Deutsche Akkreditierungsstelle
D-PL-21375-01-02
D-PL-21375-01-03

Bundesnetzagentur
BNetzA-CAB-21/21-21

INGENIEURBÜRO LENHARDT

Test Report

Test report no.: 23109361-36010-0
Date of issue: 2024-03-13

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

Applicant
Balluff GmbH

Manufacturer
Balluff GmbH

Test Item
BF-SRS01 | BAV MA-OD-00033-01

Radio Frequency Testing according to:

Title 47
FCC Regulations Subpart 15C
§15.247

ISED-Regulations
RSS-Gen, Issue 5
RSS-247, Issue 3

Tested by (name, function, signature)	*Piotr Sardyko* *Lab Manager RF*	signature
Approved by (name, function, signature)	*Andreas Bender* *Deputy Managing Director*	signature

Applicant and Test item details

Applicant	Balluff GmbH Schurwaldstrasse 9 73765 Neuhausen a.d.F. Germany
Manufacturer	Balluff GmbH Schurwaldstrasse 9 73765 Neuhausen a.d.F. Germany
Test item description	Optic radio sensor
Model/Type reference	BF-SRS01 | BAV MA-OD-00033-01

FCC ID	2AGZY-BFSRS01
IC	20739-BFSRS01

Disclaimer and Notes

The content of this rest report relates to the mentioned test sample(s) only.
Without a written permit of IBL-Lab GmbH, this test report shall not be reproduced, except in full.

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: Binary Statement for Simple Acceptance Rule according ILAC-G8:09/2019

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2 GENERAL INFORMATION

2.1 Administrative details

Testing laboratory	**IBL-Lab GmbH** Heinrich-Hertz-Allee 7 66386 Sankt Ingbert / Germany Fon: +49 6894 38938-0 Fax: +49 6894 38938-99 URL: www.ib-lenhardt.de E-Mail: info@ib-lenhardt.de
Accreditation	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: • Electronics, EMC, Radio D-PL-21375-01-01 • Electromagnetic Compatibility and Telecommunication (FCC requirements) D-PL-21375-01-02 Testing Laboratory Designation Number DE0024 • Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards D-PL-21375-01-03 ISED Company Number 27156 Testing Laboratory CAB Identifier DE0020 Website DAkkS: https://www.dakks.de/ The Deutsche Akkreditierungsstelle GmbH (DAkkS) is also a signatory to the ILAC Mutual Recognition Arrangement
Date of receipt of test samples	2024-02-07
Start – End of tests	2024-02-07 – 2024-03-13

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:	23109361-36010-0_Annex A
EUT photographs:	23109361-36010-0_Annex B
Test setup photographs:	23109361-36010-0_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)

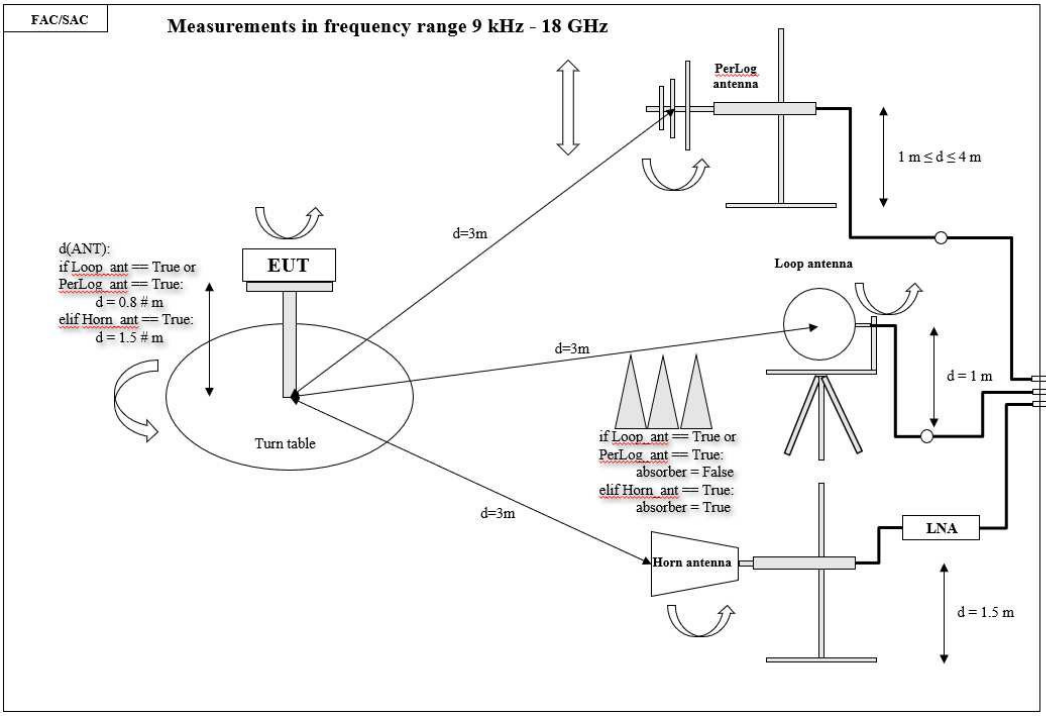
All units are dB-units, positive margin means value is below limit.

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:



3 ENVIRONMENTAL & TEST CONDITIONS

3.1 Environmental conditions

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

4 TEST STANDARDS AND REFERENCES

Test standard (accredited)	
FCC CFR Title 47 Part 15 Subpart C:2016	---
RSS-247 Issue 3	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen Issue 5	General Requirements for Compliance of Radio Apparatus
ANSI C63.10: 2013	---

Test standard (not accredited)
None

Reference	**Description**
none	---

5 EQUIPMENT UNDER TEST (EUT)

5.1 Product Description*

The sensor wirelessly transmits distance data via LoRaWAN to a nearby gateway. This data is usually then forwarded over a network to a LoRaWAN network server, where it is processed further. When the sensor is used in conjunction with the Smart Reordering System, the data is forwarded to the Smart Reordering application where it is used for automatic fill level monitoring. The ToF sensor has a viewing range of 40 to 4000 mm and an exit angle of 27 . Depending on the distance to the respective object, this results in a corresponding area (ToF window) that can be monitored.

*: declared by the applicant

5.2 Technical Data of Equipment*

TX Frequency band:	[Tx and Rx: 865-868, 868-868.6] MHz
Number of channels:	8 Tx channels: 903.9 MHz, 904.1 MHz, 904.3 MHz, 904.5 MHz, 904.7 MHz, 904.9 MHz, 905.1 MHz, 905.3 MHz 9 Rx channels: 923.3 MHz, 923.9 MHz, 924.5 MHz, 925.1 MHz, 925.7 MHz, 926.3 MHz, 926.9 MHz, 927.5 MHz, 923.3 MHz (RX2)
Channel bandwidth:	500 kHz
Channel tested:	f_{low}: 903.9 MHz, f_{mid}: 904.7 MHz, f_{high}: 905.3 MHz
Spectrum Access Mechanism:	CSS (Chirp spread- spectrum technology)
Modulation type:	LoRa
Adaptive Frequency Agility:	No
DSSS or FHSS techniques:	No
RF mode:	TX/RX
Antenna Type:	Internal, one
Antenna connector:	None
Equipment type:	Production model
Temperature range:	Tmin: -20 C, Tmax: 55 C
Type of power source:	3 V lithium battery
Test source voltage:	Vnom: 3 VDC

*: declared by the applicant

5.3 Test Item (Equipment Under Test) Description*

Short designation	EUT Model	EUT Description	Serial number / designation	Hardware status	Software status
EUT A	BF-SRS01 (conducted sample)	Optic radio sensor	SRS-V2.0 #CERT-RF2 (please see photos in Annex B)	AB	V0.3.3
EUT B	BF-SRS01 (radiated sample)	Optic radio sensor	SRS-V2.0 #CERT-RF2 RF2 (please see photos in Annex B)	AB	V0.3.3

*: declared by the applicant

5.4 Auxiliary Equipment (AE) Description*

AE short designation	AE Name (if available)	AE Description	Serial number (if available)	Software (if used)

AE1	SRS AdapterBoard v1.0 with cabels	Equipment for connection of the EUTs with computer	-	-
AE2	Termit	SW for EUT control	-	3.4

*: declared by the applicant

5.5 Operating Modes Description*

EUT operating mode no.	Description of operating modes	Additional information
op. 1	f_{low}: 903.9 MHz. Tx modulated.	Modulated signal. Tx mode. SW commands: AT+TCONF=903900000:14:6:12:4/5:0:0:1:16:25000:2:3 AT+TTX=500
op. 2	f_{mid}: 904.7 MHz. Tx modulated.	Modulated signal. Tx mode. SW commands: AT+TCONF=904700000:14:6:12:4/5:0:0:1:16:25000:2:3 AT+TTX=500
op. 3	f_{high}: 905.3 MHz. Tx modulated.	Modulated signal. Tx mode. SW commands: AT+TCONF=905300000:14:6:12:4/5:0:0:1:16:25000:2:3 AT+TTX=500

*: declared by the applicant

5.6 Set-ups Description

set. 1	EUT A + AE 1 + AE 2	Conducted tests.
set. 2	EUT B + AE 1 + AE 2	Radiated tests.

*: declared by the applicant

5.7 Test conditions

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

5.8 Additional Information

Test items differences	EUT A is a radiated sample. And it was tested with internal battery. EUT B is a conducted sample (SMA connector). And it was tested with external power supply.
Additional application considerations to test a component or sub-assembly	-

6 SUMMARY OF TEST RESULTS

Test specification
FCC 15.231 / RSS-247 (Issue 3)

Section	§15.247 Spec Clause	RSS	Test Description	Set-up	Opera-ting mode	Verdict
7.1	§15.247(b)(3)	RSS-247 5.4(d)	Peak Output Power	1	1,2,3	**Pass**
7.2	§15.207(a)	RSS-Gen 8.8	Conducted Emissions	-	-	**N/A***
7.3		RSS-Gen 6.6	99% Emission Bandwidth	1	1,2,3	**Pass**
7.4	§15.247(a)(2)	RSS-247 5.2(a)	Minimum 6 dB RF Bandwidth	1	1,2,3	**Pass**
7.5	§15.247(d)	RSS-247 5.5	Out-of-Band Emissions - Conducted	1	1,2,3	**Pass**
7.6	§15.247(d)	RSS-Gen 8.9 and 8.10	Spurious Radiated Emissions	2	1	**Pass**
7.7	§15.247(e)	RSS-Gen 7.1	Power Spectral Density for Digitally Modulated Device	1	1,2,3	**Pass**
-	-	RSS-Gen 7.1	Receiver Spurious Emissions	-	-	**N/A****

Notes
* The EUT is using 3V battery for power supply ** The EUT has no receiver stand-alone mode.

Comments and observations
None

7 TEST RESULTS

7.1 Peak output power

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

Radiated: R3

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 15 Subpart C §15.247(b)(3) and RSS-247 5.4(d):

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

Results

Set./ Op.	Peak output power, [dBm]	Limit Peak, [dBm]	Margin [dB]	Verdict
Set.1, Op. 1	-5.85	30	35.85	Pass
Set.1, Op. 2	-5.90	30	35.90	Pass
Set.1, Op. 3	-5.93	30	35.93	Pass

* Please see measurement plots in Annex A.

7.2 99% Emission Bandwidth

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

Radiated: R3

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.

Measurement information

RSS-Gen Clause 6.6:
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, [GHz]	F_{high} 99 % OBW, [GHz]	99 % OBW, [kHz]	Verdict
Set.1, Op. 1	903.64547	904.15156	506.09	Pass
Set.1, Op. 2	904.44453	904.95214	507.61	Pass
Set.1, Op. 3	905.0454	905.55232	506.92	Pass

* Please see measurement plots in Annex A.

7.3 Minimum 6 dB RF Bandwidth

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

Radiated: R3

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.

Measurement information

Part 15 Subpart C §15.247(d) and RSS-247 5.5:
(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Results

Set./ Op.	F_{low} 6 dB OBW, [GHz]	F_{high} 6 dB OBW, [GHz]	6 dB OBW, [kHz]	Verdict
Set.1, Op. 1	903.579	904.224	645	Pass
Set.1, Op. 2	904.373	905.024	651	Pass
Set.1, Op. 3	904.976	905.621	645	Pass

* Please see measurement plots in Annex A.

7.4 Out-of-Band Emissions - Conducted

Test equipment (Please see Chapter 8 for exact information of test equipment)
Radiated: R3
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.
Measurement information Part 15 Subpart C §15.247(a)(2) and RSS-247 5.2(a): (2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.
Results: please see measurement plots in annex A
Verdict: Pass

7.5 Radiated field strength measurements

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 software R&S EMC 32 V11.00.
Radiated: A1, C1, R1, SW2
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 software R&S EMC 32 V11.00.
Radiated: A2, C1, R1, SW2
Frequency range 1 GHz – 18 GHz
Measurement in a fully anechoic 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 directly with spectrum analyzer.
Radiated: A3, Amp2, Amp3, C1, R1, F2, F3, SW2
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. RBW for frequency range 1 GHz- 5 GHz: 1 MHz. See photos in Annex C for test Set-up and block diagram in Chapter 2.9.
Limits Part 15 Subpart C §15.247(d) and RSS-Gen 8.9 and 8.10: (d) 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)).
Results: please see measurement plots in annex A
Verdict: Pass

7.6 POWER SPECTRAL DENSITY

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

Radiated: R3

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

(e) 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.

Results

Set./ Op.	Peak output power, [dBm]	Limit Peak, [dBm]	Margin [dB]	Verdict
Set.1, Op. 1	-10.19	8	-18.19	Pass
Set.1, Op. 2	-10.24	8	-18.24	Pass
Set.1, Op. 3	-8.17	8	-16.17	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	2023-05-05	2026-05-05
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	SAC5	Albatross Projects GmbH	20168.PRB	LAB000235	2022-01-31	2025-01-31
2.	Climatic chamber	T-65/50	CTS GmbH	204002	LAB000110	2023-05-11	2024-05-11
3.	Shielding Cover	CMU-Z11	Rohde & Schwarz	100876	LAB000039	-	-
4.	Climatic chamber	T-70/350	CTS GmbH	194027	LAB000066	2023-06-30	2024-06-30
5.	Shielded room	Sputnik 1 (Schirmkabine)	Albatross Projects GmbH	-	LAB000257	-	-
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	2023-04-13	2024-04-13
2.	Harmonic Mixer	FS-Z75	Rohde & Schwarz	102015	LAB000112	2023-05-03	2024-05-03
3.	Harmonic Mixer	FS-Z90	Rohde & Schwarz	102020	LAB000113	2023-04-06	2024-04-06
4.	Harmonic Mixer	FS-Z110	Rohde & Schwarz	102000	LAB000114	2023-05-02	2024-05-02
5.	Harmonic Mixer	FS-Z170	Rohde & Schwarz	100996	LAB000126	2023-04-26	2024-04-26
6.	Harmonic Mixer	FS-Z220	Rohde & Schwarz	101039	LAB000116	2023-04-16	2024-04-06
7.	Harmonic Mixer	FS-Z325	Rohde & Schwarz	101015	LAB000117	2023-04-11	2024-04-11
LISN (L):							
1.	Two-line V-Network	ENV216	Rohde & Schwarz	102597	LAB000220	-	2024-09-07
2.	Two-line V-Network	ENV216	Rohde & Schwarz	102598	LAB000217	2023-06-01	2024-06-01
Multimeters (M):							
1.	Multimeter	U1242B	Keysight	MY59240021	LAB000187	2022-06-20	2024-06-20
2.	Multimeter	U1242B	Keysight	MY59160026	LAB000018	2023-09-20	2024-09-20
Multipliers (Mp):							
1.	Multiplier	SMZ75	Rohde & Schwarz	101307	-	2018-03-15	-
2.	Multiplier	SMZ110	Rohde & Schwarz	100001	-	2020-05-09	-
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	2023-05-10	2024-05-10
2.	Power meter	NRP110T	Rohde & Schwarz	101151	LAB000119	2023-06-05	2024-06-05
Receivers and Spectrumanalyzers (R):							
1.	Test Receiver, SAC5	ESW-26	Rohde & Schwarz	101517	LAB000363	2024-01-22	2025-01-22
2.	Test Receiver	ESW-26	Rohde & Schwarz	101481	LAB000236	-	-
3.	Spectrum Analyzer 1 Hz – 50 GHz	FSW-50	Rohde & Schwarz	101450	LAB000111	2023-07-26	2024-07-26
4.	Spectrum Analyzer 2 Hz – 43 GHz	FSW-43	Rohde & Schwarz	101391	LAB000289	2023-06-02	2024-06-02
Signal Generators (SG):							
1.	Signal generator 8 kHz – 50 GHz	SMA100B	Rohde & Schwarz	103838	LAB000118	2021-06-30	2024-06-30
2.	Vector Signal Generator	SMW200A	Rohde & Schwarz	109775	LAB000870	2023-10-18	2026-10-18
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

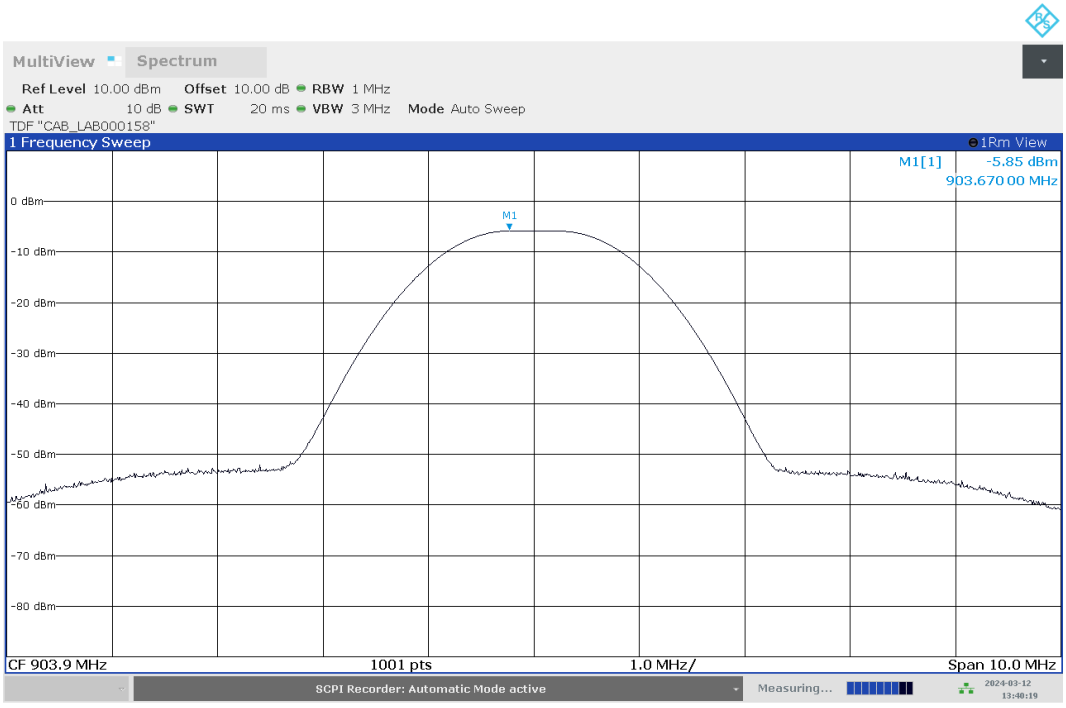
part of / in addition to

Test report no.: 23109361-36010-0

Table of contents:

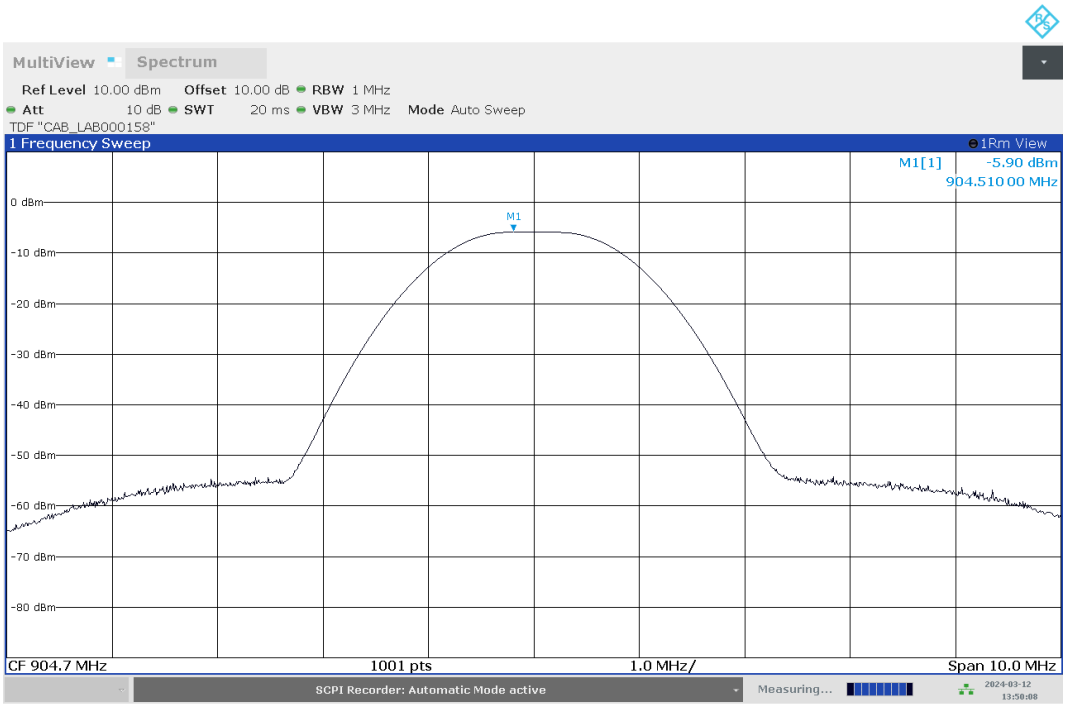
1 Fundamental field strength

1.1 Set-up 1, Op. 1



01:40:19 03/12/2024

1.2 Set-up 1, Op. 2



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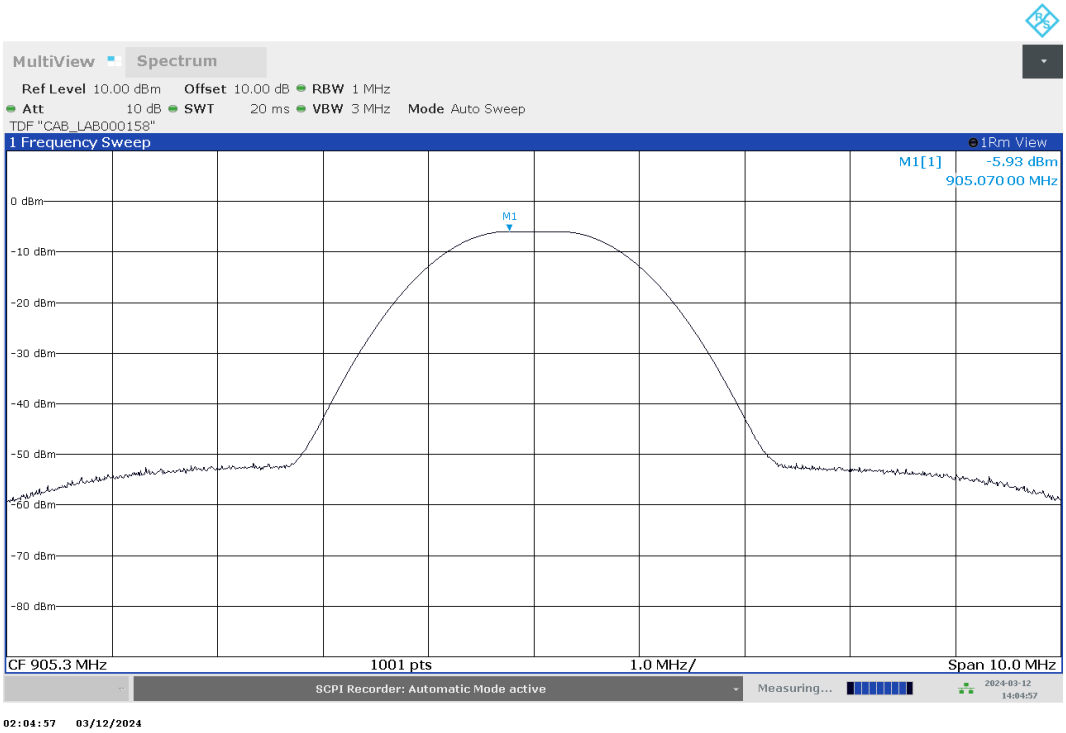
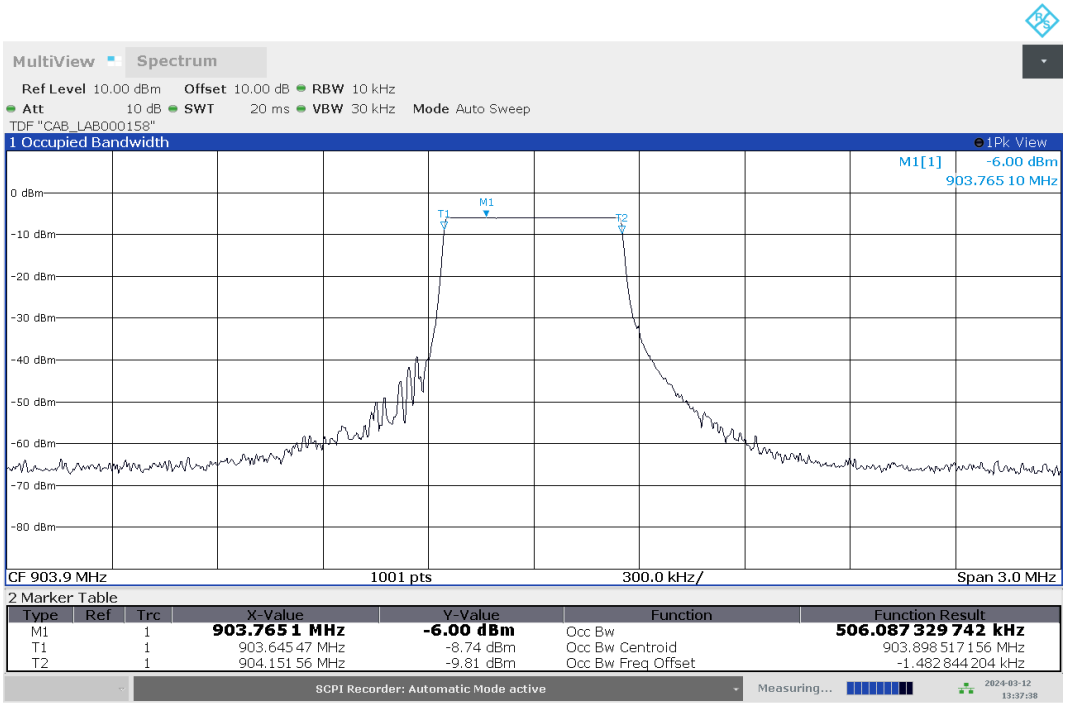
1.3 Set-up 1, Op. 3



2 99% Emission Bandwidth

2.1 Set-up 1, Op. 1



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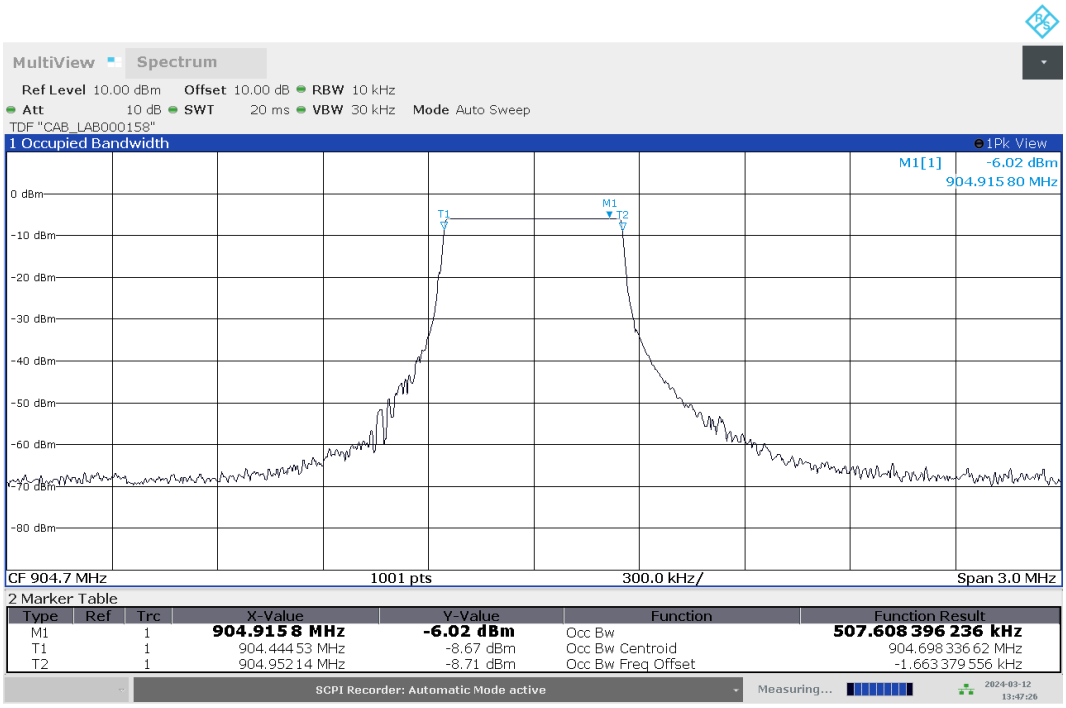
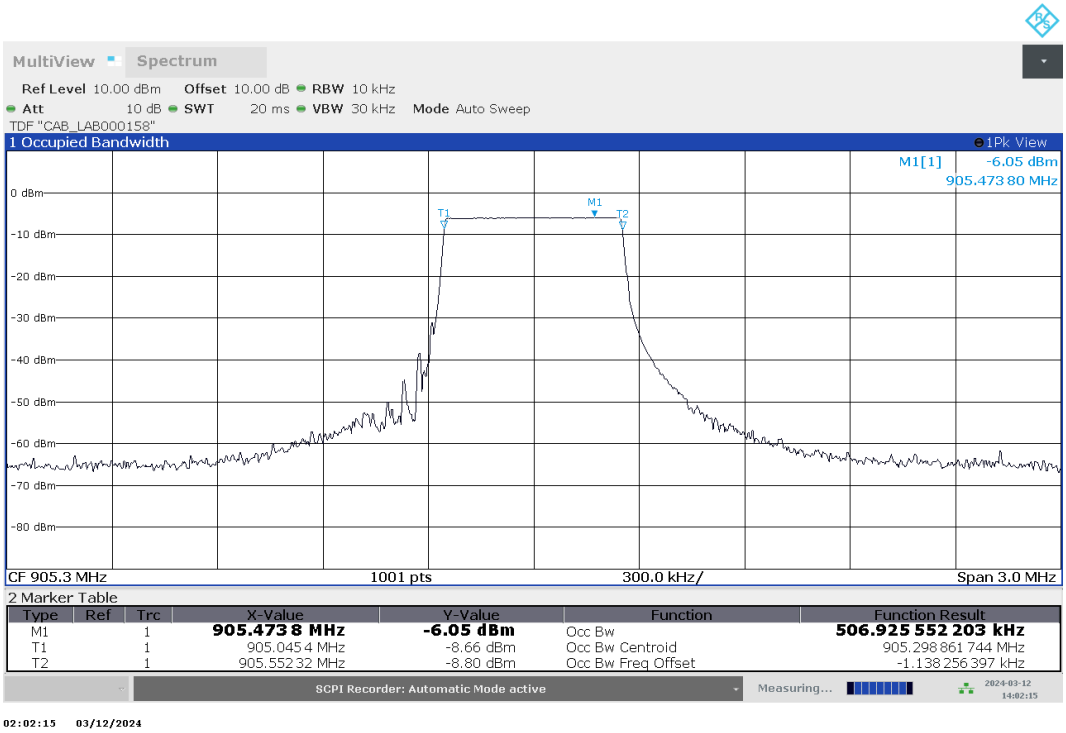
2.2 Set-up 1, Op. 2



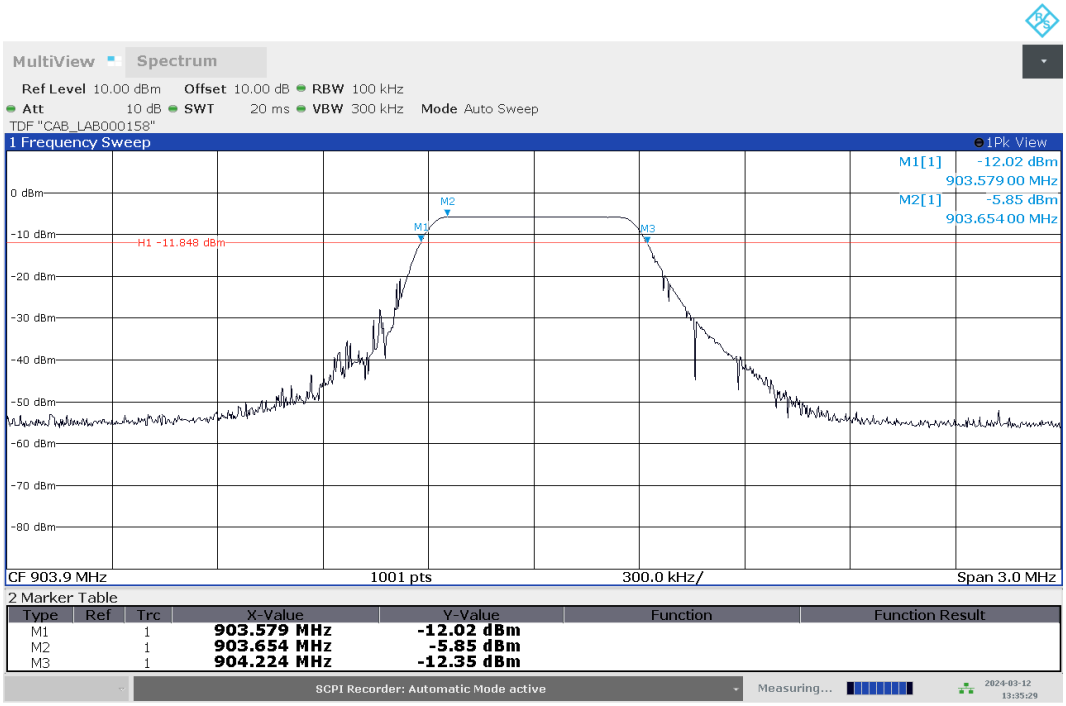
01:47:26 03/12/2024

2.3 Set-up 1, Op. 3



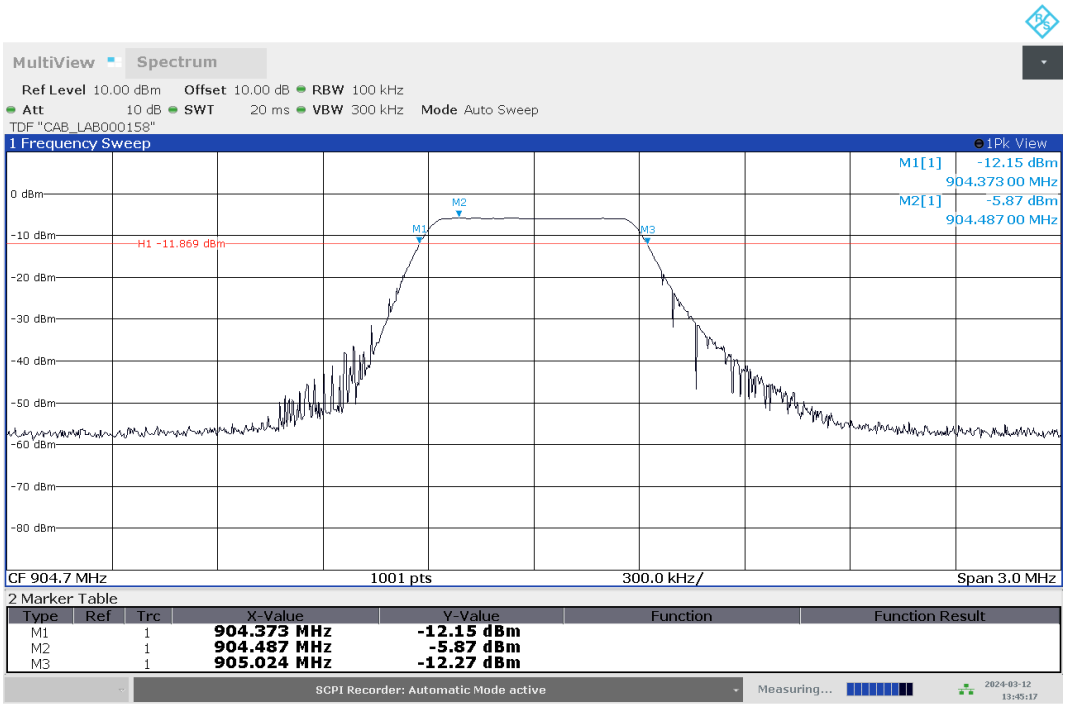
3 Minimum 6 dB RF Bandwidth

3.1 Set-up 1, Op. 1



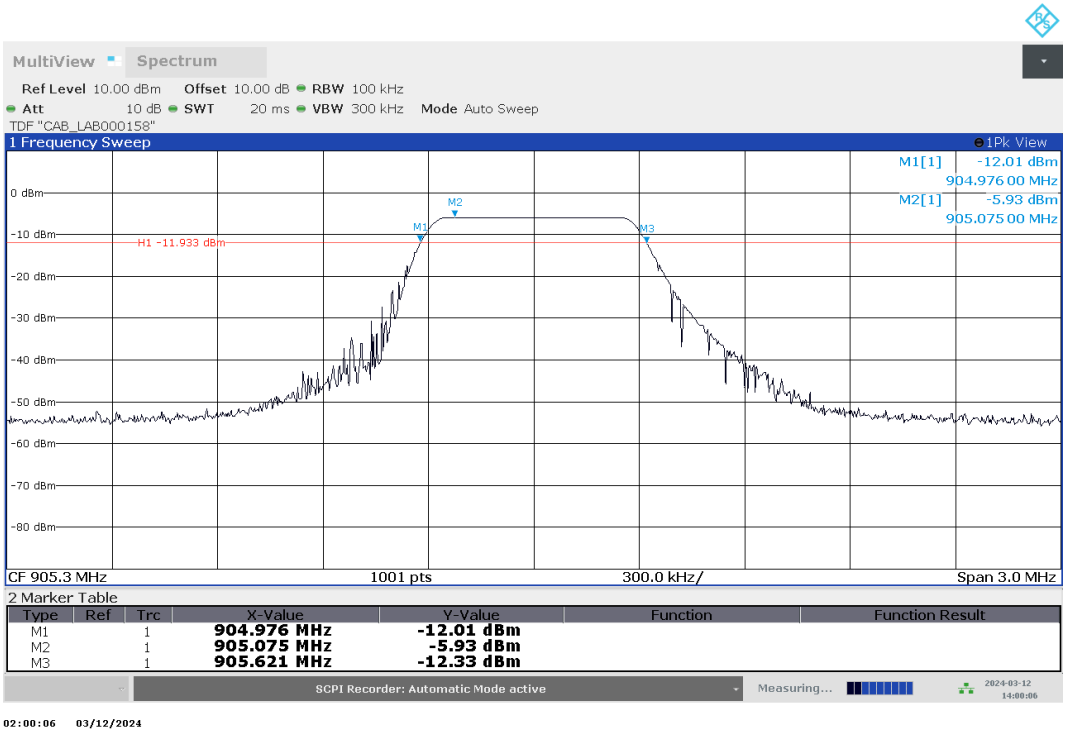
01:35:29 03/12/2024

3.2 Set-up 1, Op. 2



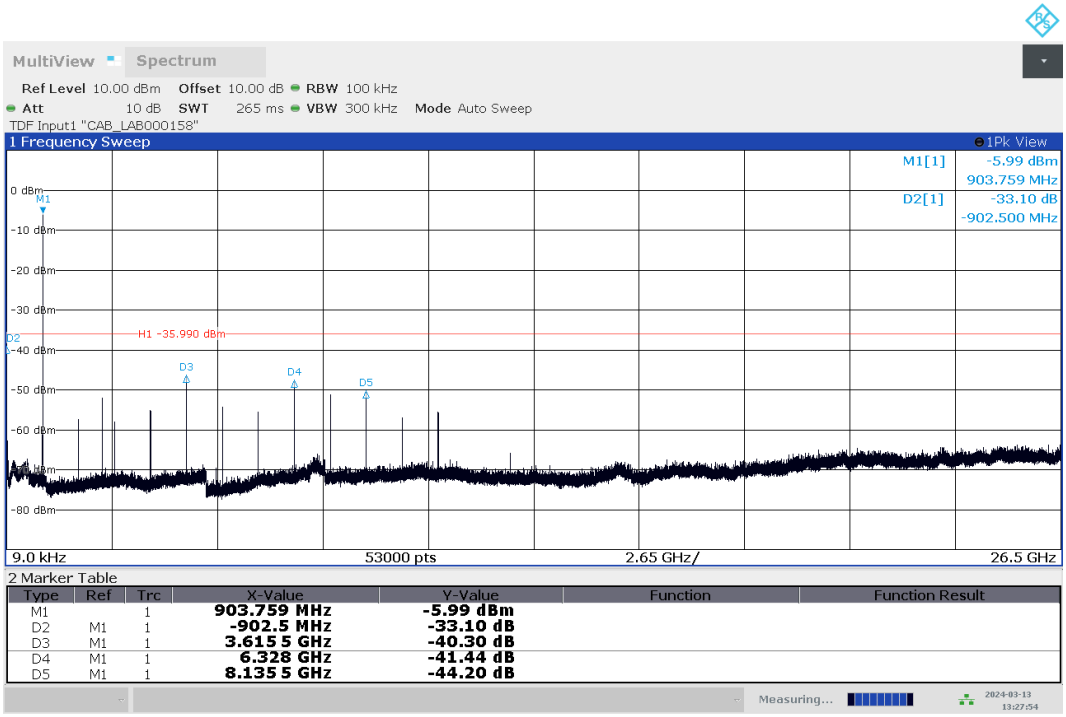
01:45:17 03/12/2024

3.3 Set-up 1, Op. 3



4 Out-of-Band Emissions - Conducted

4.1 Set-up 1, Op. 1, frequency range 9 kHz – 26.5 GHz



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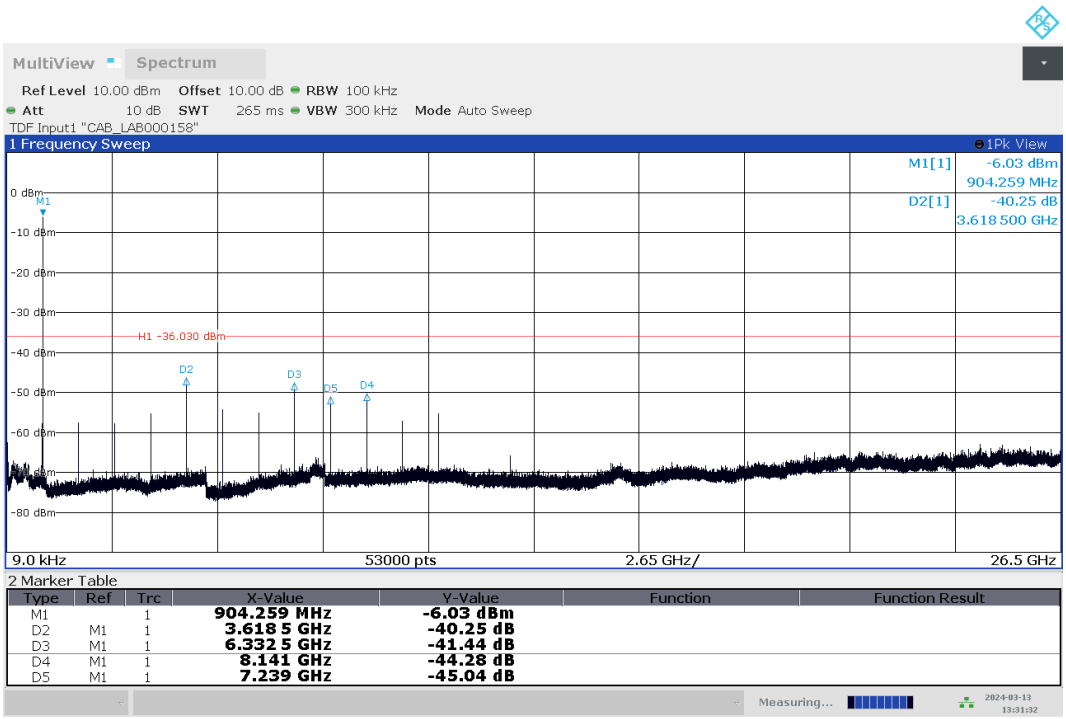
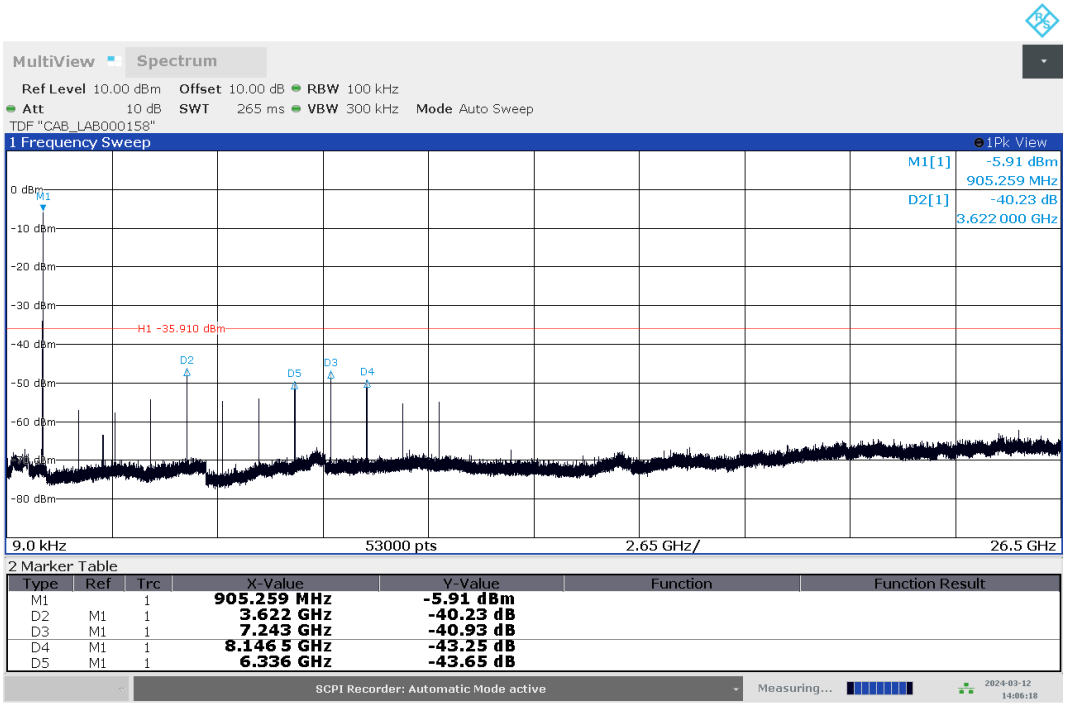
4.2 Set-up 1, Op. 2, frequency range 9 kHz – 26.5 GHz

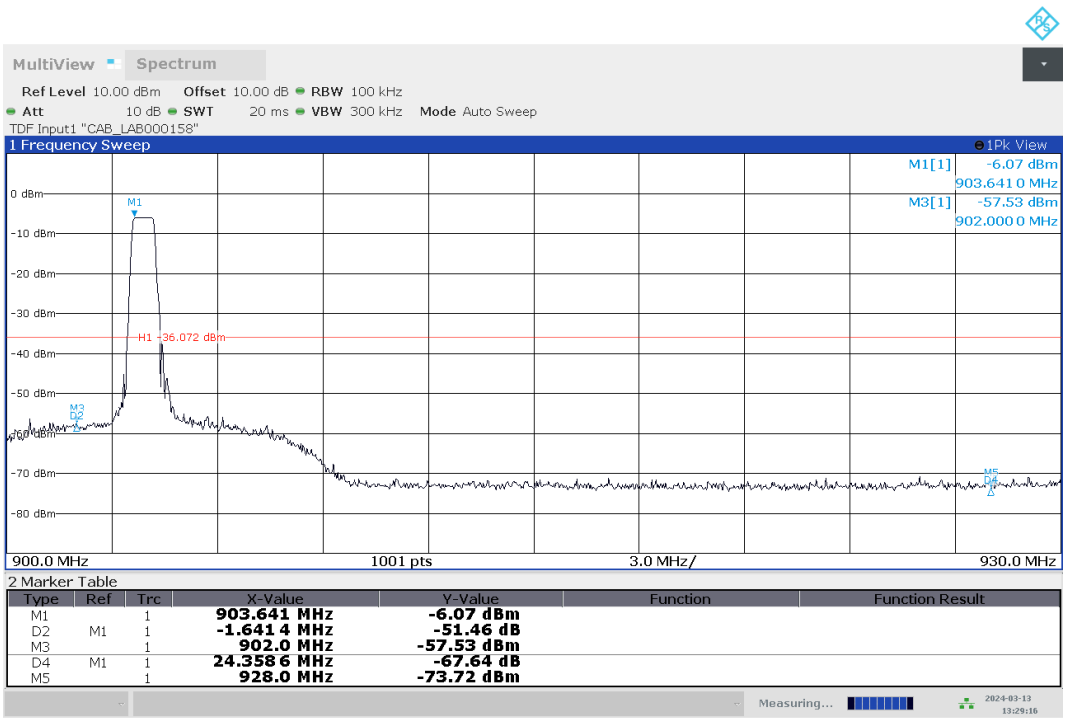


01:31:32 03/13/2024

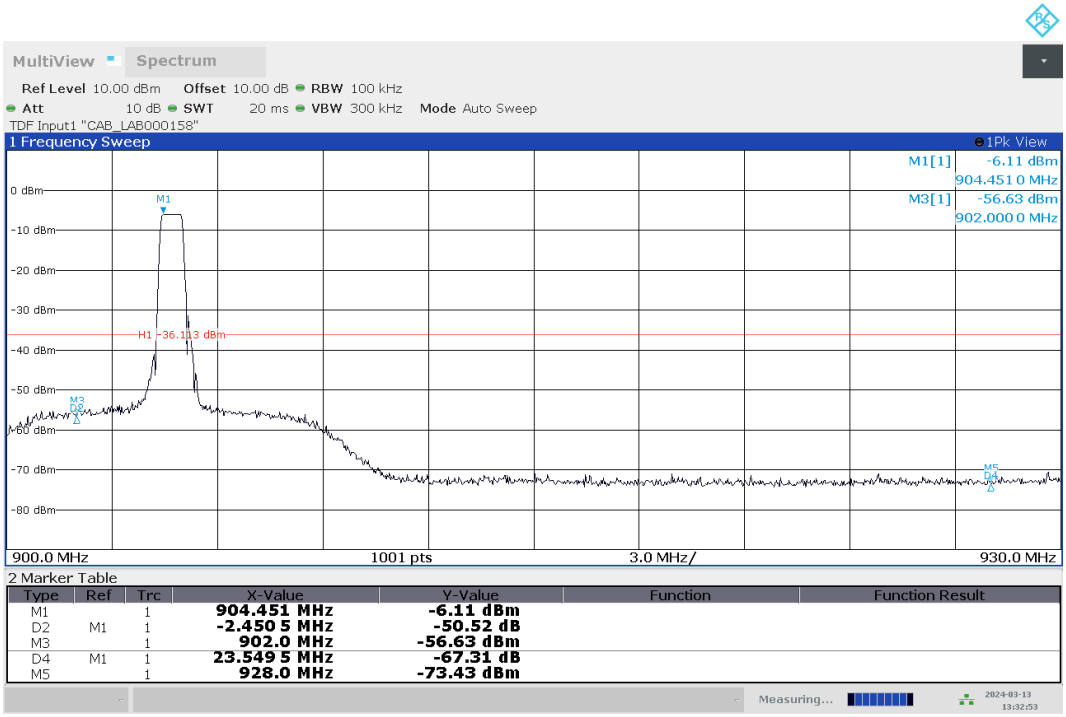
4.3 Set-up 1, Op. 3, frequency range 9 kHz – 26.5 GHz



4.4 Set-up 1, Op. 1, frequency range 900 MHz – 930 MHz



4.5 Set-up 1, Op. 2, frequency range 900 MHz – 930 MHz



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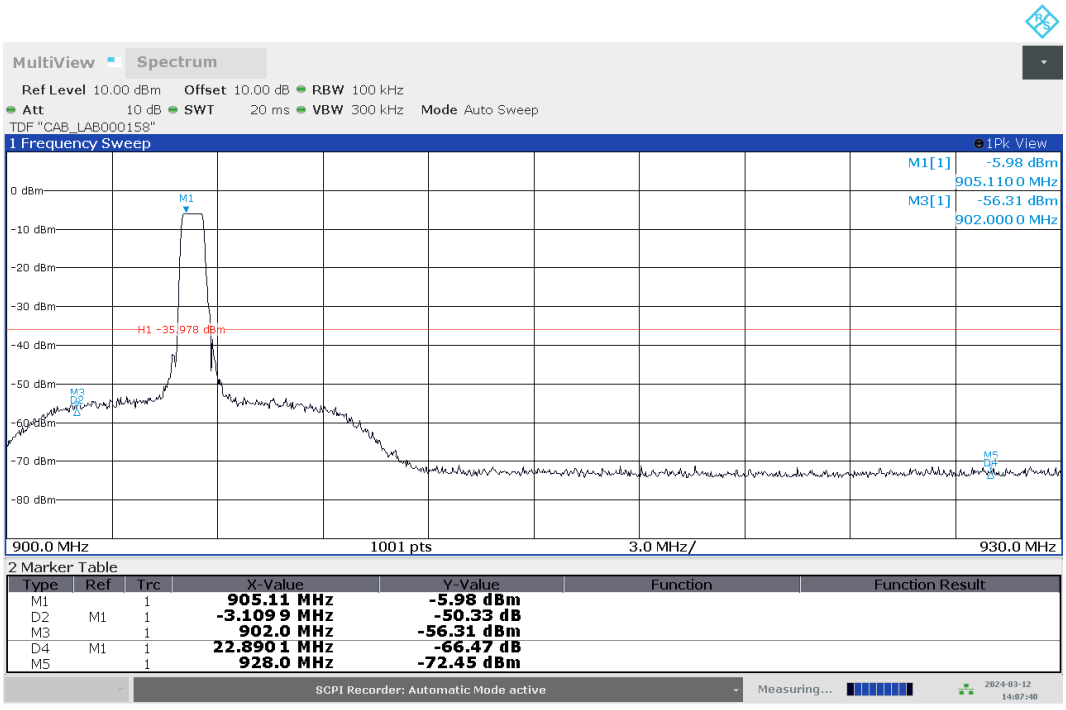
4.6 Set-up 1, Op. 3, frequency range 900 MHz – 930 MHz

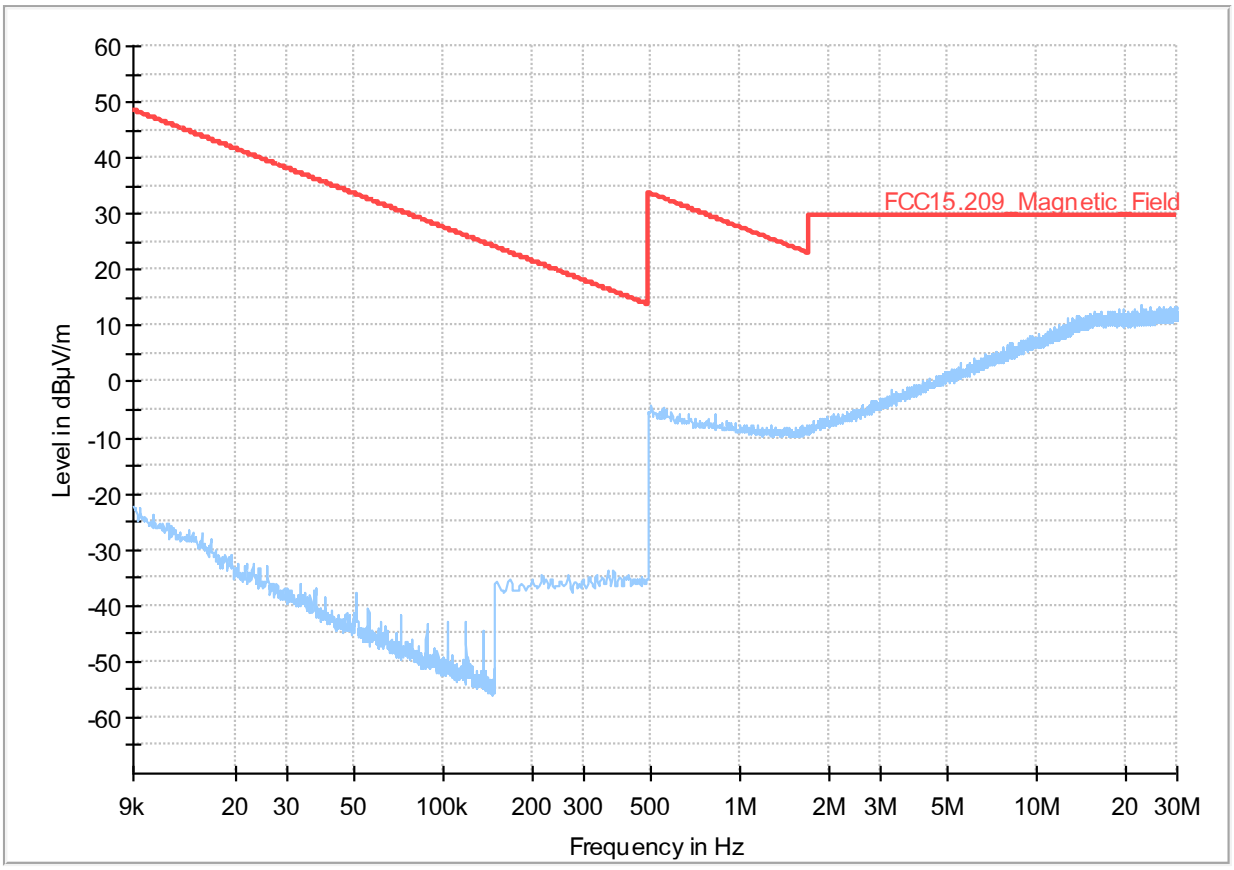


02:07:40 03/12/2024

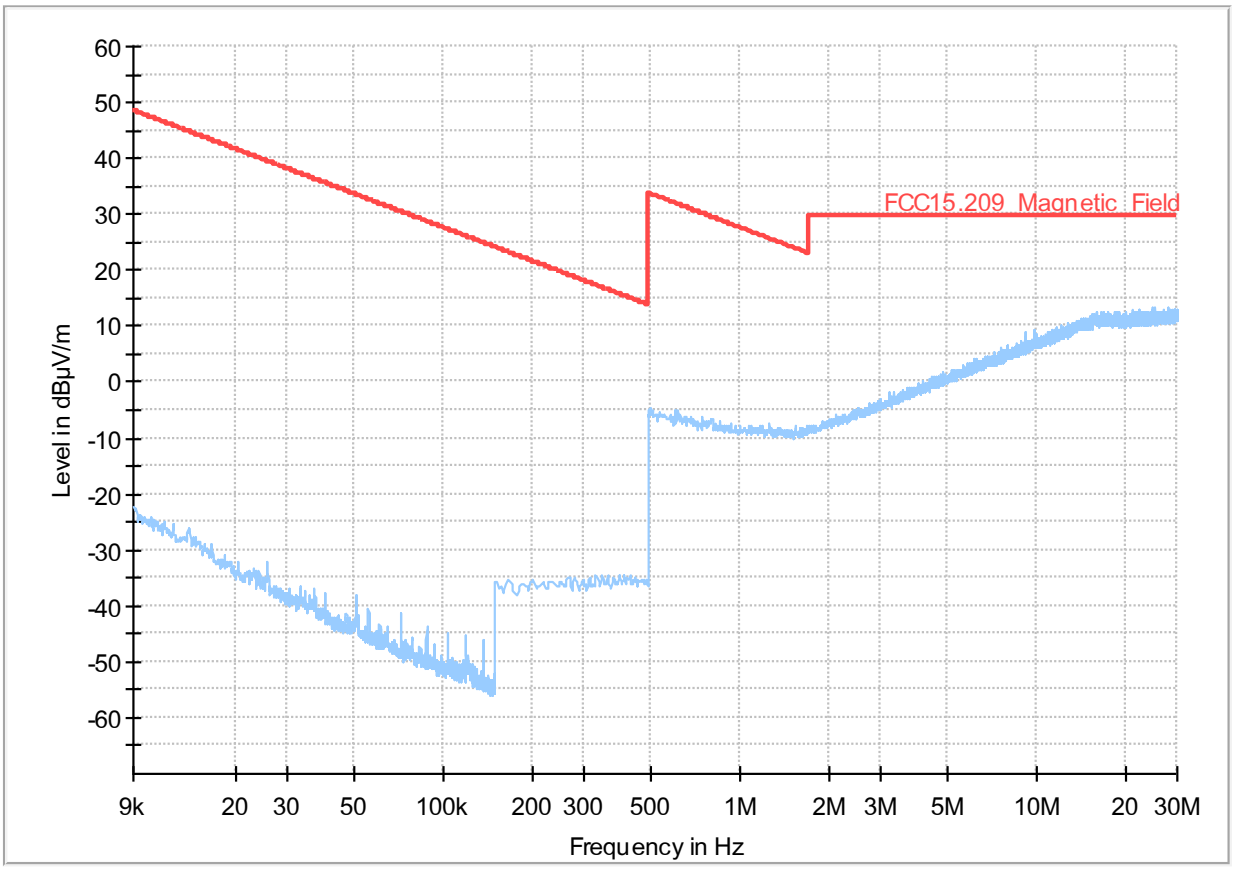
5 General Limit - Radiated field strength emissions, 9 kHz - 18 GHz

5.1 Radiated field strength measurements (f < 30 MHz)

5.1.1 Set-up 2, 9 kHz – 30 MHz, Op. 1, EUTs lying

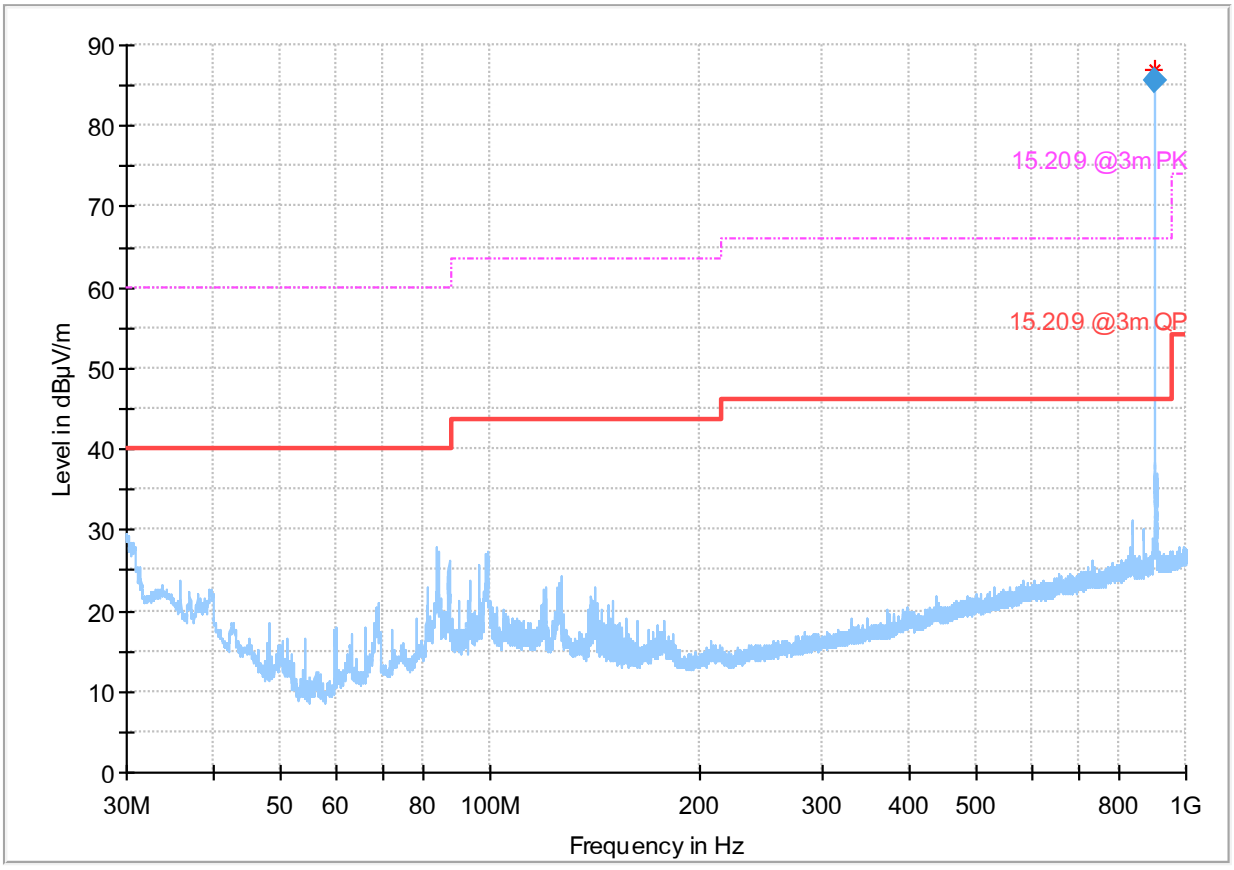


5.1.2 Set-up 2, 9 kHz – 30 MHz, Op. 1, EUTs staying



5.2 Radiated field strength measurements (30 MHz < f < 1000 MHz)

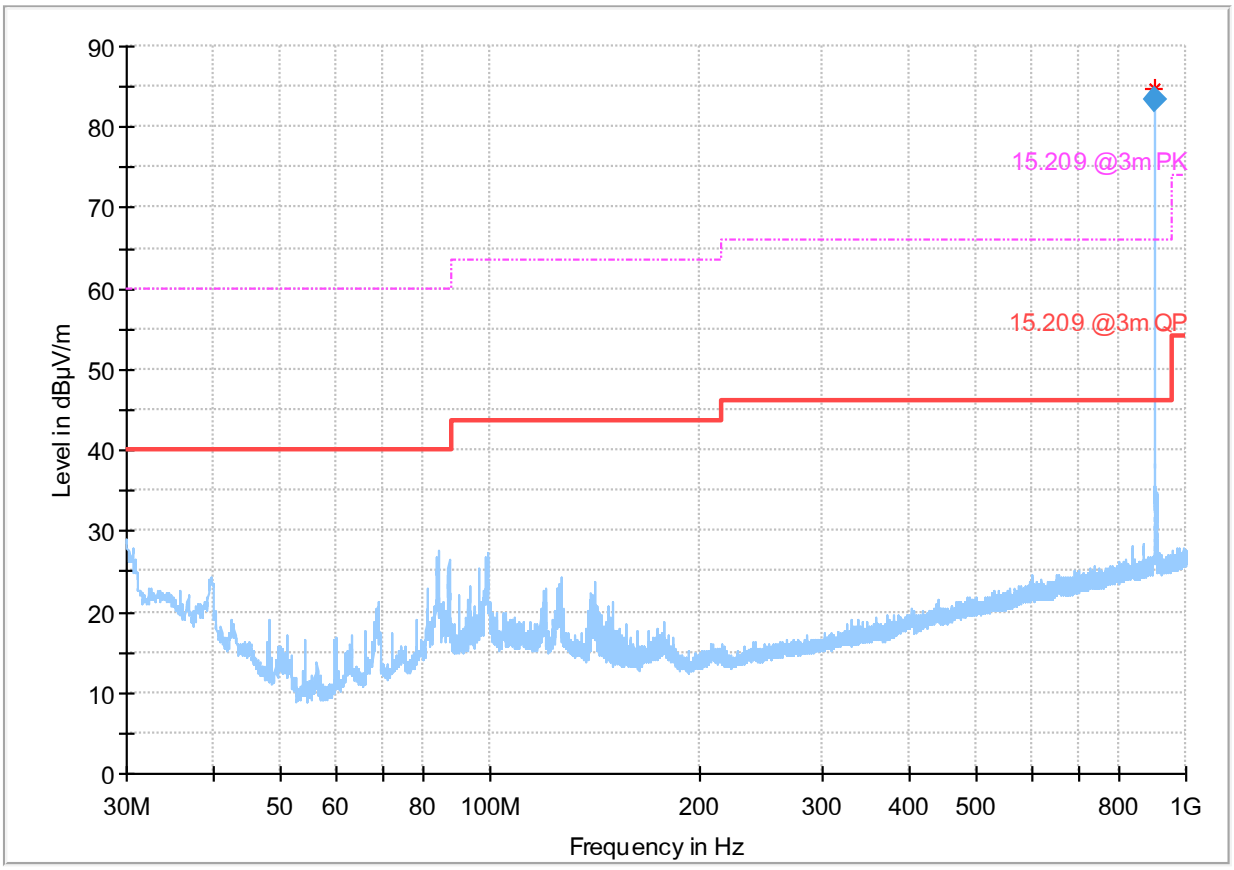
5.2.1 Lying, Set-up 2, Op. 1



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
903.680000	85.69	46.00	-39.69	100.0	120.000	100.0	H	-4.0

5.2.2 Staying, Set-up 2, Op. 1



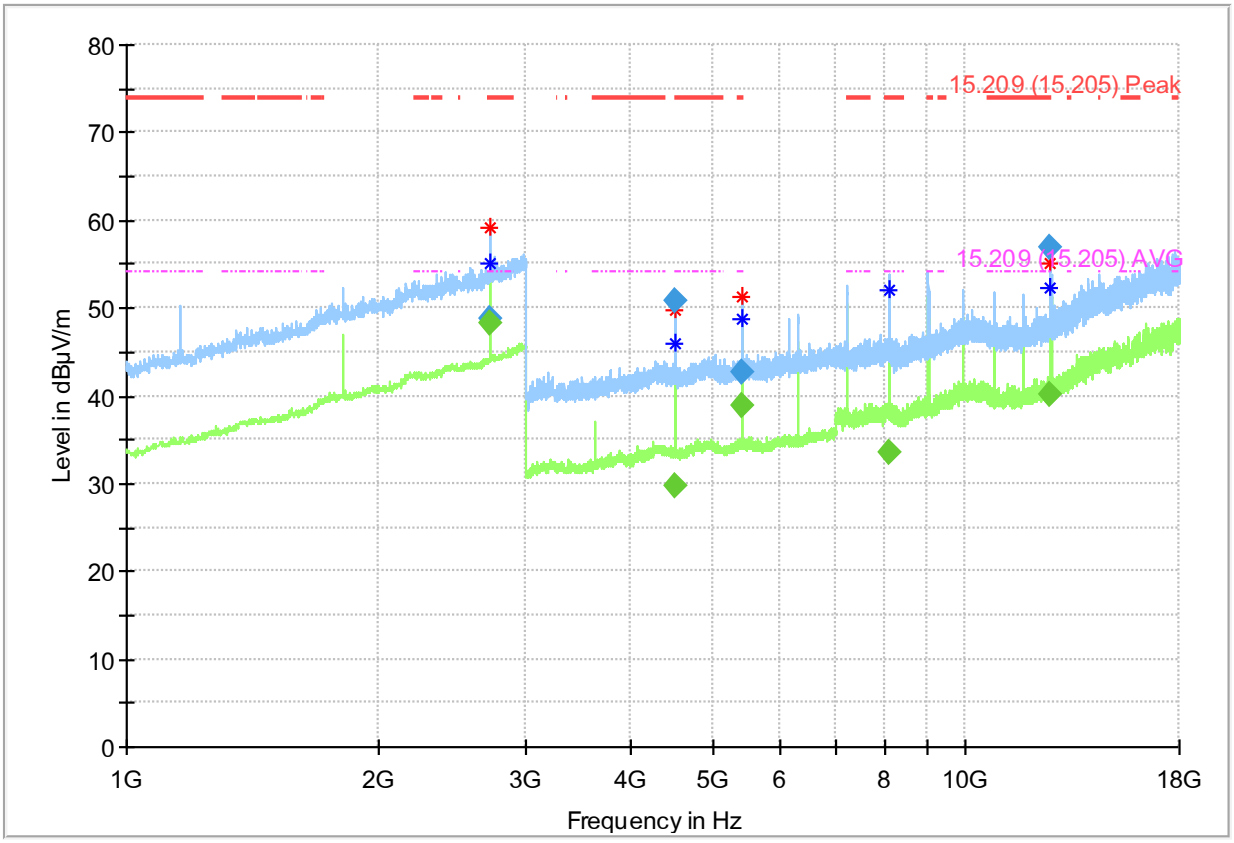
Preview Result 1-PK+
15.209 @3m PK
Critical_Freqs PK+
Final_Result QPK
15.209 @3m QP

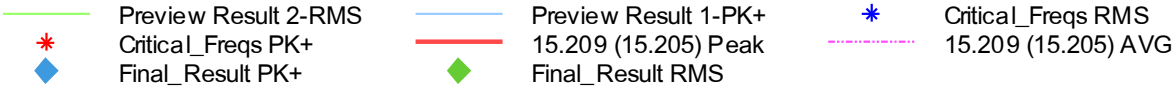
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
903.680000	83.38	46.00	-37.38	100.0	120.000	100.0	V	100.0

5.3 Radiated field strength measurements (1 GHz < f < 18 GHz)

5.3.1 1000 MHz – 18000 MHz, Set-up 2, Op. 1, lying + staying



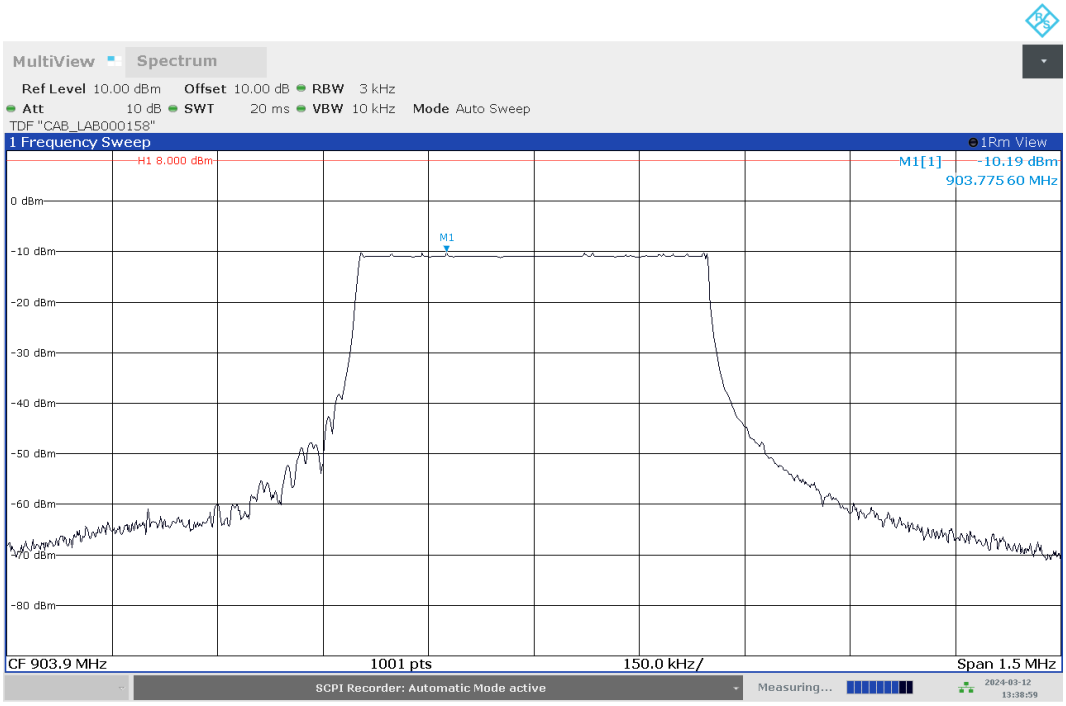


Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
2711.410000	---	48.18	54.00	5.82	1000.0	1000.000	150.0	H
2713.730000	48.77	---	74.00	25.23	1000.0	1000.000	150.0	H
4515.702500	---	29.78	54.00	24.22	1000.0	1000.000	150.0	H
4520.787500	50.71	---	74.00	23.29	1000.0	1000.000	150.0	H
5424.815000	---	38.77	54.00	15.23	1000.0	1000.000	150.0	V
5427.567500	42.72	---	74.00	31.28	1000.0	1000.000	150.0	V
8138.873333	---	33.63	54.00	20.37	1000.0	1000.000	150.0	V
12652.355000	55.68	---	74.00	17.22	1000.0	1000.000	150.0	H
12652.656667	---	40.19	54.00	13.81	1000.0	1000.000	150.0	V

6 Fundamental field strength

6.1 Set-up 1, Op. 1



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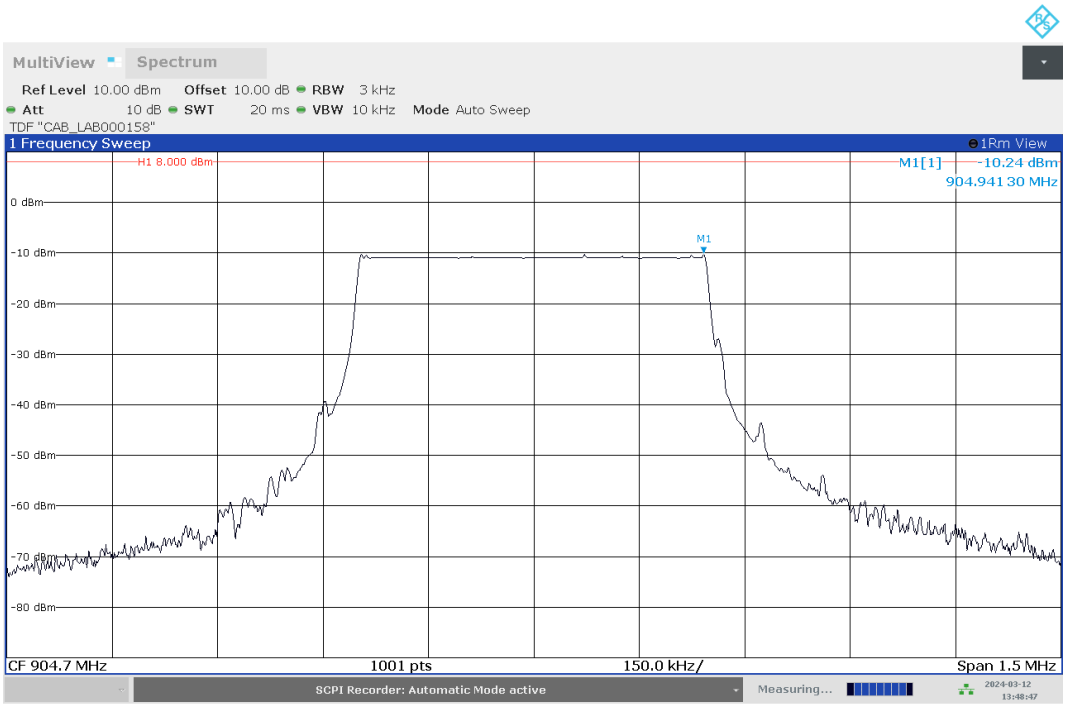
6.2 Set-up 1, Op. 2



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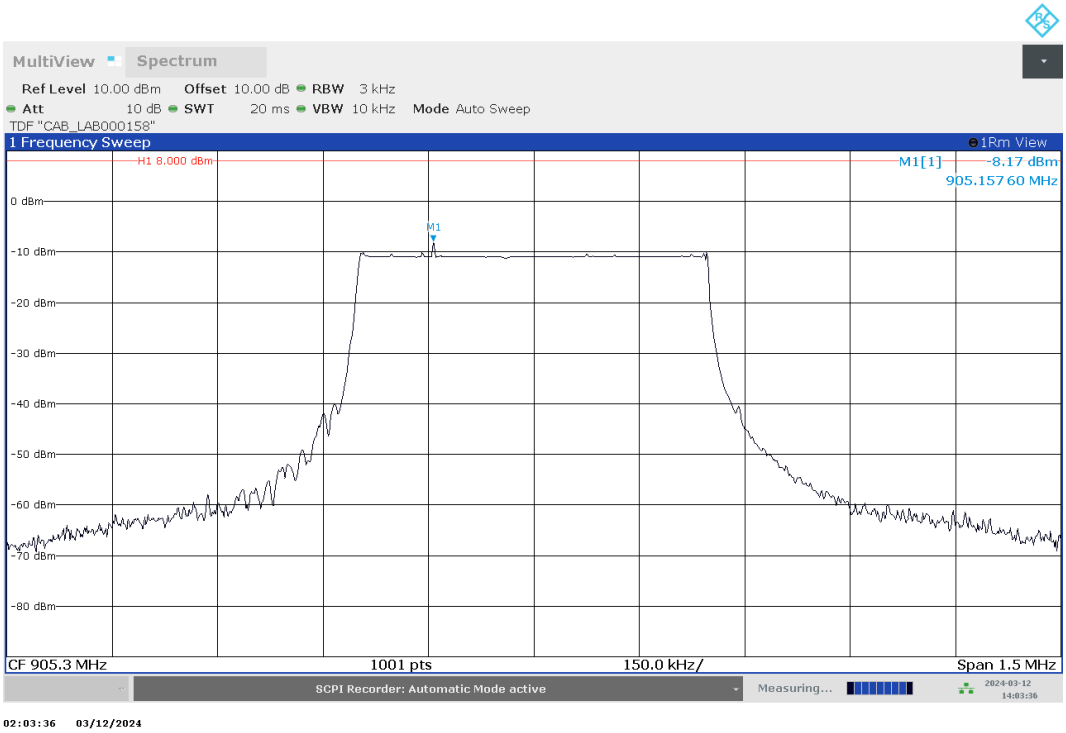
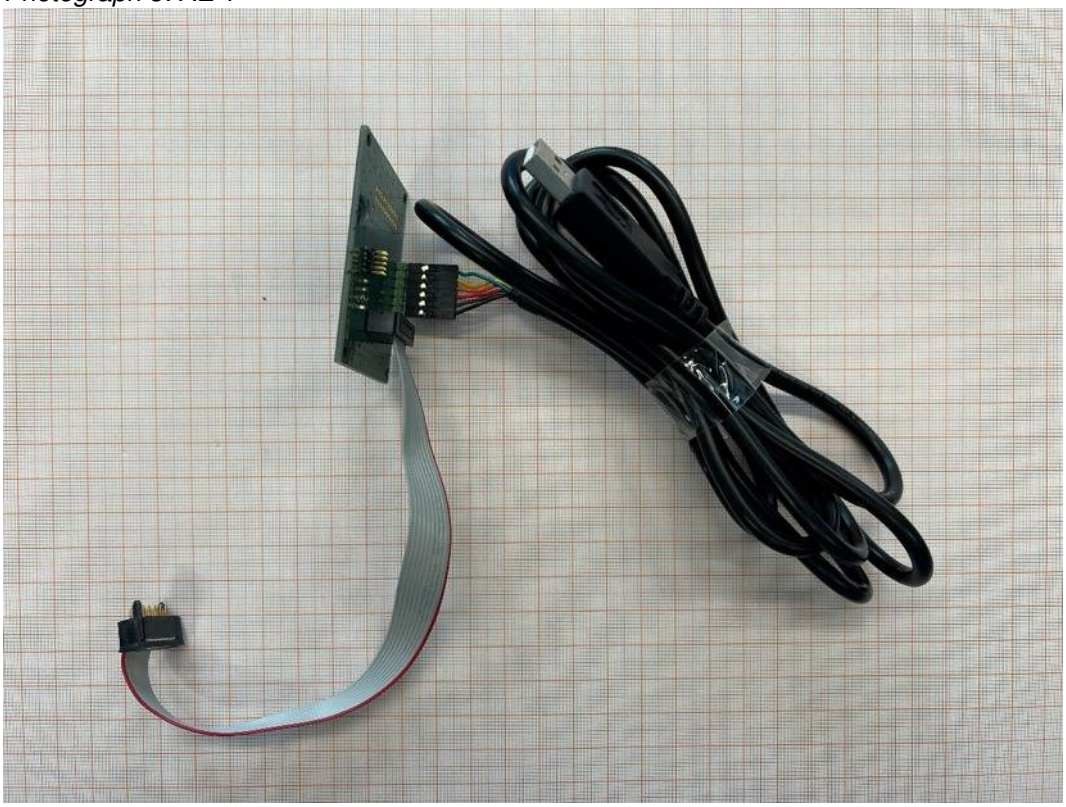
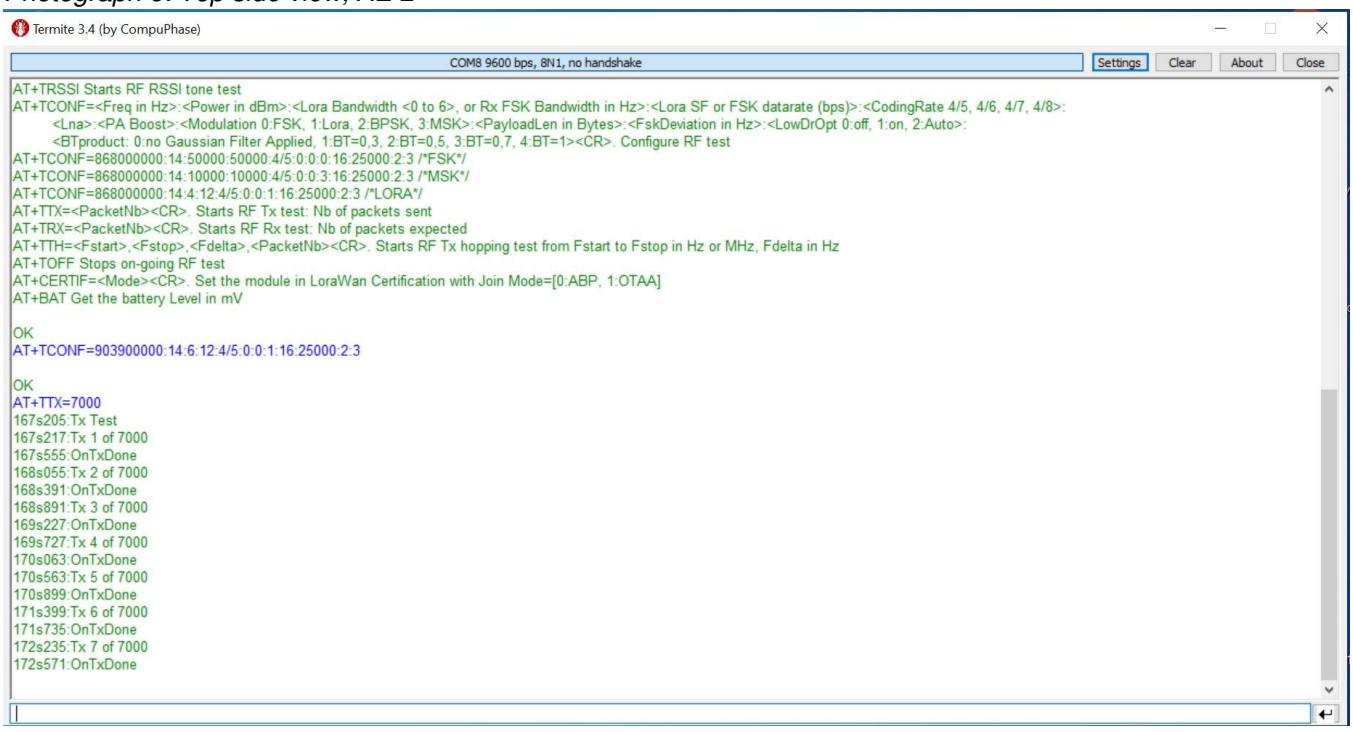
6.3 Set-up 1, Op. 3



Photograph 5: AE 1



Photograph 6: Top side view, AE 2



Photograph 7: Battery, used in radiated samples