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File Number **24/36403476M2**

TEST REPORT
Radiofrequency

Petitioner's Reference:	Verisure Sàrl		
Company Address:	Chemin Jean-Baptiste Vandelle 3, Versoix, Geneva, Switzerland		
Represented by:	James Barnett		
PMN:	Wi-Fi Extender		
Brand:	Verisure	HMN:	GWL-WXTND 489937
Sample #1:	3N75 UKMW	Applus Id:	25556-00003
Sample #2:	3N75 UJ5U	Applus Id:	25556-00004
Result:	**complies**		

It has been tested and complies with the applicable standard. See test result summary section.

Applicable Standard:	
RF standard/s:	**FCC 47 CFR Part 15 Subpart C[1]** **ANSI C63.10 (2013)**

[1]The latest modifications of the standard, published at the date of the tests reported in this document, have been considered.

Dates and Test Site:	Applus Barcelona, Bellaterra
Equipment Reception Date	December 12, 2023
Test Initial Date:	February 8, 2024
Test Final Date:	July 18, 2024
Modification Description:	M2

This report replaces and supersedes the report 24/36403476M1 dated on September 25, 2024.

Modifications performed: Version of ANSI 63.10:2013 is specified in applicable standard. Page 1.
It is responsibility of the petitioner to replace the previous version with this one.

Test Manager: Javier Miguel Nadales Lisbona
Date of issue: Bellaterra, October 20, 2024

JORGE GEIS ESTRADA
Firmado digitalmente por JORGE GEIS ESTRADA
Fecha: 2024.10.22 14:36:12 +02'00'

EMC & Wireless Technical Manager
Electrical and Electronics
LGAI Technological Center S.A.

ENSAYO ISO 17025 Nº9 / LE894

The results refer only and exclusively to the sample, product or material delivered for testing, and tested under conditions stipulated in this document. The equipment has been tested under conditions stipulated by standard(s) quoted in this document. This document will not be reproduced otherwise than in full.
This is the first page of the document, which consists of 65 pages.

1 TEST RESULTS SUMMARY

Test Description	Sample #	DUT Test Modes	Results	Criteria Note
ANTENNA REQUIEREMENTS (FCC Part 15.203)	#1, #2	Mode 1	PASS	CN4
OCCUPIED BANDWIDTH (99%) & EMISSION BANDWIDTH 20 dB (FCC Part 15.247 (a))	#1	Mode 1	PASS	CN4
6 dB BANDWITDH (FCC Part 15.247 (a))	#1	Mode 1	PASS	CN4
MAXIMUM PEAK CONDUCTED OUTPUT POWER (FCC Part 15.247 (c))	#1	Mode 1	PASS	CN4
POWER SPECTRAL DENSITY (FCC Part 15.247 (b))	#1	Mode 1	PASS	CN4
BAND EDGE (FCC Part 15.247 (d))	#1	Mode 1	PASS	CN4
RADIOFREQUENCY RADIATED EMISSIONS (FCC Part 15.247 (d))	#2	Mode 1	PASS	CN4

Table 1: Test description

The test results are shown in detail on the following pages.

The criteria to give conformity in those cases where it is not implicit in the standard or specification will be, for EMC emissions tests, a non-simple binary decision rule will be followed with a safety zone equal to the value of the uncertainty (w = U).

In this case, the upper limit of the value of the probability of false acceptance, according to ILAC G8, is 2.5 % and the criteria notes are:

CN1: The measured results are above the upper limit, even considering the uncertainty interval.
CN2: The measured results are above the specified limits, but within the uncertainty interval. It is therefore not possible to state compliance based on the 95% level of confidence. However, the results indicate that non-compliance is more probable than compliance.
CN3: The measured results are below the specified limits, but within the uncertainty interval. It is therefore not possible to state compliance based on the 95% level of confidence. However, the results indicate that compliance is more probable than non-compliance.
CN4: The measured results are within the limits, including the uncertainty interval.

2 INDEX

3 GENERAL DESCRIPTION OF TEST ITEMS

3.1 EQUIPMENT DESCRIPTION

This information has been provided by the customer and it is not covered by the accreditation. LGAI does not assume any responsibility from it.

EQUIPMENT DESCRIPTION			
Description	Wi-Fi Extender which can also be controlled and monitored over our proprietary radio protocol over Sub-GHz ISM (SRD).		
EUT Version	**FVIN**	**HVIN**	
	1.0.6	A1	
Power supply	1 PH + N	120 V	60 Hz
Equipment Size	**Length**	**Width**	**Height**
	17.5 cm	10.5 cm	2 cm
Modulation	GFSK		
Operating Frequency Band	902 – 928 MHz		
Maximum RF Output Power [dBm]	14		
Operating Channel(s) Width(s) [MHz]	1		
Equipment Type	DTS		
Number of Hopping Channels	N/A		
Emission Designator	--		
FCC ID	2A93W-GWL-WXTND		

Table 2: Equipment description

RF FEATURES					
Description	**Communication Technology**	**Radio Chipset**	**Brand**	**Module Model**	**Antenna Gain [dBi]**
	ISM	Si4463-C2A-GM	Silicon Labs	N/A	-1

Table 3: RF Features

3.2 TEST CONFIGURATION

<table>
<tr><th colspan="2">DUT Operation Modes</th></tr>
<tr><th>Mode #</th><th>Description</th></tr>
<tr><td>1</td><td>The customer provides test guidance. Equipment under test is connected to an Rpi. Use the Rpi to set up continuous modulated transmission on individual channels on the EUT.
<table>
<tr><th>Modulation</th><th>Frequency [MHz]</th><th>Script</th></tr>
<tr><td rowspan="3">GFSK</td><td>917.5</td><td>:rf:channel: 1; // :rf:carrier:modulated;</td></tr>
<tr><td>919.5</td><td>:rf:channel: 3; // :rf:carrier:modulated;</td></tr>
<tr><td>925.5</td><td>:rf:channel: 5; // :rf:carrier:modulated;</td></tr>
</table>
</td></tr>
</table>

Table 4. Test Configuration

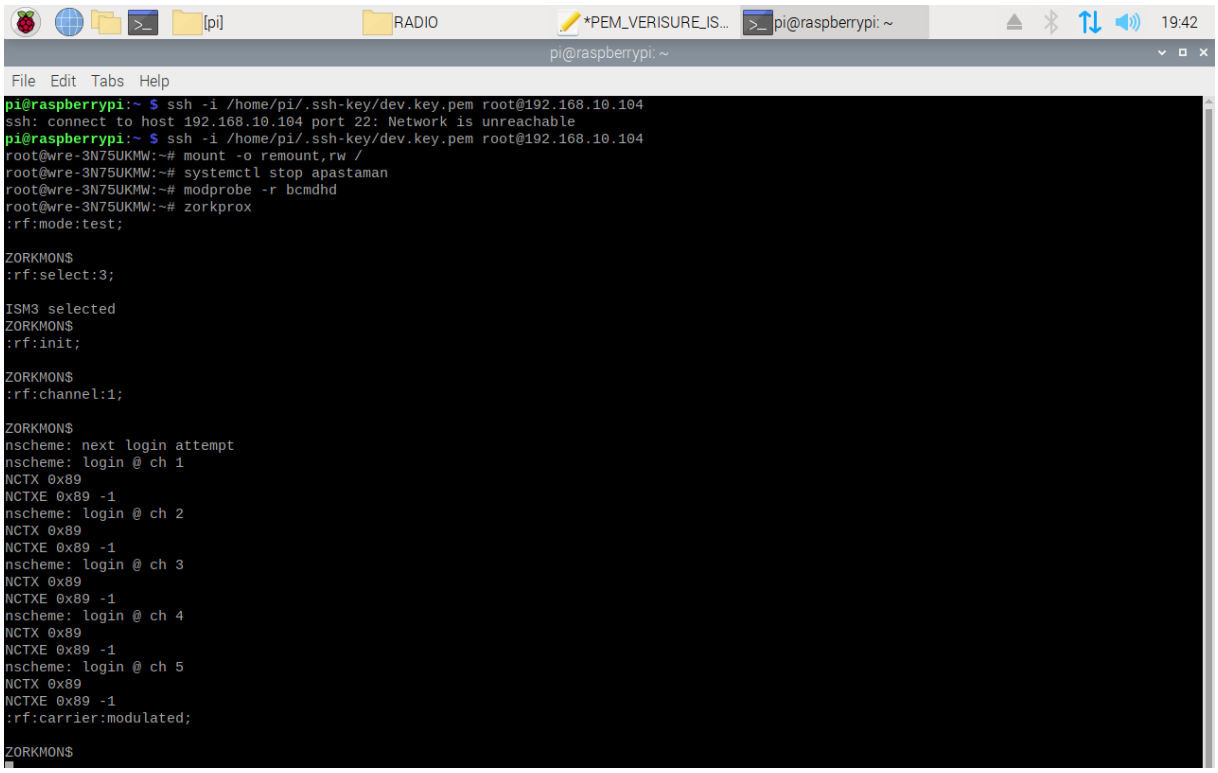

Fig. 1: Sample Configuration

3.3 PHOTOGRAPHS

Photographs identifying the equipment under test and its auxiliaries, as well as assembly photographs for radiated and conducted tests, can be found in the document with ID: 24/36403478M2

3.4 TEST FACILITIES ID

TEST FACILITIES ID	
FCC Test Firm Registration Number:	507478
ISED Assigned Code:	5766A
CABID	ES0001

Table 5: Test facilities ID

3.5 COMPETENCES AND GUARANTEES

LGAI Technological Center, S.A. is a testing laboratory accredited by the National Accreditation Body (ENAC -Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 9/LE894.
In order to assure the traceability to other national and international laboratories, Applus+ Laboratories has a calibration and maintenance program for its measurement equipment.
Applus+ Laboratories guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at Applus+ Laboratories at the time of performance of the test.
Applus+ Laboratories is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test. The results presented in this Test Report apply only to the particular item under test established in this document.

General conditions:

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of Applus+ Laboratories.

4 TEST RESULTS

4.1 ANTENNA REQUIREMENT

4.1.1 Requirements

For intentional device, according to FCC 47 CFR, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

For intentional device, according to RSS-Gen, the applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

4.1.2 Summary Test Results

The laboratory checks that the sample has an internal antenna, so that no hardware modifications are possible. Complying with the requirements of this section.

4.2 OCCUPIED CHANNEL BANDWIDTH (99%) & 20 dB BANDWIDTH

4.2.1 Test Setup Required

Fig. 2: Set-Up - Occupied Channel Bandwidth & Occupied Channel Bandwidth 99% & Emission Bandwidth 20dB

4.2.2 Requirements

The frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission. In some cases, for example multichannel frequency-division systems, the percentage of 0.5 percent may lead to certain difficulties in the practical application of the definitions of occupied and necessary bandwidth; in such cases a different percentage may prove useful

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

4.2.3 EMI Receiver configuration

During the conducted test, the EMI receiver was set with the following configurations:

Central frequency [MHz]	Span [MHz]	Detector	Trace Mode	RBW [kHz]	VBW [kHz]
Channel frequency	3	Peak	Max Hold	30	100

Table 6: EMI Receiver configuration – Occupied Channel Bandwidth 99% & Emission Bandwidth 20dB

4.2.4 Test Environmental Conditions

Test Date	Technician	Supervisor	Temperature [ºC]	Humidity [%]	Atm. Pressure [mbar]
20/02/2024	O. Merchán	Javier Miguel Nadales	22.8	45	998

Table 7: Test environmental conditions – Occupied Channel Bandwidth 99% & Emission Bandwidth 20dB

4.2.5 Summary Test Results

Channel	99% Bandwidth [kHz]	20 dB Bandwidth [kHz]	Results
917.5 MHz	618.1	658.2	PASS
919.5 MHz	617.6	657.3	PASS
925.5 MHz	616.4	655.8	PASS

Table 8: Summary Test Results – Occupied Channel Bandwidth 99% & Emission Bandwidth 20dB

4.2.6 Test Results

4.2.6.1 Sample #1. Mode #1

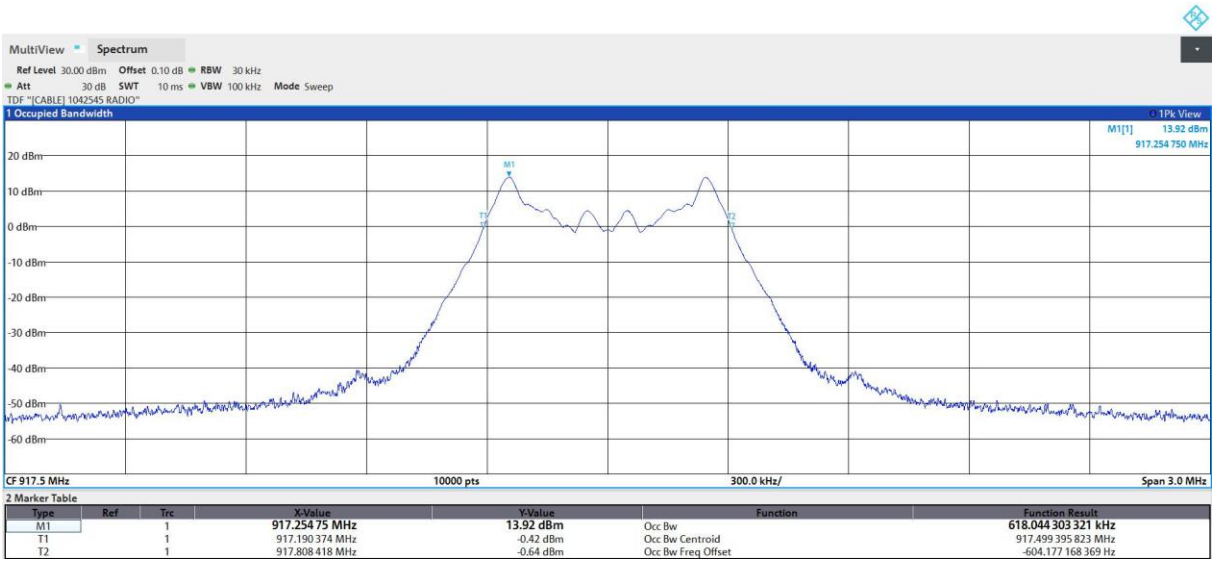

Fig. 3: Low Channel - 99% Occupied Channel Bandwidth

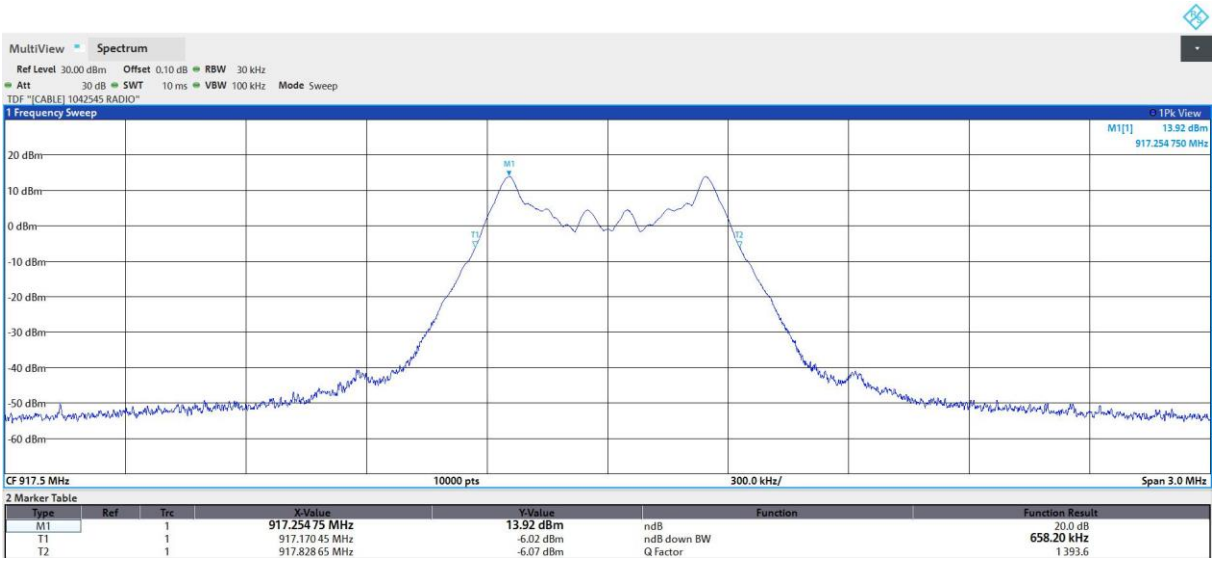

Fig. 4: Low Channel - Emission Bandwidth 20dB

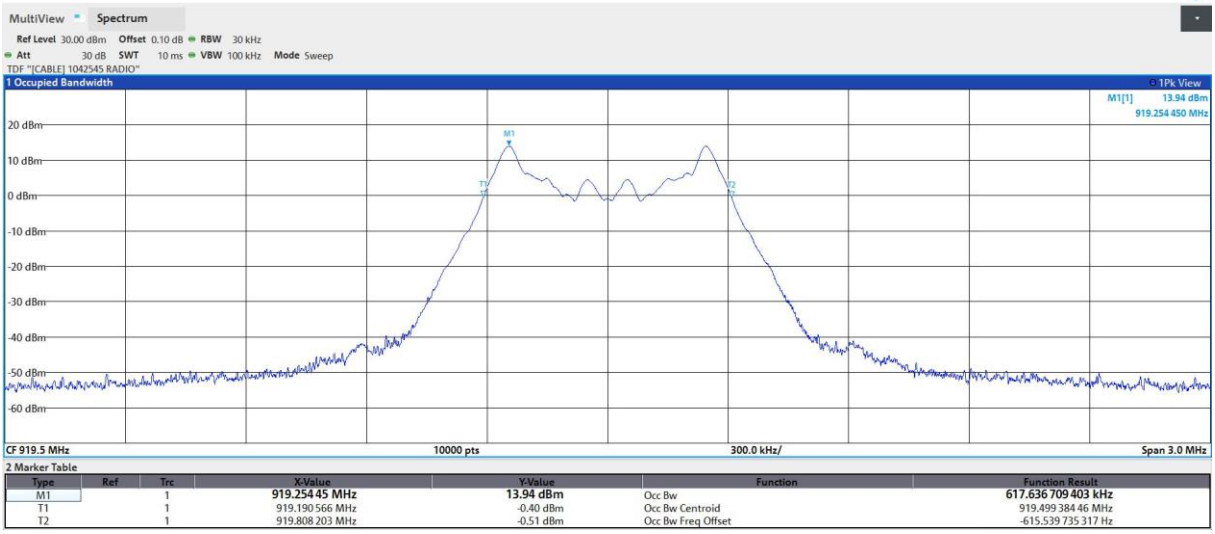

Fig. 5: Middle Channel - 99% Occupied Channel Bandwidth

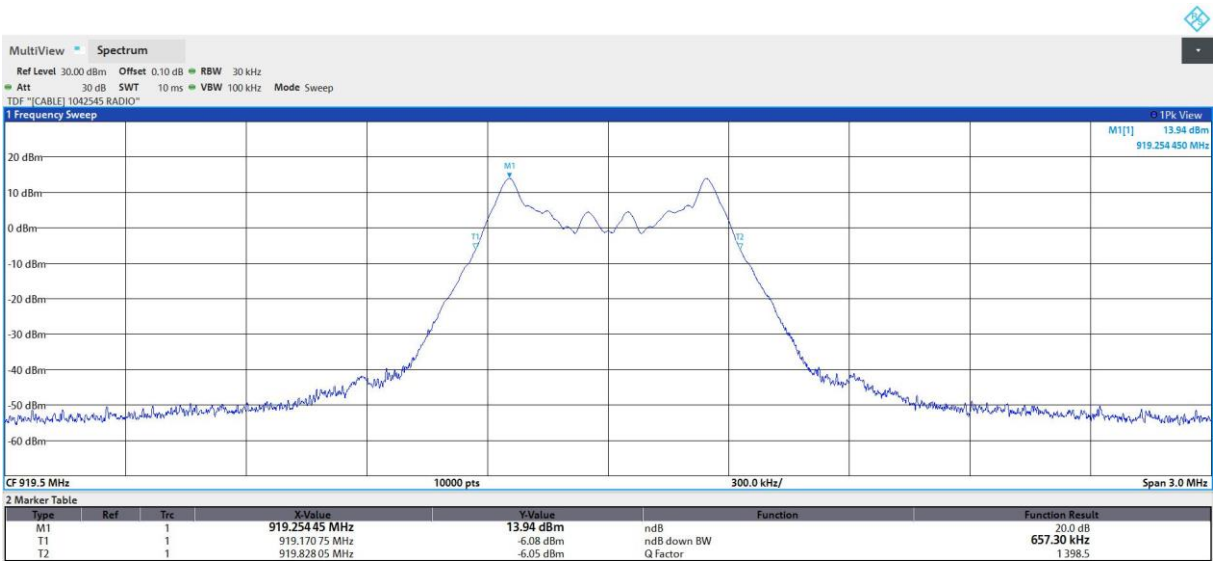

Fig. 6: Middle Channel - Emission Bandwidth 20dB

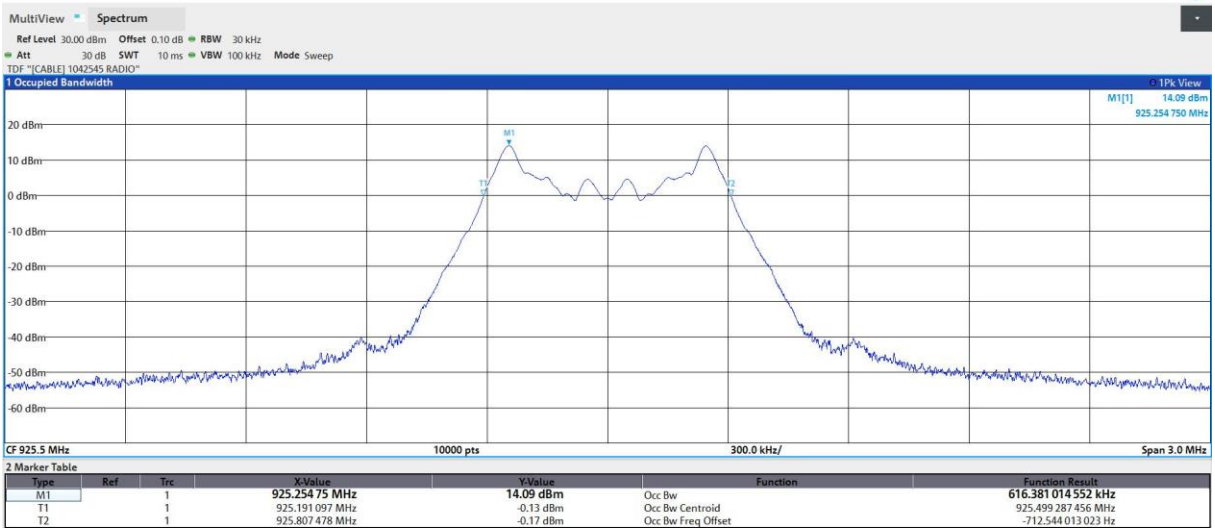

Fig. 7: High Channel - 99% Occupied Channel Bandwidth

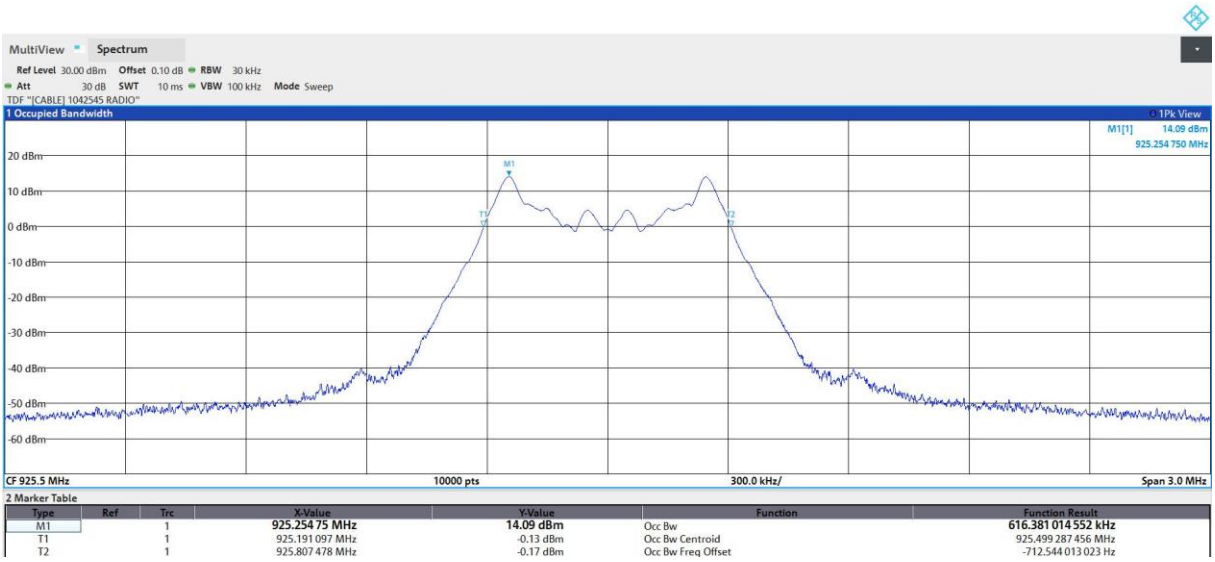

Fig. 8: High Channel - Emission Bandwidth 20dB

4.2.7 Test Equipment Used

Equipment	Brand	Model	Applus Ref.	Last Calibration	Next Calibration
SIGNAL SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSVA3044	1042700	23/02/2022	15/11/2024
CABLE RF 40 GHz	HUBERSUHNER	SF102	1042545	18/05/2023	18/05/2024
DIGITAL THERMO-HYGROMETER	TESTO	608-H1	1041916	09/02/2024	09/02/2025
SHIELDED CHAMBER SR0	ALBATROSS	SR	1042267	-	-

Table 9: Test Instruments – 99% Occupied Channel Bandwidth & Emission Bandwidth 20dB

4.2.8 Uncertainty

Test Type	Test Description	Uncertainty
Emission	RF bandwidth measurements	±76.0 Hz

Table 10: Uncertainties - 99% Occupied Channel Bandwidth & Emission Bandwidth 20dB

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by a coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%.

4.3 DTS BANDWIDTH

4.3.1 Test Setup Required

Fig. 9: Set-Up - DTS Bandwidth

4.3.2 Requirements

The frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission. In some cases, for example multichannel frequency-division systems, the percentage of 0.5 percent may lead to certain difficulties in the practical application of the definitions of occupied and necessary bandwidth; in such cases a different percentage may prove useful

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

4.3.3 EMI Receiver configuration

During the conducted test, the EMI receiver was set with the following configurations:

Central frequency [MHz]	Span [MHz]	Detector	Trace Mode	RBW [kHz]	VBW [kHz]
Channel frequency	3	Peak	Max Hold	100	300

Table 11: EMI Receiver configuration – DTS Bandwidth

4.3.4 Test Environmental Conditions

Test Date	Technician	Supervisor	Temperature [ºC]	Humidity [%]	Atm. Pressure [mbar]
20/02/2024	O.Merchan	Javier Miguel Nadales	22.8	45	998

Table 12: Test environmental conditions – DTS Bandwidth

4.3.5 Summary Test Results

Channel	DTS Bandwidth [kHz]	Results
917.5 MHz	676.2	PASS
919.5 MHz	675.6	PASS
925.5 MHz	674.7	PASS

Table 13: Summary Test Results – DTS Bandwidth

4.3.6 Test Results

4.3.6.1 Sample #1. Mode #1

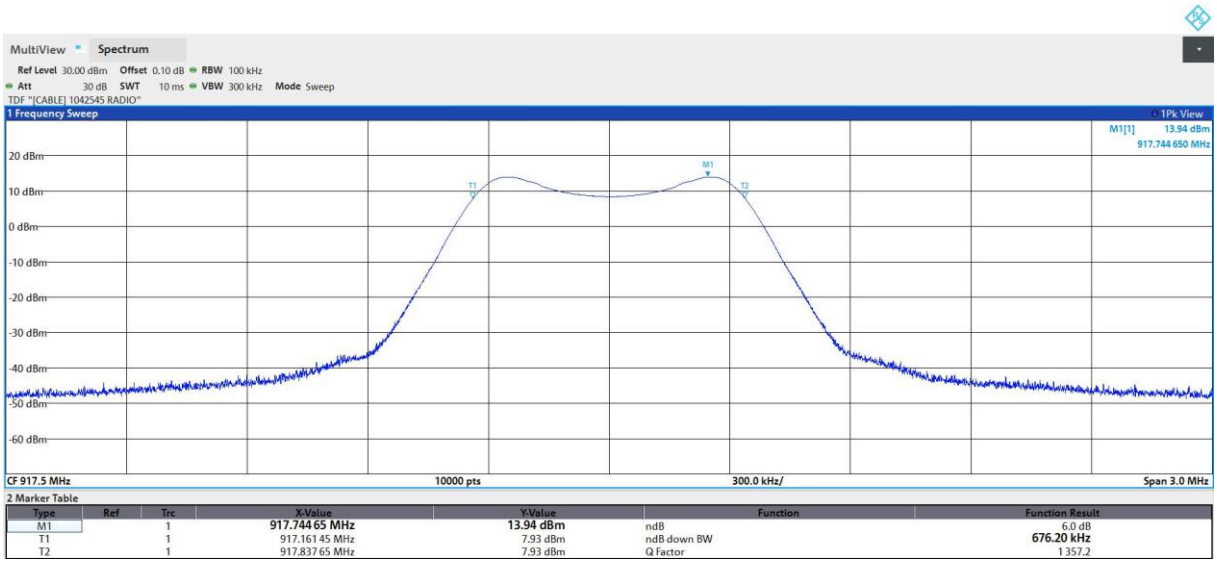

Fig. 10: Low Channel - DTS Bandwidth

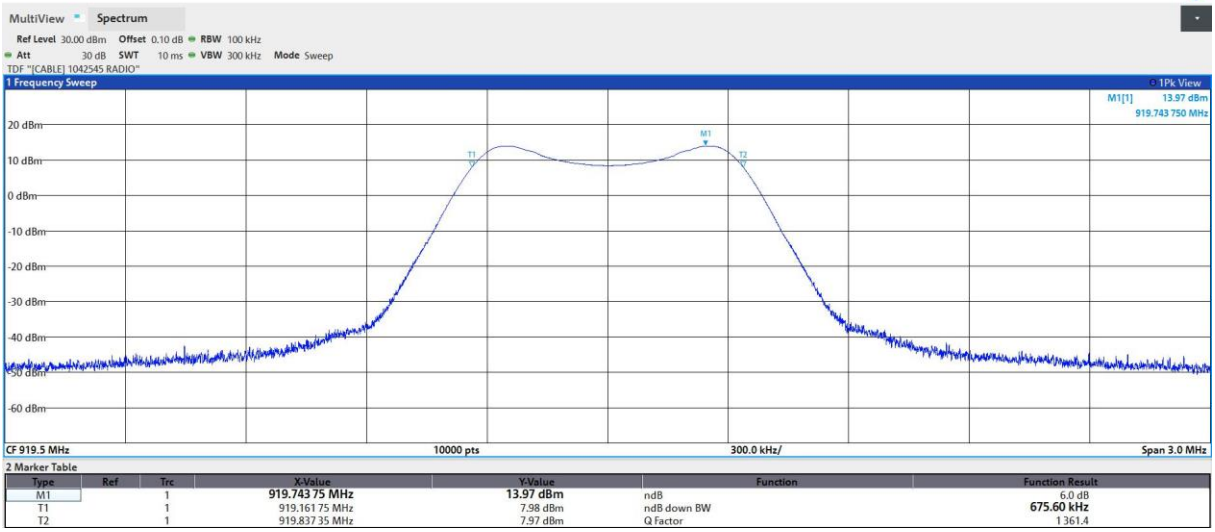

Fig. 11: Middle Channel -DTS Bandwidth

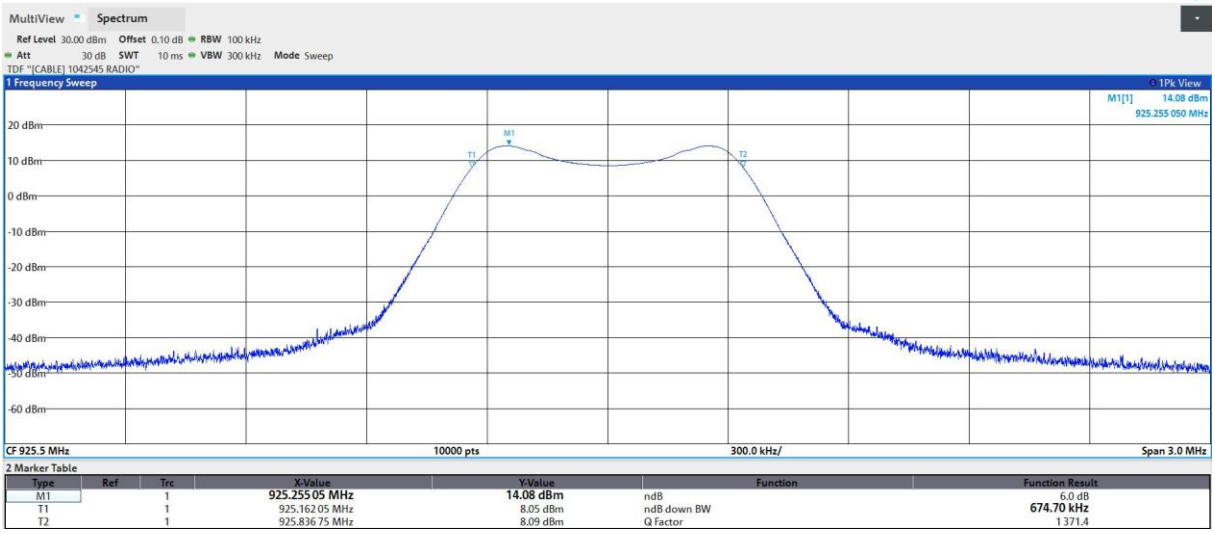

Fig. 12: High Channel - DTS Bandwidth

4.3.7 Test Equipment Used

Equipment	Brand	Model	Applus Ref.	Last Calibration	Next Calibration
SIGNAL SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSVA3044	1042700	23/02/2022	15/11/2024
CABLE RF 40 GHz	HUBERSUHNER	SF102	1042545	18/05/2023	18/05/2024
DIGITAL THERMO-HYGROMETER	TESTO	608-H1	1041916	09/02/2024	09/02/2025
SHIELDED CHAMBER SR0	ALBATROSS	SR	1042267	-	-

Table 14: Test Instruments – DTS Bandwidth

4.3.8 Uncertainty

Test Type	Test Description	Uncertainty
Emission	RF bandwidth measurements	±76.0 Hz

Table 15: Uncertainties - DTS Bandwidth

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by a coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%.

4.4 MAXIMUM CONDUCTED OUTPUT POWER

4.4.1 Test Setup Required

Fig. 13: Set-Up - Maximum Conducted Output Power

4.4.2 Requirements

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

The conducted output power limit is based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

4.4.3 EMI Receiver configuration

During the conducted test, the EMI receiver was set with the following configurations:

Central frequency [MHz]	Span [MHz]	Detector	Trace Mode	Resolution Bandwidth [kHz]	Video Bandwidth [kHz]
Channel frequency	2	RMS	Power AVG	30	100

Table 16: Power Meter configuration – Maximum Conducted Output Power

4.4.4 Test Environmental Conditions

Test Date	Technician	Supervisor	Temperature [ºC]	Humidity [%]	Atm. Pressure [mbar]
20/02/2024	O.Merchan	Javier Miguel Nadales	22.8	45	998

Table 17: Test environmental conditions – Maximum Conducted Output Power

4.4.5 Summary Test Results

Frequency [MHz]	Conducted Output Power [dBm]	Limit [dBm]	Results
917.5	13.9	30.0	PASS
919.5	13.9	30.0	PASS
925.5	14.0	30.0	PASS

Table 18: Summary Test Results – Maximum Conducted Output Power

4.4.6 Test Results

4.4.6.1 Sample #1. Mode #1

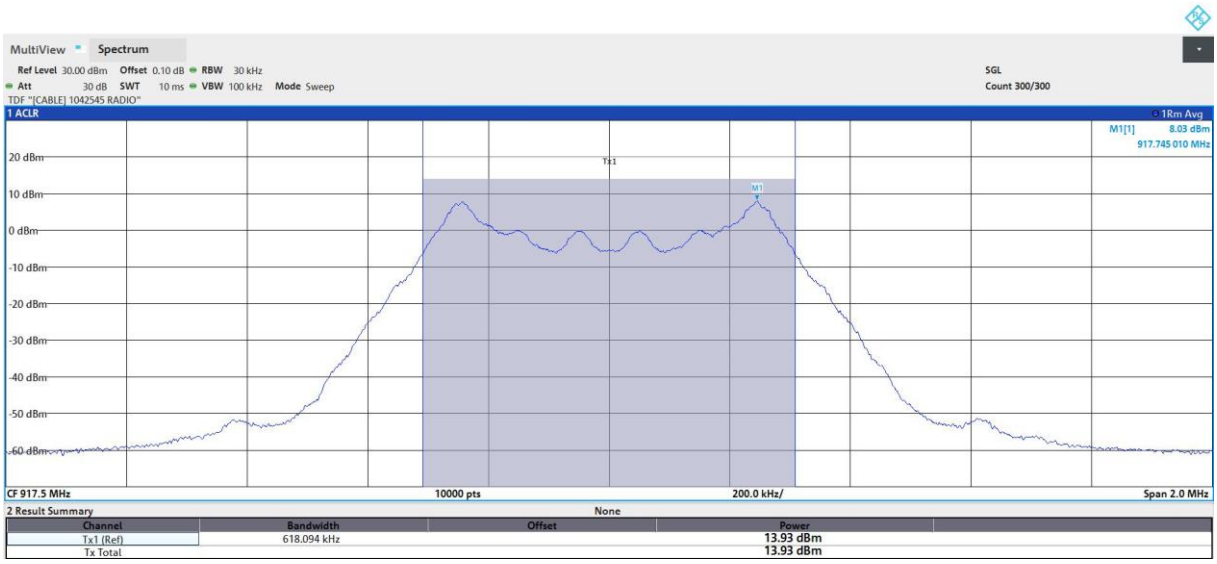

Fig. 14: Low Channel - Maximum Conducted Output Power

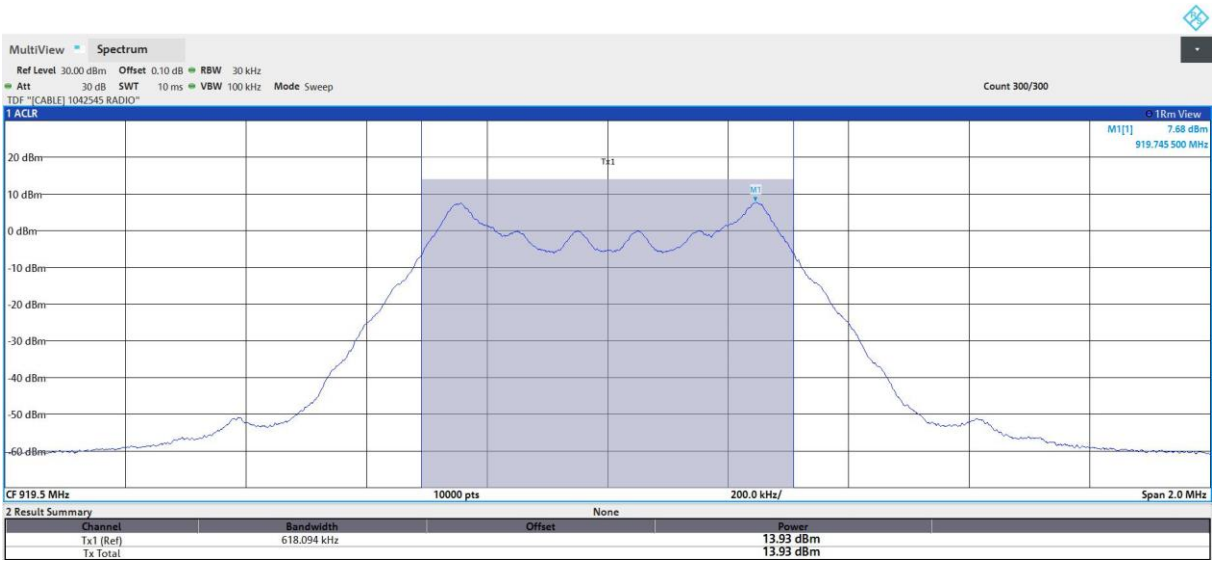

Fig. 15: Middle Channel - Maximum Conducted Output Power

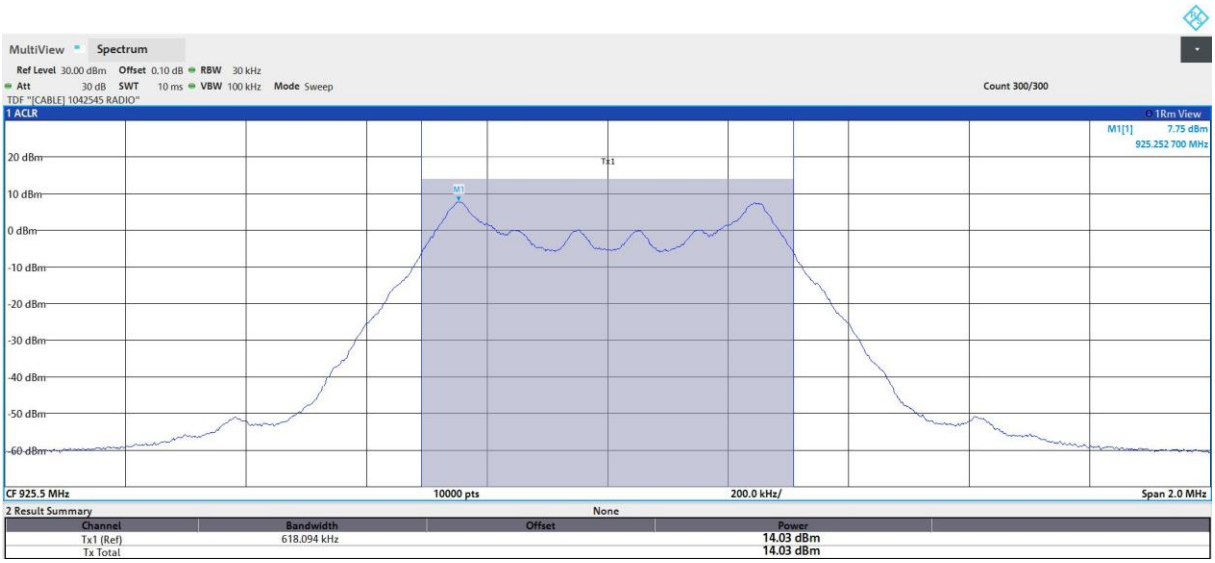

Fig. 16: High Channel - Maximum Conducted Output Power

4.4.7 Test Equipment Used

Equipment	Brand	Model	Applus Ref.	Last Calibration	Next Calibration
SIGNAL SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSVA3044	1042700	23/02/2022	15/11/2024
CABLE RF 40 GHz	HUBERSUHNER	SF102	1042545	18/05/2023	18/05/2024
DIGITAL THERMO-HYGROMETER	TESTO	608-H1	1041916	09/02/2024	09/02/2025
SHIELDED CHAMBER SR0	ALBATROSS	SR	1042267	-	-

Table 19: Test Instruments – Maximum Conducted Output Power

4.4.8 Uncertainty

Test Type	Test Description	Uncertainty
Emissions	RF output power measurements [Conducted]	±1.3 dB

Table 20: Uncertainties - Maximum Conducted Output Power

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by a coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%.

4.5 POWER SPECTRAL DENSITY

4.5.1 Test Setup Required

Fig. 17: Power Spectral Density setup of table top equipment.

4.5.2 Requirements

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. The same method of determining the conducted output power shall be used to determine the power spectral density.

4.5.3 EMI Receiver configuration

During the conducted test, the EMI receiver was set with the following configurations:

Central frequency [MHz]	Span [MHz]	Detector	Trace Mode	Resolution Bandwidth [kHz]	Video Bandwidth [kHz]
Channel frequency	1.5	RMS	Power AVG	10	30

Table 21: EMI Receiver configuration – Power Spectral Density

4.5.4 Test Environmental Conditions

Test Date	Technician	Supervisor	Temperature [ºC]	Humidity [%]	Atm. Pressure [mbar]
20/02/2024	O.Merchan	Javier Miguel Nadales	22.8	45	998

Table 22: Test environmental conditions – Power Spectral Density

4.5.5 Summary Test Results

Channel	PSD [dBm]	Limit [dBm]	Results
917.5	5.9	8.0	PASS
919.5	6.0	8.0	PASS
925.5	5.9	8.0	PASS

Table 23: Summary Test Results – Power Spectral Density

4.5.6 Test Results

4.5.6.1 Sample #1. Mode #1

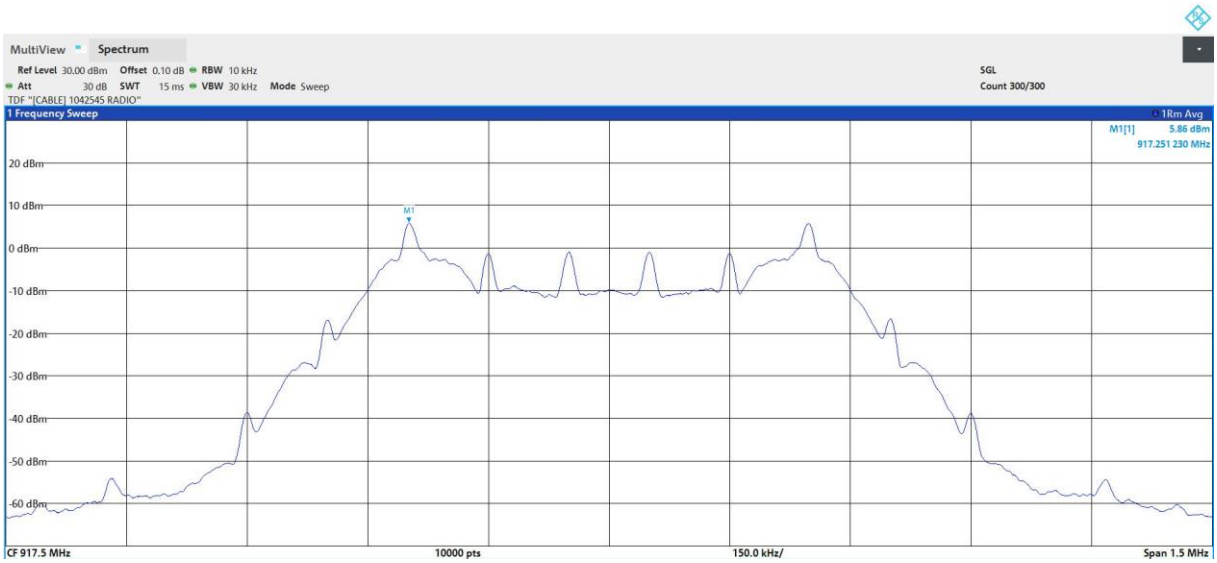

Fig. 18: Low Channel - Power Spectral Density

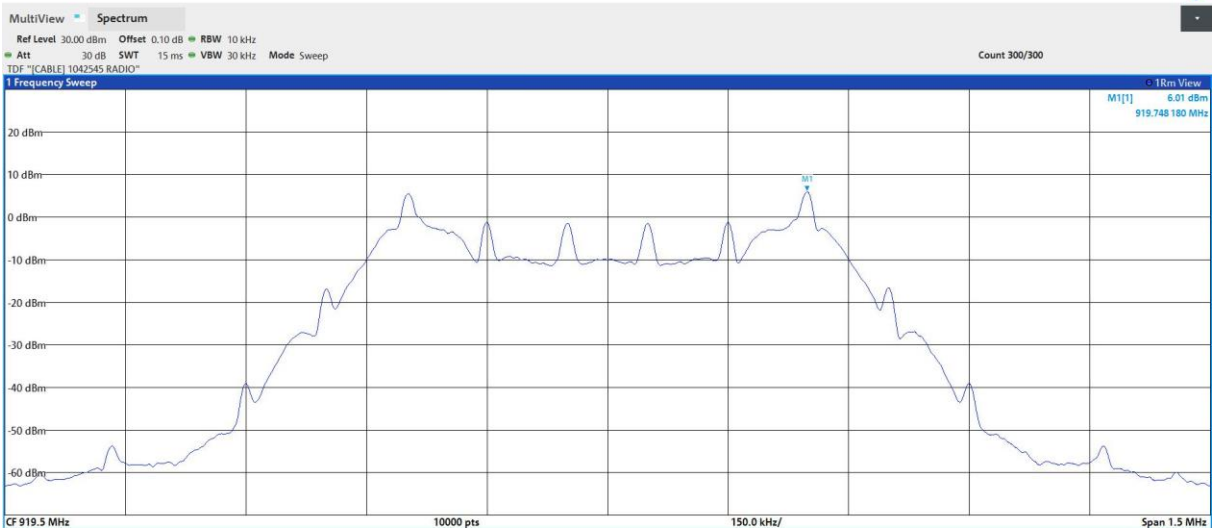

Fig. 19: Middle Channel - Power Spectral Density

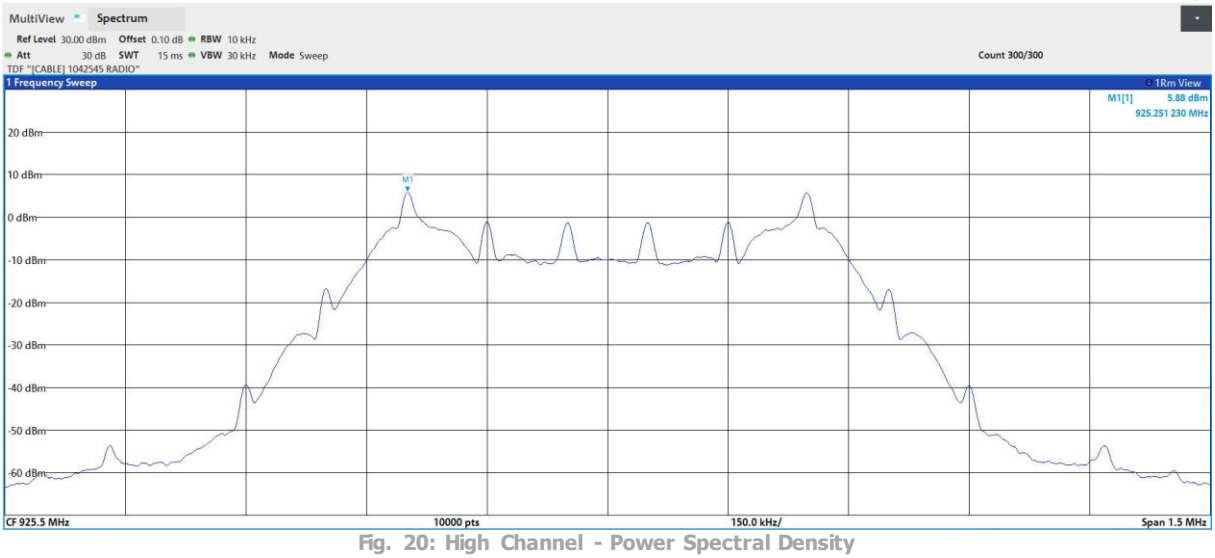

Fig. 20: High Channel - Power Spectral Density

4.5.7 Test Equipment Used

Equipment	Brand	Model	Applus Ref.	Last Calibration	Next Calibration
SIGNAL SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSVA3044	1042700	23/02/2022	15/11/2024
CABLE RF 40 GHz	HUBERSUHNER	SF102	1042545	18/05/2023	18/05/2024
DIGITAL THERMO-HYGROMETER	TESTO	608-H1	1041916	09/02/2024	09/02/2025
SHIELDED CHAMBER SR0	ALBATROSS	SR	1042267	-	-

Table 24: Test Instruments – Power Spectral Density

4.5.8 Uncertainty

Test Type	Test Description	Uncertainty
Emissions	Power spectral density measurements [Conducted]	±2.6 dB

Table 25: Uncertainties - Power Spectral Density

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by a coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%.

4.6 BAND EDGE

4.6.1 Test Setup Required

Fig. 21: Band Edge setup of table top equipment.

4.6.2 Requirements

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

4.6.3 EMI Receiver configuration

During the conducted test, the EMI receiver was set with the following configurations:

Central frequency [MHz]	Span [MHz]	Detector	Resolution Bandwidth [kHz]	Video Bandwidth [kHz]
Band Edges	40	Max Peak	100	300

Table 26: EMI Receiver configuration – Band Edge

4.6.4 Test Environmental Conditions

Test Date	Technician	Supervisor	Temperature [ºC]	Humidity [%]	Atm. Pressure [mbar]
20/02/2024	O.Merchan	Javier Miguel Nadales	22.8	45.0	998.5
18/07/2024	Pau Redondo	Javier Miguel Nadales	23.1	47.2	1001.7

Table 27: Test environmental conditions – Band Edge

4.6.5 Summary Test Results

Frequency [MHz]	Band Edge	Limit [dBm]	Results
917.5	PK < Limit - I	-16.19	PASS
925.5	PK < Limit - I	-16.18	PASS

Table 28: Summary Test Results – Band Edge

4.6.6 Test Results

4.6.6.1 Sample #1. Mode #1

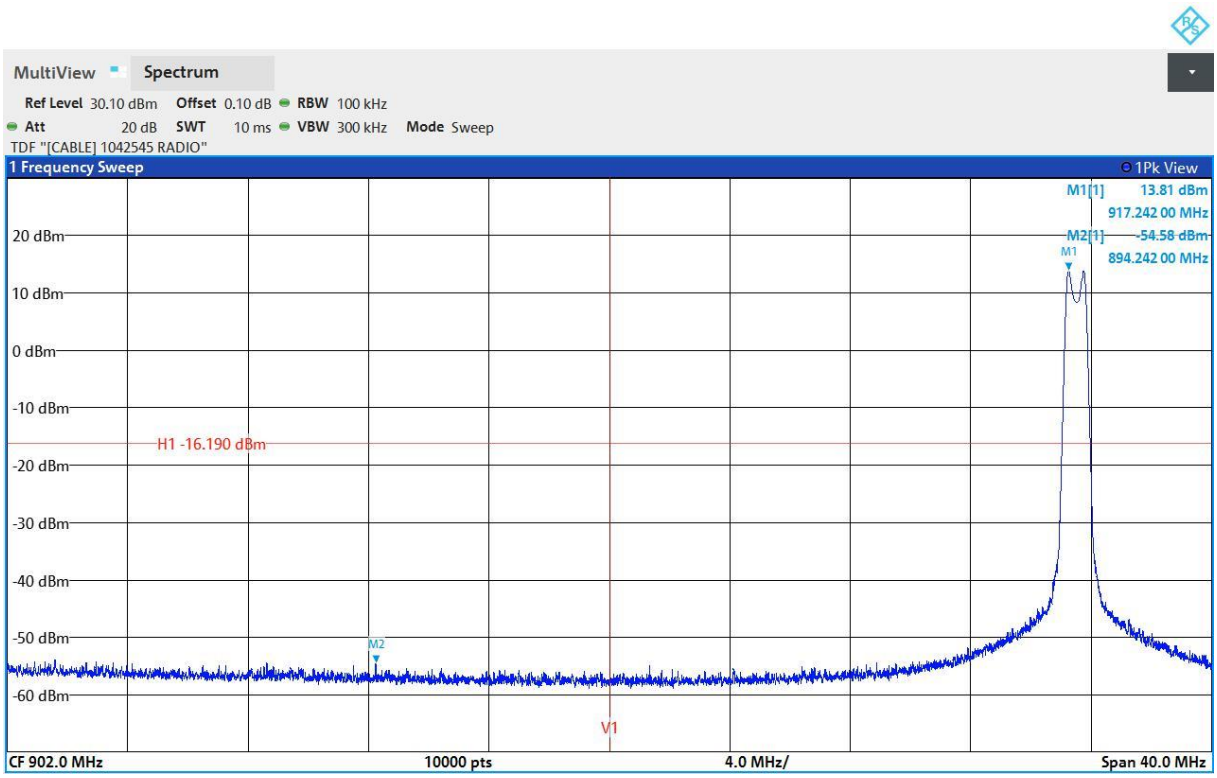

Fig. 22: Low Channel - Band Edge

FINAL MEASUREMENTS

Frequency [MHz]	Max amplitude Level [dBm]	Margin [dB]	Result
894.24	-54.58	38.39	PASS

Table 29: Low Channel - Band Edge

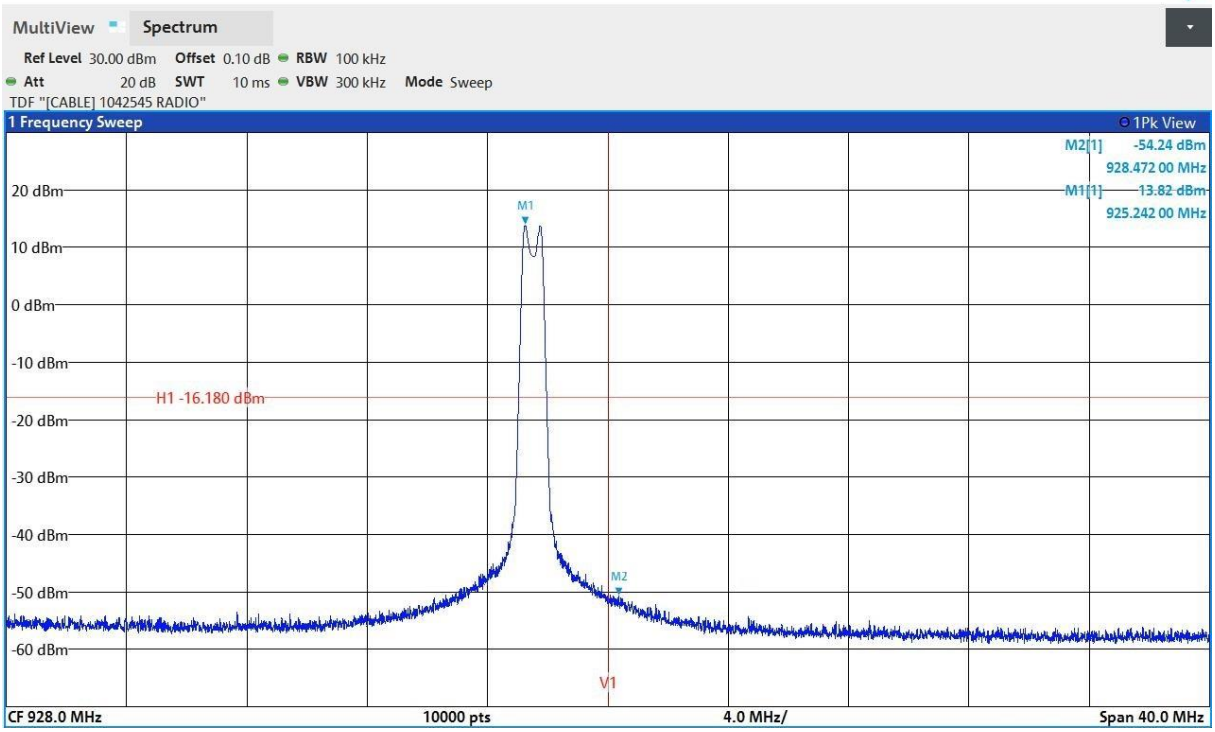

Fig. 23: High Channel - Band Edge

FINAL MEASUREMENTS

Frequency [MHz]	Max amplitude Level [dBm]	Margin [dB]	Result
928.5	-54.24	38.06	PASS

Table 30. High Channel - Band Edge

4.6.7 Test Equipment Used

Equipment	Brand	Model	Applus Ref.	Last Calibration	Next Calibration
SIGNAL SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSVA3044	1042700	23/02/2022	15/11/2024
CABLE RF 40 GHz	HUBERSUHNER	SF102	1042545	18/05/2023	18/05/2024
DIGITAL THERMO-HYGROMETER	TESTO	608-H1	1041916	09/02/2024	09/02/2025
SHIELDED CHAMBER SR0	ALBATROSS	SR	1042267	-	-

Table 31: Test Instruments – Band Edge

4.6.8 Uncertainty

Test Type	Test Description	Uncertainty
Emissions	Adjacent channels power measurement	1.3 dB

Table 32: Uncertainties - Band Edge

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by a coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%.

4.7 RADIO-FREQUENCY RADIATED EMISSIONS

4.7.1 Test Setup Required

4.7.1.1 Tabletop equipment

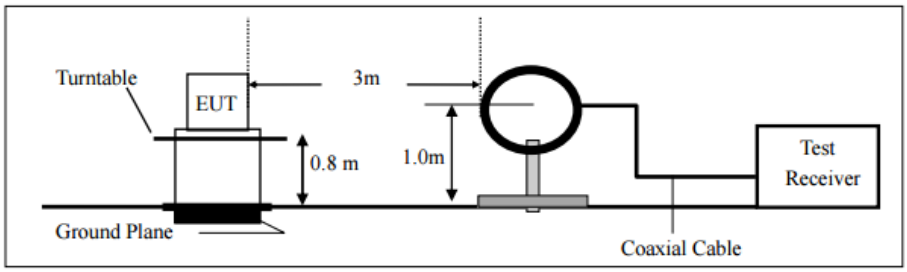

Fig. 24: Radio-frequency radiated emissions of table top equipment from 9 kHz to 30 MHz

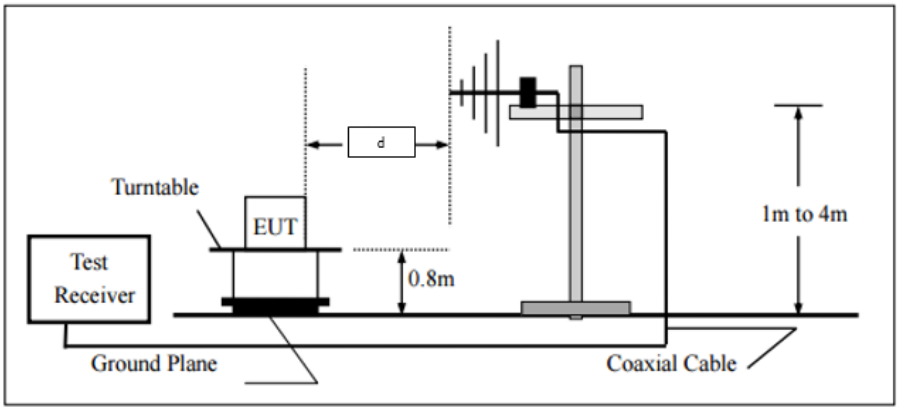

Fig. 25: Radio-frequency radiated emissions of table top equipment from 30 MHz to 1000 MHz

Distance "d" depends on test chamber.

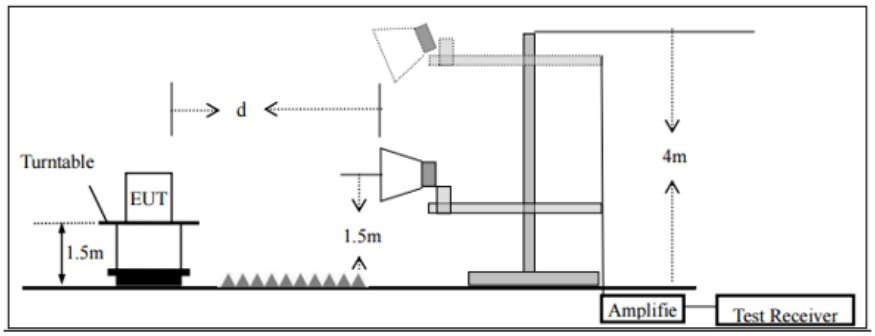

Fig. 26: Radio-frequency radiated emissions setup of table top equipment above 1 GHz

Distance "d" depends on test chamber.

4.7.2 Requirements

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Only spurious emissions are permitted in any of the frequency bands listed below:

Frequency [MHz]	Frequency [MHz]	Frequency [MHz]	Frequency [GHz)]
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
(1)0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	(2)
13.36–13.41			

Table 33. Restricted bands of operation

Note 1: Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.
Note 2: Above 38.6

According to § 15.209(a) and RSS-Gen section 8.9, the radiated emission limits for restricted bands are:

Frequency Range [MHz]	Quasi-peak detector (QP) [dBµV/m]	Peak detector (PK) [dBµV/m]		Average detector (AVG) [dBµV/m]	
	3 m measuring distance	3 m measuring distance	1 m measuring distance[1]	3 m measuring distance	1 m measuring distance[1]
0.009 – 0.490	20log(2400/F[kHz]) + 80	N/A	N/A	N/A	N/A
0.490 – 1.705	20log(24000/F[kHz]) + 40	N/A	N/A	N/A	N/A
1.705 - 30	20log(24000/F[kHz]) + 40	N/A	N/A	N/A	N/A
30 – 88	40.0	N/A	N/A	N/A	N/A
88 – 216	43.5	N/A	N/A	N/A	N/A
216 – 960	46.0	N/A	N/A	N/A	N/A
960 – 1000	54.0	N/A	N/A	N/A	N/A
1000 – 18000	N/A	74	N/A	54	N/A
18000 - 40000	N/A	N/A	83.54	N/A	63.54

Table 34: Radio-frequency radiated emissions requirements

Note 1: The limits has been modified according to the applicable standard applying the formula: $L_2 = L_1 - 20log\,(d_2/d_1)$*, where:*
L_2: New Limit.
L_1: Limit at 3 meters.
d_1: 3 meters (standard distance).
d_2: 1 meter (new measurement distance).

According to FCC Part 15 Subpart C FCC 15.247, the limits for unrestricted bands are:

Frequency Range [MHz]	Test Mode	Field strength [µV/m]	Measurement distance [m]
30 – 88	Peak power / RMS averaging	-20 dBc / -30 dBc	3
88 – 216			
216 – 960			
Above 960			

Table 35. Radiated Emission limits. Unrestricted bands

4.7.2.1 Receiver Parameters

According to standard ANSI C63.4-2014:

Frequency Range [MHz]	Detector	Resolution Bandwidth [MHz]	Video Bandwidth [MHz]
0.009 – 0.15	Quasi-peak (QP)	$200 \cdot 10^{-6}$	$1 \cdot 10^{-3}$
0.15 – 30	Quasi-peak (QP)	$9 \cdot 10^{-3}$	$30 \cdot 10^{-3}$
30 – 1000	Quasi-peak (QP)	0.12	0.30
Above 1000	Peak (PK)	1	3
	Average (AVG)	1	10

Table 36: Receiver parameters – Radio-frequency radiated emissions

4.7.3 Test Environmental Conditions

Test Date	Technician	Supervisor	Temperature [ºC]	Humidity [%]	Atm. Pressure [mbar]
08/02/2024	O. Merchán	--	22.7	44.6	1008
08/02/2024	J.M LLauradó	--	21.1	46.8	1012

Table 37: Test environmental conditions – Radio-frequency radiated emissions

4.7.4 Summary Test Results

Frequency Range [MHz]	Test Area	Distance [m]	Emissions	Results
9 kHz – 30 MHz	SAC 1	3 m	QP < Limit - I	PASS
30 MHz – 1 GHz	SAC 1	3 m	QP < Limit - I	PASS
1 GHz – 8 GHz	SAC 1	3 m	PK < Limit - I AVG < Limit - I	PASS
8 GHz – 10 GHz	SAC 1	3 m	PK < Limit - I AVG < Limit - I	PASS

Table 38: Summary test results – Radio-frequency radiated emissions

4.7.5 Test Results

4.7.5.1 Ambient Levels. Frequency range: 9 kHz – 30 MHz

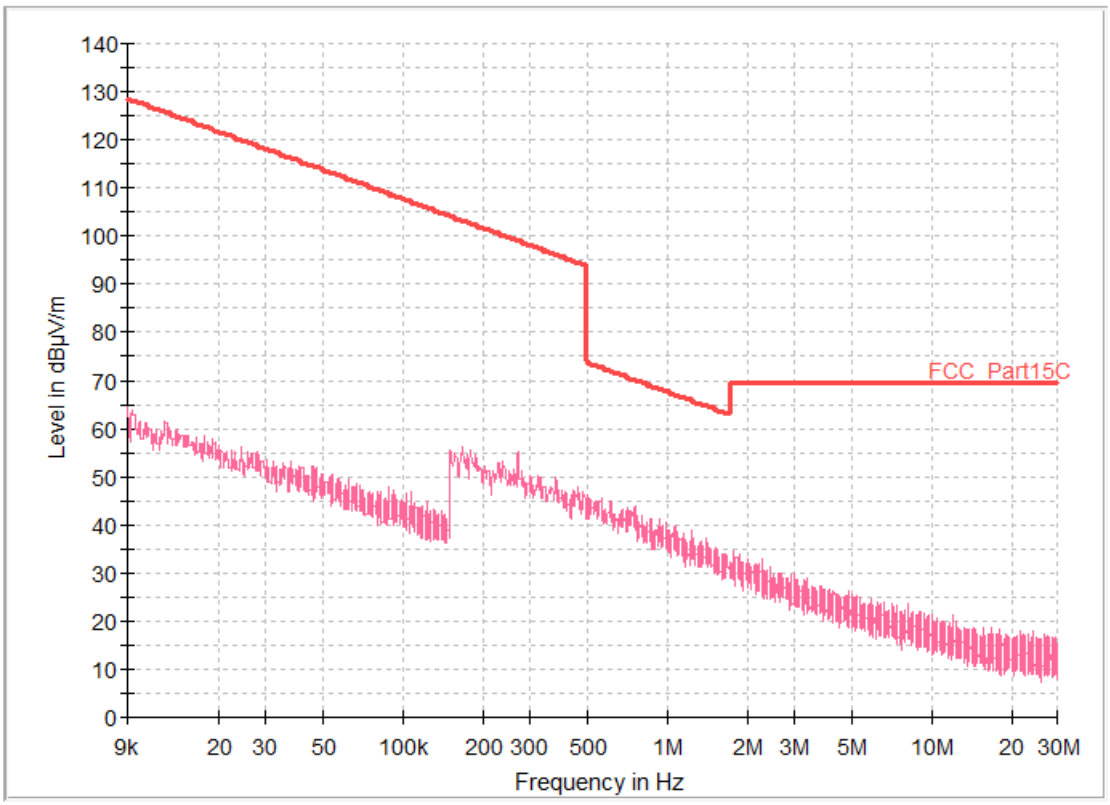

Fig. 27: Ambient level. Frequency range: 9 kHz – 30 MHz - Axis X

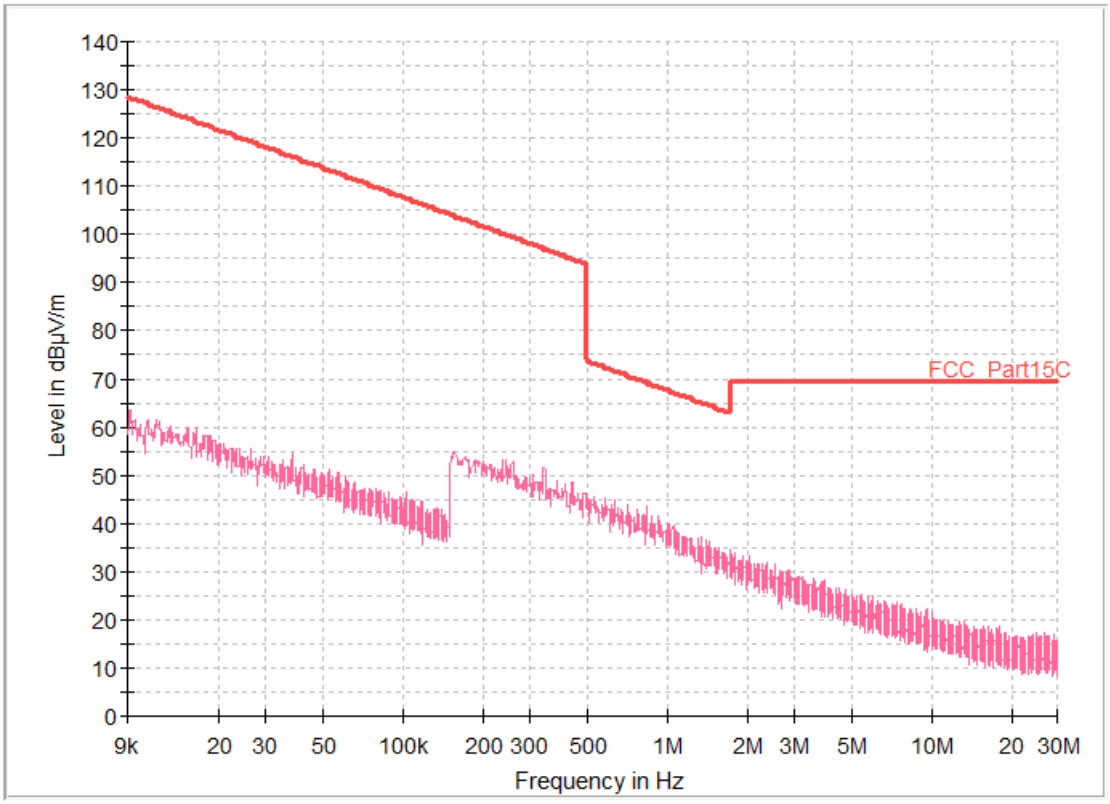

Fig. 28: Ambient level. Frequency range: 9 kHz – 30 MHz - Axis Y

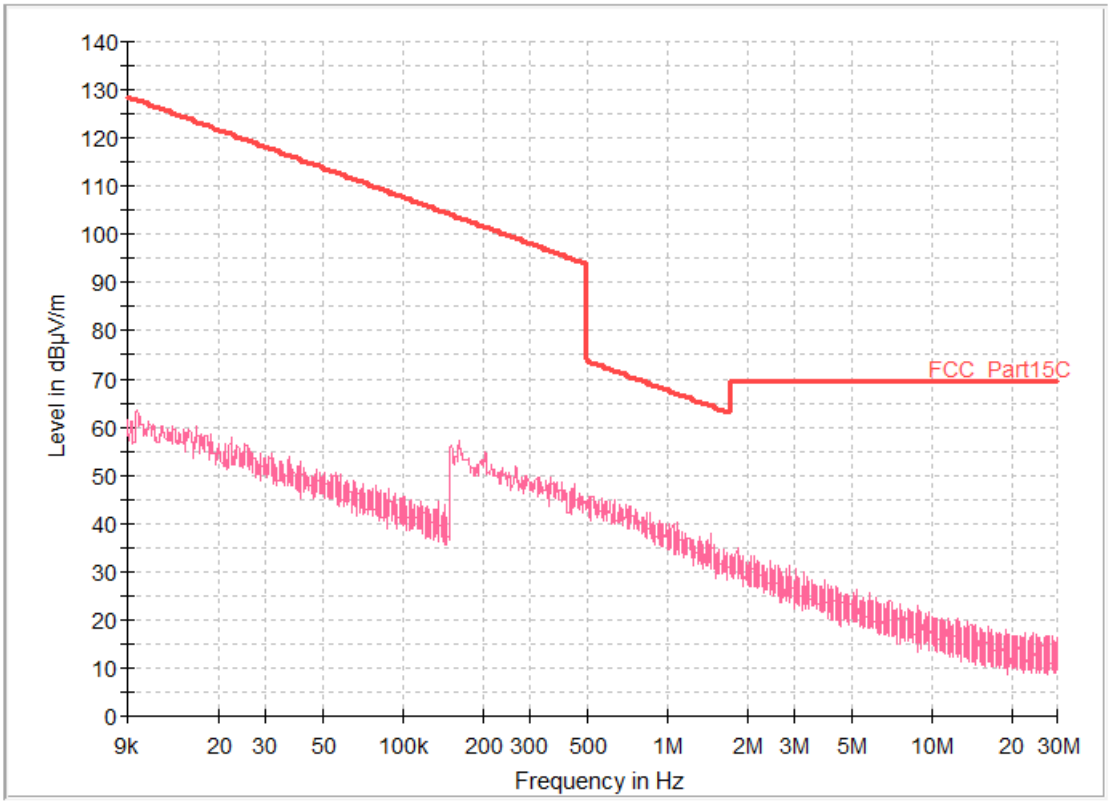

Fig. 29: Ambient level. Frequency range: 9 kHz – 30 MHz - Axis Z

4.7.5.2 Ambient Levels. Frequency range: 30 MHz – 1 GHz

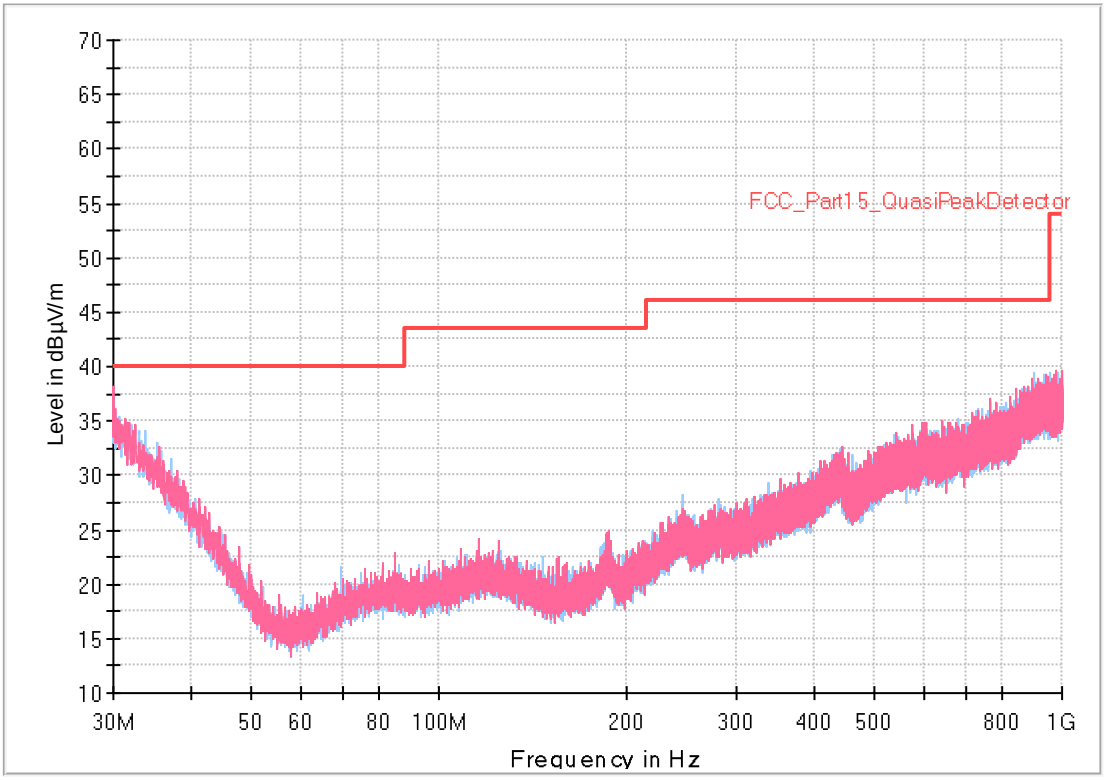

Fig. 30: Ambient level. Frequency range: 30 MHz – 1 GHz

4.7.5.3 Ambient Levels. Frequency range: 1 GHz – 8 GHz

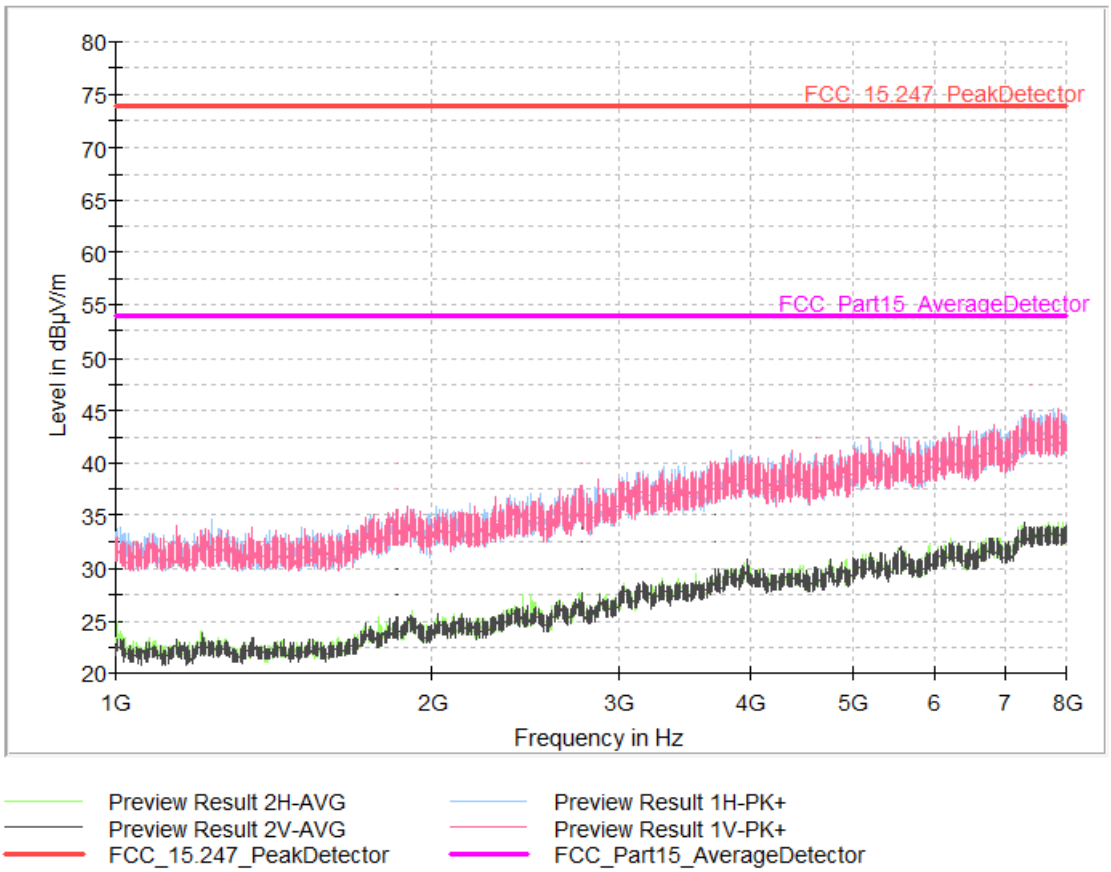

Fig. 31: Ambient level. Frequency range: 1 GHz – 8 GHz

4.7.5.4 Ambient Levels. Frequency range: 8 GHz – 10 GHz

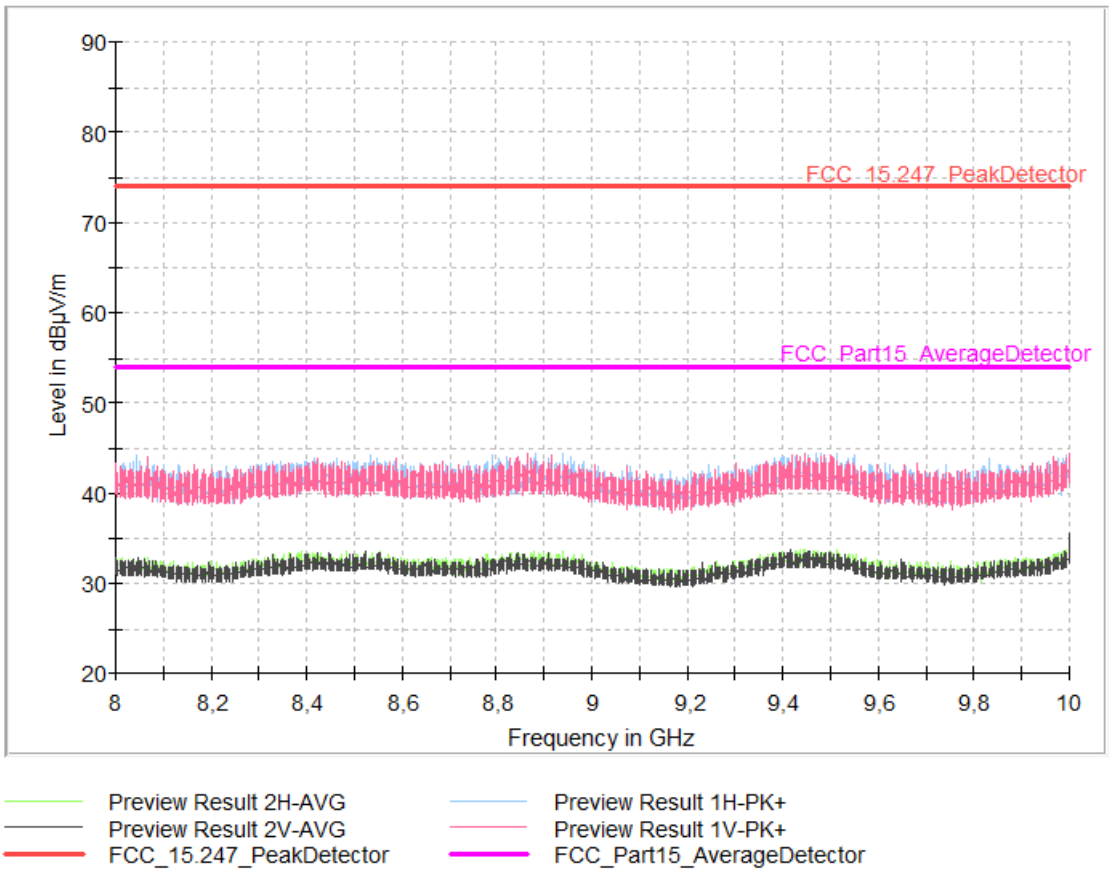

Fig. 32: Ambient level. Frequency range: 8 GHz – 10 GHz

4.7.5.5 Sample #2. Mode 1. All Channel[1]. Frequency range: 9 kHz – 30 MHz

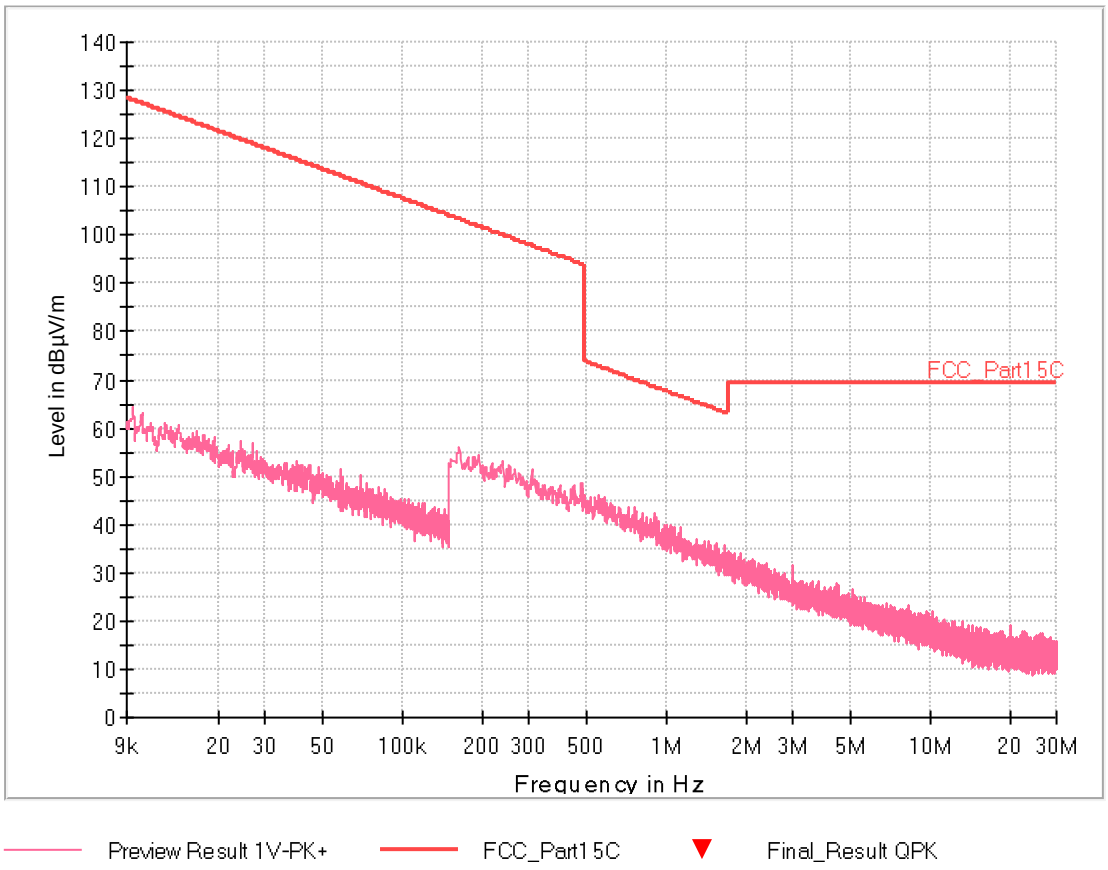

Fig. 33: All Channel. Frequency range: 9 kHz – 30 MHz – Axis X

FINAL MEASUREMENTS

No spurious detected. All emissions are below of the QPK limit

Note [1]: This frequency range has been measured in different channels and the results obtained are very similar between them. Therefore, the radiated emissions in this frequency range do not depend on the channel configured
The above graph is taken as the most representative result.

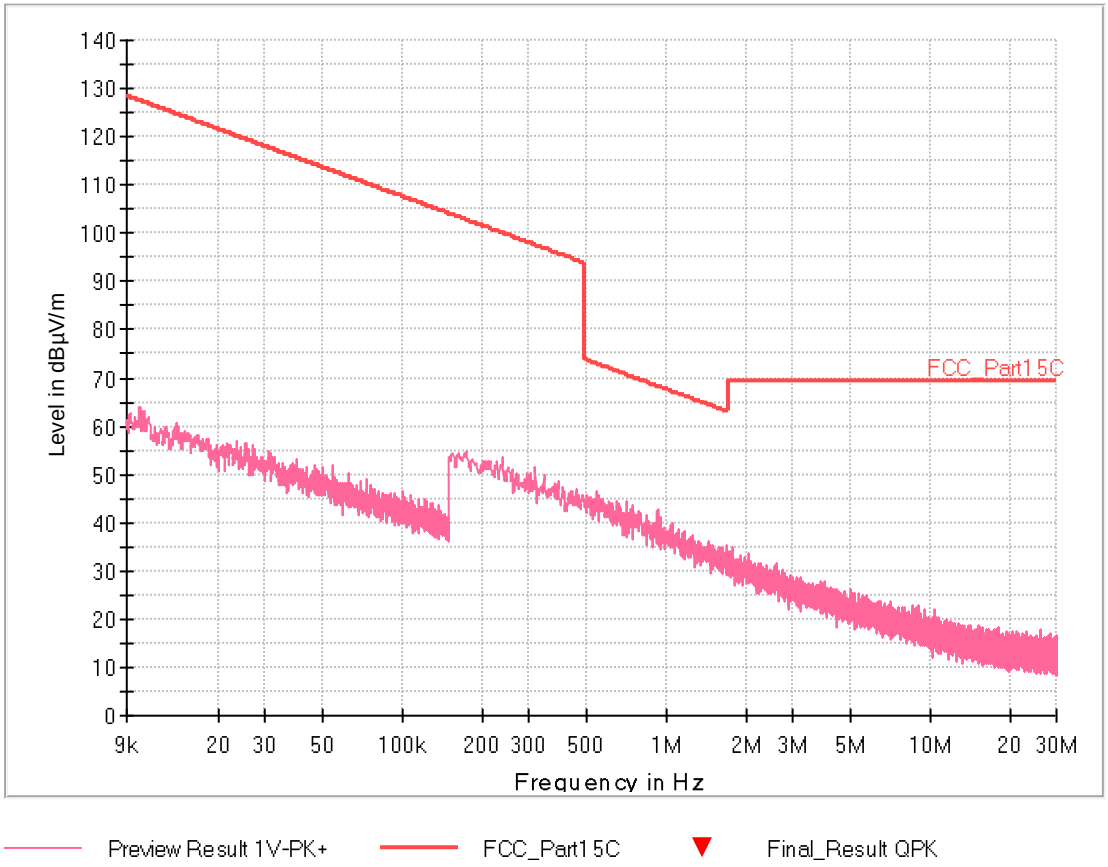

Fig. 34: All Channel. Frequency range: 9 kHz – 30 MHz – Axis Y

FINAL MEASUREMENTS

No spurious detected. All emissions are below of the QPK limit

Note [1]: This frequency range has been measured in different channels and the results obtained are very similar between them. Therefore, the radiated emissions in this frequency range do not depend on the channel configured
The above graph is taken as the most representative result.

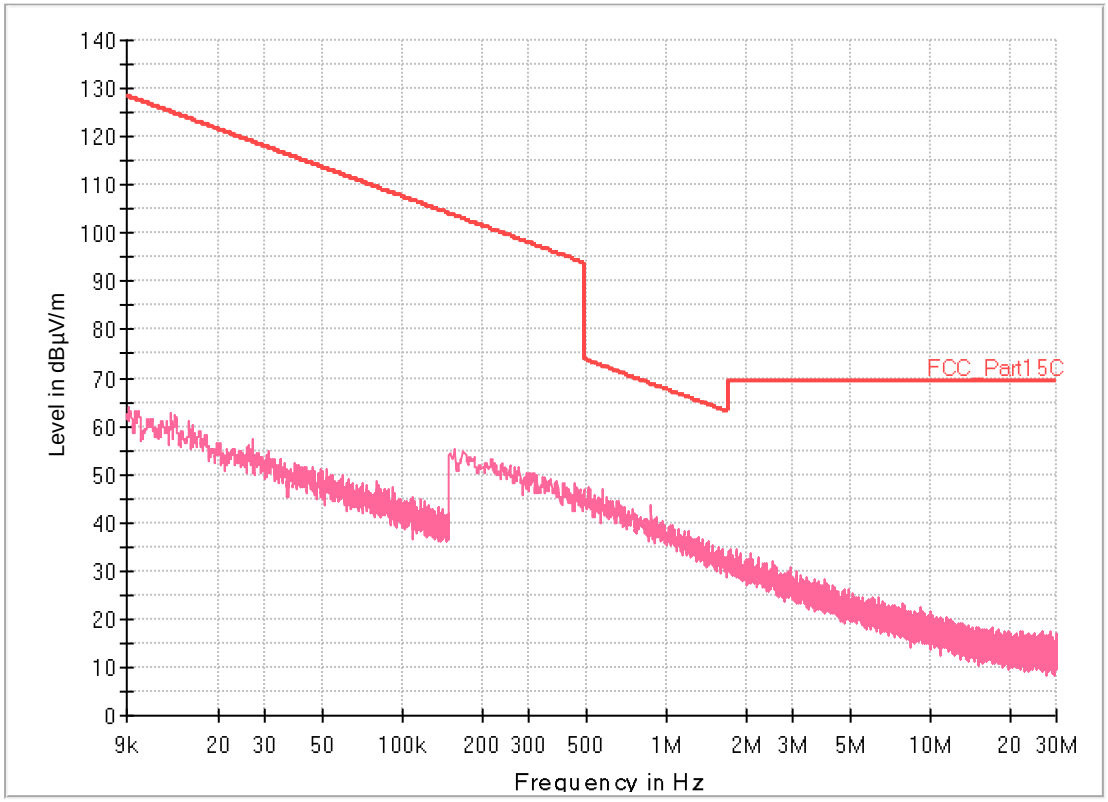

Fig. 35: All Channel. Frequency range: 9 kHz – 30 MHz – Axis Z

FINAL MEASUREMENTS

No spurious detected. All emissions are below of the QPK limit

Note [1]: This frequency range has been measured in different channels and the results obtained are very similar between them. Therefore, the radiated emissions in this frequency range do not depend on the channel configured
The above graph is taken as the most representative result.

4.7.5.6 Sample #2. Mode 1. Low Channel. Frequency range: 30 MHz – 1 GHz

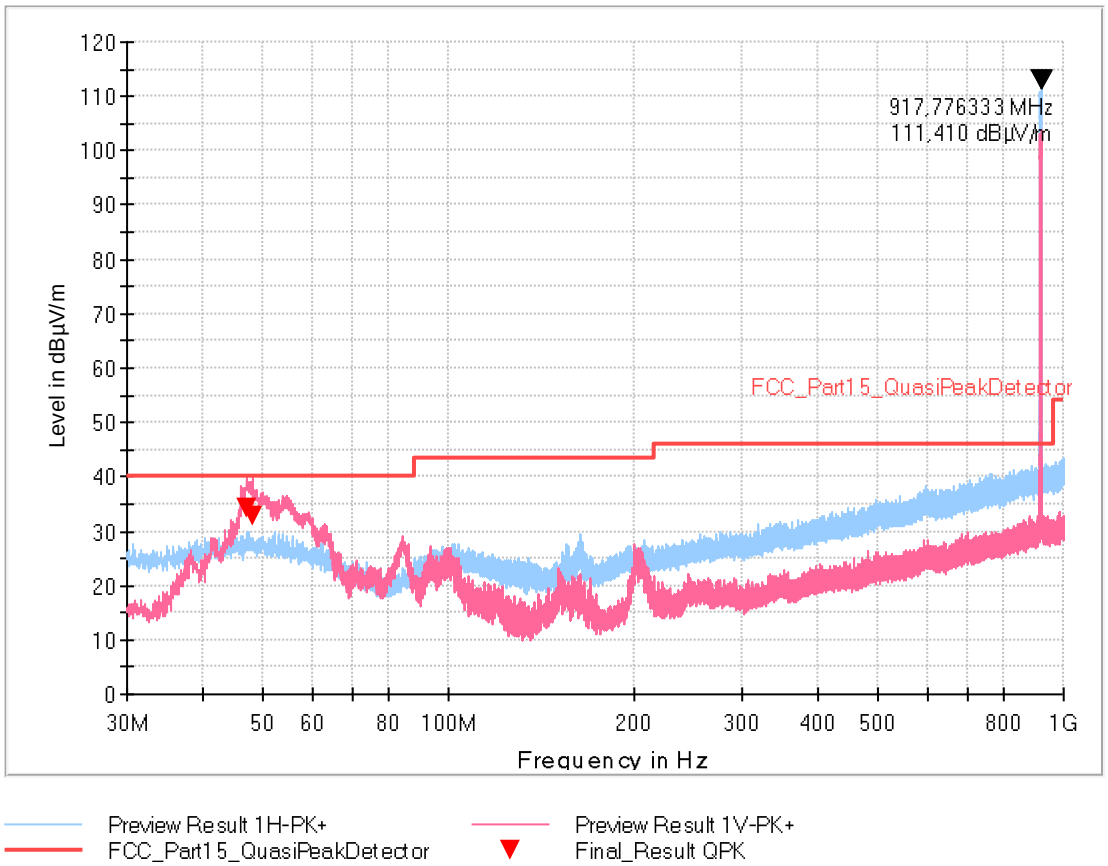

Fig. 36: Low Channel. Frequency range: 30 MHz – 1GHz

FINAL MEASUREMENTS

Frequency [MHz]	QuasiPeak [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Pol	Azimuth [deg]	Corr. [dB/m]
47.100	34.3	40.0	5.7	100.0	V	0.0	18.0
48.140	32.7	40.0	7.3	102.0	V	275.0	18.0

Table 39: Low Channel. Frequency range: 30 MHz – 1GHz

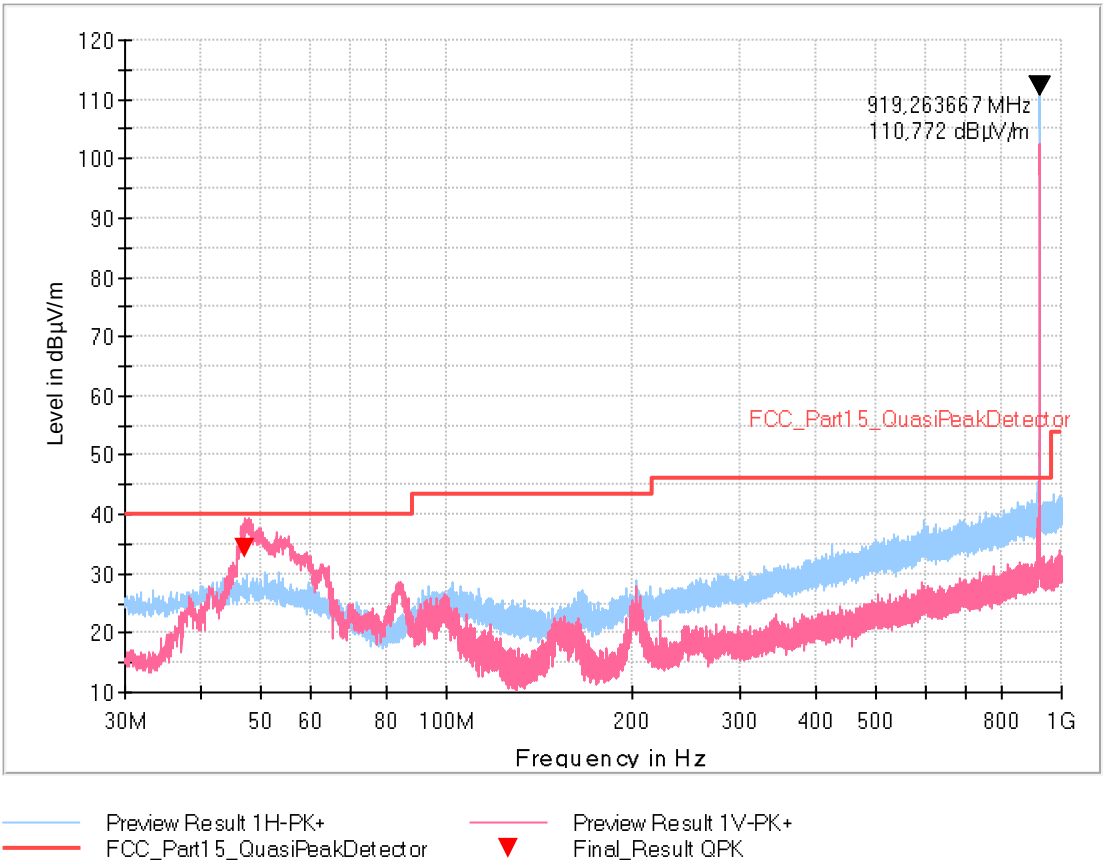

Fig. 37: Middle Channel. Frequency range: 30 MHz – 1GHz

FINAL MEASUREMENTS

Frequency [MHz]	QuasiPeak [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Pol	Azimuth [deg]	Corr. [dB/m]
47.040	34.2	40.0	5.8	105.0	V	0.0	18.0

Table 40: Middle Channel. Frequency range: 30 MHz – 1GHz

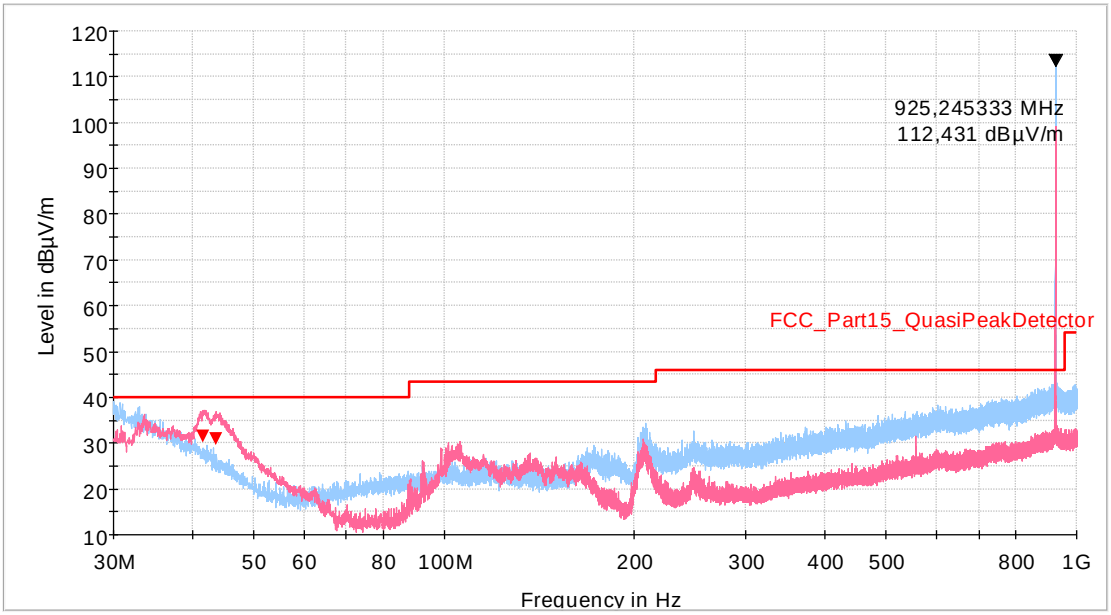

Fig. 38: High Channel. Frequency range: 30 MHz – 1GHz

FINAL MEASUREMENTS

Frequency [MHz]	QuasiPeak [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Pol	Azimuth [deg]	Corr. [dB/m]
41.570	31.4	40.0	8.6	109.0	V	276.0	18.5
43.555	30.9	40.0	9.1	100.0	V	137.0	17.0

Table 41: High Channel. Frequency range: 30 MHz – 1GHz

4.7.5.7 Sample #2. Mode 1. Frequency range: 1 GHz – 8 GHz

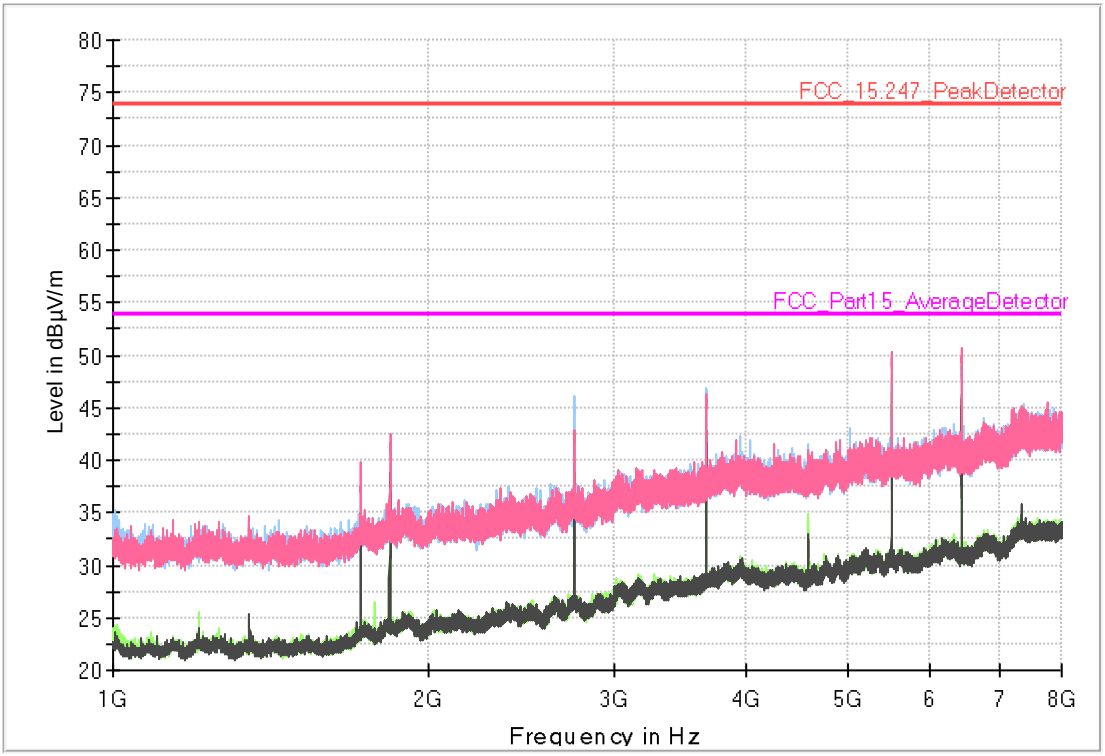

Fig. 39: Low Channel. Frequency range: 1 GHz – 8 GHz

FINAL MEASUREMENTS

No spurious detected. All emissions are 20 dB below the peak limit

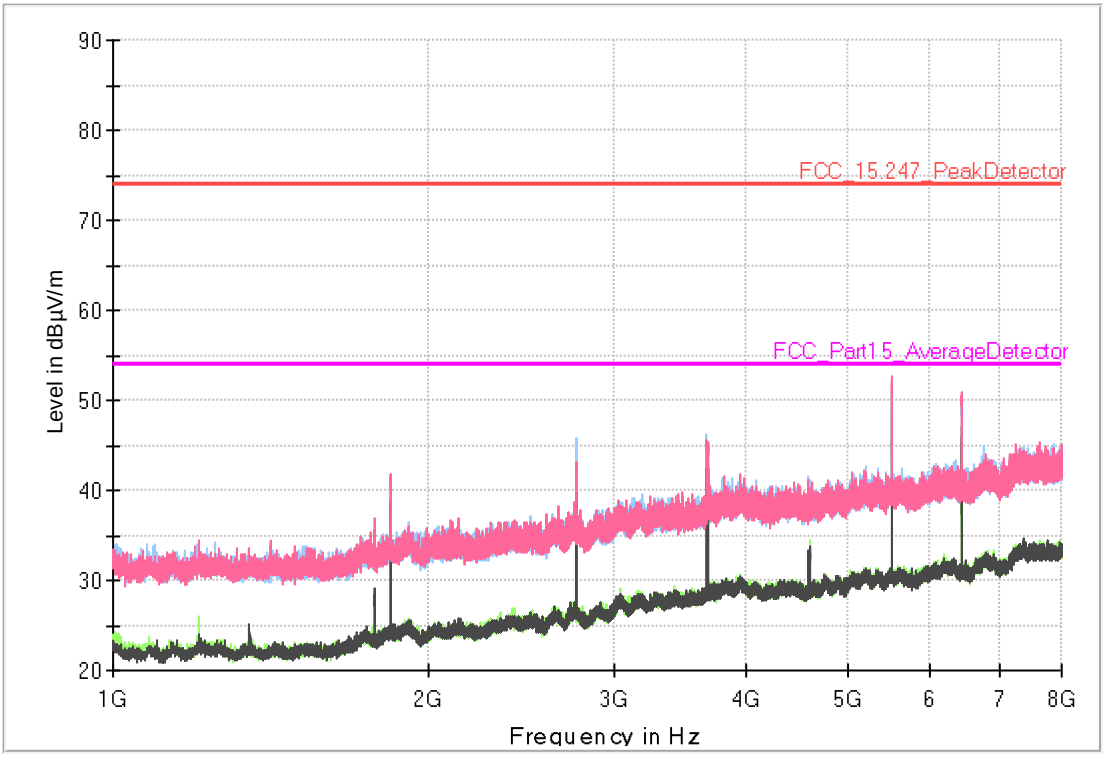

Fig. 40: Middle Channel. Frequency range: 1 GHz – 8 GHz

FINAL MEASUREMENTS

No spurious detected. All emissions are 20 dB below the peak limit

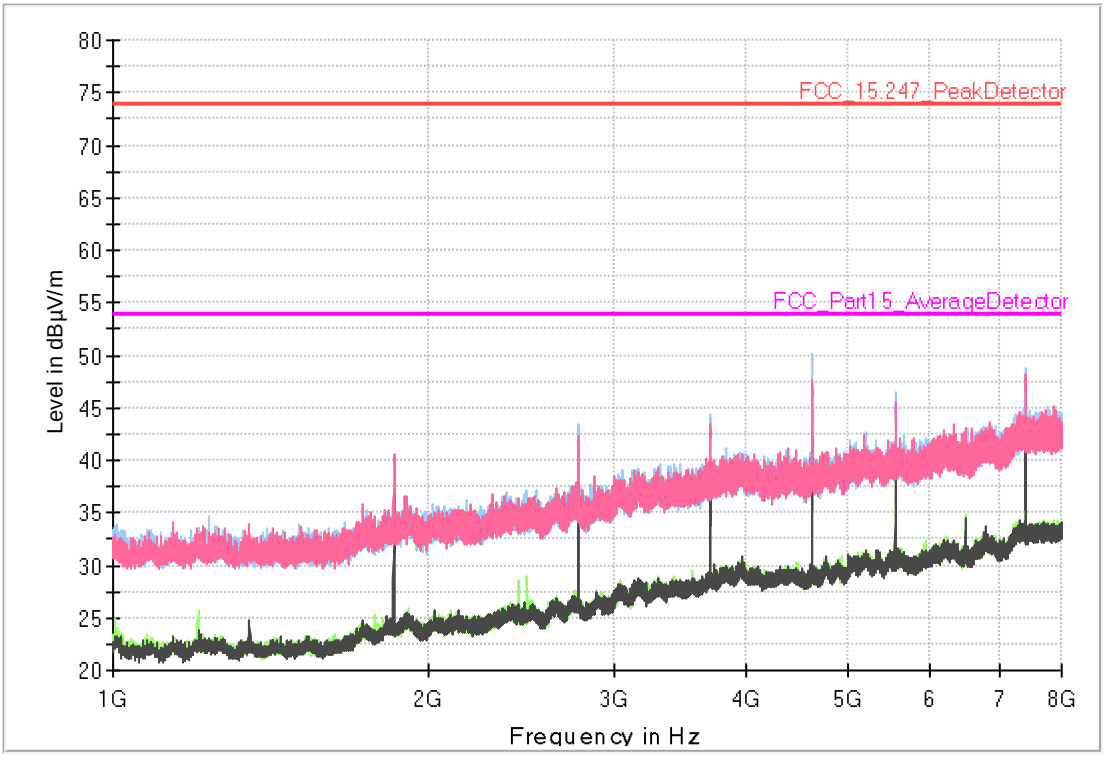

Fig. 41: High Channel. Frequency range: 1 GHz – 8 GHz

FINAL MEASUREMENTS

No spurious detected. All emissions are 20 dB below the peak limit

4.7.5.8 Sample #2. Mode 1. All Channel[1]. Frequency range: 8 GHz – 10 GHz

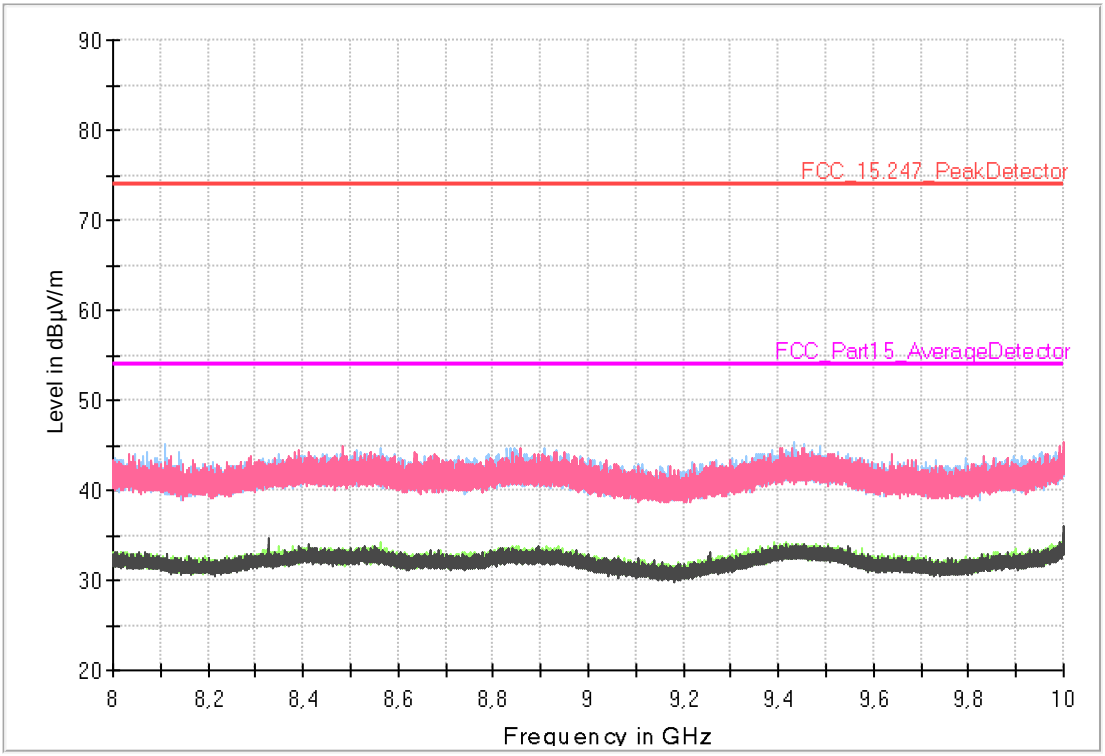

Fig. 42: All Channel. Frequency range: 8 GHz – 10 GHz

FINAL MEASUREMENTS

No spurious detected. All emissions are 20 dB below the peak limit

Note [1]: This frequency range has been measured in different channels and the results obtained are very similar between them. Therefore, the radiated emissions in this frequency range do not depend on the channel configured
The above graph is taken as the most representative result.

4.8 Test Equipment Used

Equipment	Brand	Model	Applus Ref.	Last Calibration	Next Calibration
ACTIVE LOOP ANTENNA	EMCO	6502	05-ER-019	04/10/2023	04/10/2024
BILOG ANTENNA	SCHWARZBECK	VULB 9162	1042740	08/11/2023	08/11/2024
HORN ANTENNA	EMCO	3115	05-ER-017	06/12/2023	06/12/2024
RF CABLE	HUBER+SUHNER	SF126E	1042728	21/08/2023	21/08/2024
3 DB ATTENUATOR	HUBER+SUHNER	6803.17.B	1042021	25/05/2023	25/05/2024
RF CABLE	RHODE & SCHWARZ	NA	1041502	09/10/2023	09/10/2024
RF CABLE	HUBER+SUHNER	SF104	1041964	22/06/2023	22/06/2024
HIGHPASS FILTER	WAINWRIGHT INSTRUMENTS	WHK12-935-1000-8000-40SS	1042510	22/05/2023	22/05/2024
RF CABLE	HUBER+SUHNER	SF104/11N/11N	1042585	12/05/2023	12/05/2024
RF AMPLIFIER	BONN ELEKTRONIK	BLMA 0118-M	1041733	12/05/2023	12/05/2024
EMI RECEIVER	R&S	ESW 26	1041791	14/11/2023	14/11/2024
THERMOHIGROMETER	PCE IBERICA	THB 40	1042022	07/11/2023	07/11/2024
TEST SOFTWARE	ROHDE & SCHWARZ	EMC32 v.10.50.00	104624	--	--
MAST-TABLE CONTROLLER	MATURO	NCD	1042758	--	--

Table 42: Test Instruments – Radio-frequency radiated emissions

4.7.6 Uncertainty

Test Type	Test Description	Uncertainty
Emissions	RADIO-FREQUENCY RADIATED EMISSIONS 9 kHz – 30 MHz	± 3.9 dB
Emissions	RADIO-FREQUENCY RADIATED EMISSIONS 30 MHz – 1 GHz	± 5.3 dB
Emissions	RADIO-FREQUENCY RADIATED EMISSIONS 1 GHz – 6 GHz	± 5.3 dB
Emissions	RADIO-FREQUENCY RADIATED EMISSIONS 6 GHz – 18 GHz	± 5.5 dB

Table 43: Radio-frequency radiated emissions measuring Uncertainties

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by a coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%.