DAkkS Deutsche Akkreditierungsstelle D-PL-21375-01-03 D-PL-21375-01-04

INGENIEURBÜRO LENHARDT

Bundesnetzagentur BNetzA-CAB-21/21-21

Test Report

Test report no.: 21075947-25568-0
Date of issue: 2022-05-02

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

Applicant
Continental Automotive GmbH

Manufacturer
Continental Automotive GmbH

Test Item
RHT433

RF-Spectrum Testing according to:

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

RSS-210, Issue 10 (2019-12)
Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

RSS-Gen, Issue 5 (2018-04)
General Requirements for Compliance of Radio Apparatus

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

Applicant and Test item details	
Applicant	Continental Automotive GmbH Siemensstrasse 12 D-93055, Regensburg, Germany
Manufacturer	Same as applicant
Test item description	Car Key with RKE and PASE
Model/Type reference	RHT433
FCC ID	M3NRHT433
IC	7812A-RHT433
HMN	RHT433
PMN	Continental RHT433
HVIN	N/A
FVIN	N/A
Frequency	433.92 MHz
Antenna	Integrated PCB antenna
Power supply	3 V battery
Temperature range	-20 °C to +70 °C

Disclaimer and Notes

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

IBL-Lab GmbH does not take test samples. The samples used for testing are provided by the applicant.

Decision rule:
Decision rule based on simple acceptance without guard bands, binary statement, based on mutually agreed uncertainty tolerances with expansion factor k=2 according to ILAC-G8:09/2019

1 TABLE OF CONTENTS

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 D-PL-21375-01-01 • Electromagnetic Compatibility D-PL-21375-01-02 • Electromagnetic Compatibility and Telecommunication (FCC requirements) D-PL-21375-01-03 Testing Laboratory Designation Number DE0024 • Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards D-PL-21375-01-04 ISED Company Number 27156 Testing Laboratory CAB Identifier DE0020 • Telecommunication (TC) D-PL-21375-01-05 Website DAkkS: https://www.dakks.de/ The Deutsche Akkreditierungsstelle GmbH (DAkkS) is also a signatory to the ILAC Mutual Recognition Arrangement
Testing location	**IBL-Lab GmbH** Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany
Date of receipt of test samples	2022-03-01
Start – End of tests	2022-03-10 – 2022-03-14

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

2.6 Further documents

List of further applicable documents belonging to the present test report:
– no additional documents –

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	230 V / 50 Hz

3.2 Normal and extreme test conditions

	minimum	normal	maximum
Temperature	-20 °C	20 °C	+70 °C
Relative humidity	-/-	45 % r.h.	-/-
Power supply	2.3 V DC	3 V DC	3.2 V DC

4 TEST STANDARDS AND REFERENCES

Test standard (accredited)	Description
FCC 47 CFR Part 15	Radio Frequency Devices (Subpart C)
RSS-210, Issue 10 (2019-12)	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen, Issue 5 (2018-04)	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

Car Key with RKE and PASE

5.2 Description of test item

Model name*	RHT433
Serial number*	conducted EUT: engineering sample radiated EUT: engineering sample
PCB identifier*	A2C12690100_01
Hardware status*	01
Software status*	31.00

*: as declared by applicant

5.3 Technical data of test item

Operational frequency*	433.92 MHz
Operational frequency band*	433.05 MHz – 434.79 MHz
Type of radio transmission*	**RKE protocol** LOCK – Continuous message group UNLOCK – Continuous wave TRUNK – Continuous Manchester **PASE protocol** LOCK + UNLOCK – Continuous wave TRUNK + LOCK – Continuous wave UNLOCK + TRUNK – Continuous Manchester
Modulation type*	**RKE protocol** LOCK – Continuous message group UNLOCK – ASK TRUNK – ASK **PASE protocol** LOCK + UNLOCK – FSK TRUNK + LOCK – FSK UNLOCK + TRUNK – FSK
Number of channels*	3
Antenna*	Integrated PCB antenna
Power supply*	3 V battery
Temperature range*	-20 °C to +70 °C

*: as declared by applicant

5.4 Additional information

Model differences	none
Ancillaries tested with	none
Additional equipment used for testing	none

6 SUMMARY OF TEST RESULTS

Test specification
FCC 47 CFR Part 15 **RSS-210, Issue 10 (2019-12)** **RSS-Gen, Issue 5 (2018-04)**

Clause	Requirement / Test case	Test Conditions	Result / Remark	Verdict
§15.231(b) RSS-210, D (b)	Fundamental field strength	Normal	86.4 dBµV/m @3m	Pass
§15.231(b) / §15.209(a) RSS-210, D (c)	Field strength of spurious emissions	Normal	< limit	Pass
§15.231 (a) (1) RSS-210, A.1.1(a)	Transmit time	Normal	< limit	Pass
§15.231(c) RSS-Gen, 6.7	20 dB bandwidth Occupied bandwidth	Normal	76.90 kHz 67.283 kHz	Pass

Notes
– none –

Comments and observations
– none –

7 TEST RESULTS

7.1 Field strength of fundamental

Description / Limits

§15.231 (b) / RSS-210, D (b)

In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Frequency [MHz]	Field strength of fundamental @3m	
	[µV/m]	[dBuV/m]
40.66-40.70	2250	67.04
70-130	1250	61.93
130-174	1250 to 3750*	61.93 to 71.48*
174-260	3750	71.48
260-470	3750 to 12500*	71.48 to 81.93*
Above 470	12500	81.93

*Linear interpolations

(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges. (2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

Test procedure

§15.31 (m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range	Number of frequencies	Location
< 1MHz bandwidth	1	middle
1 – 10 MHz bandwidth	2	1 near bottom and 1 near top
> 10 MHz bandwidth	3	1 near bottom / middle / top

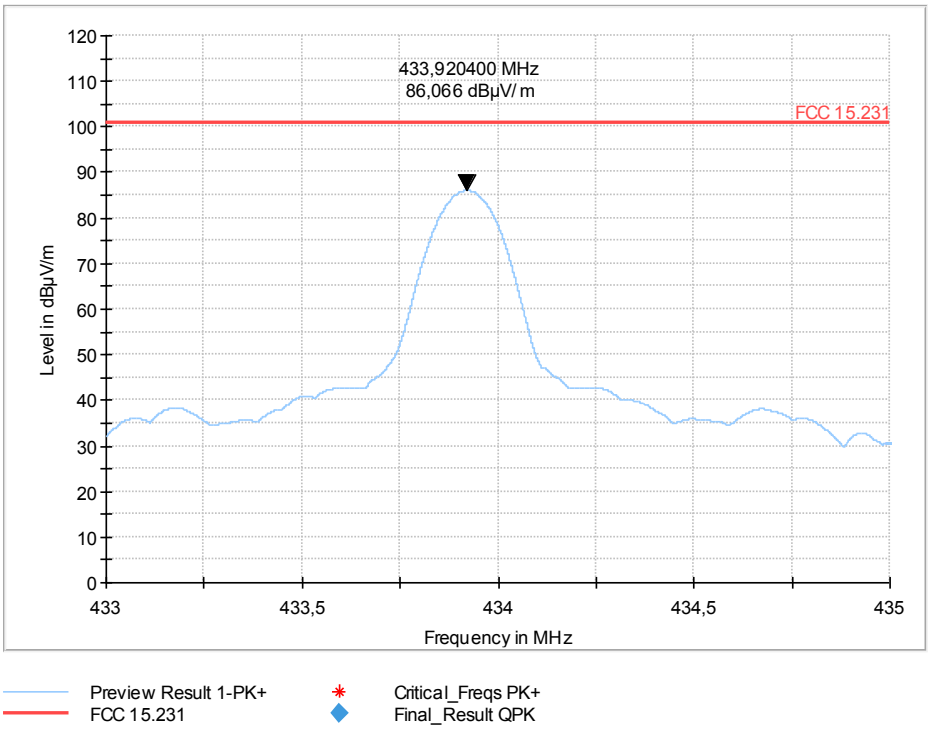
§15.35 (a) On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified. The specifications for the measuring instrumentation using the CISPR quasi-peak detector can be found in ANSI C63.4-2014, clause 4 (incorporated by reference, see §15.38). As an alternative to CISPR quasi-peak measurements, the responsible party, at its option, may demonstrate compliance with the emission limits using measuring equipment employing a peak detector function as long at the same bandwidth as indicated for CISPR quasi-peak measurements are employed.

Test setup: see 8.1

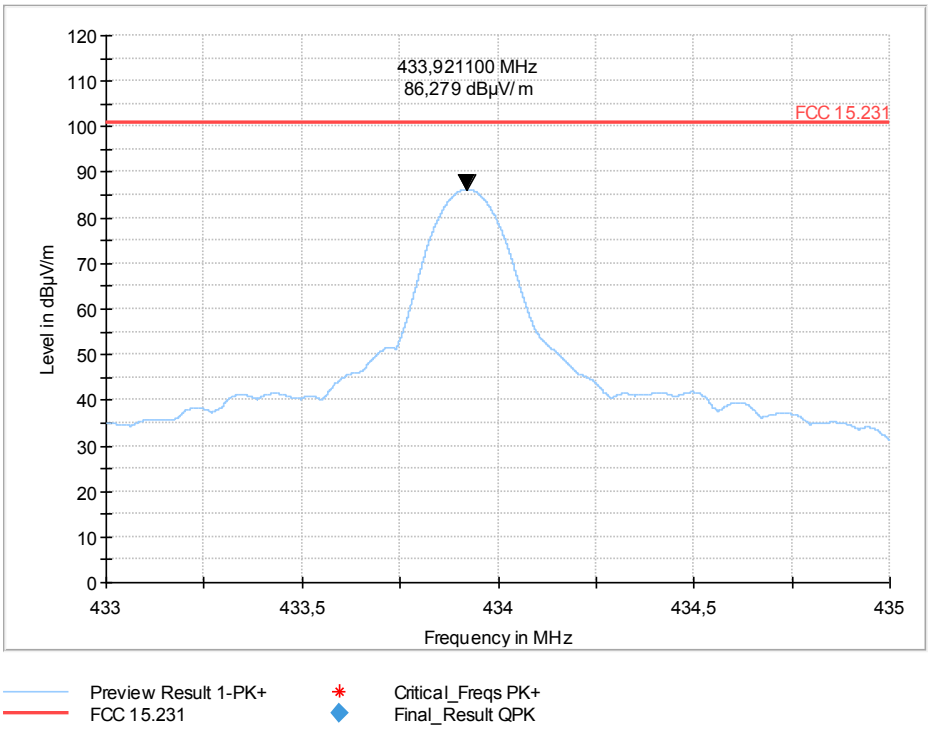
Test results:
Quasi-Peak-Limit at 433.92 MHz: 80.84 dBµV/m
Pos-Peak Limit at 433.92 MHz: 100.84 dBµV/m

EUT mode	Channel frequency [MHz]	Frequency [MHz]	Peak Field strength [dBµV/m]	Peak Limit [dBµV/m]	Margin [dB]	Verdict
RKE – LOCK	433.92	433.9204	86.066	100.84	14.774	Pass
RKE – UNLOCK	433.92	433.9211	86.279	100.84	14.561	Pass
RKE – TRUNK	433.92	433.9217	86.281	100.84	14.559	Pass
PASE – LOCK + UNLOCK	433.905	433.9055	86.194	100.84	14.646	Pass
PASE – LOCK + TRUNK	433.934	433.9344	86.253	100.84	14.587	Pass
PASE – UNLOCK + TRUNK	433.92	433.9062	**86.362**	100.84	14.478	Pass

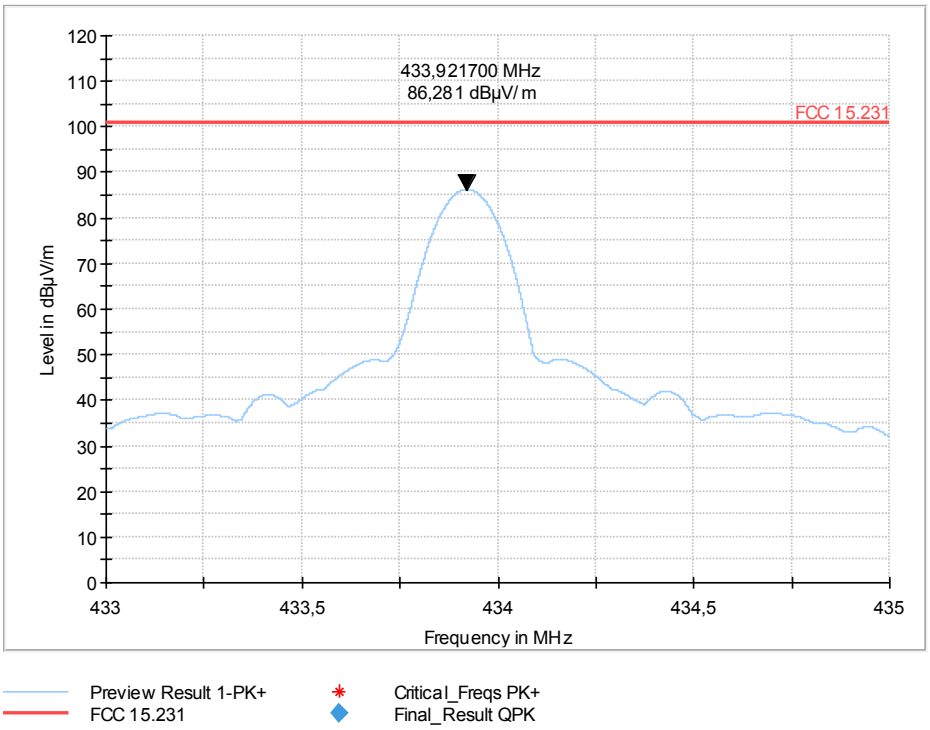
Plot no. 1: Fundamental field strength, RKE, LOCK



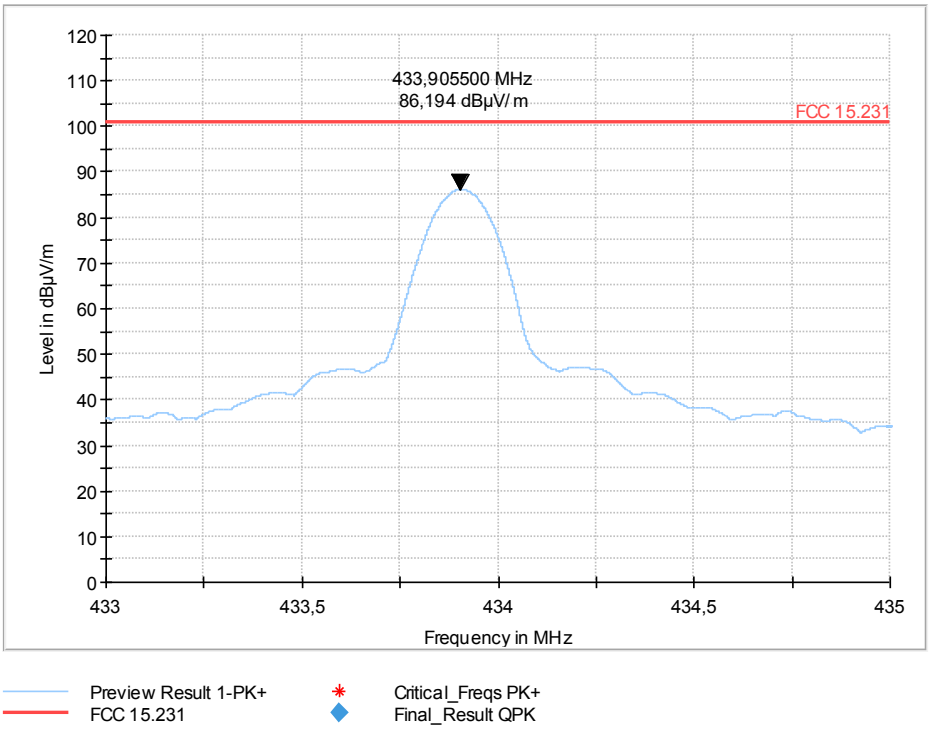
Plot no. 2: Fundamental field strength, RKE, UNLOCK



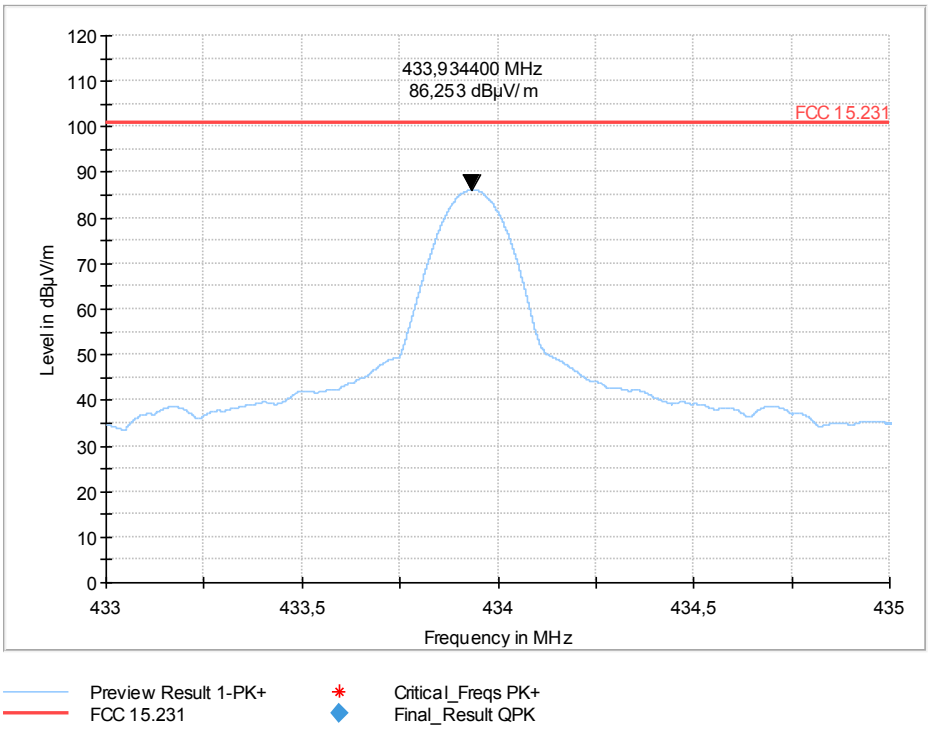
Plot no. 3: Fundamental field strength, RKE, TRUNK



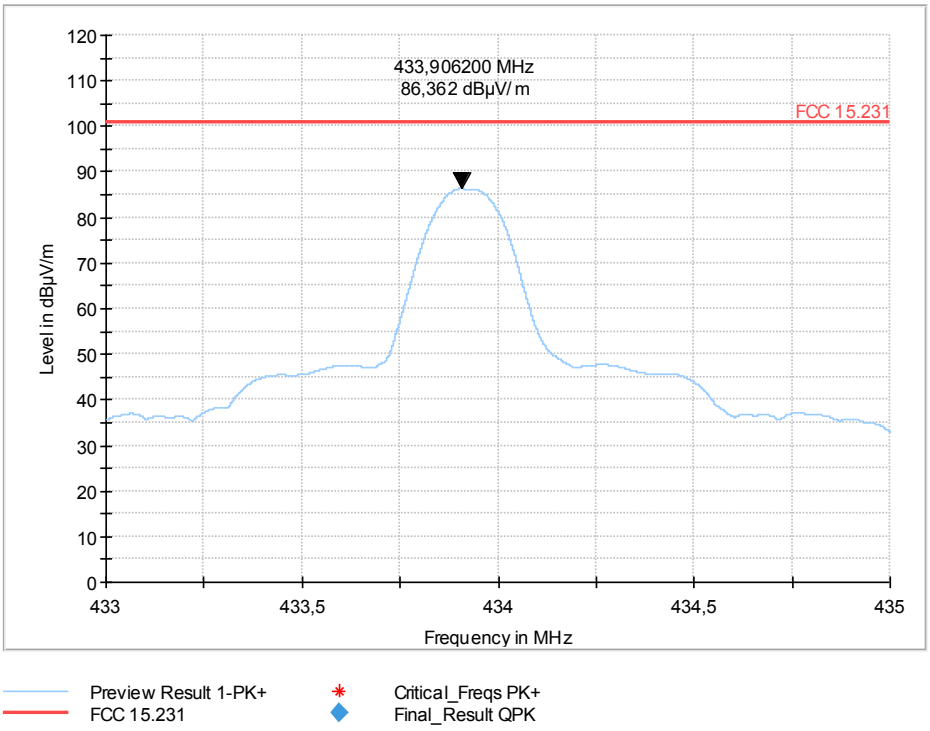
Plot no. 4: Fundamental field strength, PASE, LOCK + UNLOCK



Plot no. 5: Fundamental field strength, PASE, LOCK + TRUNK



Plot no. 6: Fundamental field strength, PASE, UNLOCK + TRUNK



7.2 Field strength of spurious emissions

Description / Limits

§15.231 (b) / RSS-210, D (c)

In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Frequency [MHz]	Field strength of spurious emissions @3m	
	[µV/m]	[dBuV/m]
40.66-40.70	225	47.04
70-130	125	41.94
130-174	125 to 375*	41.94 to 51.48*
174-260	375	51.48
260-470	375 to 1250*	51.48 to 61.94*
Above 470	1250	61.94

*Linear interpolations

(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges. (2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

§15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency	Field Strength	Measurement distance
0.009 – 0.490 MHz	2400/F[kHz] µV/m	300 m
0.490 – 1.705 MHz	24000/F[kHz] µV/m	30 m
1.705 – 30.0 MHz	30.0 µV/m / 29.5 dBµV/m	30 m
30 – 88 MHz	100 µV/m / 40.0 dBµV/m	3 m
88 – 216 MHz	150 µV/m / 43.5 dBµV/m	3 m
216 – 960 MHz	200 µV/m / 46.0 dBµV/m	3 m
960 – 100 000 MHz	500 µV/m / 54.0 dBµV/m	3 m

§15.209 (b) In the emission table above, the tighter limit applies at the band edges.

§15.209 (c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

§15.209 (d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector

Test procedure

§15.31 (m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range	Number of frequencies	Location
< 1MHz bandwidth	1	middle
1 – 10 MHz bandwidth	2	1 near bottom and 1 near top
> 10 MHz bandwidth	3	1 near bottom / middle / top

§15.35 (a) On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified. The specifications for the measuring instrumentation using the CISPR quasi-peak detector can be found in ANSI C63.4-2014, clause 4 (incorporated by reference, see §15.38). As an alternative to CISPR quasi-peak measurements, the responsible party, at its option, may demonstrate compliance with the emission limits using measuring equipment employing a peak detector function as long at the same bandwidth as indicated for CISPR quasi-peak measurements are employed.

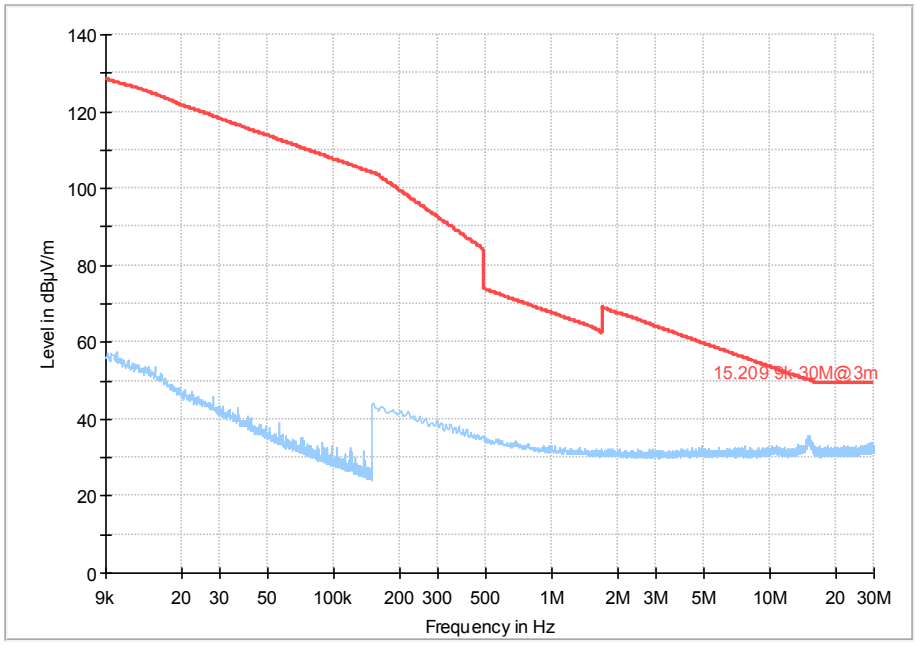
Test setup: see 8.1

Test results

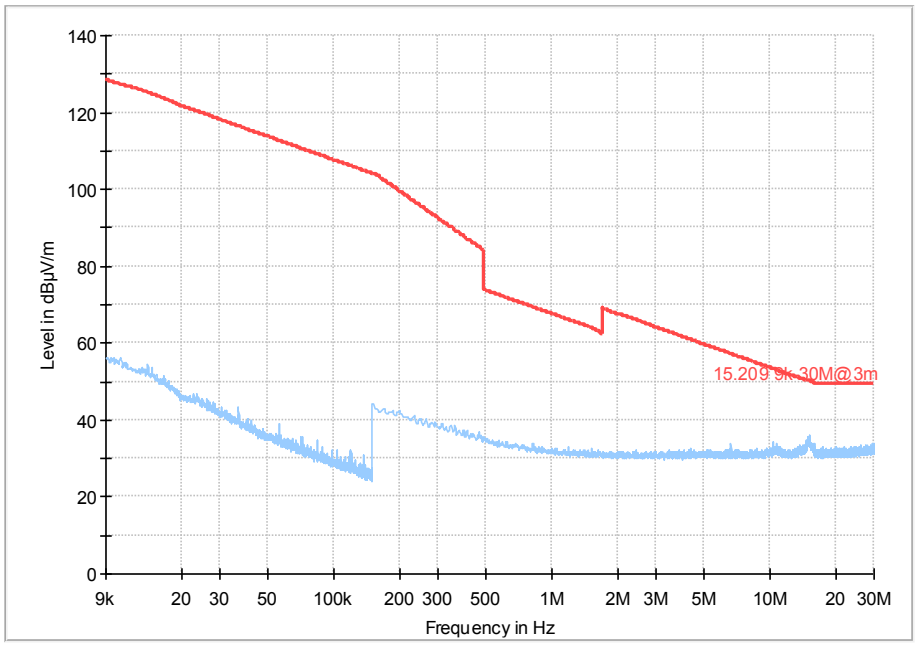
EUT mode	Channel frequency [MHz]	Frequency [MHz]	Detector	Test distance [m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]
RKE – LOCK	433.92	see plots	see plots	3	see plots	see plots	see plots
RKE – UNLOCK	433.92	see plots	see plots	3	see plots	see plots	see plots
RKE – TRUNK	433.92	see plots	see plots	3	see plots	see plots	see plots
PASE – LOCK + UNLOCK	433.905	see plots	see plots	3	see plots	see plots	see plots
PASE – LOCK + TRUNK	433.934	see plots	see plots	3	see plots	see plots	see plots
PASE – UNLOCK + TRUNK	433.92	see plots	see plots	3	see plots	see plots	see plots

Note:

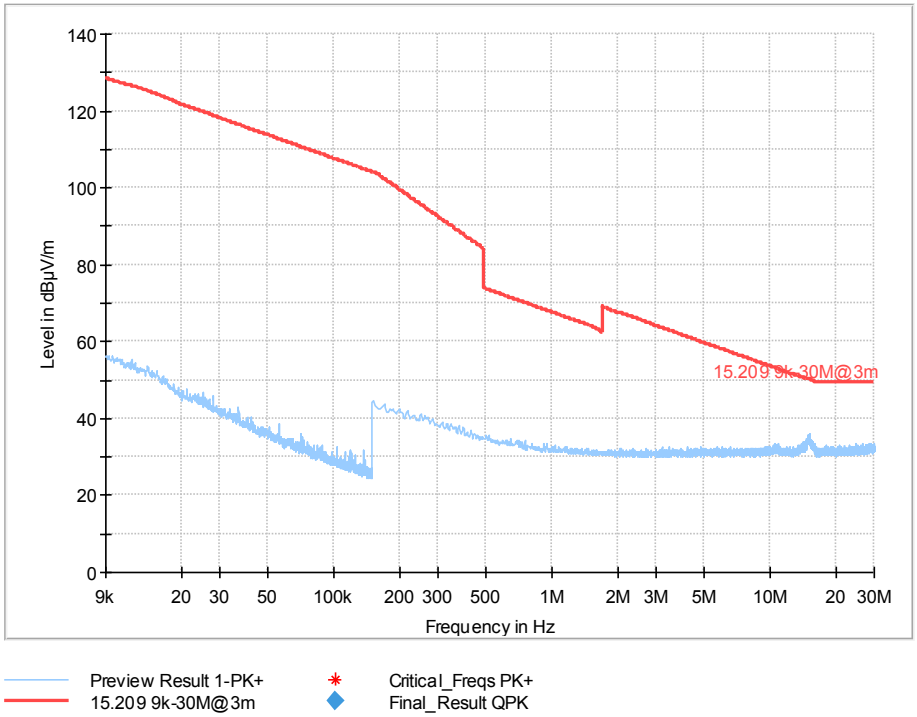
Plot no. 7: Field strength of spurious emissions 9 kHz – 30 MHz, RKE, LOCK



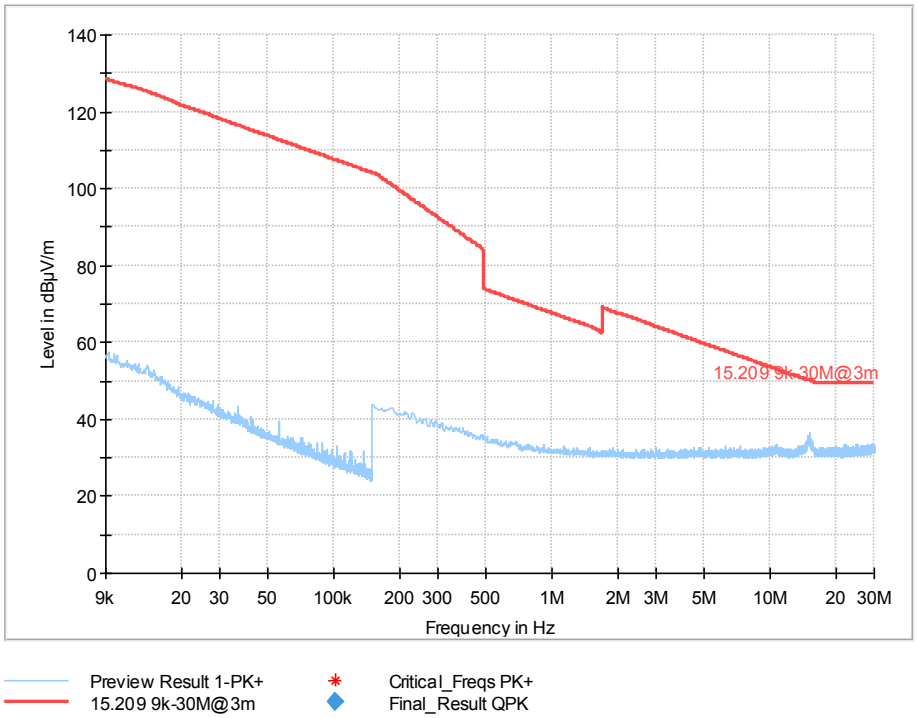
Plot no. 8: Field strength of spurious emissions 9 kHz – 30 MHz, RKE, UNLOCK



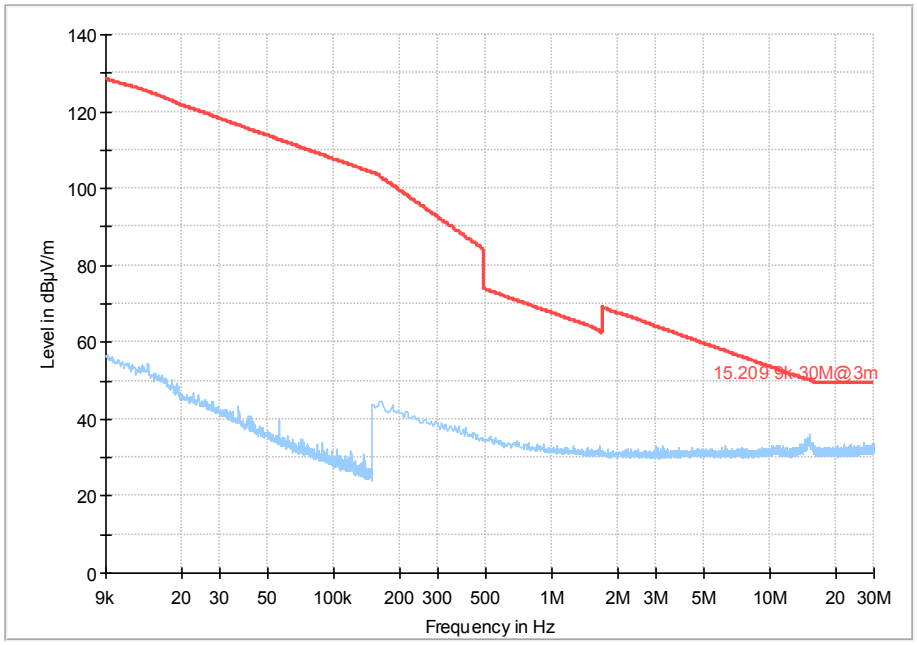
Plot No. 9: Field strength of spurious emissions 9 kHz – 30 MHz, RKE, TRUNK



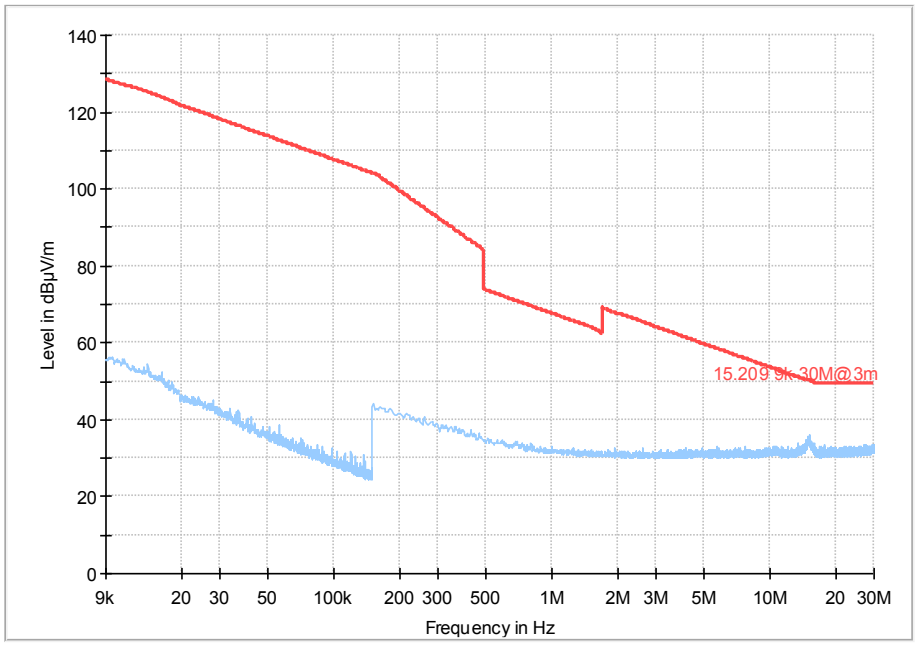
Plot no. 10: Field strength of spurious emissions 9 kHz – 30 MHz, PASE, LOCK + UNLOCK



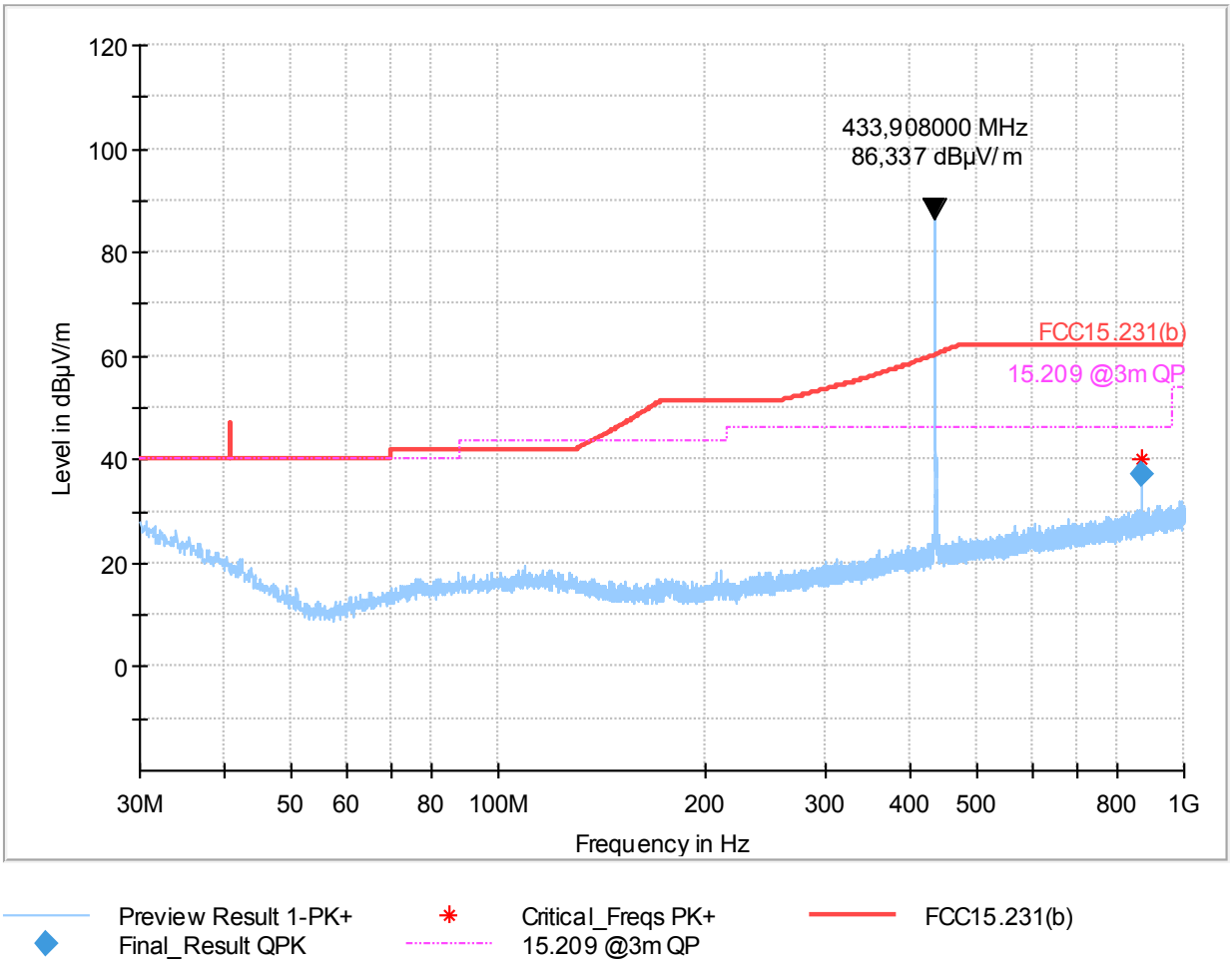
Plot no. 11: Field strength of spurious emissions 9 kHz – 30 MHz, PASE, LOCK + TRUNK



Plot no. 12: Field strength of spurious emissions 9 kHz – 30 MHz, PASE, UNLOCK + TRUNK



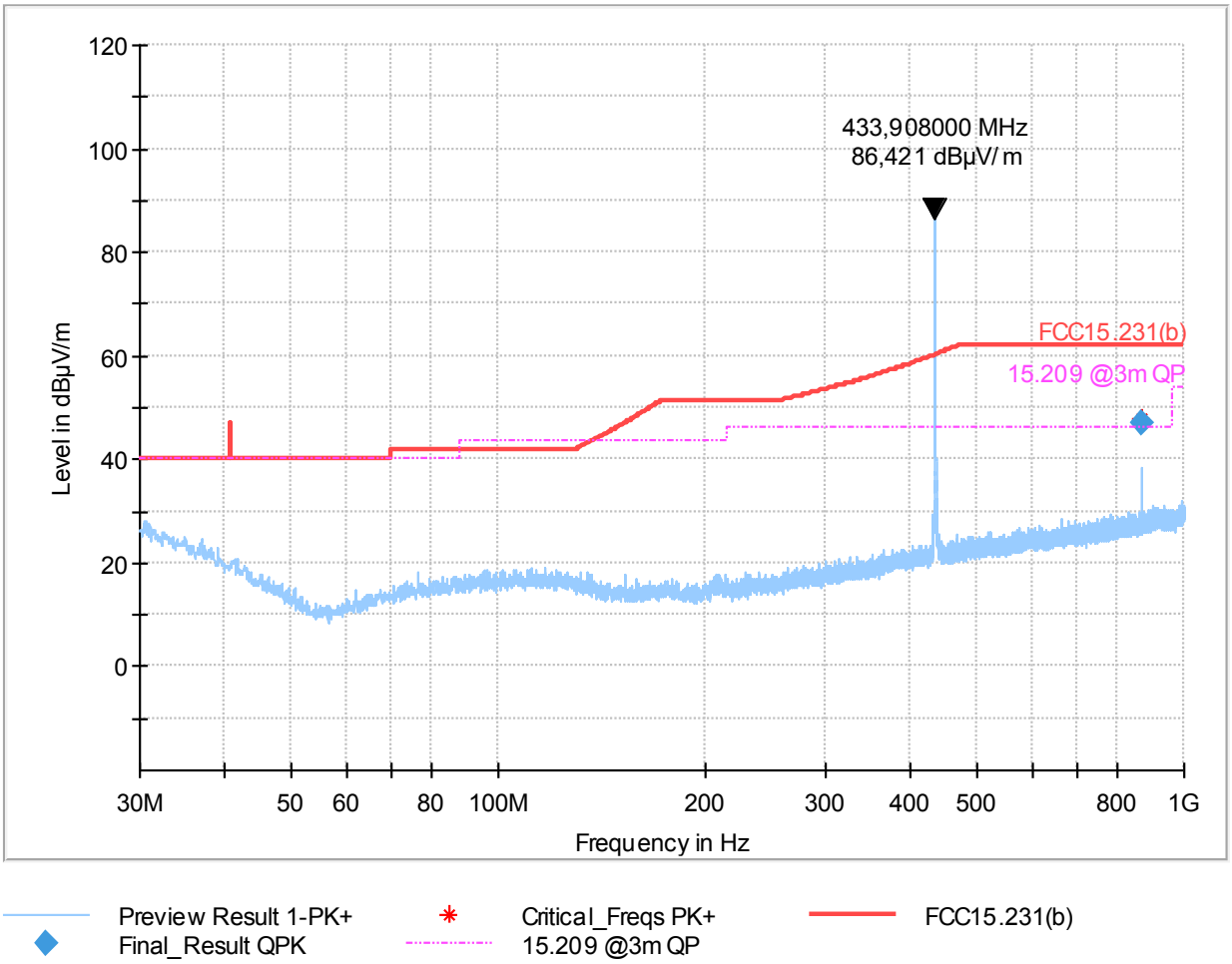
Plot no. 13: Field strength of spurious emissions 30 MHz – 1 GHz, hor./vert. polarization, RKE, LOCK



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
867.836000	37.15	61.93	24.78	100.0	120.000	154.0	V	46.0

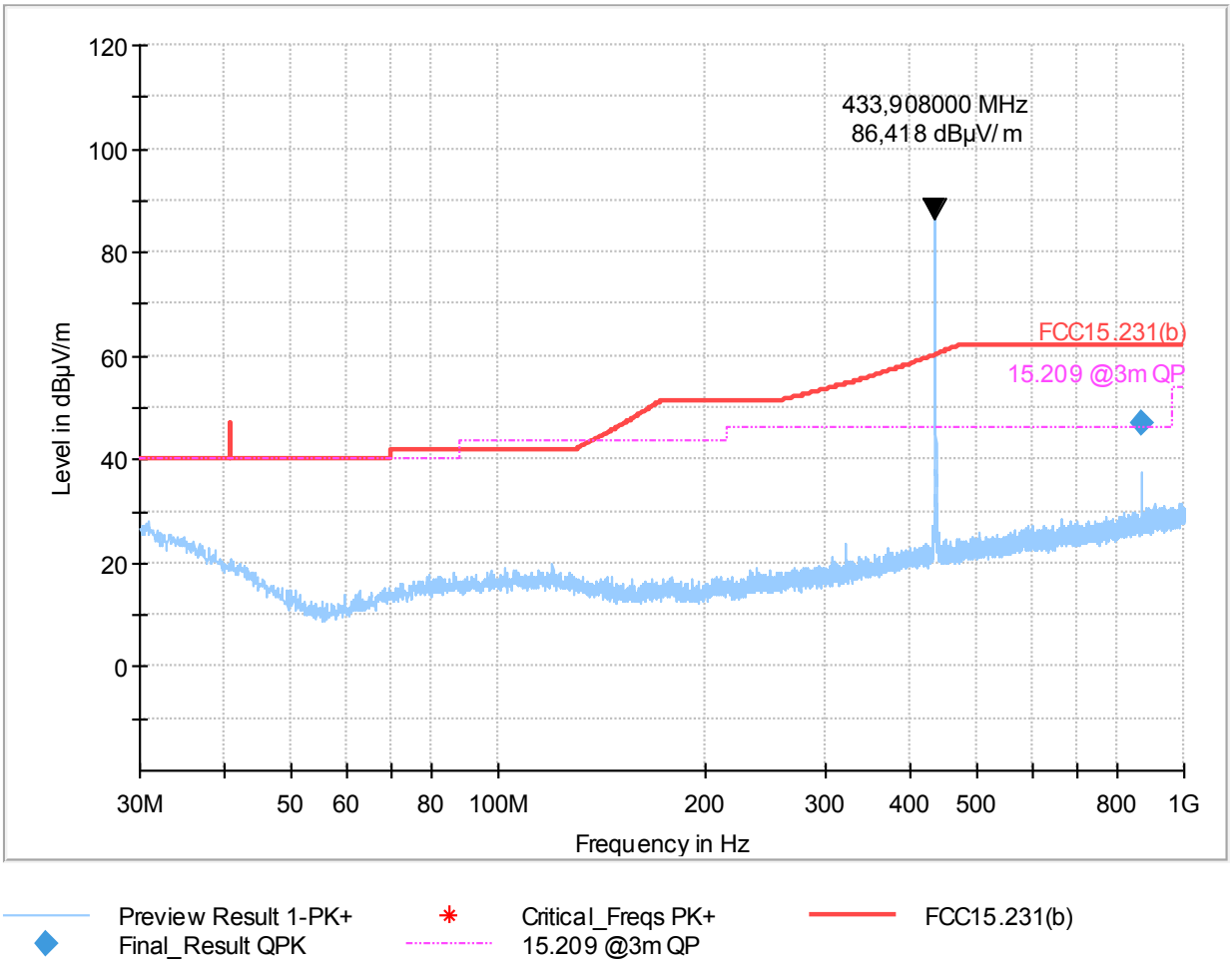
Plot no. 14: Field strength of spurious emissions 30 MHz – 1 GHz, hor./vert. polarization, RKE, UNLOCK



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
867.836000	47.19	61.93	14.74	100.0	120.000	116.0	V	69.0

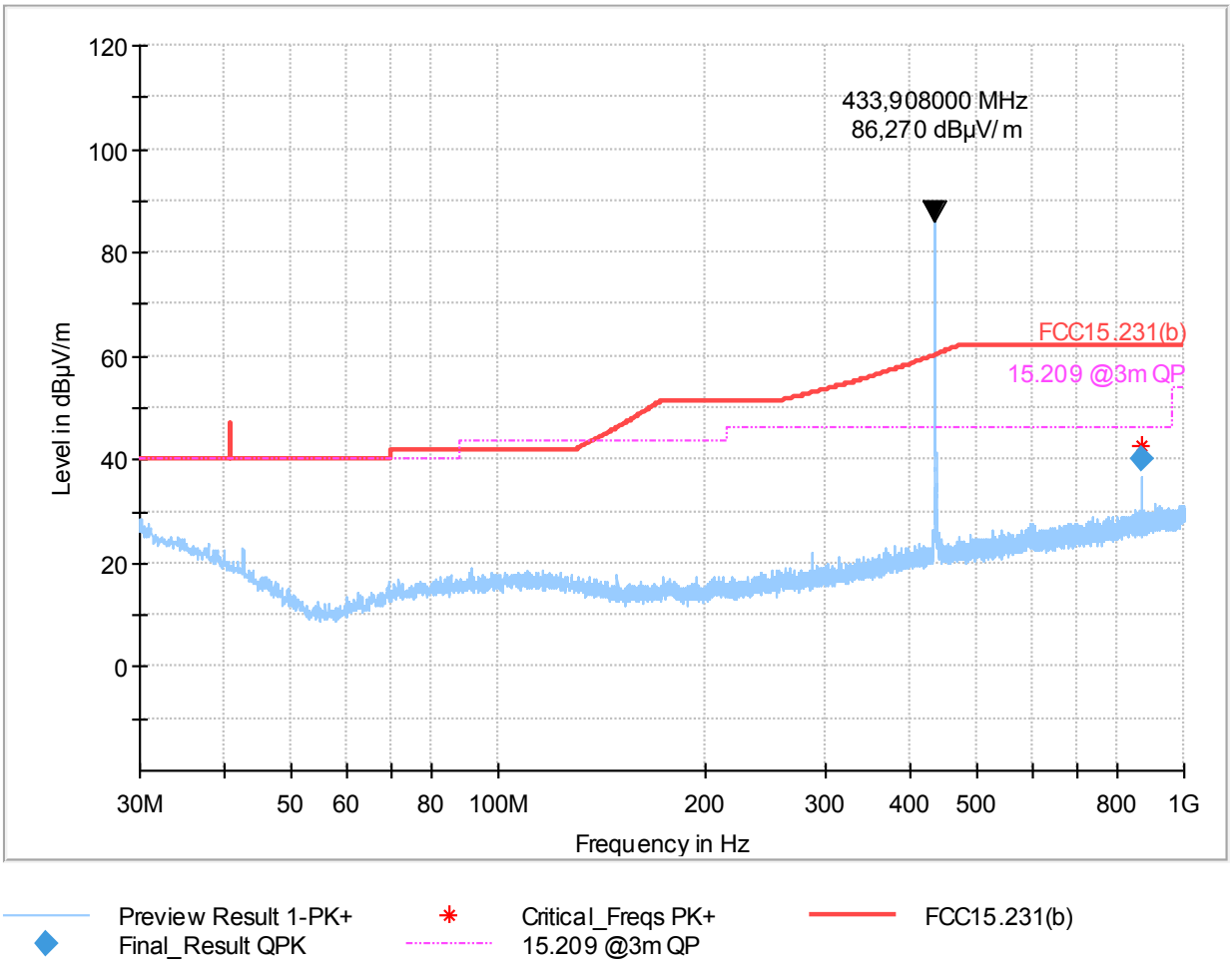
Plot no. 15: Field strength of spurious emissions 30 MHz – 1 GHz, hor./vert. polarization, RKE, TRUNK



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
867.837500	46.87	61.93	15.06	100.0	120.000	116.0	V	89.0

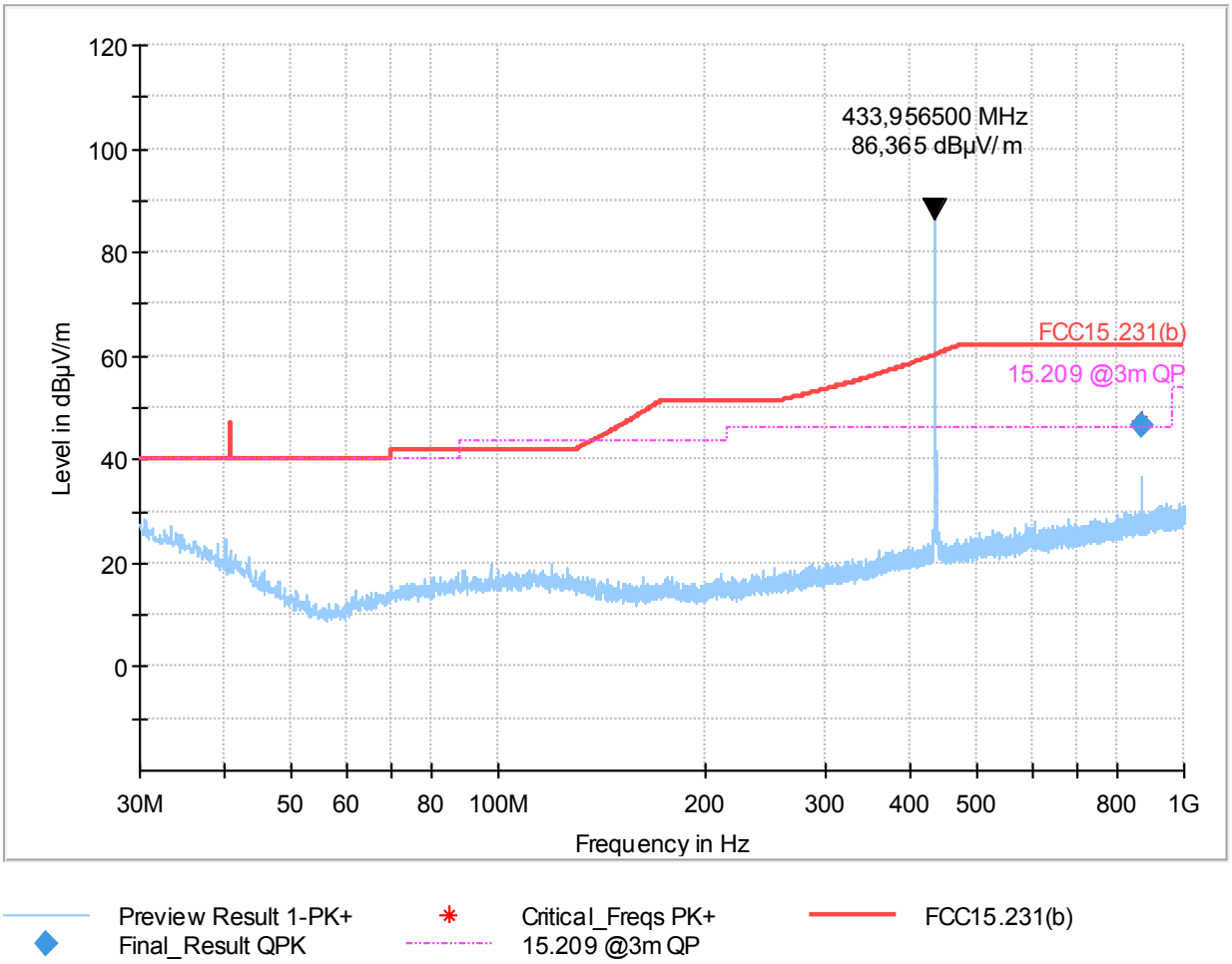
Plot no. 16: Field strength of spurious emissions 30 MHz – 1 GHz, hor./vert. polarization, PASE, LOCK + UNLOCK



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
867.812500	40.23	61.93	21.70	100.0	120.000	154.0	V	88.0

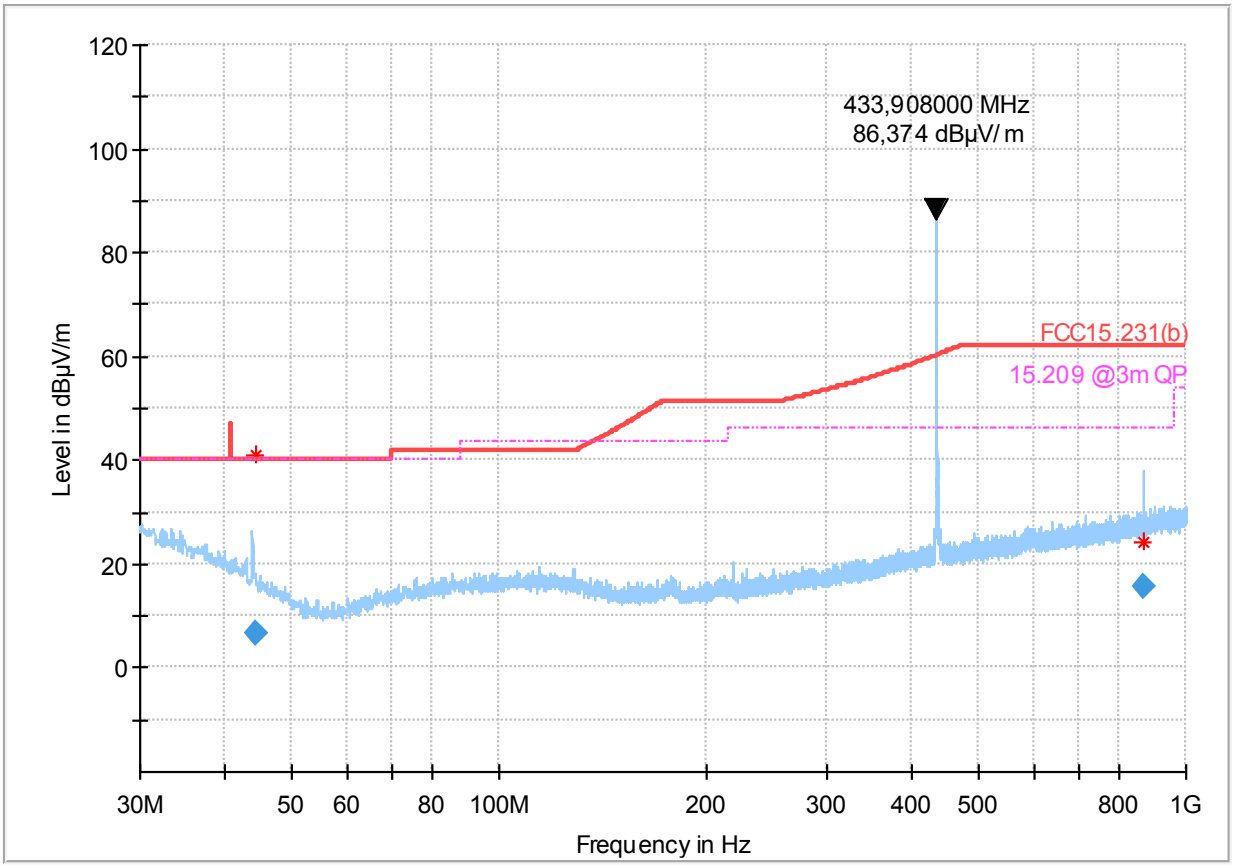
Plot no. 17: Field strength of spurious emissions 30 MHz – 1 GHz, hor./vert. polarization, RKE, LOCK + TRUNK



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
867.861000	46.77	61.93	15.16	100.0	120.000	114.0	V	77.0

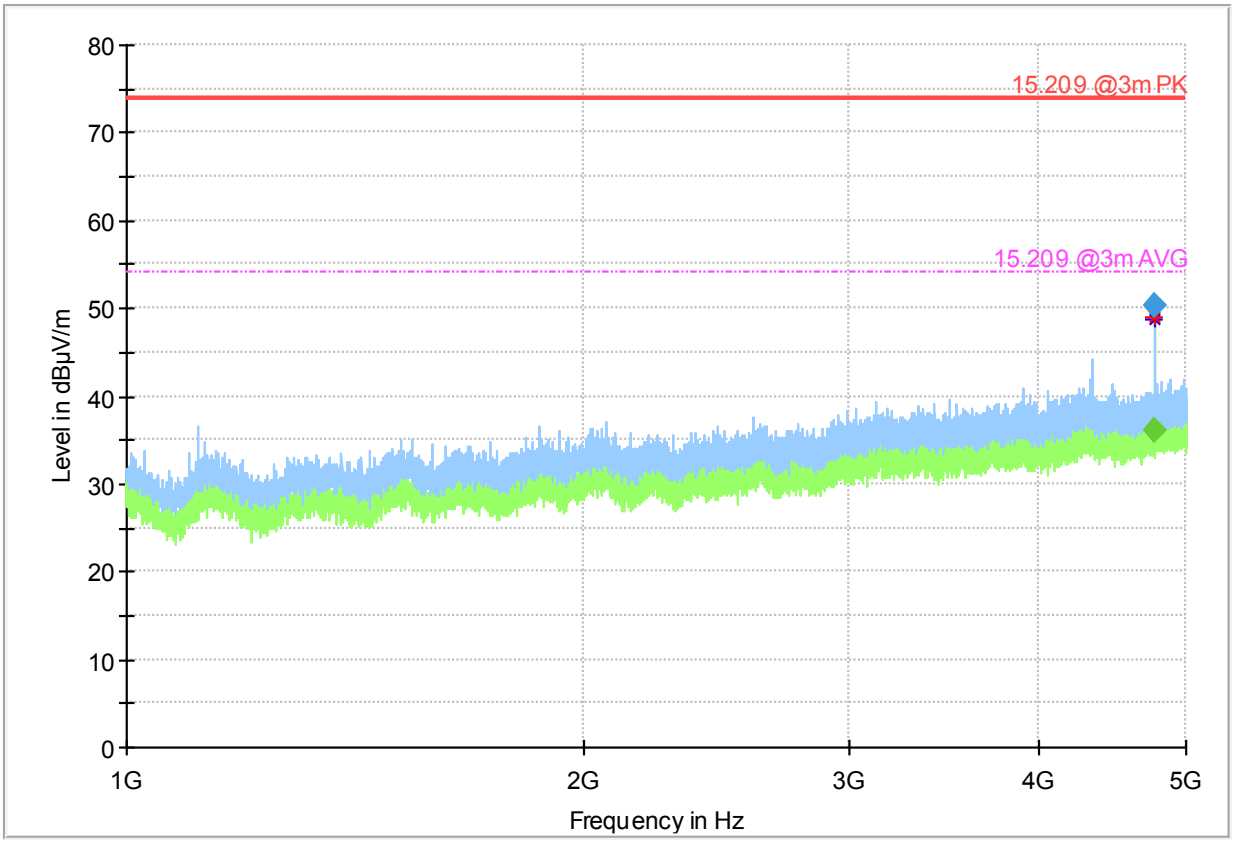
Plot no. 18: Field strength of spurious emissions 30 MHz – 1 GHz, hor./vert. polarization, RKE, UNLOCK + TRUNK

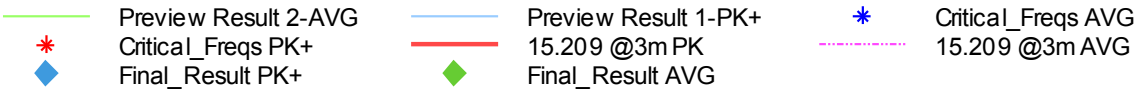


Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
44.177000	6.45	40.00	33.55	100.0	120.000	225.0	H	288.0
867.811000	15.84	61.93	46.09	100.0	120.000	246.0	V	88.0

Plot no. 19: Field strength of spurious emissions 1 GHz – 5 GHz, hor./vert. polarization, RKE, LOCK

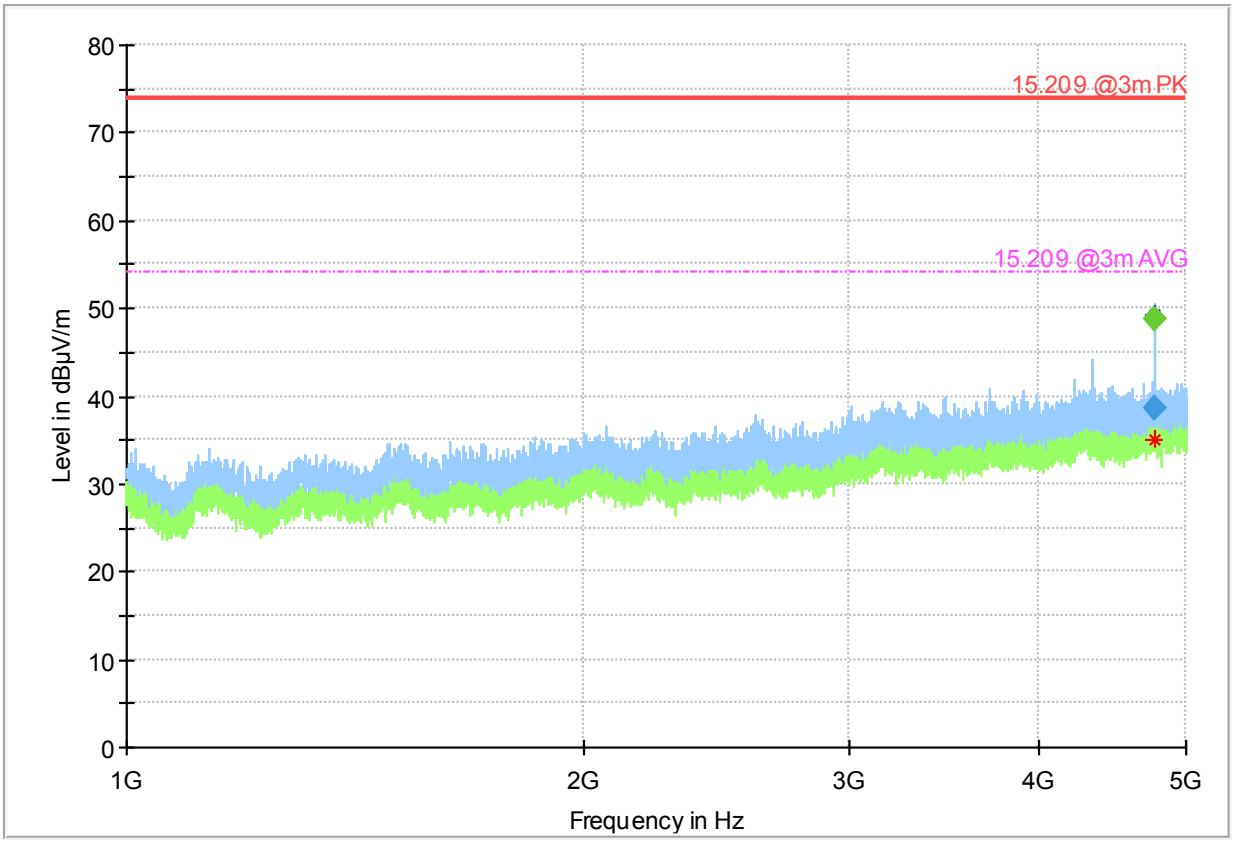




Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
4773.108333	50.31	---	74.00	23.69	100.0	1000.000	150.0	H
4773.333333	---	36.09	54.00	17.91	100.0	1000.000	150.0	H

Plot no. 20: Field strength of spurious emissions 1 GHz – 5 GHz, hor./vert. polarization, RKE, UNLOCK

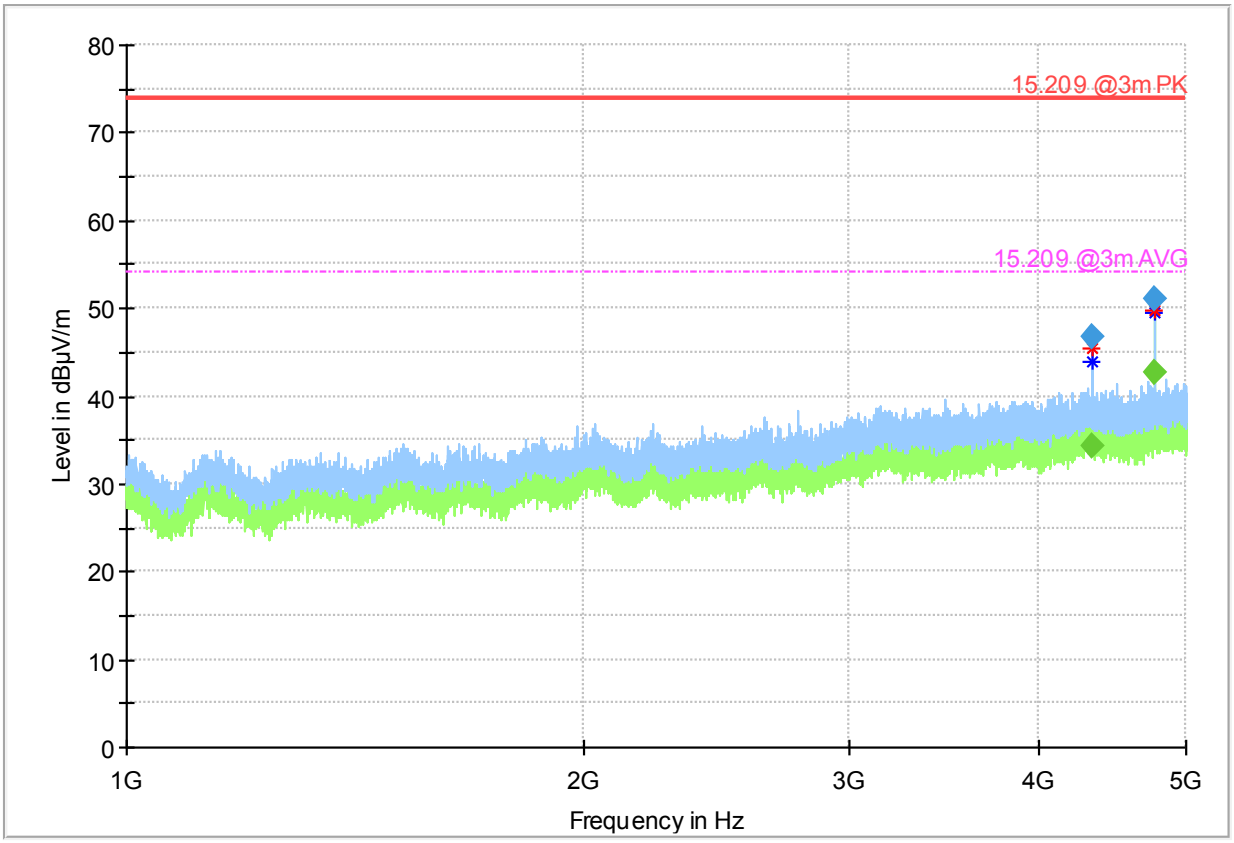


Preview Result 2-AVG
Critical_Freqs PK+
Final_Result PK+
Preview Result 1-PK+
15.209 @3m PK
Final_Result AVG
Critical_Freqs AVG
15.209 @3m AVG

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
4773.111111	---	48.75	54.00	5.25	100.0	1000.000	150.0	H
4774.086111	38.72	---	74.00	35.28	100.0	1000.000	150.0	H

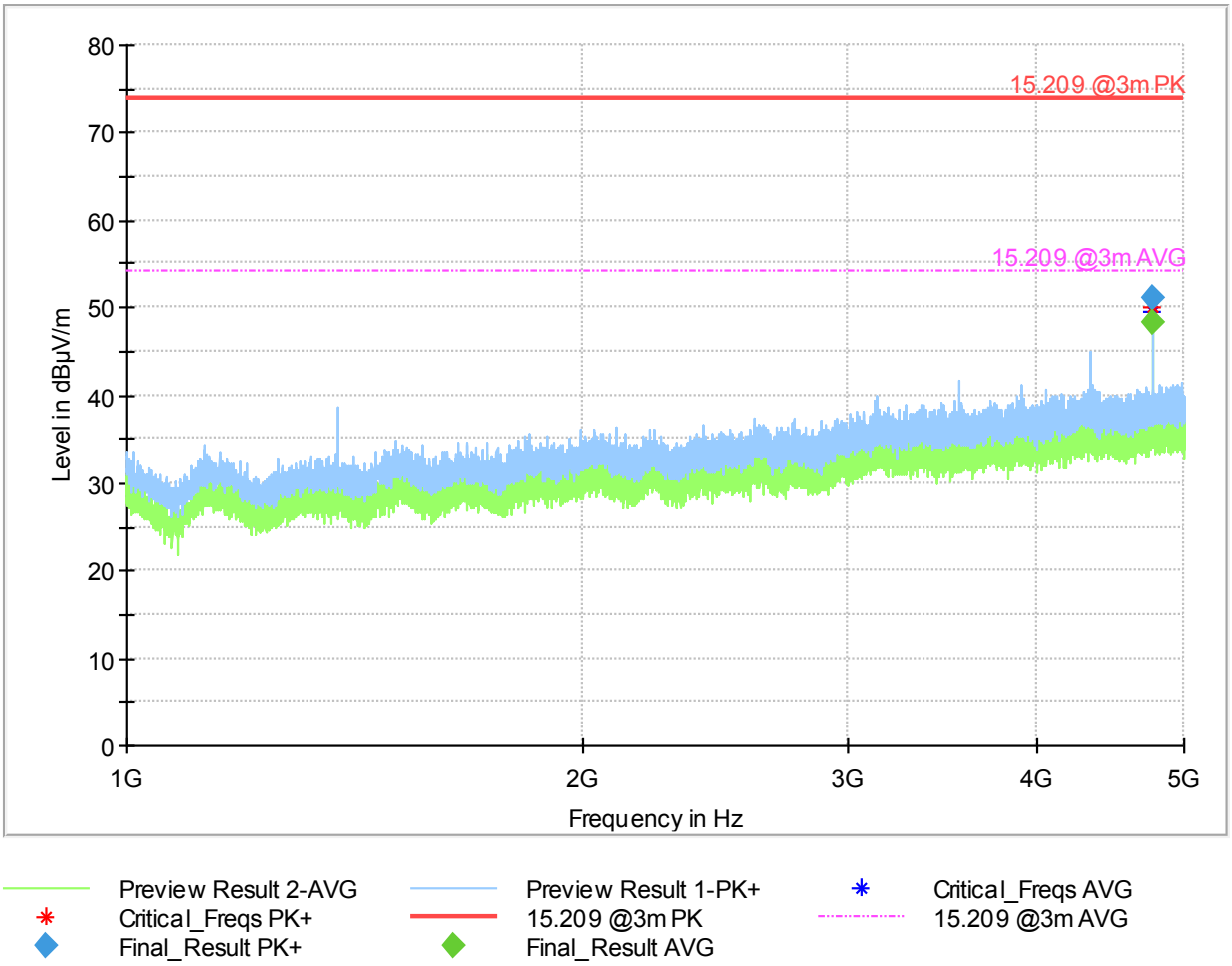
Plot no. 21: Field strength of spurious emissions 1 GHz – 5 GHz, hor./vert. polarization, RKE, TRUNK



Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
4339.180556	46.85	---	74.00	27.15	100.0	1000.000	150.0	H
4339.555556	---	34.41	54.00	19.59	100.0	1000.000	150.0	V
4773.108333	51.04	---	74.00	22.96	100.0	1000.000	150.0	H
4773.333333	---	42.57	54.00	11.43	100.0	1000.000	150.0	H

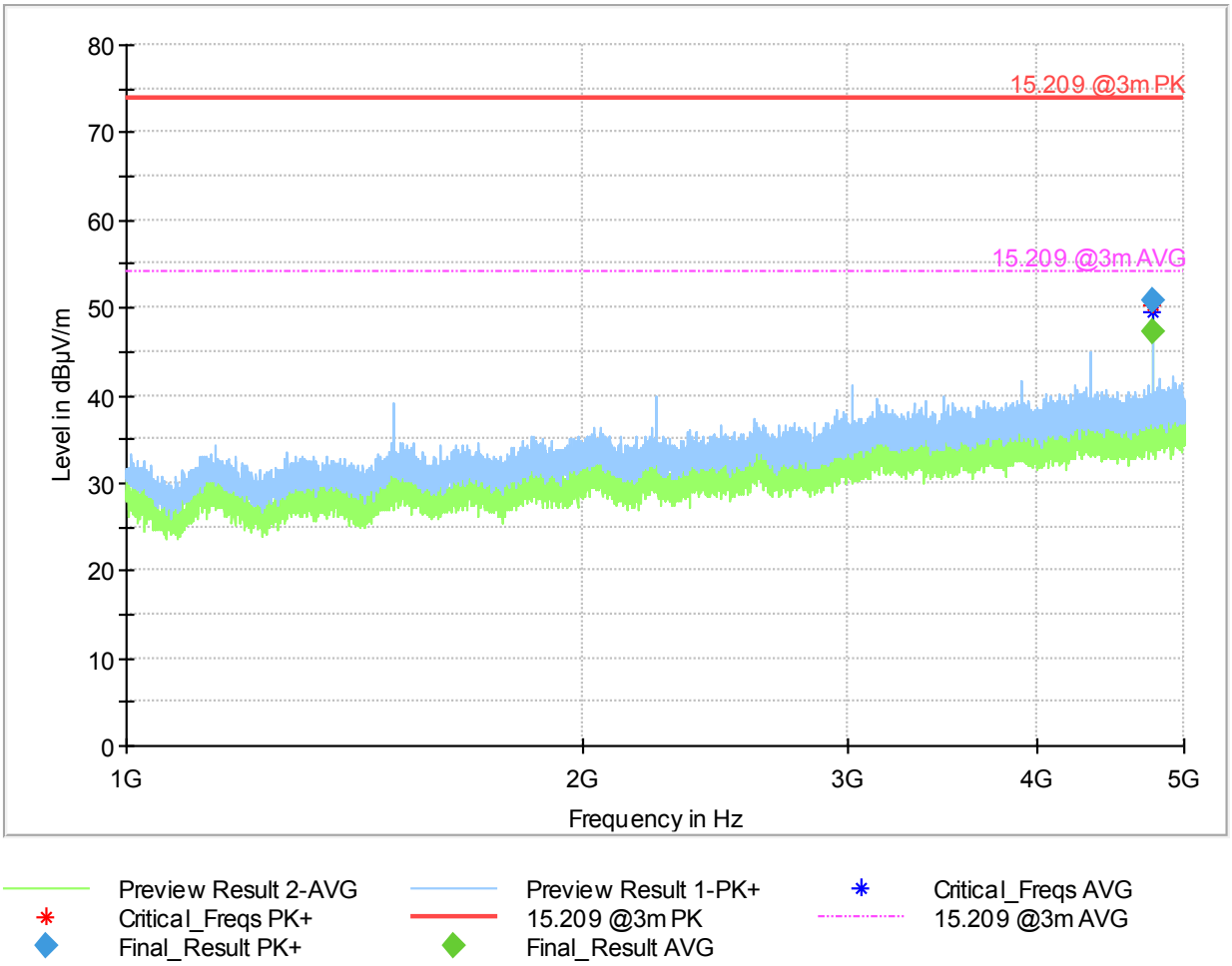
Plot no. 22: Field strength of spurious emissions 1 GHz – 5 GHz, hor./vert. polarization, PASE, LOCK + UNLOCK



Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
4772.961111	51.11	---	74.00	22.89	100.0	1000.000	150.0	H
4773.111111	---	48.21	54.00	5.79	100.0	1000.000	150.0	H

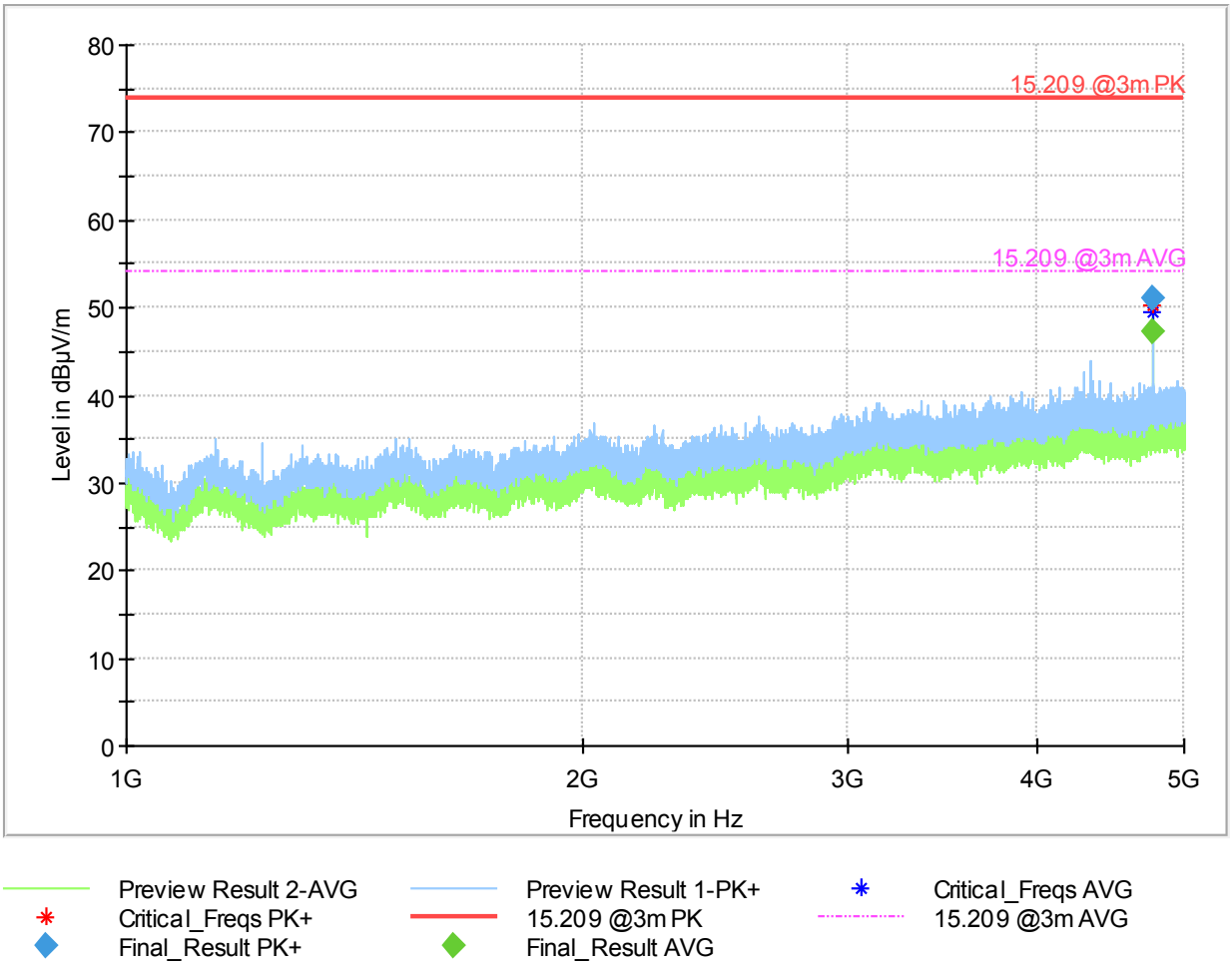
Plot no. 23: Field strength of spurious emissions 1 GHz – 5 GHz, hor./vert. polarization, PASE, LOCK + TRUNK



Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
4773.330556	50.84	---	74.00	23.16	100.0	1000.000	150.0	H
4773.555556	---	47.14	54.00	6.86	100.0	1000.000	150.0	H

Plot no. 24: Field strength of spurious emissions 1 GHz – 5 GHz, hor./vert. polarization, RKE, UNLOCK + TRUNK



Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
4772.958333	51.17	---	74.00	22.83	100.0	1000.000	150.0	H
4773.333333	---	47.33	54.00	6.67	100.0	1000.000	150.0	H

7.3 Transmission time

Description / Limits

§15.231 / RSS-210, A 1.1 (a)

(a) The provisions of this section are restricted to periodic operation within the band 40.66-40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal. The following conditions shall be met to comply with the provisions for this periodic operation:

(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition

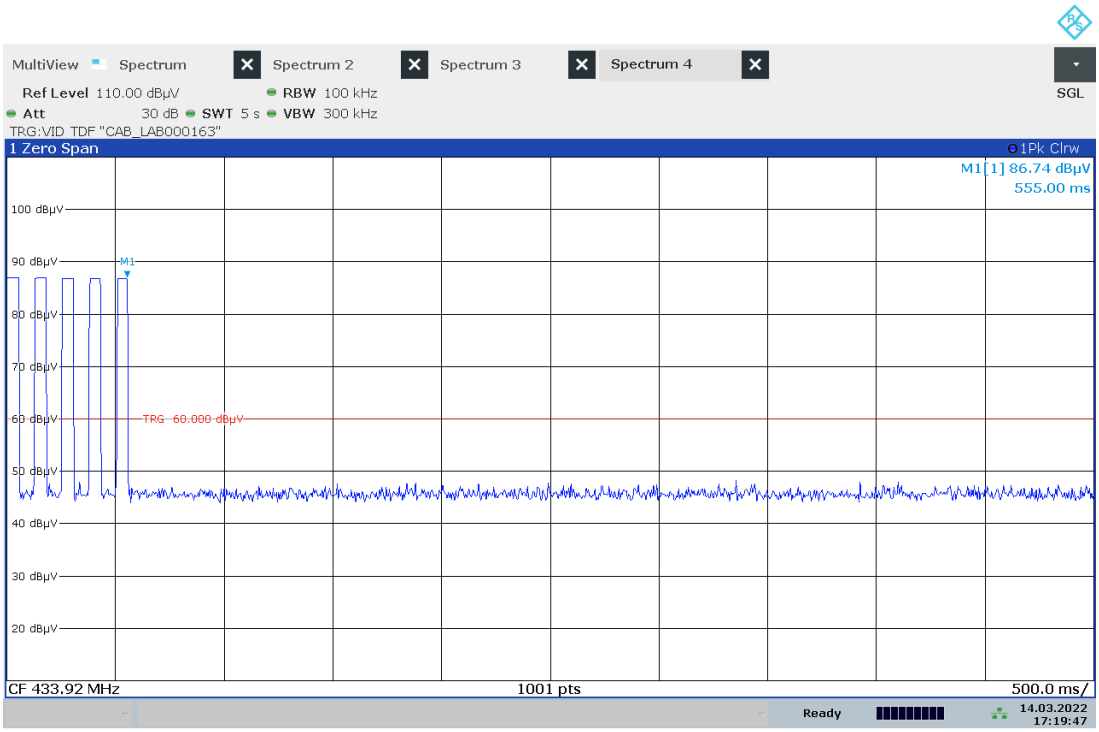
(5) Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.

Test results

EUT mode	Test conditions	Declared frequency [MHz]	Measured time [ms]	Limit [s]	Result
RKE – LOCK	Normal	433.92	555	5	Pass
RKE – UNLOCK	Normal	433.92	555	5	Pass
RKE – TRUNK	Normal	433.92	555	5	Pass
PASE – LOCK + UNLOCK	Normal	433.905	555	5	Pass
RKE – LOCK + TRUNK	Normal	433.934	555	5	Pass
RKE – UNLOCK + TRUNK	Normal	433.92	555	5	Pass

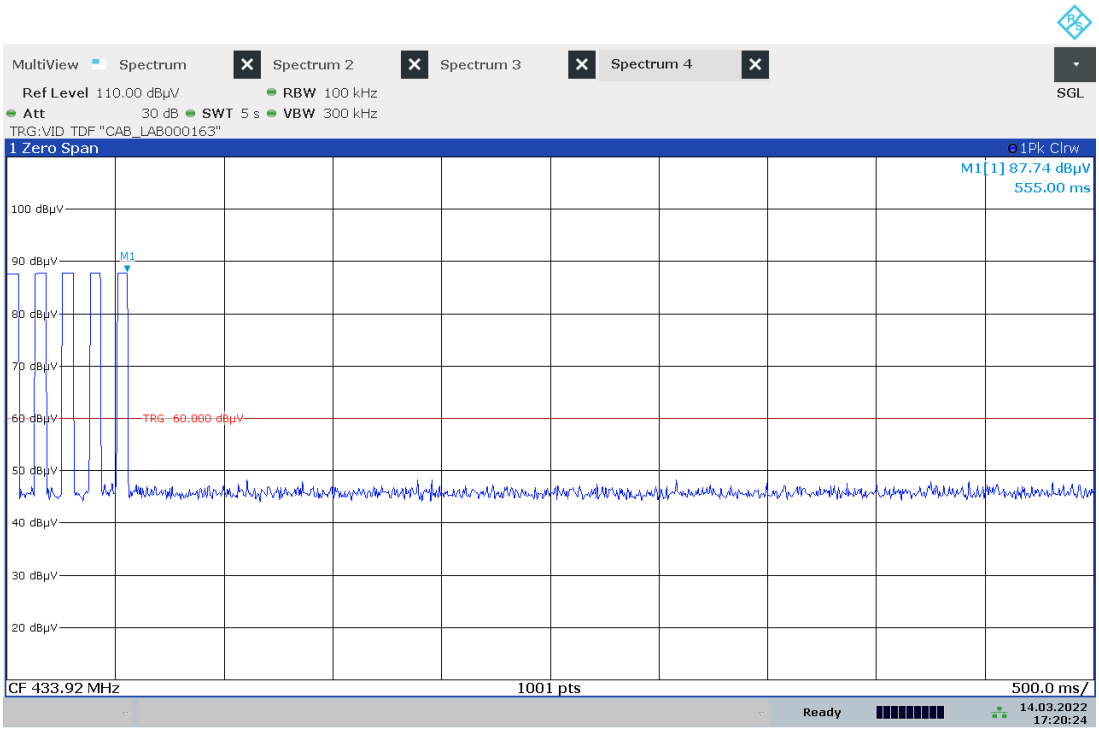
Note:

Plot no. 25: Transmission time, RKE, LOCK



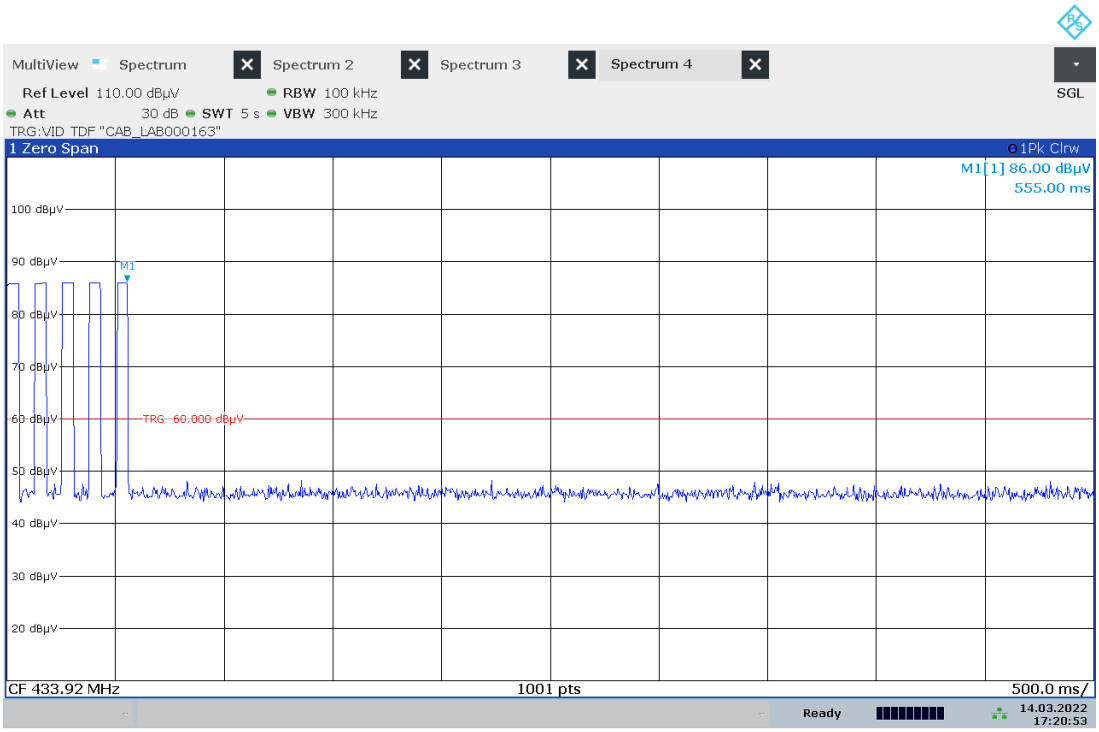
17:19:47 14.03.2022

Plot no. 26: Transmission time, RKE, UNLOCK



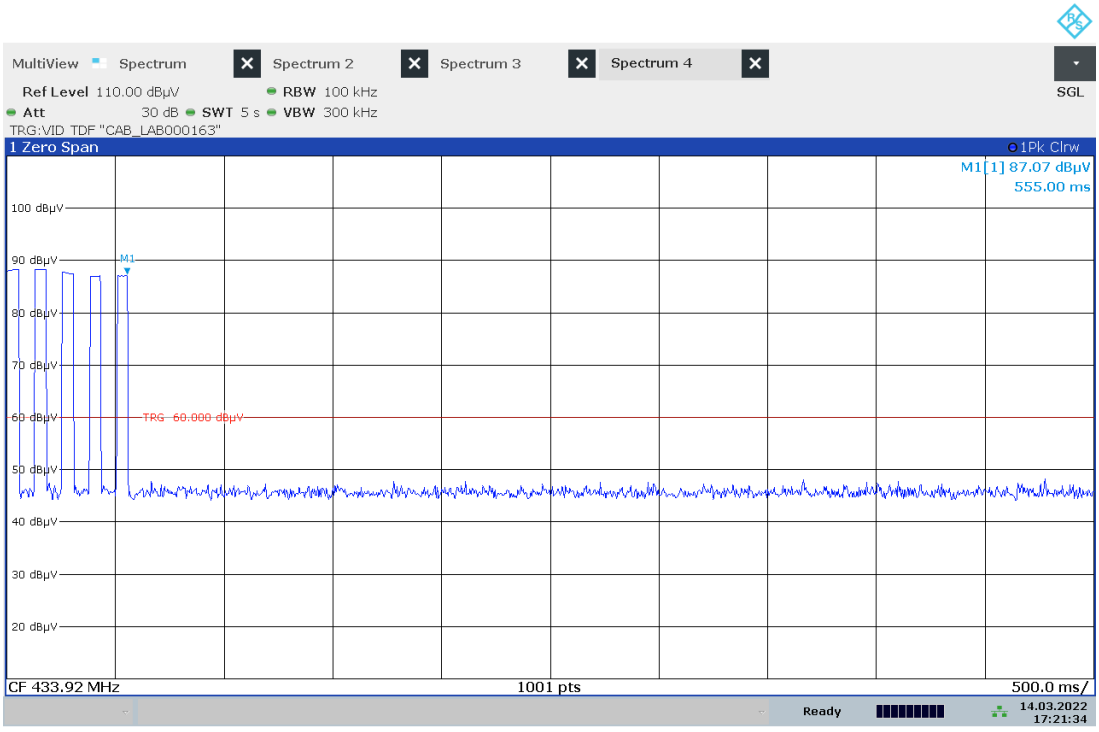
17:20:24 14.03.2022

Plot no. 27: Transmission time, RKE, TRUNK



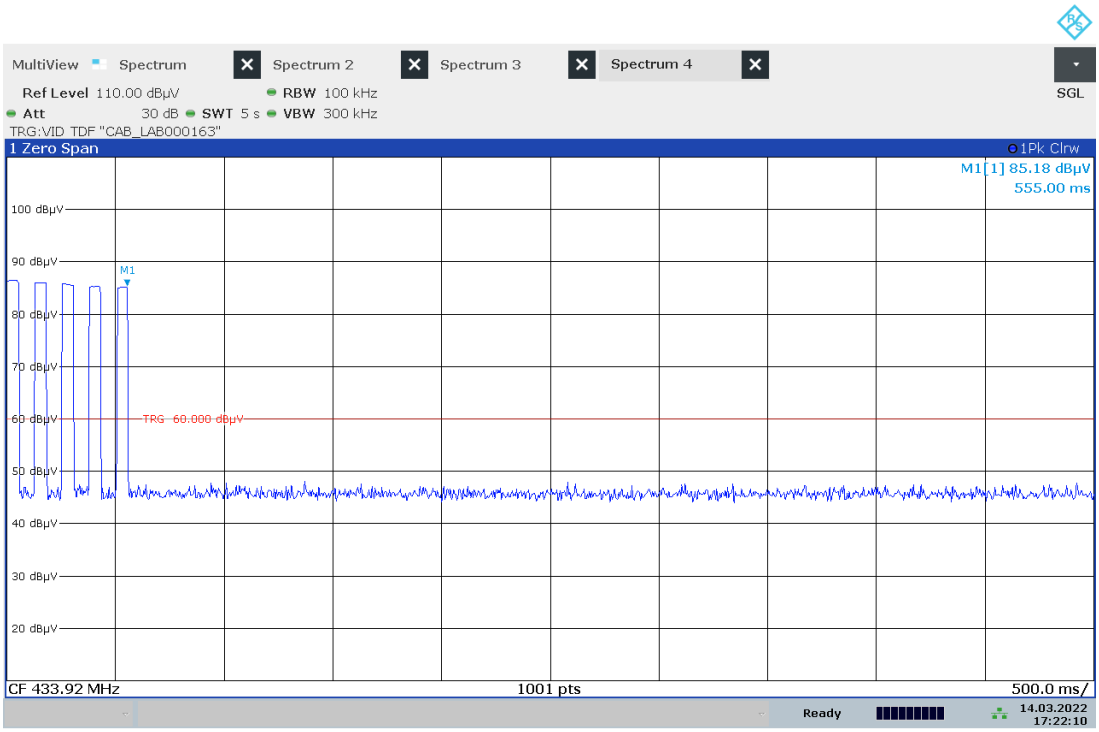
17:20:53 14.03.2022

Plot no. 28: Transmission time, RKE, LOCK + UNLOCK



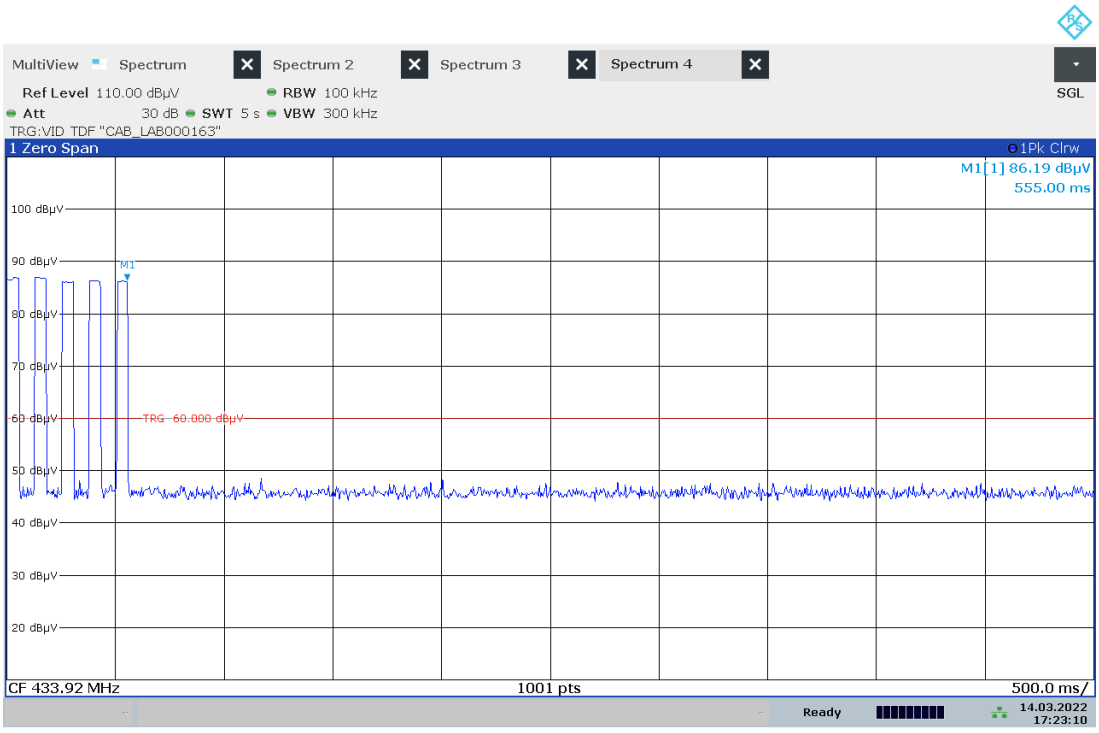
17:21:34 14.03.2022

Plot no. 29: Transmission time, RKE, LOCK + TRUNK



17:22:10 14.03.2022

Plot no. 30: Transmission time, RKE, UNLOCK + TRUNK



17:23:10 14.03.2022

7.4 20 dB bandwidth / occupied bandwidth

Description / limit

§15.231 (c) / RSS-Gen, 6.7

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

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).

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:

EUT mode	Channel frequency [MHz]	Min. Frequency F_L [MHz]	Max. frequency F_H [MHz]	Occupied bandwidth (99%) [kHz]
RKE – LOCK	433.92	433.893	433.948	55.266
RKE – UNLOCK	433.92	433.908	433.931	23.792
RKE – TRUNK	433.92	433.894	433.947	53.553
PASE – LOCK + UNLOCK	433.905	433.893	433.917	24.030
PASE – LOCK + TRUNK	433.934	433.922	433.946	24.110
PASE – UNLOCK + TRUNK	433.92	433.886	433.953	**67.283**

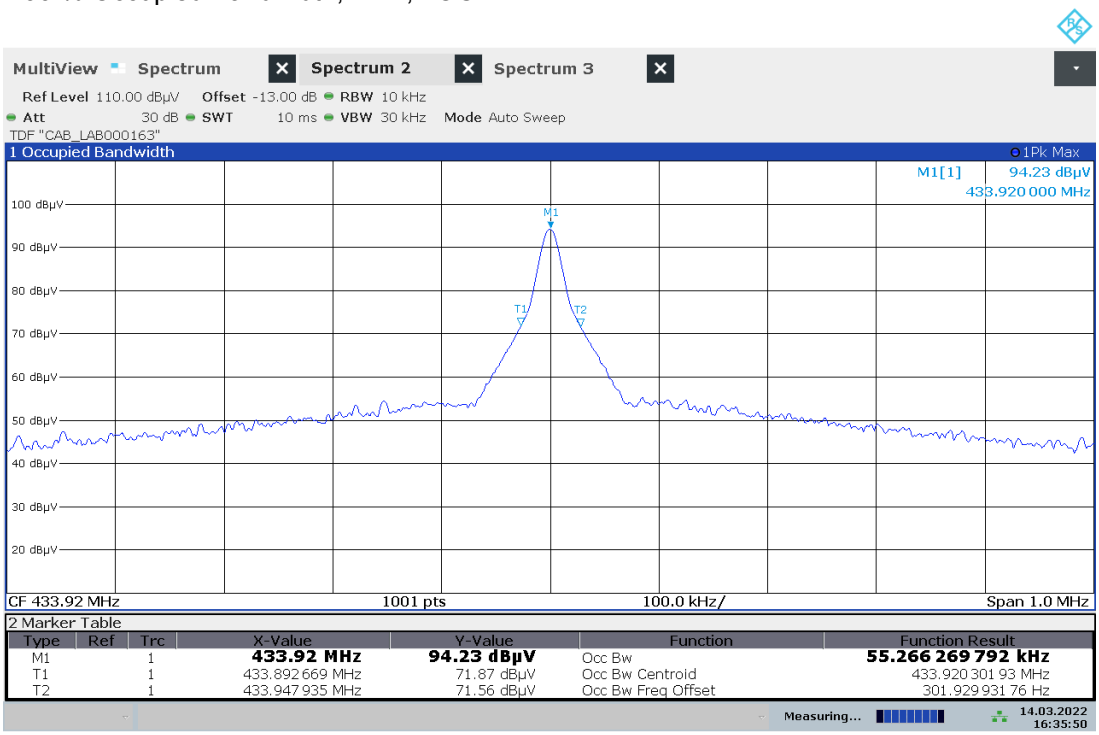
EUT mode	Channel frequency [MHz]	Min. Frequency F_L [MHz]	Max. frequency F_H [MHz]	20 dB bandwidth [kHz]
RKE – LOCK	433.92	433.898	433.942	44.0
RKE – UNLOCK	433.92	433.906	433.933	27.0
RKE – TRUNK	433.92	433.898	433.942	44.0
PASE – LOCK + UNLOCK	433.905	433.892	433.919	27.0
PASE – LOCK + TRUNK	433.934	433.92	433.947	27.0
PASE – UNLOCK + TRUNK	433.92	433.881	433.958	**76.9**

Where: F_L = is the lower edge of the OBW
F_H = is the upper edge of the OBW

Verdict	- PASS -	*Measurement plot(s) see next page(s).*

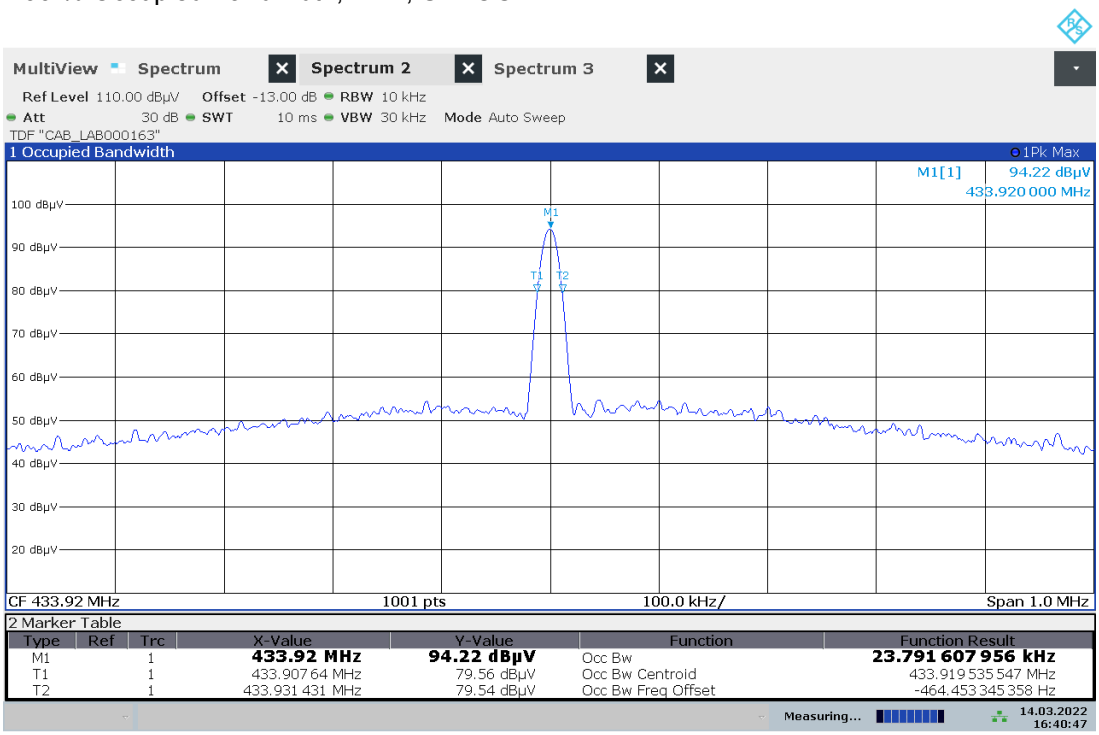
Comment	

Plot No. 31: 99 % Occupied Bandwidth, RKE, LOCK



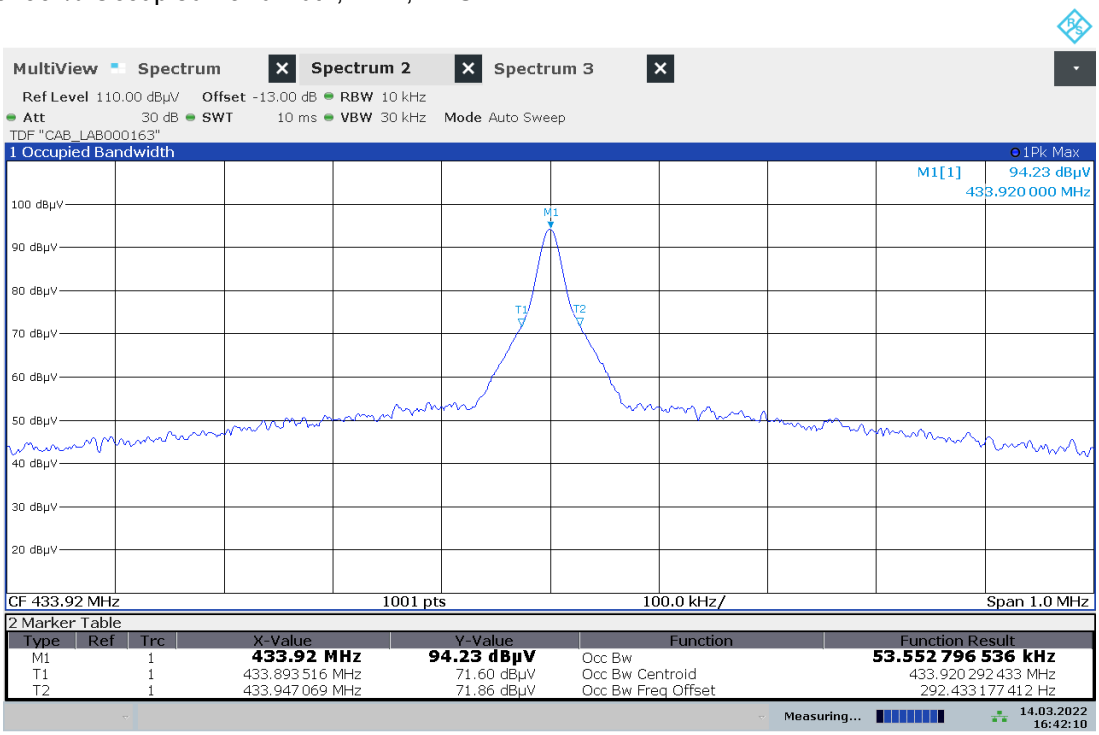
16:35:50 14.03.2022

Plot No. 32: 99 % Occupied Bandwidth, RKE, UNLOCK



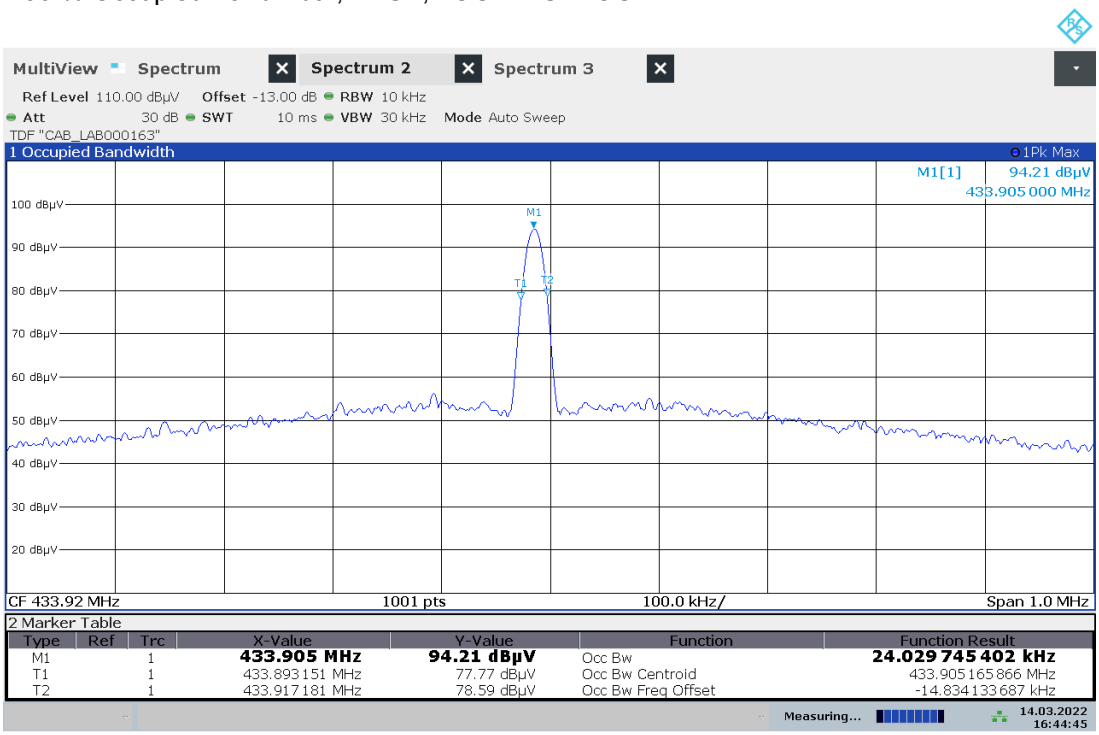
16:40:48 14.03.2022

Plot No. 33: 99 % Occupied Bandwidth, RKE, TRUNK



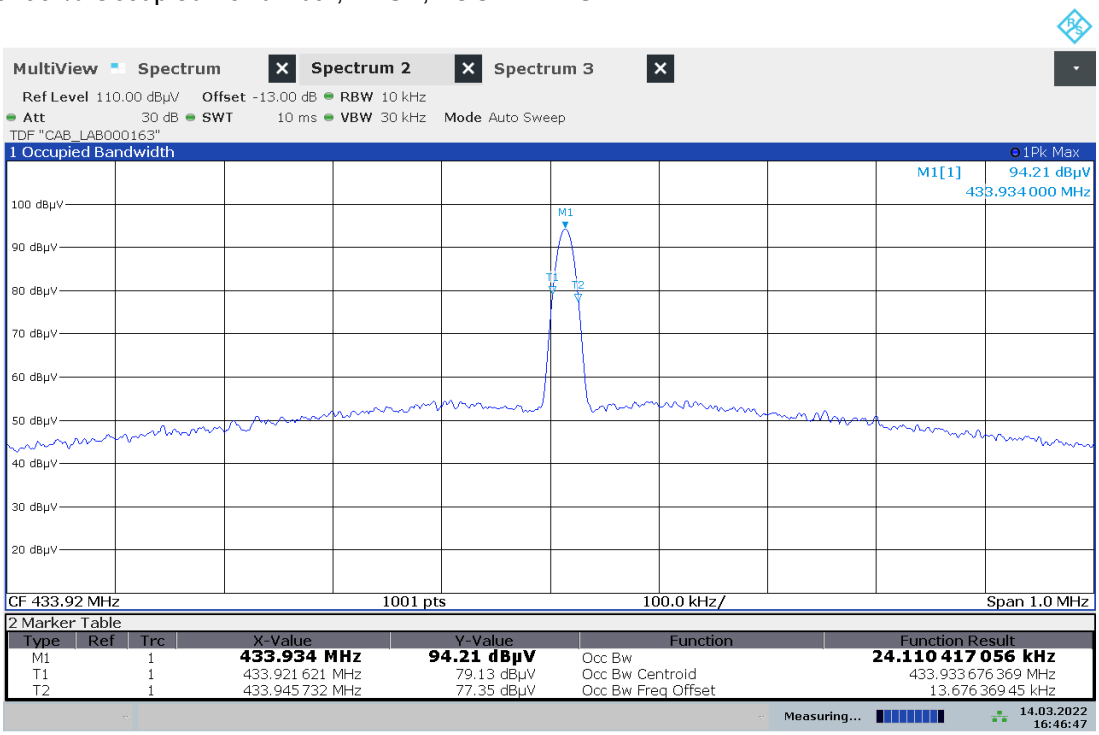
16:42:10 14.03.2022

Plot No. 34: 99 % Occupied Bandwidth, PASE, LOCK + UNLOCK



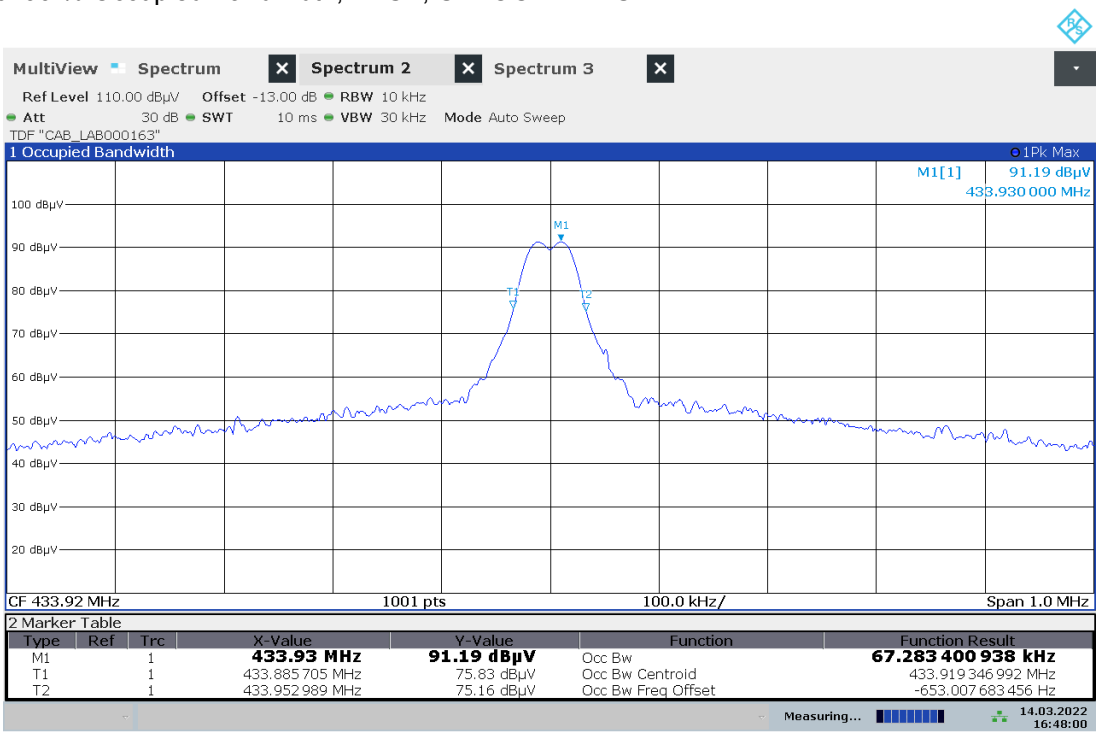
16:44:45 14.03.2022

Plot No. 35: 99 % Occupied Bandwidth, PASE, LOCK + TRUNK



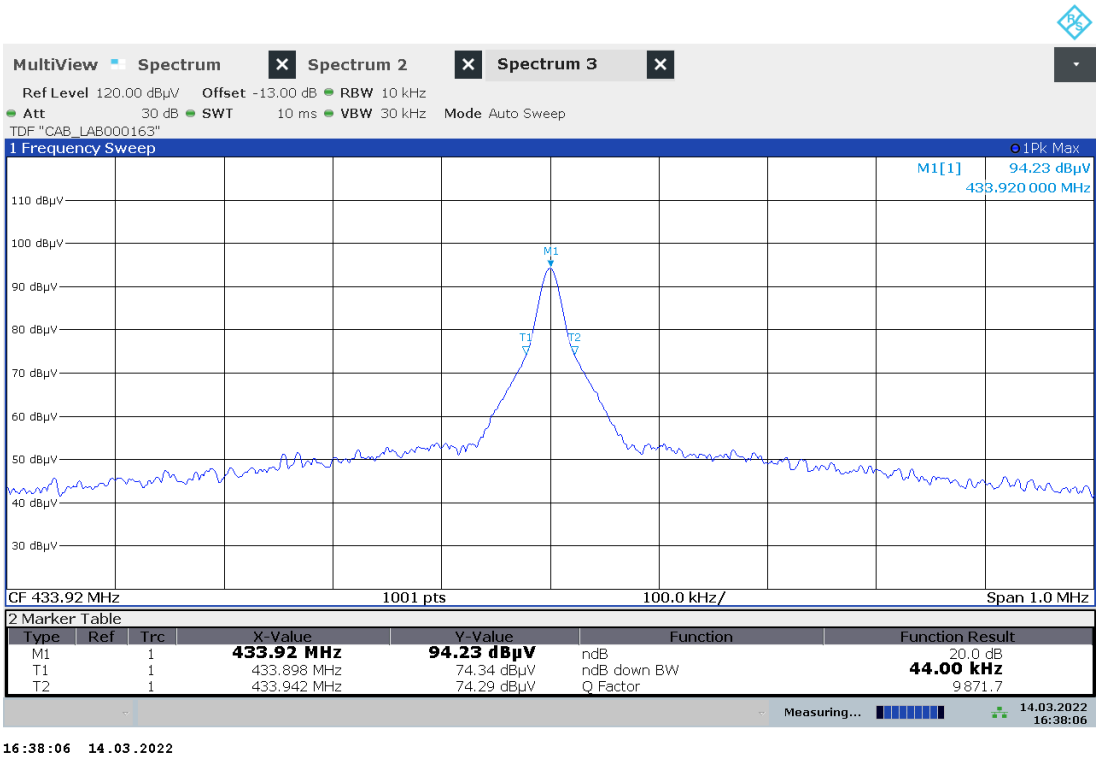
16:46:48 14.03.2022

Plot No. 36: 99 % Occupied Bandwidth, PASE, UNLOCK + TRUNK



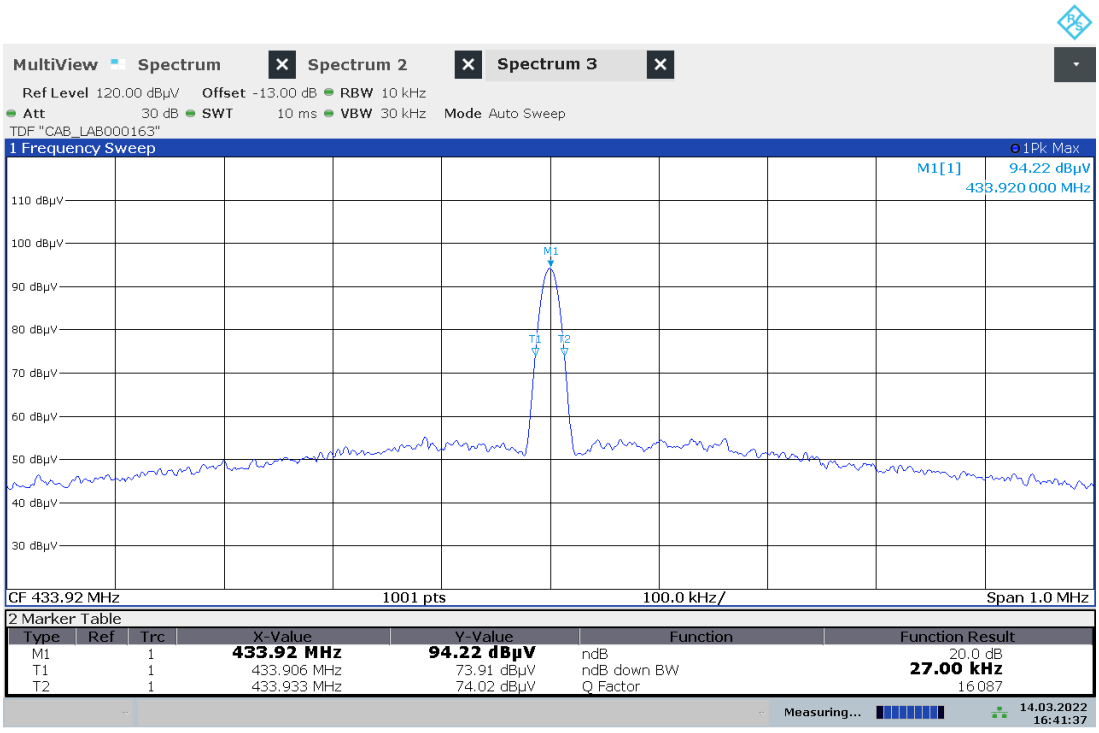
16:48:01 14.03.2022

Plot No. 37: 20 dB Bandwidth, RKE, LOCK



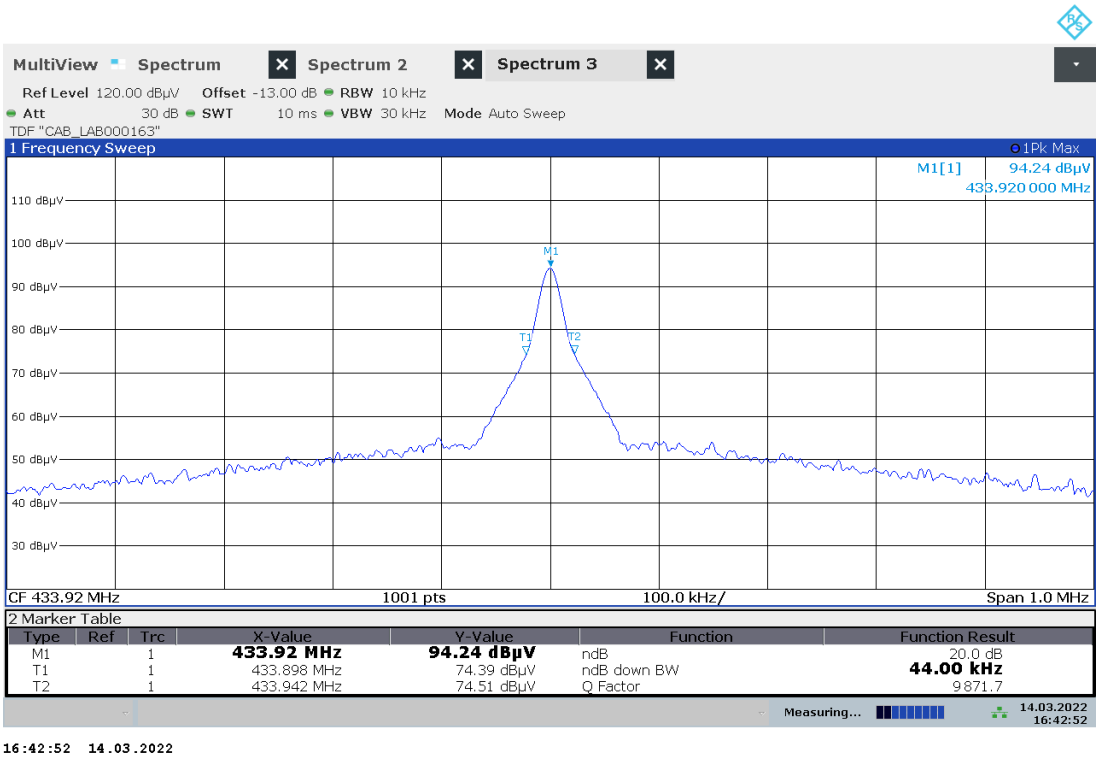
16:38:06 14.03.2022

Plot No. 38: 20 dB Bandwidth, RKE, UNLOCK



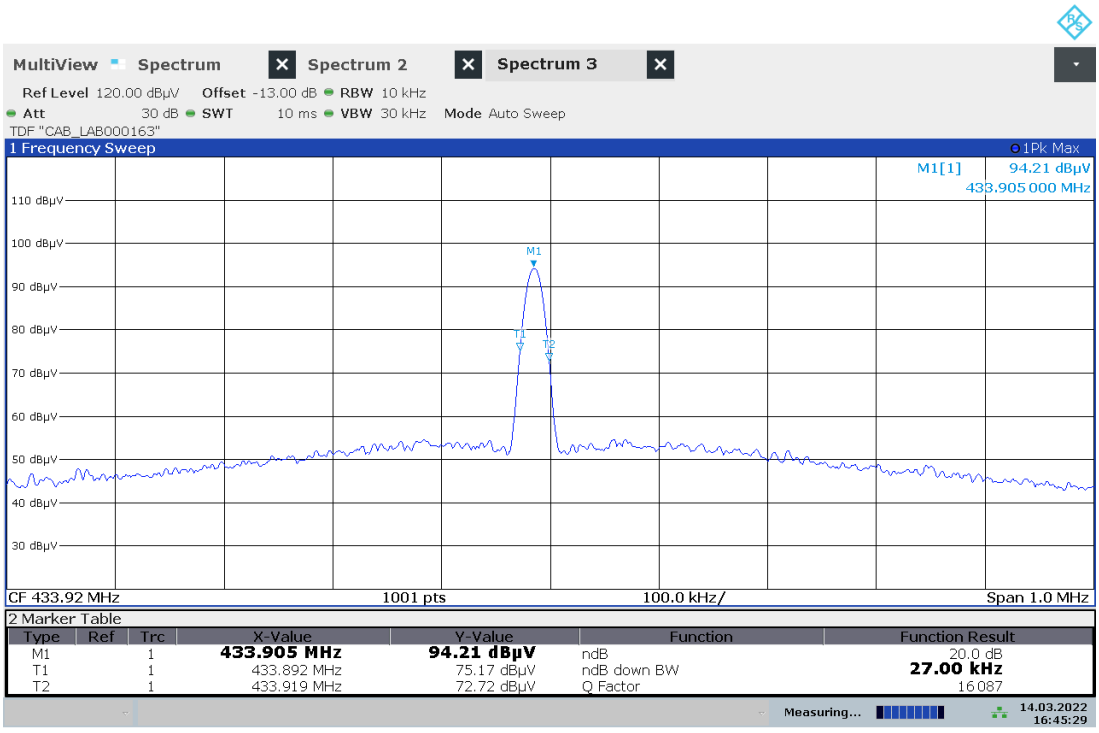
16:41:37 14.03.2022

Plot No. 39: 20 dB Bandwidth, RKE, TRUNK



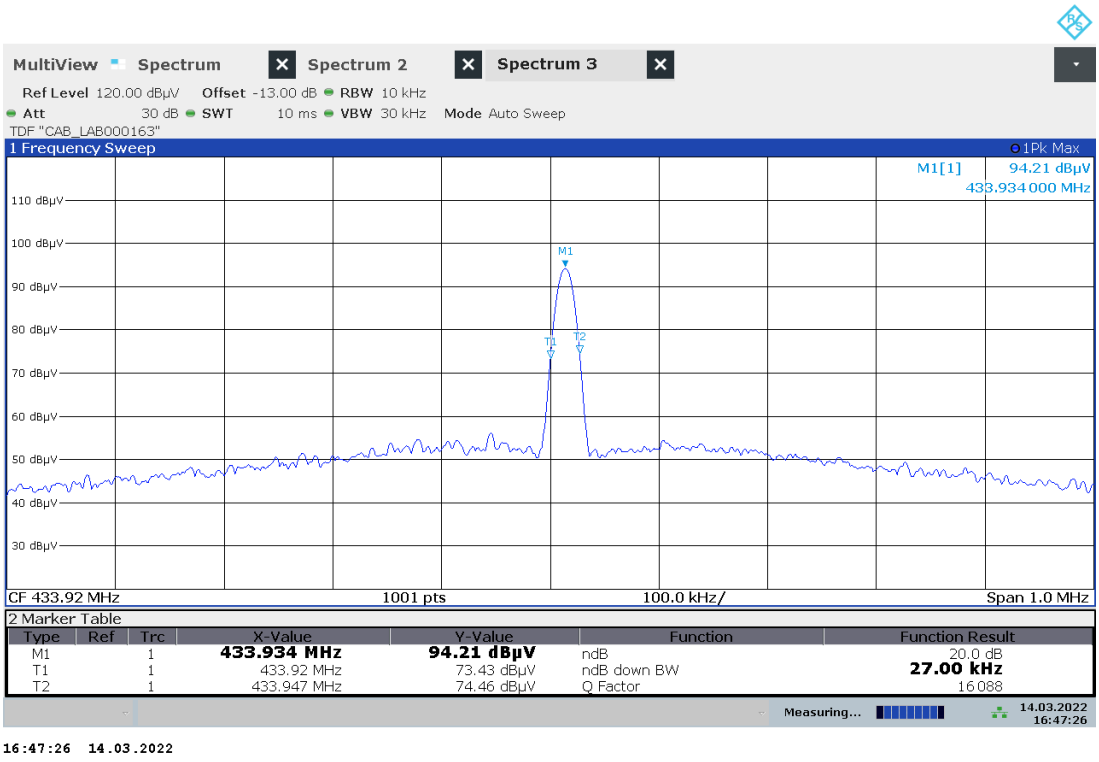
16:42:52 14.03.2022

Plot No. 40: 20 dB Bandwidth, PASE, LOCK + UNLOCK



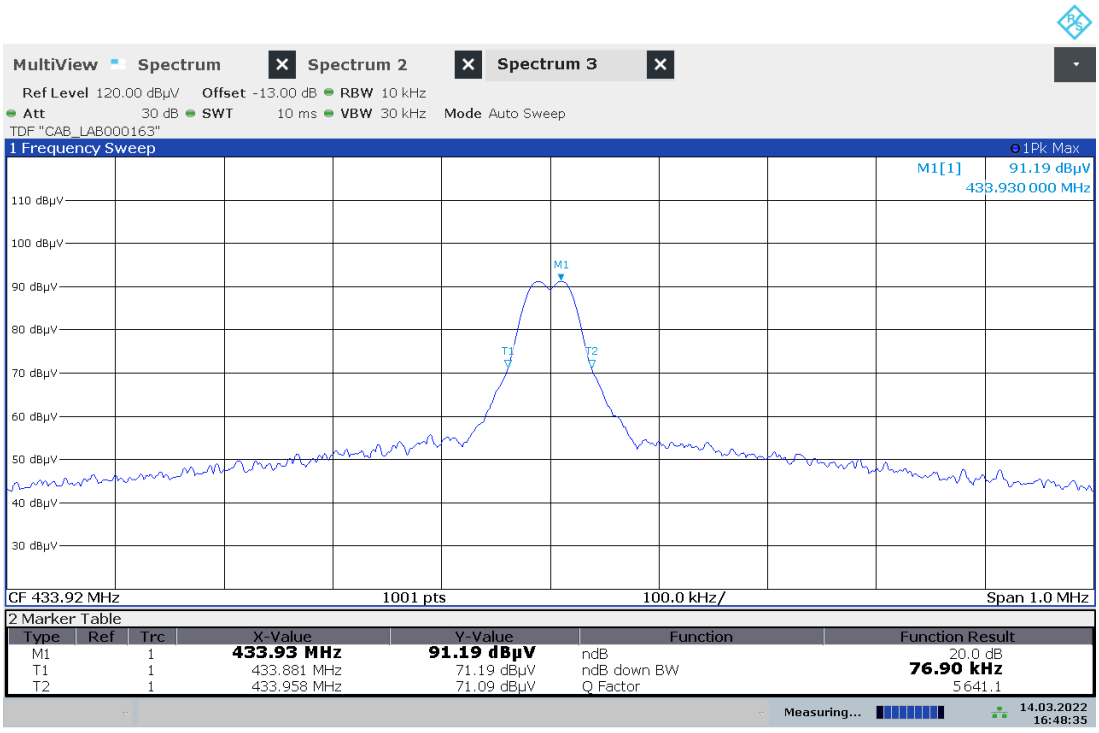
16:45:30 14.03.2022

Plot No. 41: 20 dB Bandwidth, PASE, LOCK + TRUNK



16:47:26 14.03.2022

Plot No. 42: 20 dB Bandwidth, PASE, UNLOCK + TRUNK



16:48:36 14.03.2022

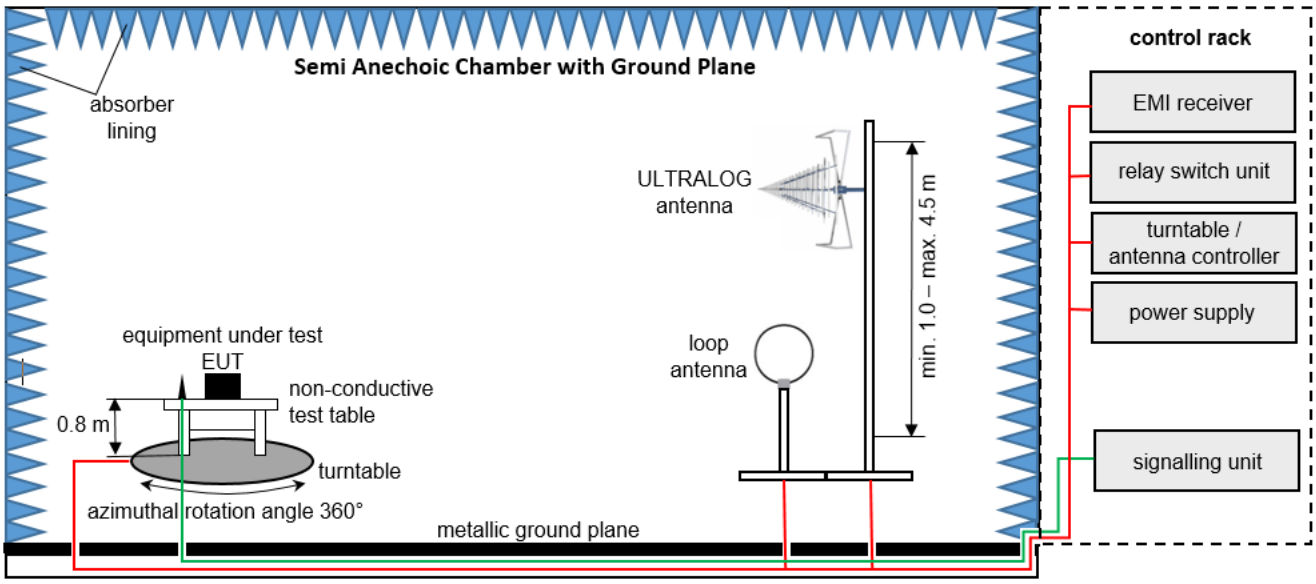
8 Test Setup Description

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Cyclically chamber inspections and range calibrations are performed. Where possible resp. necessary, RF generating and signalling equipment as well as measuring receivers and analysers are connected to an external high-precision 10 MHz reference (GPS-based frequency standard).

In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

8.1 Semi Anechoic Chamber with Ground Plane

Radiated measurements are performed in vertical and horizontal plane in the frequency range 30 MHz to 1 GHz in a Semi Anechoic Chamber with a metallic ground plane. The EUT is positioned on a non-conductive test table with a height of 0.80 m above the metallic ground plane that covers the whole chamber. The receiving antennas conform to specification ANSI C63.10-2013, American National Standard for Testing Unlicensed Wireless Devices. These antennas can be moved over the height range between 1.0 m and 4.5 m in order to search for maximum field strength emitted from the EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by a spectrum analyzer where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: ULTRALOG antenna 3 m; loop antenna 3 m
EMC32 software version: 11.10.00

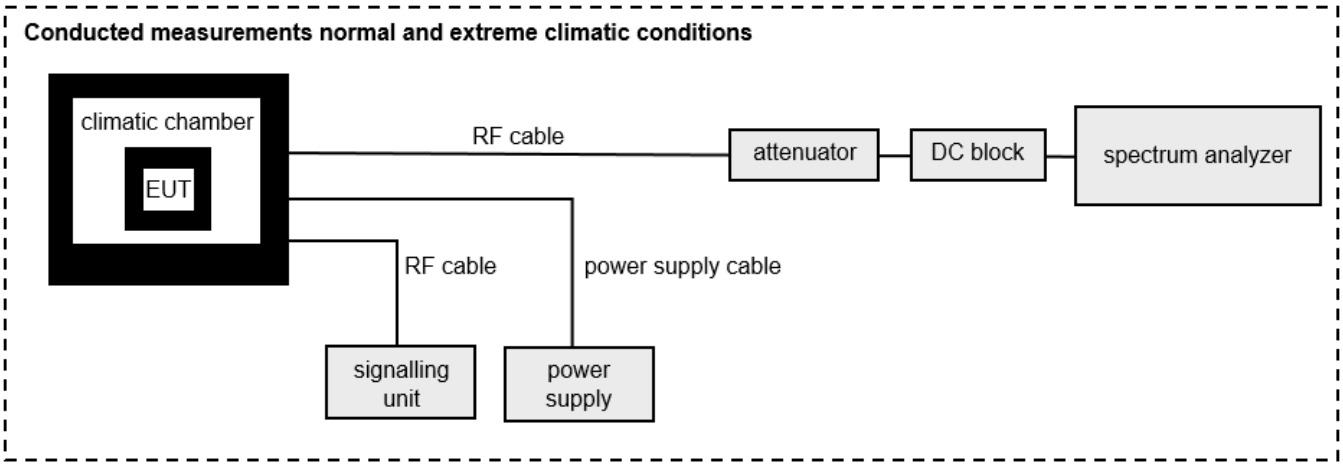
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 12.35 [dBµV/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dBµV/m] (35.69 µV/m)

List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Calibration
1	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PSI 9080-40 T	2000230001	LAB000313	NE	–
2	Test table	innco systems GmbH	PT1208-080-RH	-	LAB000306	NE	–
3	Power Supply	Chroma	61604	616040005416	LAB000285	NE	–
4	Positioner	maturo GmbH	TD 1.5-10KG		LAB000258	NE	–
5	Compressed Air	Implotex	1-850-30	-	LAB000256	NE	–
6	EMI Test Receiver	Rohde & Schwarz	ESW26	101481	LAB000236	K	2021-07-01 → 12M → 2022-07-01
78	Semi-Anechoic Chamber (SAC)	Albatross Projects GmbH	Babylon 5 (SAC 5)	20168.PRB	LAB000235	NE	–
9	Measurement Software	Rohde & Schwarz	EMC32 V11.20		LAB000226	NE	–
10	Turntable	maturo GmbH	TT2.0-2t	TT2.0-2t/921	LAB000225	NE	–
11	Antenna Mast	maturo GmbH	CAM4.0-P	CAM4.0-P/316	LAB000224	NE	–
12	Antenna Mast	maturo GmbH	BAM4.5-P	BAM4.5-P/272	LAB000223	NE	–
132	Controller	maturo GmbH	FCU 3.0	10082	LAB000222	NE	–
14	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PS 2042-10 B	2878350292	LAB000191	NE	–
14	Pre-Amplifier	Schwarzbeck Mess-Elektronik OHG	BBV 9718 C	84	LAB000169	NE	–
15	Antenna	Rohde & Schwarz	HF907	102899	LAB000151	K	2020-04-23 → 36M → 2023-04-23
16	Antenna	Rohde & Schwarz	HL562E	102005	LAB000150	K	2020-07-05 → 36M → 2023-07-05
17	Open Switch and Control Platform	Rohde & Schwarz	OSP200 Base Unit 2HU	101748	LAB000149	NE	–
18	Antenna	Rohde & Schwarz	HF907	102898	LAB000124	K	2020-04-23 → 36M → 2023-04-23
19	Antenna	Rohde & Schwarz	HL562E	102001	LAB000123	K	2020-07-05 → 36M → 2023-07-05
20	Antenna	Rohde & Schwarz	HFH2-Z2E - Active Loop Antenna	100954	LAB000108	K	2020-03-25 → 36M → 2023-03-25

8.2 Measurements under normal and extreme climatic conditions



FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 12.35 [dBµV/m] + 1.90 [dB] + 16.80 [dBµV/m] = 31.05 [dBµV/m]

List of test equipment used:

No.	Equipment	Type	Manufacturer	Serial No.	IBL No.	Kind of Calibration	Calibration
1	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PS 2042-10 B	2878350263	LAB000190	NE	–
2	Coaxial Cable	Huber & Suhner	ST18/72"	2278434	LAB000160	ZW	2021-08-16 → 12M → 2022-08-16
3	Spectrum Analyser	Rohde & Schwarz	FSW50	101450	LAB000111	K	2021-07-22 → 12M → 2022-07-22
4	Climatic Chamber	CTS GmbH	T-65/50	204002	LAB000110	ZW	2021-06-18 → 12M → 2022-06-18
5	RF cable	ST18/72"	Huber & Suhner	2278434	LAB000160	-	-

9 Measurement procedures

9.1 Radiated spurious emissions from 9 kHz to 30 MHz

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

- Turntable performs an azimuthal rotation from 0° to 315° in 45° steps.
- For each turntable step 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 by rotating the turntable from 0° to 360°.
- Loop antenna is rotated with special 3D adapter set to find maximum level of emissions.
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, turn table position and settings of measuring equipment is recorded.

Distance correction (extrapolation)

- When performing measurements on test distances other than defined in the rules, the results shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 40 dB/decade of distance in the region closer than λ in m divided by 2π (i.e., λ/2π), and at 20 dB/decade of distance beyond that, using the measurement of a single point at the radial angle that produces the maximum emission.
  This correction is already included in the limit line of corresponding measurement plots.

Detailed requirements can be found in e.g. ANSI C63.4 / C63.10

9.2 Radiated spurious emissions from 30 MHz to 1 GHz

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

- Turntable performs an azimuthal rotation from 0° to 315° in 45° steps.
- Antenna polarisation is changed (H-V / V-H) and antenna height is changed from 1 meter to 4 meters.
- For each turntable step / antenna polarisation / antenna height 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 by rotating the turntable and changing antenna height and polarisation.
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C6.4).
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, turn table position, antenna polarisation and settings of measuring equipment is recorded.

Distance correction (extrapolation)

- When performing measurements on test distances other than defined in the rules, the results shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 20 dB/decade of distance beyond the region λ in m divided by 2π (i.e., λ/2π), using the measurement of a single point at the radial angle that produces the maximum emission.
  This correction is already included in the corresponding measurement plots.

Detailed requirements can be found in e.g. ANSI C63.4 / C63.10

9.3 Radiated spurious emissions from 1 GHz to 5 GHz

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

- Turntable performs an azimuthal rotation from 0° to 315° in 45° steps.
- Antenna polarisation is changed (H-V / V-H) and antenna height is changed from 1 meter to 4 meters.
- For each turntable step / antenna polarisation / antenna height 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 by rotating the turntable and changing antenna height and polarisation.
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C6.4).
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, turn table position, antenna polarisation and settings of measuring equipment is recorded.

Distance correction (extrapolation)

- When performing measurements on test distances other than defined in the rules, the results shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 20 dB/decade of distance beyond the region λ in m divided by 2π (i.e., λ/2π), using the measurement of a single point at the radial angle that produces the maximum emission.
  This correction is already included in the corresponding measurement plots.

Detailed requirements can be found in e.g. ANSI C63.4 / C63.10

10 MEASUREMENT UNCERTAINTIES

Radio frequency	≤ ± 10 ppm
Radiated emission	≤ ± 6 dB
Temperature	≤ ± 1 °C
Humidity	≤ ± 5 %
DC and low frequency voltages	≤ ± 3 %

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 %.