DAkkS Deutsche Akkreditierungsstelle D-PL-21375-01-00

LENHARDT WORLDWIDE | TESTING | CERTIFICATION

Bundesnetzagentur BNetzA-CAB-21/21-21

Test Report

Test report no.: 25010978-44359-0
Date of issue: 2025-05-12

Test result: The test item **- passed -** and complies with the listed standards.

Applicant
Rohde & Schwarz GmbH & Co. KG

Manufacturer
Rohde & Schwarz GmbH & Co. KG

Test Item
SK4105

Radio Frequency Testing according to:

Title 47
FCC Regulations Part 87

Tested by (name, function, signature)	*Piotr Sardyko* *Lab Manager RF*	signature
Approved by (name, function, signature)	*Janoschka Sebastian* *Head of Department Radio*	signature

Applicant and Test item details	
Applicant	Rohde & Schwarz GmbH & Co. KG Muehldorfstrasse 15 81671 Munich Germany
Manufacturer	Rohde & Schwarz GmbH & Co. KG Muehldorfstrasse 15 81671 Munich Germany
Test item description	5 KW HF HIGH-POWER TRANSMITTER
Model/Type reference	SK4105

FCC ID	KVW-SK4105V208

Disclaimer and Notes

The content of this report relates to the mentioned test sample(s) only.
IBL-Lab GmbH does not take samples. The samples used for testing are provided by the applicant.
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The last valid version is available at TAMSys®.
Signatures are done electronically, if signer does not match stated signer, it is signed per order.
Information supplied by the applicant can affect the validity of results. The data is marked accordingly.

Within this test report, a ☒ point / ☐ comma is used as a decimal separator.
If otherwise, a detailed note is added adjected to its use.

Decision rule:
Decision rule based on simple acceptance without guard bands, binary statement, based on mutually agreed uncertainty tolerances with expansion factor k=2.

1 TABLE OF CONTENTS

2 GENERAL INFORMATION

2.1 Administrative details

Testing laboratory	**IBL-Lab GmbH** Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany Fon: +49 6894 38938-0 Fax: +49 6894 38938-99 URL: https://ib-lenhardt.com/ E-Mail: info@ib-lenhardt.com
Accreditation / Designation	The testing laboratory is accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025:2018. Scope of testing and registration number: • Attachment to the accreditation certificate D-PL-21375-01-00 ○ Electronics ○ Electromagnetic Compatibility ○ Radio ○ Electromagnetic Compatibility and Telecommunication (FCC requirements) ○ Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards ○ Automotive EMC Website DAkkS: https://www.dakks.de/ The Deutsche Akkreditierungsstelle GmbH (DAkkS) is also a signatory to the ILAC Mutual Recognition Arrangement. • Designations ○ FCC Testing Laboratory Designation No. DE0024 ○ ISED Company Number 27156 Testing Laboratory CAB Identifier DE0020 Kraftfahrt-Bundesamt KBA-P 00120-23
Testing location	**IBL-Lab GmbH** Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany
Date of receipt of test samples	2025-03-31
Start – End of tests	2025-04-03 – 2025-04-24

2.2 Possible verdicts of the results

Test sample meets the requirements	P (PASS) – the measured value is below the acceptance limit, AL = TL
Test sample does not meet the requirements	F (FAIL) – the measured value is above the acceptance limit, AL = TL
Test case does not apply to the test sample	N/A (Not applicable)
Test case not performed	N/P (Not performed)

2.3 Observations

No additional observations other than the reported observations within this test report have been made.

2.4 Opinions and Interpretations

No appropriate opinions or interpretations according ISO/IEC 17025:2017 clause 7.8.7 are within this test report.

2.5 Revision History

-0 Initial Version

2.6 Further documents

List of further applicable documents belonging to the present test report:

Measurement plots:	25010978-44359-0_Annex A
EUT photographs:	25010978-44359-0_Annex B
Test setup photographs:	25010978-44359-0_Annex C

2.7 Formula for determination of correction values (E_C)

$E_C = E_R + AF + C_L + D_F - G_A$ (1)

$M = L_T - E_C$ (2)

E_C = Electrical field – corrected value
E_R = Receiver reading
M = Margin
L_T = Limit
AF = Antenna factor
C_L = Cable loss
D_F = Distance correction factor (if used)
G_A = Gain of pre-amplifier (if used)

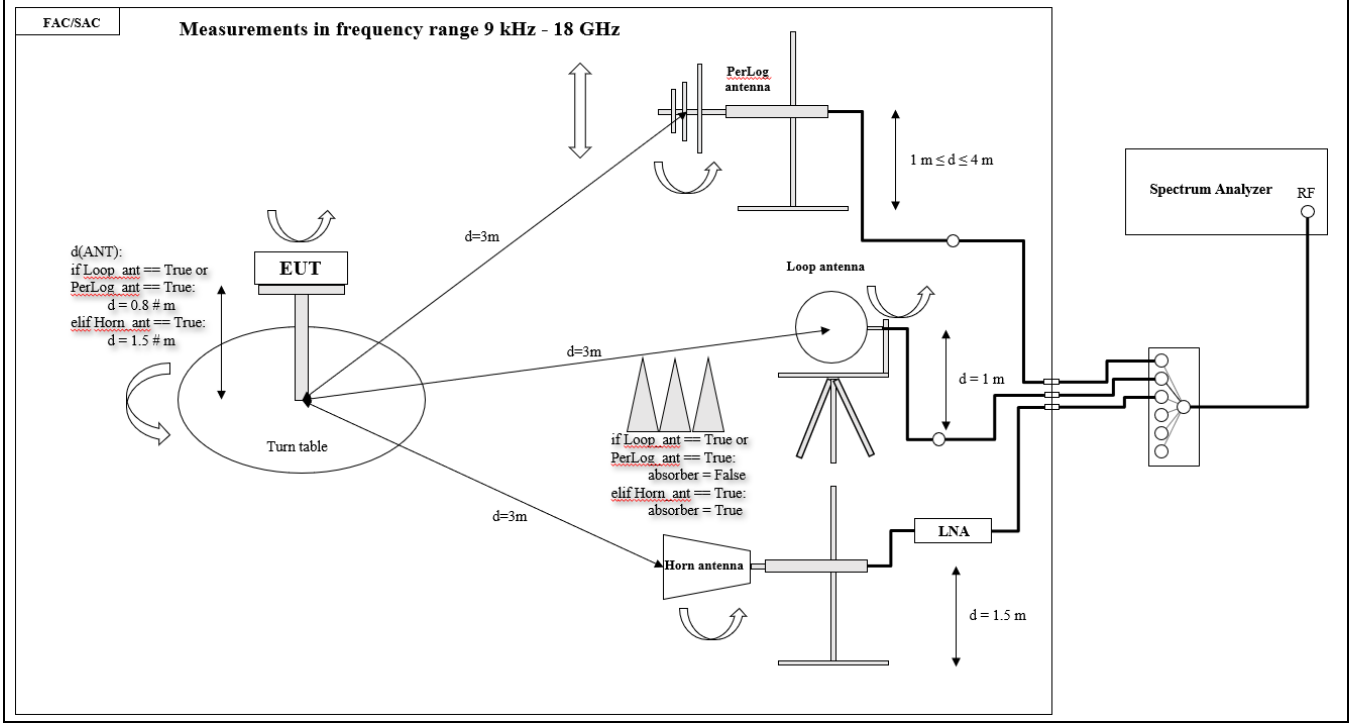
All units are dB-units, positive margin means value is below limit.

2.8 Software/Firmware used for measurements

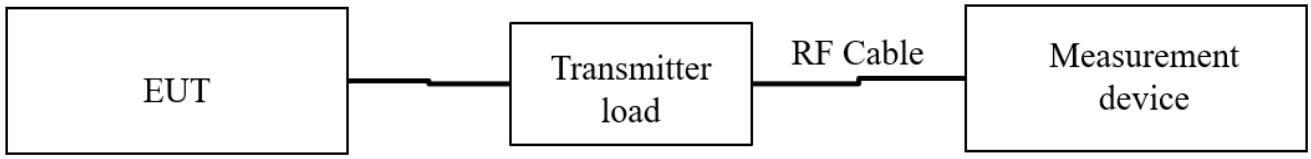
All measurements were done directly with spectrum analyzer or SW R&S EMC32.
In some measurements (please see test equipment list for each test) R&S ESW 26 was used (please see chapter 8).
(Instrument) Firmware Version: **1.70**
In some measurements (please see test equipment list for each test) R&S FSW 50 was used (please see chapter 8).
(Instrument) Firmware Version: **4.61**
In some measurements SW R&S EMC32 was used.
Version: **11.10.00**

2.9 Block diagrams

Block diagram 1 (radiated measurement):



Block diagram 2 (conducted measurement):



3 ENVIRONMENTAL & TEST CONDITIONS

3.1 Environmental conditions of lab

Temperature	20°C ± 5°C
Relative humidity	25-75 % R.H.
Barometric Pressure	860-1060 mbar
Power supply	External power supply

4 TEST STANDARDS AND REFERENCES

Test standard (accredited)	
FCC CFR Title 47 Part 87	---
FCC CFR Title 47 Part 2 Subpart J	---
ANSI C63.10: 2020	---

Test standard (not accredited)
None

Reference	**Description**
none	---

5 EQUIPMENT UNDER TEST (EUT)

5.1 Product Description*

5 kW HF High-Power Transmitter

*: declared by the applicant

5.2 Technical Data of Equipment*

Frequency band:	1.5 MHz – 30 MHz
Modulation types:	J3E, H2B, A1A
Channel bandwidth:	for J3E, H2B < 3 kHz; for A1A < 0.25 kHz. H2B is intended to be used only SELCAL32 radio system (312.6 Hz – 1557.8 Hz).
Channel tested:	**J3E**, **A1A, H2B**: CH_{low}: 1.5 MHz, CH_{mid}: 14.25 MHz, CH_{high}: 29.996 MHz
HF transmission power:	250 W – 5000 W
Equipment type:	Production model
Type of power source:	three-phase 208 VAC

*: declared by the applicant

5.3 Test Item (Equipment Under Test) Description*

Short designation	EUT Model	EUT Description	Serial number / ID**	Hardware status	Software status
EUT A	SK4105	HF High-Power Transmitter	5304.9013K05-100666-Uk	GX4100: 14.20 OPLC: 1.6.0 ACB: 04.71	5304.9007.06

*: declared by the applicant

**: please see the list of all the main parts of EUT A in Subchapter 5.8.

5.4 Auxiliary Equipment (AE) Description*

AE short designation	AE Name (if available)	AE Description	Serial number (if available)	Software (if used)
AE1	01 BN 546423C0400 (Please see photos in Annex B)	Load 10 kW 50 Ω	A373988	-
AE2	(Please see photos in Annex B)	Thermofin heat exchanger	-	-
AE 3	XK 4100 (Please see photos in Annex B)	Audio signal controller	-	-
AE 4	R&S CMA180	Radio Test Set	104560	-
AE 5	3 UI 210/130 (Please see photos in Annex B)	3-phase transformator 380 V / 200 V	-	-

*: declared by the applicant

5.5 Operating Modes Description*

EUT operating mode no.	Description of operating modes	Additional information
op. 1	J3E modulation, CH_{low}	Power: 5000 W, f_{in}: 1 kHz single tone
op. 2	J3E modulation, CH_{mid}	Power: 5000 W, f_{in}: 1 kHz single tone
op. 3	J3E modulation, CH_{high}	Power: 5000 W, f_{in}: 1 kHz single tone
op. 4	H2B modulation, CH_{low}	Power: 5000 W, f_{in}: SELCAL32 with H4-A9 pairs
op. 5	H2B modulation, CH_{mid}	Power: 5000 W, f_{in}: SELCAL32 with H4-A9 pairs
op. 6	H2B modulation, CH_{high}	Power: 5000 W, f_{in}: SELCAL32 with H4-A9 pairs
op. 7	A1A modulation, CH_{low}	Power: 1250 W, f_{in}: 1 kHz single tone
op. 8	A1A modulation, CH_{mid}	Power: 1250 W, f_{in}: 1 kHz single tone
op. 9	A1A modulation, CH_{high}	Power: 1250 W, f_{in}: 1 kHz single tone

*: declared by the applicant

5.6 Set-ups Description

set. 1	EUT A + AE 1 + AE 2 + AE 3 + AE 4 + AE 5	Conducted tests. Attenuator out-connector is connected with the help of HF cable with different measurement devices.
set. 2	EUT A + AE 1 + AE 2 + AE 3 + AE 4 + AE 5	Cabinet test. Attenuator out-connector is terminated with 50 Ω.

*: declared by the applicant

5.7 Test conditions

Temperature, [°C]		Voltage, [V]	
Tnom	20 ± 5	Vnom	3-phase 208 VAC
Tmax	-	Vmax	-
Tmin	-	Vmin	-

5.8 Additional Information

Test items additional information	EUT A consists of the following main parts: 1. Communication system GX4100D, ID: 6137.4480.08-100760-Ck (Receiver/Exciter) 2. Radio software GS4100D, ID: 6192.2604.03-100713-rV (FSW V11.01) 3. High-Power Amplifier HPA4100, ID: 5304.2202.02-101995-Ct 4. High-Power Amplifier HPA4100, ID: 5304.2202.02-101996-TY 5. High-Power Filter HPF4100, ID: 6211.1384.03-100495-CN 6. High-Power Filter HPF4100, ID: 6211.1384.03-100494-mh 7. High-Power Filter HPF4100, ID: 5304.2902.02-101285-SE 8. Highpoweramplisys, ID: 6057.7002.05-101053-NC 9. SK4100 NVT Mech. 208 V, ID: 2109.4002.19-100710-HF 10. SK41-T10 POW.DIS. 208 V 2, ID: 5304.9607.06-101544-dg 11. SK4105, HF HIGH-POWER TR. 5KW208V, ID: 5304.9007.06-100826-Jz 12. Basic rack SK4105 208V, ID: 5304.9107.06-100826-Fw 13. Transformer Kit 1TR-2KVA/, ID: 5304.8000.05-100826-rH
Additional information	According to applicants' information H2B modulation is intended to be used only with SELCAL radio system. SELCAL32 consists of 32 tones with lowest frequency 312.6 Hz and highest frequency 1557.8 Hz. A (312.6 Hz), H (645.7 Hz), 4 (927.9 Hz), 9 (1557.8 Hz) tones were chosen for testing. During the testing the tone pairs H4 and A9 are played sequently.

6 SUMMARY OF TEST RESULTS

Test specification
FCC CFR Title 47 Part 87

Section	Spec Clause	Test Description		Set-up	Operating mode	Verdict
7.1	§2.1046, §87.131, §87.137	Output power (conducted)		1	1-9	**Pass**
7.2	§2.1049, §87.135(a), §87.137	Bandwidth of Emissions 99 % Occupied Bandwidth		1	1-9	**Pass**
7.3	§2.1051, §87.139	Emission Limitation	Spurious Emission at Antenna Port	1	1-9	**Pass**
			Emission Mask	1	1-9	**Pass**
7.4	§2.1053, §87.139	Field Strength of Spurious Emission		2	1-9**	**Pass**
7.5	§2.1047, §87.141	Modulation Characteristics		1	J3E, H2B	**Pass**
7.6	§2.1055, §87.133	Frequency Stability		-	-	**N/A***

Notes
* Frequency Stability Test is not applicable here for EUT A according to the answer from FCC to the correspondent request. ** Please see note in Chapter 7.4.

Comments and observations
-

7 TEST RESULTS

7.1 Output power (conducted)

Test equipment (Please see Chapter 8 for exact information of test equipment)

Conducted: PM1, SG1 (used for reading the PM1 values)

Description

This is a conducted measurement made with power meter.
The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.10: 2013.
See photos in Annex C for test Set-up.

Limits

Part 87 § 87.131:
The following table lists authorized emissions and maximum power. Power must be determined by direct measurement:

Class of station:	Frequency band/frequency:	Authorized emission(s):	Maximum power, [kW]:
Aeronautical enroute and aeronautical fixed	HF	R3E, H3E, **J3E**, J7B, **H2B**, J2D	6
Aeronautical enroute and aeronautical fixed	HF	**A1A**, F1B, J2A, J2B	1.5

Results

Set./ Op.	Output power, [dBm]	Output power, [W]	Limit, [W]	Margin [W]	Verdict
Set.1, Op. 1	66.716	4694.6	6000	1305.4	Pass
Set.1, Op. 2	67.201	5249.3	6000	750.7	Pass
Set.1, Op. 3	67.182	5226.4	6000	773.6	Pass
Set.1, Op.4	62.576	1809.7	6000	4190.3	Pass
Set.1, Op. 5	63.131	2056.4	6000	3943.6	Pass
Set.1, Op. 6	63.052	2019.3	6000	3980.7	Pass
Set.1, Op. 7	61.026	1266.5	1500	233.5	Pass
Set.1, Op. 8	61.261	1336.9	1500	163.1	Pass
Set.1, Op.9	61.452	1397.0	1500	103.0	Pass

Note

All the measured signals are basically CW signals while using amplitude modulation. Thus, there is no reason to mention used detector during the measurement (Peak or Average). Because the power values are the same for both detectors.
f_in = 1 kHz and U_in = 0.7 V was used for all measurements.

* Please see measurement plots in Annex A.

7.2 Bandwidth of Emissions. 99 % Occupied Bandwidth.

Test equipment (Please see Chapter 8 for exact information of test equipment)

Conducted: R4

Description

This is a conducted measurement.
The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.10: 2013.
Please see measurement plots in Annex A for spectrum analyzer settings.
See photos in Annex C for test Set-up.

Limits

Part 87 § 87.135(a):
The assignable emissions, corresponding emission designators and authorized bandwidths are as follows:

Class of emission:	Emission designator:	Authorized bandwidth (kHz):		
		Below 50 MHz	Above 50 MHz	Frequency deviation
J3E	2K80J3E	3	-	-
H2B	2K80H2B	3	-	-
A1A	100HA1A	0.25	-	-

Measurement information

ANSI C63.10: 2013:
The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth.
When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.
• The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
• The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
• The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.
Note: Video averaging is not permitted.
A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.
The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.
The difference between the two recorded frequencies is the 99% occupied bandwidth.

Results

Set./ Op.	F_{low} 99 % OBW, [MHz]	F_{high} 99 % OBW, [MHz]	99 % OBW, [kHz]	Verdict
Set.1, Op. 1	1.5002959	1.5028376	2.5417	Pass
Set.1, Op. 2	14.2502837	14.2528334	2.5497	Pass
Set.1, Op. 3	29.9963132	29.9988413	2.5281	Pass

Set.1, Op.4	1.4999496	1.5016459	1.6963	Pass
Set.1, Op. 5	14.2499497	14.2516198	1.6701	Pass
Set.1, Op. 6	29.9959497	29.9976119	1.6622	Pass
Set.1, Op. 7	1.49998909	1.50001093	0.02184**	Pass
Set.1, Op. 8	14.2499892	14.2500111	0.02193**	Pass
Set.1, Op.9	29.9959893	29.9960115	0.02215**	Pass

Note
For J3E modulation the f_in was swept over all detectable frequencies. U_in = 0.7 V was used.
For H2B SELCAL lowest sign ‘A’ (312.6 Hz) and highest sign ‘9’ (1557.8 Hz) (among others) were used to determine the bandwidth.

* Please see measurement plots in Annex A.
** The signal is basically a CW signal. Thus, the rule of 1 % - 5 % of RBW doesn’t apply here.

7.3 Emission Limitation. Spurious Emission at Antenna Port & Emission Mask

Test equipment (Please see Chapter 8 for exact information of test equipment)

Conducted: R4

Description

This is a conducted measurement.
The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.10: 2013.
Please see measurement plots in Annex A for spectrum analyzer settings.
See photos in Annex C for test Set-up.

Limits

Part 87 § 87.139:

(c) For aircraft station transmitters first installed after February 1, 1983, and for aeronautical station transmitters in use after February 1, 1983, and using H2B, H3E, J3E, J7B or J9W, the peak envelope power of any emissions must be attenuated below the peak envelope power of the transmitter (pX) as follows:

(1) When the frequency is removed from the assigned frequency by more than 50 percent up to and including 150 percent of the authorized bandwidth of 3.0 kHz, the attenuation must be at least 30 dB.

(2) When the frequency is removed from the assigned frequency by more than 150 percent up to and including 250 percent of the authorized bandwidth of 3.0 kHz, the attenuation must be at least 38 dB.

(3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth of 3.0 kHz for aircraft transmitters the attenuation must be at least 43 dB. For aeronautical station transmitters with transmitter power up to and including 50 watts the attenuation must be at least 43 + 10 $\log_{10}$ pX dB and with transmitter power more than 50 watts the attenuation must be at least 60 dB.

Results: please see measurement plots in annex A

Verdict Spurious Emission at Antenna Port**: Pass**
Verdict Emission Mask: **Pass**

Note

U_in = 0.7 V was used.

7.4 Field Strength of Spurious Emission

Test equipment

Frequency range 9 kHz – 30 MHz

Measurement in a semianechoic room with the distance between the EUT and the reference point of the antenna 3 m (see photos in Annex B). The measurement was done with R&S Elektra EMC test software.

Radiated: A1, C6, R2, SW3

Frequency range 30 MHz – 1 GHz

Measurement in a semianechoic room with the distance between the EUT and the reference point of the antenna 3 m (see photos in Annex B). The measurement was done with R&S Elektra EMC test software.

Radiated: A2, C6, R2, SW3.

Description

The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.10: 2013.
The measurement antenna was situated in 3 m distance to the EUT.
RBW for frequency range 9 kHz- 30 MHz: 200 Hz, 9 kHz.
RBW for frequency range 30 MHz- 1 GHz: 120 kHz.
See photos in Annex C for test Set-up and block diagram in Chapter 2.9.
The RF output of the EUT was terminated with 50 Ω.
The radiated cabinet measurements were done in two stages.
At first all operational modes were tested in an anechoic chamber with closed door with generated power on EUT 2 kW. The socket in turn table was used for connection of EUT to power supply. Please see photos 3 and 4 in Annex C. When all the operational modes were tested with 2 kW power the worst cases were chosen for the measurements with 5 kW. 5 kW measurements were done with the door of the chamber slightly open to have a possibility to get a power supply cable through it. Please see photos 5 and 6 in Annex C. The procedure was chosen because the current filter at the chamber is designed for max 32 A current. It is the current at filter when the EUT is working with 2 kW power.
Op. 3,6,9 were tested in frequency range 9 kHz – 30 MHz with power 5kW. Op. 9 was tested in frequency range 30 MHz – 1 GHz with power 5 kW.

Limits

Part 87 § 87.139:

(c) For aircraft station transmitters first installed after February 1, 1983, and for aeronautical station transmitters in use after February 1, 1983, and using H2B, H3E, J3E, J7B or J9W, the peak envelope power of any emissions must be attenuated below the peak envelope power of the transmitter (pX) as follows:

(3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth of 3.0 kHz for aircraft transmitters the attenuation must be at least 43 dB. For aeronautical station transmitters with transmitter power up to and including 50 watts the attenuation must be at least 43 + 10 $\log_{10}$ pX dB and with transmitter power more than 50 watts the attenuation must be at least **60 dB**.

Here:

The worst case operational mode was chosen for the common limit line.
Here it is Set-up 2, **Op. 9**: 61.5 dBm – 60 dB = **1.5 dBm.**
The measurements in frequency range 9 kHz to 30 MHz were done with dBµA/m unit. And the measurements in frequency range 30 MHz – 1 GHz were done with dBµV/m unit.
The limit in dBµV based on conducted measurement is calculated according to the equation:
dBµV = dBm + 10LOG(Z) + 90 dB Here: 1.5 dBm + 10LOG(50) + 90 dB = 1.5 dBm + 107 dB = **108.5 dBuV** (this value is used in all measurement plots for radiated cabinet emissions).
Assuming that the measurement is based on a EIRP results (the used PerLog antenna is calibrated originally for EIRP), measured at 3 m the limit is calculated according to the equation (33) from ANSI-C63: 10-2020:

E(dBµV/m)=EIRP(dBm) +95.3 dB Here: 1.5 dBm + 95.3 dB = 96.8 dBµV/m. The difference between limits based on conducted and radiated measurements is 11.7 dB. With both limits the measurements are pass. The margin to the limit line is by all measurements over 12 dB. The limit in dBµA units is calculated according to the equation: dBµA = dBµV – 20LOG(Z) = dBµV – 20LOG(50Ω) = dBµV – 34 dB Here: 108.5 dBuV – 34 dB = 74.5 dBµV (based on conducted measurement, this value is used for limits in all measurement plots) and 74.5 dB – 11.7 dB = 62.8 dBµV/m@3m based on radiated measurements. Similar as for 30 MHz -1 GHz frequency range the measurements for 9 kHz -30 MHz frequency range are pass for both limits. Because the margin to limit line is always over 12 dB.
Results: please see measurement plots in annex A
Verdict: Pass.

7.5 Modulation Characteristics

Test equipment (Please see Chapter 8 for exact information of test equipment)
Conducted: PM1, SG1 (used for reading the PM1 values), R4, O1
Description This is a conducted measurement. Based on Part 2.1047 a curve equivalent data showing the frequency response of the audio modulating circuit over a range of 100 Hz to 5000 Hz shall be submitted. Figures in Chapter 4 of the Annex A display the audio frequency response of the modulator. The highest measured level was taken as the 0-dB reference. The Frequency was varied from 100 Hz to 5000 Hz. And the levels of the signal were measured either with power meter (J3E) or with the marker function of spectrum analyzer (H2B). For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted. According to customers' information there is now low-pass filter in the EUT. Thus, this test is not applicable for the equipment under test. Based on Part 2.1047 a curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed. Figures in Chapter 4 of the Annex A shows the modulation characteristics of each different frequencies while the input voltage was varied. The frequency is held constant and the percent modulation is calculated from min/max level values of modulated signal, measured with the help of oscilloscope (O1). See photos in Annex C for test Set-up.
Limits Not available
Results
Verdict: Pass**.**

* Please see measurement plots in Annex A.

8 MEASUREMENT EQUIPMENT

No	Equipment	Type	Manufacturer	Serial No.	Int. No.	Last Calibration	Next Calibration
Antennas (**A**):							
1.	Active Loop Antenna	HFH2-Z2E	Rohde & Schwarz	100108	LAB000108	2023-05-05	2026-05-05
2.	Ultrabroadband antenna	HL562E	Rohde & Schwarz	102005	LAB000150	2022-12-22	2025-12-22
3.	Double-Ridged Waveguide Horn Antenna	HF-907	Rohde & Schwarz	102899	LAB000151	2023-05-15	2026-05-15
4.	Rod Antenna	-	-	-	LAB000290	-	-
5.	Horn Antenna (2.6 GHz – 3.95 GHz)	PE9863/SF-10	Pasternack	-	LAB000312	2021-01-13	-
6.	Horn Antenna (3.95 GHz – 5.85 GHz)	PE9861/SF-10	Pasternack	-	LAB000264	2020-09-29	-
7.	Horn Antenna (10 GHz – 15 GHz)	PE9855 SF-20	Pasternack	-	LAB000263	2020-09-29	-
8.	Horn Antenna (12.4 GHz – 18 GHz)	62-HA20-A-SMF	TTE Europe	-	LAB000282	2020-09-29	-
9.	Horn Antenna (17.6 GHz – 26.7 GHz)	20240-20	Flann Microwave Ltd	266402	LAB000127	2020-06-29	-
10.	Horn Antenna (26.4 GHz – 40.1 GHz)	22240-20	Flann Microwave Ltd	270447	LAB000129	2020-06-29	-
11.	Horn Antenna (33 GHz – 50.1 GHz)	23240-20	Flann Microwave Ltd	273430	LAB000132	2020-07-01	-
12.	Horn Antenna (49.9 GHz – 75.8 GHz)	25240-20	Flann Microwave Ltd	272860	LAB000133	2020-07-01	-
13.	Horn Antenna (60.5 GHz – 91.5 GHz)	26240-20	Flann Microwave Ltd	273417	LAB000135	2020-07-01	-
14.	Horn Antenna (73.8 GHz – 114 GHz)	27240-20	Flann Microwave Ltd	273368	LAB000138	2020-07-01	-
15.	Horn Antenna (114 GHz – 173 GHz)	29240-20	Flann Microwave Ltd	273382	LAB000139	2020-07-01	-
16.	Horn Antenna (145 GHz – 220 GHz)	30240-20	Flann Microwave Ltd	273390	LAB000178	2020-08-01	-
17.	Horn Antenna (217 GHz – 330 GHz)	32240-20	Flann Microwave Ltd	273469	LAB000152	2020-08-01	-
18.	Horn Antenna (49.9 GHz – 75.8 GHz)	25240-20	Flann Microwave Ltd	272861	LAB000134	2020-07-01	-
19.	Horn Antenna (60.5 GHz – 91.5 GHz)	26240-20	Flann Microwave Ltd	273418	LAB000136	2020-08-01	-
Amplifiers (**Amp**)*:							
1.	Pre-Amplifier	BBV 9718 C	Schwarzbeck Mess-Elektronik OHG	84	LAB000169	-	-
2.	Low noise amplifier	BZ-01000900-111550-202320	B&Z Technologies	24336	LAB000296	-	-
3.	Low noise amplifier	BZ-08001800-180855-202020	B&Z Technologies	22105	LAB000297	-	-
4.	Low noise amplifier	BZ-18004000-270845-252525	B&Z Technologies	22449	LAB000298	-	-
Attenuator (**Att**)*:							
1.	Attenuator	25081-20 (49.9 GHz - 75.8 GHz)	Flann Microwave Ltd	234411	LAB000229	-	-

2.	Attenuator	27081-20 (73.8 GHz – 112 GHz)	Flann Microwave Ltd	270004	LAB000230	-	-
RF Cables (Cab)*:							
1.	Coaxial cable	LU7-022-1000	Rosenberger	33	LAB000153	-	-
2.	Coaxial cable	LU7-022-1000	Rosenberger	34	LAB000153	-	-
3.	Coaxial cable	SF101/1.5m	Huber & Suhner	503987/1	LAB000165	-	-
Chambers (C):							
1.	Semi/Fully Anecoic Chamber	Babylon 5 (SAC 5)	Albatross Projects GmbH	20168.PRB	LAB000235	2024-02-28	2026-02-28
2.	Climatic chamber	T-65/50	CTS GmbH	204002	LAB000110	2024-05-12	2025-05-12
3.	Shielding Cover	CMU-Z11	Rohde & Schwarz	100876	LAB000039	-	-
4.	Climatic chamber	T-70/350	CTS GmbH	194027	LAB000066	2024-07-01	2025-07-01
5.	Shielded room	Sputnik 1 (Schirmkabine)	Albatross Projects GmbH	-	LAB000257	-	-
6.	Semi/Fully Anecoic Chamber	Atlas 5 (SAC 5)	Albatross Projects GmbH	P31018	LAB000686	2025-03-18	2028-03-18
Corner Reflector (CR):							
1.	Trihedral Corner Reflector	SAJ-080-S1	ERAVANT	04756-01	LAB000201	-	-
Directional coupler (DC):							
1.	Directional coupler	CPL-5230-10-SMA-79	Midwest Microwave	-	LAB000672	-	-
Distance meter (DM):							
1.	Laser distance meter	GLM 50 C	Bosch	-	-	-	-
2.	Laser distance meter	GLM 120 C	Bosch	-	-	-	-
Filter (F)*:							
1.	High-pass filter (84 GHz – 110 GHz)	10-WHPF-84.5-UG387	TTE	-	LAB000299	-	-
2.	High-pass filter (7 GHz – 23 GHz)	HPF 7-23	AtlantRF	-	LAB000444	-	-
3.	High-pass filter (3.3 GHz – 12.75 GHz)	HPF 3.3-11	AtlantRF	-	LAB000382	-	-
4.	High-pass filter (1.3 GHz – 12.75 GHz)	H1G713G1	Microwave Circuits Inc	46291	LAB000443	-	-
5.	High-pass filter (1.3 GHz – 12.75 GHz)	H1G713G1	Microwave Circuits Inc	1896-01	LAB000670	-	-
6.	Bandstop filter (30MHz – 3GHz for 900 MHz Band)	WRCG876/960-847/989-50/8SS	Wainwright Instruments GmbH	-	LAB000671	-	-
Harmonic mixers (H):							
1.	Harmonic Mixer	FS-Z60	Rohde & Schwarz	101350	LAB000375	2024-04-11	2025-04-11
2.	Harmonic Mixer	FS-Z75	Rohde & Schwarz	102015	LAB000112	2024-05-01	2025-05-01
3.	Harmonic Mixer	FS-Z90	Rohde & Schwarz	102020	LAB000113	2024-04-06	2025-04-06
4.	Harmonic Mixer	FS-Z110	Rohde & Schwarz	102000	LAB000114	2024-05-02	2025-05-02
5.	Harmonic Mixer	FS-Z170	Rohde & Schwarz	100996	LAB000126	2024-05-07	2025-05-07
6.	Harmonic Mixer	FS-Z220	Rohde & Schwarz	101039	LAB000116	2024-04-03	2025-04-03
7.	Harmonic Mixer	FS-Z325	Rohde & Schwarz	101015	LAB000117	2024-04-16	2025-04-16
LISN (L):							
1.	Two-line V-Network	ENV216	Rohde & Schwarz	102597	LAB000220	2023-11-07	2025-10-28
2.	Two-line V-Network	ENV216	Rohde & Schwarz	102598	LAB000217	2024-06-06	2025-06-06
Multimeters (M):							
1.	Multimeter	U1242B	Keysight	MY59240021	LAB000187	2024-06-20	2026-06-20
2.	Multimeter	U1242B	Keysight	MY59160026	LAB000018	2024-09-06	2025-09-05
Multipliers (Mp):							
1.	Multiplier	SMZ75	Rohde & Schwarz	101307	-	2018-03-15	-
2.	Multiplier	SMZ110	Rohde & Schwarz	100001	-	2020-05-09	-

Oscilloscopes (O):							
1.	Oscilloscope	RTE 1104	Rohde & Schwarz	1317.2500K04 - 101439-Rn	LAB000849	2025-01-31	2026-01-31
Power Supply (P):							
1.	Power Supply	PS 2042-10 B	Elektro-Automatic GmbH	2878350263	LAB000190	-	-
2.	Power Supply	PS 2042-10 B	Elektro-Automatic GmbH	2878350322	LAB000192	-	-
3.	Power Supply	E3640A	Agilent	MY40005693	LAB000036	-	-
Power meters (PM):							
1.	Power meter	NRP-Z81	Rohde & Schwarz	106194	LAB000120	2024-05-22	2025-05-22
2.	Power meter	NRP110T	Rohde & Schwarz	101151	LAB000119	2024-05-24	2025-05-24
Receivers and Spectrumanalyzers (R):							
1.	Test Receiver, SAC5	ESW-26	Rohde & Schwarz	101517	LAB000363	2025-01-10	2026-01-10
2.	Test Receiver	ESW-26	Rohde & Schwarz	101481	LAB000236	2023-07-09	2025-07-09
3.	Spectrum Analyzer 1 Hz – 50 GHz	FSW-50	Rohde & Schwarz	101450	LAB000111	2024-07-19	2025-07-19
4.	Spectrum Analyzer 2 Hz – 43 GHz	FSW-43	Rohde & Schwarz	101391	LAB000289	2024-06-04	2025-06-04
Signal Generators (SG):							
1.	Signal generator 8 kHz – 50 GHz	SMA100B	Rohde & Schwarz	103838	LAB000118	2024-06-28	2025-06-28
2.	Vector Signal Generator	SMW200A	Rohde & Schwarz	109775	LAB000870	2023-10-18	2026-10-18
3.	Signal generator 100 kHz – 20 GHz	SMB100A	Rohde & Schwarz	178175	LAB000276	2024-04-03	2025-04-03
Software (SW):							
No	Type	Name	Manufacturer	Version	Int. No.	Build	Rev
1.	Software	R&S Power Viewer	Rohde & Schwarz	11.3, 3.2.2020	-	7338	3230
2.	Software	R&S EMC32	Rohde & Schwarz	11.20	-	-	-
3.	Software	R&S Elektra EMC test software	Rohde & Schwarz	13.00	-	-	-

* The gain values of Amp and attenuation values of Cab and Att are remeasured annually internal.

9 MEASUREMENT UNCERTAINTIES

Test case	Measurement uncertainty*
Radiated field strength	≤ ± 6 dB
Occupied bandwidth	± 100 kHz
Time domain measurement	± 2.32 ms
DC and low frequency voltages	± 3 %
Temperature	± 1 °C
Humidity	± 3 %

*) The indicated expanded measurement uncertainty corresponds to the standard measurement uncertainty for the measurement results multiplied by the coverage factor k = 2. The true value is located in the corresponding interval with a probability of 95 %.

END OF THE REPORT

Annex A

Measurement plots

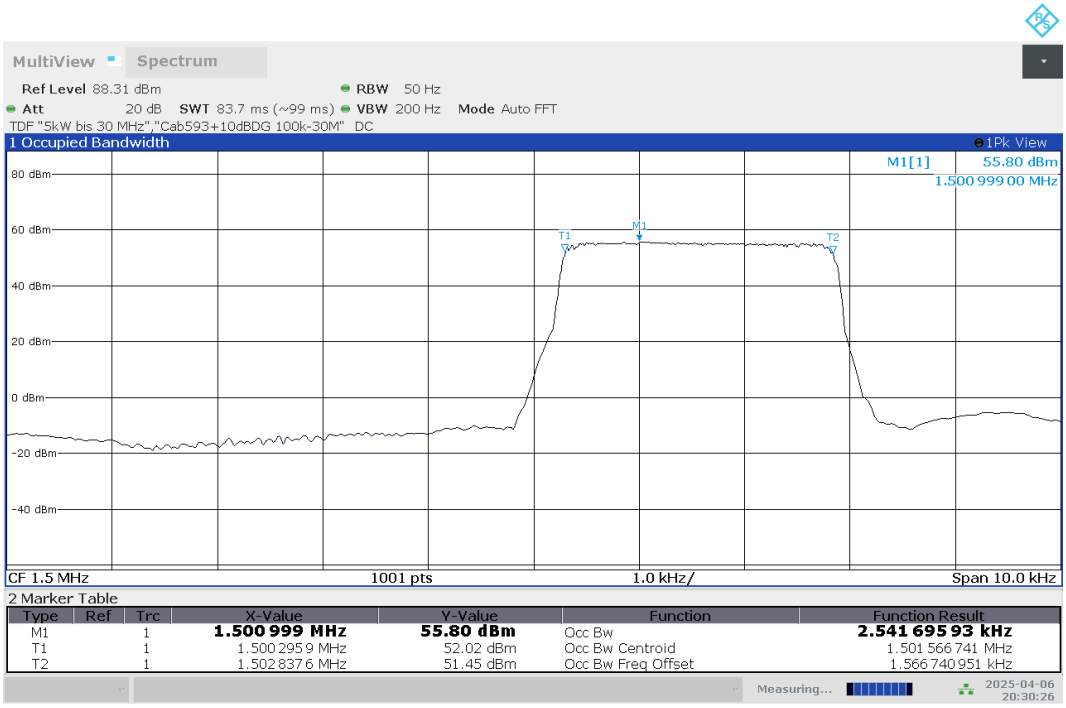
part of / in addition to

Test report no.: 25010978-44359-0

Table of contents:

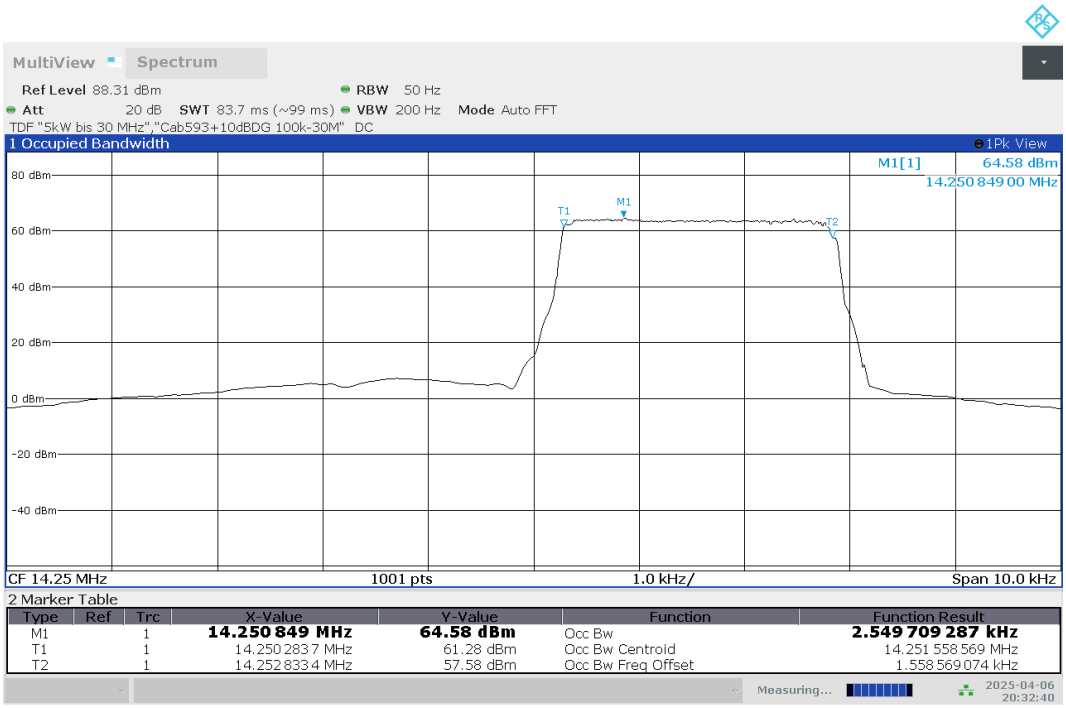
1 Bandwidth of Emissions. 99 % Occupied Bandwidth.

1.1 Set-up 1, Op. 1



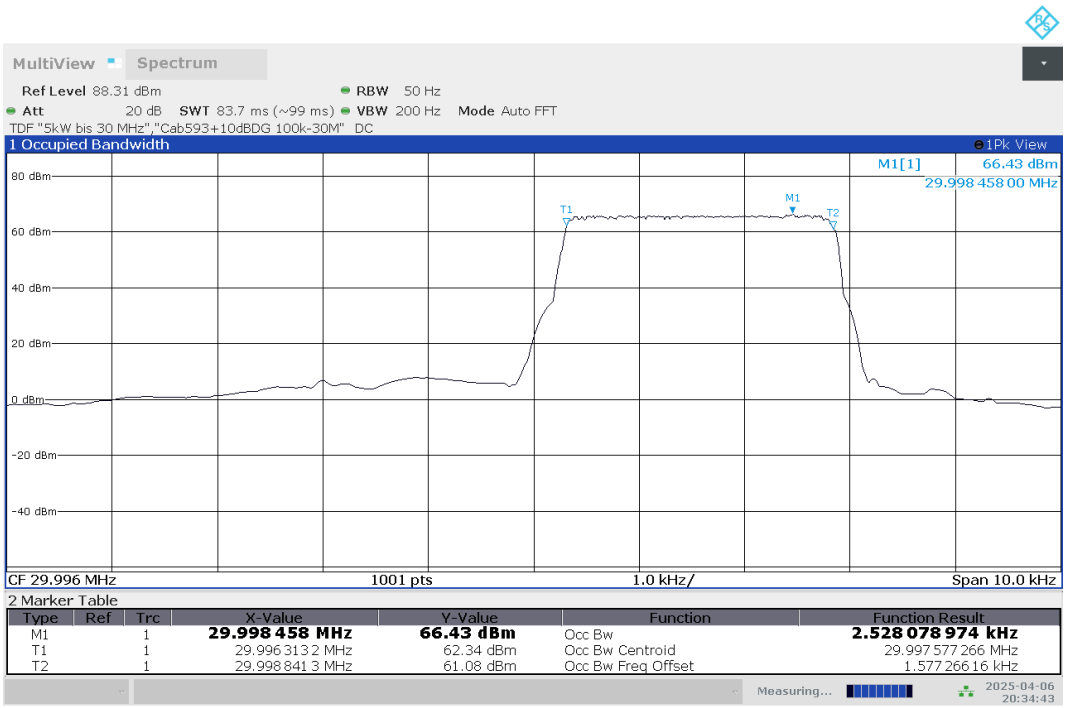
08:30:26 04/06/2025

1.2 Set-up 1, Op. 2



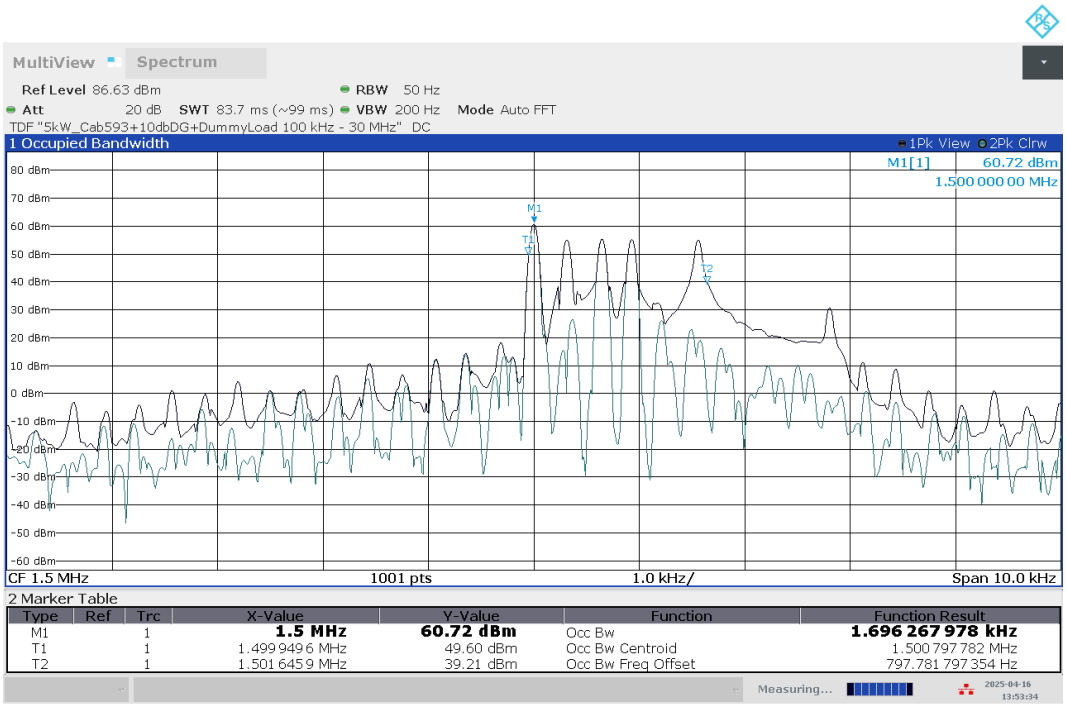
08:32:41 04/06/2025

1.3 Set-up 1, Op. 3



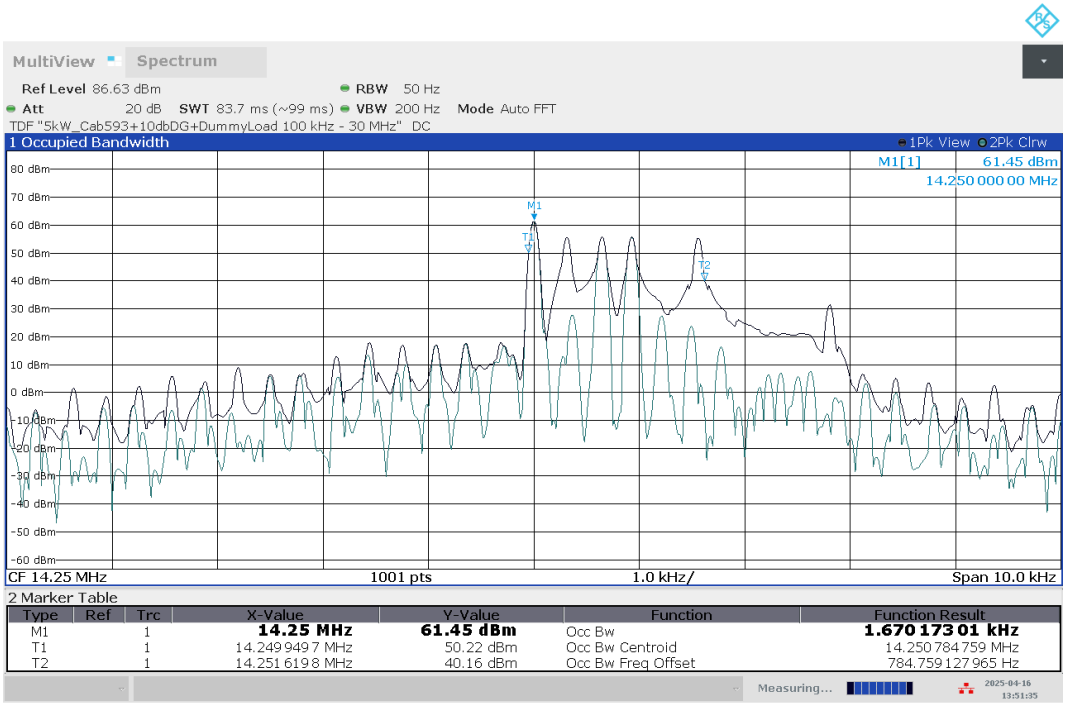
08:34:43 04/06/2025

1.4 Set-up 1, Op. 4

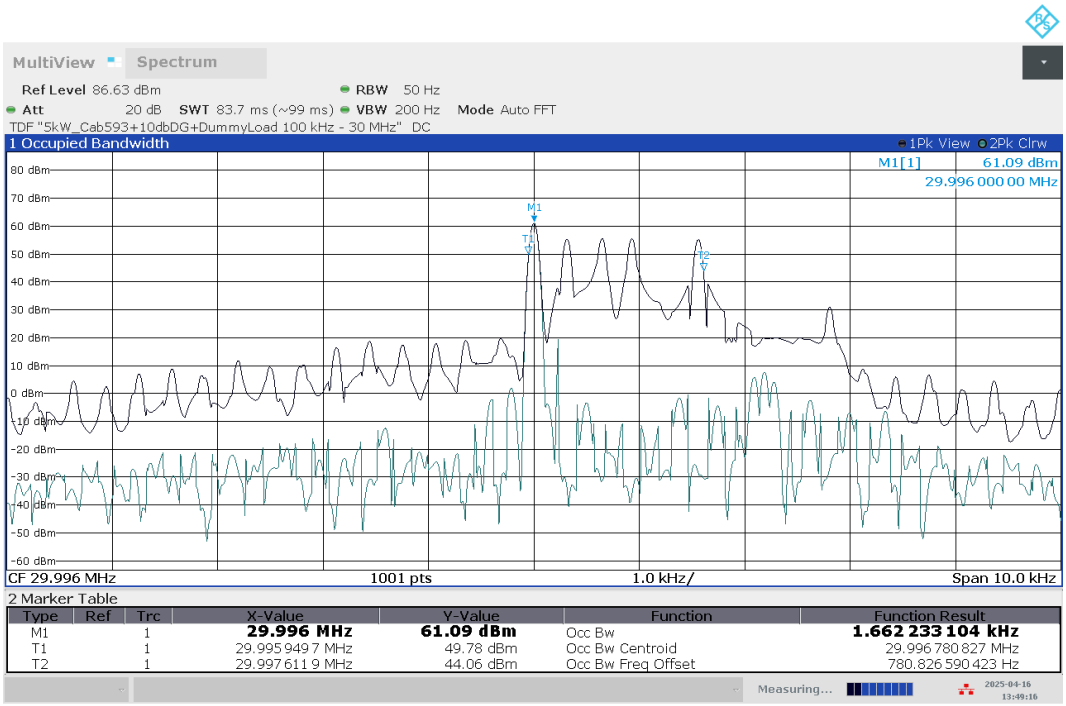


01:53:34 04/16/2025

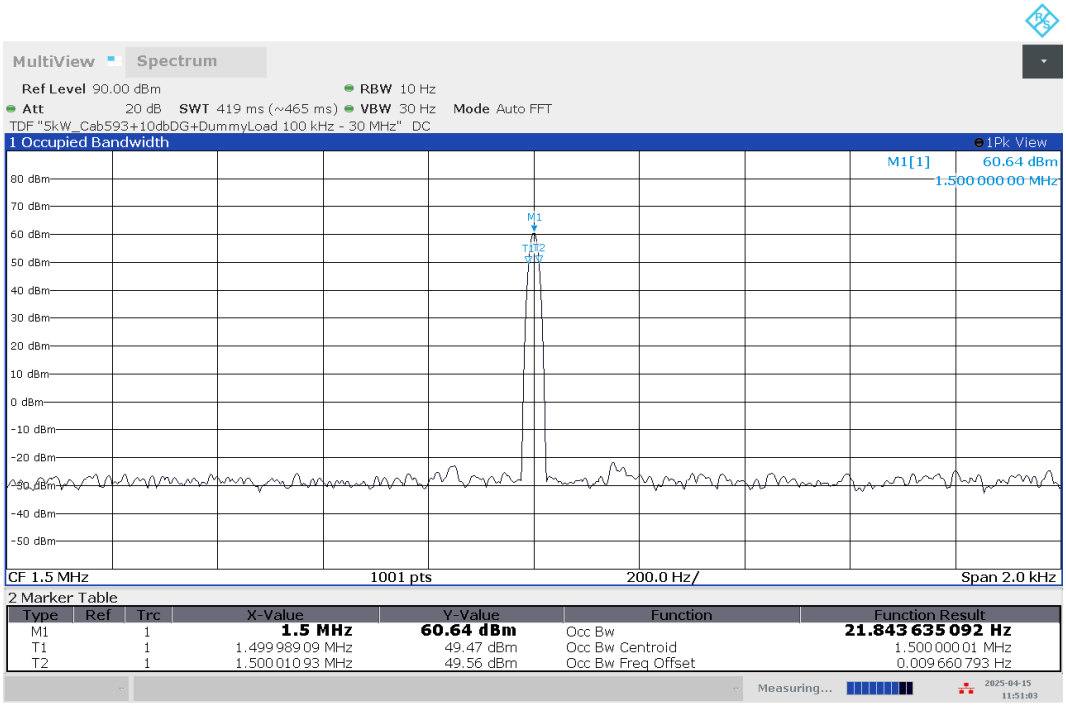
1.5 Set-up 1, Op. 5



1.6 Set-up 1, Op. 6

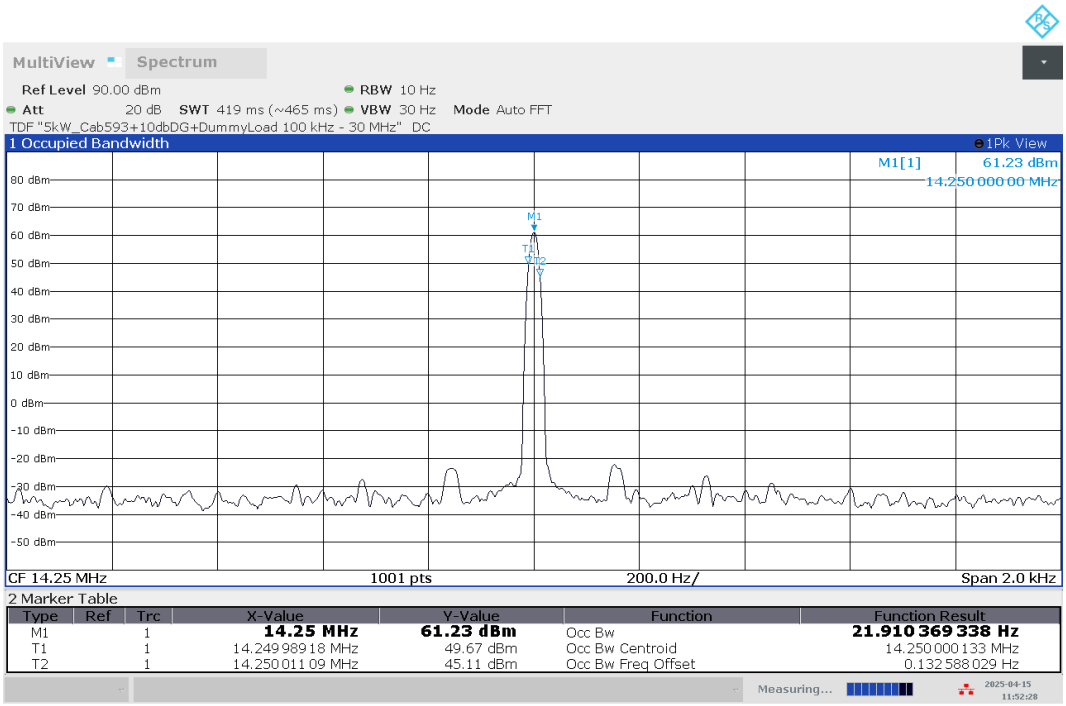


1.7 Set-up 1, Op. 7



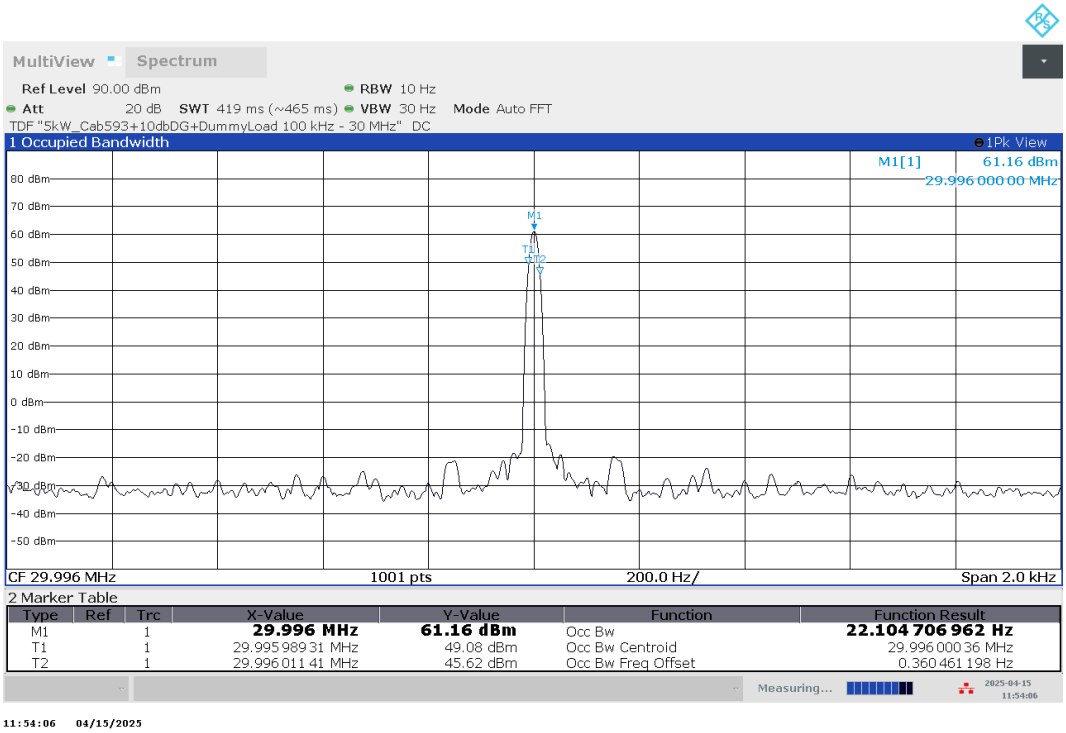
11:51:04 04/15/2025

1.8 Set-up 1, Op. 8



11:52:28 04/15/2025

1.9 Set-up 1, Op. 9



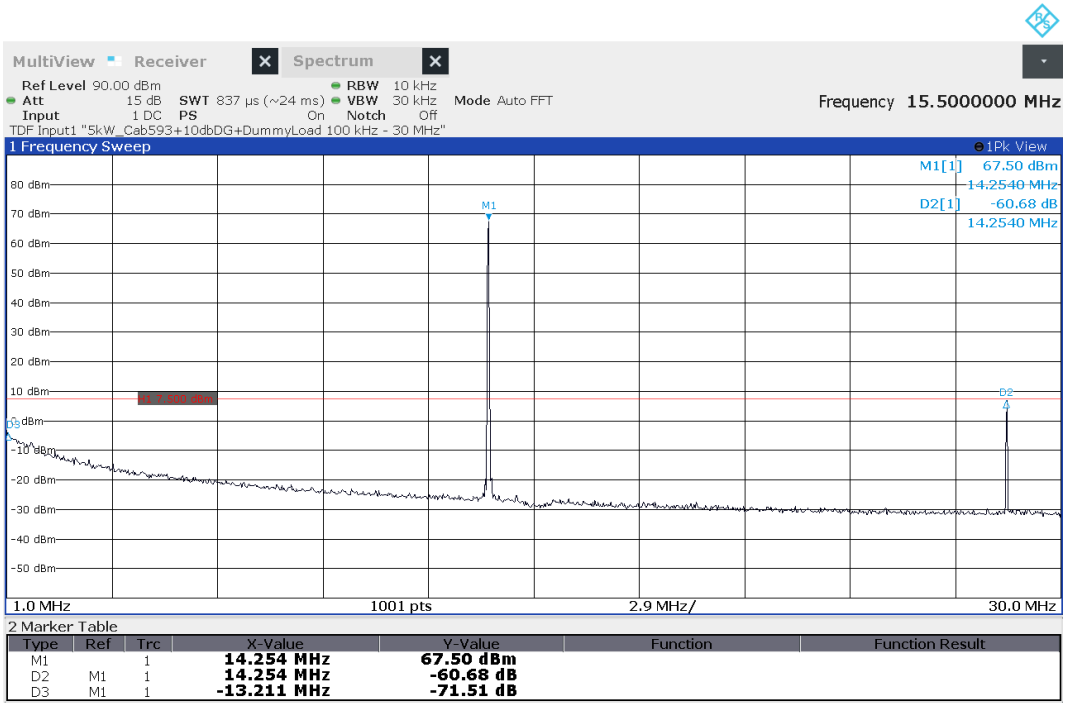
2 Spurious Emission at Antenna & Emission Mask

2.1 Spurious Emission at Antenna

2.1.1 Set-up 1, Op. 1, 1 MHz – 30 MHz

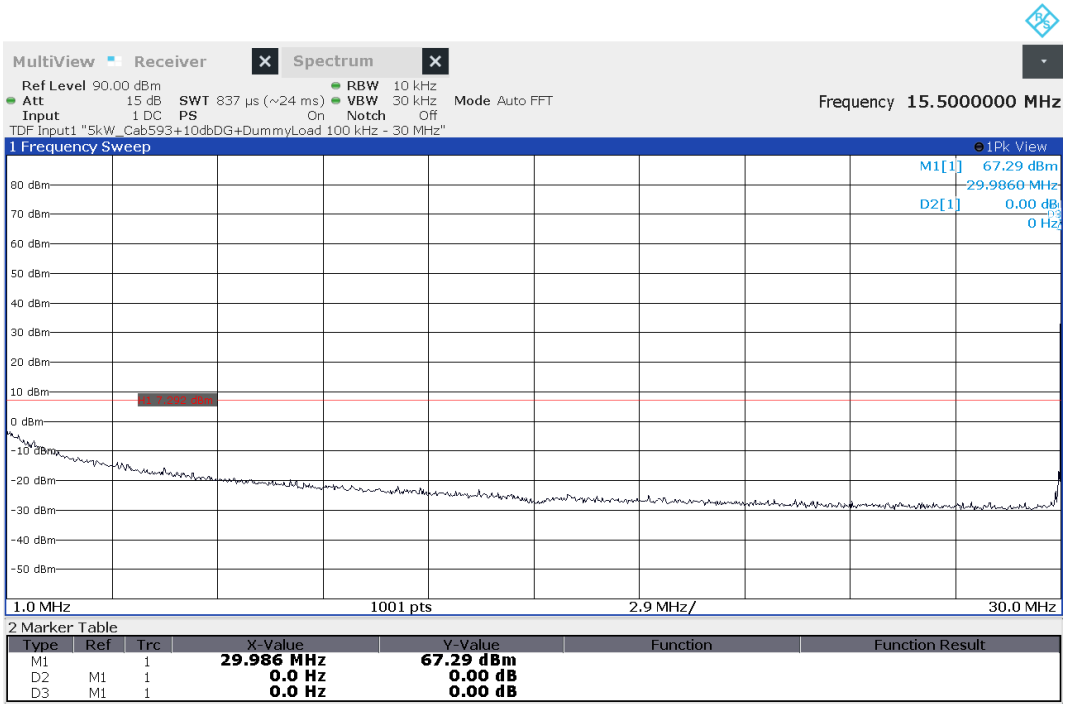
01:27:32 04/14/2025

2.1.2 Set-up 1, Op. 2, 1 MHz – 30 MHz

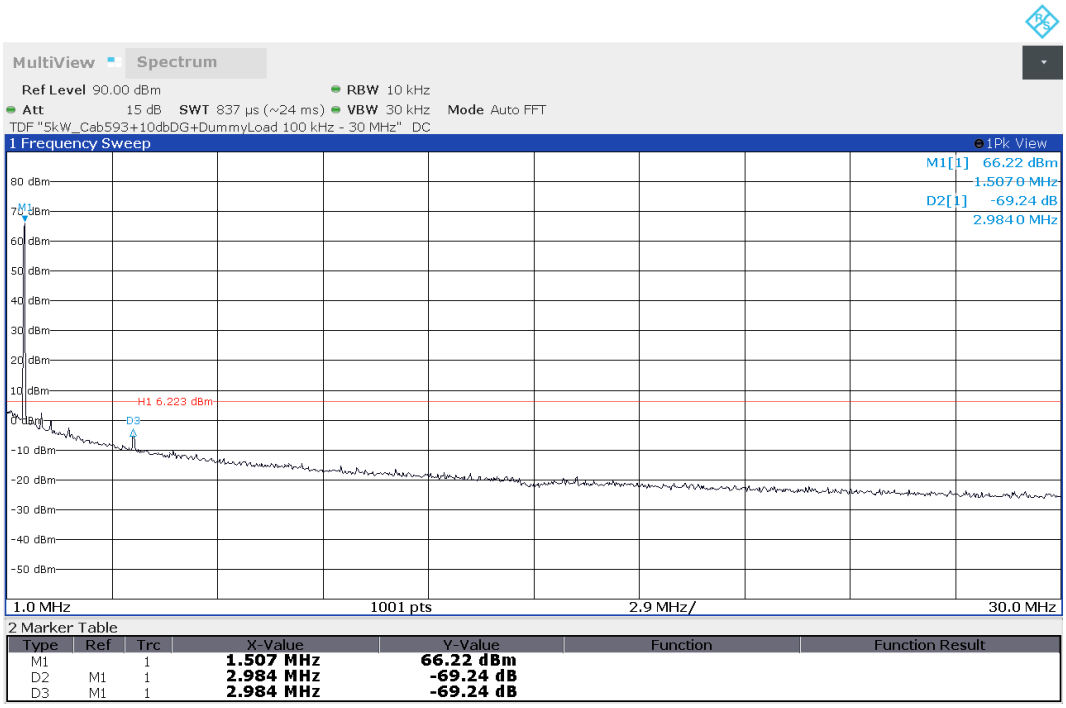


01:46:01 04/14/2025

2.1.3 Set-up 1, Op. 3, 1 MHz – 30 MHz



2.1.4 Set-up 1, Op. 4, 1 MHz – 30 MHz



2.1.5 Set-up 1, Op. 5, 1 MHz – 30 MHz

2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**14.254 MHz**	**66.78 dBm**		
D2	M1	1	**-13.211 MHz**	**-64.05 dB**		
D3	M1	1	**14.254 MHz**	**-72.56 dB**		

04:06:40 04/16/2025

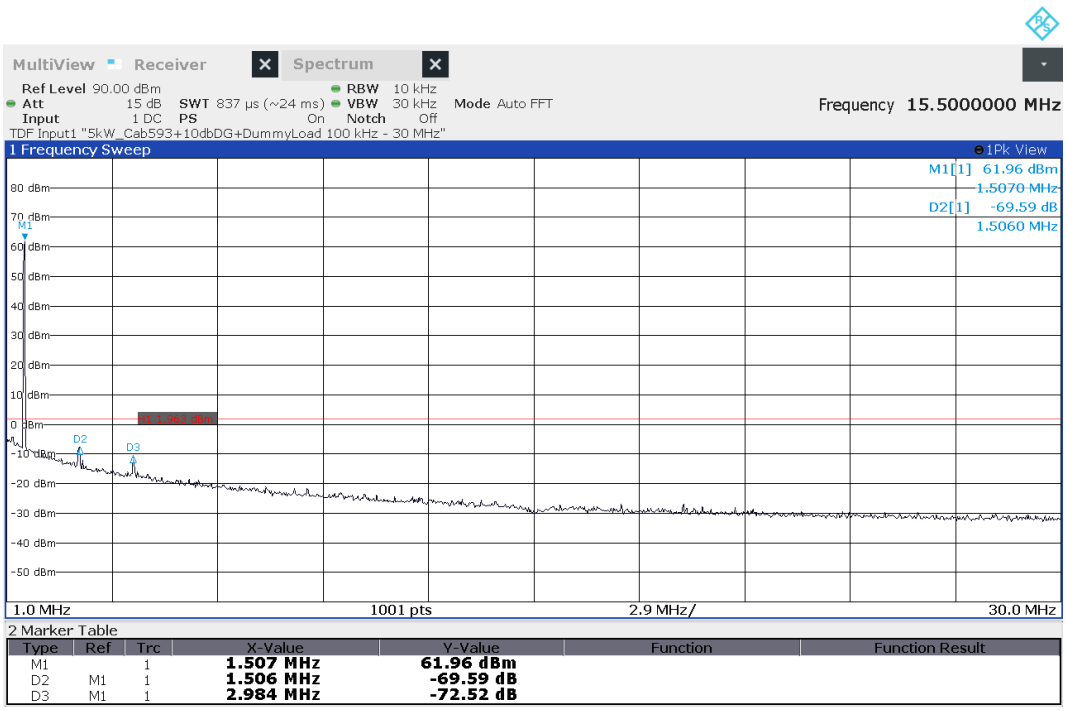
2.1.6 Set-up 1, Op. 6, 1 MHz – 30 MHz

2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**29.986 MHz**	**66.90 dBm**		
D2	M1	1	**-28.942 MHz**	**-63.28 dB**		
D3	M1	1	**-28.942 MHz**	**-63.28 dB**		

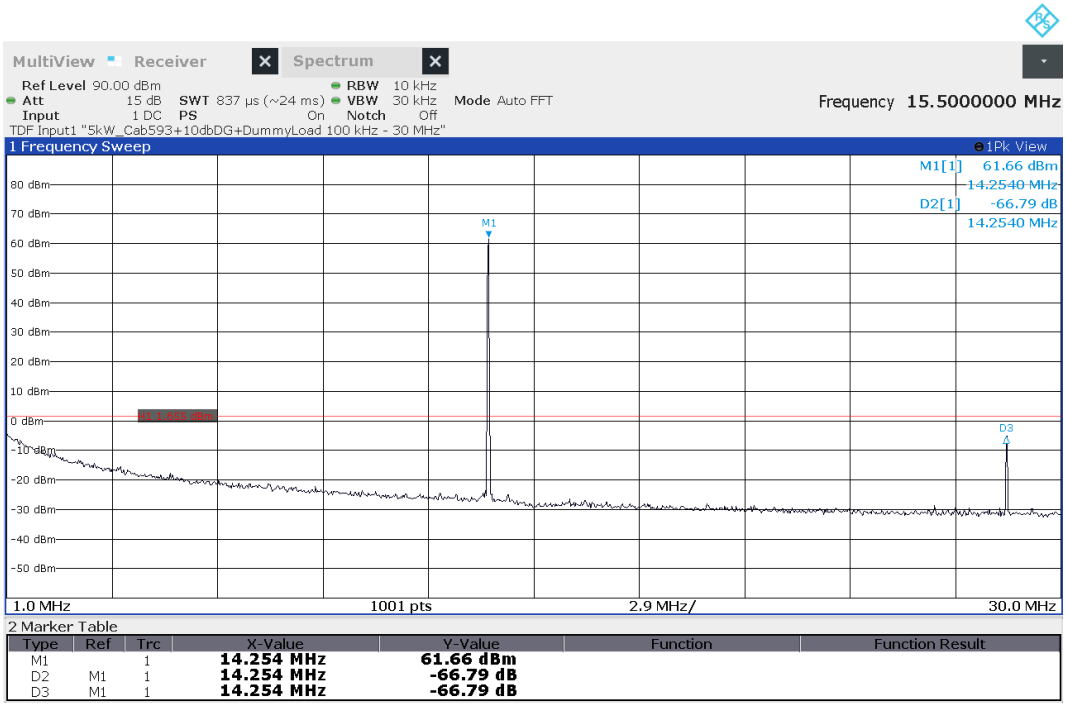
04:09:45 04/16/2025

2.1.7 Set-up 1, Op. 7, 1 MHz – 30 MHz



02:01:49 04/14/2025

2.1.8 Set-up 1, Op. 8, 1 MHz – 30 MHz

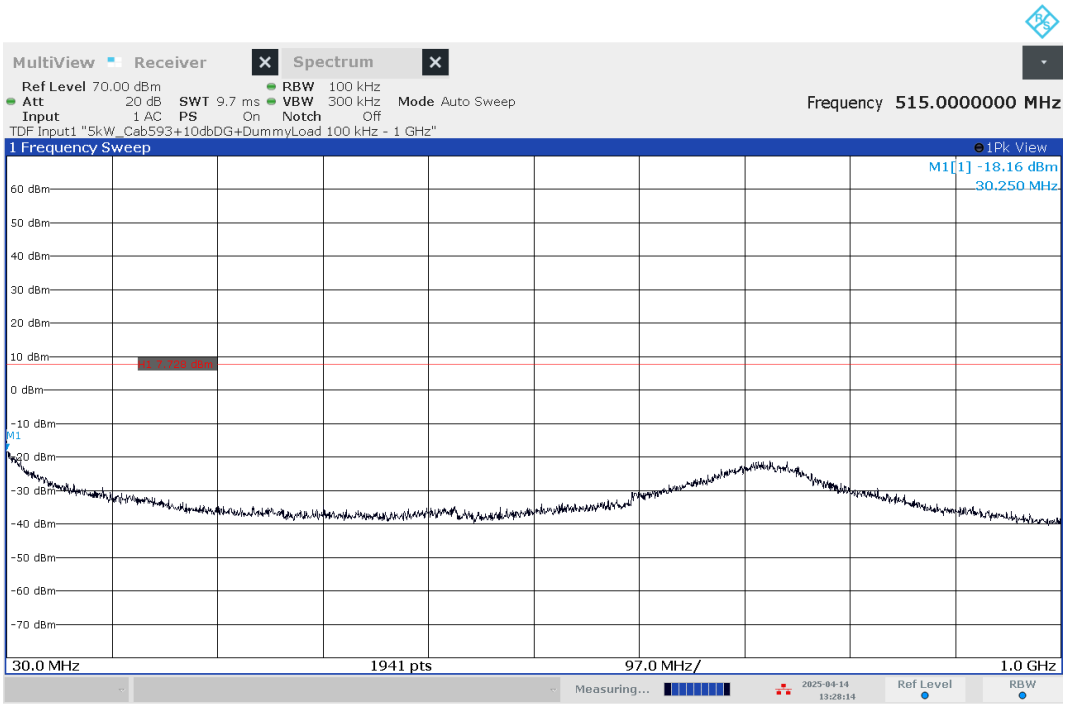


02:03:47 04/14/2025

2.1.9 Set-up 1, Op. 9, 1 MHz – 30 MHz

02:06:09 04/14/2025

2.1.10 Set-up 1, Op. 1, 30 MHz – 1 GHz



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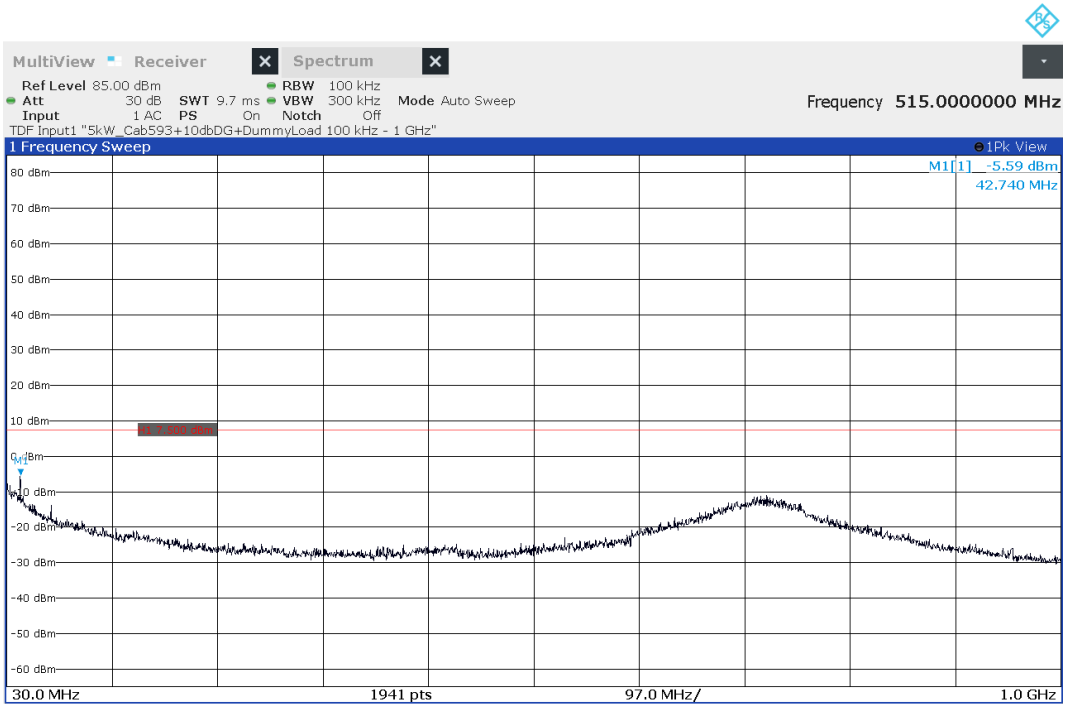
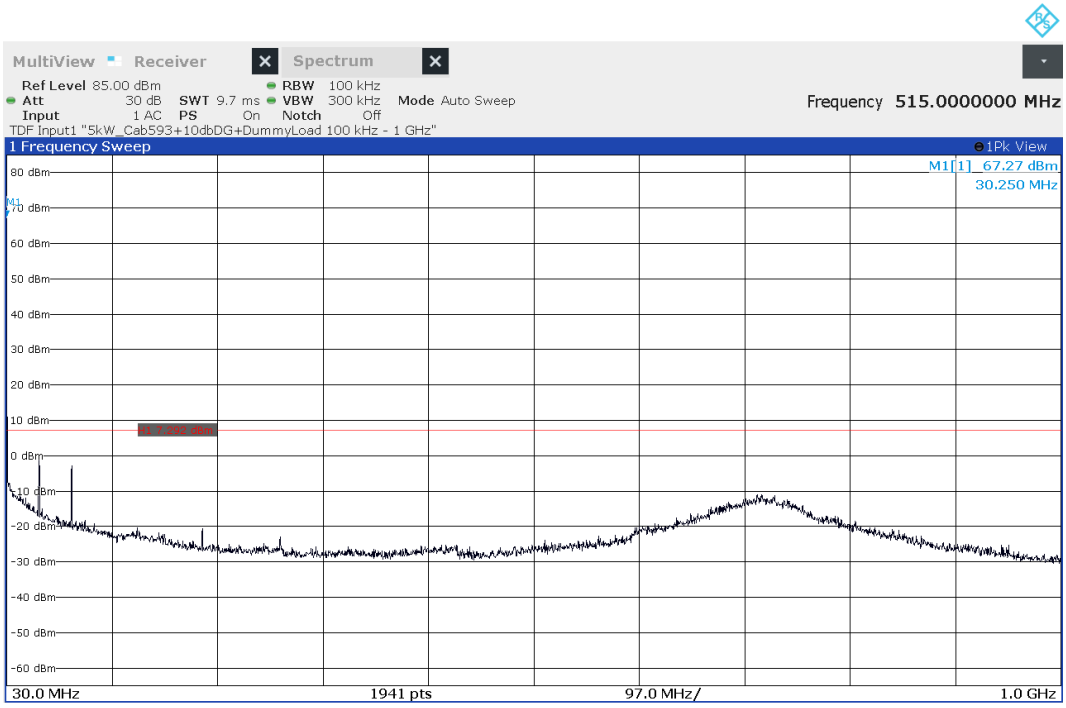
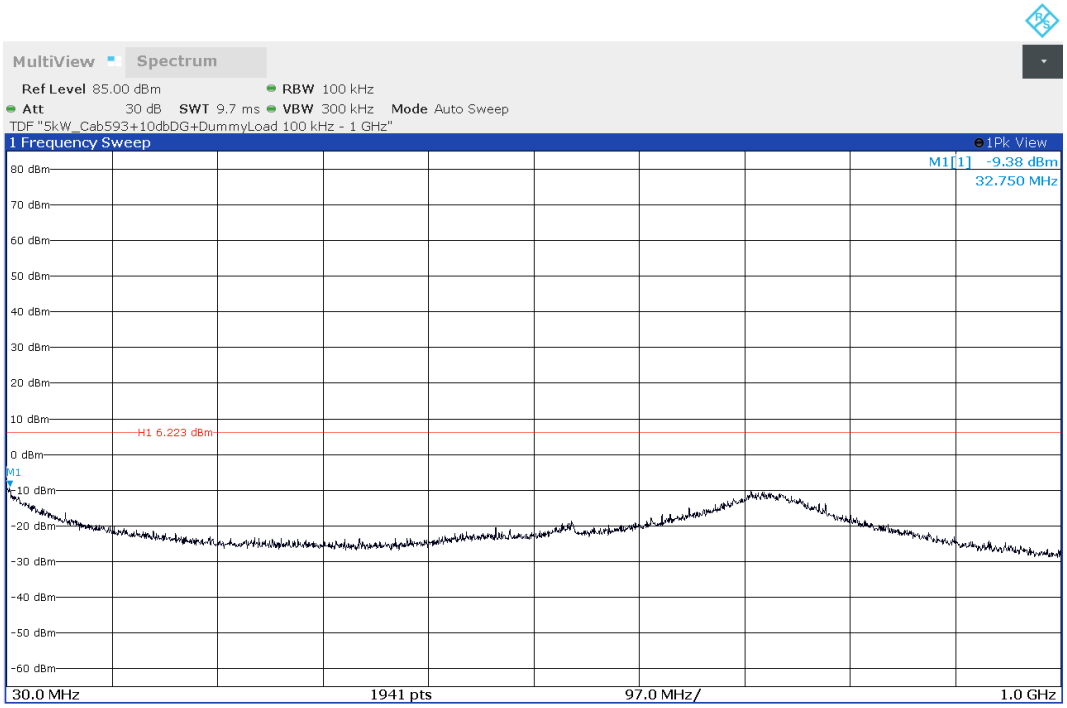
2.1.11 Set-up 1, Op. 2, 30 MHz – 1 GHz



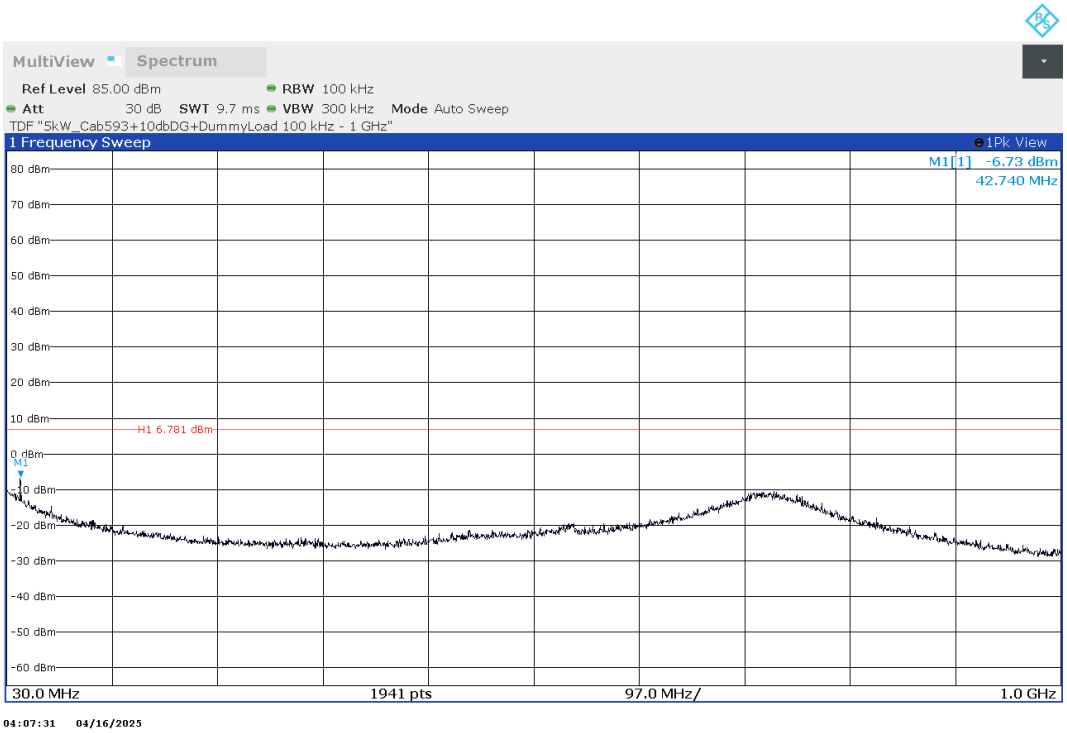
2.1.12 Set-up 1, Op. 3, 30 MHz – 1 GHz



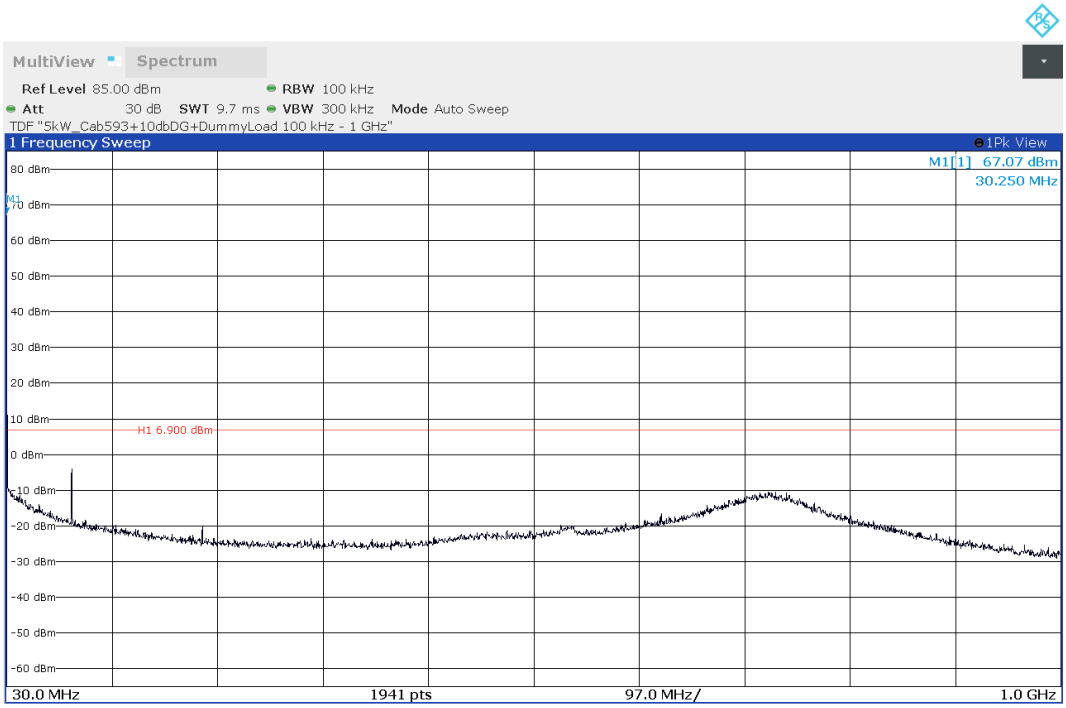
2.1.13 Set-up 1, Op. 4, 30 MHz – 1 GHz



2.1.14 Set-up 1, Op. 5, 30 MHz – 1 GHz

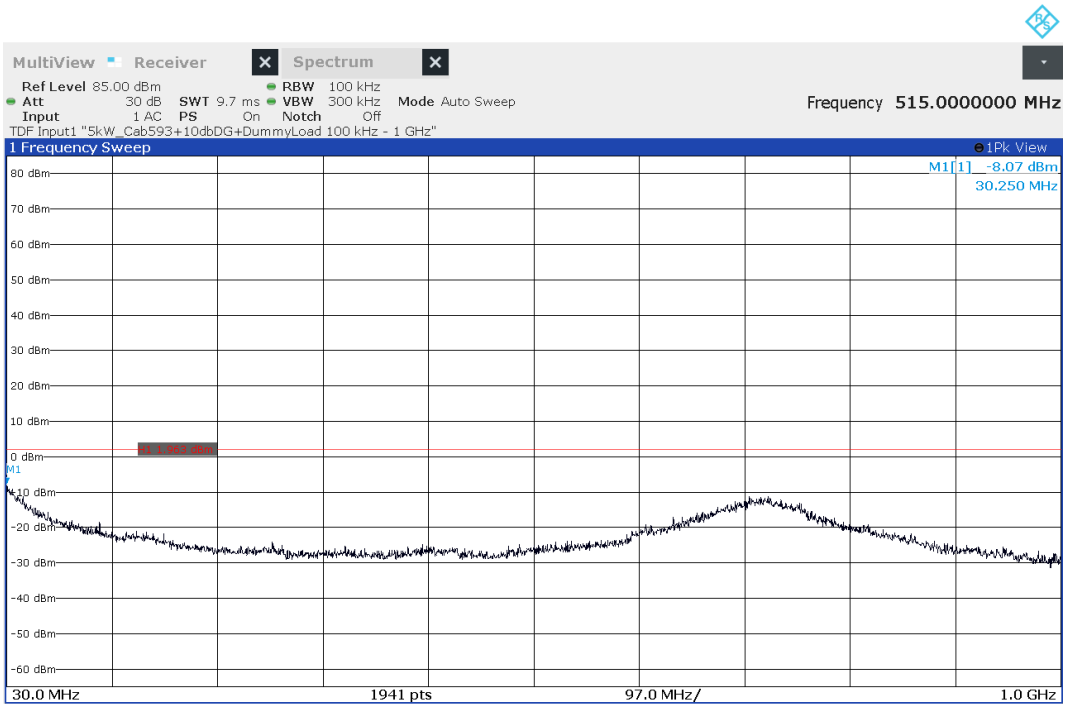


2.1.15 Set-up 1, Op. 6, 30 MHz – 1 GHz



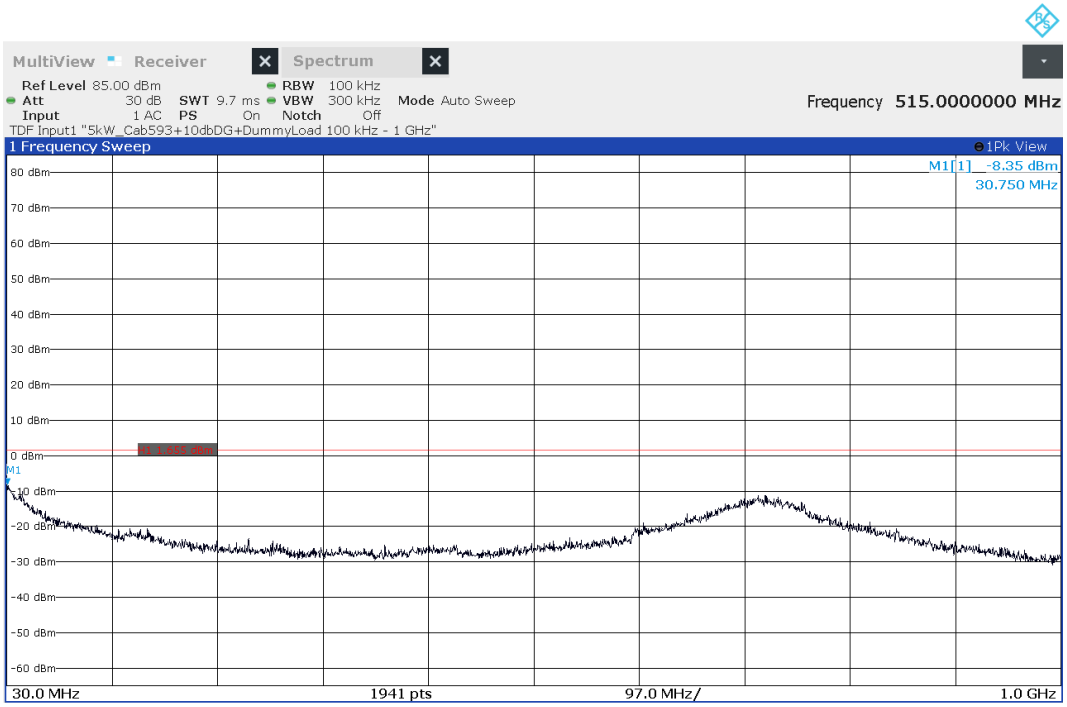
04:10:37 04/16/2025

2.1.16 Set-up 1, Op. 7, 30 MHz – 1 GHz

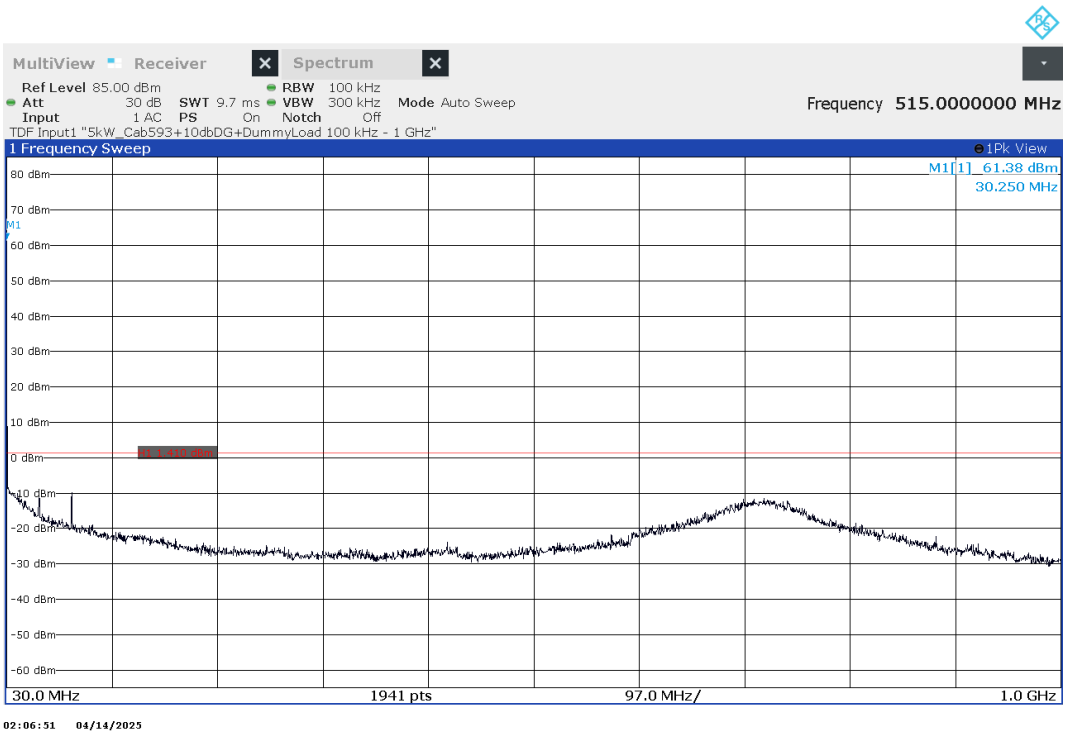


02:02:31 04/14/2025

2.1.17 Set-up 1, Op. 8, 30 MHz – 1 GHz

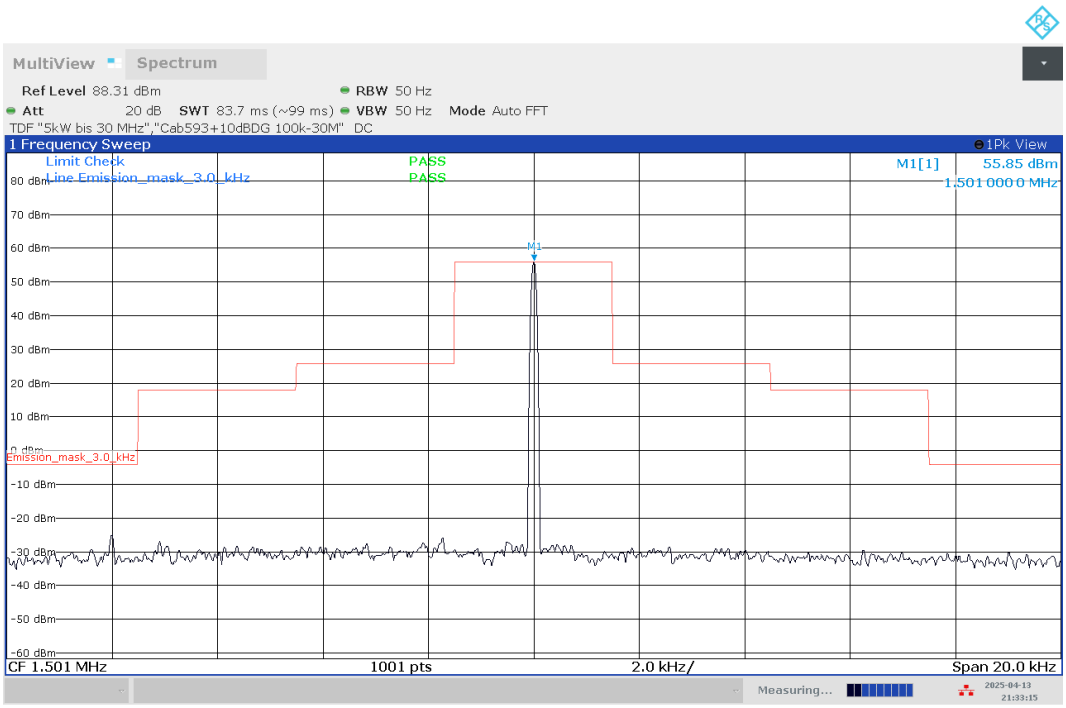


2.1.18 Set-up 1, Op. 9, 30 MHz – 1 GHz



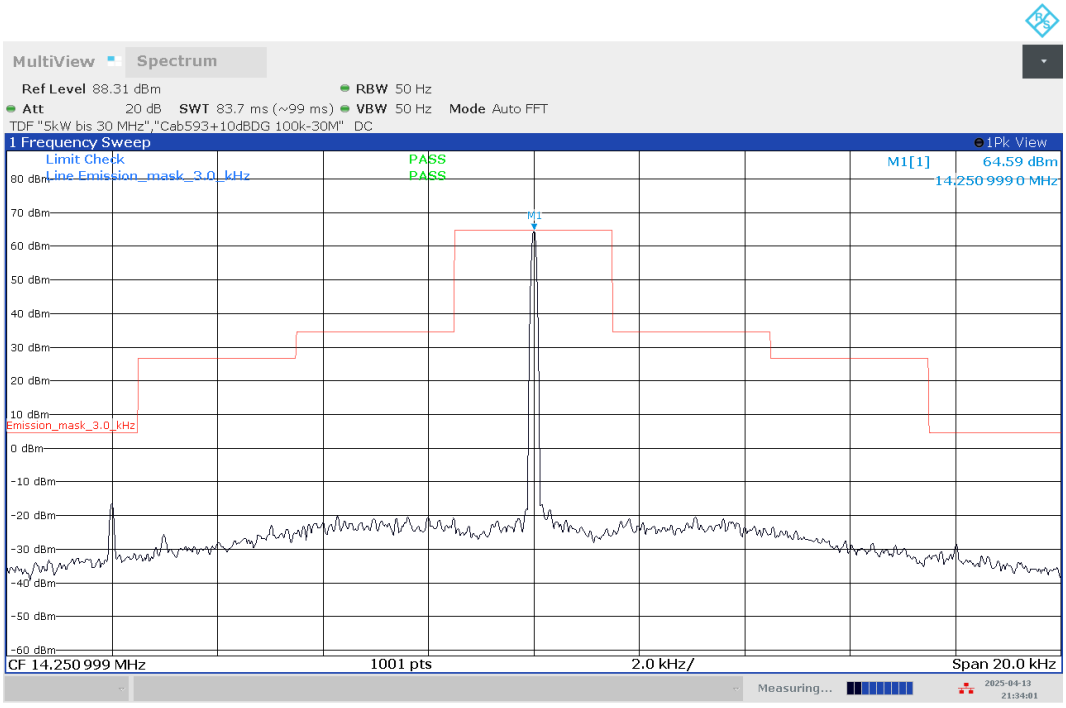
2.2 Emission Mask

2.2.1 Set-up 1, Op. 1



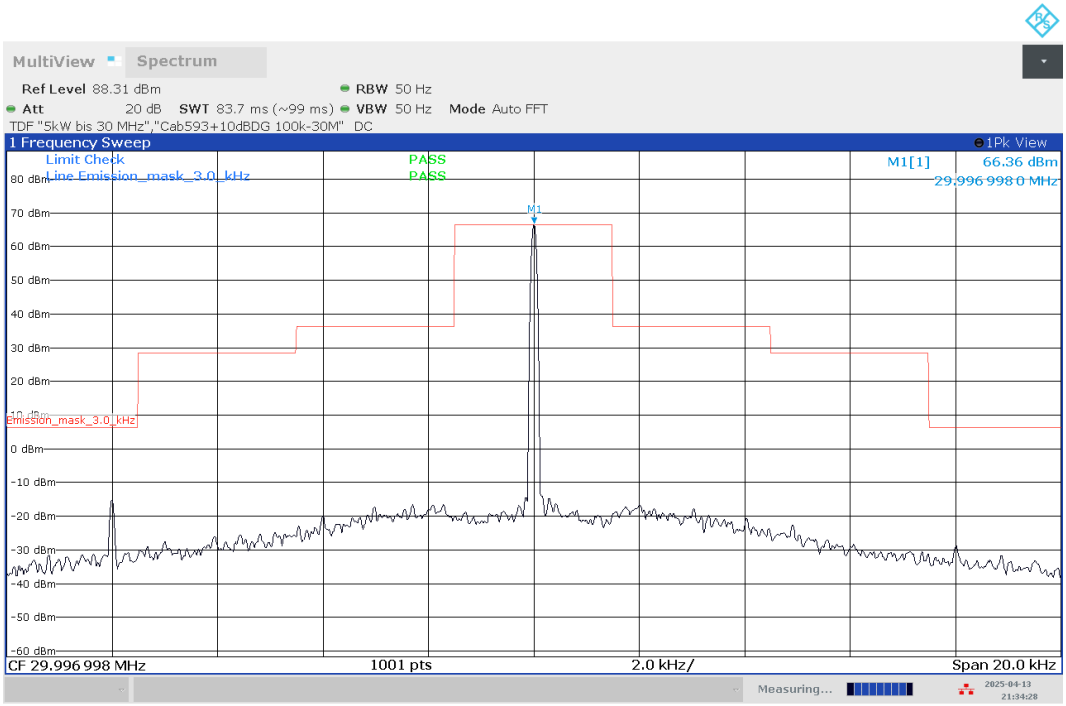
09:33:15 04/13/2025

2.2.2 Set-up 1, Op. 2



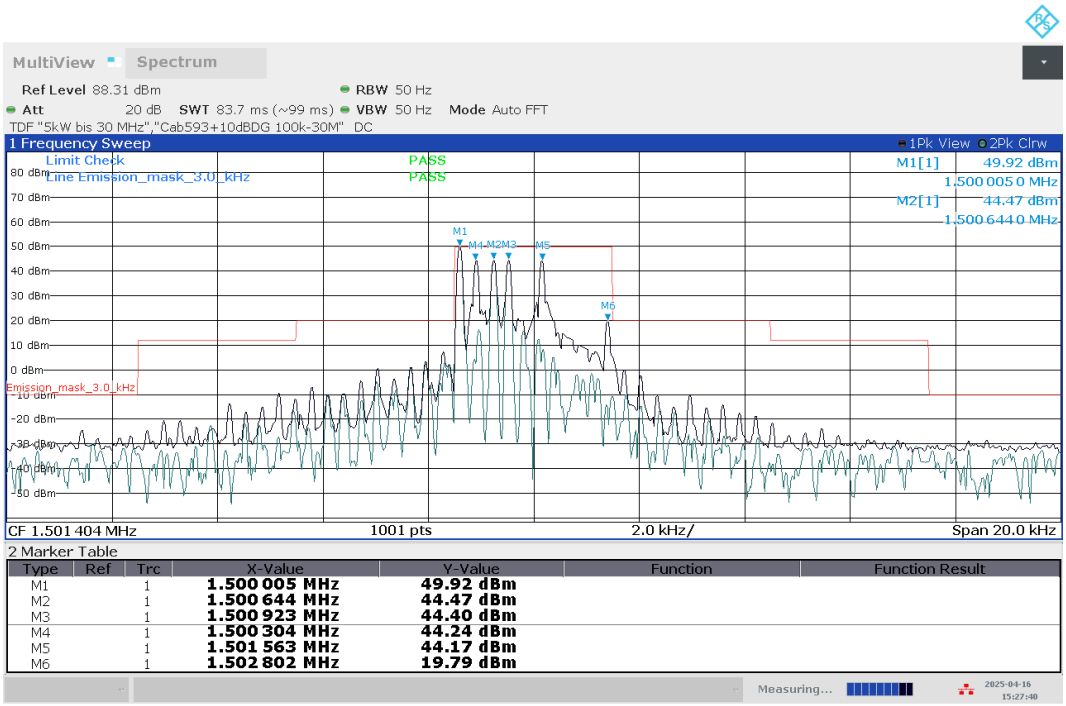
09:34:01 04/13/2025

2.2.3 Set-up 1, Op. 3



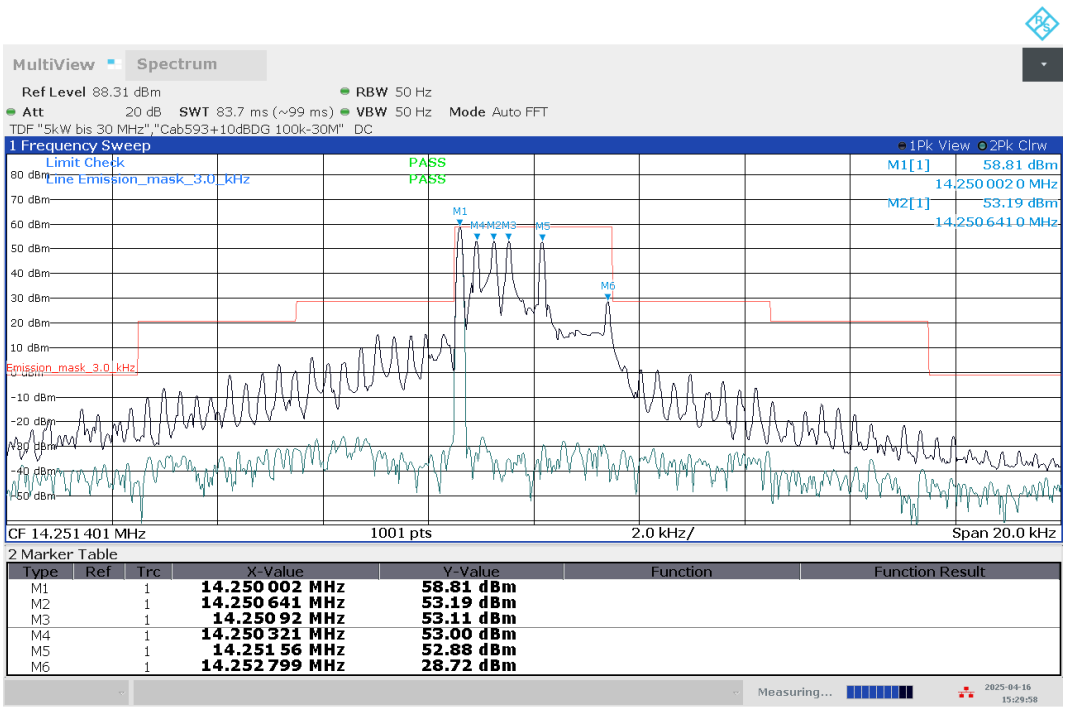
09:34:28 04/13/2025

2.2.4 Set-up 1, Op. 4



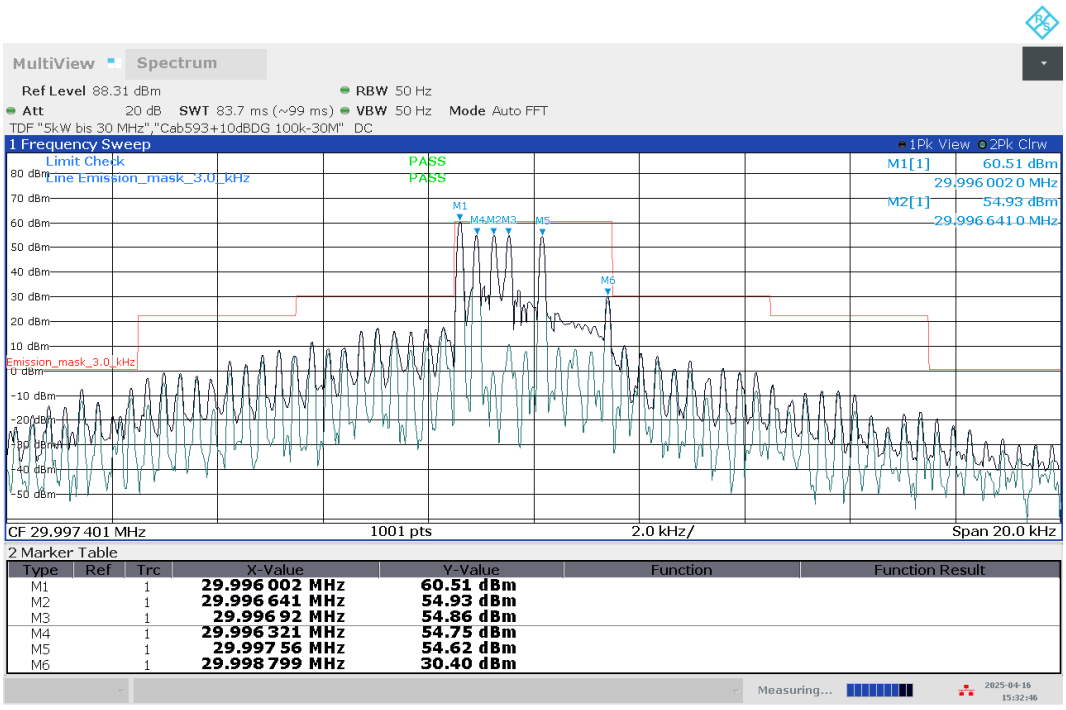
03:27:41 04/16/2025

2.2.5 Set-up 1, Op. 5



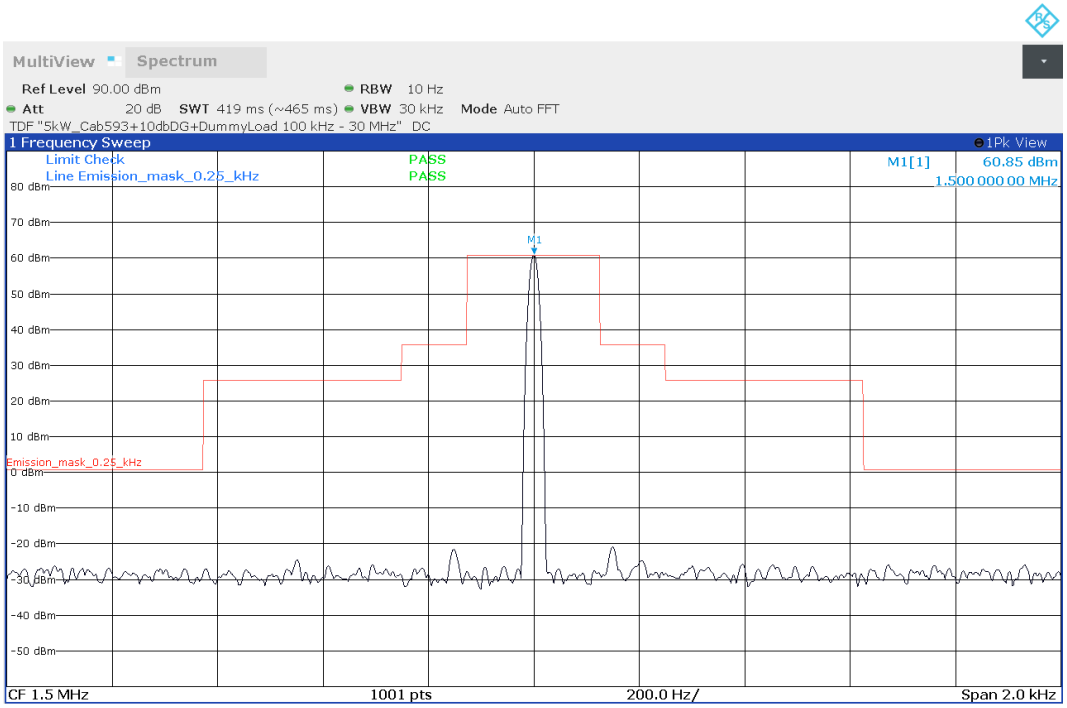
03:29:58 04/16/2025

2.2.6 Set-up 1, Op. 6

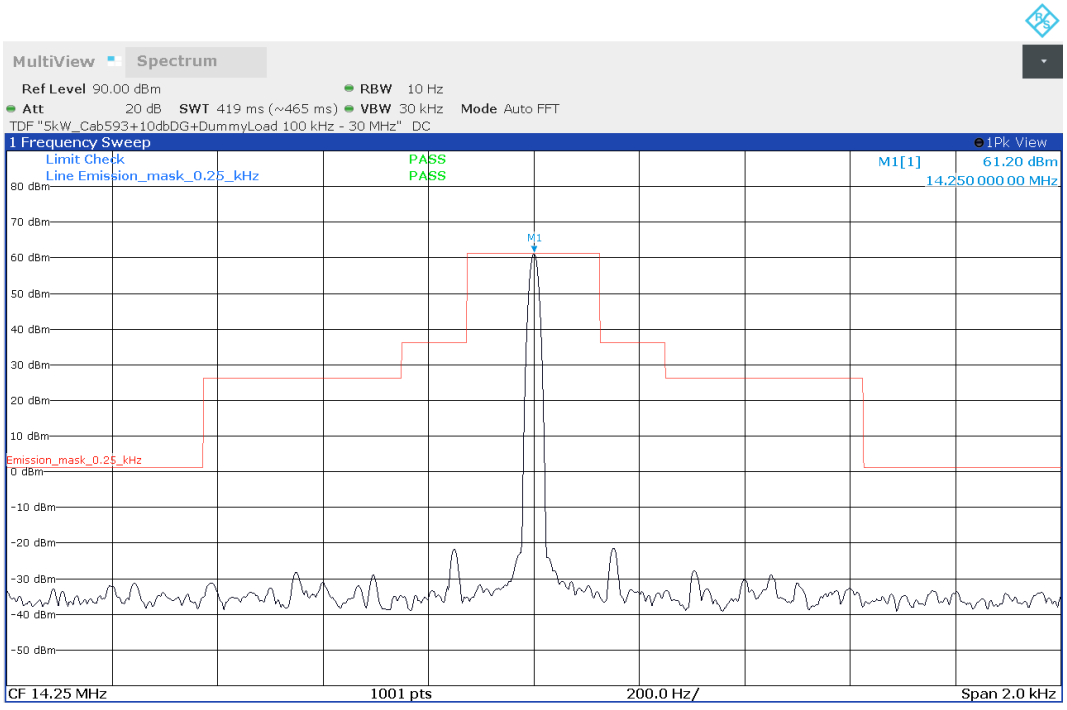


03:32:47 04/16/2025

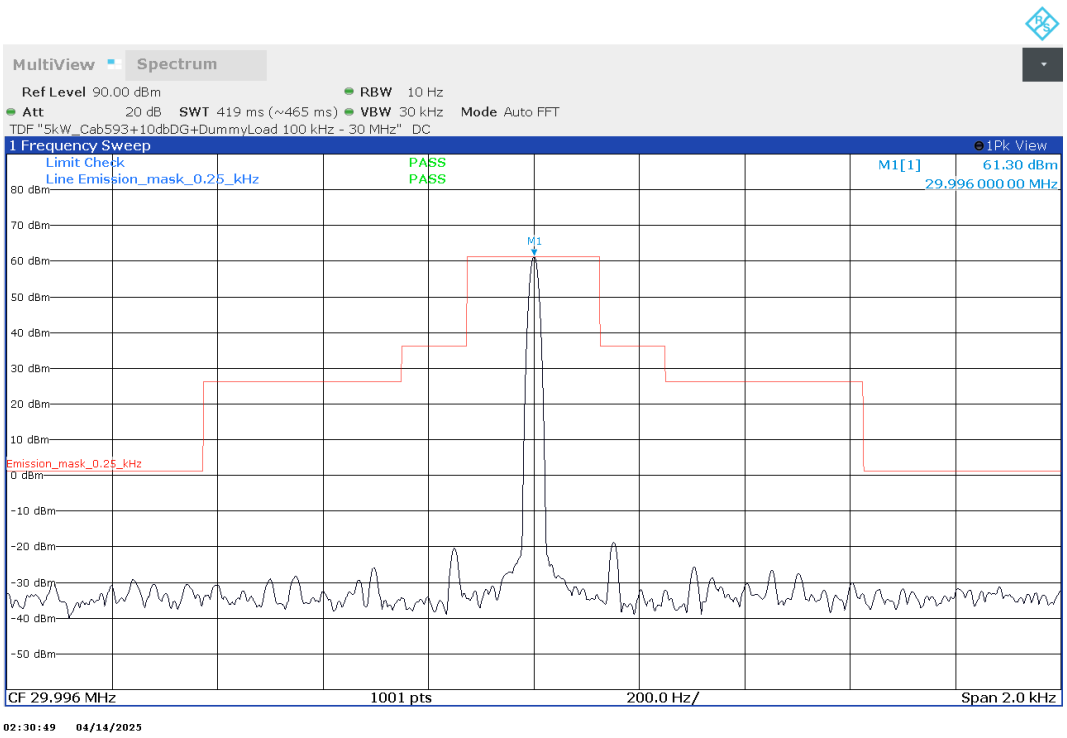
2.2.7 Set-up 1, Op. 7



2.2.8 Set-up 1, Op. 8

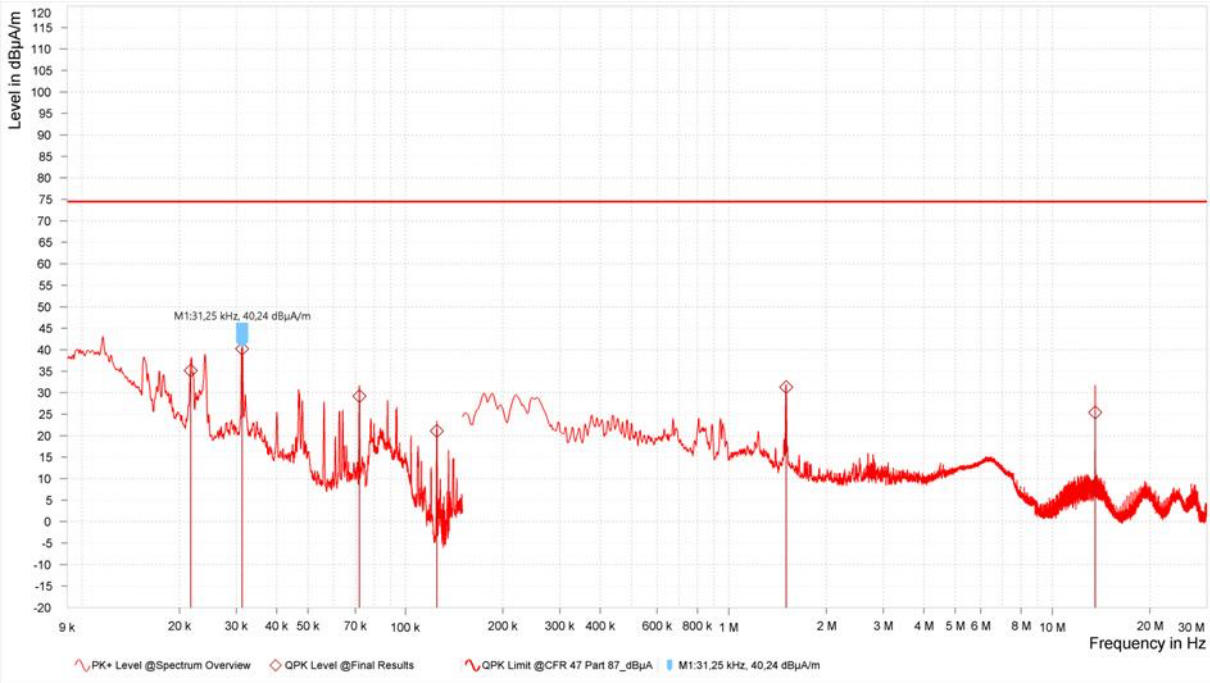


2.2.9 Set-up 1, Op. 9



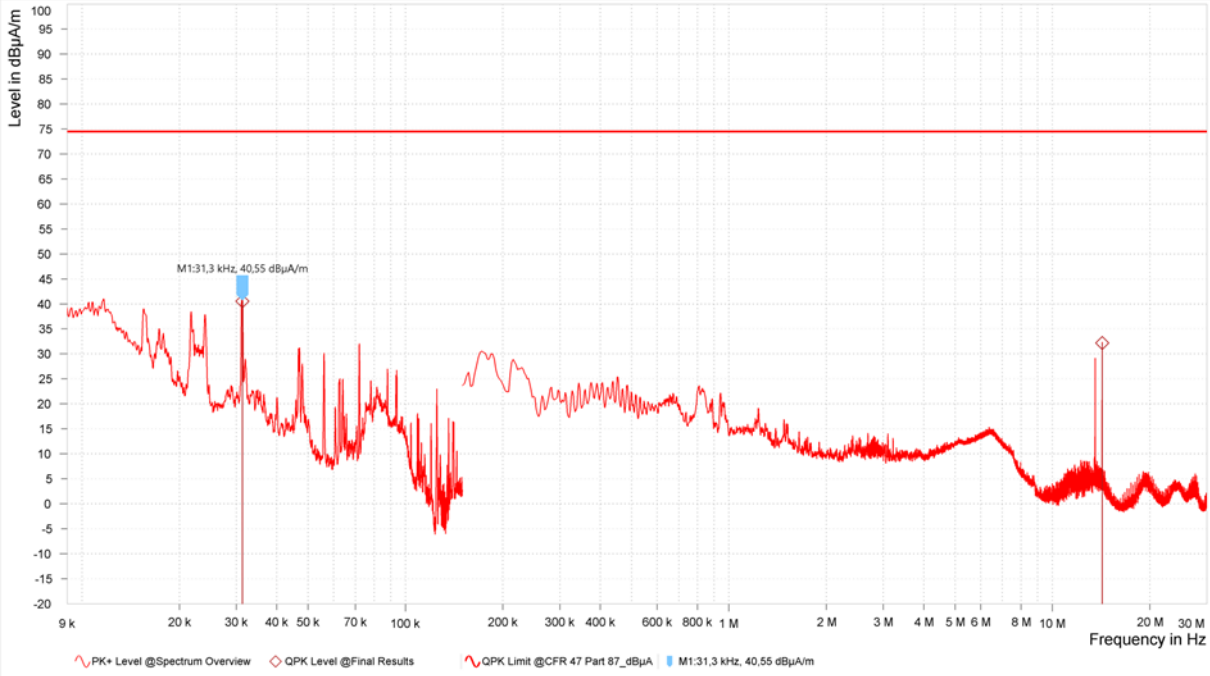
3 Field Strength of Spurious Emission, 9 kHz - 1 GHz

3.1 9 kHz to 30 MHz, FCC Part 87_J3E_1.5MHz_2kW



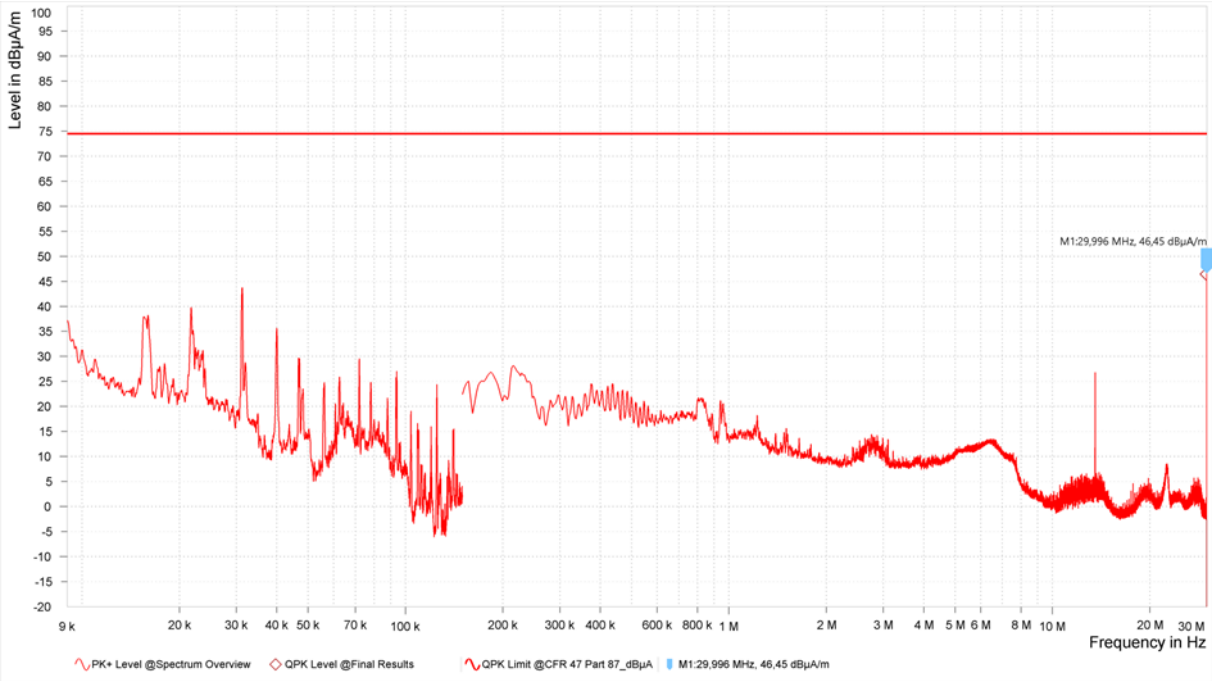
Rg	Frequency [MHz]	QPK Level [dBµA/m]	QPK Limit [dBµA/m]	QPK Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Meas. Time [s]
1	0,022	35,17	74,50	39,33	-14,58	V	10,4	1,00	0,200	15,000
1	0,031	40,24	74,50	34,26	-13,54	V	112,6	1,00	0,200	15,000
1	0,072	29,22	74,50	45,28	-13,82	V	261,5	1,00	0,200	15,000
1	0,125	21,10	74,50	53,40	-13,83	V	116,4	1,00	0,200	15,000
2	1,502	31,28	74,50	43,22	-13,90	V	245,3	1,00	9,000	15,000
2	13,560	25,41	74,50	49,09	-13,68	V	282,3	1,00	9,000	15,000

3.2 9 kHz to 30 MHz, FCC Part 87_J3E_14.25MHz_2kW



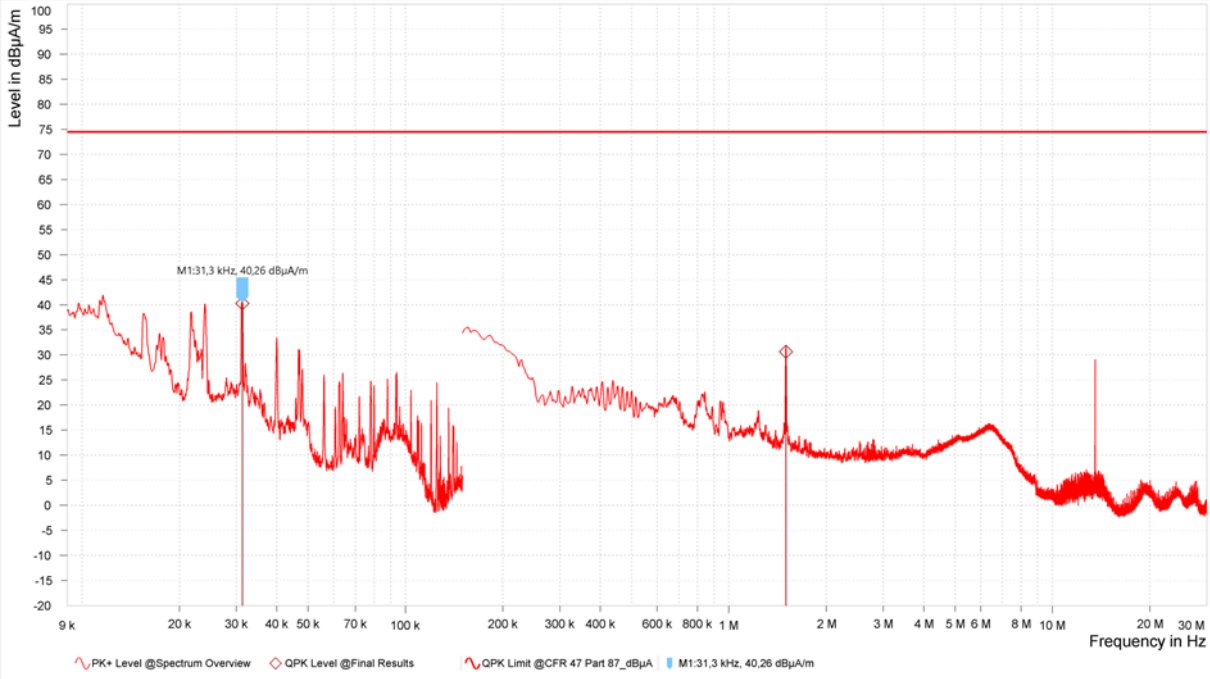
Rg	Frequency [MHz]	QPK Level [dBµA/m]	QPK Limit [dBµA/m]	QPK Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Meas. Time [s]
1	0,031	40,55	74,50	33,95	-13,54	V	107,2	1,00	0,200	15,000
2	14,251	32,18	74,50	42,32	-13,68	V	51,5	1,00	9,000	15,000

3.3 9 kHz to 30 MHz, FCC Part 87_J3E_29.996 MHz_5kW



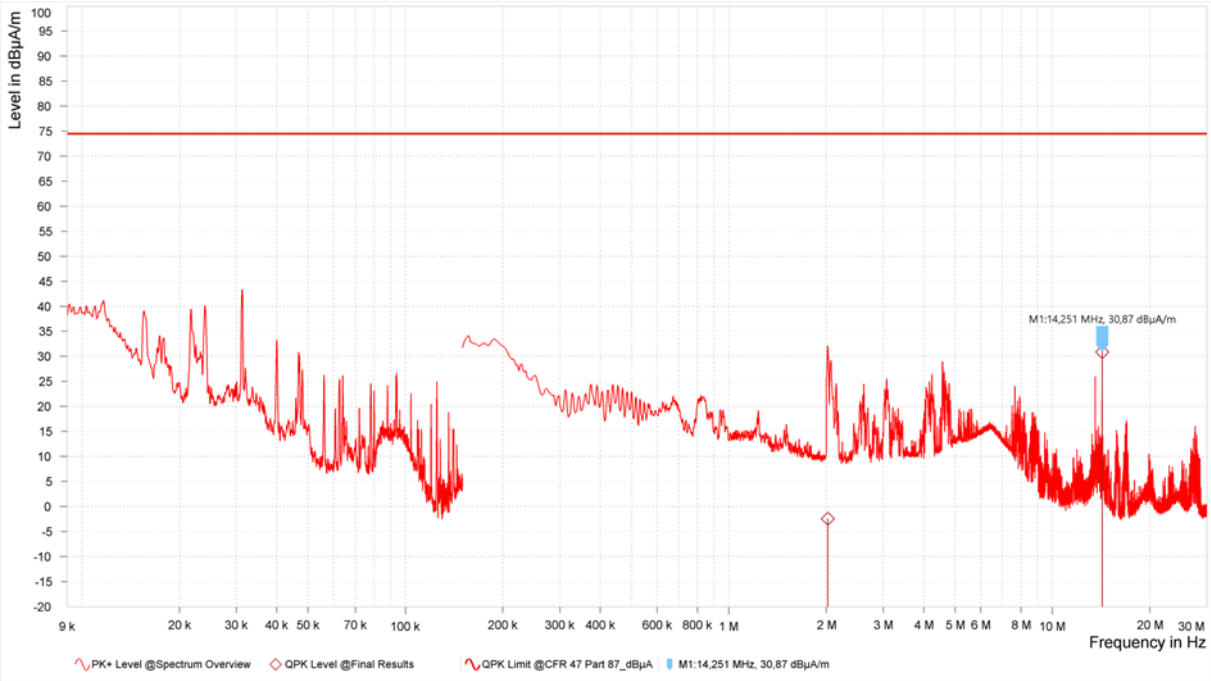
Rg	Frequency [MHz]	QPK Level [dBµA/m]	QPK Limit [dBµA/m]	QPK Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Meas. Time [s]
2	29,996	46,45	74,50	28,05	-13,42	V	198	1,00	9,000	15,000

3.4 9 kHz to 30 MHz, FCC Part 87_H2B_1.5 MHz_ 2 kW



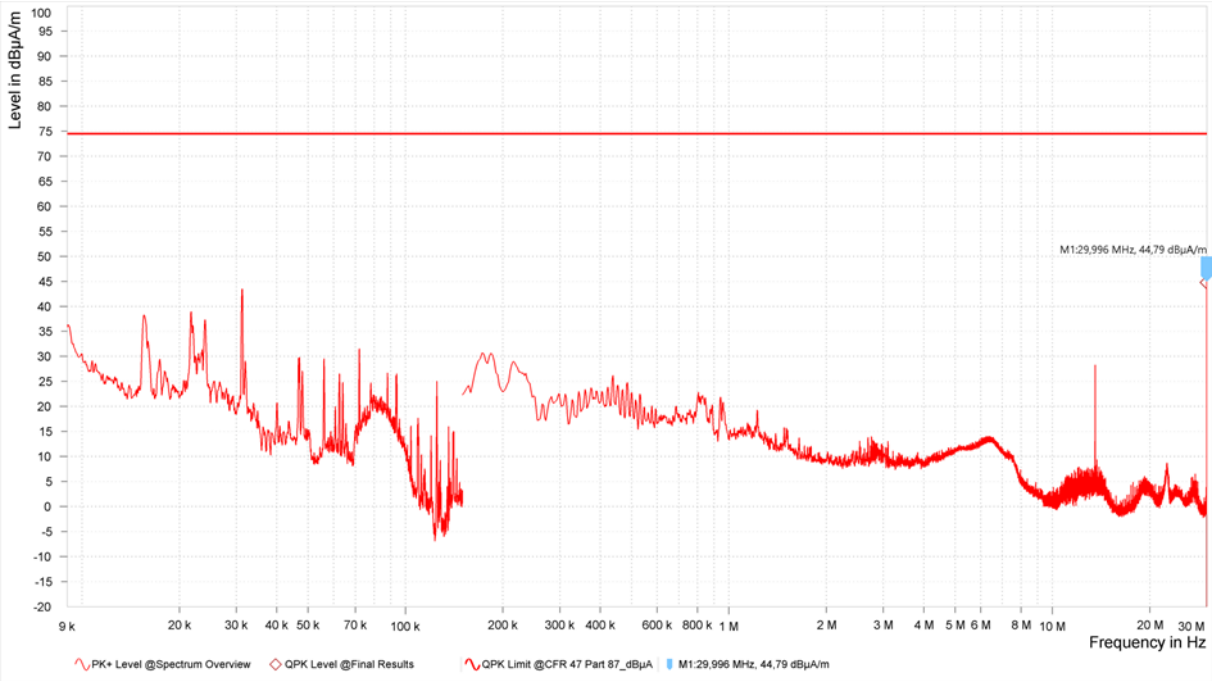
Rg	Frequency [MHz]	QPK Level [dBµA/m]	QPK Limit [dBµA/m]	QPK Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Meas. Time [s]
1	0,031	40,26	74,50	34,24	-13,54	V	103,1	1,00	0,200	15,000
2	1,500	30,63	74,50	43,87	-13,90	V	236,3	1,00	9,000	15,000

3.5 9 kHz to 30 MHz, FCC Part 87_H2B_14.25 MHz_2 kW



Rg	Frequency [MHz]	QPK Level [dBµA/m]	QPK Limit [dBµA/m]	QPK Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Meas. Time [s]
2	2,020	-2,44	74,50	76,94	-13,91	H	96,8	1,00	9,000	15,000
2	14,251	30,87	74,50	43,63	-13,68	V	47,2	1,00	9,000	15,000

3.6 9 kHz to 30 MHz, FCC Part 87_H2B_29.996 MHz_5 kW



Rg	Frequency [MHz]	QPK Level [dBµA/m]	QPK Limit [dBµA/m]	QPK Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Meas. Time [s]
2	29,996	44,79	74,50	29,71	-13,42	V	197,3	1,00	9,000	15,000