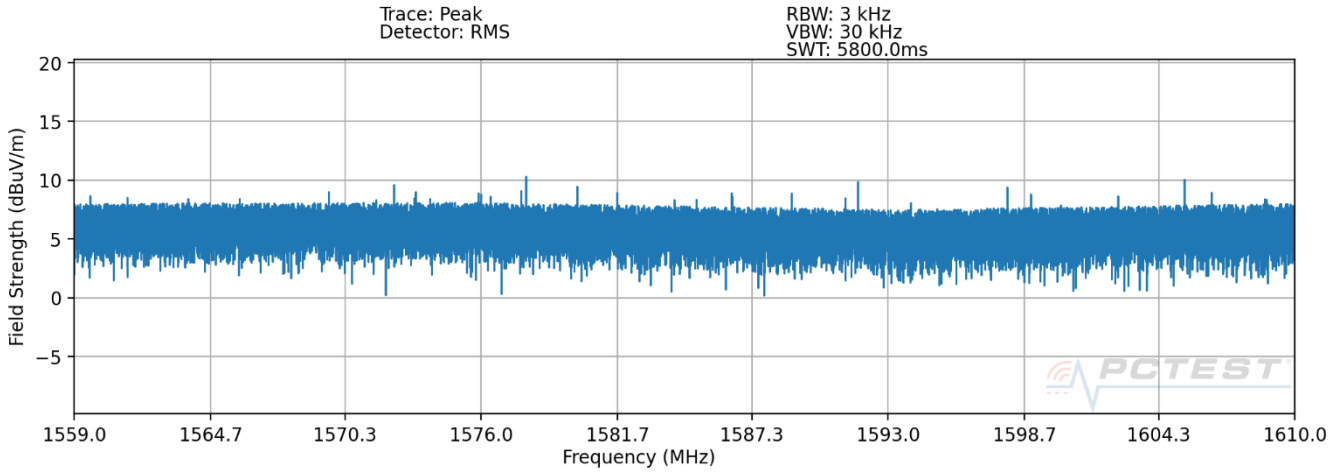
Channel:	5
Frequency (MHz):	6500
Preamble id:	29
Config	SP3

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
1615.00	AVERAGE	H	-	-	-77.81	-0.99	28.20	-67.06	-63.30	-3.76
4989.00	AVERAGE	H	-	-	-76.55	6.82	37.27	-57.98	-41.30	-16.68
8022.00	AVERAGE	H	-	-	-80.26	11.81	38.55	-56.71	-41.30	-15.41
8520.00	AVERAGE	H	-	-	-80.72	12.58	38.86	-56.40	-41.30	-15.10
10981.00	AVERAGE	H	-	-	-94.12	16.00	28.88	-66.38	-61.30	-5.08

Table 7-10. Radiated Spurious Emissions CH. 5 – ANT1



Plot 7-167. Radiated Spurious Pre-Scan 1164 - 1240 MHz - CH.5 - ANT 1

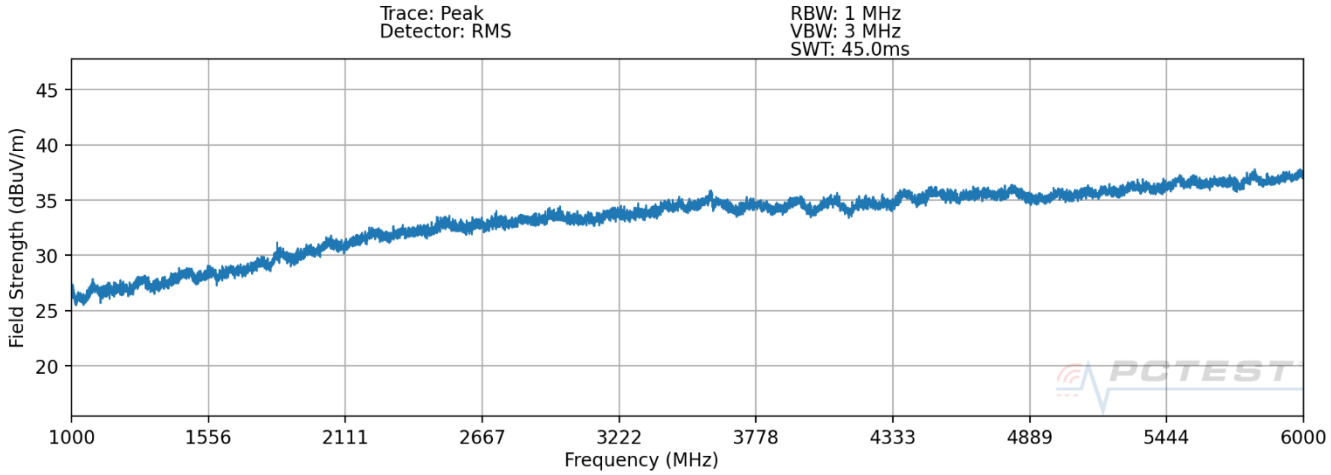


Plot 7-168. Radiated Spurious Pre-Scan 1559 - 1610 MHz - CH.5 - ANT 1

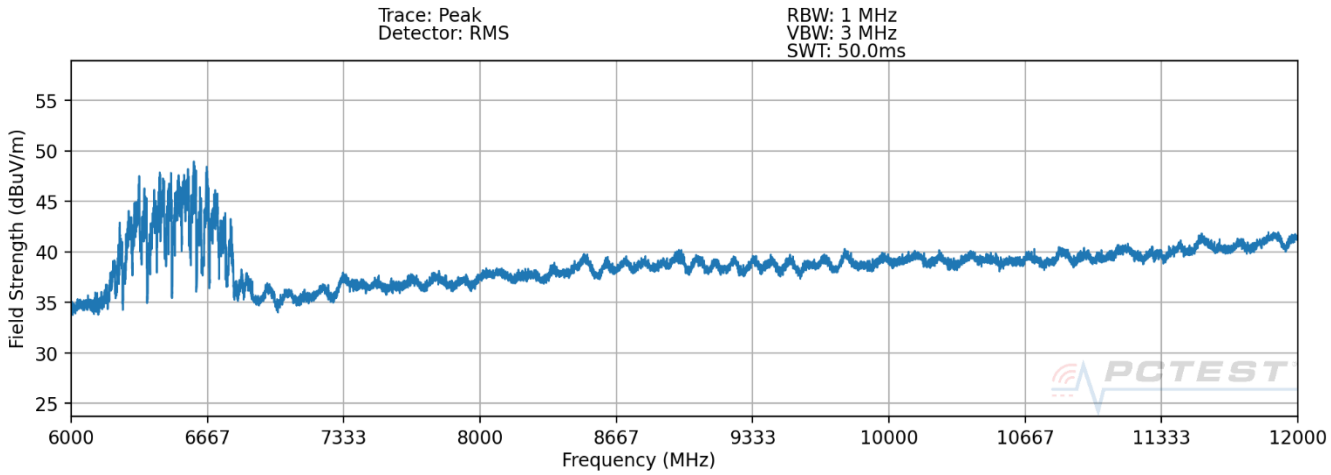
Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
1218.00	AVERAGE	H	-	-	-99.67	-6.70	0.63	-94.63	-85.30	-9.33
1591.00	AVERAGE	H	-	-	-99.86	-2.43	4.71	-90.55	-85.30	-5.25
1607.00	AVERAGE	H	-	-	-102.42	-0.95	3.63	-91.63	-85.30	-6.33

Table 7-11. Radiated Spurious Emissions CH. 5 – ANT1 – GPS BANDs

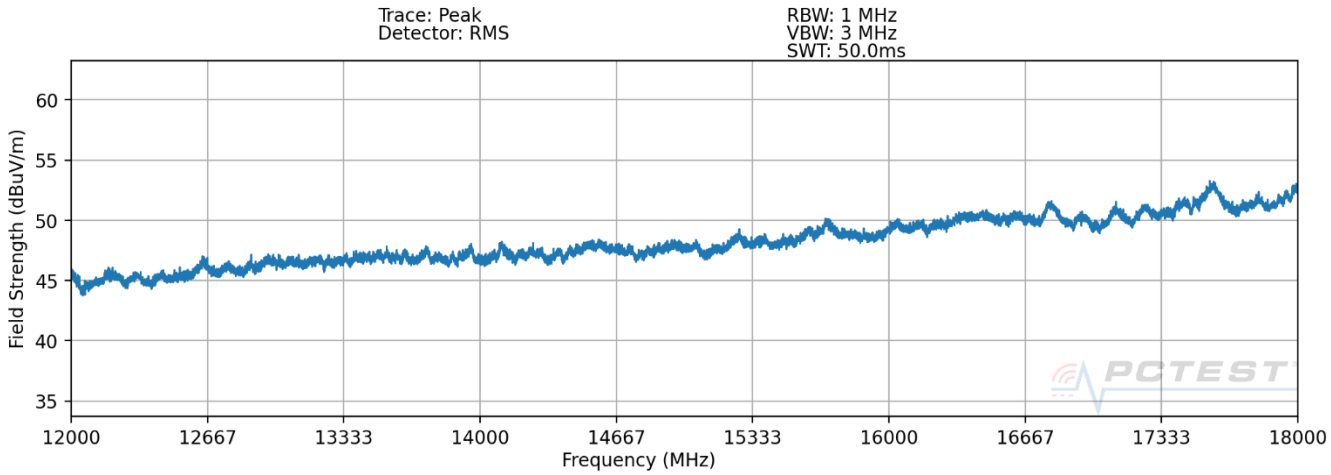
Channel 5 ANTENNA 2:



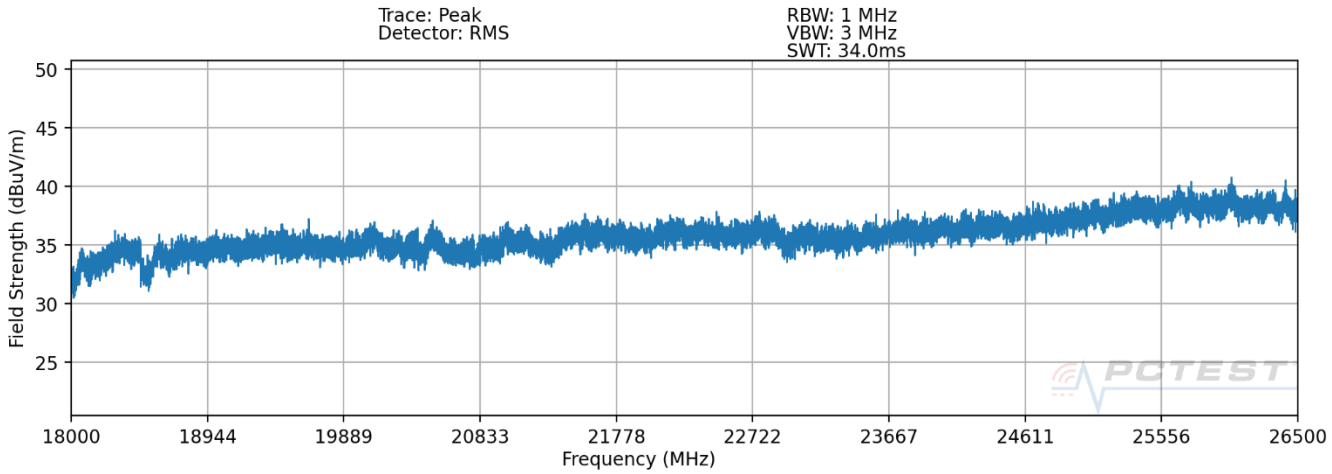
Plot 7-169. Radiated Spurious Pre-Scan 960 - 6000 MHz - CH.5 - ANT 2



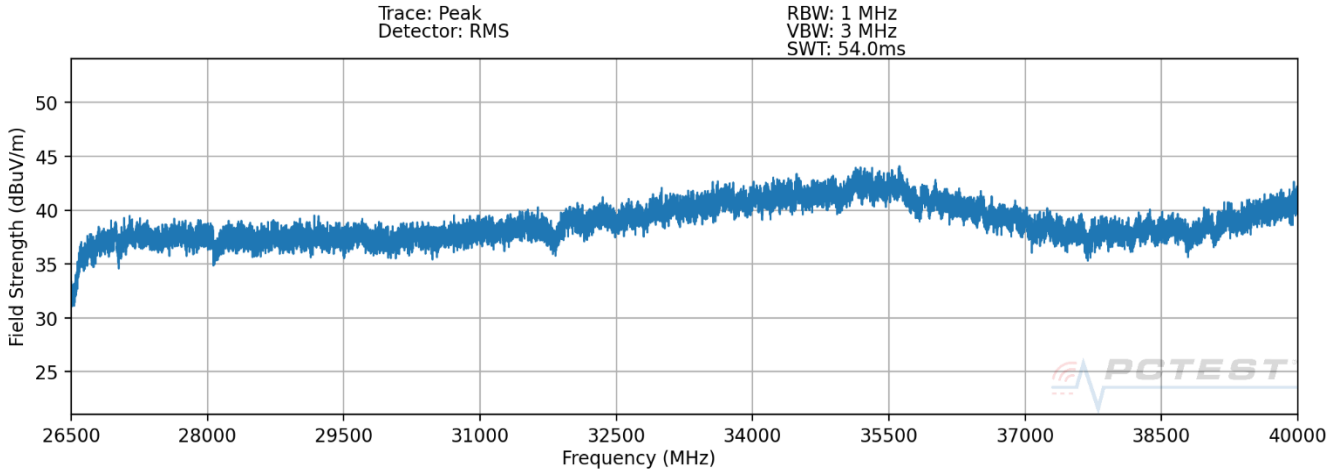
Plot 7-170. Radiated Spurious Pre-Scan 6000 - 12000 MHz - CH.5 - ANT 2



Plot 7-171. Radiated Spurious Pre-Scan 12000 - 18000 MHz - CH.5 - ANT 2



Plot 7-172. Radiated Spurious Pre-Scan 18 – 26.5 GHz - CH.5 - ANT 2

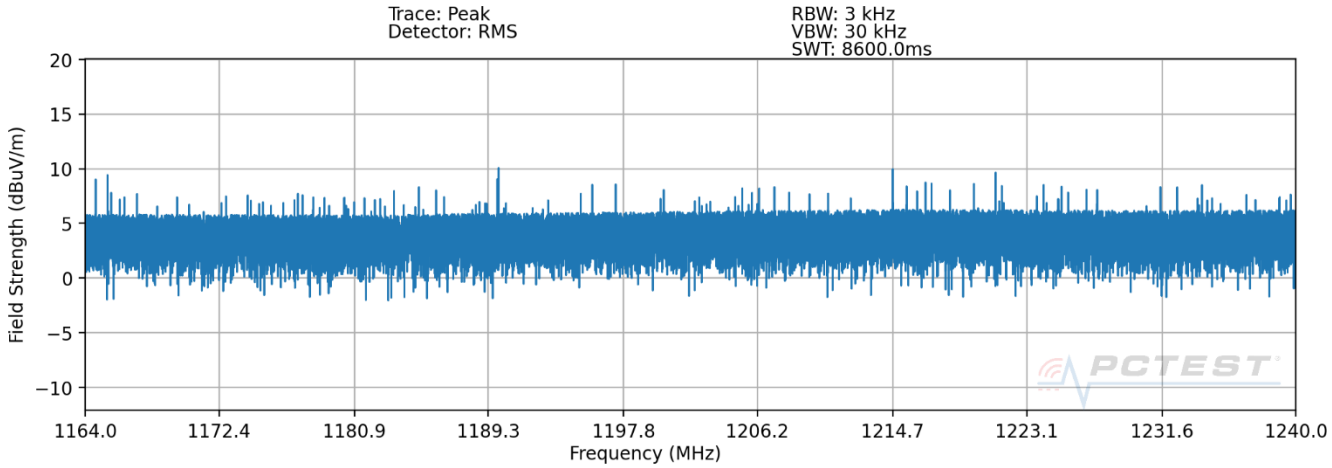


Plot 7-173. Radiated Spurious Pre-Scan 26.5 – 40.0 GHz - CH.5 - ANT 2

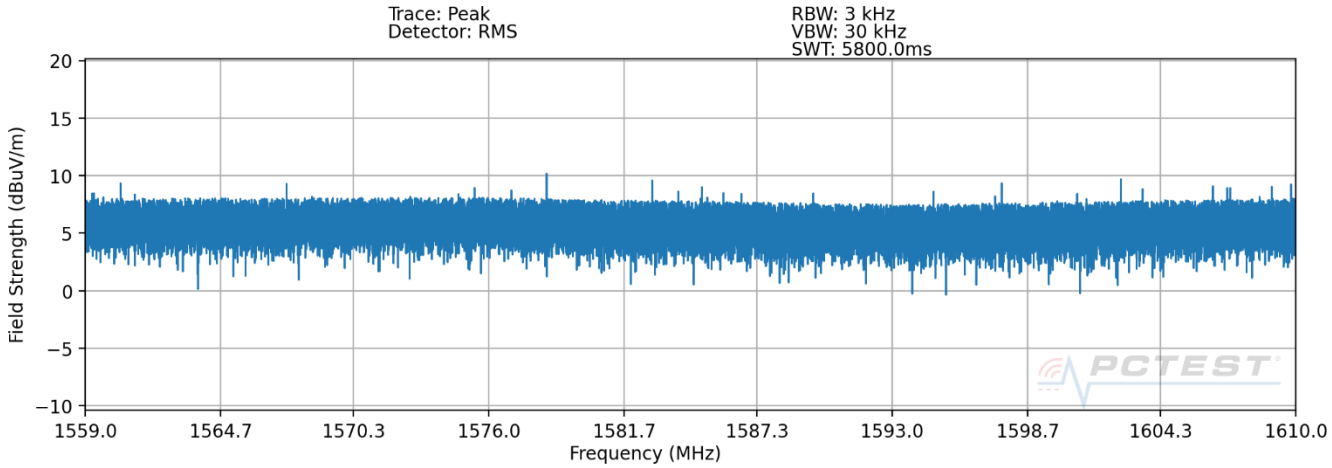
Channel:	5
Frequency (MHz):	6500
Preamble id:	10
Config	SP3

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
1772.00	AVERAGE	H	-	-	-76.91	-4.48	25.61	-69.65	-63.30	-6.35
2329.00	AVERAGE	H	-	-	-77.54	-2.57	26.89	-68.37	-61.30	-7.07
6717.00	AVERAGE	H	-	-	-83.93	22.06	45.13	-50.13	-41.30	-8.83
8501.00	AVERAGE	H	-	-	-84.53	16.76	39.23	-56.03	-41.30	-14.73
10521.00	AVERAGE	H	-	-	-85.84	24.76	45.92	-49.34	-41.30	-8.04

Table 7-12. Radiated Spurious Emissions CH. 5 – ANT2



Plot 7-174. Radiated Spurious Pre-Scan 1164 - 1240 MHz - CH.5 - ANT 2

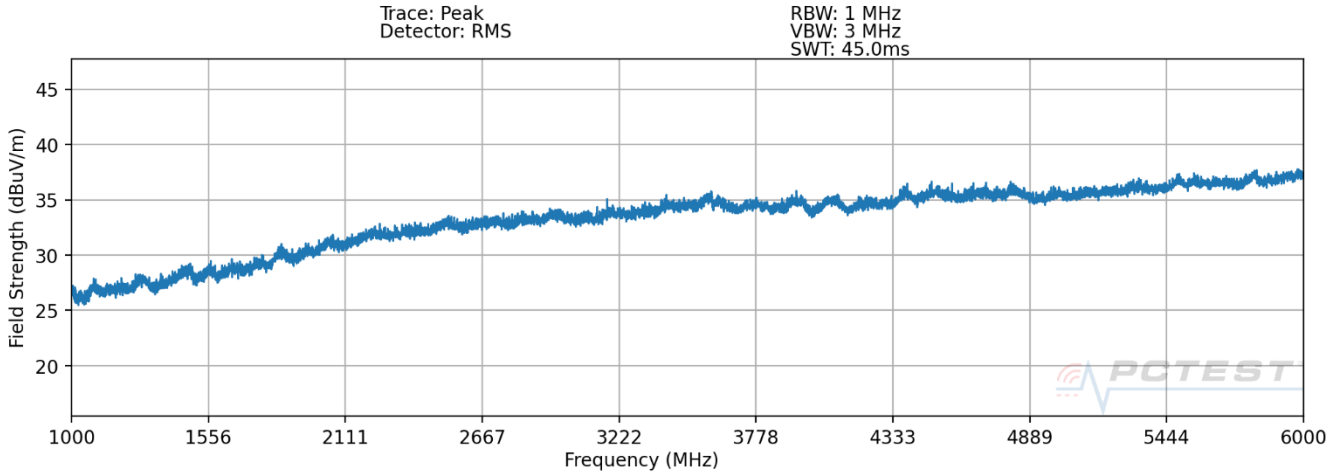


Plot 7-175. Radiated Spurious Pre-Scan 1559 - 1610 MHz - CH.5 - ANT 2

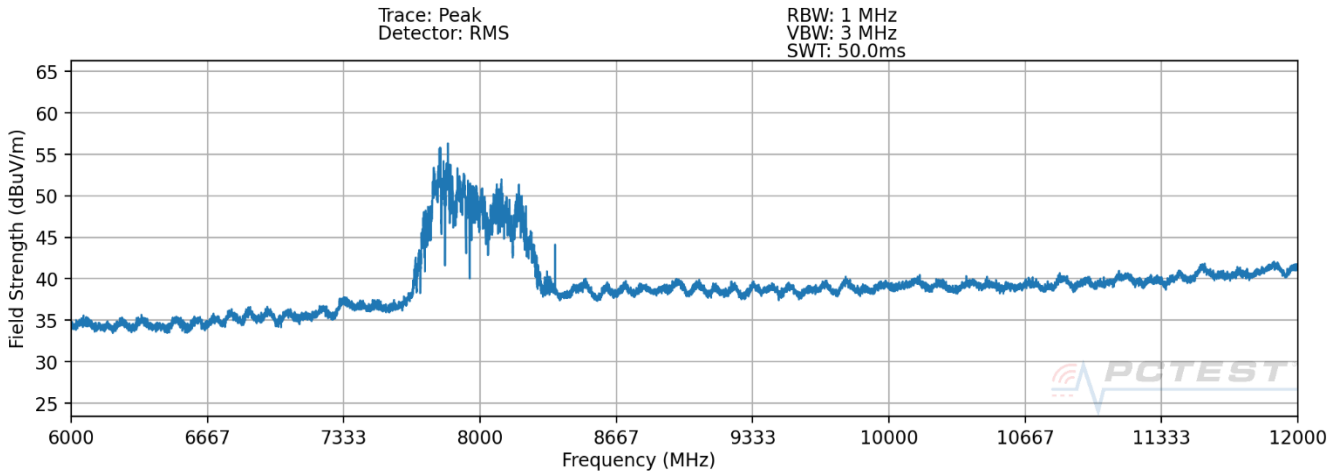
Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
1213.00	AVERAGE	H	-	-	-99.73	-3.76	3.51	-91.75	-85.30	-6.45
1583.00	AVERAGE	H	-	-	-100.17	-2.16	4.67	-90.58	-85.30	-5.28

Table 7-13. Radiated Spurious Emissions CH. 5 – ANT2 – GPS BANDs

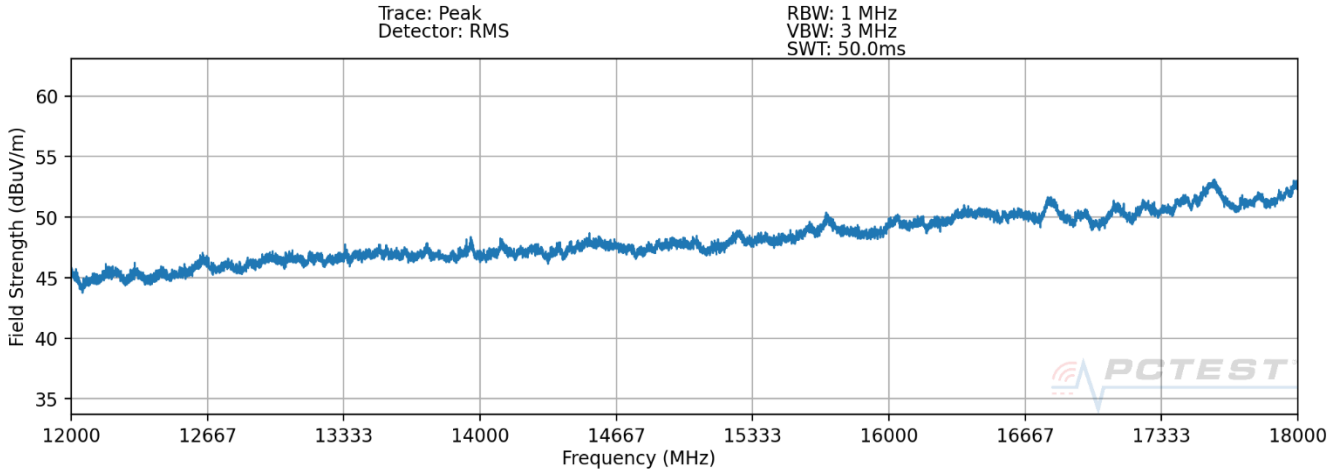
Channel 9 ANTENNA 1:



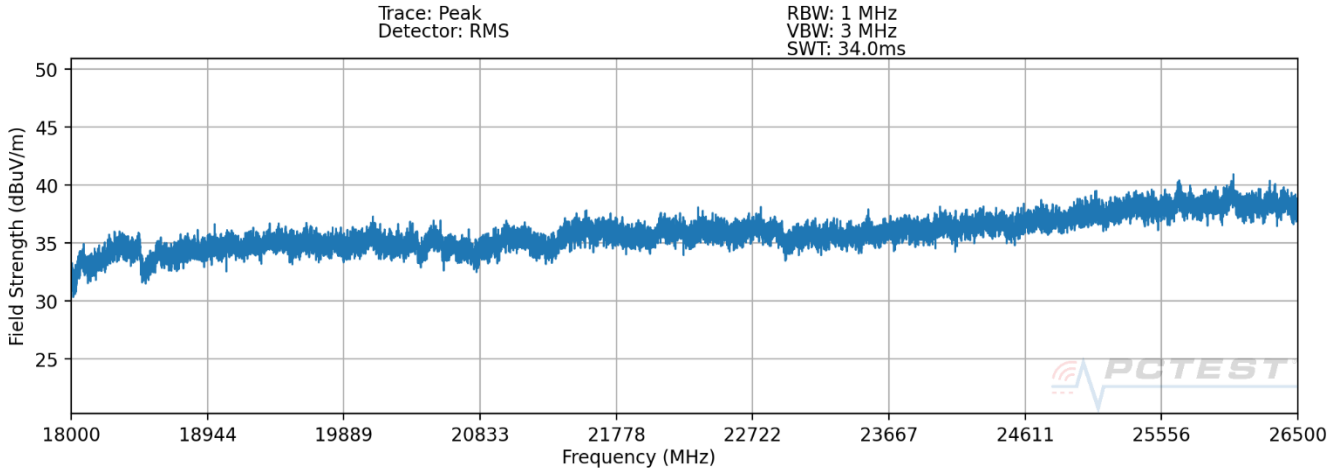
Plot 7-176. Radiated Spurious Pre-Scan 960 - 6000 MHz - CH.9 - ANT 1



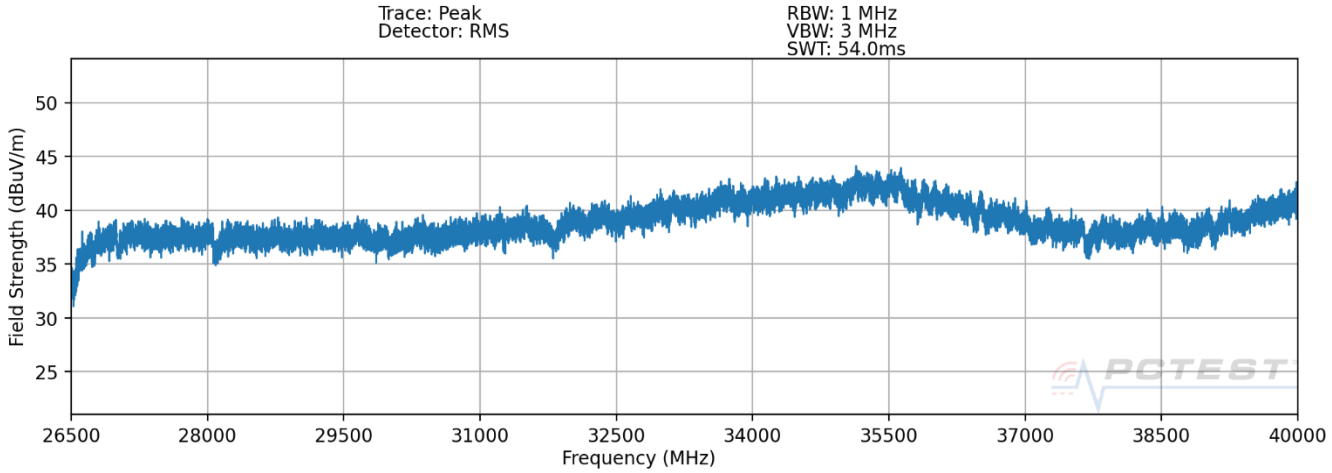
Plot 7-177. Radiated Spurious Pre-Scan 6000 - 12000 MHz - CH.9 - ANT 1



Plot 7-178. Radiated Spurious Pre-Scan 12000 - 18000 MHz - CH.9 - ANT 1



Plot 7-179. Radiated Spurious Pre-Scan 18 – 26.5 GHz - CH.9 - ANT 1



Plot 7-180. Radiated Spurious Pre-Scan 26.5 – 40.0 GHz - CH.9 - ANT 1

Channel:	9
Frequency (MHz):	8000
Preamble id:	10
Config	SP3

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
1633.00	AVERAGE	H	-	-	-77.00	-5.72	-70.98	-63.30	-7.68
3022.00	AVERAGE	H	-	-	-77.93	-0.26	-66.45	-61.30	-5.15
4963.00	AVERAGE	H	-	-	-78.36	3.34	-63.28	-41.30	-21.98
7422.00	AVERAGE	H	-	-	-79.63	8.63	-59.25	-41.30	-17.95
11316.00	AVERAGE	H	-	-	-93.89	16.45	-65.70	-61.30	-4.40

Table 7-14. Radiated Spurious Emissions CH. 9 – ANT1