



BNetzA-CAB-21/21-21

Test Report

Test report no.: 22107918-31529-2

Date of issue: 2023-11-16

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

Applicant

Balluff GmbH

Manufacturer

Balluff GmbH

Test Item

BF-IDC03

RF-Spectrum Testing according to:

FCC 47 CFR Part 15
Radio Frequency Devices (Subpart C)

RSS-Gen, Issue 5 (2019-03)
General Requirements for Compliance of Radio Apparatus

Tested by
(name, function, signature)

Piotr Sardyko
Deputy Head of Laboratory 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	RFID processor unit
Model/Type reference	BF-IDC03
FCC ID	2AGZY-BFIDC03
IC	20739-BFIDC03
HMN	-/-
PMN	Balluff BF-IDC03
HVIN	BF-IDC03
FVIN	-/-
Frequency	70 kHz
Antenna	External RFID Read/Write Heads or passive RFID antennas
Power supply (function)	24 VDC
Temperature range	0 °C – +60 °C

Disclaimer and Notes

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Within this test report, a ☒ point / ☐ comma is used as a decimal separator.
 If otherwise, a detailed note is added adjoined 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 St. Ingbert / Germany Fon: +49 6894 38938-0 Fax: +49 6894 38938-99 URL: www.ib-lenhardt.de E-Mail: info@ib-lenhardt.de
Accreditation	<p>The testing laboratory is accredited by Deutsche Akkreditierungsstelle GmbH (DAkKS) in compliance with DIN EN ISO/IEC 17025:2018.</p> <p>Scope of testing and registration number:</p> <ul style="list-style-type: none"> • Attachment to the accreditation certificate D-PL-21375-01-00 <ul style="list-style-type: none"> ○ Electronics ○ Electromagnetic Compatibility ○ Radio ○ Electromagnetic Compatibility and Telecommunication (FCC requirements) ○ Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards ○ Automotive EMC <p>Website DAkKS: https://www.dakks.de/ The Deutsche Akkreditierungsstelle GmbH (DAkKS) is also a signatory to the ILAC Mutual Recognition Arrangement.</p> <ul style="list-style-type: none"> • Designations <ul style="list-style-type: none"> ○ FCC Testing Laboratory Designation Number DE0024 ○ ISED 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	2023-04-12
Start – End of tests	2023-04-12 – 2023-11-10

2.2 Possible test case verdicts

Test sample meets the requirements	P (PASS)
Test sample does not meet the requirements	F (FAIL)
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

-1:

- radiated emission limits test was repeated with set-up 1 (see subchapter 5.6.) and made additionally with set-up 2 (see subchapter 5.6.)
- conducted emission limits test was done additionally with set-up 2 (see subchapter 5.6.)
- occupied bandwidth test was done separately with set-up 3-10 (see subchapter 5.6.)

-2:

- test description was edited in Chapter 7.2.
- the names of the plots were corrected in Annex A

This test report 22107918-31529-2 replaces the previous test report 22107918-31529-1.

2.6 Further documents

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

Measurement plots: 22107918-31529-2_Annex A
 EUT photographs: 22107918-31529-2_Annex B
 Test setup photographs: 22107918-31529-2_Annex C

2.7 Formula for determination of correction values (E_c)

$$E_c = E_R + AF + C_L + D_F - G_A \quad (1)$$

$$M = L_T - E_c \quad (2)$$

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.

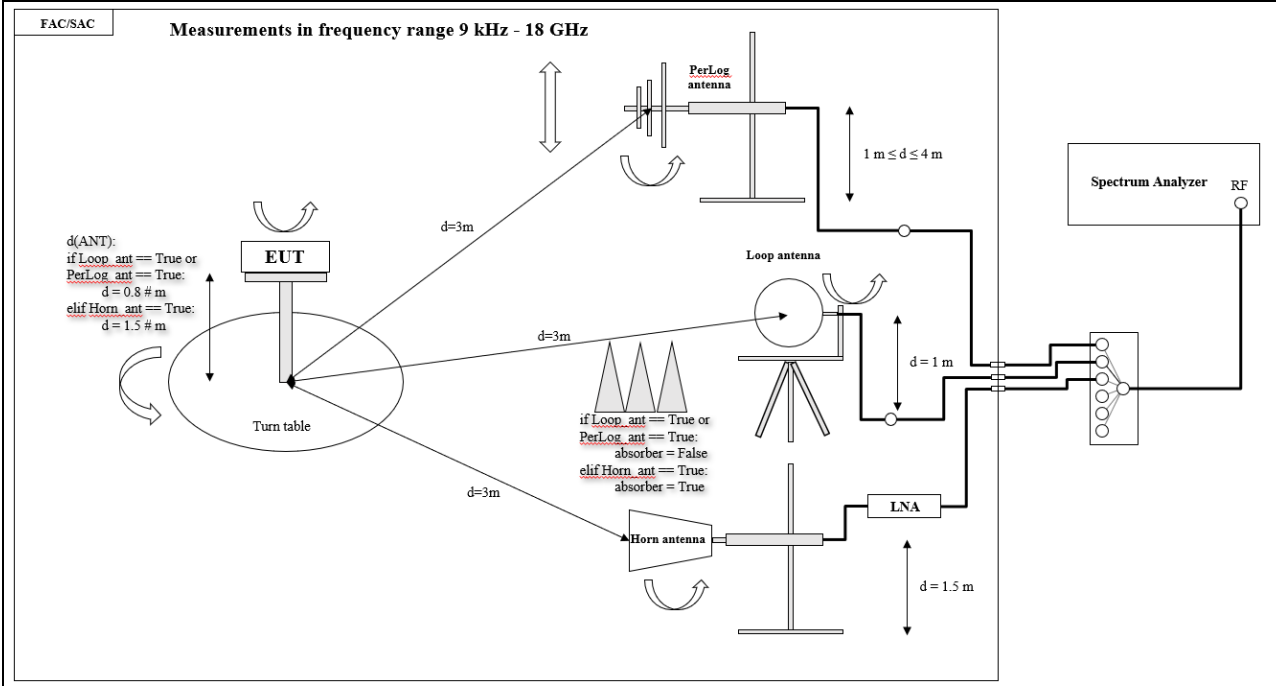
TR no.: 22107918-31529-2

2023-11-16

Version: 11.10.00

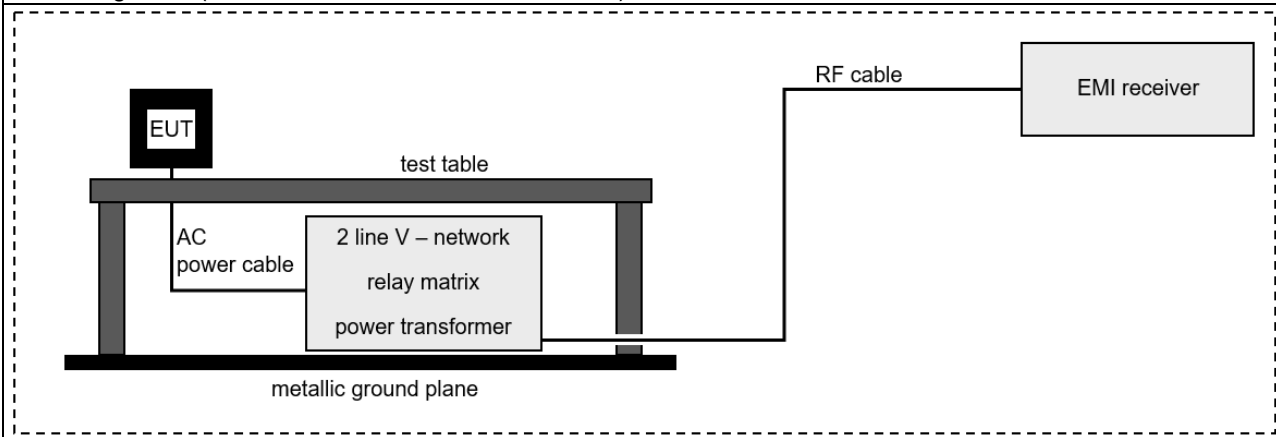
2.9 Block diagrams

Block diagram 1*:



* depending on limit line different horn antennas, correspondingly different measurement distances, can be used. If the case here, please see the annex C with test set-up photos.

Block diagram 2 (conducted emissions measurements):



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	24 VDC

3.2 Normal and extreme test conditions

	minimum	normal	maximum
Temperature	-	20 °C	-
Relative humidity	-	45 % r.h.	-
Power supply	-	24 V DC	-

4 TEST STANDARDS AND REFERENCES

Test standard (accredited)	Description
FCC 47 CFR Part 15	Radio Frequency Devices (Subpart C)
RSS-Gen, Issue 5 (2019-03)	General Requirements for Compliance of Radio Apparatus

Reference	Description
ANSI C63.4-2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

5 EQUIPMENT UNDER TEST (EUT)

5.1 Product Description*

The BF-IDC03 is a RFID processor unit that provides LF and HF RFID functionality when connected to RFID Read/Write Heads or passive RFID antennas.

*: declared by the applicant

5.2 Technical Data of Equipment*

Operational frequency*	70 kHz
Modulation type*	ASK
Number of channels*	1
Channel bandwidth*	-/-
Channel spacing*	-/-
Antenna*	External RFID Read/Write Heads or passive RFID antennas
Power supply*	24 VDC
Temperature range*	0 °C – +60 °C

*: declared by the applicant

5.3 Test Item (Equipment Under Test) Description*

Short designation	EUT Model	EUT Description	ID / MAC	Hardware status	Software status
EUT A	BF-IDC03	RFID processor unit	MAC ID: 00:19:31:23:CE:5D	3.0	4.41

*: declared by the applicant

5.4 Auxiliary Equipment (AE) Description*

AE short designation	EUT Name (if available)	EUT Description	Serial number (if available)	Software (if used)
AE 1	BIS005Z BIS C-300-PU1-05	RFID antenna (see photos in Annex B)	-	-
AE 2	BIS0067 BIS C-305-PU1-05	RFID antenna (see photos in Annex B)	-	-
AE 3	BIS006F BIS C-306-PU1-05	RFID antenna (see photos in Annex B)	-	-
AE 4	BIS00PH BIS C-310-PU1-05	RFID antenna (see photos in Annex B)	-	-
AE 5	BIS00PL BIS C-315-PU1-05	RFID antenna (see photos in Annex B)	-	-
AE 6	BIS007K BIS C-323/05-S4	RFID antenna (see photos in Annex B)	-	-
AE 7	BIS007M BIS C-324/05-S4	RFID antenna (see photos in Annex B)	-	-
AE 8	BIS01F0 BIS C-351-PUV-05	RFID antenna (see photos in Annex B)	-	-
AE 9	-	Power supply cable for EUT A	-	-

AE 10**	-	Connection cable for RFID antenna	-	-
AE 11**	-	Adapter cable	-	-

*: declared by the applicant

** . Please see photos in Annex B and Annex C to know at what set-ups these cables were used

5.5 Test Item Operating Modes Description*

EUT operating mode no.	Description of operating modes	Additional information
op. 1	Continuous modulated	-

*: declared by the applicant

5.6 Test Item Set-ups Description

set. 1	EUT A + AE 4 + AE 5 + AE 7 + AE 8 + AE 9
set. 2	EUT A + AE 1 + AE 2 + AE 3 + AE 6 + AE 9
set. 3	EUT A + AE 1 + AE 9
set. 4	EUT A + AE 2 + AE 9
set. 5	EUT A + AE 3 + AE 9
set. 6	EUT A + AE 4 + AE 9
set. 7	EUT A + AE 5 + AE 9
set. 8	EUT A + AE 6 + AE 9
set. 9	EUT A + AE 7 + AE 9
set. 10	EUT A + AE 8 + AE 9

5.7 Test Conditions

Temperatur, [°C]		Voltage, [V]	
Tnom	20 ± 5	Vnom	24

5.8 Additional Information

Test items differences	-
Additional application considerations to test a component or sub-assembly	-

6 SUMMARY OF TEST RESULTS

Test specification

FCC 47 CFR Part 15
RSS-Gen, Issue 5 (2019-03)

Clause	Requirement / Test case	Test Conditions	Result / Remark	Verdict
§15.207 RSS-Gen	Conducted emission limits	Normal	< limit	P
§15.209 RSS-Gen	Radiated emission limits	Normal	< limit	P
RSS-Gen, 6.7	Occupied bandwidth	Normal	< limit	P

Notes

– none –

Comments and observations

– none –

7 TEST RESULTS

7.1 Conducted emissions limits

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

Radiated: R1, L1, C5, SW2, SW3

Description

Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- In case of floor standing equipment, it is placed in the middle of the turn table.
In case of tabletop equipment it is placed on a non-conductive table with a height of 80 cm.
- Additional equipment, cables, ... necessary for testing, are positioned like under normal operation.
- Interface cables, e.g. power supply, network, ... are connected to the connection box in the turn table.
- EUT is powered on and set into operation.

Pre-scan

- The EMI-receiver/spectrum analyser performs a positive-peak/max-hold sweep (=worst-case). Data is transferred to EMI-software and recorded. EMI-software will show the maximum level of all single sweeps as the final result for the pre-scan.

Final measurement

- Significant emissions found during the pre-scan will be maximized by the EMI-software based on evaluated data during the pre-scan.
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C63.4).
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, and settings of measuring equipment is recorded.

Detailed requirements can be found in e.g. ANSI C63.4

Please see test set-up photos in Annex C and block diagram 2 in Chapter 2.9.

Limits

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

Please see FCC Title 47 § 15.207 for more details.

Test Results

Set-up / Op.	Line	Verdict
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1 / 1	L1	Pass
1 / 1	N	Pass
2 / 1	L1	Pass
2 / 1	N	Pass
All Readings were done with Quasi-Peak and Average detector.		

Comment:	---
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Verdict	- PASS -	For plots please see Annex A to current report
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7.2 Radiated field strength / emission limits

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

Radiated: A1, C1, R1, SW2, M1, P1,

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).

Radiated: A2, C1, R1, SW2, M1, P1,

Description

The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.10:2013.

RBW for frequency range 9 kHz- 30 MHz: 200 Hz, 9 kHz.

The loop antenna was placed at 1 m height above ground plane and 3 m measurement distance from set-up for investigations. Because of reduced measurement distance, correction data were applied.

Reference for applied correction (extrapolating) factors due to reduced measurement distance:
ANSI C63.10:2013, §6.4.4.2 - Equations (2) + (3) + (4)

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.

Limits

According to FCC 15.209(a):

Frequency (MHz)	Magnetic field strength (HField) ($\mu\text{A/m}$)*	Field strength (microvolts/meter)	Measurement distance (meters)	Remarks
0.009-0.490	$6.37/F$ (F in kHz)	$2400/F$ (kHz)	300	Correction factor used due to measurement distance of 3 m
0.490-1.705	$63.7/F$ (F in kHz)	$24000/F$ (kHz)	30	Correction factor used due to measurement distance of 3 m
1.705-30.0	0.08	30	30	Correction factor used due to measurement distance of 3 m
30-88	-	100	3	-
88-216	-	150	3	-
216-960	-	200	3	-

* the measurement was done with dBuV/m units.

Test Results

Set-up / Op.	Frequency	Verdict
1 / 1	9 kHz – 1 GHz	Pass
2 / 1	9 kHz – 1 GHz	Pass

All Readings below 1 GHz are Quasi-Peak or Peak detector.

Comment: ---

Verdict	- PASS -	For plots please see Annex A to current report
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7.3 Occupied bandwidth

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

Radiated: R3, M1, P1, power supply cable made antenna

Description

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

In some cases, the “x dB bandwidth” is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and 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 occupied bandwidth (or the 99% emission bandwidth).

See photos in Annex C for test Set-up.

Test procedure

ANSI C63.10, 6.9.3

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

The following procedure shall be used for measuring 99% power bandwidth:

- a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
- b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
- c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.
- d) Step a) through step c) might require iteration to adjust within the specified range.
- e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
- f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.
- g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power 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; that frequency is recorded as the lower frequency.

The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.
 h) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

Note
 Measurements with the peak detector are also suitable to demonstrate compliance of an EUT, as long as the required resolution bandwidth is used, because peak detection will yield amplitudes equal to or greater than amplitudes measured with RMS detector. The measurement data from a spectrum analyser peak detector will represent the worst-case results (see ANSI C63.10).

Test Results: Please see Annex A for test results for set-up 3 to 10.

<p>Comment</p>	<p>The tested signal has an ASK modulation (form of amplitude modulation that represents digital data as variations in the amplitude of a carrier wave). What is close to CW signal. So, the rule of 1% to 5% of the OBW is not applicable here.</p>
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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	Flann Microwave Ltd	270004	LAB000230	-	-

		(73.8 GHz – 112 GHz)					
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	2022-09-27	2023-09-27
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	2021-08-30	2023-08-30
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	2023-01-31	2024-01-30
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	108822	LAB000288	-	-
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

Radio frequency	$\leq \pm 10$ ppm
Radiated emission	$\leq \pm 6$ dB
Temperature	$\leq \pm 1$ °C
Humidity	$\leq \pm 5$ %
DC and low frequency voltages	$\leq \pm 3$ %
Conducted emissions	2.21 dB

The indicated expanded measurement uncertainty corresponds to the standard measurement uncertainty for the measurement results multiplied by the coverage factor $k = 2$. It was determined in accordance with EA-4/01 m:2013. The true value is located in the corresponding interval with a probability of 95 %.

End of Test Report

Annex A

Measurement plots

part of / in addition to

Test report no.: 22107918-31529-2

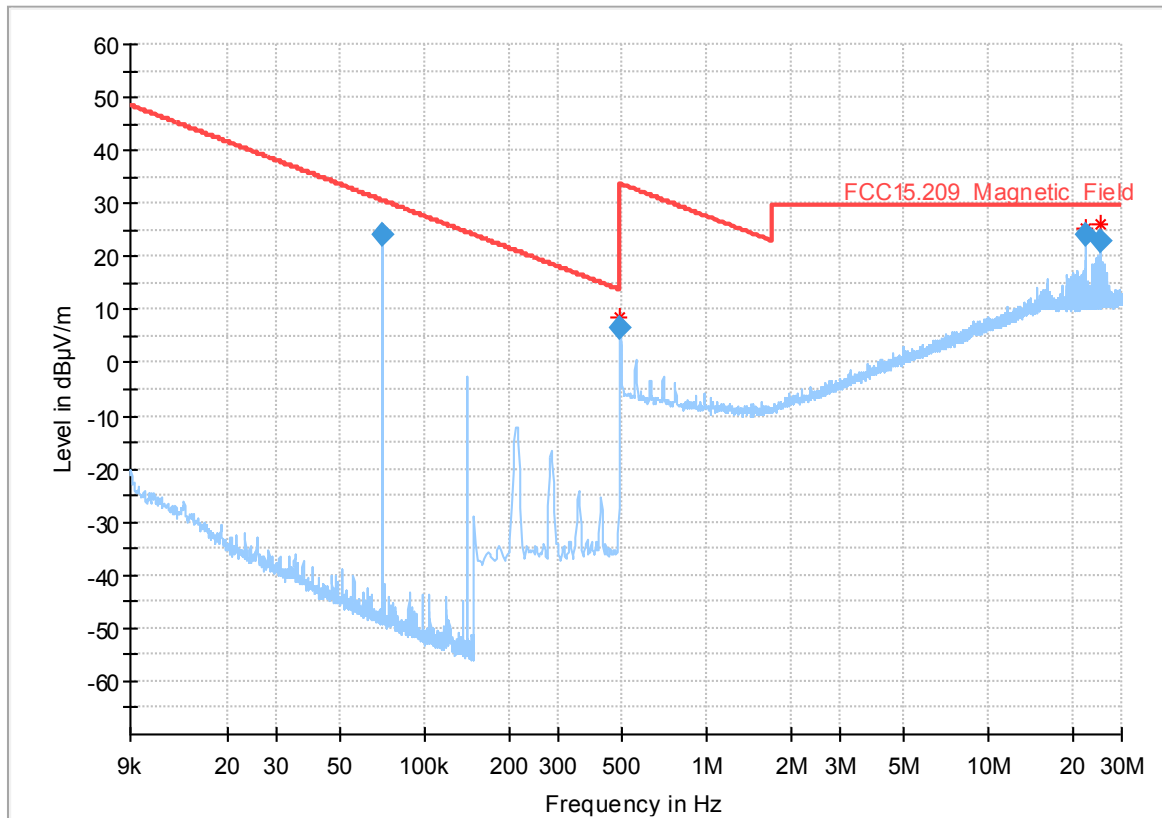
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1 GENERAL LIMIT - RADIATED FIELD STRENGTH EMISSIONS, 9 kHz – 1 GHz

1.1 Radiated field strength measurements (f < 30 MHz)

1.1.1 9 kHz – 30 MHz, set-up 1, op. 1, EUTs lying

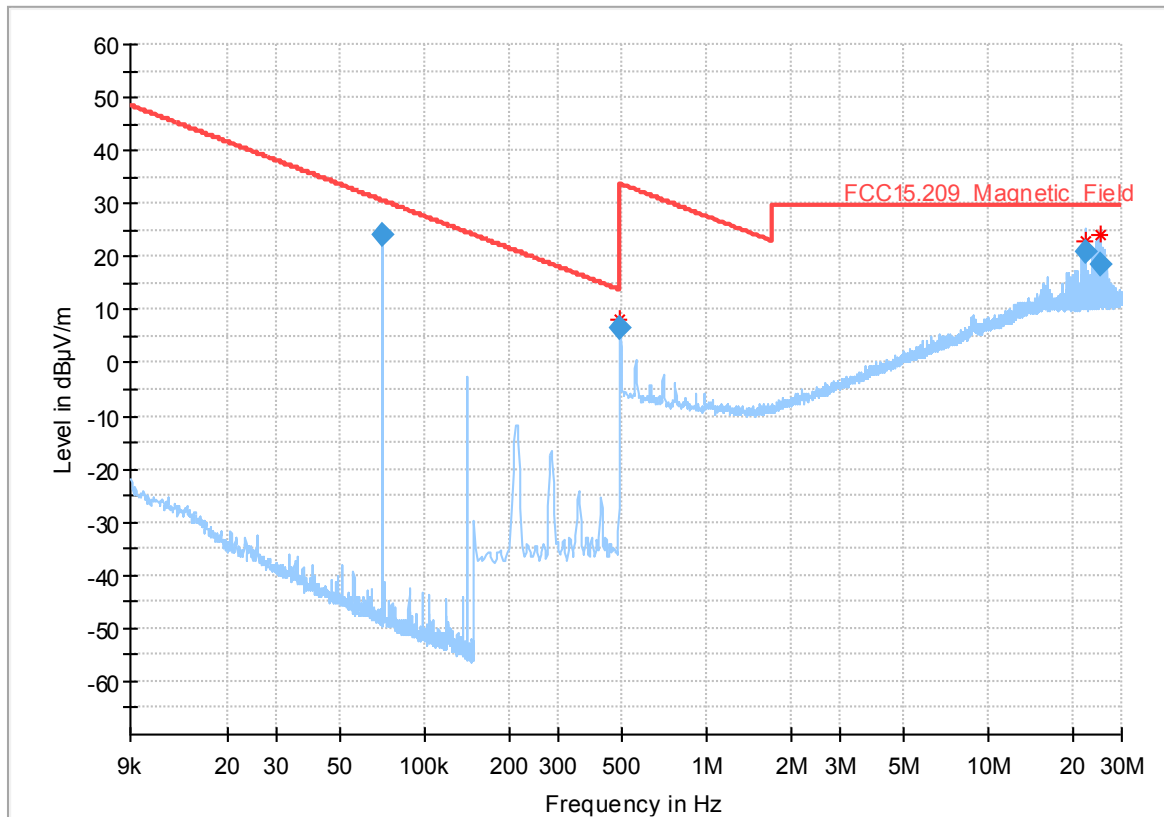


— Preview Result 1-PK+ * Critical_Freqs PK+
— FCC15.209_Magnetic_Field ◆ Final_Result QPK

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
0.070600	24.30	30.62	6.32	100.0	0.200	V	97.0	-59.5
0.494250	6.72	33.73	27.01	100.0	9.000	V	104.0	-19.6
22.175250	24.12	29.54	5.42	100.0	9.000	V	300.0	0.6
25.071000	22.96	29.54	6.58	100.0	9.000	V	-19.0	0.7

1.1.2 9 kHz – 30 MHz, set-up 1, op. 1, EUTs staying

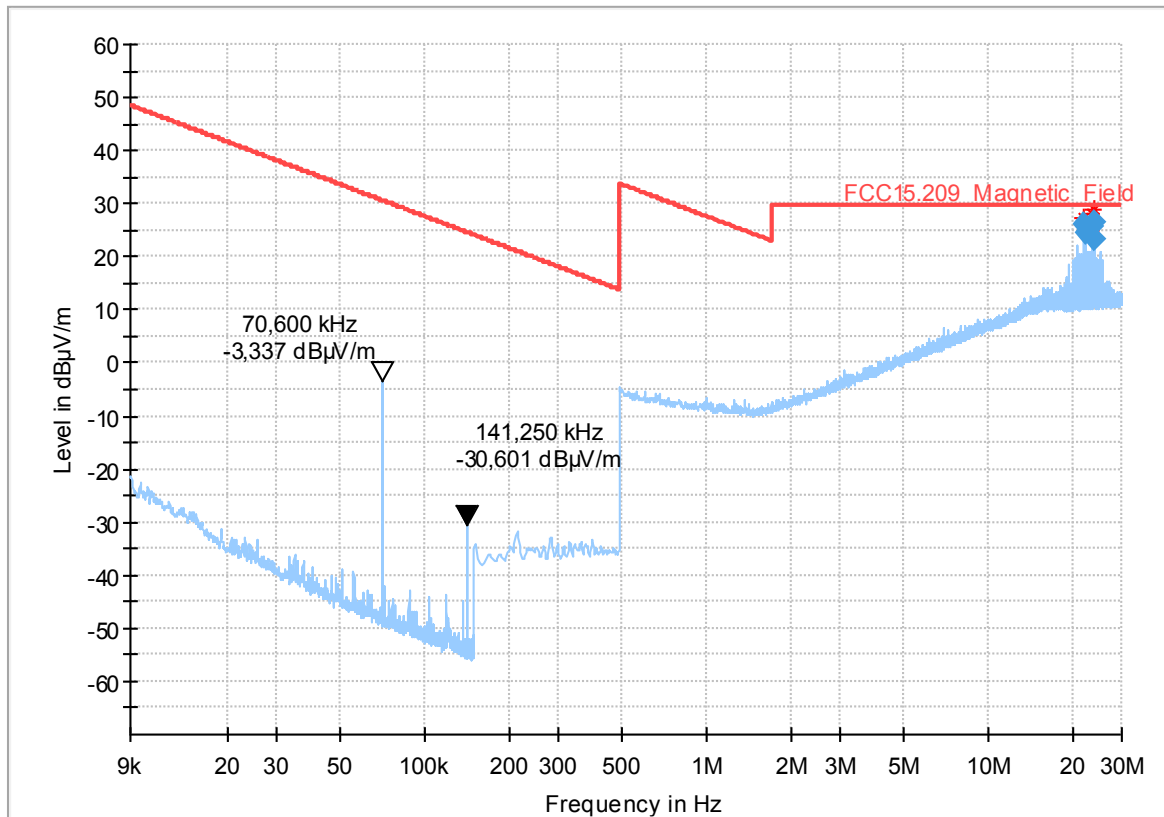


— Preview Result 1-PK+ * Critical_Freqs PK+
— FCC15.209_Magnetic_Field ◆ Final_Result QPK

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
0.070600	23.94	30.62	6.68	100.0	0.200	V	97.0	-59.5
0.494250	6.48	33.73	27.25	100.0	9.000	V	107.0	-19.6
22.175250	21.06	29.54	8.48	100.0	9.000	V	269.0	0.6
25.071000	18.35	29.54	11.19	100.0	9.000	V	211.0	0.7

1.1.3 9 kHz – 30 MHz, set-up 2, op. 1, EUTs lying



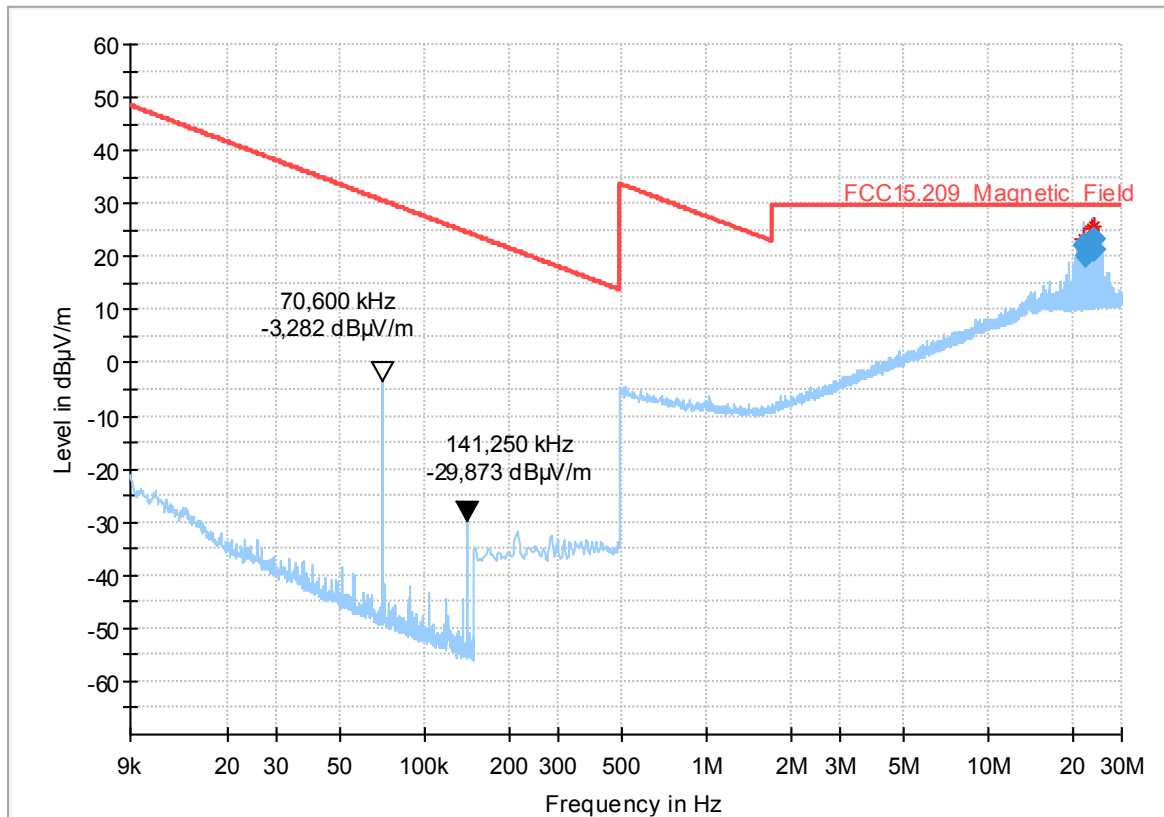
— Preview Result 1-PK+ * Critical_Freqs PK+
— FCC15.209_Magnetic_Field ◆ Final_Result QPK

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
22.033500	25.95	29.54	3.59	100.0	9.000	V	30.0	0.6
22.317000	24.40	29.54	5.14	100.0	9.000	V	345.0	0.6
23.588250	25.71	29.54	3.83	100.0	9.000	V	300.0	0.6
23.869500	23.30	29.54	6.24	100.0	9.000	V	246.0	0.6
24.081000	26.58	29.54	2.96	100.0	9.000	V	265.0	0.6

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1.1.4 9 kHz – 30 MHz, set-up 2, op. 1, EUTs staying



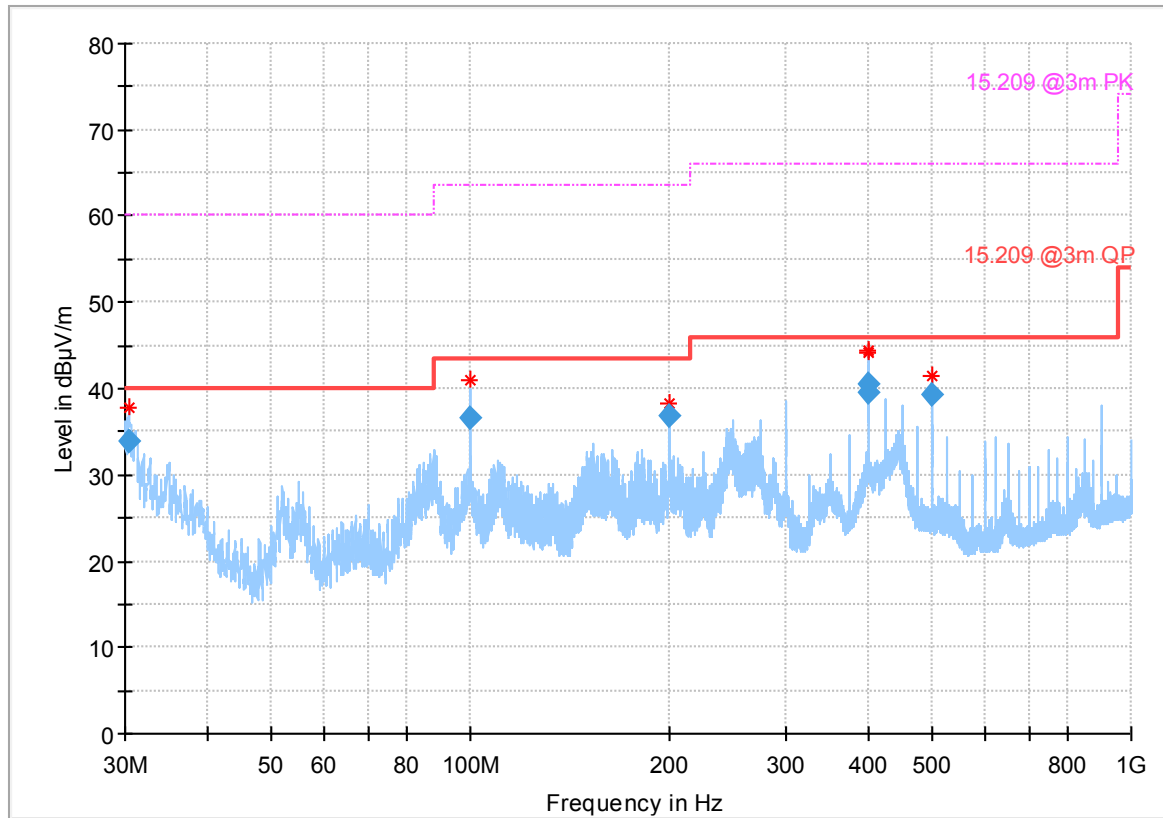
— Preview Result 1-PK+ * Critical_Freqs PK+
— FCC15.209_Magnetic_Field ◆ Final_Result QPK

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
22.033500	22.04	29.54	7.50	100.0	9.000	V	335.0	0.6
22.317000	20.24	29.54	9.30	100.0	9.000	V	291.0	0.6
23.588250	22.74	29.54	6.80	100.0	9.000	V	260.0	0.6
23.799750	21.38	29.54	8.16	100.0	9.000	V	257.0	0.6
23.941500	21.30	29.54	8.24	100.0	9.000	V	251.0	0.6
24.081000	23.31	29.54	6.23	100.0	9.000	V	261.0	0.6

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

1.2.1 30 MHz – 1 GHz, set-up 1, op. 1, EUTs lying

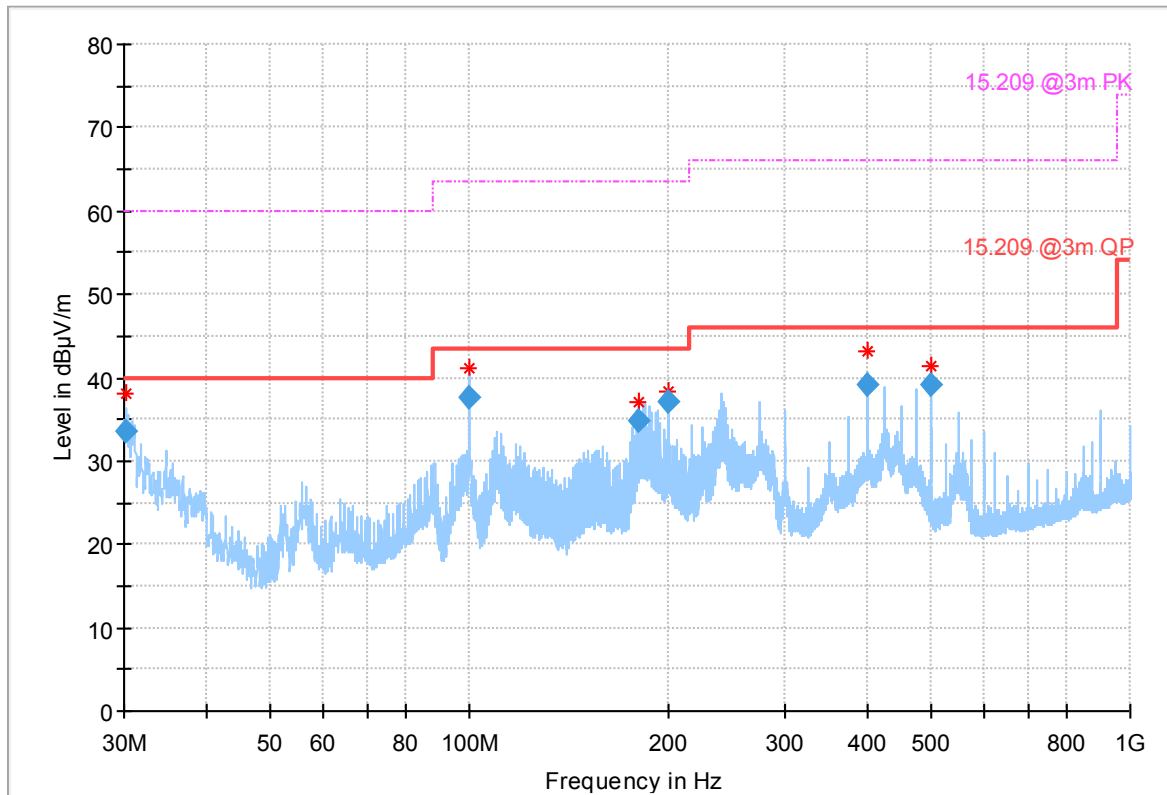


— Preview Result 1-PK+ * Critical_Freqs PK+ — 15.209 @3m QP
- - - 15.209 @3m PK ◆ Final_Result QPK

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
30.360000	33.92	40.00	6.08	100.0	120.000	100.0	V	60.0
100.000000	36.62	43.50	6.88	100.0	120.000	217.0	V	251.0
200.000000	36.74	43.50	6.76	100.0	120.000	100.0	V	14.0
399.970000	39.40	46.00	6.60	100.0	120.000	100.0	V	289.0
399.990000	40.37	46.00	5.63	100.0	120.000	103.0	V	289.0
500.000000	39.25	46.00	6.75	100.0	120.000	104.0	V	322.0

1.2.2 30 MHz – 1 GHz, set-up 1, op. 1, EUTs staying

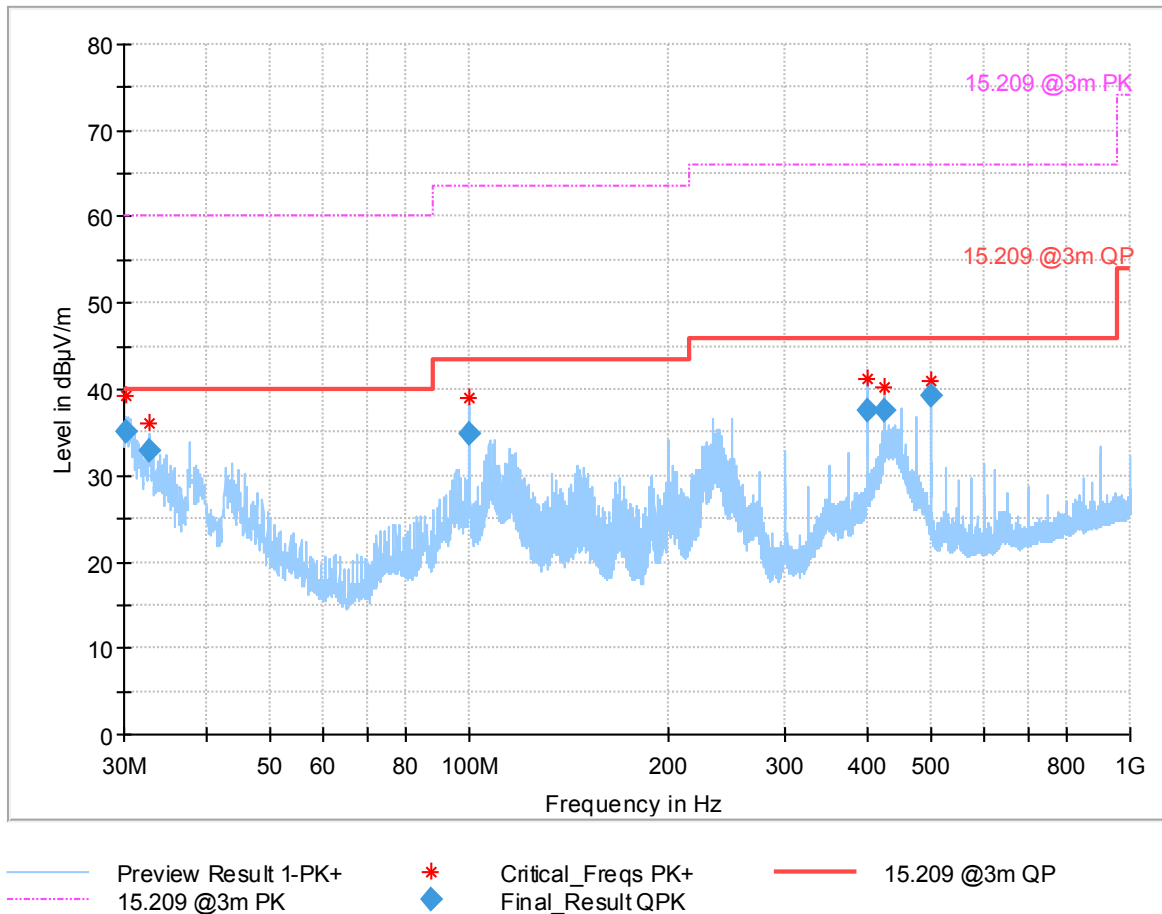


- Preview Result 1-PK+
- - - 15.209 @3m PK
- + QuasiPeak-QPK (Single)
- * Critical_Freqs PK+
- ◆ Final_Result QPK
- 15.209 @3m QP
- × MaxPeak-PK+ (Single)

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
30.240000	33.59	40.00	6.41	100.0	120.000	100.0	V	60.0
100.000000	37.71	43.50	5.79	100.0	120.000	100.0	V	214.0
180.755000	34.86	43.50	8.64	100.0	120.000	100.0	V	275.0
200.000000	37.04	43.50	6.46	100.0	120.000	100.0	V	271.0
400.000000	38.99	46.00	7.01	100.0	120.000	209.0	H	285.0
500.000000	39.12	46.00	6.88	100.0	120.000	103.0	V	311.0

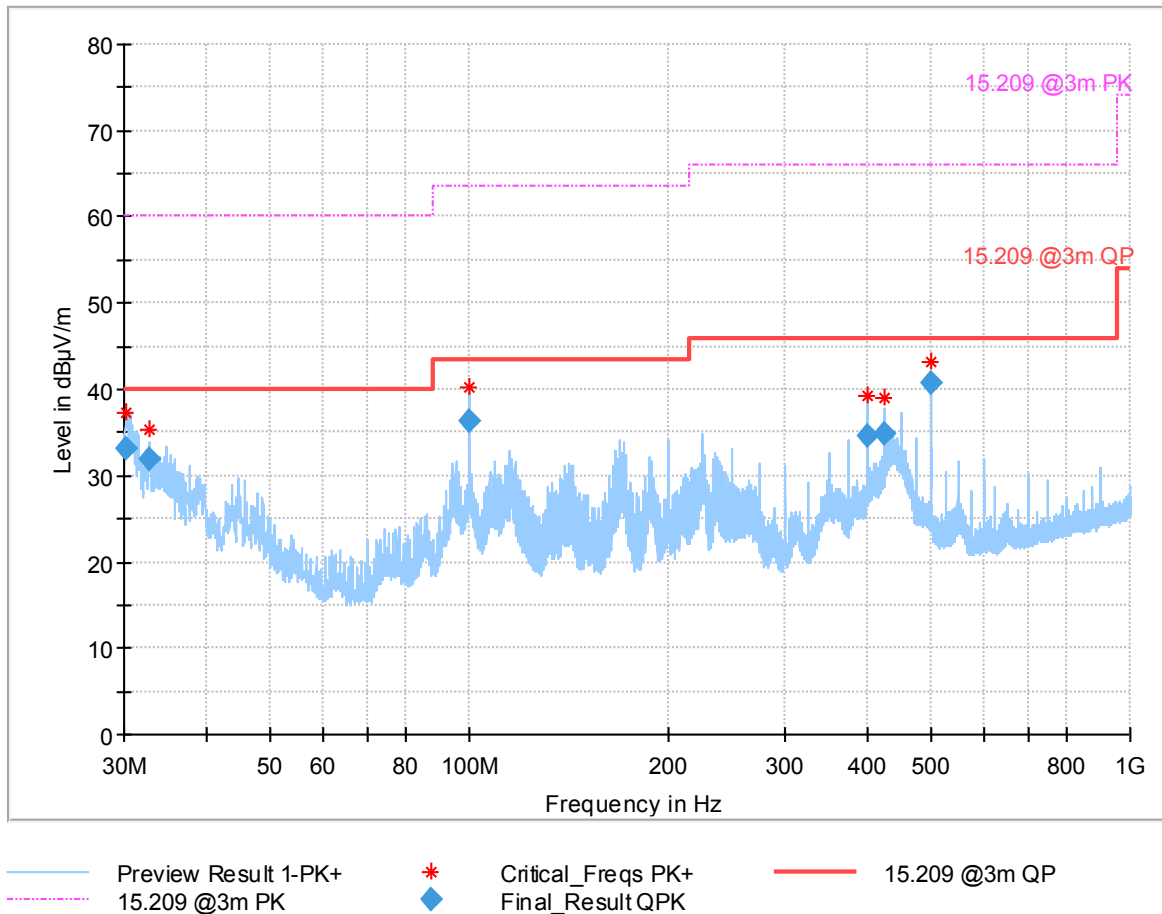
1.2.3 30 MHz – 1 GHz, set-up 2, op. 1, EUTs lying



Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
30.180000	35.14	40.00	4.86	100.0	120.000	103.0	V	120.0
32.695000	32.92	40.00	7.08	100.0	120.000	100.0	V	209.0
100.000000	34.94	43.50	8.56	100.0	120.000	243.0	H	134.0
400.000000	37.56	46.00	8.44	100.0	120.000	104.0	V	30.0
425.000000	37.44	46.00	8.56	100.0	120.000	100.0	V	355.0
500.000000	39.15	46.00	6.85	100.0	120.000	100.0	V	10.0

1.2.4 30 MHz – 1 GHz, set-up 2, op. 1, EUTs staying

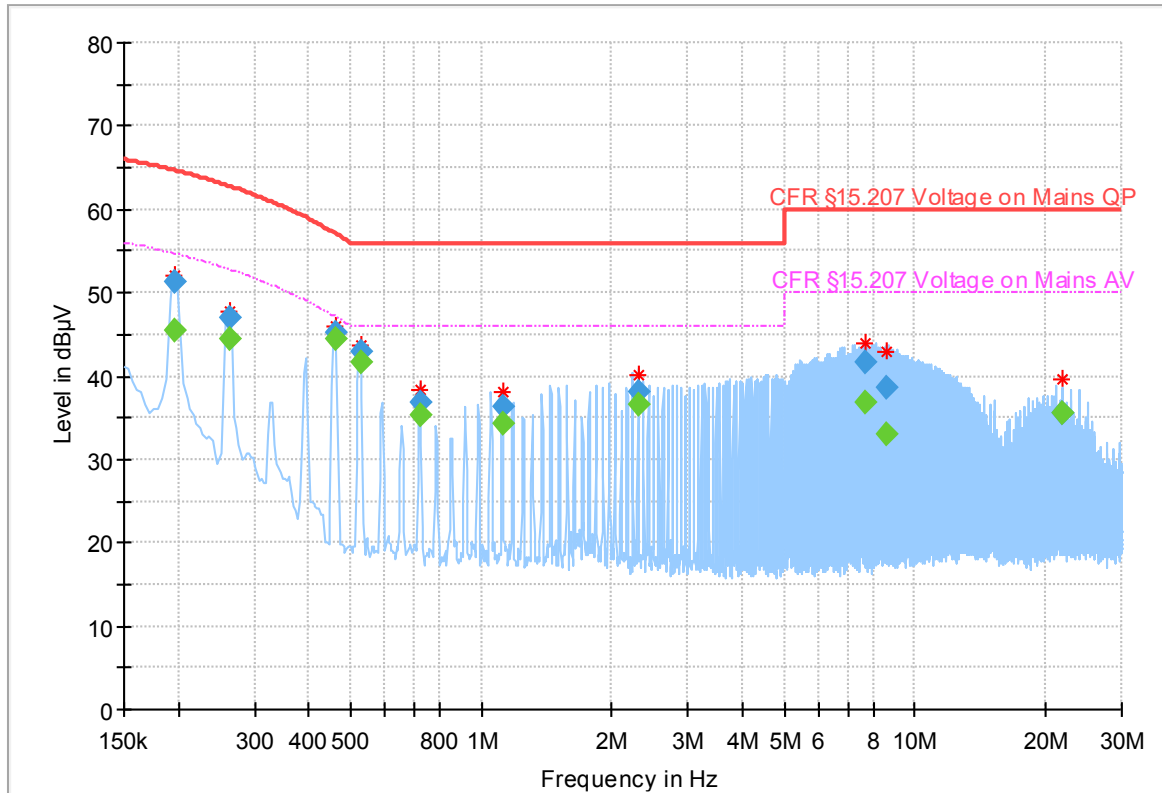


Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
30.180000	33.18	40.00	6.82	100.0	120.000	103.0	V	270.0
32.725000	31.89	40.00	8.11	100.0	120.000	100.0	V	134.0
100.000000	36.25	43.50	7.25	100.0	120.000	230.0	H	126.0
400.000000	34.67	46.00	11.33	100.0	120.000	100.0	V	4.0
425.000000	34.96	46.00	11.04	100.0	120.000	104.0	V	295.0
500.000000	40.79	46.00	5.21	100.0	120.000	100.0	V	300.0

2 CONDUCTED EMISSIONS

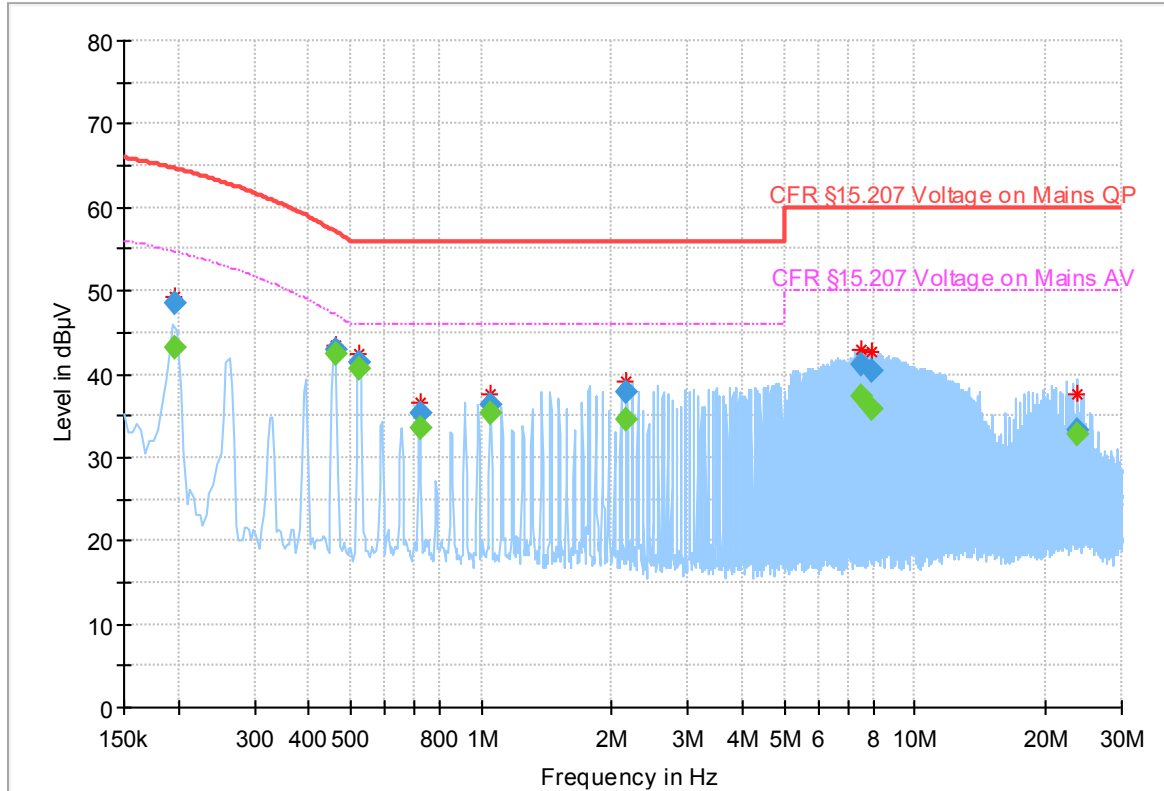
2.1 Conducted emissions, line L1, set-up 1, op. 1



Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter
0.197106	---	45.58	54.65	9.08	15000.0	9.000	L1	OFF
0.197106	51.32	---	64.65	13.34	15000.0	9.000	L1	OFF
0.263521	---	44.38	52.76	8.38	15000.0	9.000	L1	OFF
0.263521	47.02	---	62.76	15.74	15000.0	9.000	L1	OFF
0.459524	---	44.54	47.16	2.62	15000.0	9.000	L1	OFF
0.459524	45.26	---	57.16	11.89	15000.0	9.000	L1	OFF
0.526781	---	41.77	46.00	4.23	15000.0	9.000	L1	OFF
0.526781	42.80	---	56.00	13.20	15000.0	9.000	L1	OFF
0.722954	---	35.28	46.00	10.72	15000.0	9.000	L1	OFF
0.722954	36.87	---	56.00	19.13	15000.0	9.000	L1	OFF
1.117797	---	34.29	46.00	11.71	15000.0	9.000	L1	OFF
1.117797	36.43	---	56.00	19.57	15000.0	9.000	L1	OFF
2.301242	---	36.62	46.00	9.38	15000.0	9.000	L1	OFF
2.301242	38.21	---	56.00	17.79	15000.0	9.000	L1	OFF
7.691898	---	36.89	50.00	13.11	15000.0	9.000	L1	OFF
7.691898	41.53	---	60.00	18.47	15000.0	9.000	L1	OFF
8.613593	---	32.99	50.00	17.01	15000.0	9.000	L1	OFF
8.613593	38.53	---	60.00	21.47	15000.0	9.000	L1	OFF
21.962414	---	35.47	50.00	14.53	15000.0	9.000	L1	OFF
21.962414	35.66	---	60.00	24.34	15000.0	9.000	L1	OFF

2.2 Conducted emissions, line N, set-up 1, op. 1

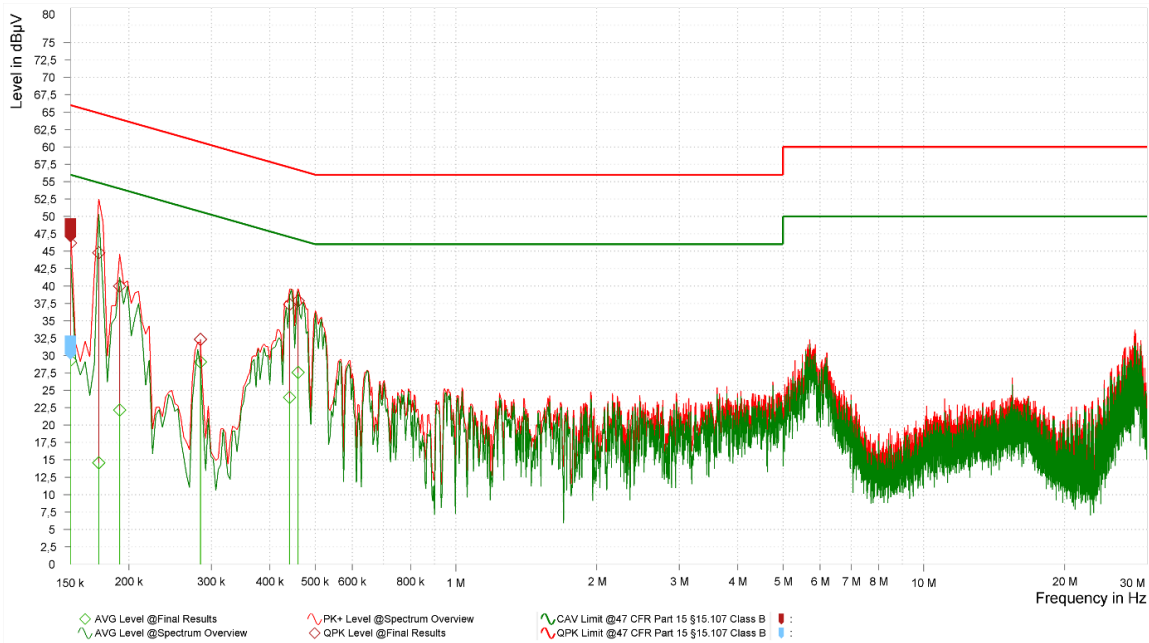


- Preview Result 1-PK+
- CFR §15.207 Voltage on Mains QP
- ◆ Final_Result QPK
- - - CFR §15.207 Voltage on Mains AV
- * Critical_Freqs PK+
- ◆ Final_Result AVG

Final Result

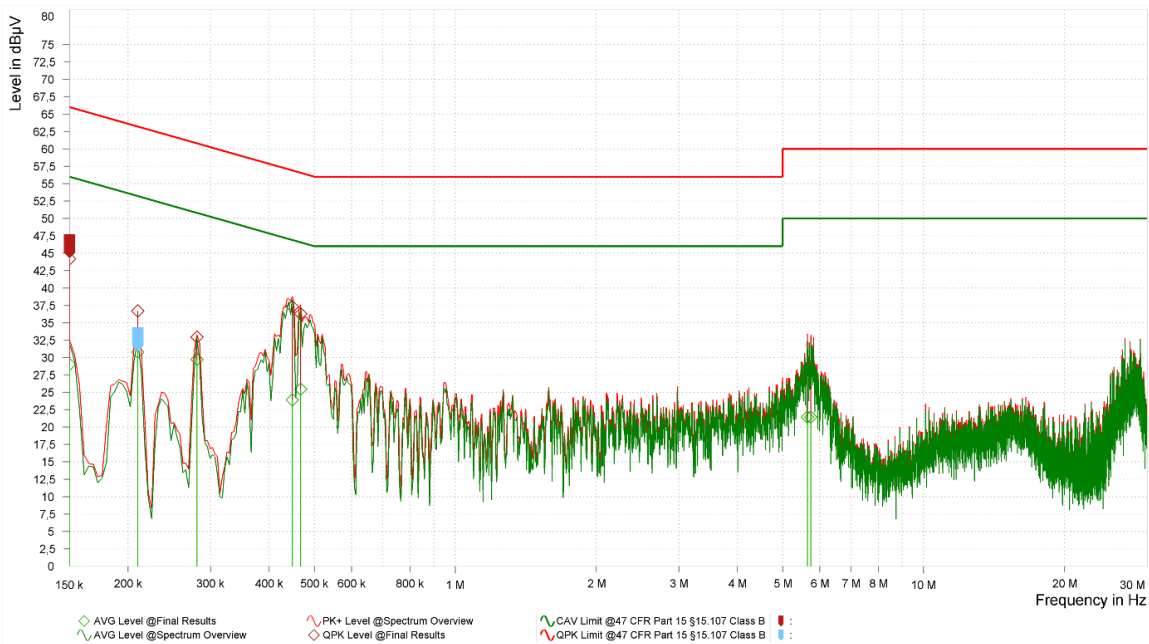
Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter
0.196915	---	43.17	54.66	11.49	15000.0	9.000	N	OFF
0.196915	48.55	---	64.66	16.11	15000.0	9.000	N	OFF
0.459715	---	42.33	47.15	4.82	15000.0	9.000	N	OFF
0.459715	42.84	---	57.15	14.31	15000.0	9.000	N	OFF
0.525430	---	40.54	46.00	5.46	15000.0	9.000	N	OFF
0.525430	41.52	---	56.00	14.48	15000.0	9.000	N	OFF
0.722593	---	33.50	46.00	12.50	15000.0	9.000	N	OFF
0.722593	35.32	---	56.00	20.68	15000.0	9.000	N	OFF
1.051624	---	35.33	46.00	10.67	15000.0	9.000	N	OFF
1.051624	36.35	---	56.00	19.65	15000.0	9.000	N	OFF
2.167458	---	34.53	46.00	11.47	15000.0	9.000	N	OFF
2.167458	37.89	---	56.00	18.11	15000.0	9.000	N	OFF
7.489885	---	37.25	50.00	12.75	15000.0	9.000	N	OFF
7.489885	41.26	---	60.00	18.74	15000.0	9.000	N	OFF
7.950281	---	35.89	50.00	14.11	15000.0	9.000	N	OFF
7.950281	40.39	---	60.00	19.61	15000.0	9.000	N	OFF
23.656567	---	32.83	50.00	17.17	15000.0	9.000	N	OFF
23.656567	33.35	---	60.00	26.65	15000.0	9.000	N	OFF

2.3 Conducted emissions, line L1, set-up 2, op. 1



Rg	Frequency [MHz]	QPK Level [dBµV]	QPK Limit [dBµV]	QPK Margin [dB]	AVG Level [dBµV]	AVG: CAV Limit [dBµV]	AVG Margin [dB]	Correction [dB]	Line	Meas. BW [kHz]	Meas. Time [s]
1	0,150	46,17	66,00	19,83	29,30	56,00	26,70	10,79	L1	9,000	15,000
1	0,172	44,78	64,84	20,07	14,56	54,84	40,28	9,95	L1	9,000	15,000
1	0,191	39,99	63,99	24,00	22,17	53,99	31,83	9,90	L1	9,000	15,000
1	0,284	32,33	60,69	28,35	29,06	50,69	21,63	9,79	L1	9,000	15,000
1	0,441	37,36	57,04	19,69	23,99	47,04	23,06	10,06	L1	9,000	15,000
1	0,460	37,85	56,70	18,85	27,58	46,70	19,12	10,07	L1	9,000	15,000

2.4 Conducted emissions, line N, set-up 2, op. 1

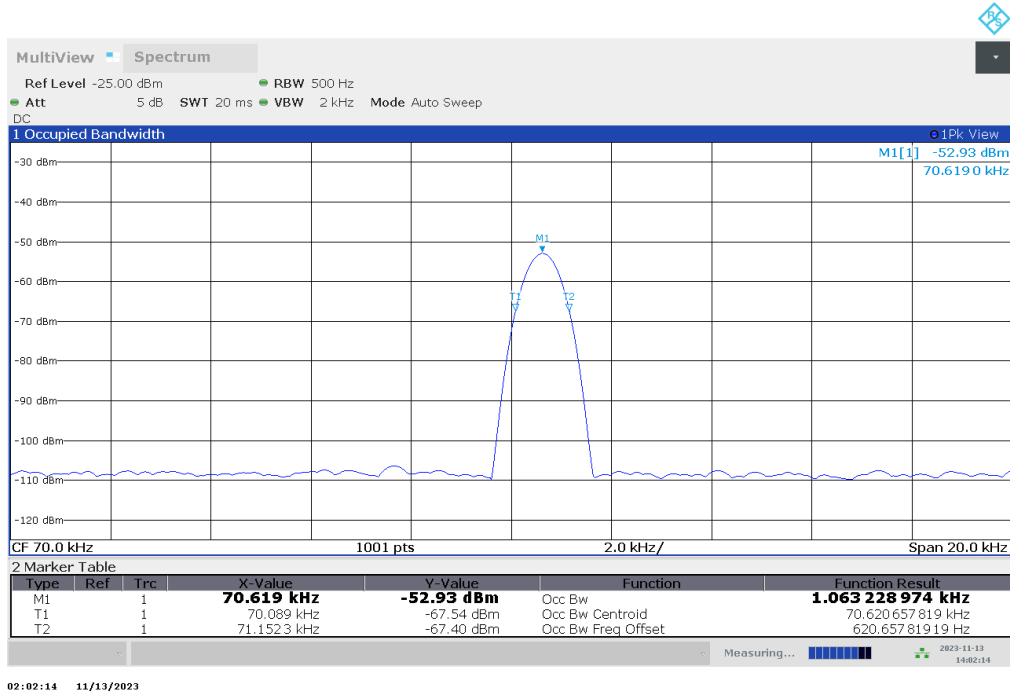


Rg	Frequency [MHz]	QPK Level [dBµV]	QPK Limit [dBµV]	QPK Margin [dB]	AVG Level [dBµV]	AVG: CAV Limit [dBµV]	AVG Margin [dB]	Correction [dB]	Line	Meas. BW [kHz]	Meas. Time [s]
1	0,150	44,20	66,00	21,80	29,02	56,00	26,98	10,79	N	9,000	15,000
1	0,210	36,71	63,22	26,51	30,80	53,22	22,42	9,84	N	9,000	15,000
1	0,281	32,95	60,80	27,84	29,73	50,80	21,07	9,79	N	9,000	15,000
1	0,449	37,31	56,90	19,59	23,90	46,90	23,01	10,07	N	9,000	15,000
1	0,467	36,30	56,56	20,26	25,45	46,56	21,11	10,08	N	9,000	15,000
1	5,646	28,46	60,00	31,54	21,45	50,00	28,55	10,02	N	9,000	15,000
1	5,743	28,72	60,00	31,28	21,44	50,00	28,56	10,03	N	9,000	15,000

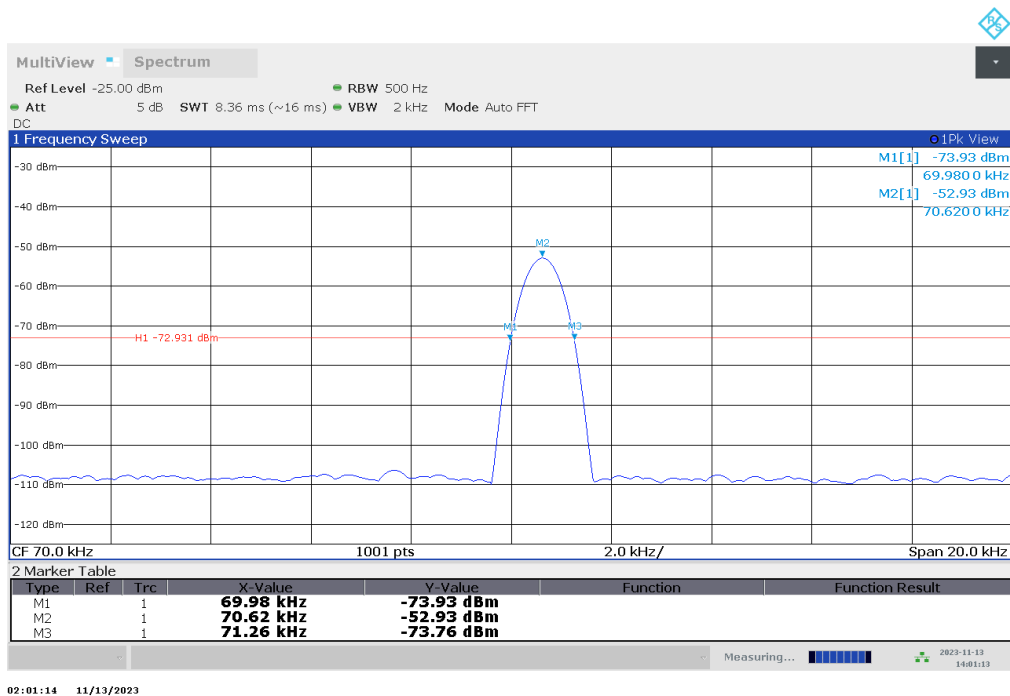
Annex A of TR no.: 22107918-31529-2

3 OCCUPIED BANDWIDTH

3.1 BW 99 %, set-up 3, op. 1

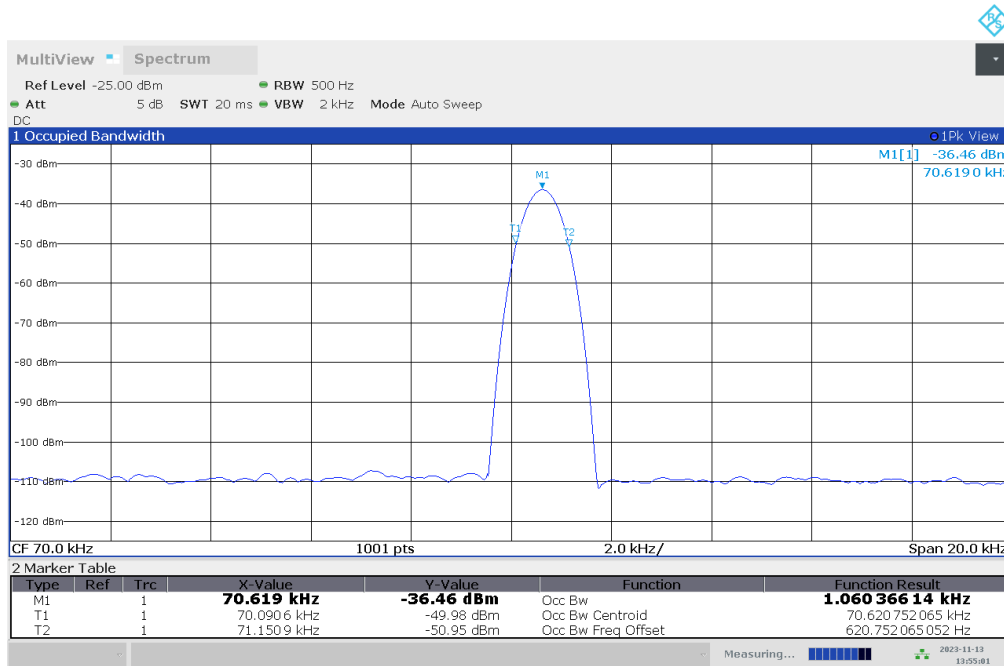


3.2 BW 20 dB, set-up 3, op. 1



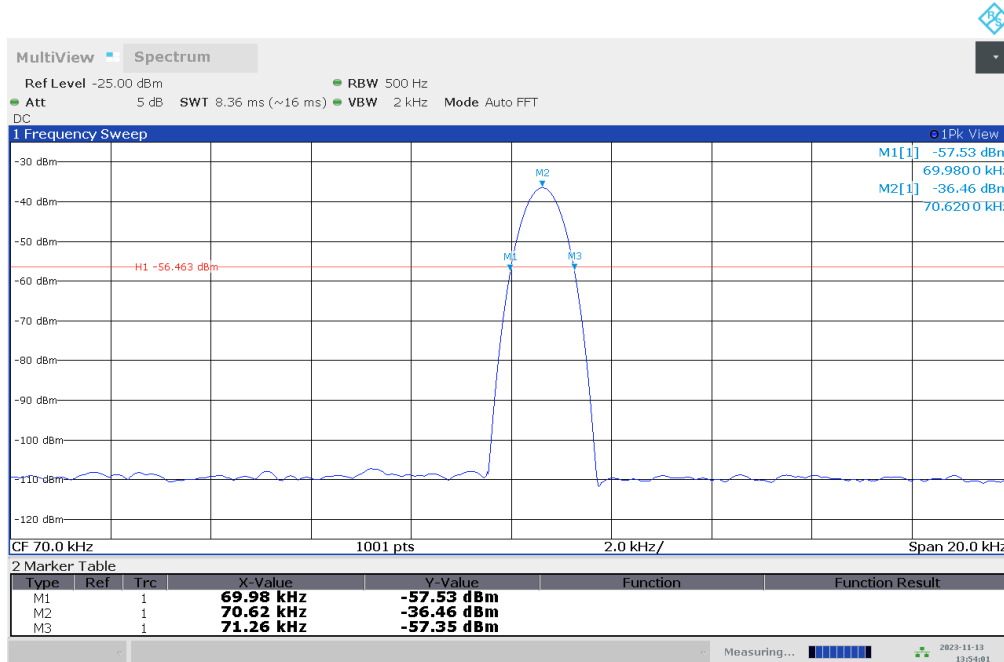
Annex A of TR no.: 22107918-31529-2

3.3 BW 99 %, set-up 4, op. 1



01:55:01 11/13/2023

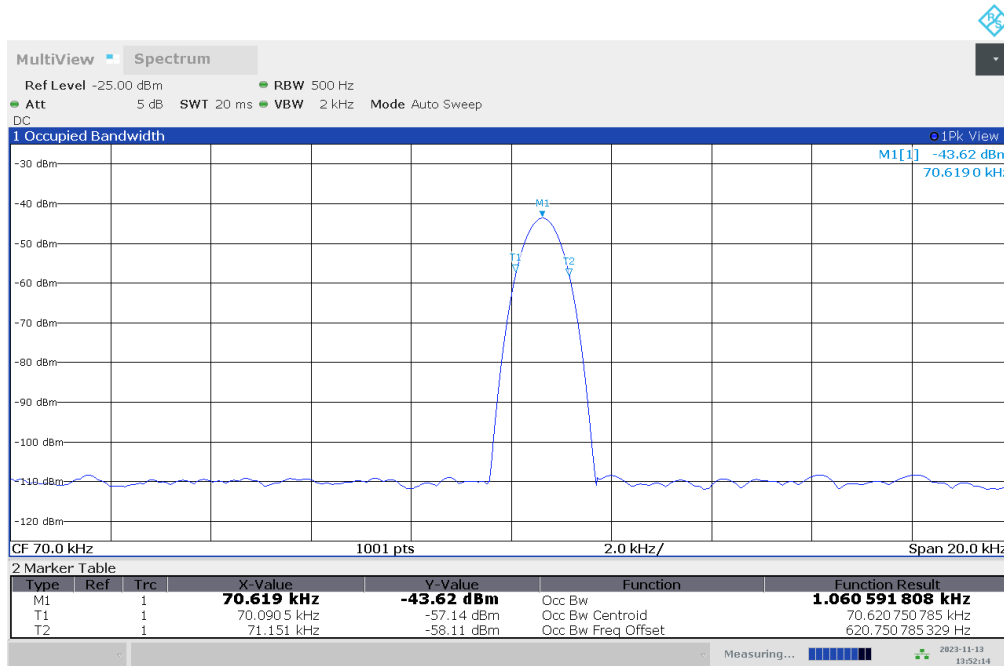
3.4 BW 20 dB, set-up 4, op. 1



01:54:01 11/13/2023

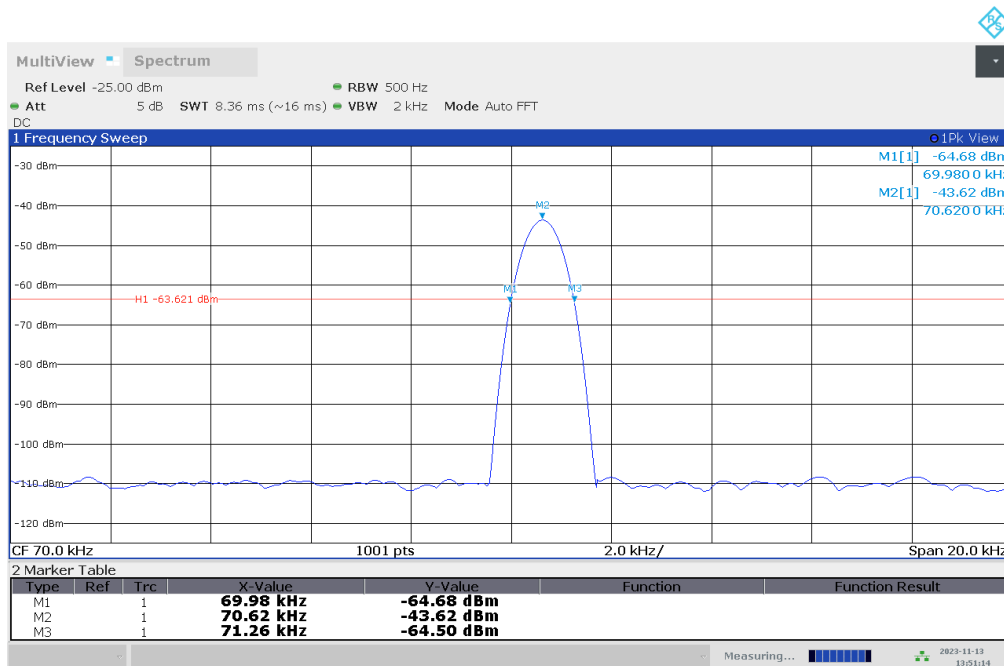
Annex A of TR no.: 22107918-31529-2

3.5 BW 99 %, set-up 5, op. 1



01:52:15 11/13/2023

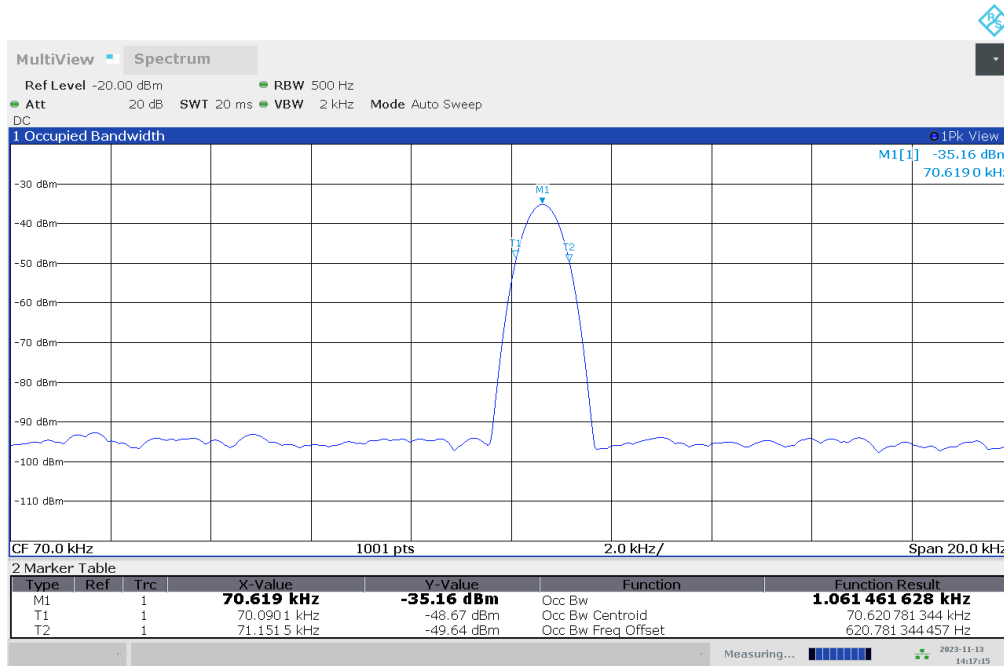
3.6 BW 20 dB, set-up 5, op. 1



01:51:14 11/13/2023

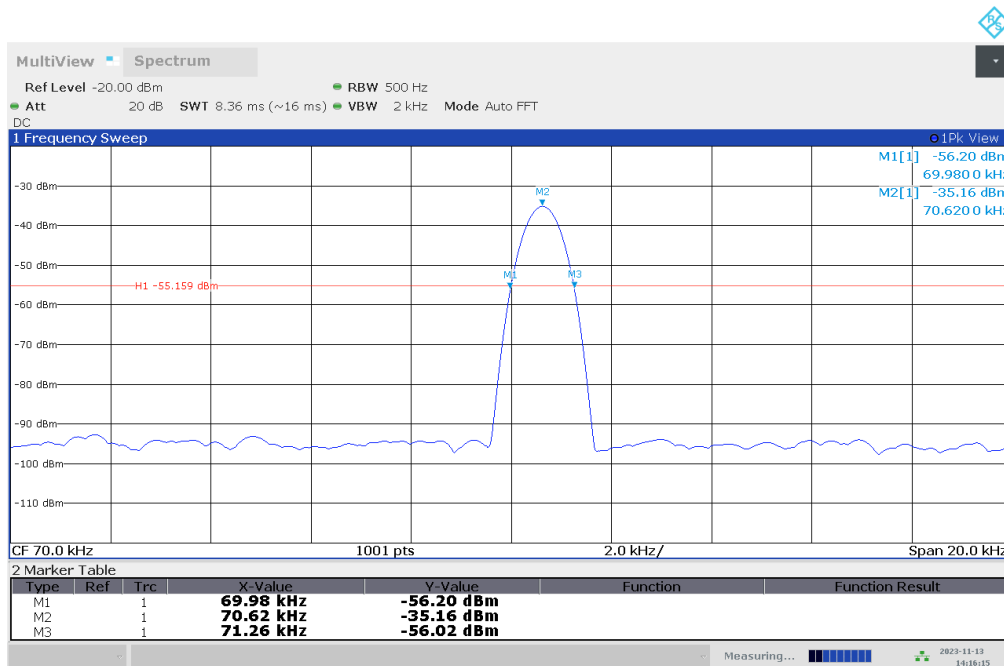
Annex A of TR no.: 22107918-31529-2

3.7 BW 99 %, set-up 6, op. 1



02:17:16 11/13/2023

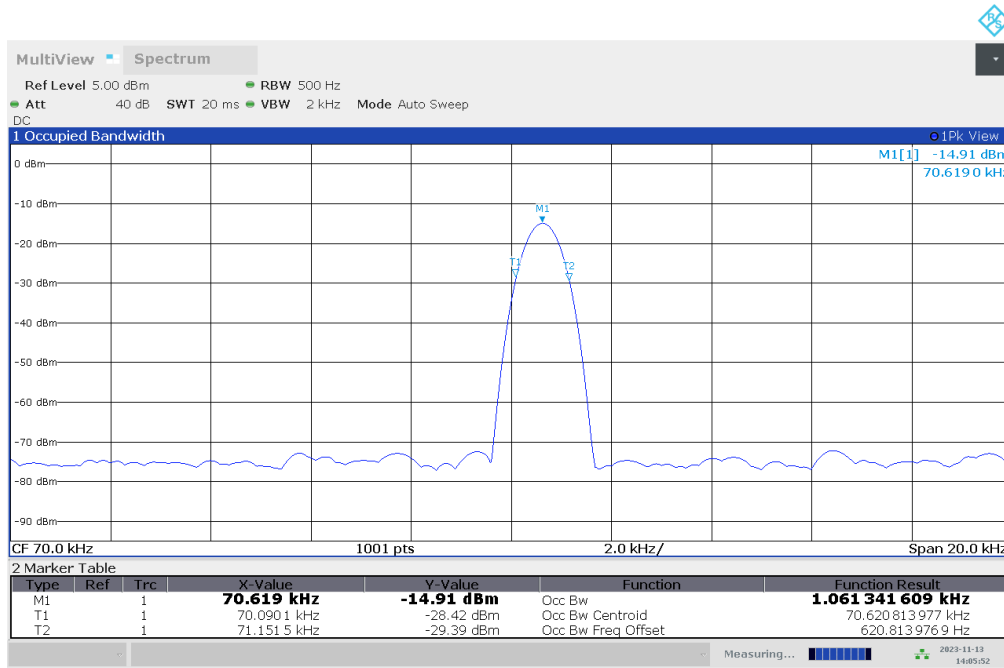
3.8 BW 20 dB, set-up 6, op. 1



02:16:16 11/13/2023

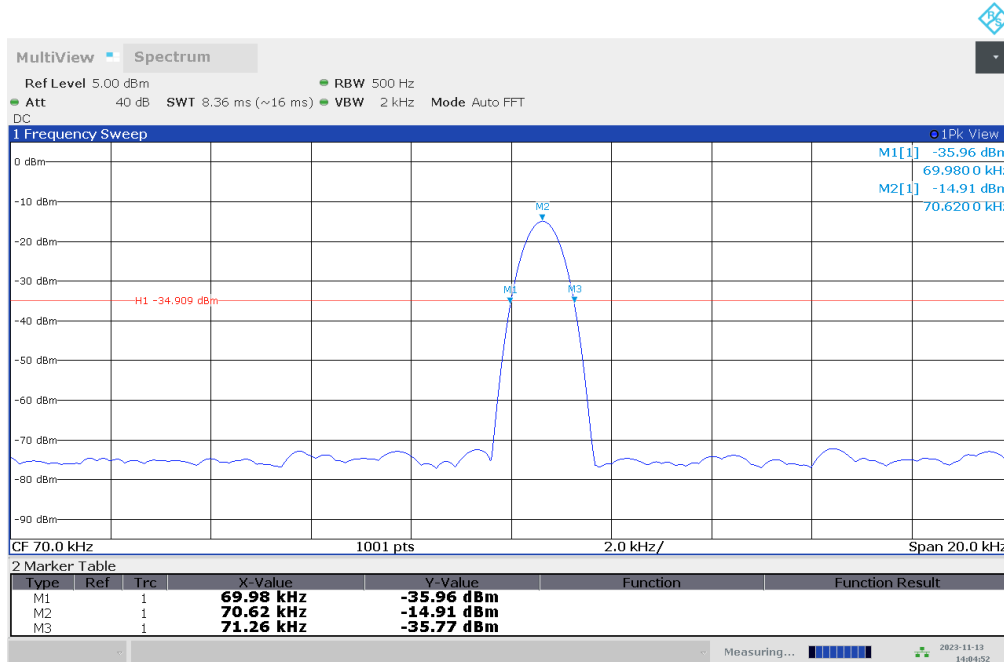
Annex A of TR no.: 22107918-31529-2

3.9 BW 99 %, set-up7 , op. 1



02:05:53 11/13/2023

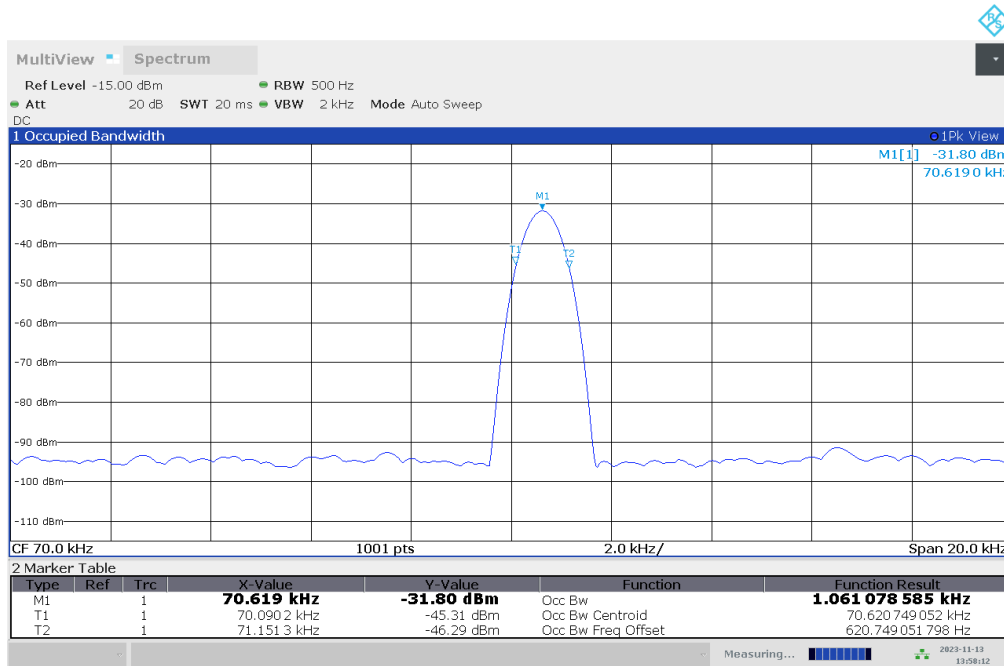
3.10 BW 20 dB, set-up 7, op. 1



02:04:53 11/13/2023

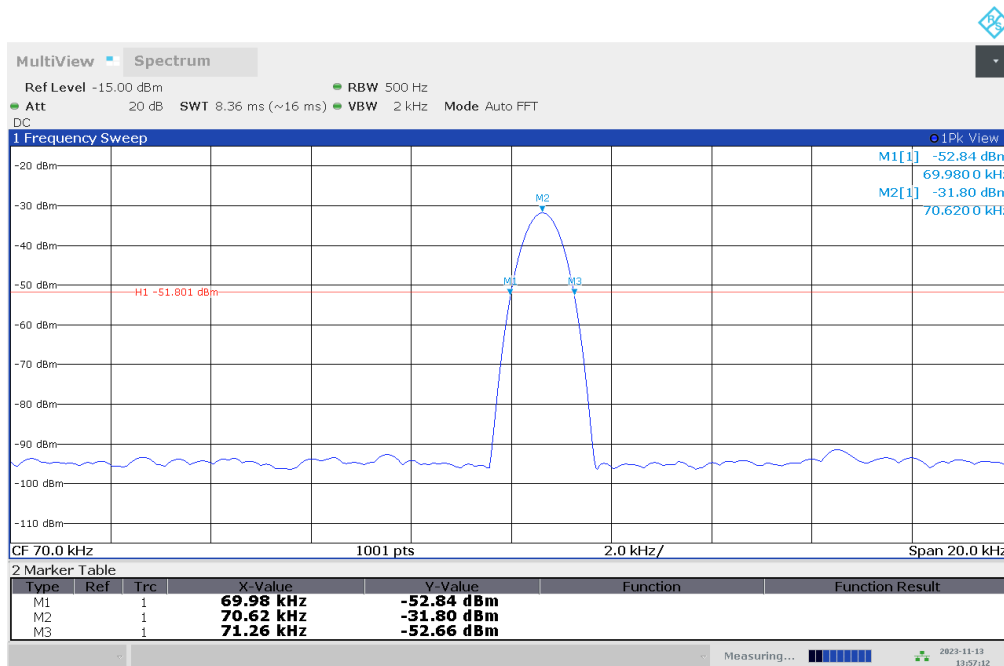
Annex A of TR no.: 22107918-31529-2

3.11 BW 99 %, set-up 8, op. 1



01:58:13 11/13/2023

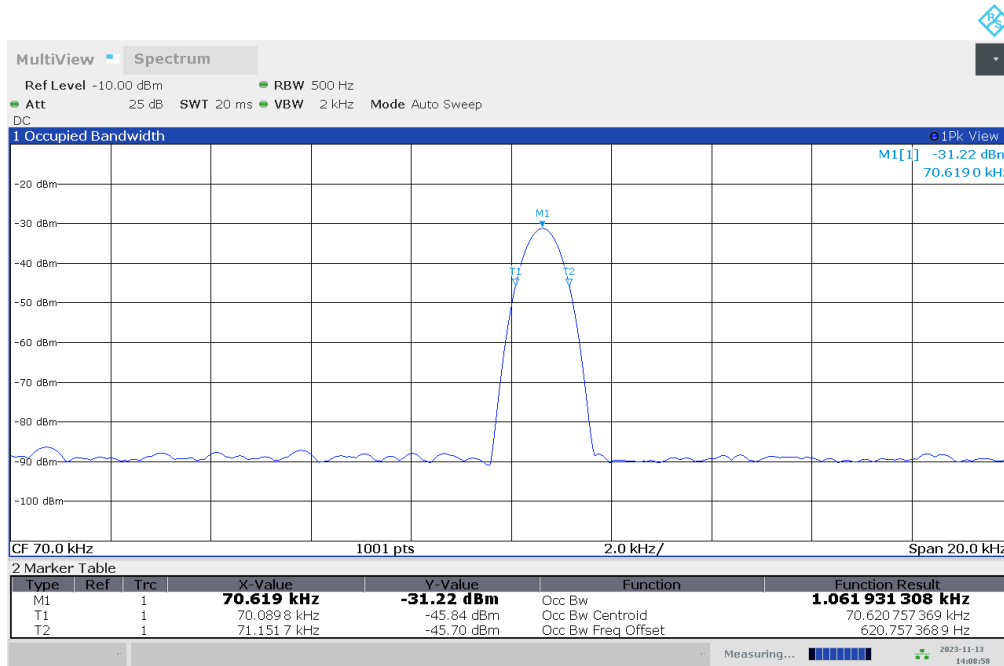
3.12 BW 20 dB, set-up 8, op. 1



01:57:13 11/13/2023

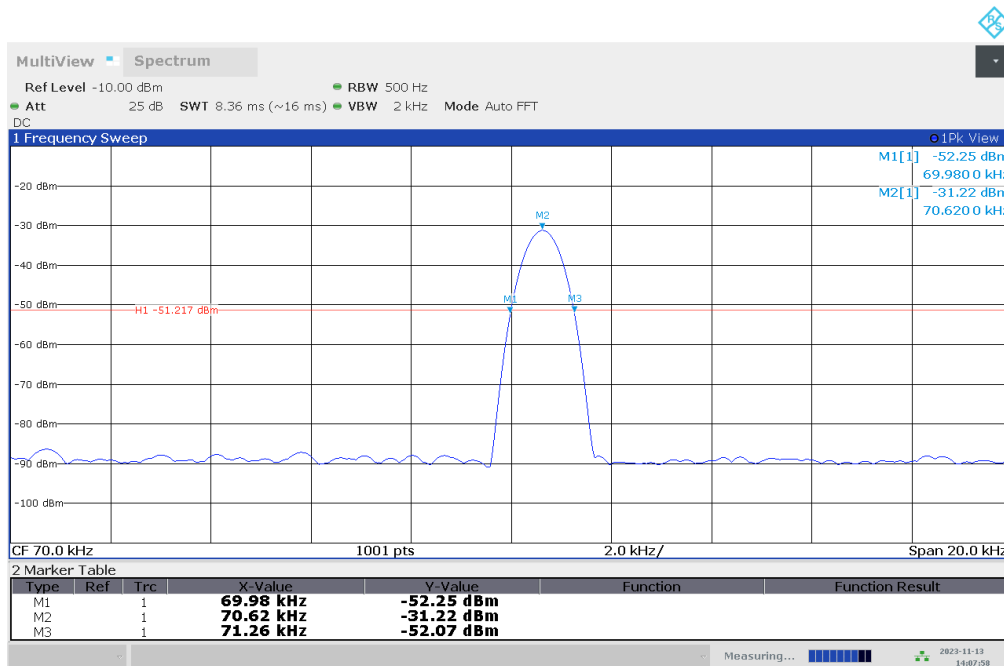
Annex A of TR no.: 22107918-31529-2

3.13 BW 99 %, set-up 9, op. 1



02:08:59 11/13/2023

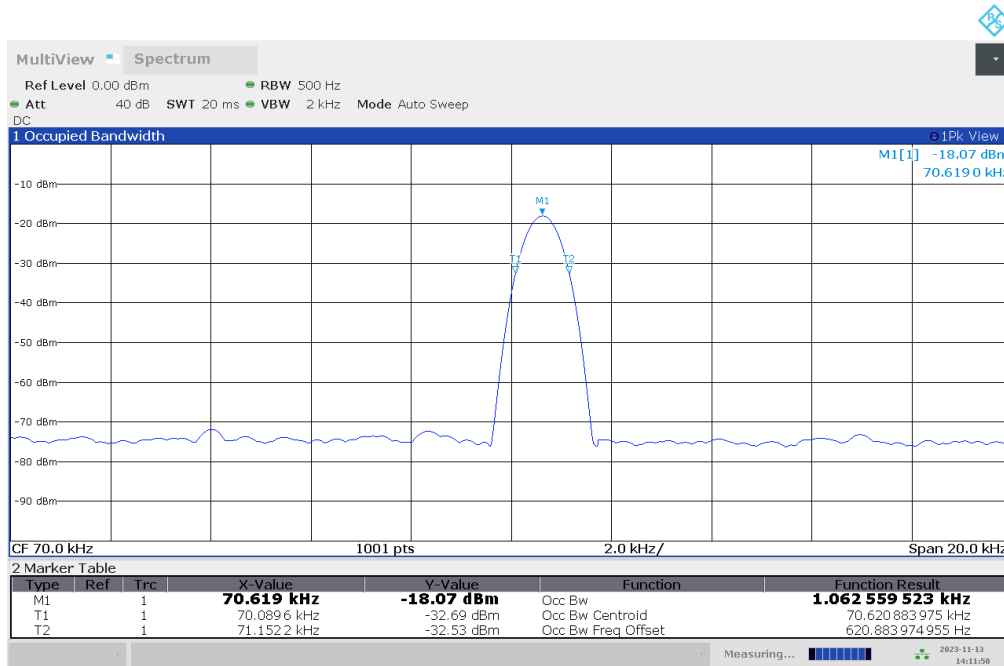
3.14 BW 20 dB, set-up 9, op. 1



02:07:59 11/13/2023

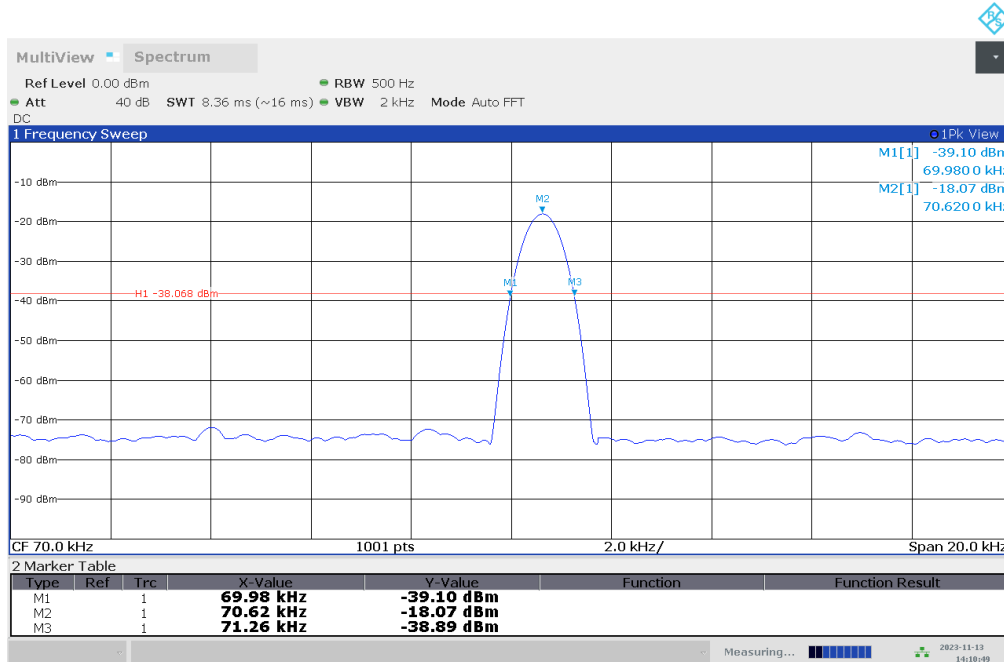
Annex A of TR no.: 22107918-31529-2

3.15 BW 99 %, set-up 10, op. 1



02:11:50 11/13/2023

3.16 BW 20 dB, set-up 10, op. 1



02:10:50 11/13/2023