

8.3 FCC 15.247(d) and RSS-247 5.5 Spurious (out-of-band) unwanted emissions

8.3.1 Definitions and limits

FCC:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

ISED:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Table 8.3-1: FCC §15.209 and RSS-Gen – Radiated emission limits

Frequency, MHz	Field strength of emissions		Measurement distance, m
	µV/m	dBµV/m	
0.009–0.490	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes: In the emission table above, the tighter limit applies at the band edges.

For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test

Table 8.3-2: ISED restricted frequency bands

MHz	MHz	MHz	GHz
0.090–0.110	12.51975–12.52025	399.9–410	5.35–5.46
2.1735–2.1905	12.57675–12.57725	608–614	7.25–7.75
3.020–3.026	13.36–13.41	960–1427	8.025–8.5
4.125–4.128	16.42–16.423	1435–1626.5	9.0–9.2
4.17725–4.17775	16.69475–16.69525	1645.5–1646.5	9.3–9.5
4.20725–4.20775	16.80425–16.80475	1660–1710	10.6–12.7
5.677–5.683	25.5–25.67	1718.8–1722.2	13.25–13.4
6.215–6.218	37.5–38.25	2200–2300	14.47–14.5
6.26775–6.26825	73–74.6	2310–2390	15.35–16.2
6.31175–6.31225	74.8–75.2	2655–2900	17.7–21.4
8.291–8.294	108–138	3260–3267	22.01–23.12
8.362–8.366	156.52475–156.52525	3332–3339	23.6–24.0
8.37625–8.38675	156.7–156.9	3345.8–3358	31.2–31.8
8.41425–8.41475	240–285	3500–4400	36.43–36.5
12.29–12.293	322–335.4	4500–5150	Above 38.6

Note: Certain frequency bands listed in Table 8.3-2 and above 38.6 GHz are designated for low-power licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard

Table 8.3-3: FCC restricted frequency bands

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

8.3.2 Test summary

Test date	June 30, 2025	Verdict	Pass
Test engineer	D. Guarnone	Sample tested	PRJ0080060005

8.3.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10th harmonic.

EUT was set to transmit with 100 % duty cycle.

Radiated measurements were performed at a distance of 3 m.

EUT set to following TX parameters via Nordic DTM tool (Channel L/M/H as needed, Transmit Power = 4dBm, Physical layer = LE 1Mbps, Packet type = PRBS9, Packet length = 37 Bytes, No timeout)

Please remove 100% duty cycle

Spectrum analyser settings for radiated measurements within restricted bands below 1 GHz:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for peak radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for average radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	10 Hz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for conducted spurious emissions measurements:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

8.3.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Semi-anechoic chamber	Nemko Spa	10m semi-anechoic chamber	530	2023-09	2025-09
3m Semi anechoic chamber	Comtest	SAC-3	1711-150	2024-09	2026-09
EMI Receiver	Rohde & Schwarz	ESW44	101620	2024-09	2025-09
EMI Receiver	Rohde & Schwarz	ESU8	100202	2024-09	2025-09
Spectrum Analyzer	Rohde & Schwarz	FSW43	101767	2025-01	2026-01
Antenna Trilog 25MHz - 8GHz	Schwarzbeck Mess-Elektronik	VULB9162	9162-025	2024-08	2027-08
Antenna Trilog 25-2000 MHz	Schwarzbeck Mess-Elektronik	VULB9168	9168-242	2024-08	2027-08
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STLP 9148-152	2024-10	2027-10
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STPL 9148-123	2024-08	2027-08
Double Ridge Horn Antenna	RFSpin	DRH40	061106A40	2023-05	2026-05
Antenna loop	Rohde & Schwarz	HFH2-Z2	831 247/011	2024-02	2027-02
Antenna Loop Attiva+Power Inserter	Teseq	HLA6121+PI6121	45749	2023-08	2026-08
Broadband Amplifier	Schwarzbeck Mess-Elektronik	BBV9718C	00121	2025-01	2026-01
Preamplifier	Schwarzbeck Mess-Elektronik	BBV9718	BBV9718-137	2024-06	2025-06
RF Power Sensor	Rohde & Schwarz	NRP18AN	100990	2025-03	2026-03
RF Power Sensor	Rohde & Schwarz	NRP18AN	100987	2024-11	2025-11
RF Vector Signal Generator	Rohde & Schwarz	SMBV100A	263254	2024-06	2025-06
RF Signal Generator	Rohde & Schwarz	SMB100A	180431	2025-01	2026-01
RF Signal Generator	Rohde & Schwarz	SMA100B	104075	2024-10	2025-10
Broad-Band Horn Antenna	Schwarzbeck Mess-Elektronik	BBHA9120D	01874	2024-03	2027-03
Broadband Amplifier	Schwarzbeck Mess-Elektronik	BBV9718C	00121	2025-01	2026-01
Preamplifier	Schwarzbeck Mess-Elektronik	BBV9718	BBV9718-137	2024-06	2025-06
RF Power Sensor	Rohde & Schwarz	NRP18AN	100990	2025-03	2026-03
RF Power Sensor	Rohde & Schwarz	NRP18AN	100987	2024-11	2025-11
Double Ridge Horn Antenna	RFSpin	DRH40	061106A40	2023-05	2026-05
Broadband Bench Top Amplifier	Sage	STB-1834034030-KFKF-L1	18490-01	2024-07	2025-07

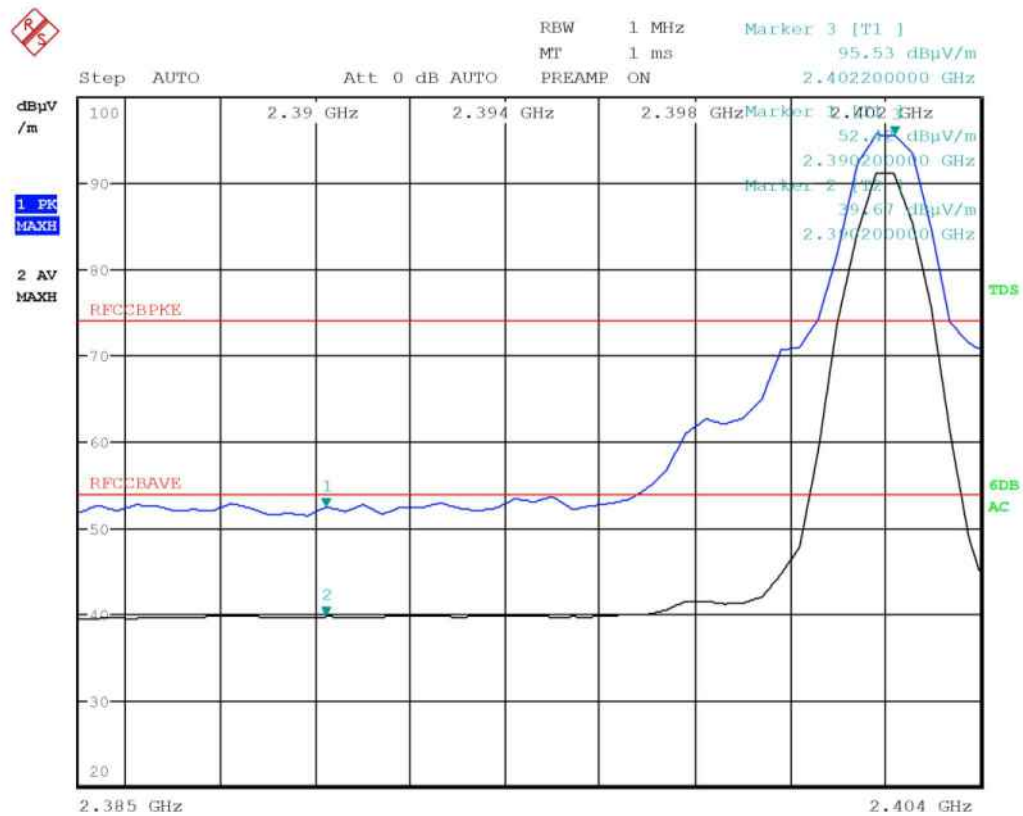
Notes: NCR - no calibration required, VOU - verify on use

8.3.5 Test data

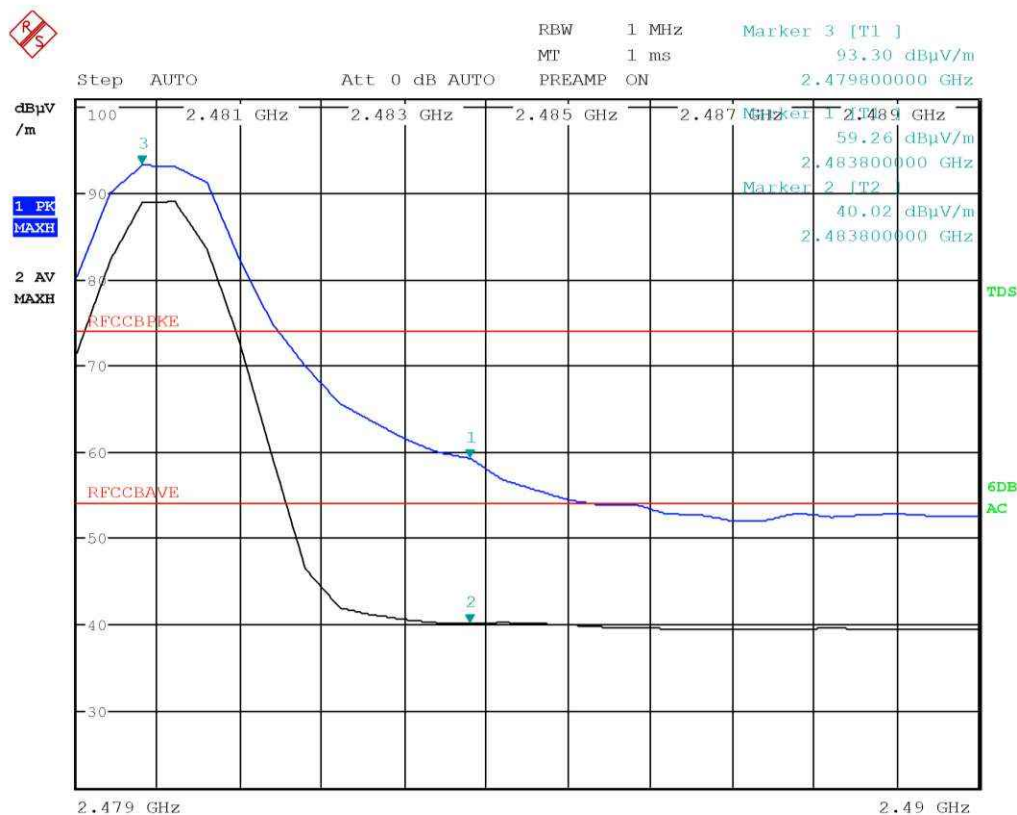
Table 8.3-4: Radiated field strength measurement results

Channel	Frequency, MHz	Peak Field strength, dBμV/m		Margin, dB	Average Field strength, dBμV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390.0	52.4	74.00	21.6	39.7	54.00	14.3
High	2483.5	59.3	74.00	14.7	40	54.00	14.0

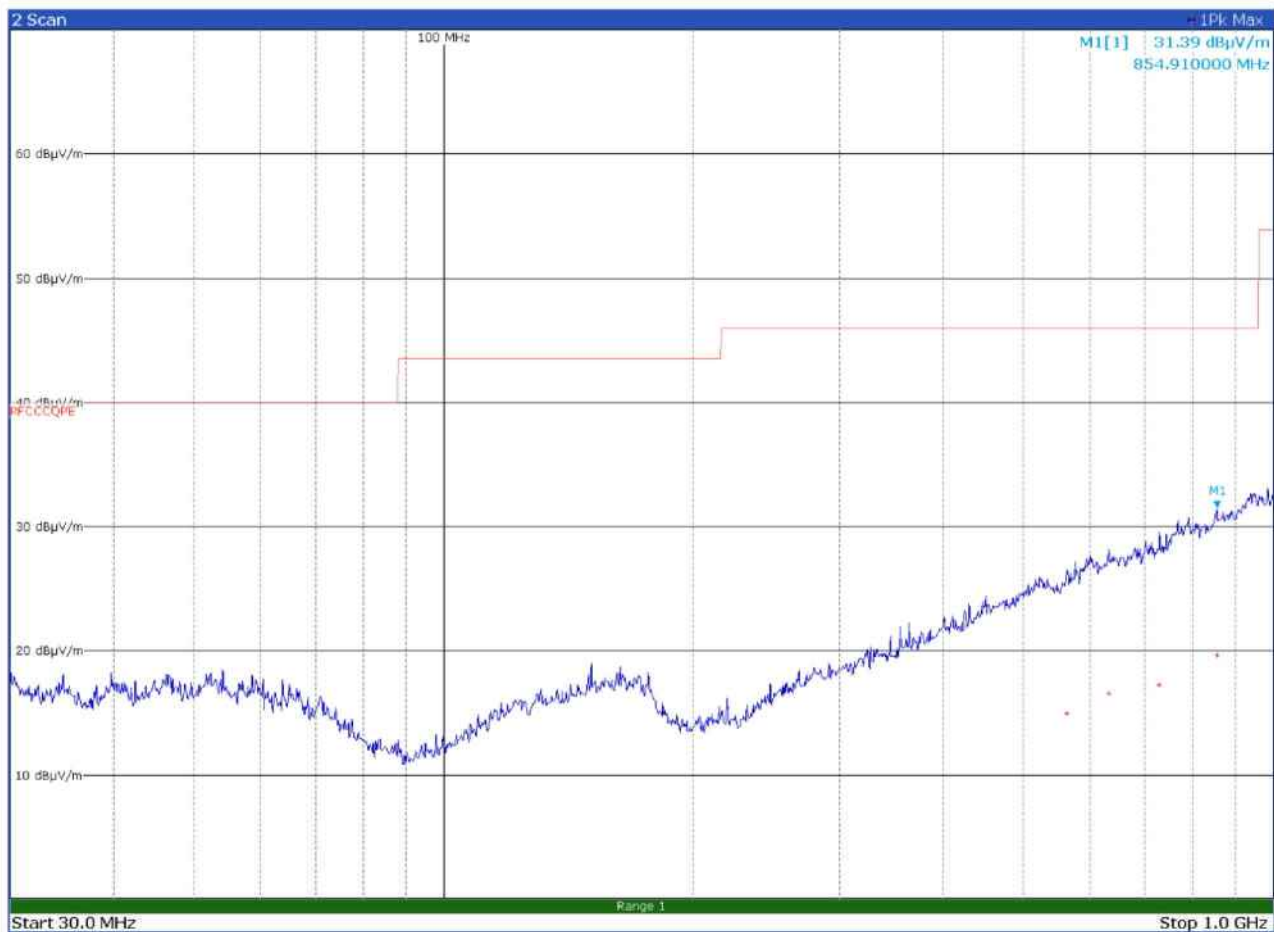
Note: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.



Low channel band edge, horizontal polarization

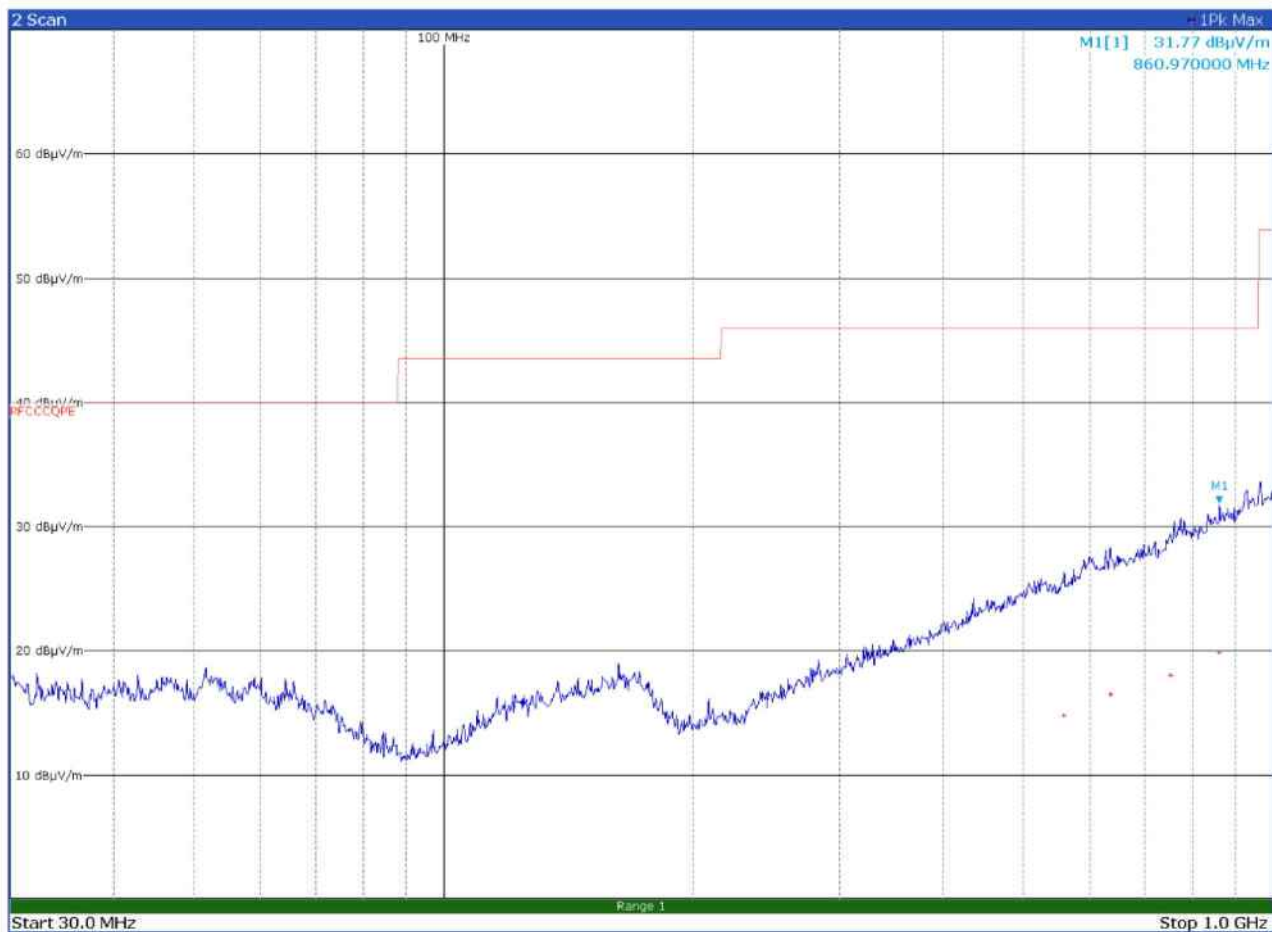


High channel band edge, horizontal polarization



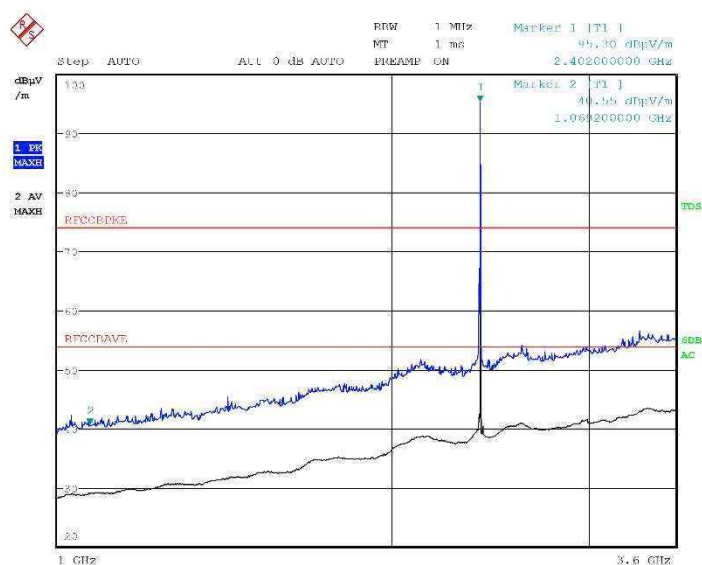
Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
563.9100	15.0	46.0	-31.0	QP
633.8400	16.6	46.0	-29.4	QP
729.0000	17.3	46.0	-28.7	QP
854.9100	19.7	46.0	-26.3	QP

Low channel 30 MHz to 1 GHz horizontal polarization

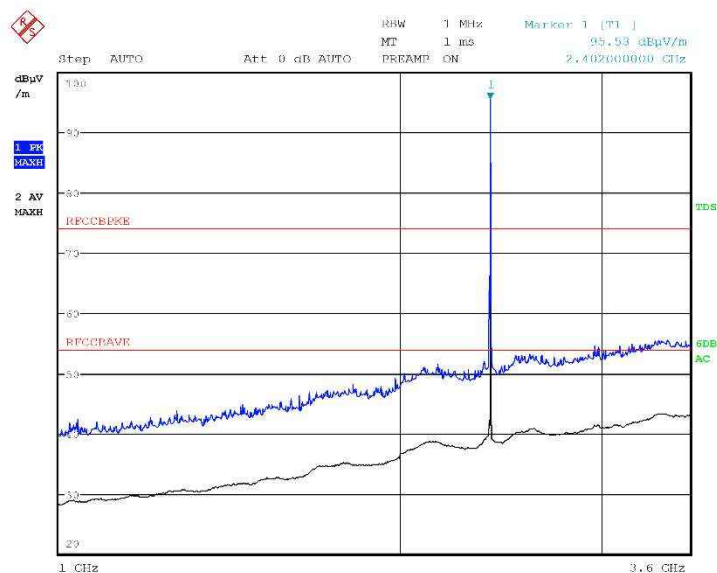


Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
560.0100	14.9	46.0	-31.1	QP
636.0300	16.6	46.0	-29.4	QP
752.1300	18.1	46.0	-27.9	QP
860.9700	19.9	46.0	-26.1	QP

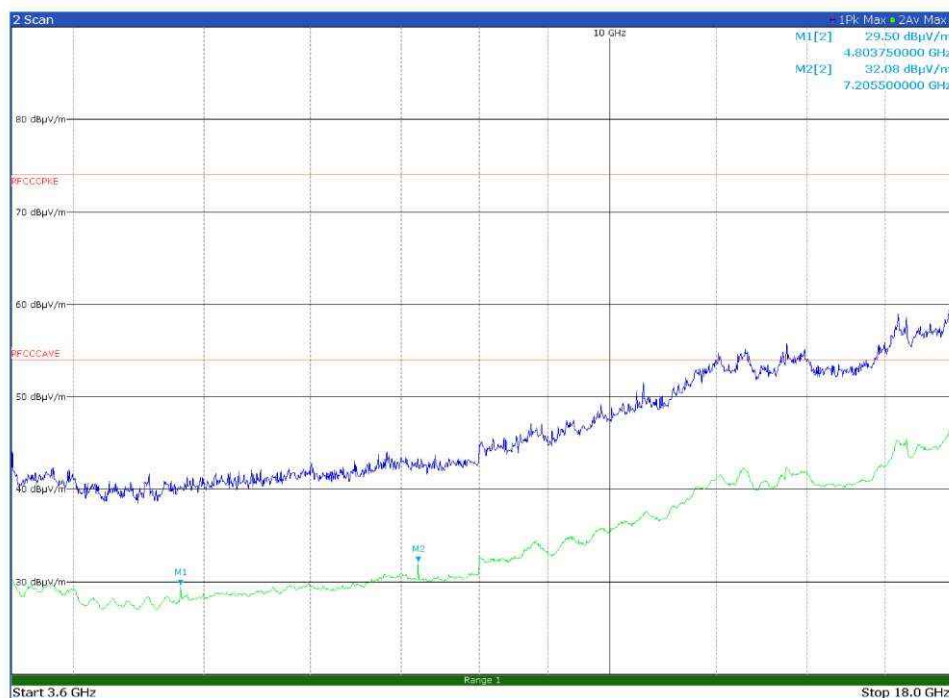
Low channel 30 MHz to 1 GHz vertical polarization



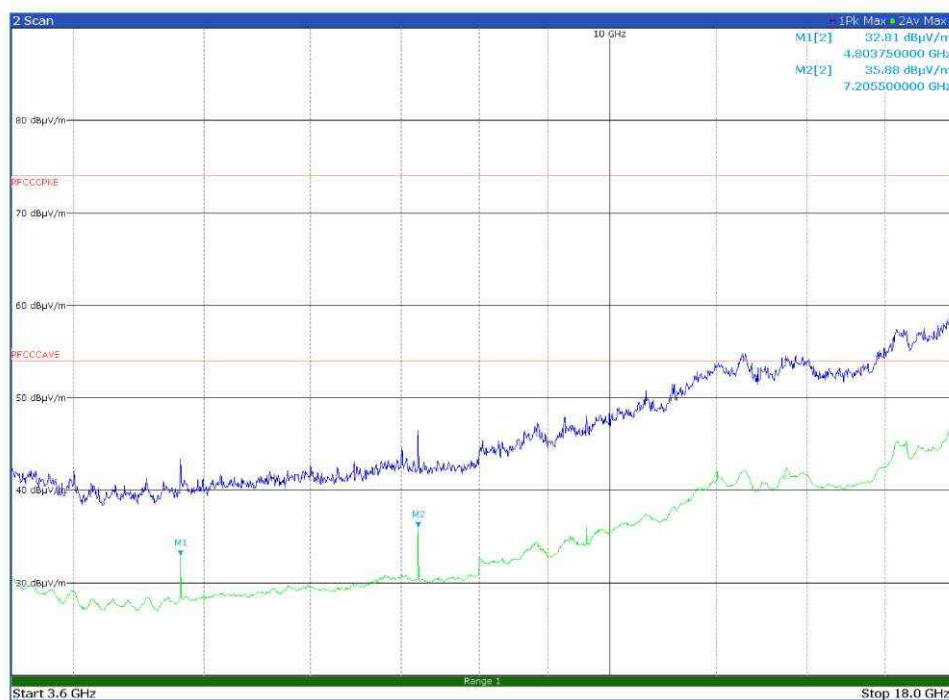
Low channel, 1 to 3.6 GHz horizontal polarization



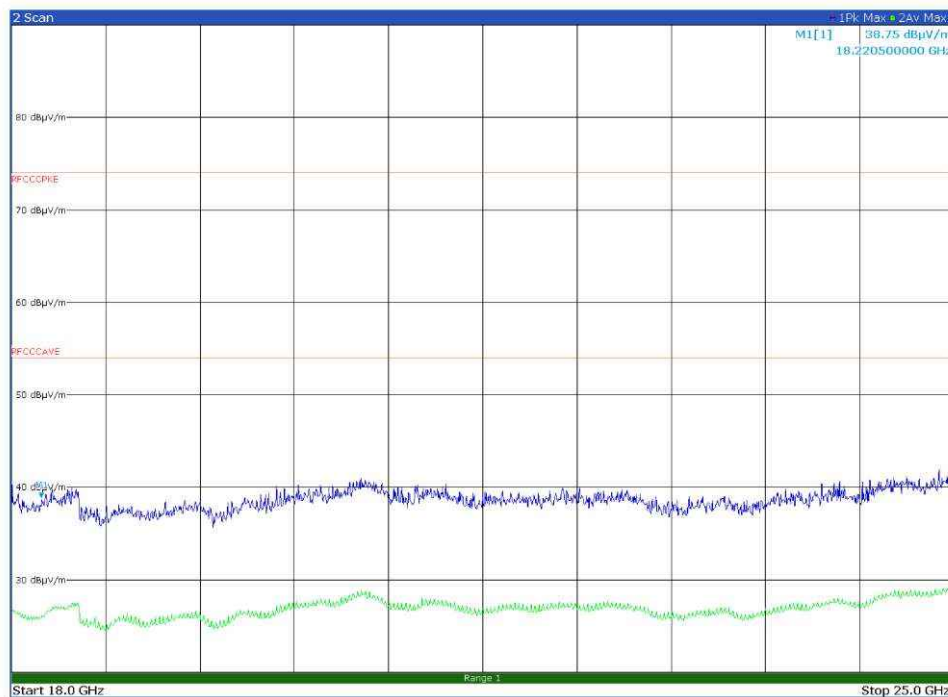
Low channel 1 to 3.6 GHz vertical polarization



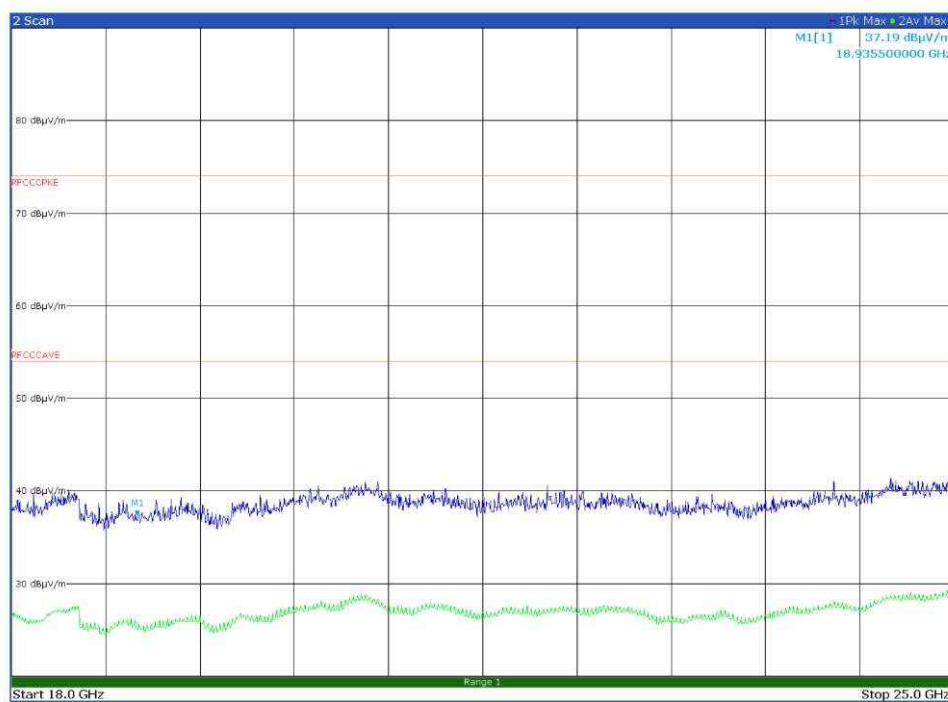
Low channel, 3.6 to 18 GHz horizontal polarization



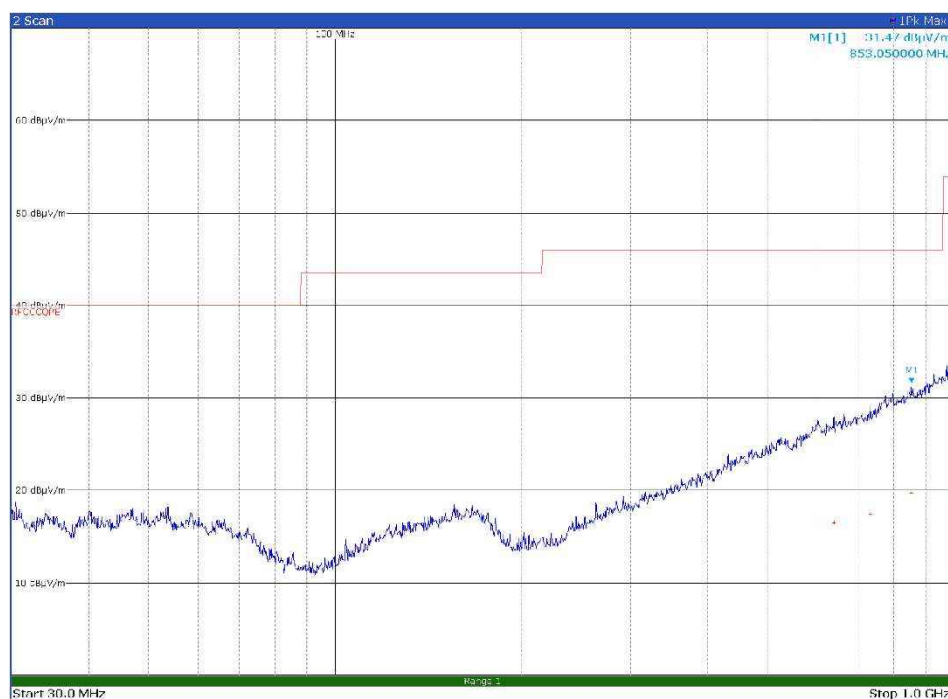
Low channel, 3.6 to 18 GHz vertical polarization



Low channel, 18 to 25 GHz vertical polarization

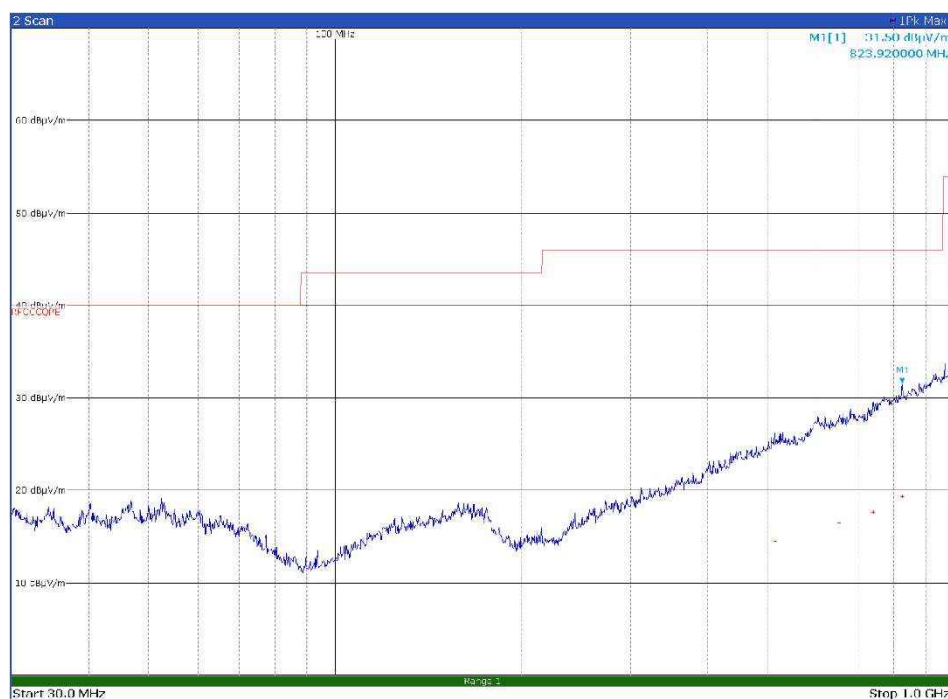


Low channel, 18 to 25 GHz horizontal polarization



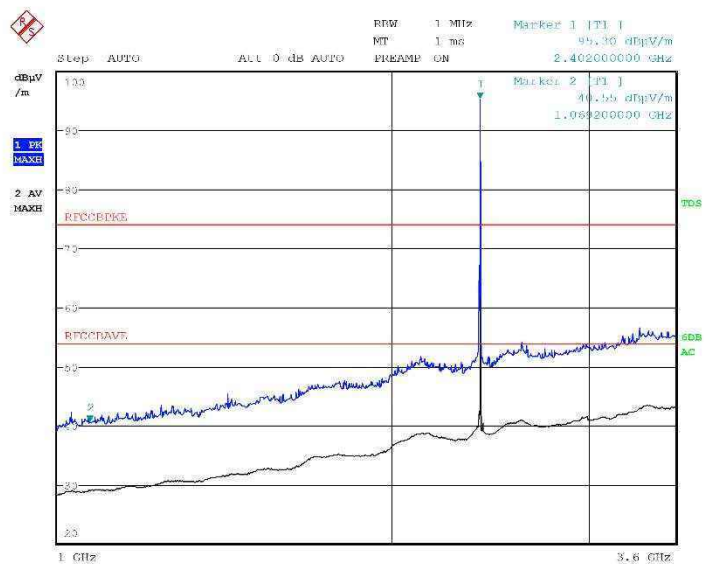
Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
639.2400	16.5	46.0	-29.5	QP
732.5100	17.5	46.0	-28.5	QP
853.0500	19.8	46.0	-26.2	QP

Middle channel 30 MHz to 1 GHz vertical polarization

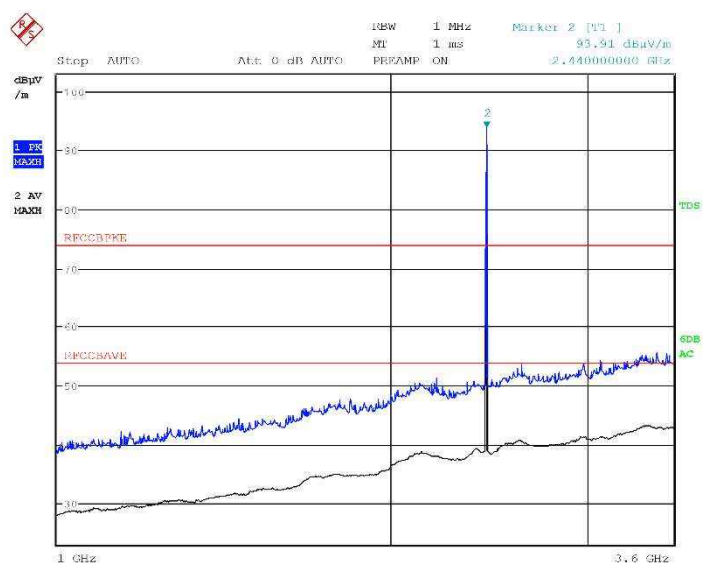


Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
513.8100	14.5	46.0	-31.5	QP
652.1700	16.6	46.0	-29.4	QP
739.1100	17.7	46.0	-28.3	QP
823.9200	19.4	46.0	-26.6	QP

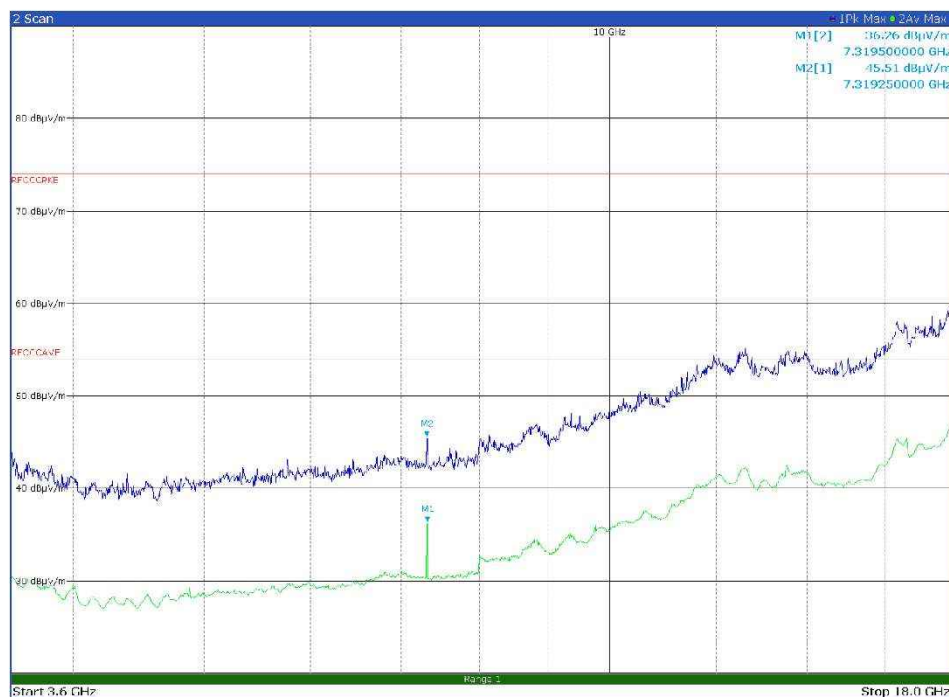
Middle channel 30 MHz to 1 GHz horizontal polarization



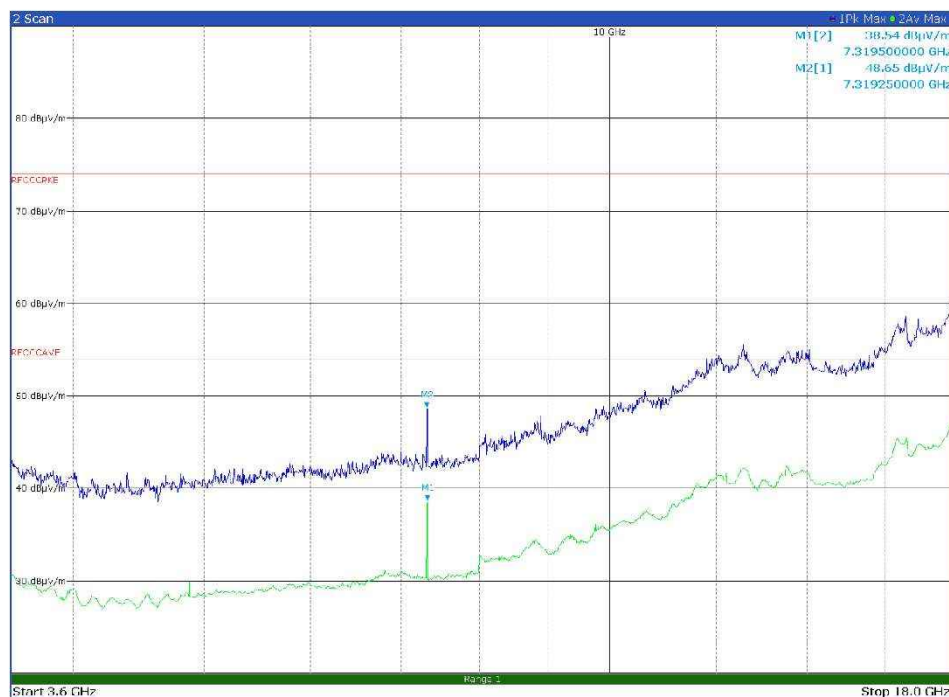
middle channel, 1 to 3.6 GHz horizontal polarization



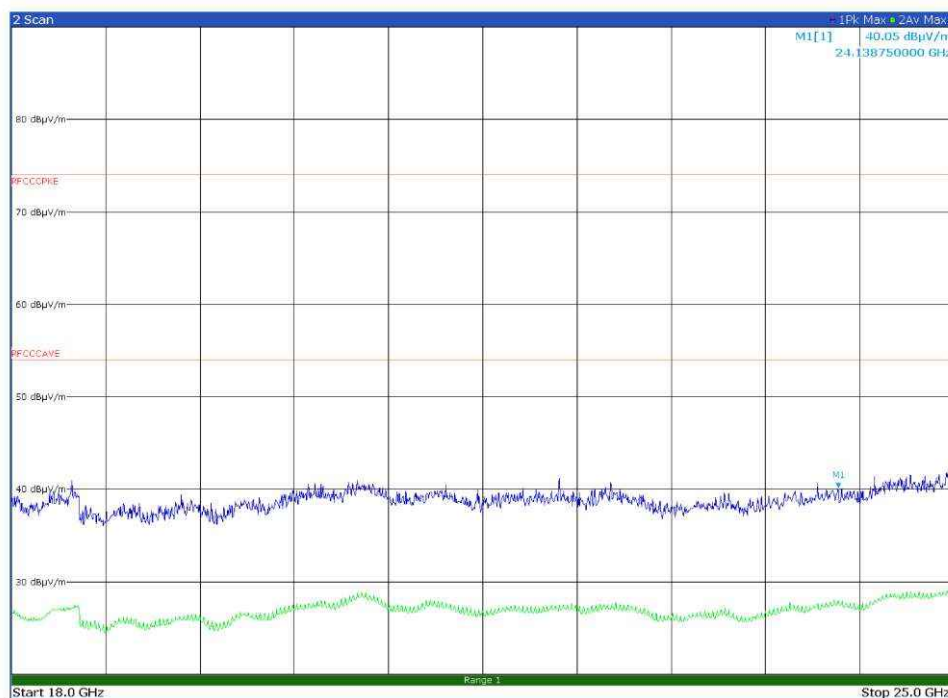
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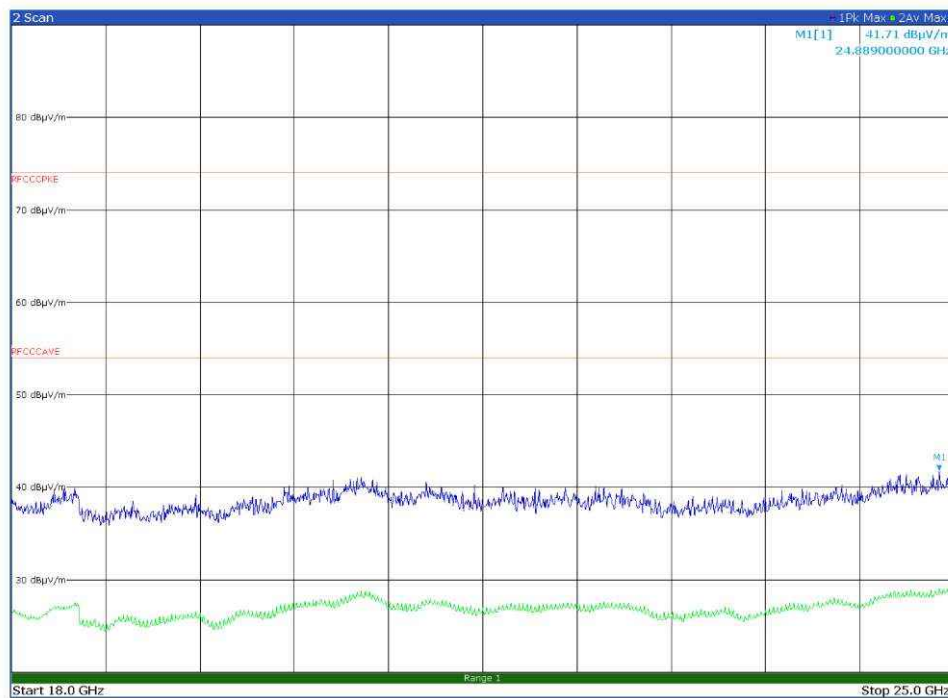
middle channel, 3.6 to 18 GHz horizontal polarization



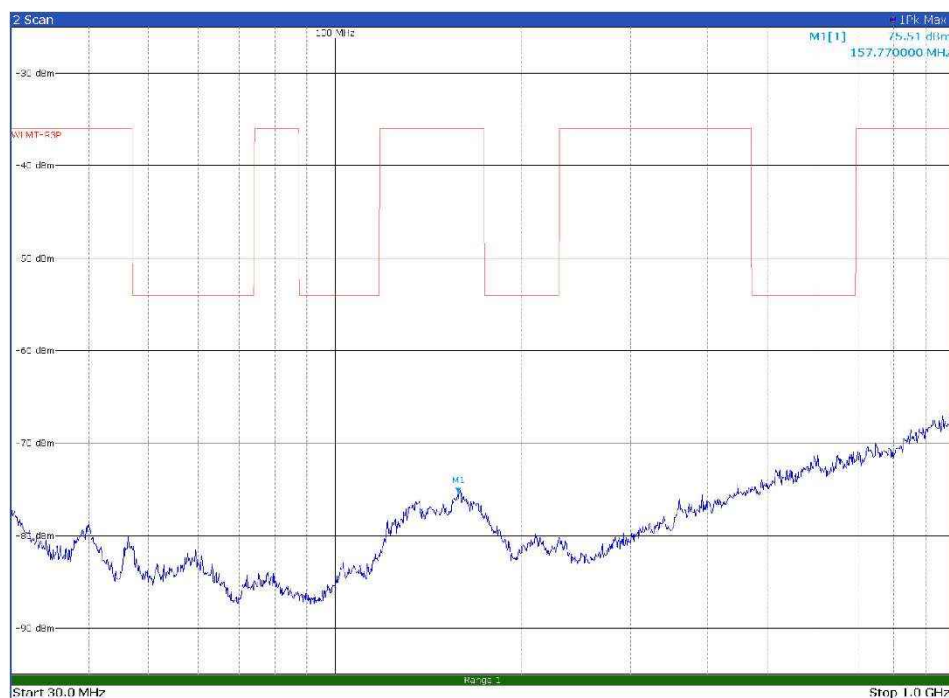
middle channel, 3.6 to 18 GHz vertical polarization



middle channel, 18 to 25 GHz horizontal polarization

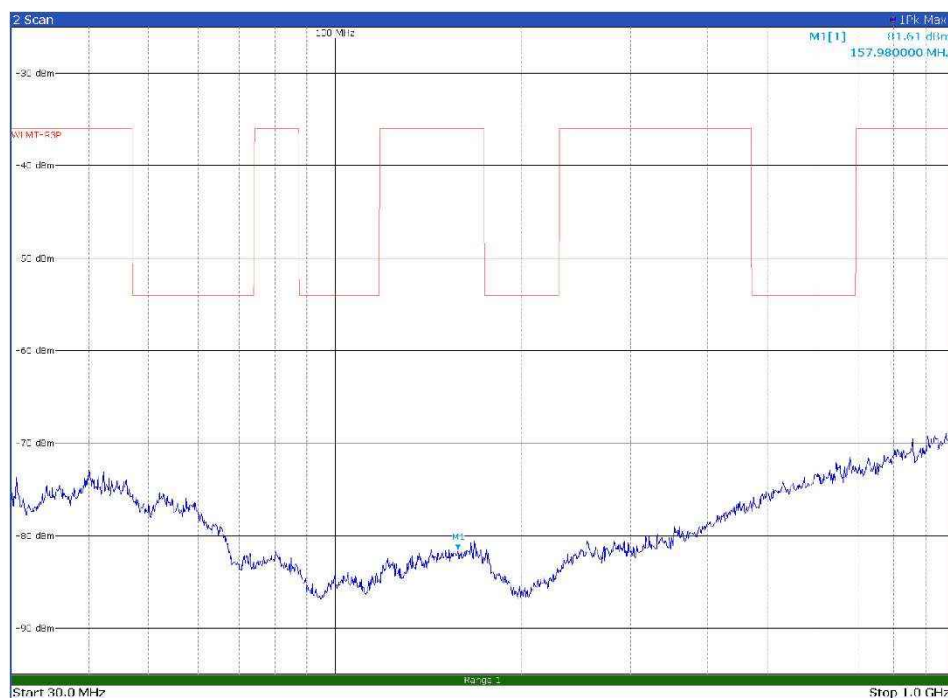


middle channel, 18 to 25 GHz vertical polarization



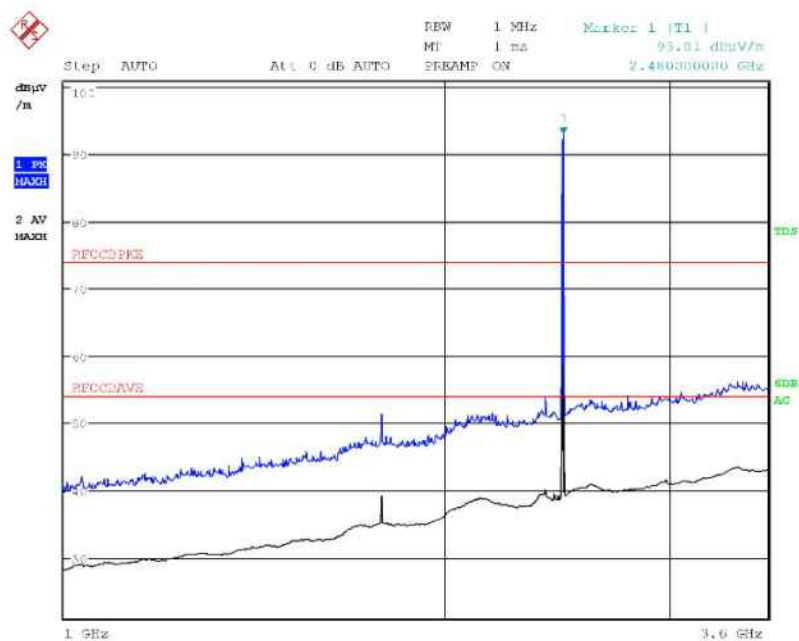
Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
506.1300	14.4	46.0	-31.6	QP
648.7800	16.2	46.0	-29.8	QP
753.1500	18.2	46.0	-27.8	QP
839.5200	19.7	46.0	-26.3	QP
950.3400	21.5	46.0	-24.5	QP

high channel 30 MHz to 1 GHz vertical polarization

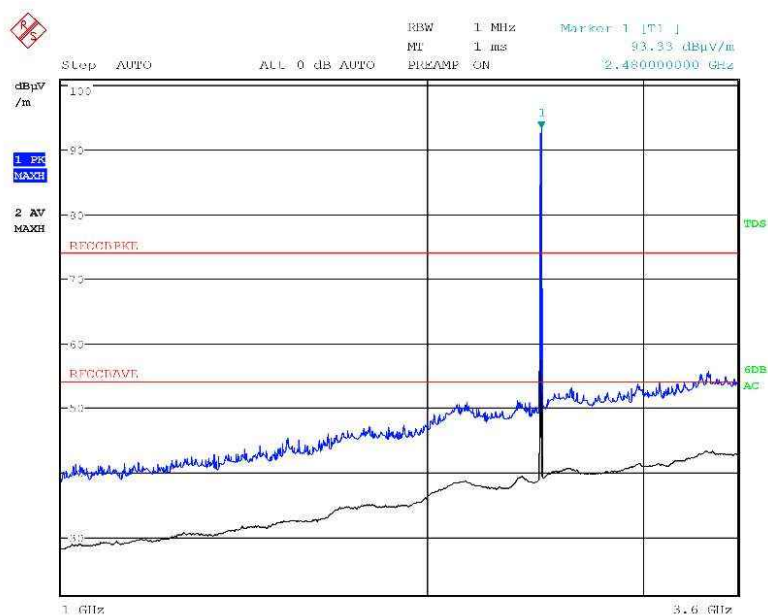


Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
611.7000	16.2	46.0	-29.8	QP
749.3700	18.0	46.0	-28.0	QP
846.0300	20.0	46.0	-26.0	QP

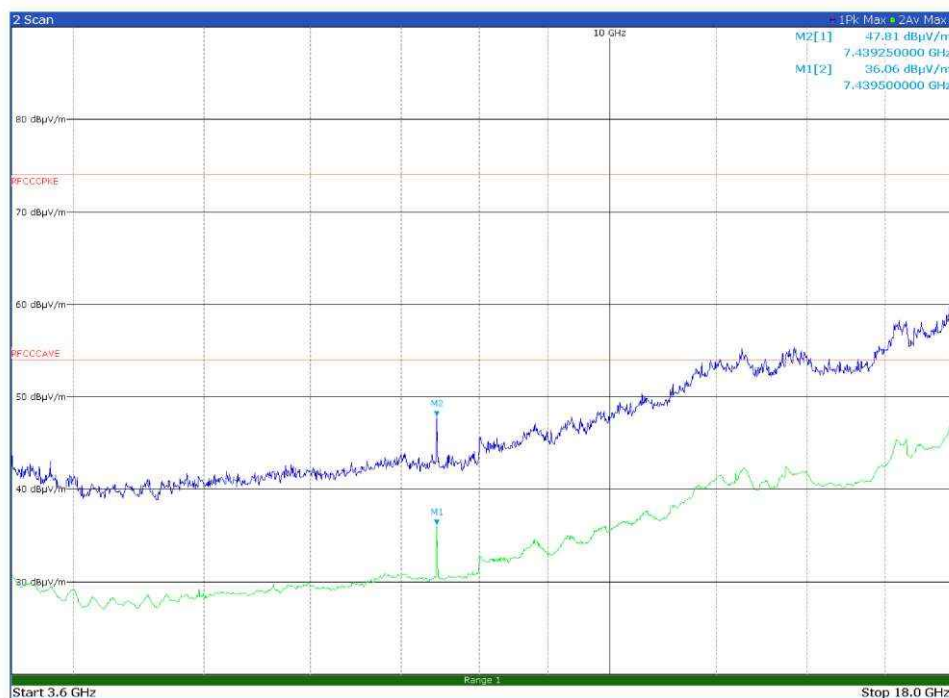
high channel 30 MHz to 1 GHz horizontal polarization



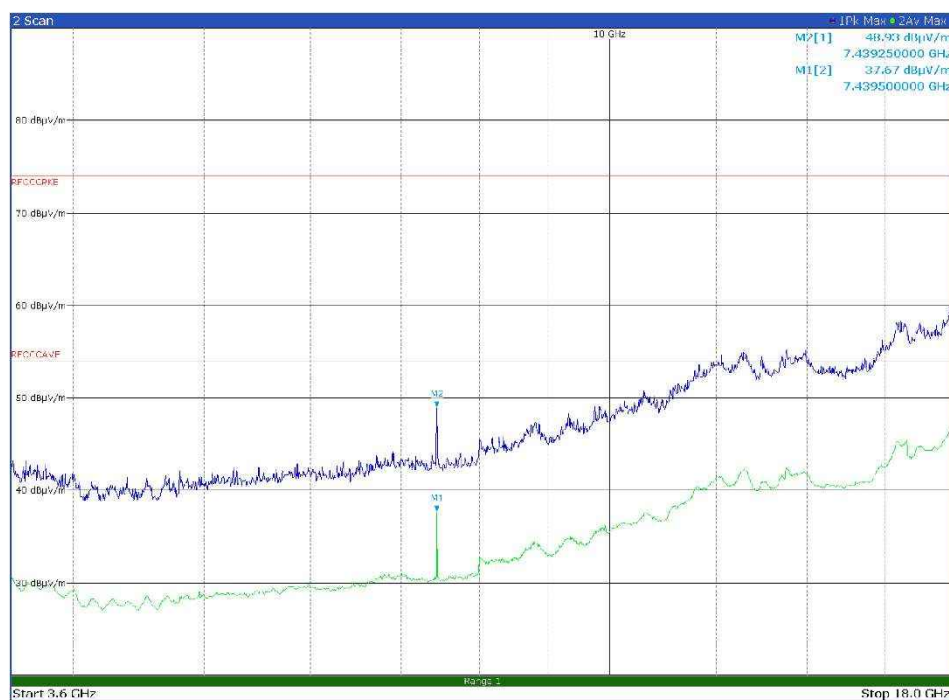
high channel, 1 to 3.6 GHz horizontal polarization



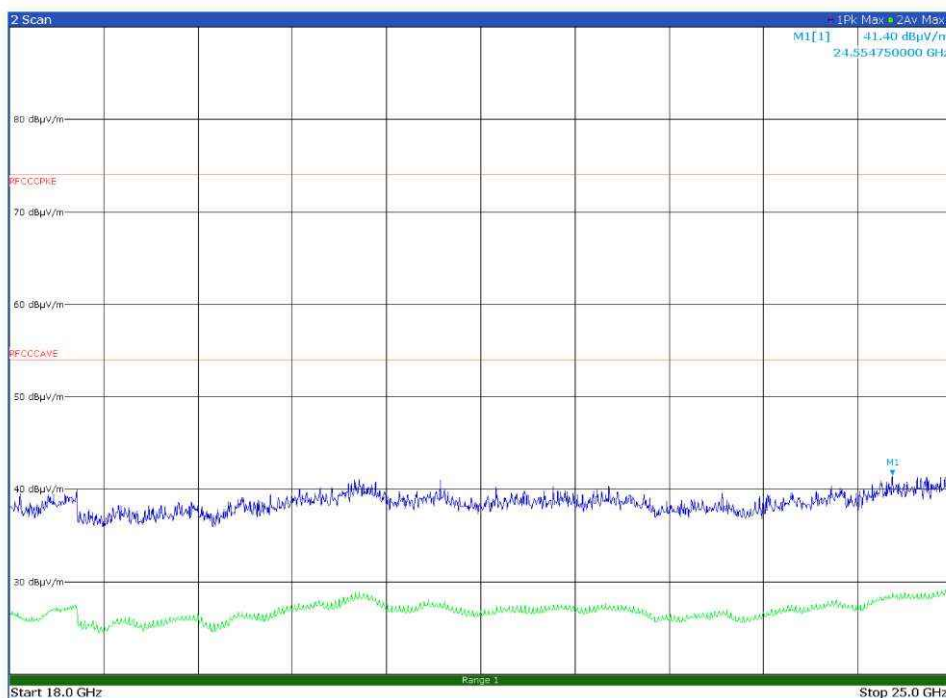
high channel 1 to 3.6 GHz vertical polarization



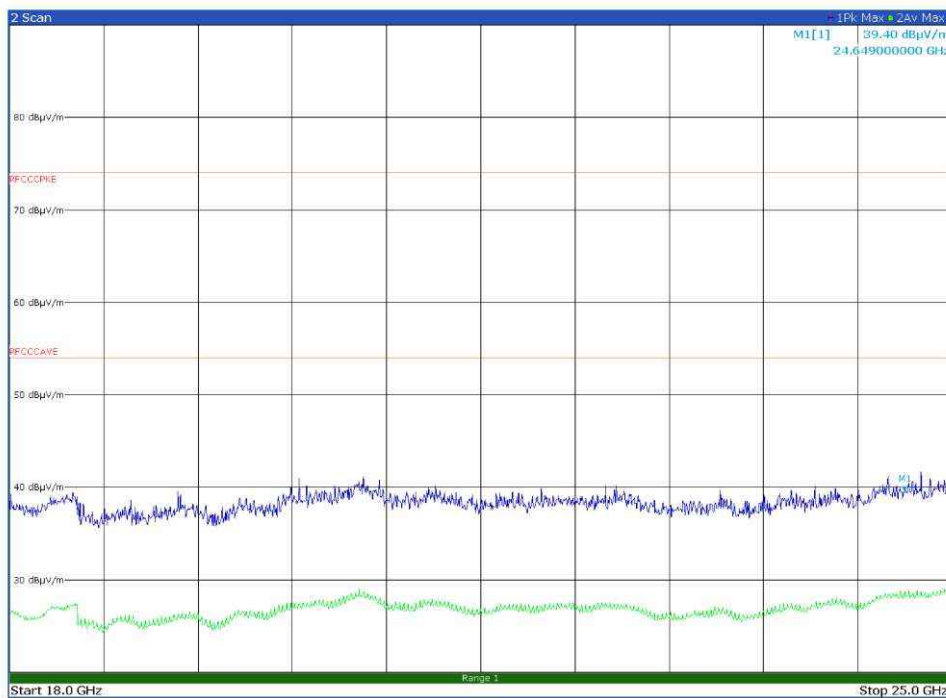
high channel 3.6 to 18 GHz vertical polarization



high channel 3.6 to 18 GHz horizontal polarization



high channel 18 to 25 GHz vertical polarization



high channel 18 to 25 GHz horizontal polarization

8.4 FCC 15.247(e) and RSS-247 5.2(b) Power spectral density for digitally modulated devices

8.4.1 Definitions and limits

FCC:

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

ISED:

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

8.4.2 Test summary

Test date	June 30, 2025	Verdict	Pass
Test engineer	Daniele Guarnone	Sample tested	

8.4.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth:	3 kHz ≤ RBW ≤ 100 kHz
Video bandwidth:	≥ 3 × RBW
Frequency span:	1.5 times the OBW
Detector mode:	RMS
Trace mode:	Power average
Averaging sweeps number:	100

8.4.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Semi-anechoic chamber	Nemko Spa	10m semi-anechoic chamber	530	2023-09	2025-09
3m Semi anechoic chamber	Comtest	SAC-3	1711-150	2024-09	2026-09
EMI Receiver	Rohde & Schwarz	ESW44	101620	2024-09	2025-09
EMI Receiver	Rohde & Schwarz	ESU8	100202	2024-09	2025-09
Spectrum Analyzer	Rohde & Schwarz	FSW43	101767	2025-01	2026-01
Antenna Trilog 25MHz - 8GHz	Schwarzbeck Mess-Elektronik	VULB9162	9162-025	2024-08	2027-08
Antenna Trilog 25-2000 MHz	Schwarzbeck Mess-Elektronik	VULB9168	9168-242	2024-08	2027-08
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STLP 9148-152	2024-10	2027-10
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STPL 9148-123	2024-08	2027-08
Double Ridge Horn Antenna	RFSpin	DRH40	061106A40	2023-05	2026-05
Antenna loop	Rohde & Schwarz	HFH2-Z2	831 247/011	2024-02	2027-02
Antenna Loop Attiva+Power Inserter	Teseq	HLA6121+PI6121	45749	2023-08	2026-08
Broadband Amplifier	Schwarzbeck Mess-Elektronik	BBV9718C	00121	2025-01	2026-01
Preamplifier	Schwarzbeck Mess-Elektronik	BBV9718	BBV9718-137	2024-06	2025-06
RF Power Sensor	Rohde & Schwarz	NRP18AN	100990	2025-03	2026-03
RF Power Sensor	Rohde & Schwarz	NRP18AN	100987	2024-11	2025-11
RF Vector Signal Generator	Rohde & Schwarz	SMBV100A	263254	2024-06	2025-06
RF Signal Generator	Rohde & Schwarz	SMB100A	180431	2025-01	2026-01
RF Signal Generator	Rohde & Schwarz	SMA100B	104075	2024-10	2025-10
Broad-Band Horn Antenna	Schwarzbeck Mess-Elektronik	BBHA9120D	01874	2024-03	2027-03
Broadband Amplifier	Schwarzbeck Mess-Elektronik	BBV9718C	00121	2025-01	2026-01
Preamplifier	Schwarzbeck Mess-Elektronik	BBV9718	BBV9718-137	2024-06	2025-06
RF Power Sensor	Rohde & Schwarz	NRP18AN	100990	2025-03	2026-03

RF Power Sensor	Rohde & Schwarz	NRP18AN	100987	2024-11	2025-11
Double Ridge Horn Antenna	RFSpin	DRH40	061106A40	2023-05	2026-05
Broadband Bench Top Amplifier	Sage	STB-1834034030-KFKF-L1	18490-01	2024-07	2025-07

Notes: NCR - no calibration required, VOU - verify on use

8.4.5 Test data

Table 8.4-1: PSD measurements results

Modulation	Frequency, MHz	PSD, dBm/3 kHz	PSD limit, dBm/3 kHz	Margin, dB
BLE	2402	-22.0	8.00	
	2440	-19.0	8.00	
	2480	-21.3	8.00	

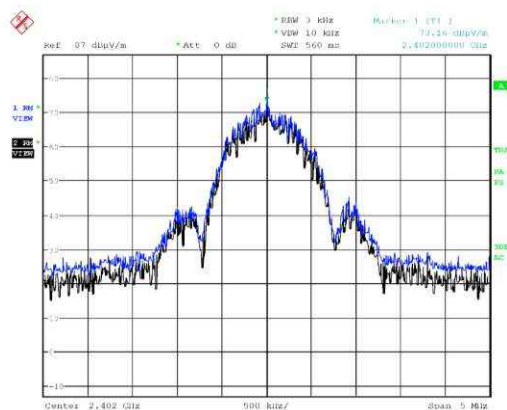


Figure 8.4-1: PSD sample plot on low channel
PSD= 73.2 dBuV/m=-22 dBm eirp

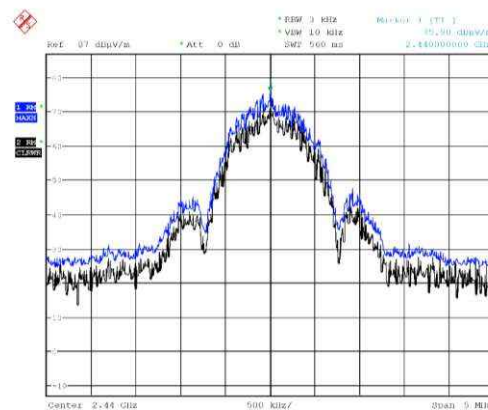


Figure 8.4-2: PSD sample plot on middle channel
PSD= 75.9 dBuV/m=-19.3 dBm eirp

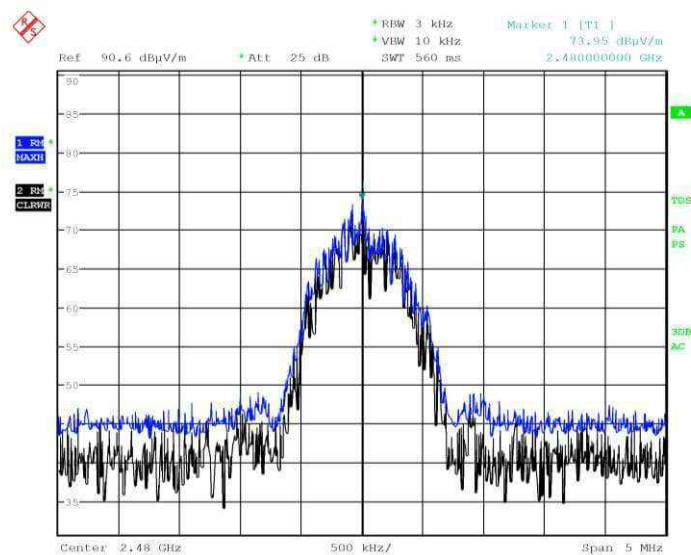
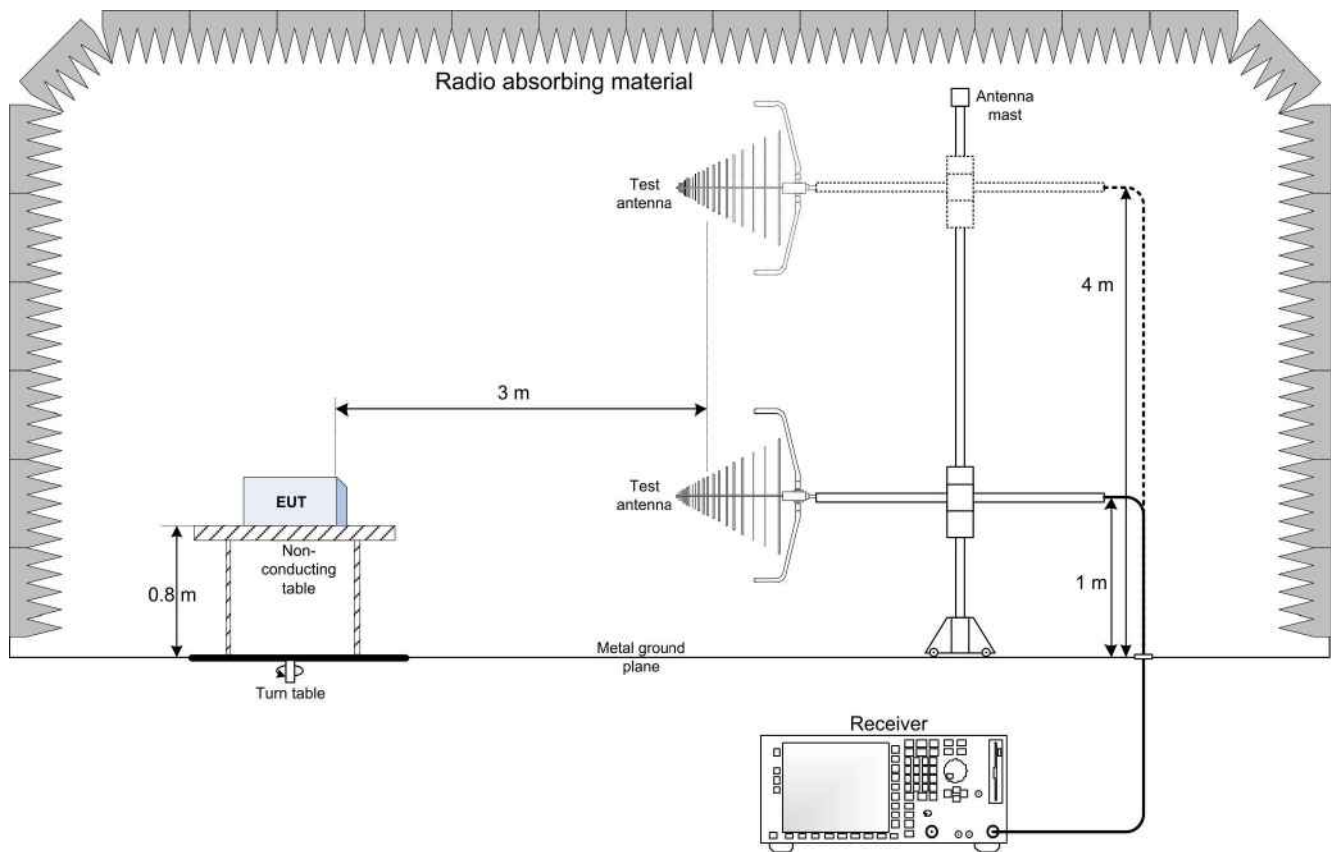


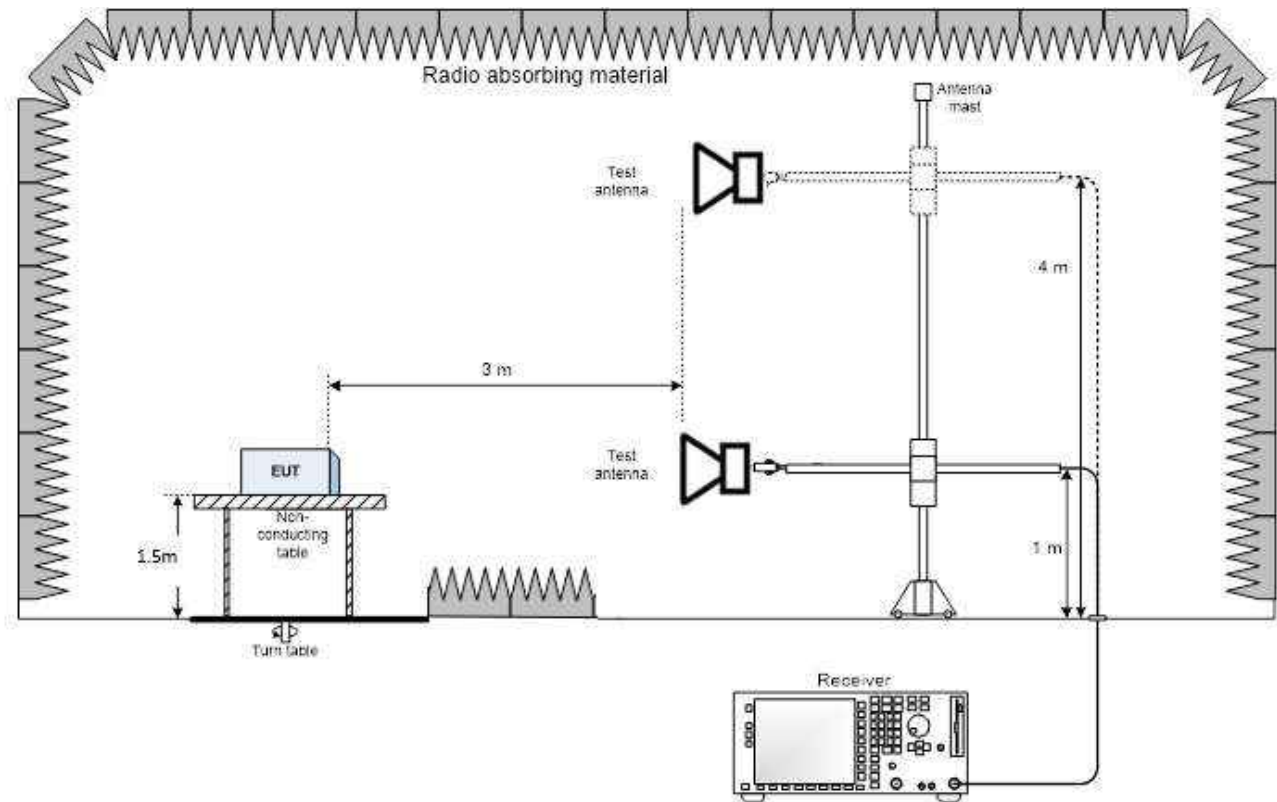
Figure 8.4-3: PSD sample plot on high channel
PSD= 73.9 dBuV/m=-21.3 dBm eirp

Section 9. Block diagrams of test set-ups

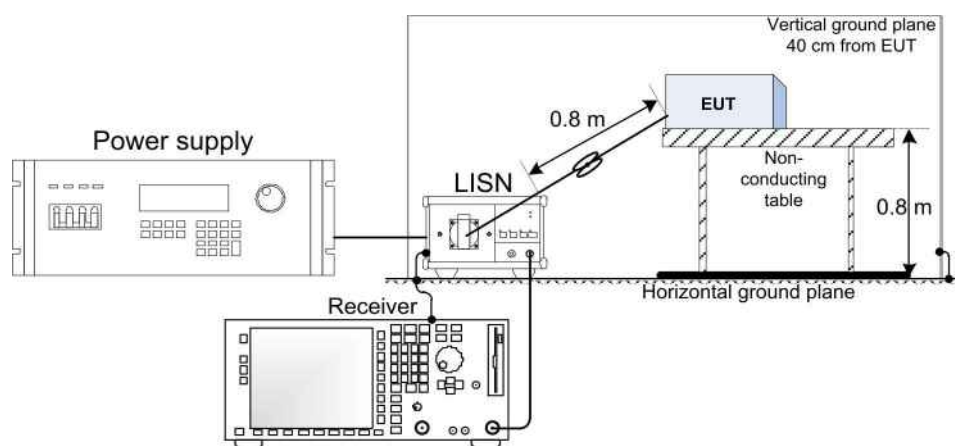
9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz



9.3 Conducted emissions set-up



Section 10. Photos

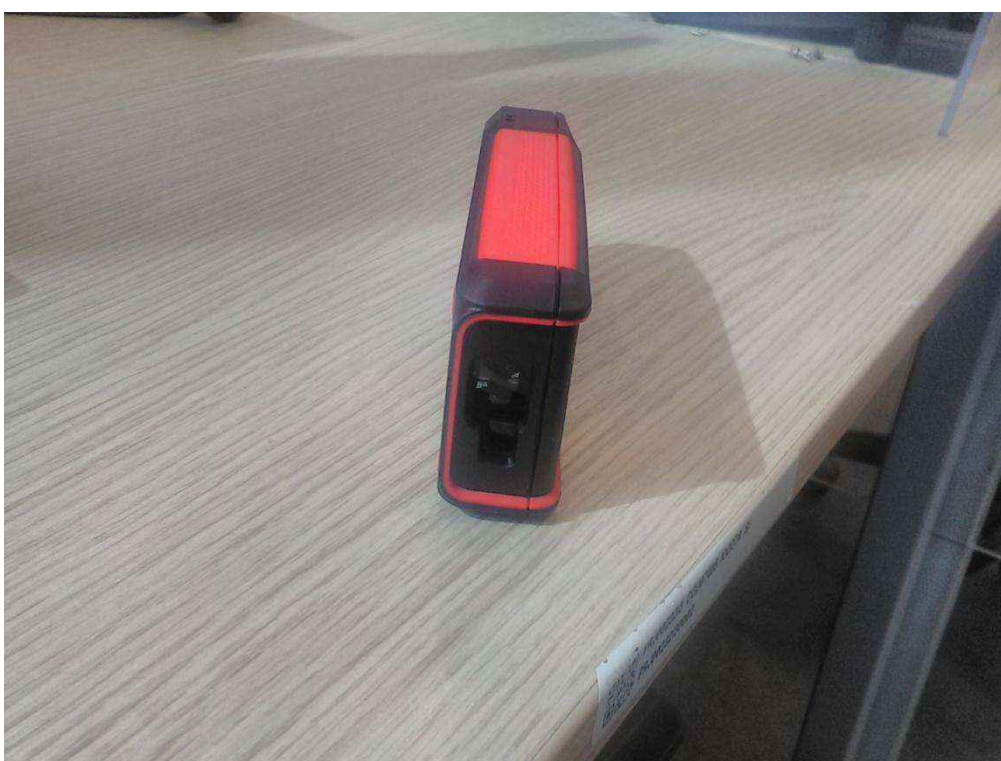
10.1 Test Set-up



10.2 EUT









End of report