

File Number **24/36405324M1**

TEST REPORT

Radiofrequency

Petitioner's Reference:		Lock Up Smart Doors S.L.	
Company Address:		Escritor Jeronimo Tristante, N10, 3B. 30100- Murcia – Spain.	
Represented by:		Juan Jesús Pinuaga Cascales	
PMN:		Access controller - Lock up smart door	
Brand:	OPERTO	HMN:	OC1-EXT
Sample #1:	45013	Applus Id:	22053-00002
Sample #2:	42622	Applus Id:	22053-00001
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 (October 2023)¹**
ANSI C63.10 (2013)
RSS-247 — Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices – Issue 3¹
RSS-Gen ¹

¹The 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		March 7, 2024	
Test Initial Date:		March 15, 2024	
Test Final Date:		May 24, 2024	
Modification Description:		M1	

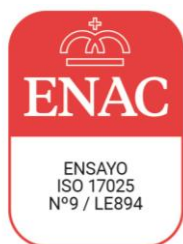
This report replaces and supersedes the report 24/36405324 dated on December 12, 2024.

Modifications performed: Blue highlighting in the report code is removed due to a typographical error from page 3 to page 61. High channel band edge limit correction made due to typographical error on page 31. It is responsibility of the petitioner to replace the previous version with this one.

Test Manager: Javier Miguel Nadales Lisbona

Date of issue: Bellaterra, March 4, 2025

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



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 61 pages.

1 TEST RESULTS SUMMARY

Test Description	Sample #	DUT Test Modes	Results	Criteria Note
ANTENNA REQUIEREMENTS (FCC Part 15.203, RSS-GEN 6.8)	#1, #2	Mode 1	PASS	--
OCCUPIED BANDWIDTH (99%) & EMISSION BANDWIDTH 20 dB (FCC Part 15.247 (a), RSS-247 5.2)	#1	Mode 1	PASS	CN4
6 dB BANDWITDH (FCC Part 15.247 (a), RSS-247 5.2)	#1	Mode 1	PASS	CN4
MAXIMUM PEAK CONDUCTED OUTPUT POWER (FCC Part 15.247 (c), RSS-247 5.4)	#1	Mode 1	PASS	CN4
POWER SPECTRAL DENSITY (FCC Part 15.247 (b), RSS-247 5.4)	#1	Mode 1	PASS	CN4
BAND EDGE (FCC Part 15.247 (d), RSS-247 5.5)	#1	Mode 1	PASS	CN4
RADIOFREQUENCY RADIATED EMISSIONS (FCC Part 15.247 (d), RSS-247 5.5)	#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.

Service Quality Assurance

Applus+, guarantees that this work has been made in accordance with our Quality and Sustainability System, fulfilling the contractual conditions and legal norms.

Within our improvement program we would be grateful if you would send us any commentary that you consider opportune, to the person in charge who signs this document, or to the Quality Manager of Applus+, in the following e-mail address:

satisfaccion.cliente@applus.com

2 INDEX

1	TEST RESULTS SUMMARY	2
2	INDEX	3
3	GENERAL DESCRIPTION OF TEST ITEMS	5
	3.1 EQUIPMENT DESCRIPTION	5
	3.2 TEST CONFIGURATION.....	6
	3.3 PHOTOGRAPHS	7
	3.4 TEST FACILITIES ID	7
	3.5 COMPETENCES AND GUARANTEES	7
4	TEST RESULTS	8
	4.1 ANTENNA REQUIREMENT	8
	4.1.1 Requirements.....	8
	4.1.2 Summary Test Results	8
	4.2 OCCUPIED CHANNEL BANDWIDTH (99%) & 20 DB BANDWIDTH	9
	4.2.1 Test Setup Required	9
	4.2.2 Requirements.....	9
	4.2.3 EMI Receiver configuration	9
	4.2.4 Test Environmental Conditions.....	10
	4.2.5 Summary Test Results	10
	4.2.6 Test Results	11
	4.2.7 Test Equipment Used	14
	4.2.8 Uncertainty	15
	4.3 DTS BANDWIDTH	16
	4.3.1 Test Setup Required	16
	4.3.2 Requirements.....	16
	4.3.3 EMI Receiver configuration	16
	4.3.4 Test Environmental Conditions.....	16
	4.3.5 Summary Test Results	16
	4.3.6 Test Results	17
	4.3.7 Test Equipment Used	19
	4.3.8 Uncertainty	20
	4.4 MAXIMUM CONDUCTED OUTPUT POWER.....	21
	4.4.1 Test Setup Required	21
	4.4.2 Requirements.....	21
	4.4.3 EMI Receiver configuration	21
	4.4.4 Test Environmental Conditions.....	21
	4.4.5 Summary Test Results	21
	4.4.6 Test Results	22
	4.4.7 Test Equipment Used	24
	4.4.8 Uncertainty	25
	4.5 POWER SPECTRAL DENSITY	26
	4.5.1 Test Setup Required	26
	4.5.2 Requirements.....	26
	4.5.3 EMI Receiver configuration	26
	4.5.4 Test Environmental Conditions.....	26
	4.5.5 Summary Test Results	26
	4.5.6 Test Results	27
	4.5.7 Test Equipment Used	29
	4.5.8 Uncertainty	30
	4.6 BAND EDGE	31
	4.6.1 Test Setup Required	31
	4.6.2 Test Parameters	31

4.6.3	EMI Receiver configuration	31
4.6.4	Test Environmental Conditions.....	31
4.6.5	Summary Test Results	31
4.6.6	Test Results	32
4.6.7	Test Equipment Used	34
4.6.8	Uncertainty	35
4.7	RADIO-FREQUENCY RADIATED EMISSIONS	36
4.7.1	Test Setup Required	36
4.7.2	Test Procedure	37
4.7.3	Requirements.....	37
4.7.4	Test Environmental Conditions.....	38
4.7.5	Summary Test Results	39
4.7.6	Test Results	40
4.8	Test Equipment Used.....	60
4.7.7	Uncertainty	61

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	The device is WiFi and BLE access system controller used to interact with a variety of access systems as can be common doors, entrance doors, electrical strikes, parking barriers, and elevators among others.		
EUT Version	FVIN		HVIN
	7.6.2		LockUpAIR_V4
Power supply	+/-	12 V	-- Hz
Equipment Size	Length	Width	Height
	80 mm	80 mm	30 mm
Modulation	GFSK		
Operating Frequency Band	2400MHz - 2483.5 MHz		
Maximum RF Output Power [dBm]	10		
Operating Channel(s) Width(s) [MHz]	1		
Equipment Type	DTS		
Number of Hopping Channels	N/A		
Emission Designator	1M1G1D		
FCC ID	--		

Table 2: Equipment description

RF FEATURES					
Description	Communication Technology	Radio Chipset	Brand	Module Model	Antenna Gain [dBi]
	Bluetooth	CC2640	TI	Not provided	3.3

Table 3: RF Features

3.2 TEST CONFIGURATION

DUT Operation Modes	
Mode #	Description
1	The customer provides instructions for setting up the sample in test mode with continuously modulated transmission operating on a single channel through the RF Smart Studio software.

Table 4. Test Configuration

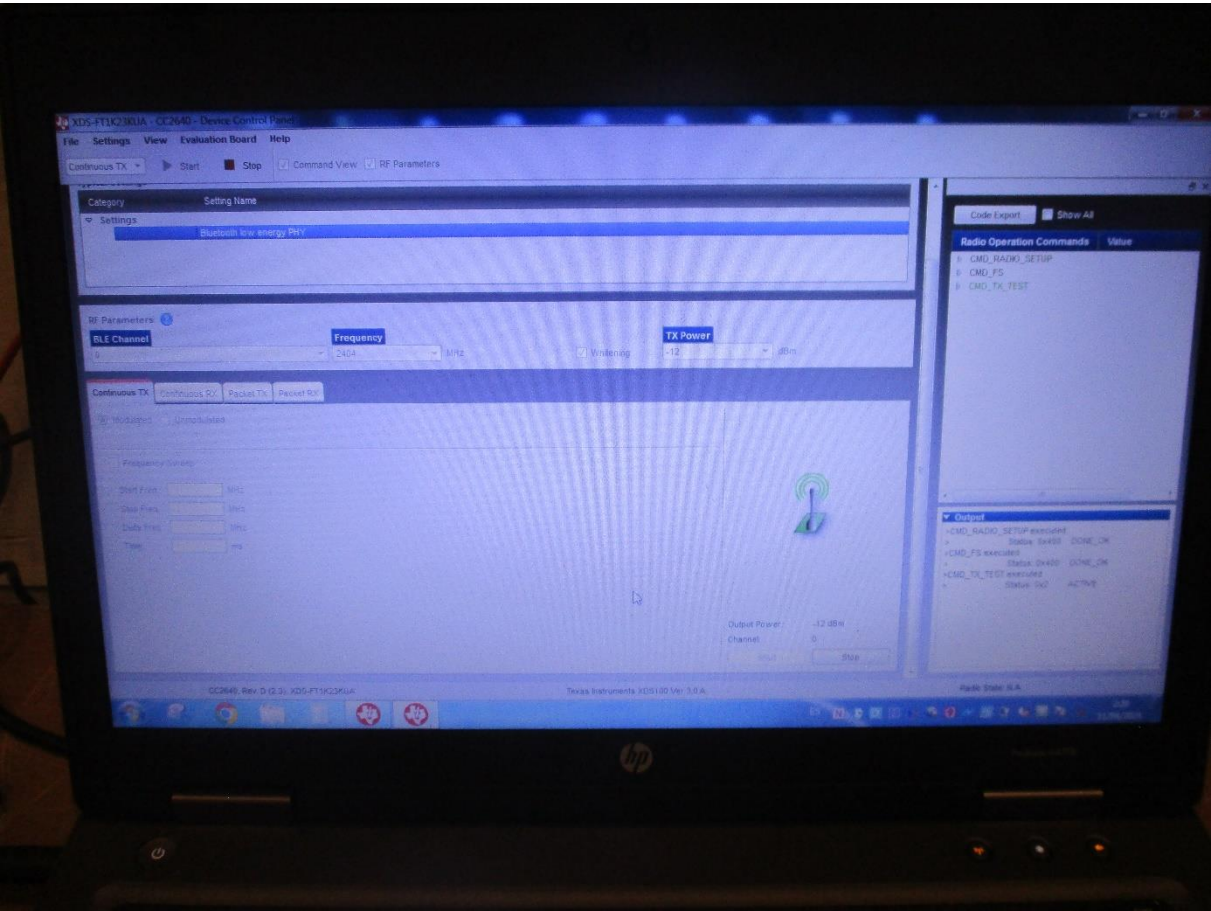


Fig. 1: – Sample Configuration

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 24/36405327

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.

IMPORTANT: No parts of this report may be reproduced or quoted out of context, in any form or by any means, except in full, without the previous written permission of Applus+ Laboratories.

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.

This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of Applus+ Laboratories and the Accreditation Bodies.

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

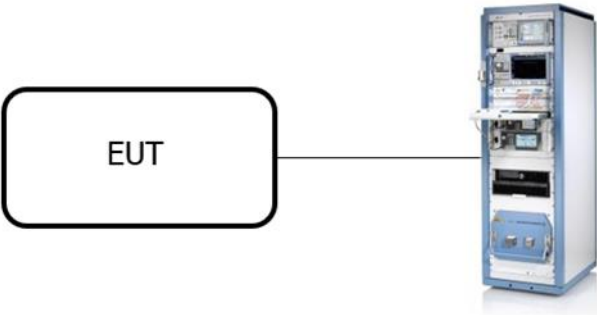


Fig. 2: Set-Up - Occupied Channel Bandwidth & Occupied Channel Bandwidth 99% & Emission Bandwidth 20dB

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	2	Peak	Max Hold	10	30

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

4.2.4 Test Environmental Conditions

Test Date	Technician	Supervisor	Temperature [°C]	Humidity [%]	Atm. Pressure [mbar]
15/03/2024	P. Redondo	J.M. Nadales	22.8	45	998

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

4.2.5 Summary Test Results

Frequency [MHz]	99% Bandwidth [MHz]	20 dB Bandwidth [kHz]	Results
2402	1.1	1.2	PASS
2440	1.0	1.2	PASS
2480	1.1	1.2	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

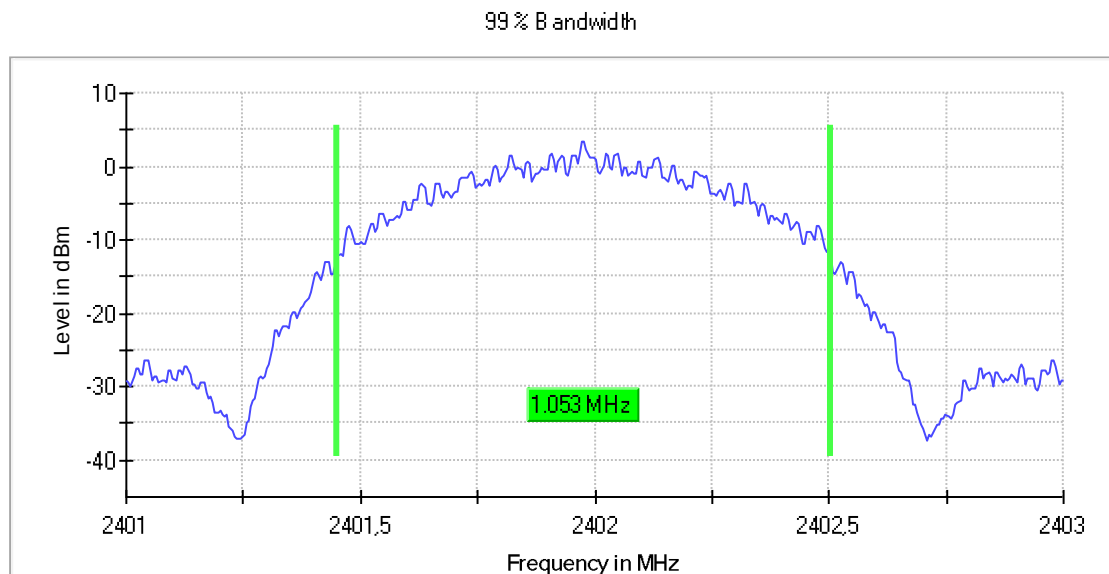


Fig. 3: Low Channel - 99% Occupied Channel Bandwidth

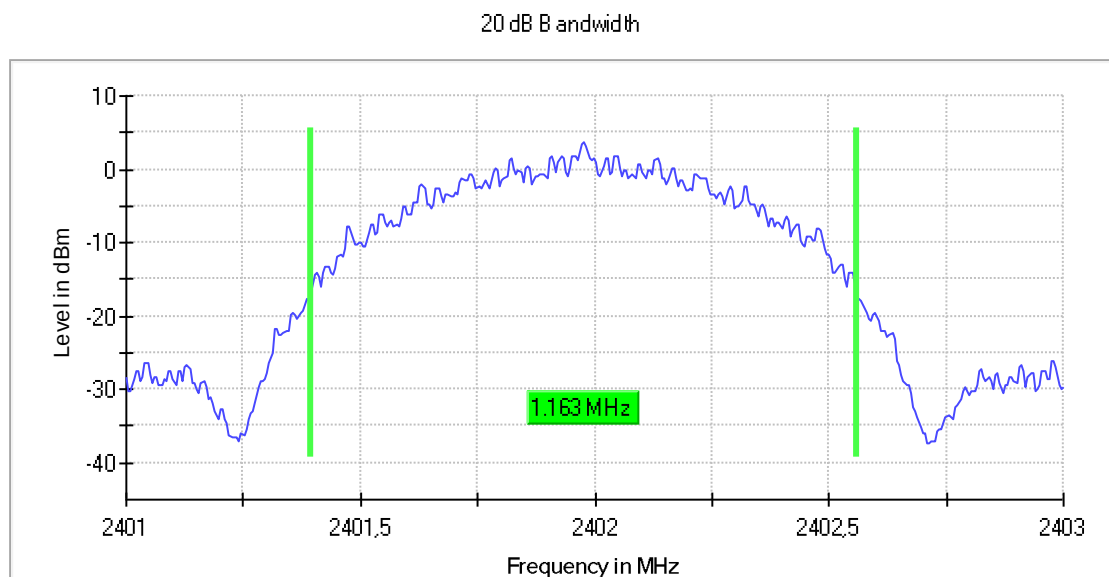


Fig. 4: Low Channel - Emission Bandwidth 20dB

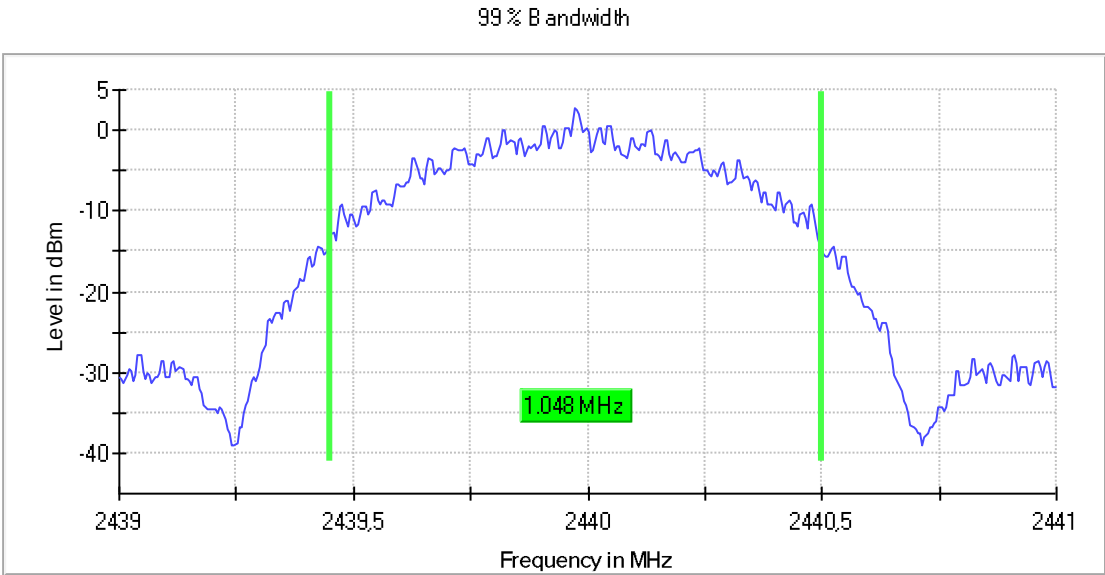


Fig. 5: Middle Channel - 99% Occupied Channel Bandwidth

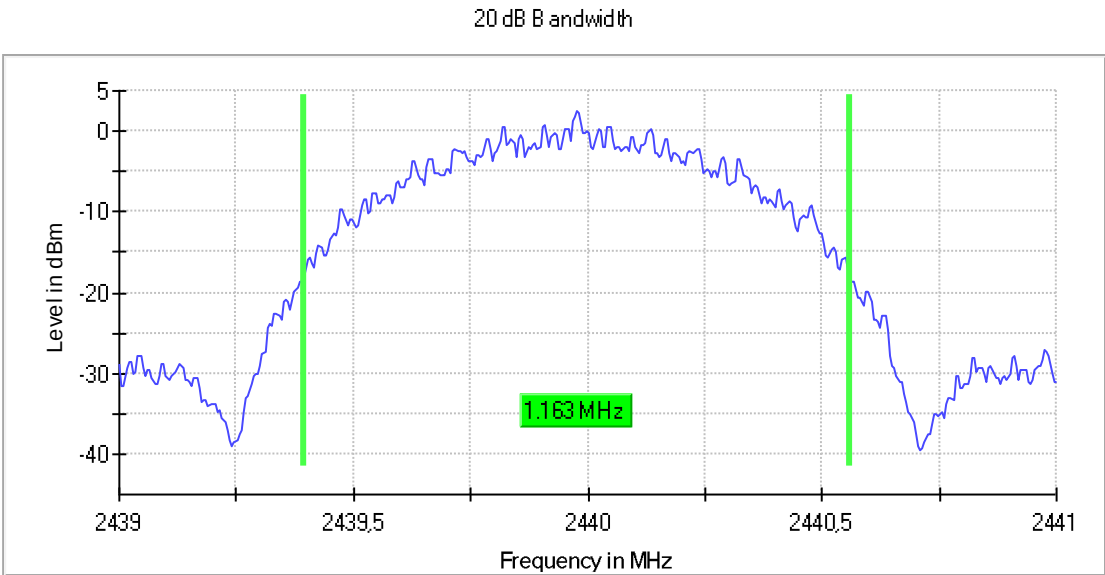


Fig. 6: Middle Channel - Emission Bandwidth 20dB

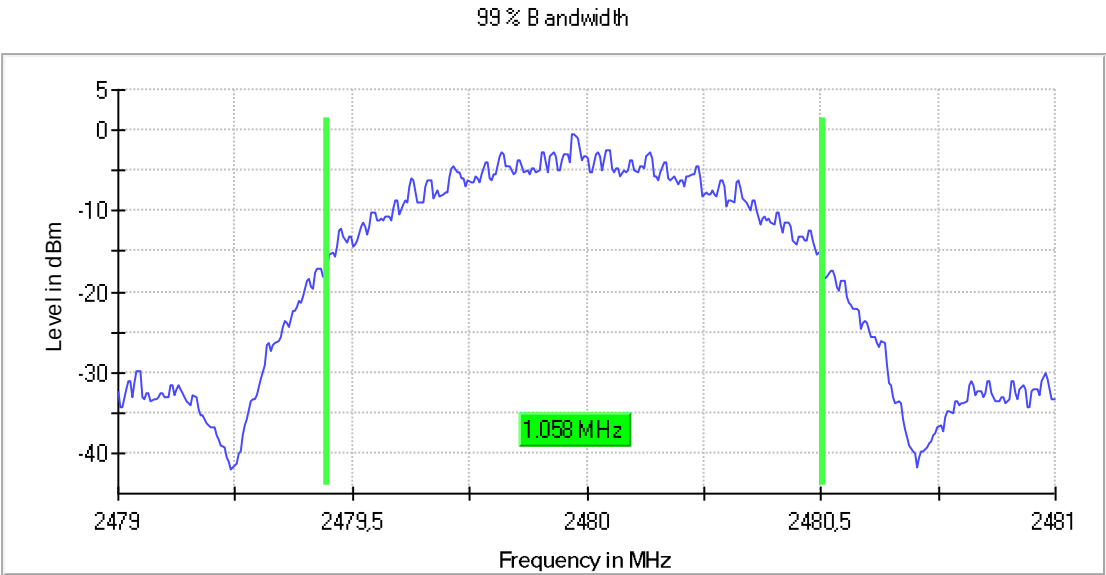


Fig. 7: High Channel - 99% Occupied Channel Bandwidth

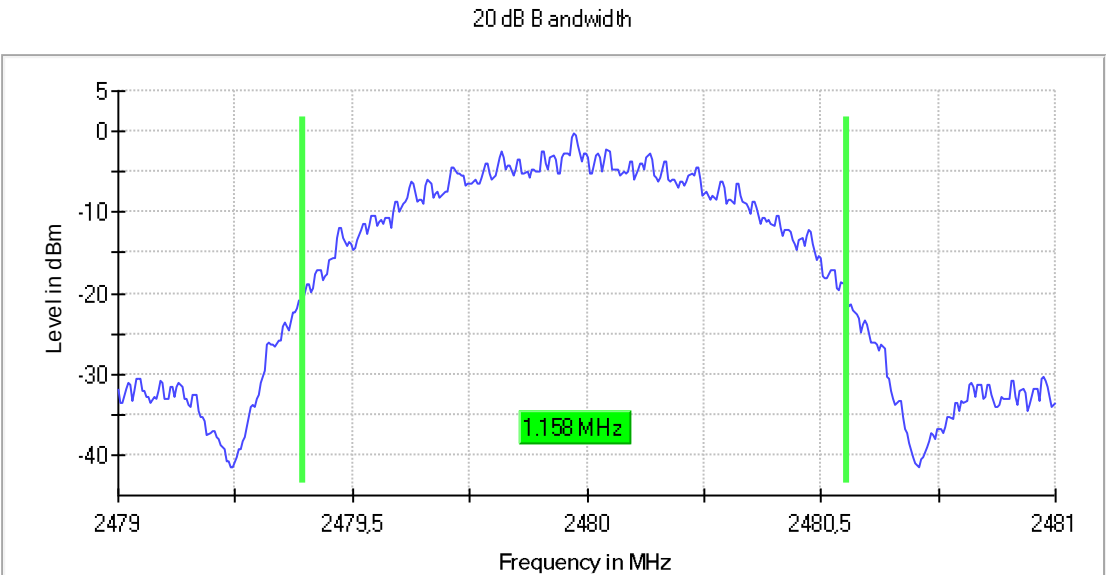


Fig. 8: High Channel - Emission Bandwidth 20dB

4.2.7 Test Equipment Used

Equipment	Brand	Model	Applus Ref.	Last Calibration	Next Calibration
DIGITAL THERMO-HYGROMETER	TESTO	608-H1	1041916	09/02/2024	09/02/2025
SHIELDED CHAMBER SR0	ALBATROSS	SR	1042267	-	-
RF SWITCH	ROHDE & SCHWARZ	OSP120	1042701	24/03/2022	24/03/2024
SIGNAL SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSVA3044	1042700	23/02/2022	15/11/2024
CABLE RF 40 GHz	HUBERSUHNER	SF102	1042545	28/05/2024	28/05/2025
RF CABLE	ASTROLAB	32026-29094-29094-24TC	1041825	16/05/2023	16/05/2024

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

4.3.1.1 Tabletop equipment

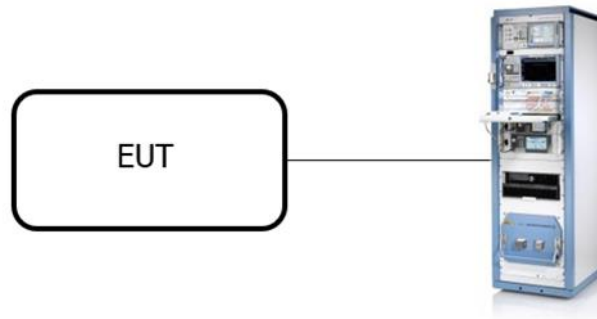


Fig. 9: Set-Up - DTS Bandwidth

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	2	Peak	Max Hold	100	300

Table 11: EMI Receiver configuration – DTS Bandwidth

4.3.4 Test Environmental Conditions

Test Date	Technician	Supervisor	Temperature [°C]	Humidity [%]	Atm. Pressure [mbar]
15/03/2024	P. Redondo	J.M. Nadales	22.8	45	998

Table 12: Test environmental conditions – DTS Bandwidth

4.3.5 Summary Test Results

Frequency [MHz]	DTS Bandwidth [kHz]	Results
2402	740.0	PASS
2440	760.0	PASS
2480	760.0	PASS

Table 13: Summary Test Results – DTS Bandwidth

4.3.6 Test Results

4.3.6.1 Sample #1. Mode #1

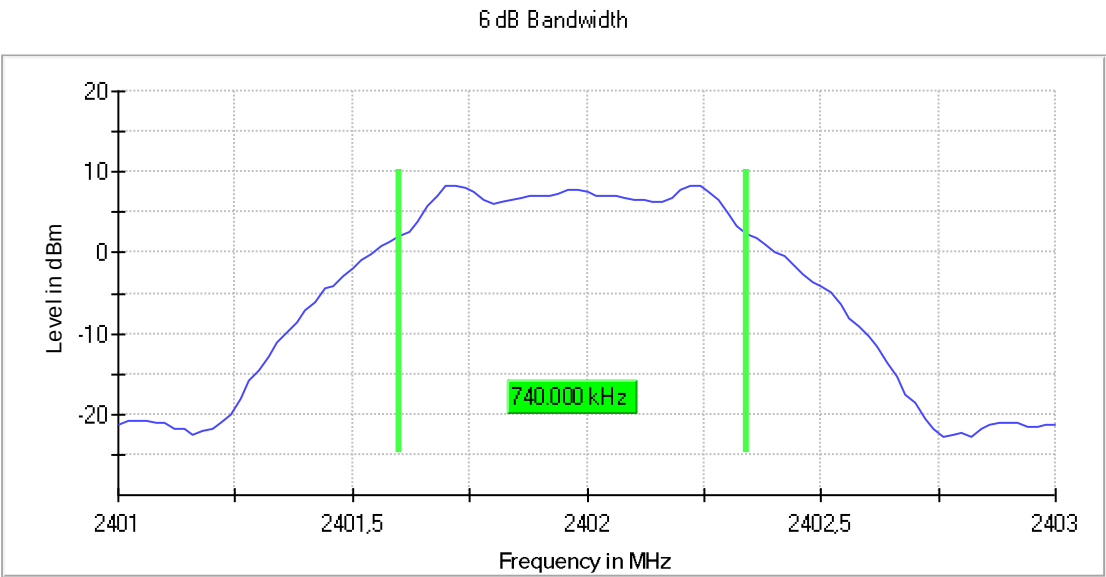


Fig. 10: Low Channel - DTS Bandwidth

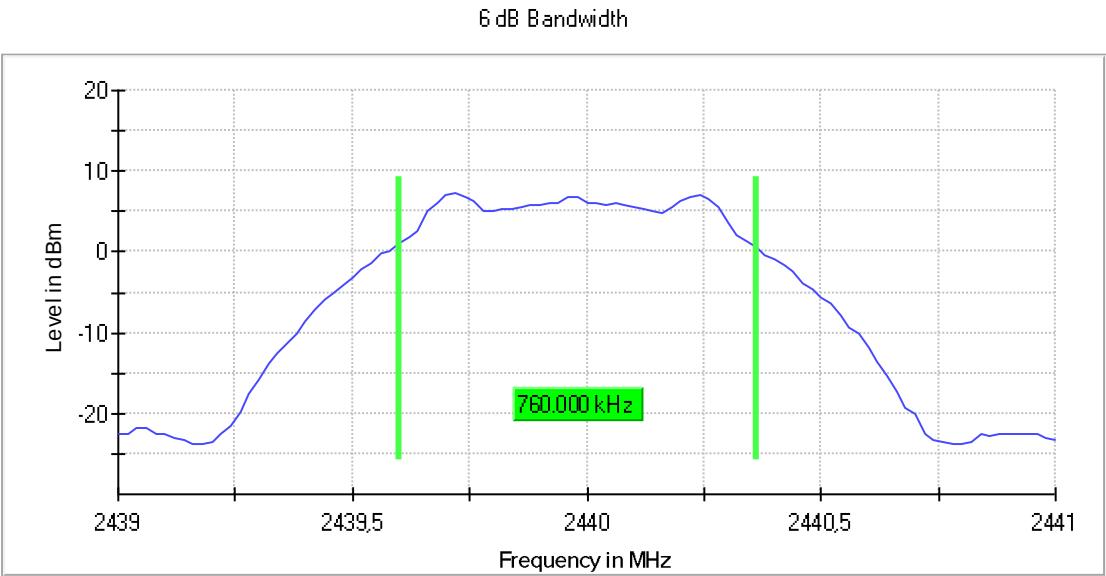


Fig. 11: Middle Channel -DTS Bandwidth

6 dB Bandwidth

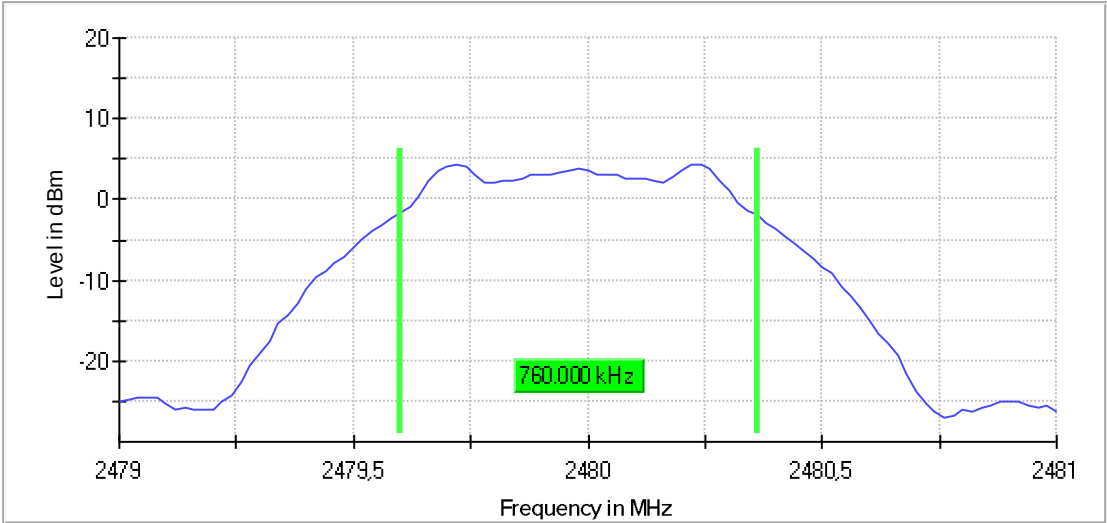


Fig. 12: High Channel - DTS Bandwidth

4.3.7 Test Equipment Used

Equipment	Brand	Model	Applus Ref.	Last Calibration	Next Calibration
DIGITAL THERMO-HYGROMETER	TESTO	608-H1	1041916	09/02/2024	09/02/2025
SHIELDED CHAMBER SR0	ALBATROSS	SR	1042267	-	-
RF SWITCH	ROHDE & SCHWARZ	OSP120	1042701	24/03/2022	24/03/2024
SIGNAL SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSVA3044	1042700	23/02/2022	15/11/2024
CABLE RF 40 GHz	HUBERSUHNER	SF102	1042545	28/05/2024	28/05/2025
RF CABLE	ASTROLAB	32026-29094-29094-24TC	1041825	16/05/2023	16/05/2024

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

4.4.1.1 Tabletop equipment

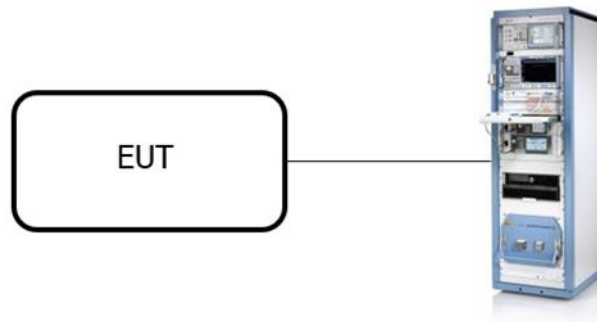


Fig. 13: Set-Up - Maximum Conducted Output Power

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.

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	3	Peak	Max Hold	1000	3000

Table 16: Power Meter configuration – Maximum Conducted Output Power

4.4.4 Test Environmental Conditions

Test Date	Technician	Supervisor	Temperature [°C]	Humidity [%]	Atm. Pressure [mbar]
15/03/2024	P. Redondo	J.M. 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]	Antenna Gain [dBi]	EIRP [dBm]	Limit [dBm]	Results
2402	8.6	30.0	3.3	11.9	36.0	PASS
2440	7.4	30.0	3.3	10.7	36.0	PASS
2480	4.6	30.0	3.3	7.9	36.0	PASS

Table 18: Summary Test Results – Maximum Conducted Output Power

4.4.6 Test Results

4.4.6.1 Sample #1. Mode #1

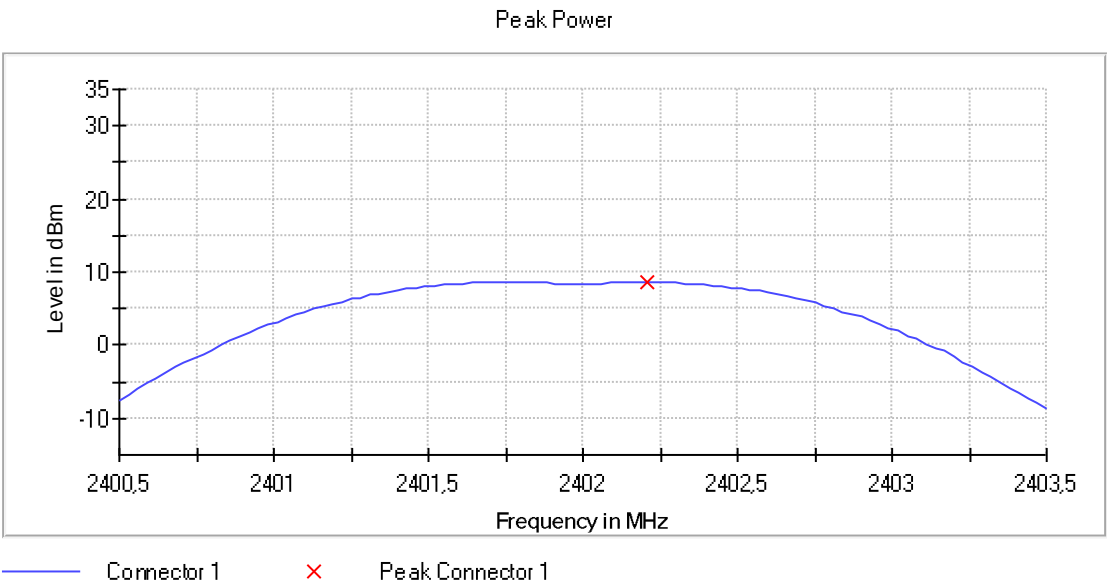


Fig. 14: Low Channel - Maximum Conducted Output Power

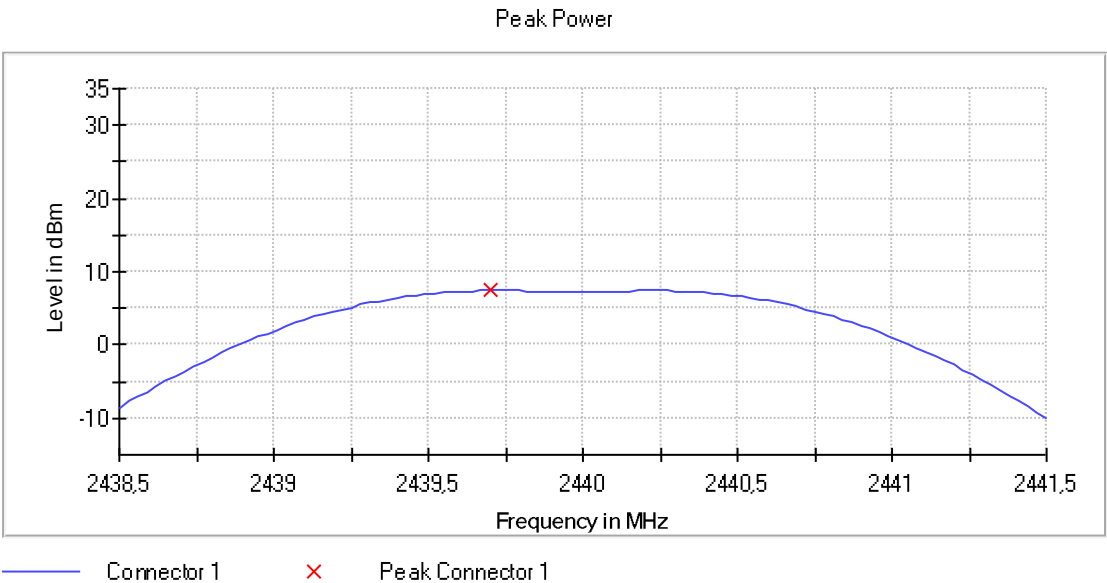


Fig. 15: Middle Channel - Maximum Conducted Output Power

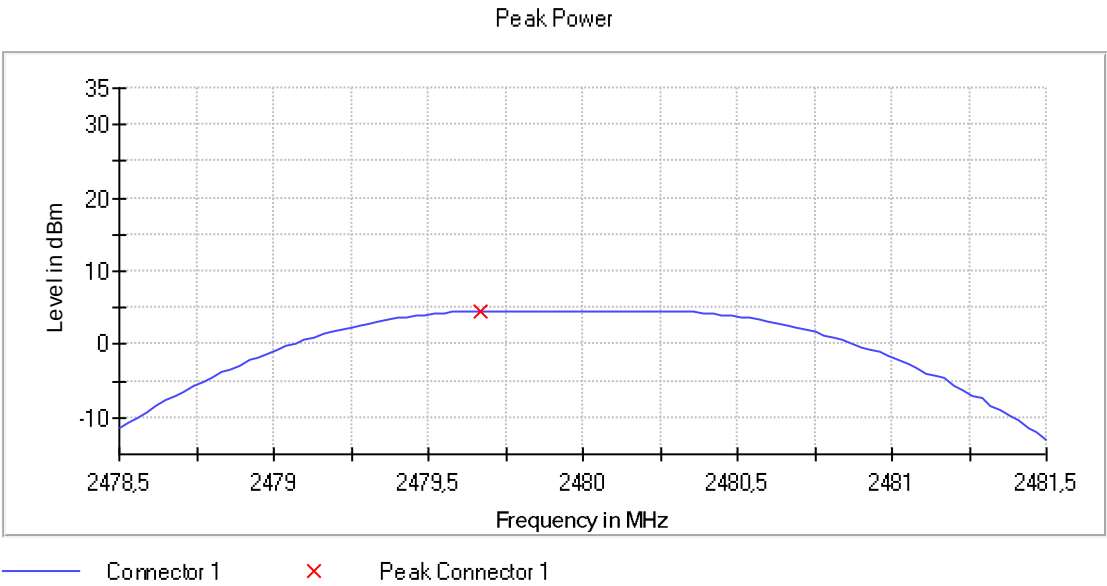


Fig. 16: High Channel - Maximum Conducted Output Power

4.4.7 Test Equipment Used

Equipment	Brand	Model	Applus Ref.	Last Calibration	Next Calibration
DIGITAL THERMO-HYGROMETER	TESTO	608-H1	1041916	09/02/2024	09/02/2025
SHIELDED CHAMBER SR0	ALBATROSS	SR	1042267	-	-
RF SWITCH	ROHDE & SCHWARZ	OSP120	1042701	24/03/2022	24/03/2024
SIGNAL SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSVA3044	1042700	23/02/2022	15/11/2024
CABLE RF 40 GHz	HUBERSUHNER	SF102	1042545	28/05/2024	28/05/2025
RF CABLE	ASTROLAB	32026-29094-29094-24TC	1041825	16/05/2023	16/05/2024

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

4.5.1.1 Tabletop equipment

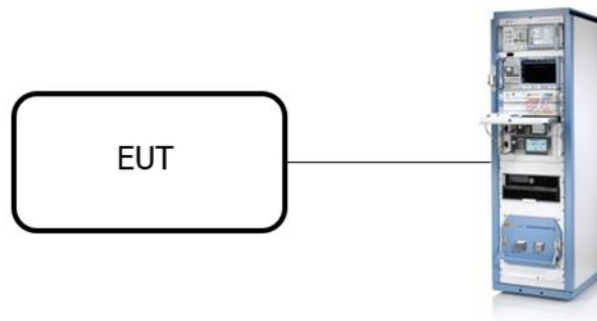


Fig. 17: Power Spectral Density setup of table top equipment.

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. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

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	3	Peak	Max Hold	10	30

Table 21: EMI Receiver configuration – Power Spectral Density

4.5.4 Test Environmental Conditions

Test Date	Technician	Supervisor	Temperature [°C]	Humidity [%]	Atm. Pressure [mbar]
15/03/2024	P. Redondo	J.M. Nadales	22.8	45	998

Table 22: Test environmental conditions – Power Spectral Density

4.5.5 Summary Test Results

Frequency [MHz]	PSD [dBm]	Limit [dBm]	Results
2402	3.6	8.00	PASS
2440	1.3	8.00	PASS
2480	-0.5	8.00	PASS

Table 23: Summary Test Results – Power Spectral Density

4.5.6 Test Results

4.5.6.1 Sample #1. Mode #1

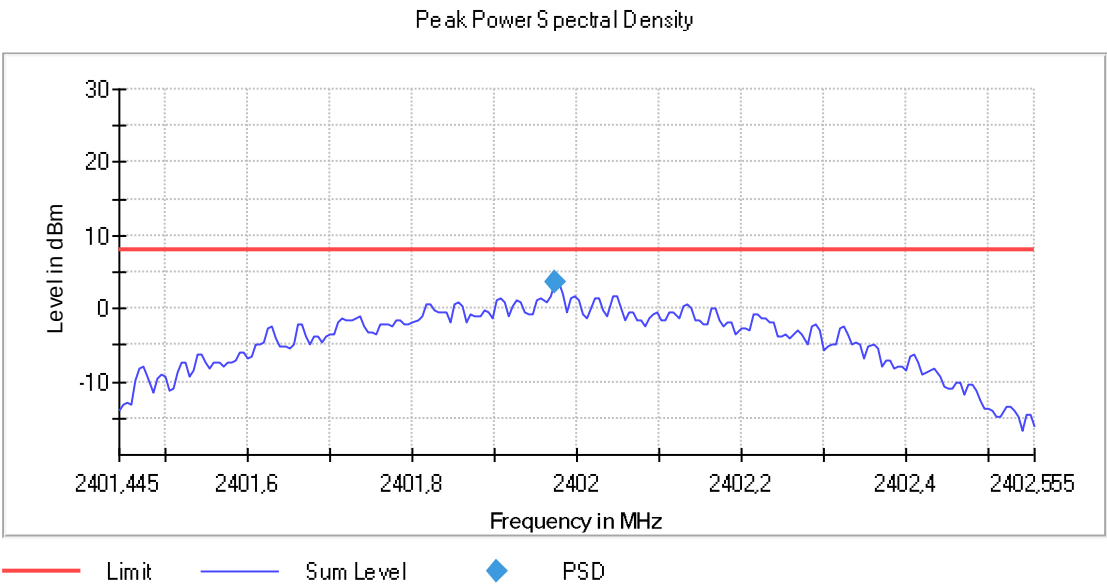


Fig. 18: Low Channel - Power Spectral Density

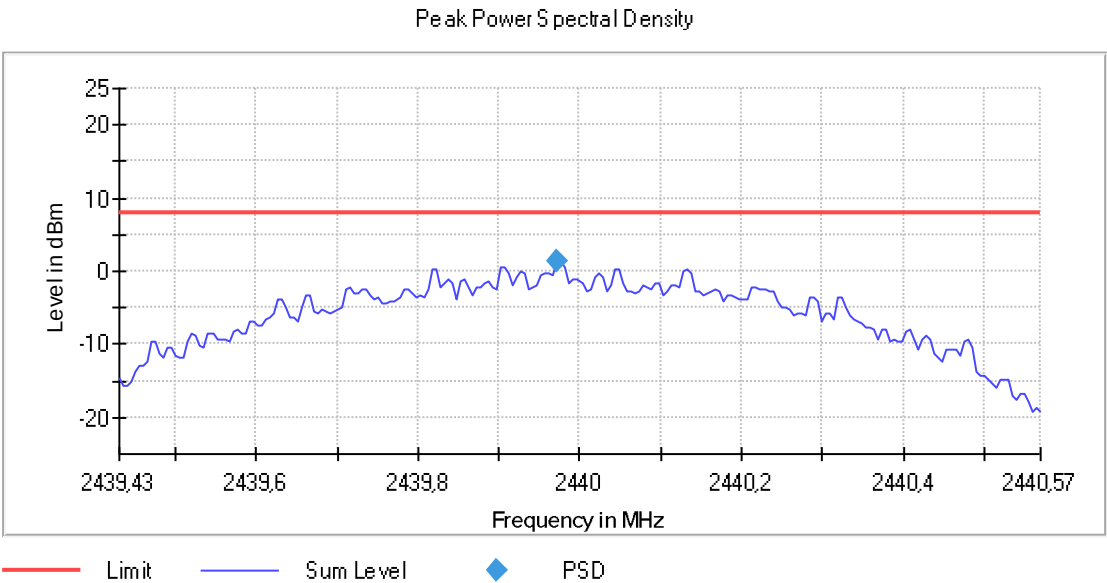


Fig. 19: Middle Channel - Power Spectral Density

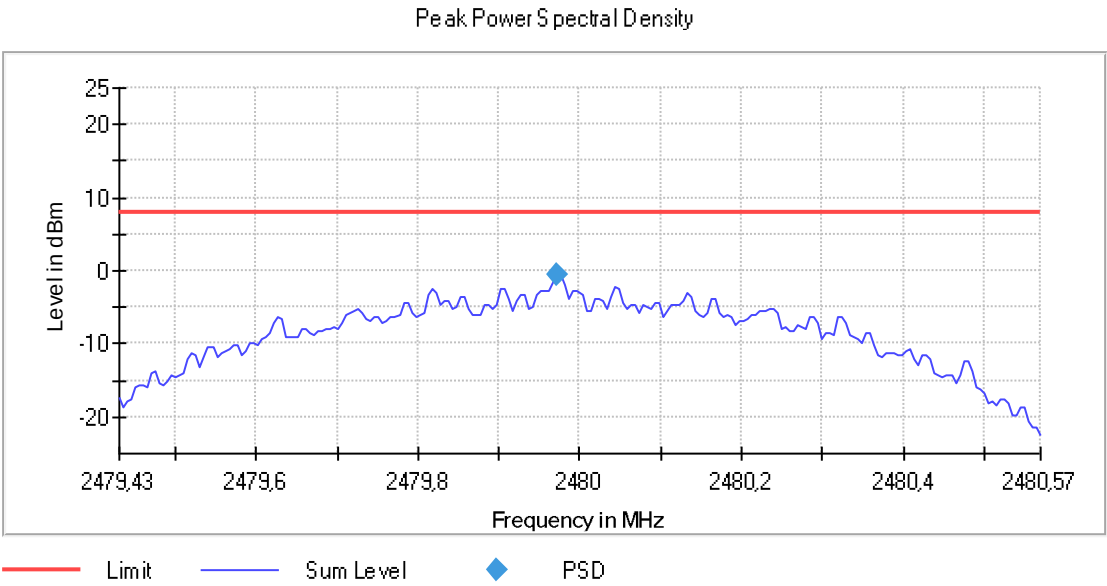


Fig. 20: High Channel - Power Spectral Density

4.5.7 Test Equipment Used

Equipment	Brand	Model	Applus Ref.	Last Calibration	Next Calibration
DIGITAL THERMO-HYGROMETER	TESTO	608-H1	1041916	09/02/2024	09/02/2025
SHIELDED CHAMBER SR0	ALBATROSS	SR	1042267	-	-
RF SWITCH	ROHDE & SCHWARZ	OSP120	1042701	24/03/2022	24/03/2024
SIGNAL SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSVA3044	1042700	23/02/2022	15/11/2024
CABLE RF 40 GHz	HUBERSUHNER	SF102	1042545	28/05/2024	28/05/2025
RF CABLE	ASTROLAB	32026-29094-29094-24TC	1041825	16/05/2023	16/05/2024

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

4.6.1.1 Tabletop equipment

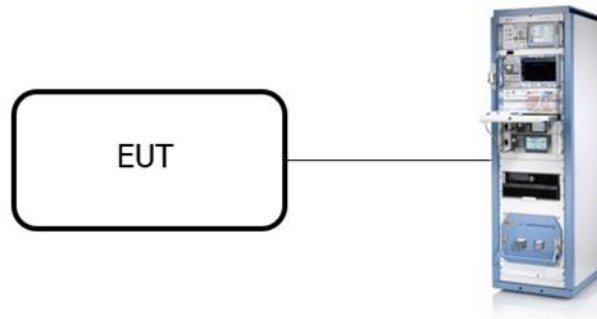


Fig. 21: Band Edge setup of table top equipment.

4.6.2 Test Parameters

4.6.2.1 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	100	Max Peak	100	300

Table 26: EMI Receiver configuration – Band Edge

4.6.4 Test Environmental Conditions

Test Date	Technician	Supervisor	Temperature [°C]	Humidity [%]	Atm. Pressure [mbar]
15/03/2024	P. Redondo	J.M. Nadales	22.8	45	998

Table 27: Test environmental conditions – Band Edge

4.6.5 Summary Test Results

Frequency [MHz]	Band Edge	Limit [dBm]	Results
2402	PK < Limit - I	-8.3	PASS
2480	PK < Limit - I	-12.5	PASS

Table 28: Summary Test Results – Band Edge

4.6.6 Test Results

4.6.6.1 Sample #1. Mode #1

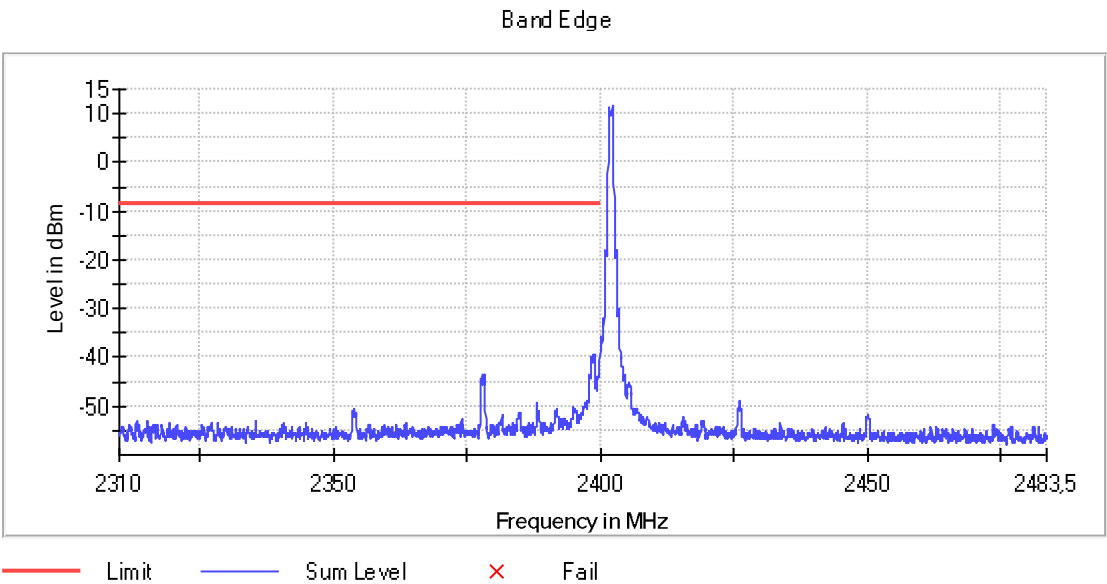


Fig. 22: Low Channel - Band Edge

FINAL MEASUREMENTS			
Frequency [MHz]	Max amplitude Level [dBm]	Margin [dB]	Result
2399.950	-38.8	30.5	PASS

Table 29: Low Channel - Band Edge

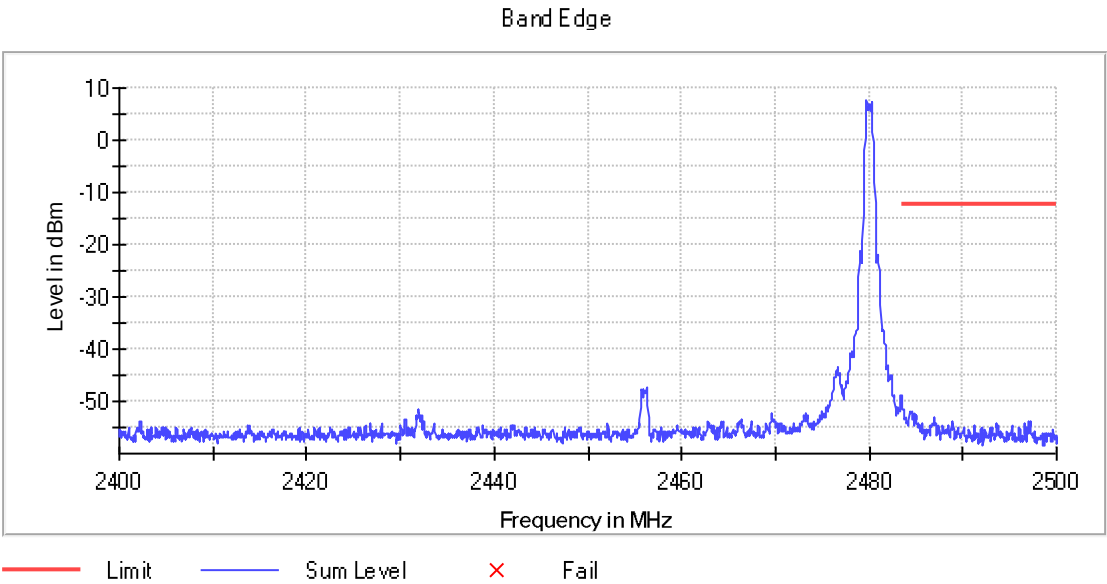


Fig. 23: High Channel - Band Edge

FINAL MEASUREMENTS

Frequency [MHz]	Max amplitude Level [dBm]	Margin [dB]	Result
2483.550	-50.4	37.9	PASS

Table 30. High Channel - Band Edge

4.6.7 Test Equipment Used

Equipment	Brand	Model	Applus Ref.	Last Calibration	Next Calibration
DIGITAL THERMO-HYGROMETER	TESTO	608-H1	1041916	09/02/2024	09/02/2025
SHIELDED CHAMBER SR0	ALBATROSS	SR	1042267	-	-
RF SWITCH	ROHDE & SCHWARZ	OSP120	1042701	24/03/2022	24/03/2024
SIGNAL SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSVA3044	1042700	23/02/2022	15/11/2024
CABLE RF 40 GHz	HUBERSUHNER	SF102	1042545	28/05/2024	28/05/2025
RF CABLE	ASTROLAB	32026-29094-29094-24TC	1041825	16/05/2023	16/05/2024

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 setup of table top equipment.

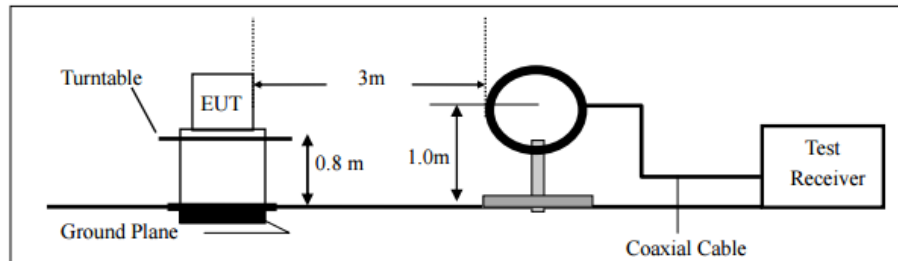


Fig. 25: Radio-frequency radiated emissions of table top equipment from 9 kHz to 30 MHz

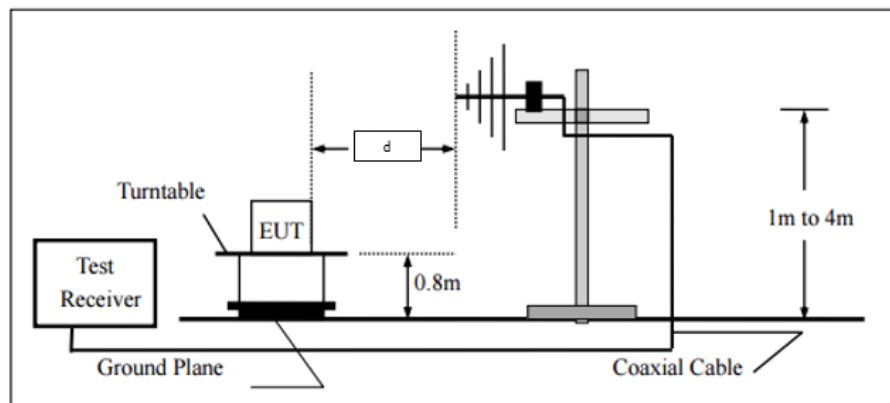


Fig. 26: Radio-frequency radiated emissions of table top equipment from 30 MHz to 1000 MHz
Distance "d" depends on test chamber.

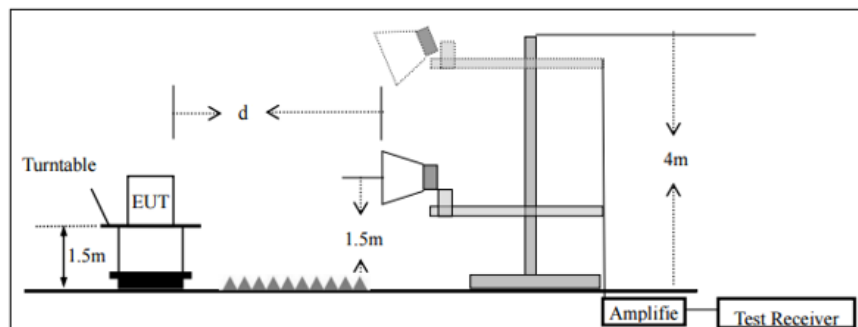


Fig. 27: Radio-frequency radiated emissions setup of table top equipment above 1 GHz

Distance "d" depends on test chamber.

4.7.2 Test Procedure

According to ANSI C63.4-2014 & ANSI C63.4a-2017:

All radiated test are performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m. The EUT is placed at a height of 80 cm above the reference ground plane in the center of the chamber turntable to perform the measurements below 1 GHz.

For measurements above 1 GHz the EUT is placed at a height of 1.5 m above the test chamber floor in the center of the turntable.

4.7.3 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	$20\log(2400/F[\text{kHz}]) + 80$	N/A	N/A	N/A	N/A
0.490 – 1.705	$20\log(24000/F[\text{kHz}]) + 40$	N/A	N/A	N/A	N/A
1.705 - 30	$20\log(24000/F[\text{kHz}]) + 40$	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: $L_2 = L_1 - 20\log(d_2/d_1)$, 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	Measurement distance [m]
30 – 88	QPK	3
88 – 216		
216 – 960		
Above 960		
Above 18000	Peak power	1

Table 35. Radiated Emission limits. Unrestricted bands

4.7.3.1 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

4.7.4 Test Environmental Conditions

Test Date	Technician	Supervisor	Temperature [°C]	Humidity [%]	Atm. Pressure [mbar]
11/04/2024	J. M Llaurodo	--	21.3	51.4	1010.8
11/04/2024	A. Pérez	J.M. Nadales	21.3	51.4	1010.8
12/04/2024	J. M Llaurodo	--	21.0	50.1	1008.4
24/05/2024	A. Moliner	J.M. Nadales	22.9	47.2	998.3

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

4.7.5 Summary Test Results

Frequency Range [MHz]	Test Area	Distance [m]	Emissions	Results
9 kHz – 30 MHz	SAC 1	3 m	Limit - I <= QP < Limit	PASS
30 MHz – 1 GHz	SAC 1	3 m	Limit - I <= QP < Limit	PASS
1 GHz – 18 GHz	SAC 1	3 m	Limit - I <= PK < Limit Limit - I <= AVG < Limit	PASS
18 GHz – 26 GHz	SAC 1	1 m	Limit - I <= PK < Limit Limit - I <= AVG < Limit	PASS

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

4.7.6 Test Results

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

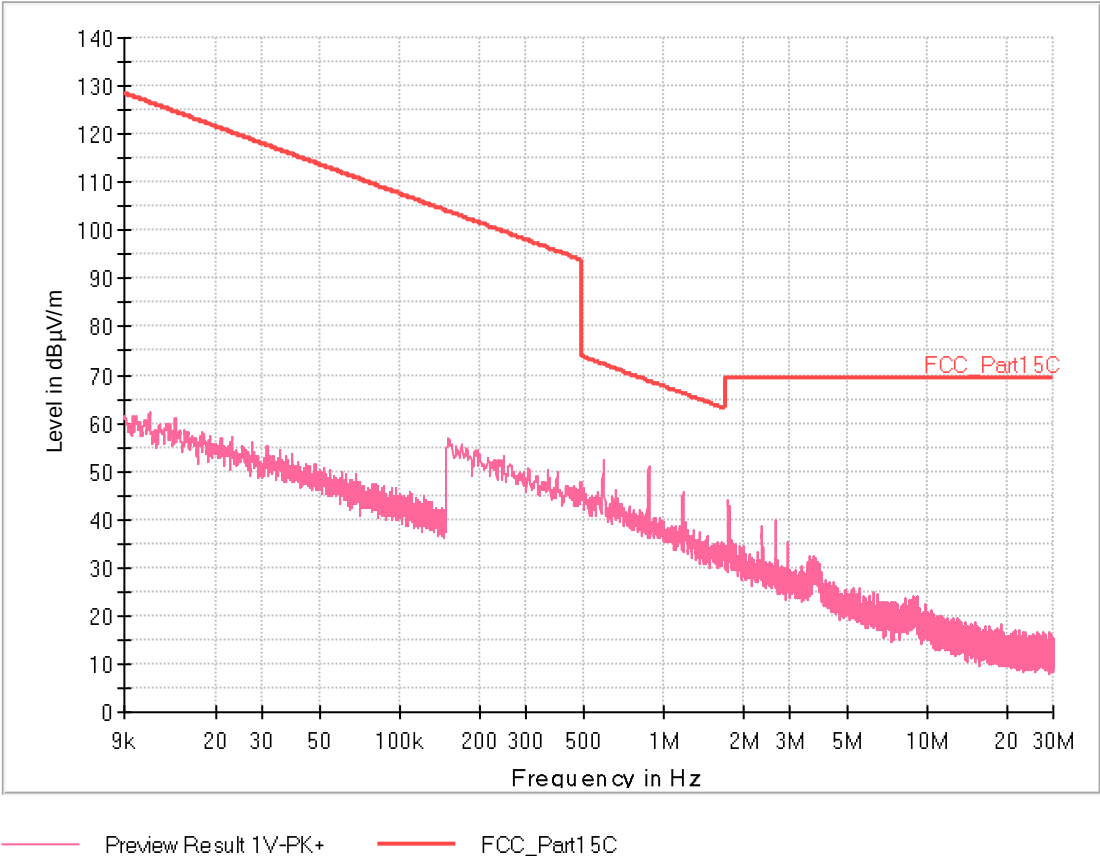


Fig. 28: Ambient level. Frequency range: 9 kHz – 30 MHz - Axis X

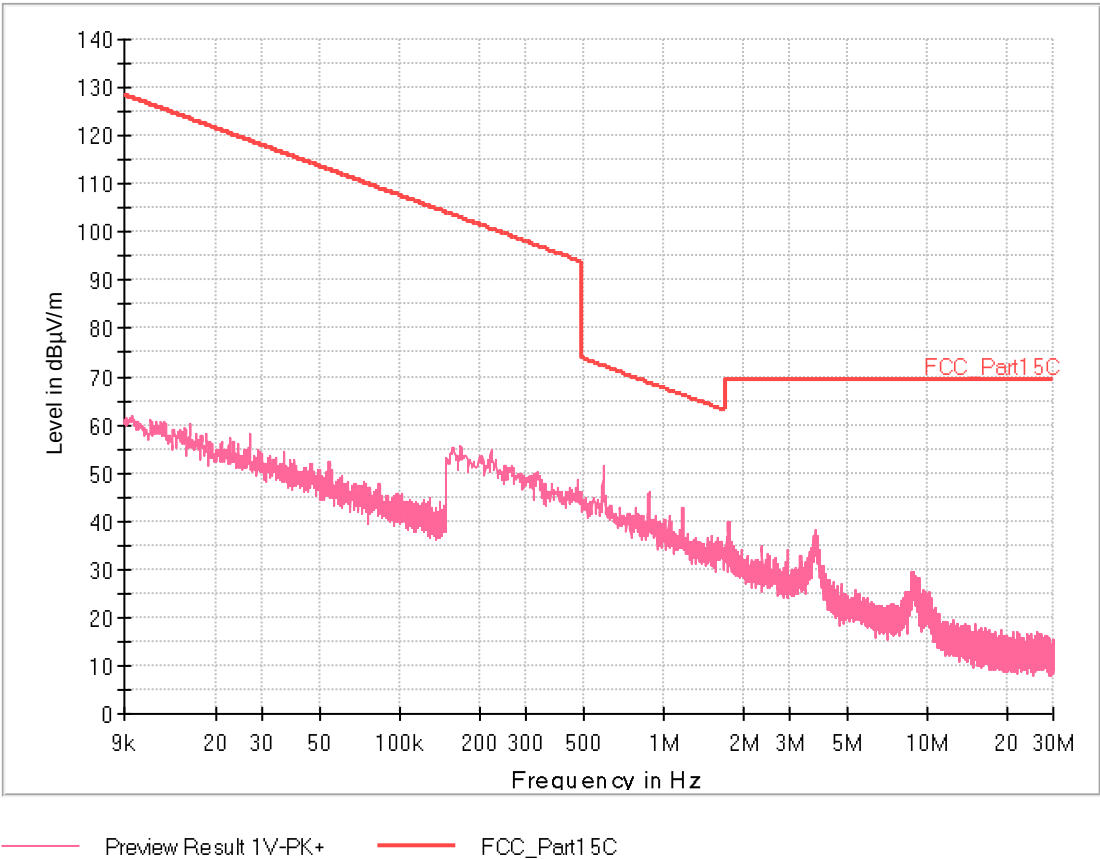


Fig. 29: Ambient level. Frequency range: 9 kHz – 30 MHz - Axis Y

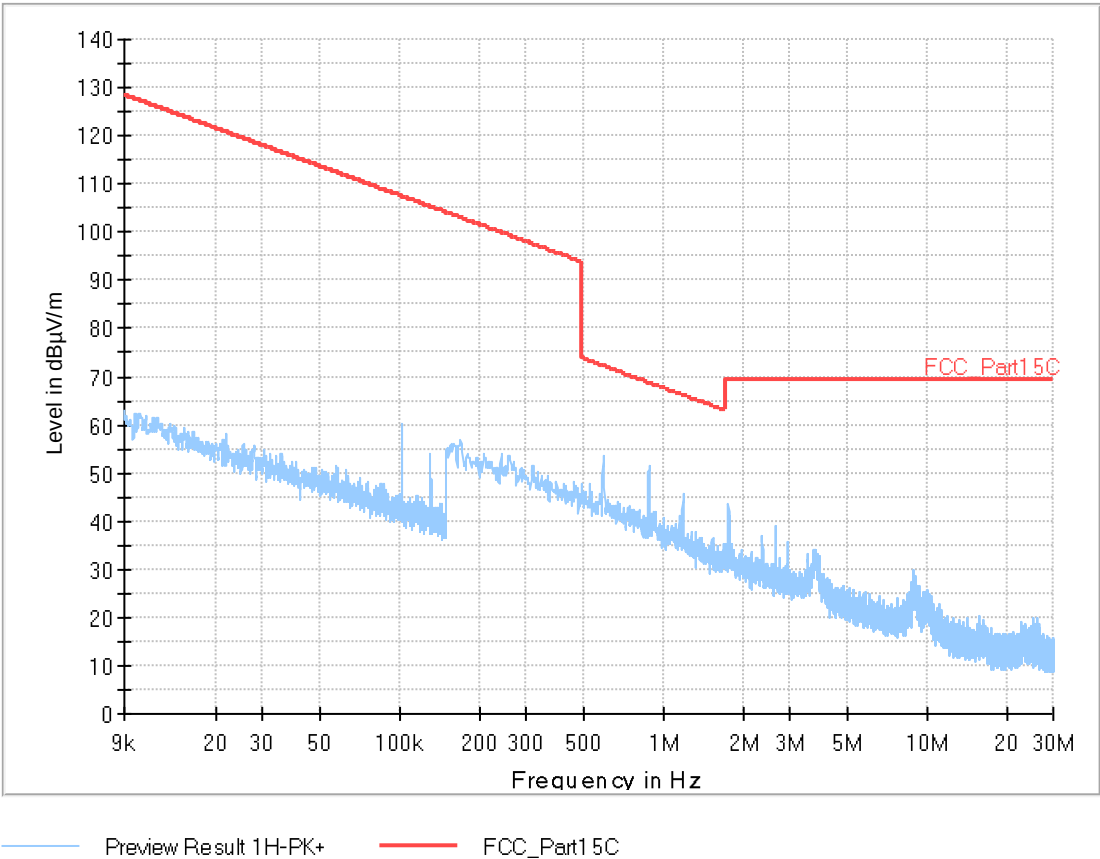


Fig. 30: Ambient level. Frequency range: 9 kHz – 30 MHz - Axis Z

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

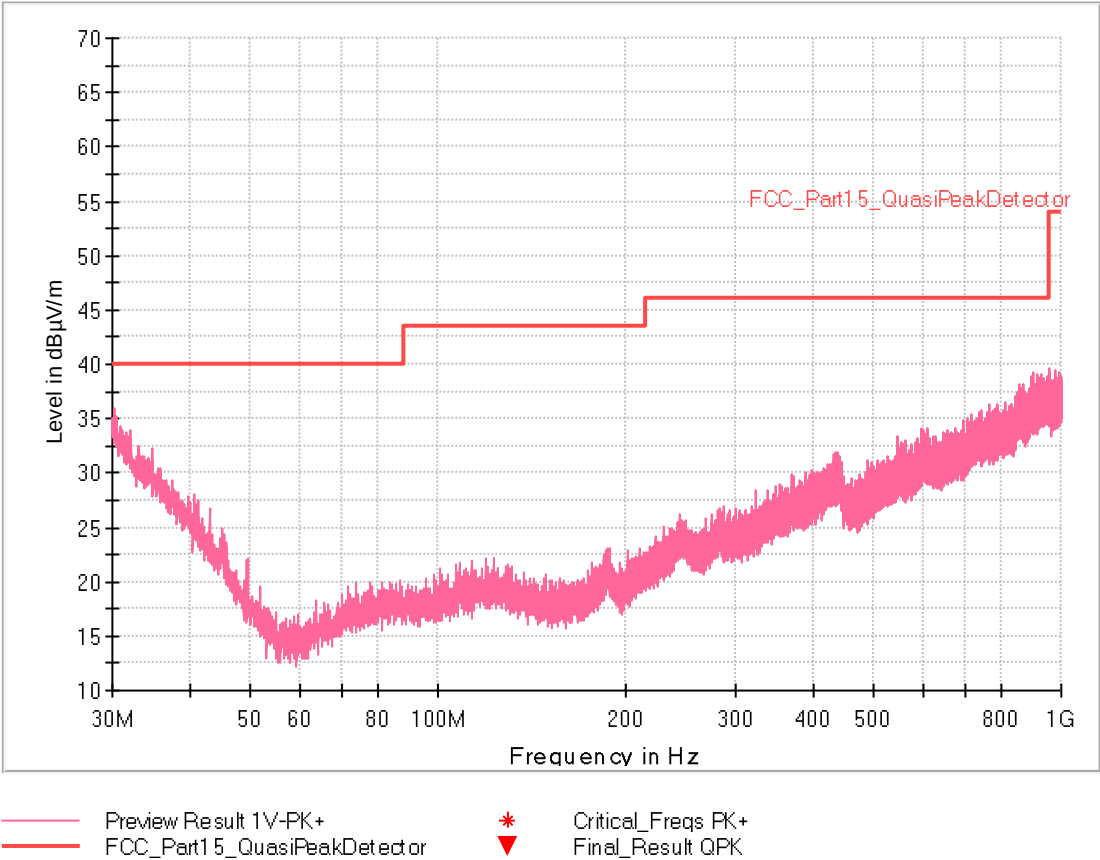


Fig. 31: Ambient level. Frequency range: 30 MHz – 1 GHz

4.7.6.3 Ambient Levels. Frequency range: 1 GHz – 3.5 GHz

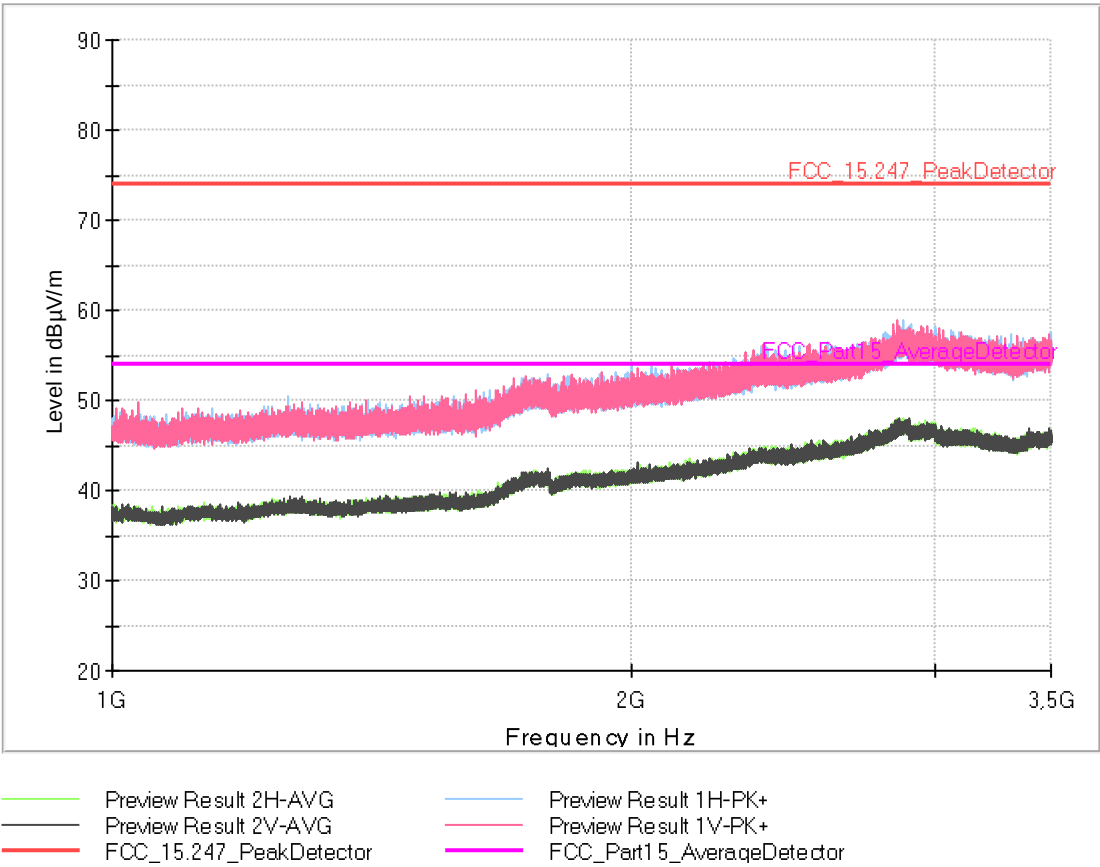


Fig. 32: Ambient level. Frequency range: 1 GHz – 3.5 GHz

4.7.6.4 Ambient Levels. Frequency range: 3.5 GHz – 18 GHz

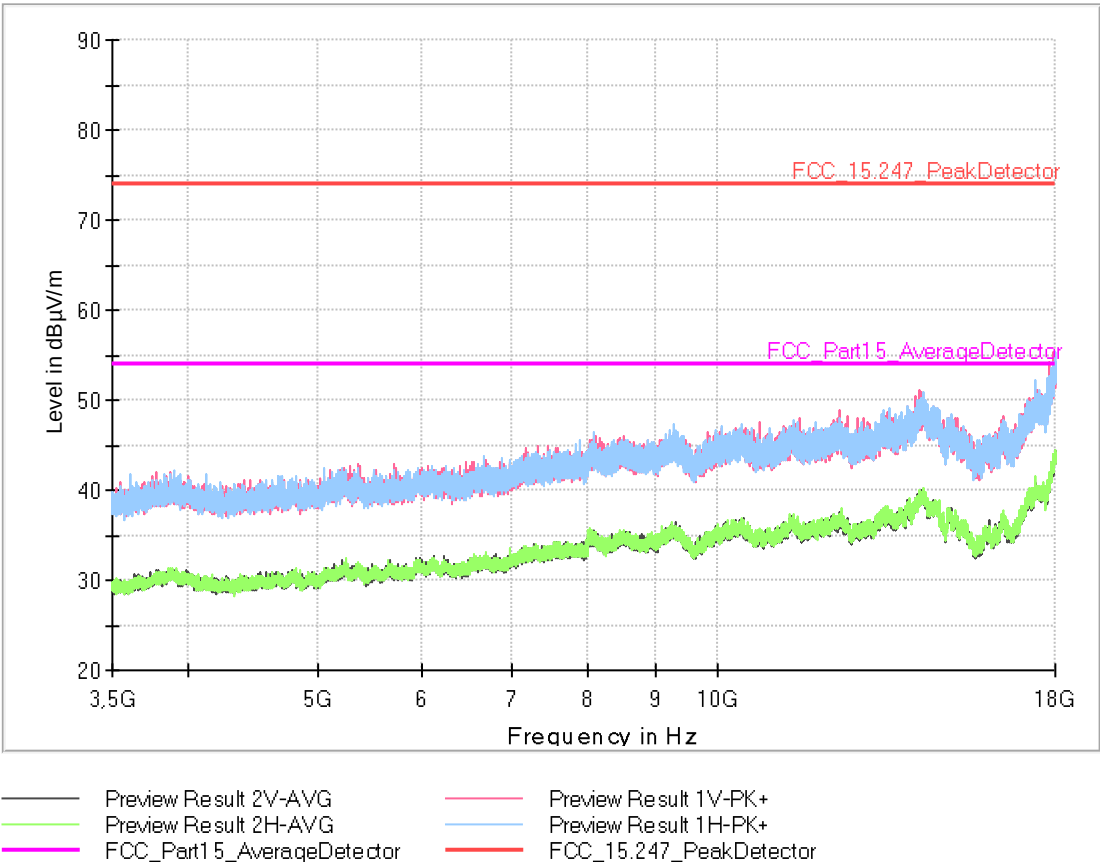


Fig. 33: Ambient level. Frequency range: 3.5 GHz – 18 GHz

4.7.6.5 Ambient Levels. Frequency range: 18 GHz – 26 GHz

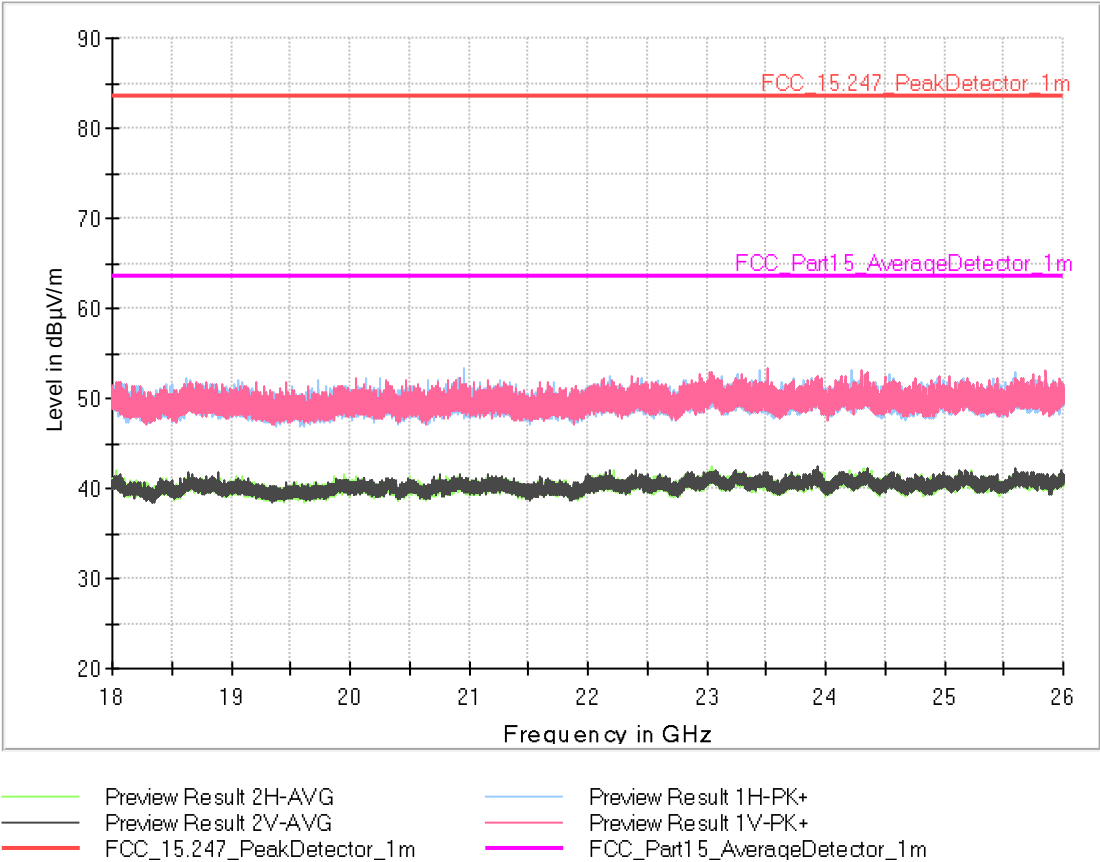


Fig. 34: Ambient level. Frequency range: 18 GHz – 26 GHz

4.7.6.6 Sample #2. Mode 1. All Channel¹. Frequency range: 9 kHz – 30 MHz

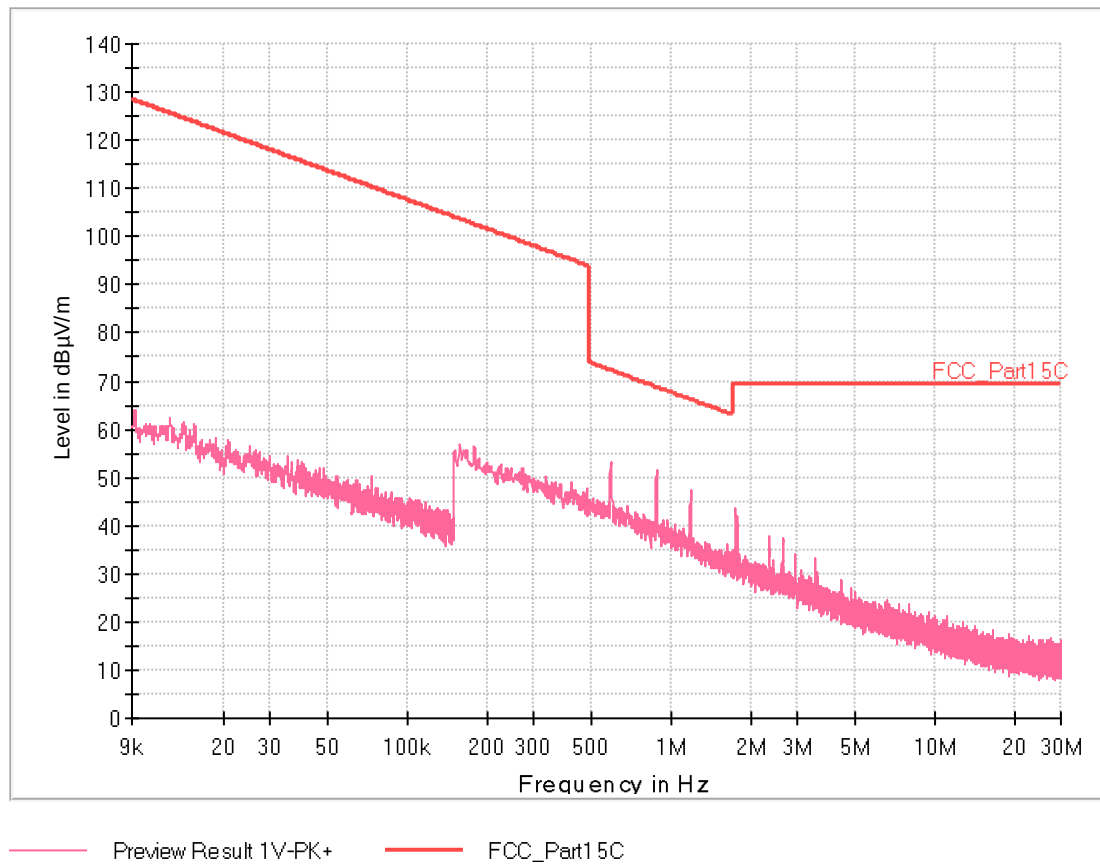


Fig. 35: All Channel. Frequency range: 9 kHz – 30 MHz – Axis X
FINAL MEASUREMENTS

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.

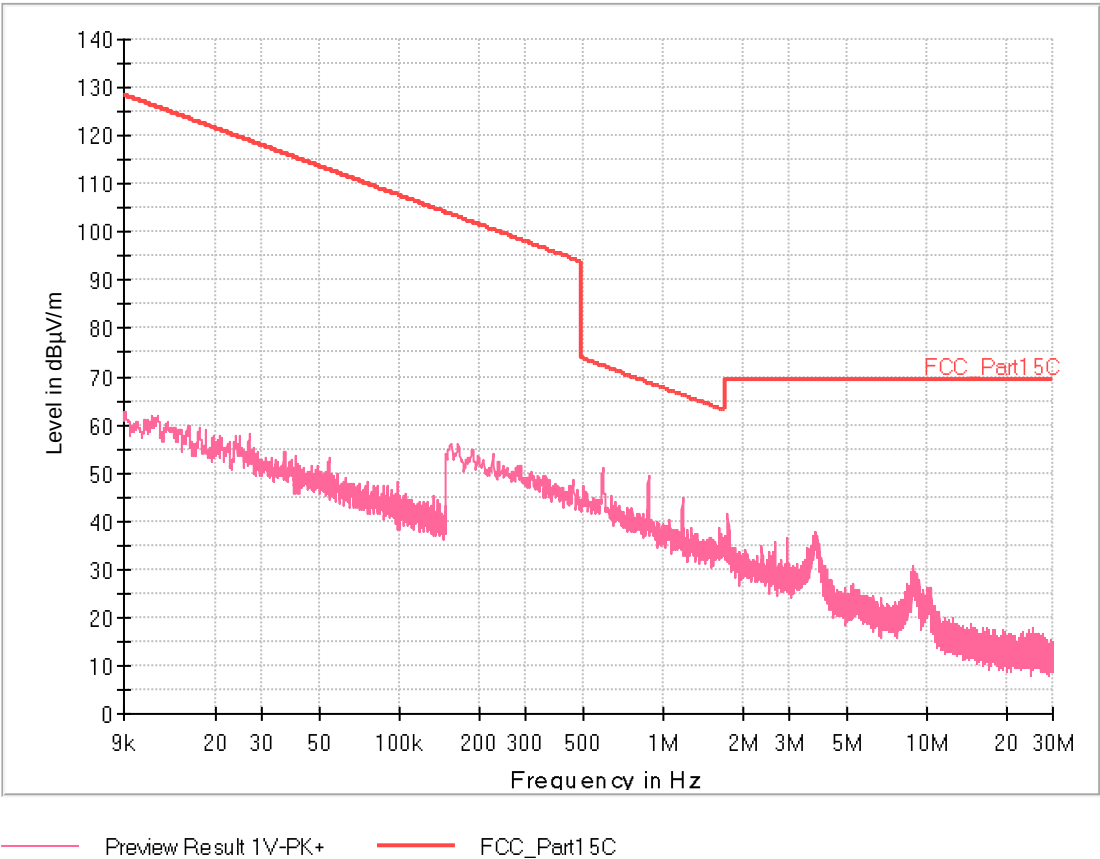


Fig. 36: All Channel. Frequency range: 9 kHz – 30 MHz – Axis Y
FINAL MEASUREMENTS

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.

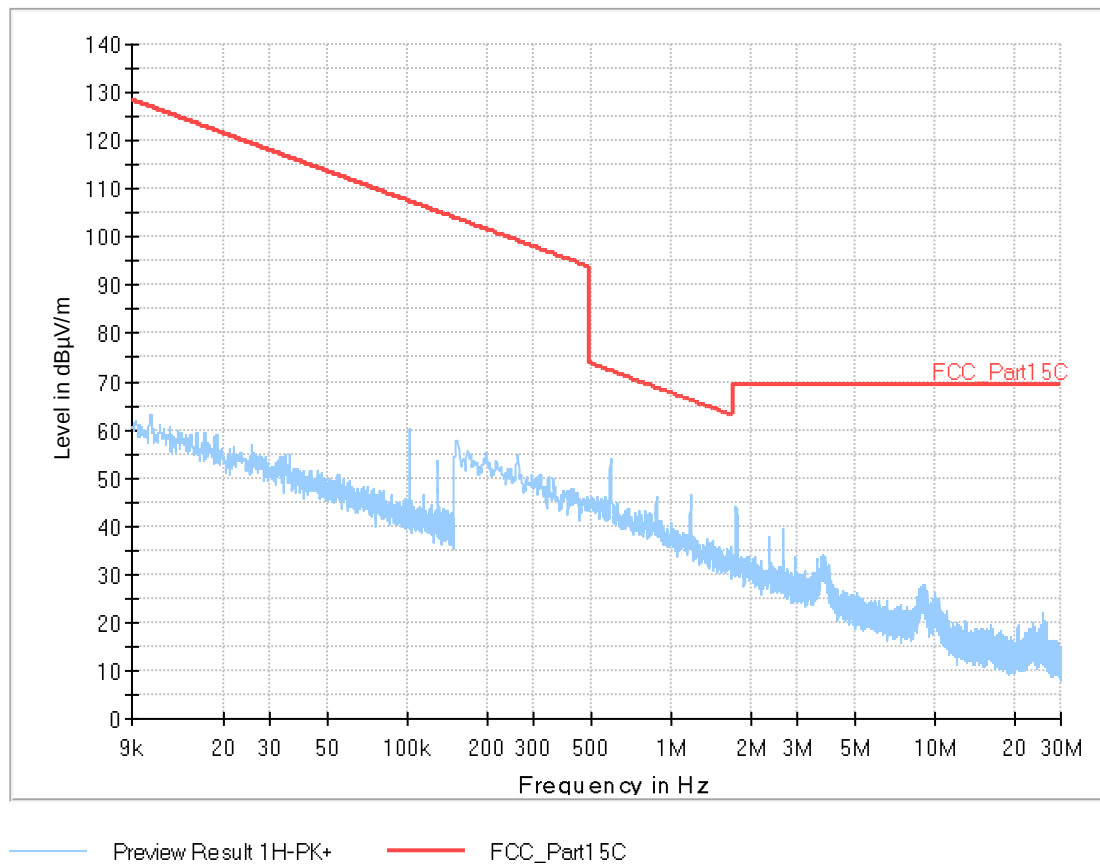
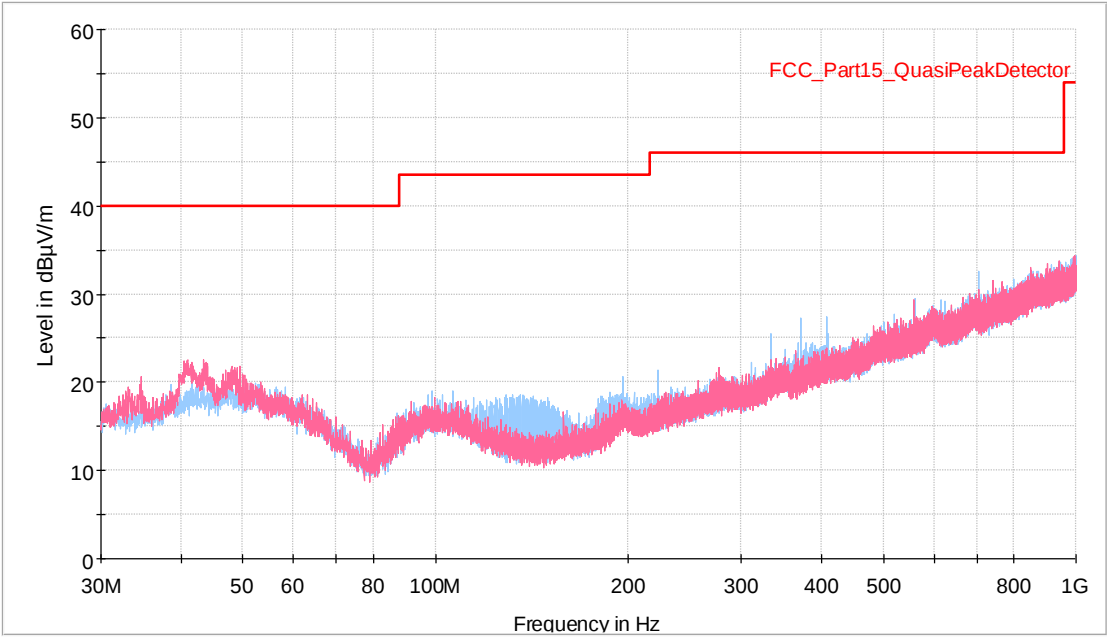


Fig. 37: All Channel. Frequency range: 9 kHz – 30 MHz – Axis Z
FINAL MEASUREMENTS

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.

4.7.6.7 Sample #2. Mode 1. Frequency range: 30 MHz – 1 GHz



Preview Result 1H-PK+ Preview Result 1V-PK+ FCC_Part15_QuasiPeakDetector

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

FINAL MEASUREMENTS

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

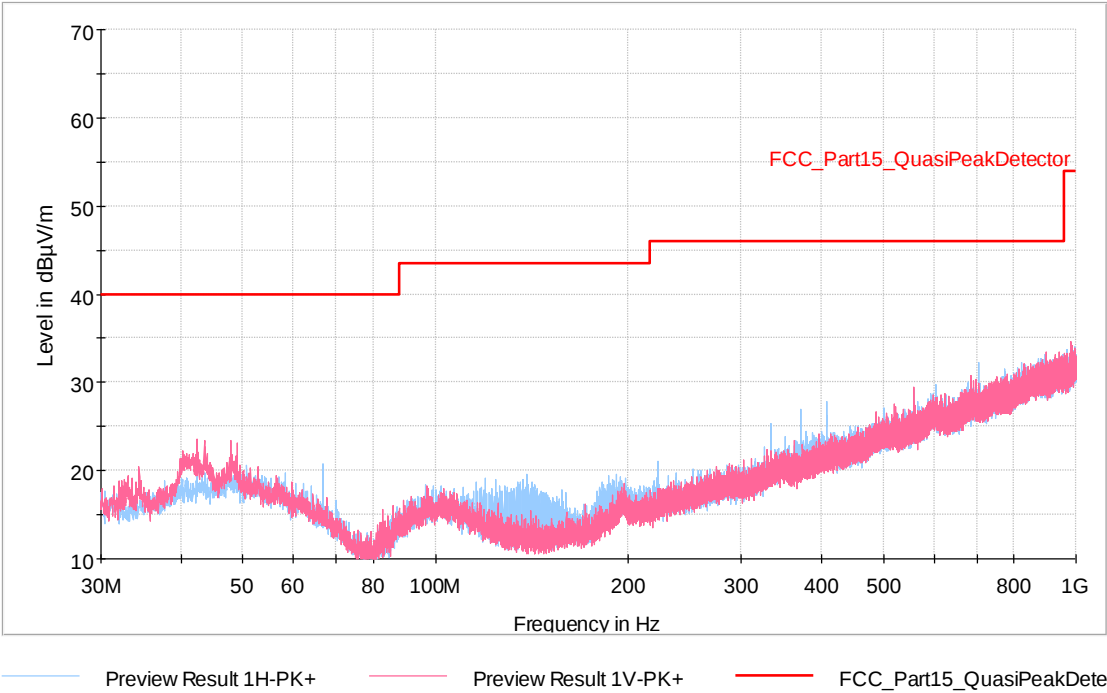
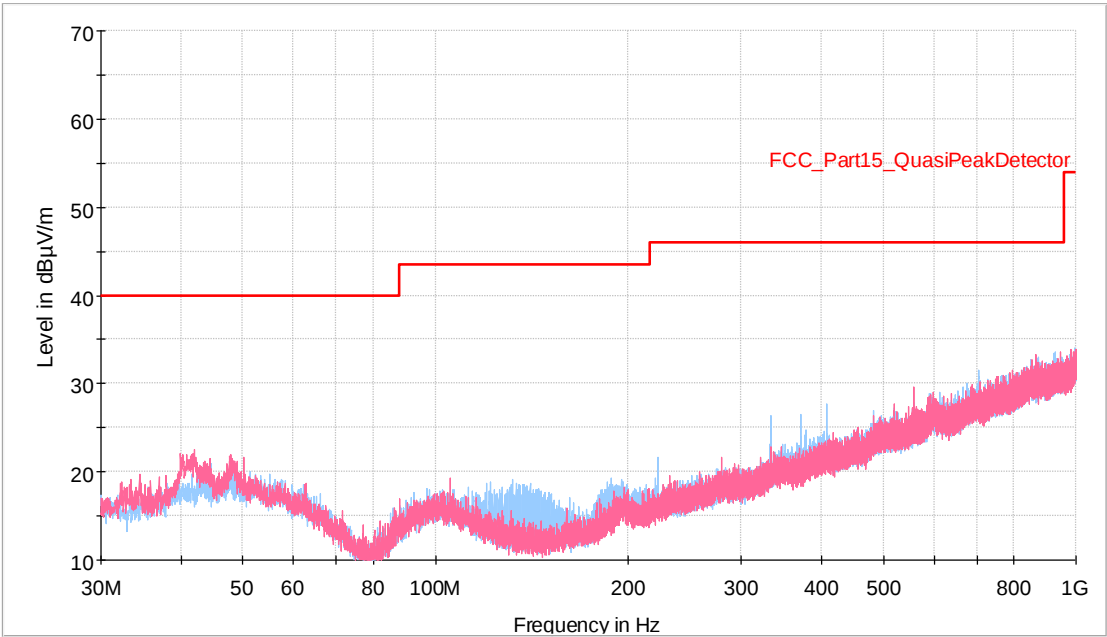


Fig. 39: Middle Channel. Frequency range: 30 MHz – 1GHz

FINAL MEASUREMENTS

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



Preview Result 1H-PK+ Preview Result 1V-PK+ FCC_Part15_QuasiPeakDetector

Fig. 40: High Channel. Frequency range: 30 MHz – 1GHz

FINAL MEASUREMENTS

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

4.7.6.8 Sample #2. Mode 1.. Frequency range: 1 GHz – 3.5 GHz

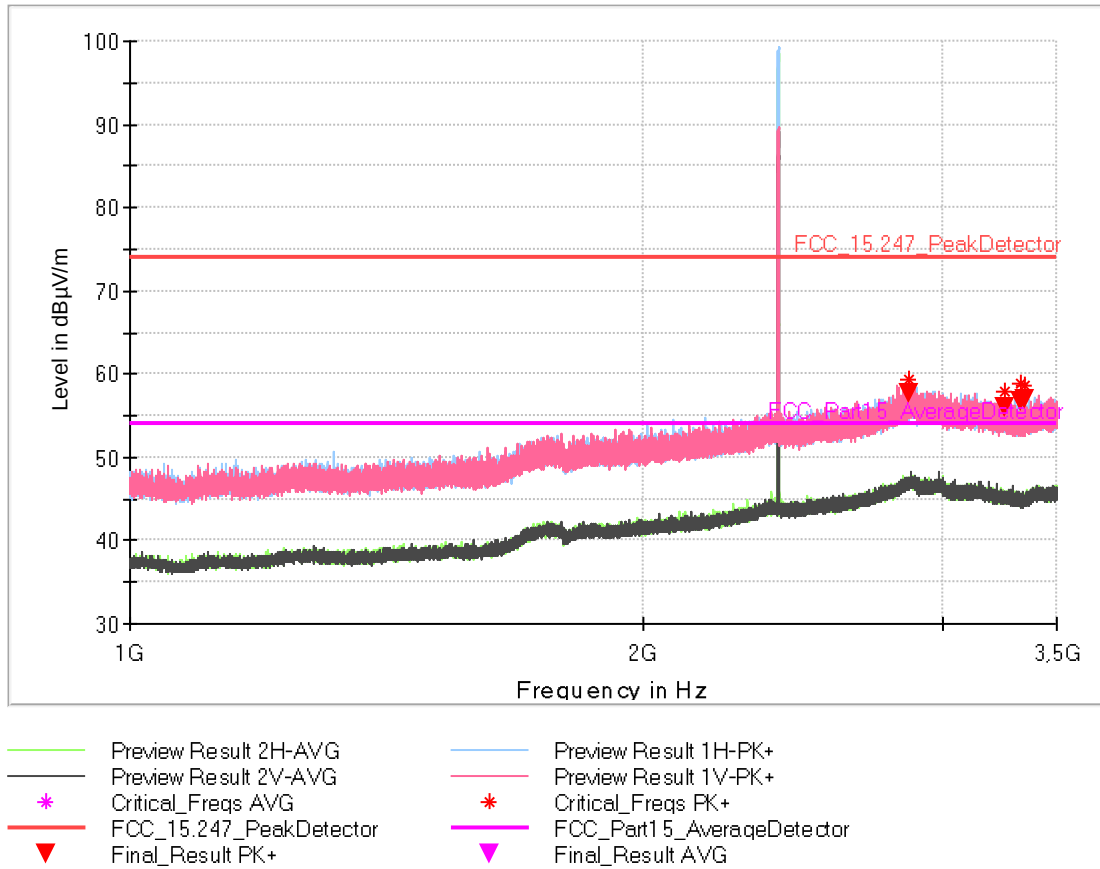


Fig. 41: Low Channel. Frequency range: 1 GHz – 3.5 GHz

FINAL MEASUREMENTS							
Frequency [MHz]	MaxPeak [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Pol	Azimuth [deg]	Corr. [dB/m]
2862.750 ¹	57.71	74.00	16.29	120.0	V	0.0	32.9
3332.170 ¹	56.76	74.00	17.24	222.0	V	0.0	34.9
3355.080 ¹	57.05	74.00	16.95	336.0	V	9.0	34.9

Table 39: Low Channel - Frequency range: 1 GHz – 3.5 GHz

Note ¹: The final frequency measurements within the restricted band correspond to the ambient level as can be seen in the graphs above. Therefore, a maximization with peak detector as worst case is performed.

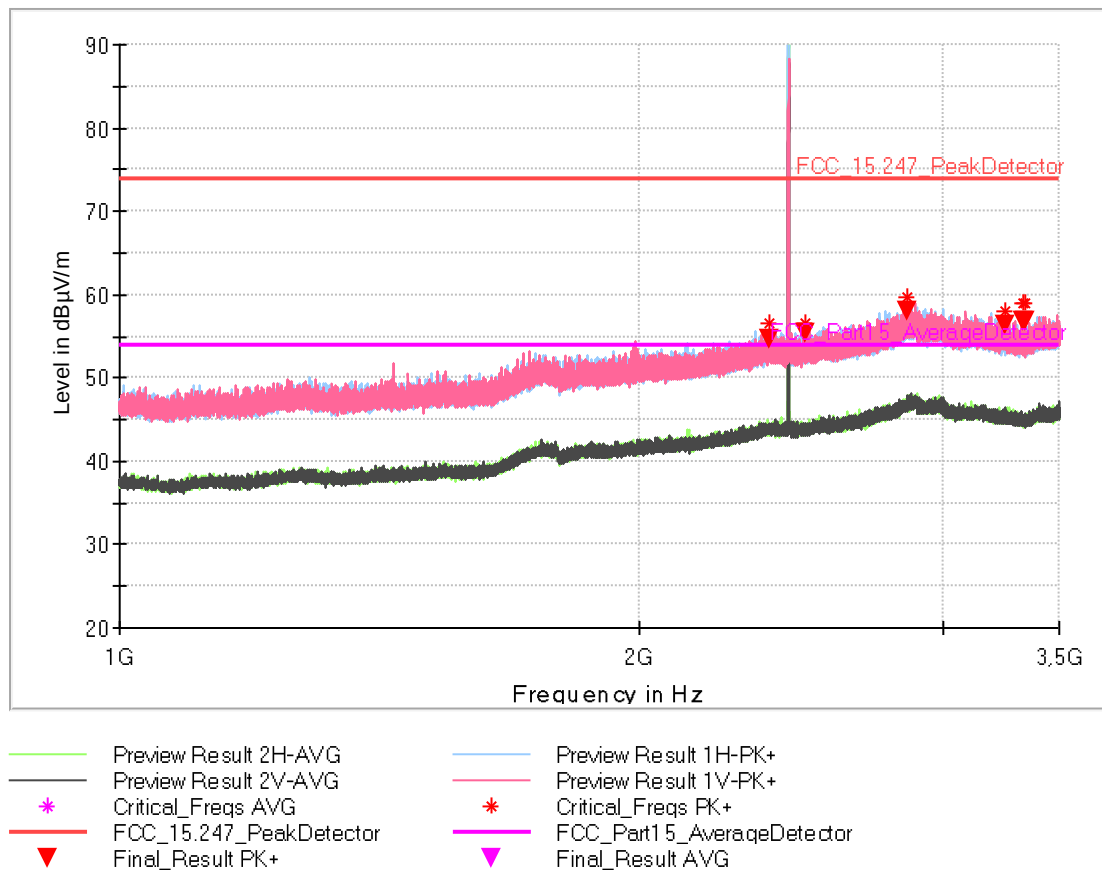


Fig. 42: Middle Channel. Frequency range: 1 GHz – 3.5 GHz

FINAL MEASUREMENTS							
Frequency [MHz]	MaxPeak [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Pol	Azimuth [deg]	Corr. [dB/m]
2375.080 ¹	54.60	74.00	19.40	223.0	V	348.0	31.9
2493.000 ¹	55.39	74.00	18.61	100.0	V	187.0	32.0
2861.420 ¹	57.93	74.00	16.07	253.0	V	266.0	32.9
3336.830 ¹	56.88	74.00	17.12	122.0	V	204.0	34.8

Table 40: Middle Channel - Frequency range: 1 GHz – 3.5 GHz

Note ¹: The final frequency measurements within the restricted band correspond to the ambient level as can be seen in the graphs above. Therefore, a maximization with peak detector as worst case is performed.

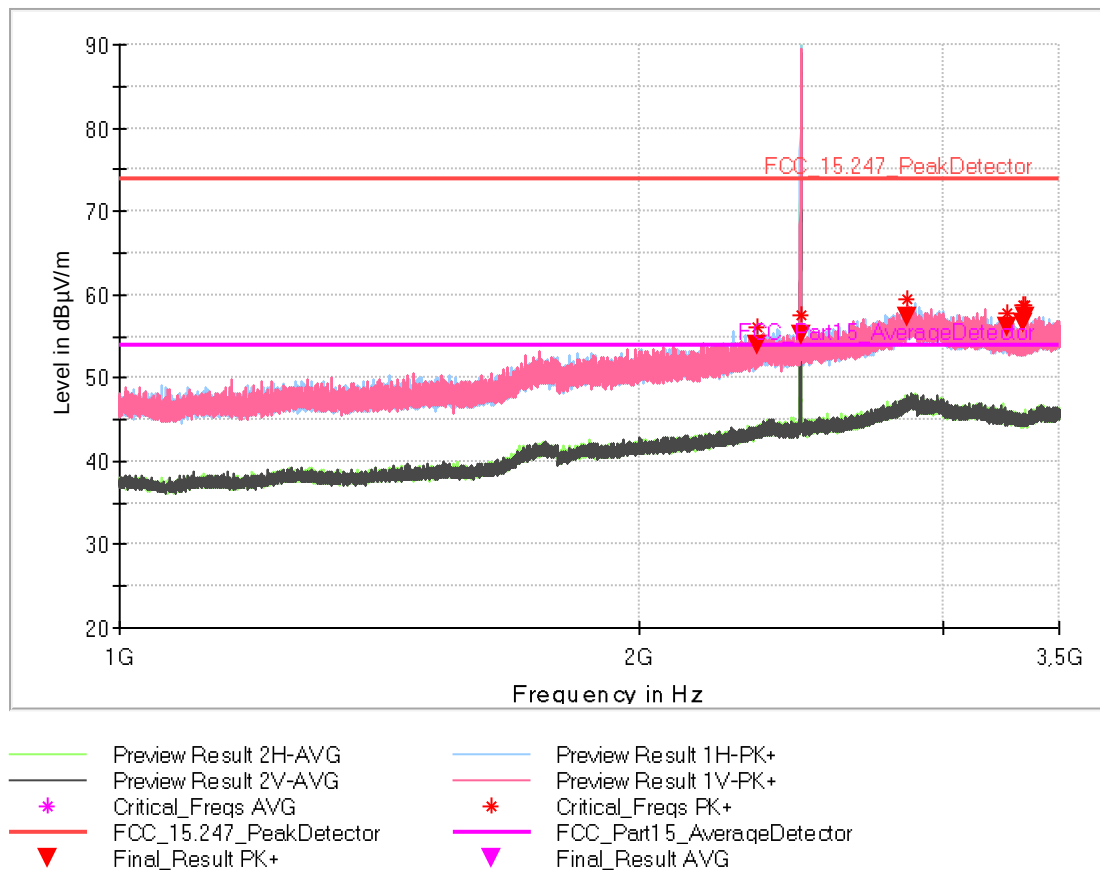


Fig. 43: High Channel. Frequency range: 1 GHz – 3.5 GHz

FINAL MEASUREMENTS							
Frequency [MHz]	MaxPeak [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Pol	Azimuth [deg]	Corr. [dB/m]
2340.250 ¹	53.89	74.00	20.11	223.0	H	198.0	31.6
2484.080 ¹	55.18	74.00	18.82	100.0	H	147.0	31.9
2858.670 ¹	57.37	74.00	16.63	253.0	V	300.0	32.9
3348.580 ¹	57.30	74.00	16.70	122.0	V	165.0	34.9

Table 41: High Channel - Frequency range: 1 GHz – 3.5 GHz

Note ¹: The final frequency measurements within the restricted band correspond to the ambient level as can be seen in the graphs above. Therefore, a maximization with peak detector as worst case is performed.

4.7.6.9 Sample #2. Mode 1.. Frequency range: 3.5 GHz – 18 GHz

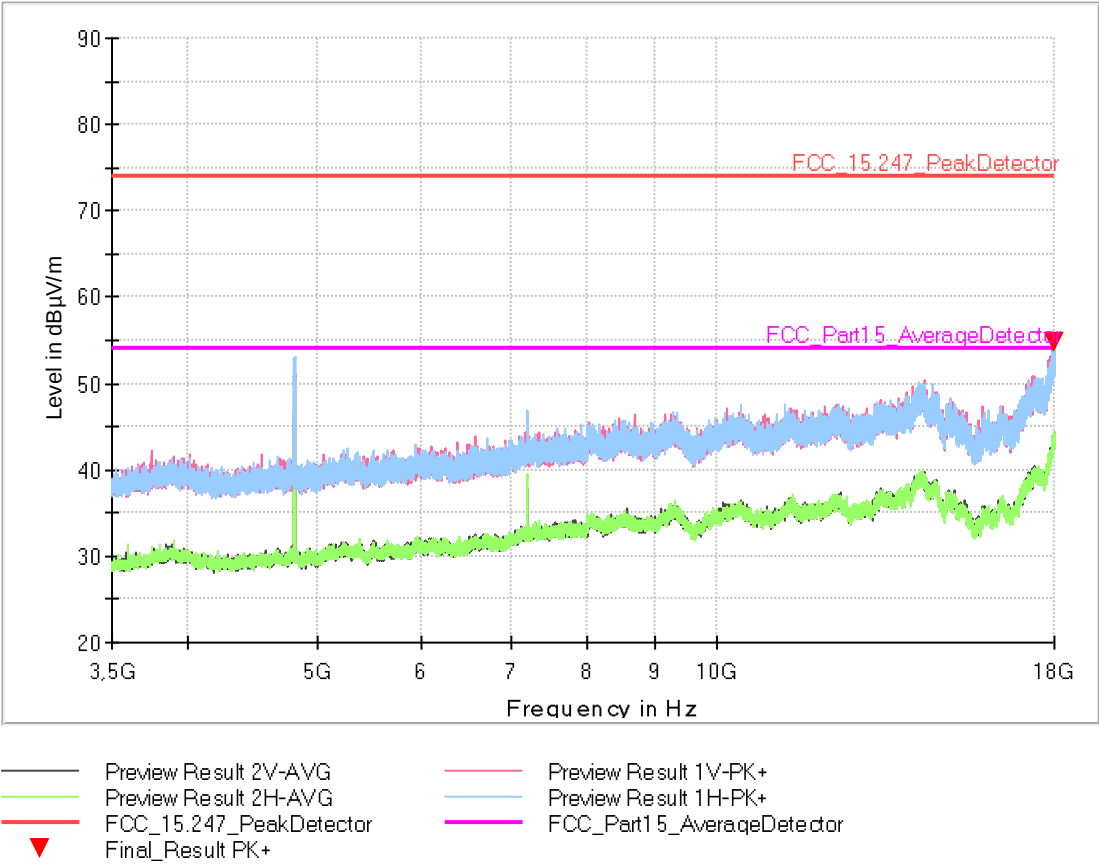


Fig. 44: Low Channel. Frequency range: 3.5 GHz - 18 GHz

FINAL MEASUREMENTS							
Frequency [MHz]	MaxPeak [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Pol	Azimuth [deg]	Corr. [dB/m]
17966.650 ¹	55.40	74.00	18.60	151.0	H	0.0	8.0

Table 42: Low Channel - Frequency range: 3.5 GHz - 18 GHz

Note ¹: The final frequency measurements within the restricted band correspond to the ambient level as can be seen in the graphs above. Therefore, a maximization with peak detector as worst case is performed.

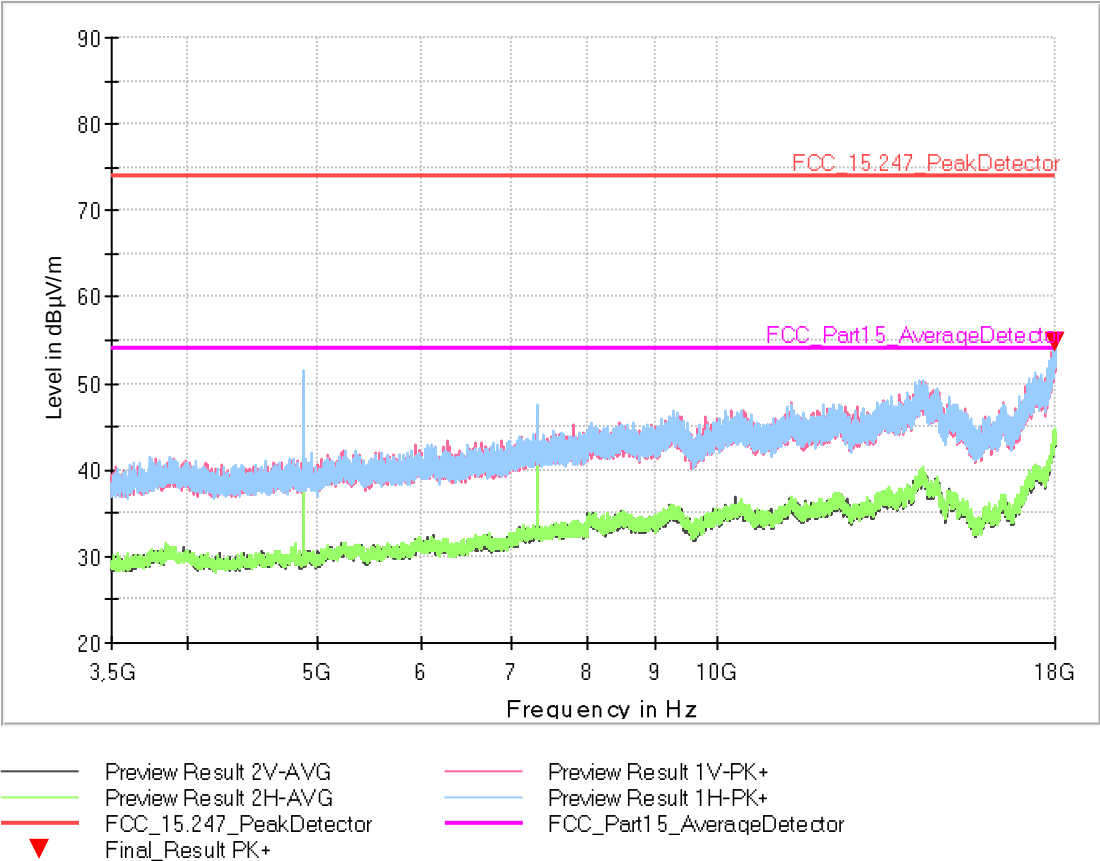


Fig. 45: High Channel. Frequency range: 3.5 GHz - 18 GHz

FINAL MEASUREMENTS							
Frequency [MHz]	MaxPeak [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Pol	Azimuth [deg]	Corr. [dB/m]
17835.670 ¹	54.97	74.00	19.03	343.0	H	142.0	7.1

Table 43: High Channel - Frequency range: 3.5 GHz - 18 GHz

*Note*¹: The final frequency measurements within the restricted band correspond to the ambient level as can be seen in the graphs above. Therefore, a maximization with peak detector as worst case is performed.

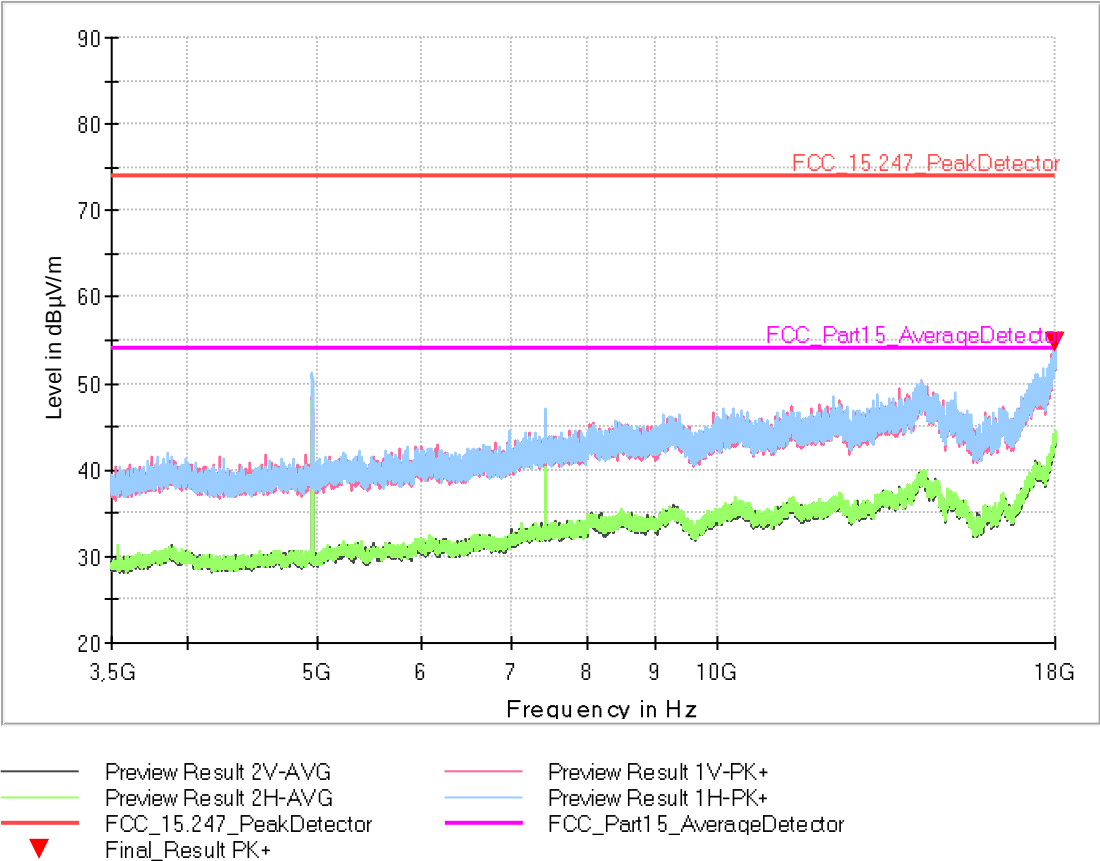


Fig. 46: Middle Channel. Frequency range: 3.5 GHz - 18 GHz

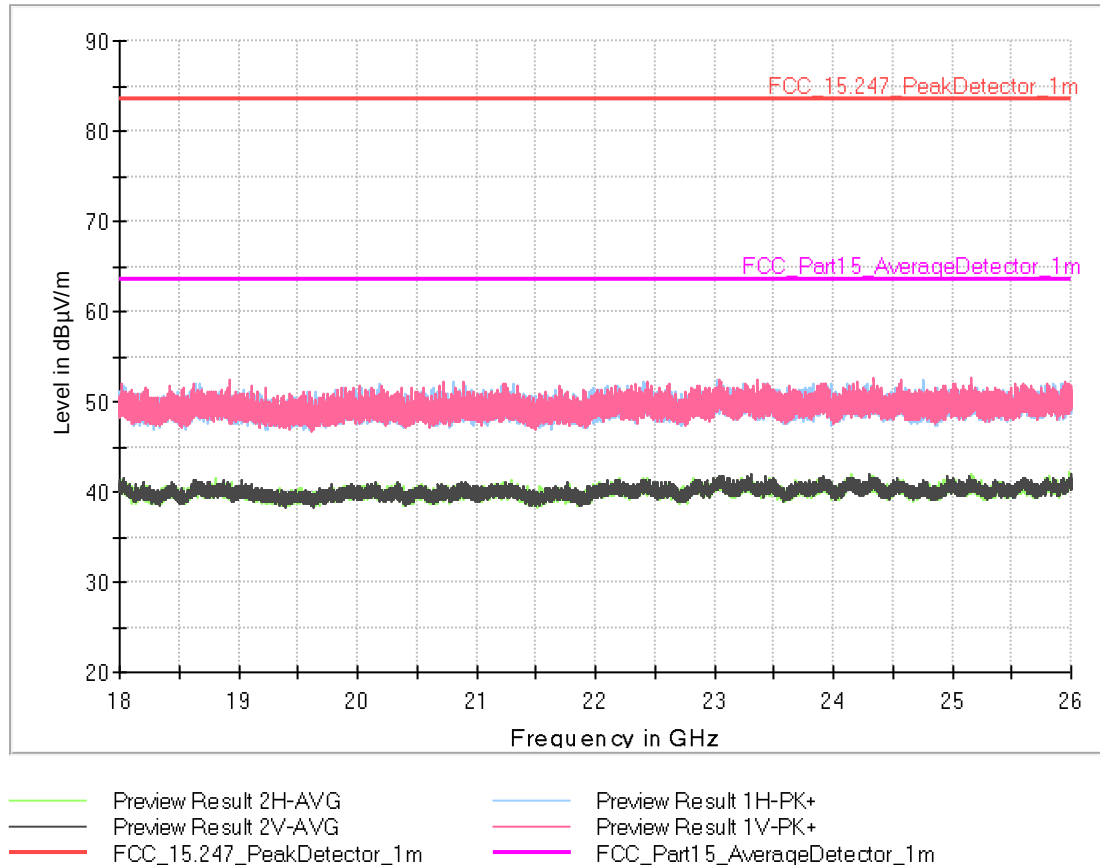
FINAL MEASUREMENTS							
Frequency [MHz]	MaxPeak [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Pol	Azimuth [deg]	Corr. [dB/m]
17954.570 ¹	55.45	74.00	18.55	151.0	H	205.0	8.0

Table 44: Middle Channel - Frequency range: 3.5 GHz - 18 GHz

Note ¹: The final frequency measurements within the restricted band correspond to the ambient level as can be seen in the graphs above. Therefore, a maximization with peak detector as worst case is performed.

4.7.6.10 Sample #2. Mode 1. All Channel¹. Frequency range: 18 GHz – 26 GHz

Fig. 47: All Channel. Frequency range: 18 GHz – 26 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	1042229	27/02/2024	27/02/2025
HORN ANTENNA	EMCO	3115	05-ER-017	06/12/2023	06/12/2024
HORN ANTENNA	MVG	EH 1840	1042685	14/04/2022	21/06/2026
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	WHNX6-2765-3500-26500-40CC	1042511	12/05/2023	29/04/2025
RF CABLE	HUBER+SUHNER	SF104/11N/11N	1042585	12/05/2023	12/05/2024
RF CABLE	HUBER+SUHNER	SF102	1042546	18/04/2023	28/04/2025
RF AMPLIFIER	BONN ELEKTRONIK	BLMA 0118-M	1041733	12/05/2023	25/04/2025
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 45: Test Instruments – Radio-frequency radiated emissions

4.7.7 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
Emissions	RADIO-FREQUENCY RADIATED EMISSIONS 18 GHz – 26 GHz	± 5.1 dB

Table 46: 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%.