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LAB N° 1347 L

RAPPORTO DI PROVA

TEST REPORT

Rif. / Ref. n.	**FCCTR_181512-1**	Data Emissione /Issue Date:	**28/09/2022**	Pagine / Pages:	**61**

Scopo delle prove *Test object*	Prove di tipo in accordo alla Norme *Type test according to Standards* **47 CFR FCC part 15 - Subpart C - §15.247**
Richiedente *Applicant*	**Paradox Engineering SA** Via Passeggiata 7 – 6883 Novazzano – CH Tel.: +41912330100
Marchio commerciale *Trade mark*	MinebeaMitsumi Passion to Create Value through Difference
Fabbricante *Manufacturer*	**MinabeaMitsumi Inc.** 3-9-6 Mita, Minato-ku, Tokyo 108-8330 Tel.: 81-3-6758-6711
Prodotto *Product*	Sub 1-GHz IPv6/6LoWPAN Hardware radio device, compliant within NEMA standard, that operates as: Smart Lighting Node and Gateway for other Nodes
Modello *Model*	**NDLM007US-1**
Identificativo FCC *FCC ID*	**2AKPQNDLM007**
Data ricevimento campioni *Date of test samples receipt*	09/05/2022
Campioni verificati *No. of tested samples*	1 – Sampled by the applicant
Data verifiche *Testing date*	From 26/05/2022 to 08/06/2022
Sito di prova *Testing site*	PRSLAB S.r.l. Unipersonale - Via Campagna 92 - 22020 Faloppio - Como - Italy
Identificativo FCC del sito di prova *FCC designation number*	IT0012
Esito delle valutazioni *Assessment results*	**CONFORME / COMPLIANT**

Verifiche effettuate da *Verifications carried out by*	**Daniele AOSANI** Tecnico Laboratorio *Laboratory Engineer*	Daniele Aosani
Approvato *Approved by*	**Riccardo PFEIFFER** Responsabile Laboratorio *Laboratory Manager*	Riccardo Pfeiffer

I risultati delle prove riportati nel presente rapporto di prova si riferiscono solo ai campioni esaminati.
The test results reported in this test report shall refer only to the samples tested.
Il campione è stato fornito dal cliente ed i risultati si riferiscono al campione così come ricevuto
The sample has been provided by the customer and the results apply to the sample as received

CONTENUTO

TABLE OF CONTENTS

0. RELEASE CONTROL RECORD

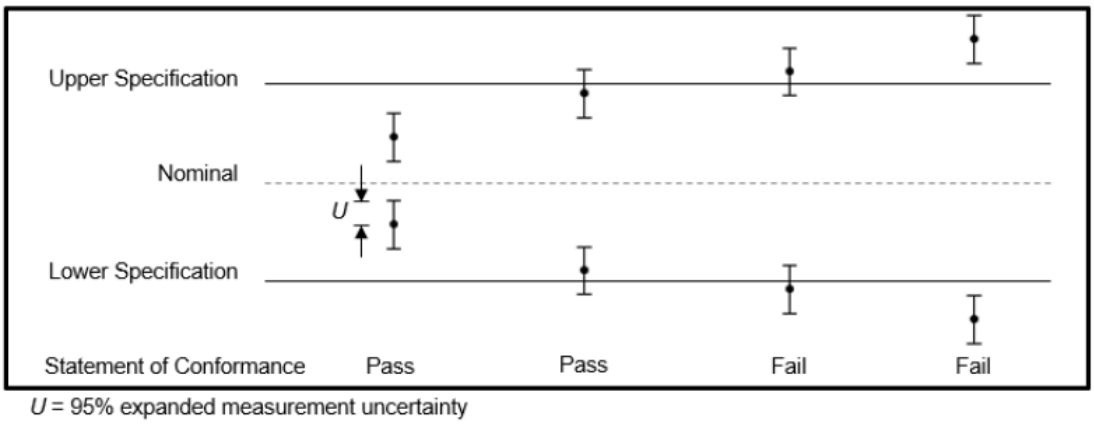
TEST REPORT NUMBER	REASON OF CHANGE	DATE OF ISSUE
FCCTR_181512-0	Original release	21/07/2022
FCCTR_181512-1	Typo error at pag.14	28/09/2022

This document is valid in last revision that deletes and replaces the previous one

1. DECISION RULE

PRS LAB specifies that, if the decision rules of conformity of the test results are not indicated in detail in the standard/s object of tests, it takes as a decision rule for the declaration of conformity the simple binary system (w = 0) stated in the ILAC-G8-09:2019 document.

The decision rule is applicable for all parts of standard



U = 95% expanded measurement uncertainty

Statements of conformity are reported as:

- Pass: the measured value is below the acceptance limit, AL=TL.
- Fail: the measured value is above the acceptance limit, AL=TL.

Definitions

- Guard Band (w): interval between a tolerance limit and a corresponding acceptance limit where length w=|TL−AL|.
- Tolerance Limit (TL) (Specification Limit): specified upper or lower bound of permissible values of a property.
- Acceptance Limit (AL): specified upper or lower bound of permissible measured quantity values.

2. INFORMATION PROVIDED BY CUSTOMER

Differences between versions declared by manufacturer		
	PRODUCT VERSION	**DIFFERENCE**
Tested Version	**NDLM007US-1**	The difference between the two product versions is the LTE module which is pin to pin compatible. The main version mounts the CAT M1 WP7702 module. The variant mounts the CAT 1 WP7611-1 module.
Variant	**NDLM007US-2**	

According to Manufacturer declaration, the tested model is the most representative and the most complex. The differences between the tested one and his variants are described in the table above and are declared by Manufacturer.

3. GENERAL REMARKS

- None

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4. TECHNICAL INFORMATION OF EQUIPMENT UNDER TEST (EUT)

4.1 EUT Identification

DESCRIPTION	Sub 1-GHz IPv6/6LoWPAN Hardware radio device, compliant within NEMA standard, that operates as: - Smart Lighting Node - Gateway for other Nodes
COMMERCIAL NAME	PE Smart Lighting Node Hybrid NEMA
MODEL NAME	NDLM007US-1
SERIAL NO.	Prototype
PRSLAB IDENTIFICATION	BC 144/2022 1/4
TRADEMARK	MinebeaMitsumi Passion to Create Value through Difference
MANUFACTURER	MinebeaMitsumi Inc.
COUNTRY OF MANUFACTURER	Japan
SINGLE UNIT OR SYSTEM	Single
FCC CLASSIFICATION	Class B
POWER SOURCE	AC main
SUPPLY VOLTAGE	100 – 277V ~ 50-60Hz
MAX POWER or MAX ABSORBED CURRENT	600W with max load
OPERATING TEMPERATURE	-40°C ÷ +70°C
HW VERSION	PRD-LMN-0058 (-01) NDLM007US-1
FW VERSION	4.6.0
DIMENSIONS	Diameter 84mm; Height 106.9mm
EUT STANDING	Mounted on street lights (NEMA connector)

4.2 Bluetooth Low Energy module technical data

MODULE MANUFACTURER	life.augmented
MODULE MODEL	**BlueNRG-2**
ETS CATEGORY	Bluetooth Low Energy 5.2
TYPE OF RADIO DEVICE	Transceiver
FREQUENCY BAND	2400 – 2483.5MHz
NUMBER OF CHANNELS	40
CHANNEL BANDWIDTH	2MHz
CHANNEL SPACING	2MHz
TYPE OF MODULATION	GFSK
DATA RATES (Mbit/s)	1
ANTENNA TYPE	Ceramic chip antenna
ANTENNA GAIN	5.05dBi
ANTENNA MODEL	**ANT3216LL00R2400A (ELC-OTH-0166)**
ANTENNA MANUFACTURER	YAGEO

4.2.1 Channel List Bluetooth Low Energy

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY	CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

4.3 Ports identification

	PORT	DESCRIPTION	CONNECTION	NOTES
☒	Enclosure	Plastic	Snaps	---
☒	AC mains power port	115V ~ 60Hz	Plug	---
☐	DC mains power port	Port not present	---	---
☐	Wired network port	Port not present	---	---
☒	Signal / Control port	Load connection	---	<3m
☐	Antenna port	☒Internal; ☐External	---	---

Note:
During the tests all cables must be what provided the manufacturer or the same that used in the real employment of the EUT.

4.4 Modifications incorporated in E.U.T.

The following items are the modifications introduced in the equipment under test:

- None

4.5 Auxiliary equipment

- Personal computer model AH532, manufacturer by Fujitsu, to set channels.

5. REFERENCE STANDARDS

CODE OF FEDERAL REGULATIONS	DESCRIPTION
Title 47 Part 15 Subpart C § 15.209	Radio Frequency Devices – Intentional Radiators Radiated emission limits; general requirements
Title 47 Part 15 Subpart C § 15.247	Radio Frequency Devices – Intentional Radiators Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz
ANSI C63.10:2013	American National Standard for Testing Unlicensed Wireless Devices
Title 47 Part 1 Subpart I § 1.1310	Procedures Implementing the National Environmental Policy Act of 1969. Radiofrequency radiation exposure limits.
Title 47 Part 2 Subpart J § 2.1091	Radiofrequency radiation exposure evaluation: mobile devices.
ANSI C63.4:2014	American National Standard for Methods of Measuring of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz – 40 GHz

6. OPERATING TEST MODES AND TEST CONDITIONS

In the following table there are the operating conditions adopted during tests identified by an indicator (#) at which has been referred the item “Operating condition of the equipment under test”

OPERATING CONDITION	DESCRIPTION
#1	Continuous transmission at maximum power in modulated carrier on channel 0
#2	Continuous transmission at maximum power in modulated carrier on channel 19
#3	Continuous transmission at maximum power in modulated carrier on channel 39

Special Test Software: Special software by the Applicant to operate the EUT at each channel frequency continuously. For example, the transmitter will be operated at each of the lowest, middle and highest frequencies individually continuously during testing.

Special Hardware Used: None

Transmitter Test Antenna: The EUT has been tested with the antenna fitted in a manner typical of normal intended

7. SUMMARY OF TEST RESULTS

SUMMARY OF TEST RESULTS for Subpart C				
Port	**Test[1]**	**Reference Standard**	**Operating Condition**	**Results**
Enclosure	Transmitter radiated emissions	FCC Part 15 §15.205 §15.209 §15.247 (d)	#1, #2, #3	Within the limits
AC power input	Conducted Emissions	FCC Part 15 §15.207 §15.247 (c)	#1	Within the limits
Antenna port	Antenna requirement	FCC Part 15 §15.203	---	Within the limits
	Maximum Peak Output Power	FCC Part 15 §15.247 (b) (3)	#1, #2, #3	Within the limits
	6 dB Bandwidth	FCC Part 15 §15.247 (a) (2)	#1, #2, #3	Within the limits
	Power Spectral Density	FCC Part 15 §15.247 (e)	#1, #2, #3	Within the limits
	Band-Edge	FCC Part 15 § 15.247 (d)	#1, #3	Within the limits
	RF radiated Spurious Emissions at the Transmitter Antenna Terminal	FCC Part 15 § 15.247 (d)	#1, #2, #3	Within the limits

Note: FCC classifies Bluetooth LE as a system using digital modulation techniques.

[1]All tests are performed with the device in position shown in the photographic documentation.

8. UNITS OF MEASUREMENTS

Conducted EMI Data is in dBµV; dB referenced to one microvolt
Radiated EMI Data is in dBµV/m; dB/m referenced to one microvolt per meter

Sample Calculation:

RFS = Radiated Field Strength,
FSM = Field Strength Measured,
A.F. = Receive antenna factor,
Gain = amplification gains and/or cable losses.

RFS (dBµV/m @ 3m) = FSM (dBµV) + A.F. (dB/m) - Gain (dB)

9. TEST RESULTS

TEST **1.**	**ANTENNA REQUIREMENTS**
REFERENCE DOCUMENT	**According to §15.203 / 15.204** 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. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sec. 15.211, Sec. 15.213, Sec. 15.217, Sec. 15.219, or Sec. 15.221. 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, in accordance with Sec. 15.31(d), 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

Antenna Requirements
The EUT has an integrated ceramic chip antenna.
RESULT: **COMPLIANT**

TEST **2.**	**MAXIMUM PEAK OUTPUT POWER**
REFERENCE DOCUMENT	**According to §15.247(b) (3)** 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 signalling 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.

• **TEST LOCATION**	Semi-Anechoic Chamber					
• **DISTANCE OF MEASUREMENT**	3m					
• **TYPE OF MEASUREMENT**	Radiated					
• **TEST EQUIPMENT USED FOR TEST**	**Instrument**	**Manufacturer**	**Model**	**Serial n°**	**Calibrated On**	**Due to**
	MXE Emi Receiver	Keysight	N9038A	MY57290150	07/2021	07/2022
	Semi-Anechoic Chamber	Siemens	B83117-D6019-T232	003-005-134/94C	02/2022	02/2023
	Horn antenna	Electro Metrics	EM-6961	100437	10/2020	10/2023
	Software EMC	Rohde & Schwarz	EMC32-E	V 8.40.0	N.A.	
• **TESTED PORT**	Antenna					
• **TEST METHOD**	ANSI C63.10:2013 section 11.9					
• **FREQUENCY RANGE**	Carrier					
• **UNCERTAINTY OF MEASURE**	Level of confidence = 95% (k=2) Expanded uncertainty = 3 dB					

TEST CONDITIONS	REQUIRED	MEASURED
Ambient temperature	**23°C ± 5°C**	24 °C
Ambient humidity	**25 - 75%rH**	45%
Pressure	**85 - 106kPa (860mbar - 1060mbar)**	960 mbar

OPERATING CONDITION :**#1, #2, #3**

RESULT: **WITHIN THE LIMITS**

MEASUREMENT PARAMETER	
Resolution bandwidth	RBW ≥ DTS bandwidth
Video bandwidth	VBW ≥ 3 x RBW
Span	span ≥ 3 x RBW
Sweep time	Auto couple
Detector	Peak
Trace-Mode	Max. hold

TEST DESCRIPTION

Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously - rotating, remotely - controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency.

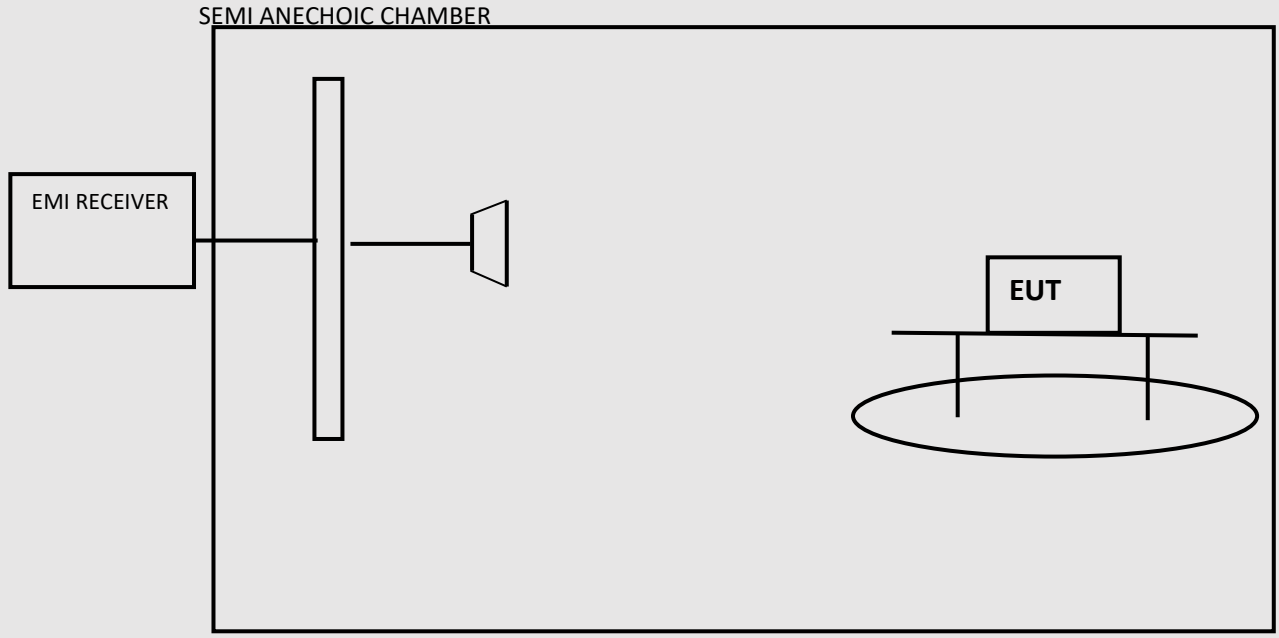
The EUT is placed at test table.

For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m

Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m~4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3m.

This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

TEST SETUP BLOCK DIAGRAM



TEST RESULTS

Channel	Frequency (MHz)	EIRP (dBm)	Antenna Gain (dBi)	Max Conducted Output power	Limit (dBm)	Result
0	2402	0.23	+5.05	-4,82	30	WITHIN THE LIMITS
19	2440	0.26	+5.05	-4,79		
39	2480	-1.30	+5.05	-6,35		
Note: ---						

TEST **3.**	**6dB CHANNEL BANDWIDTH**
REFERENCE DOCUMENT	**According to §15,247(a)(2)** Systems using digital modulation techniques may operate in the 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz bands, The minimum 6 dB bandwidth shall be at least 500 kHz.

• **TEST LOCATION**	Radio test area					
• **TYPE OF MEASUREMENT**	Radiated					
• **TEST EQUIPMENT USED FOR TEST**	**Instrument**	**Manufacturer**	**Model**	**Serial n°**	**Calibrated On**	**Due to**
	MXE Emi Receiver	Keysight	N9038A	MY57290150	07/2021	07/2022
• **TESTED PORT**	Antenna					
• **TEST METHOD**	ANSI C63.10:2013 section 6.9					
• **FREQUENCY RANGE**	Carrier					

TEST CONDITIONS	REQUIRED	MEASURED
Ambient temperature	**23°C ± 5°C**	24 °C
Ambient humidity	**25 - 75%rH**	45%
Pressure	**85 - 106kPa (860mbar - 1060mbar)**	960 mbar

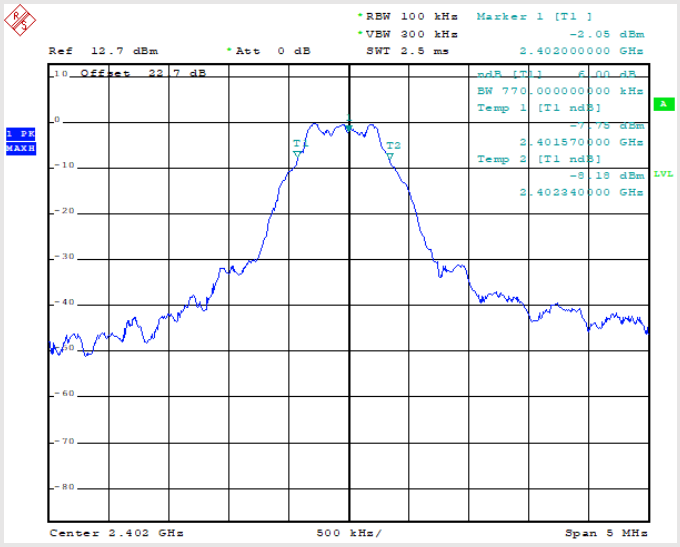
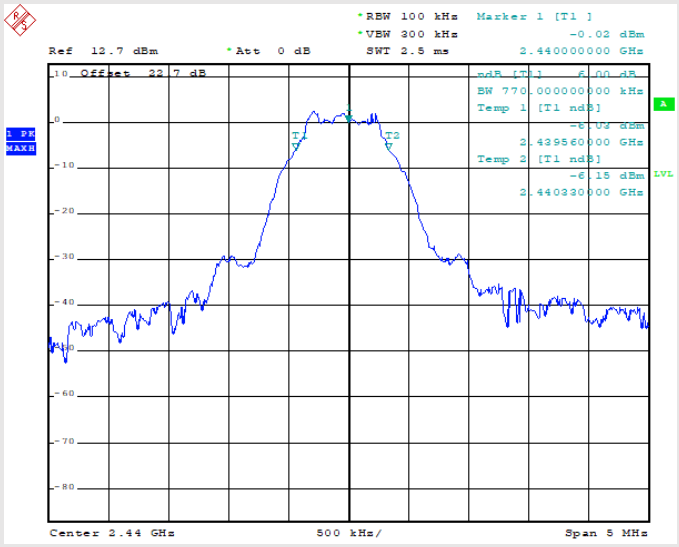
OPERATING CONDITION :**#1, #2, #3**

RESULT: **COMPLIANT**

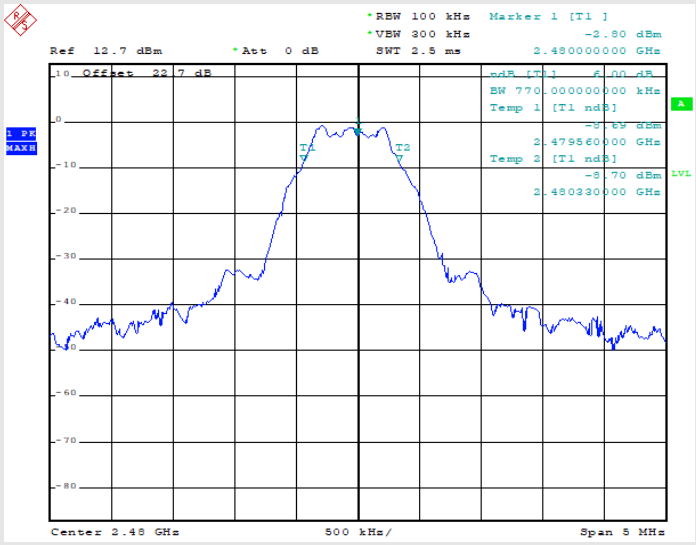
MEASUREMENT PARAMETER	
Resolution bandwidth	100kHz
Video bandwidth	300kHz
Span	5MHz
Sweep time	Auto couple
Detector	Peak
Trace-Mode	Max. hold

TEST DESCRIPTION
Allow the trace to stabilize. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

TEST RESULTS

Channel: 0	Channel: 19
	

Channel: 39



Channel	Frequency (MHz)	6dB Bandwidth (kHz)	Limits (kHz)	Result
0	2402	770	>500	**COMPLIANT**
19	2440	770	>500	**COMPLIANT**
39	2480	770	>500	**COMPLIANT**

TEST **4.**	**BAND EDGE**
REFERENCE DOCUMENT	**According to §15,247(d)** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits, If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB, Attenuation below the general limits specified in Sec, 15,209(a) is not required, In addition, radiated emissions which fall in the restricted bands, as defined in Sec, 15,205(a), must also comply with the radiated emission limits specified in Sec, 15,209(a) (see Sec, 15,205(c)),

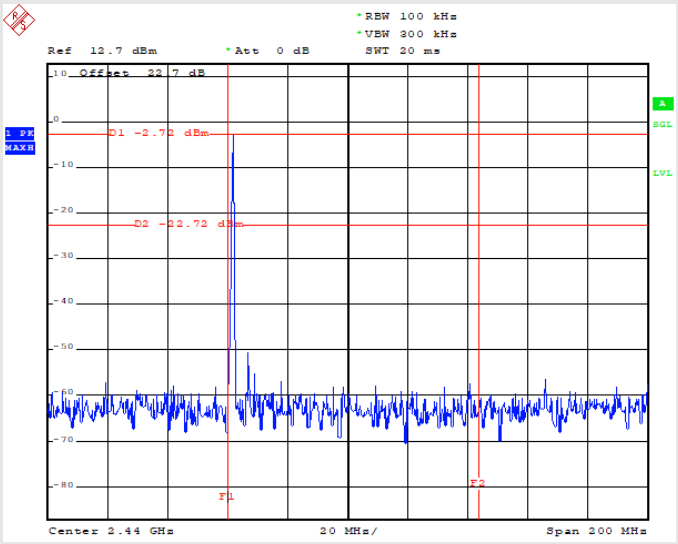
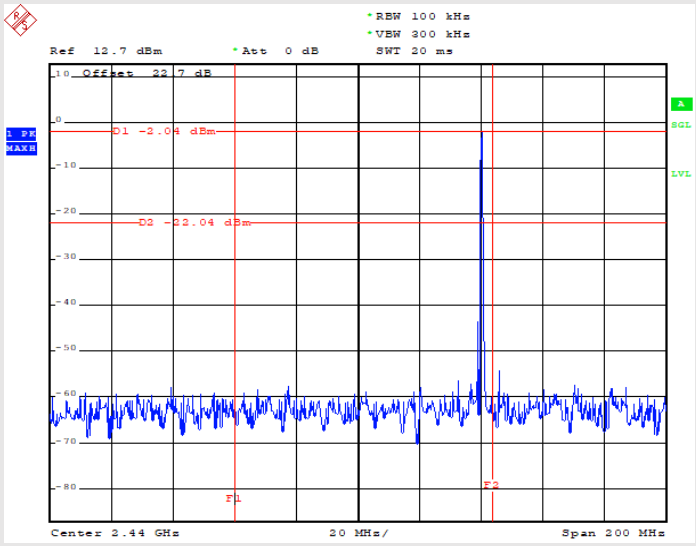
• **TEST LOCATION**	Radio test area					
• **TYPE OF MEASUREMENT**	Radiated					
• **TEST EQUIPMENT USED FOR TEST**	**Instrument**	**Manufacturer**	**Model**	**Serial n°**	**Calibrated On**	**Due to**
	MXE Emi Receiver	Keysight	N9038A	MY57290150	07/2021	07/2022
• **TESTED PORT**	Antenna					
• **TEST METHOD**	ANSI C63.10:2013 section 6.10					
• **FREQUENCY RANGE**	Carrier					

TEST CONDITIONS	REQUIRED	MEASURED
Ambient temperature	**23°C ± 5°C**	24 °C
Ambient humidity	**25 - 75%rH**	45%
Pressure	**85 - 106kPa (860mbar - 1060mbar)**	960 mbar

OPERATING CONDITION :**#1, #3**

RESULT: **COMPLIANT**

TEST RESULTS

LOWER BAND-EDGE **CH 0**	
UPPER BAND-EDGE **CH 39**	

TEST **5.**	**POWER SPECTRAL DENSITY**
REFERENCE DOCUMENT	**According to §15,247) (e)** For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission, This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section, The same method of determining the conducted output power shall be used to determine the power spectral density

• **TEST LOCATION**	Radio test area					
• **TYPE OF MEASUREMENT**	Radiated					
• **TEST EQUIPMENT USED FOR TEST**	**Instrument**	**Manufacturer**	**Model**	**Serial n°**	**Calibrated On**	**Due to**
	MXE Emi Receiver	Keysight	N9038A	MY57290150	07/2021	07/2022
• **TESTED PORT**	Antenna					
• **TEST METHOD**	ANSI C63.10:2013 section 11.10					
• **FREQUENCY RANGE**	Carrier					

TEST CONDITIONS	REQUIRED	MEASURED
Ambient temperature	**23°C ± 5°C**	24 °C
Ambient humidity	**25 - 75%rH**	45%
Pressure	**85 - 106kPa (860mbar - 1060mbar)**	960 mbar

OPERATING CONDITION :**#1, #2, #3**

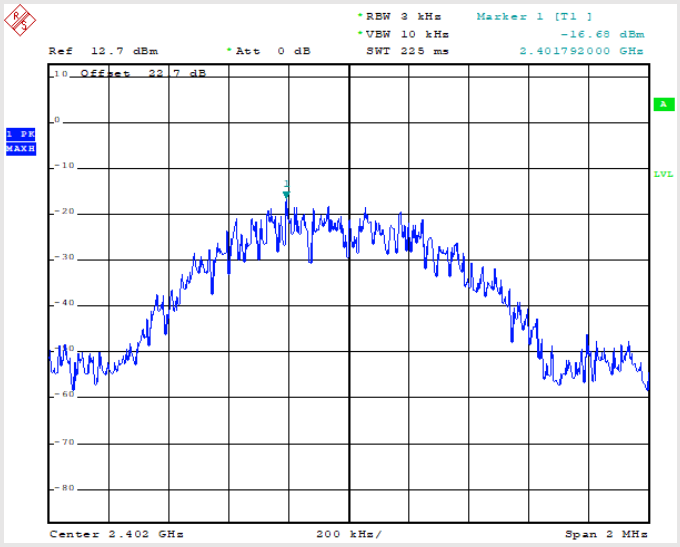
RESULT: **COMPLIANT**

MEASUREMENT PARAMETER	
Resolution bandwidth	3kHz
Video bandwidth	10kHz
Span	2MHz
Sweep time	Auto couple
Detector	Peak
Trace-Mode	Max. hold

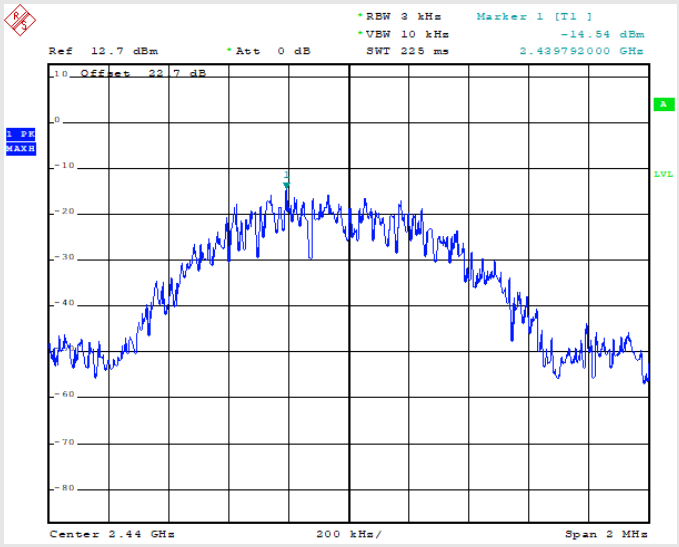
TEST DESCRIPTION
Allow trace to fully stabilize. Use the peak marker function to determine the maximum amplitude level within the RBW. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat

TEST RESULTS

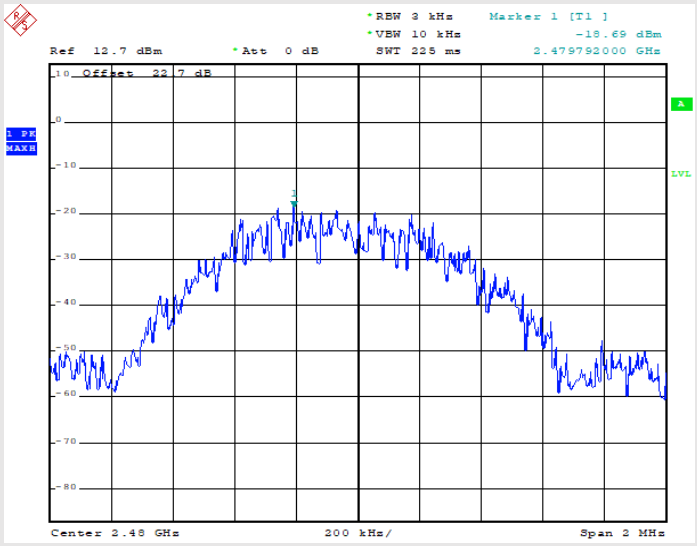
Channel: 0



Channel: 12



Channel: 39



Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)	Result
0	2402	-16.68	8	24.68	**COMPLIANT**
19	2440	-14.54	8	22.54	**COMPLIANT**
39	2480	-18.69	8	26.69	**COMPLIANT**

TEST **6.**	**RF RADIATED SPURIOUS EMISSIONS AT THE TRANSMITTER ANTENNA TERMINAL**
REFERENCE DOCUMENT	**According to $ 15.247 (d) and $ 15.209 (a)** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 Db below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 Db instead of 20 Db. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

• **TEST LOCATION**	Radio test area					
• **TYPE OF MEASUREMENT**	Radiated					
• **TEST EQUIPMENT USED FOR TEST**	**Instrument**	**Manufacturer**	**Model**	**Serial n°**	**Calibrated On**	**Due to**
	MXE Emi Receiver	Keysight	N9038A	MY57290150	07/2021	07/2022
• **TESTED PORT**	Enclosure					
• **TEST METHOD**	ANSI C63.10:2013 section 6.5 and 6.6					
• **FREQUENCY RANGE**	9kHz – 1GHz					
• **LIMITS**	Acc. To ref. Std.					

TEST CONDITIONS	REQUIRED	MEASURED
Ambient temperature	**23°C ± 5°C**	24 °C
Ambient humidity	**25 - 75%rH**	45%
Pressure	**85 - 106kPa (860mbar - 1060mbar)**	960 mbar

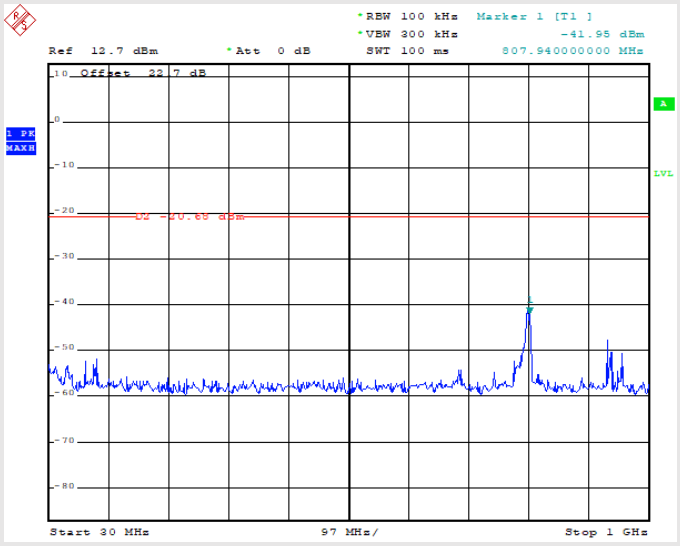
OPERATING CONDITION :**#1, #2, #3**

RESULT: **WITHIN THE LIMITS**

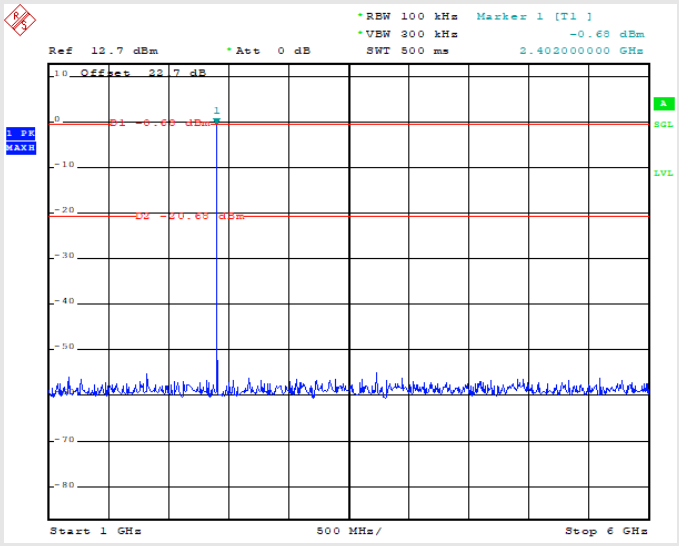
TEST RESULTS

Channel: 0

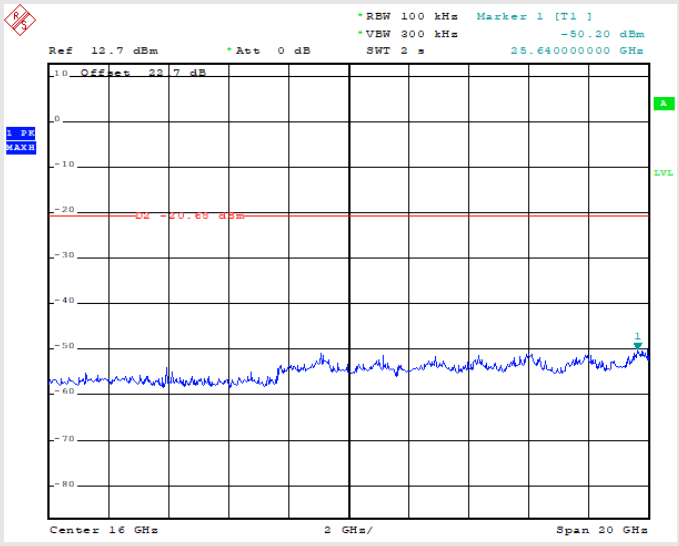
Frequency range: 30MHz – 1GHz



Frequency range: 1GHz – 6GHz

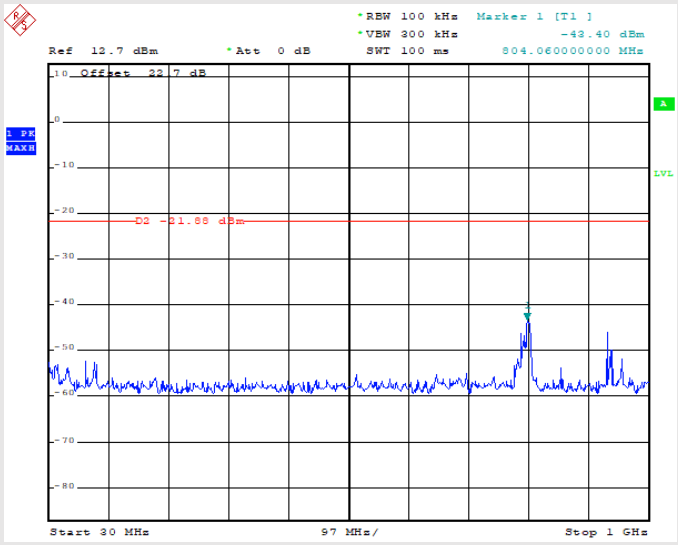


Frequency range: 6GHz – 26GHz

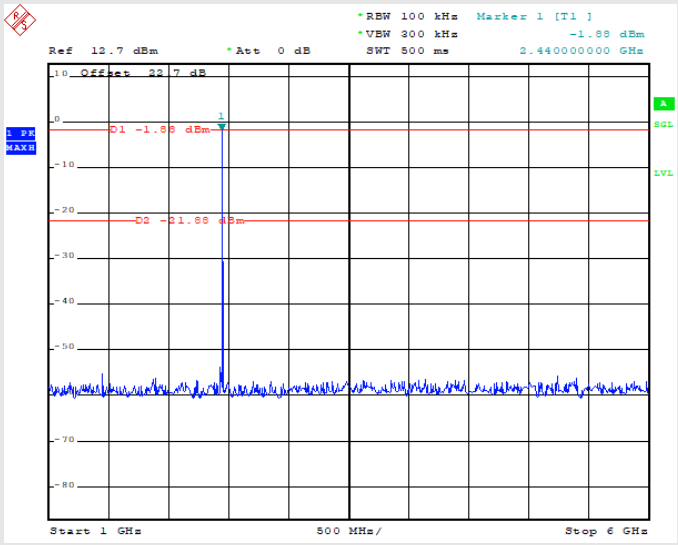


Channel: 19

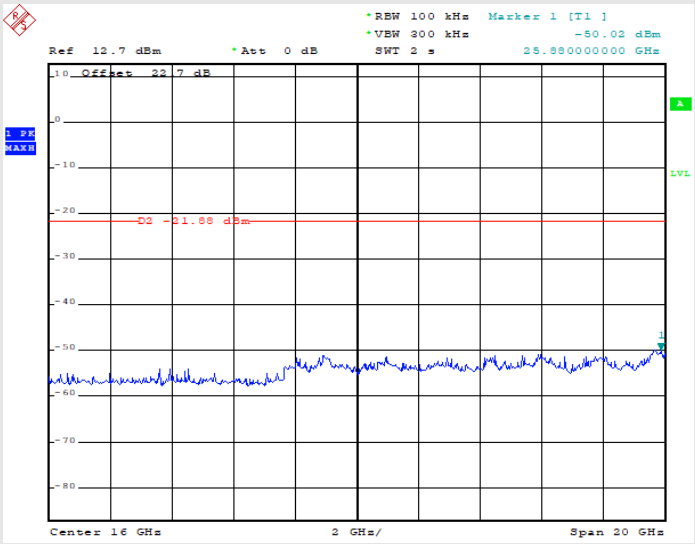
Frequency range: 30MHz – 1GHz



Frequency range: 1GHz – 6GHz

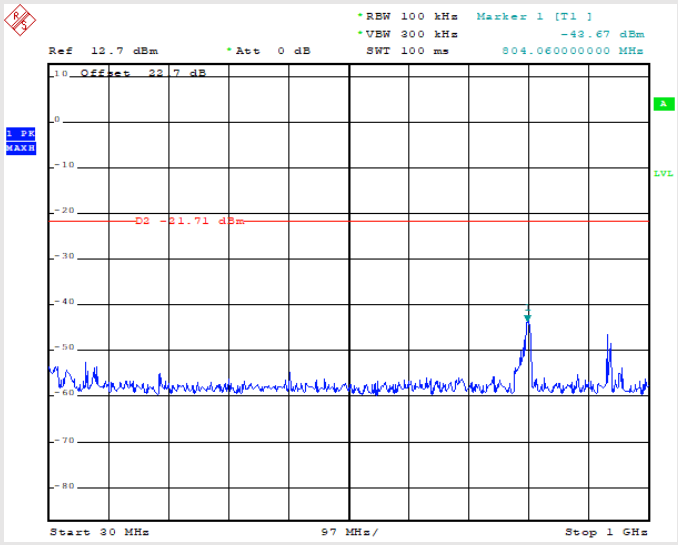


Frequency range: 6GHz – 26GHz

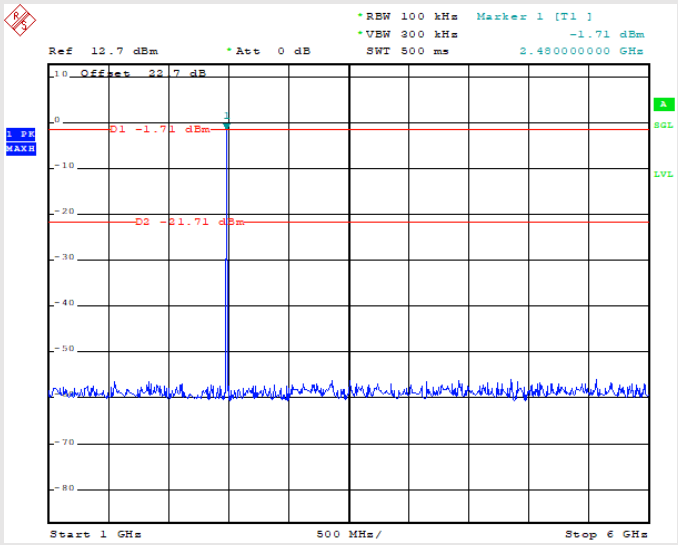


Channel: 39

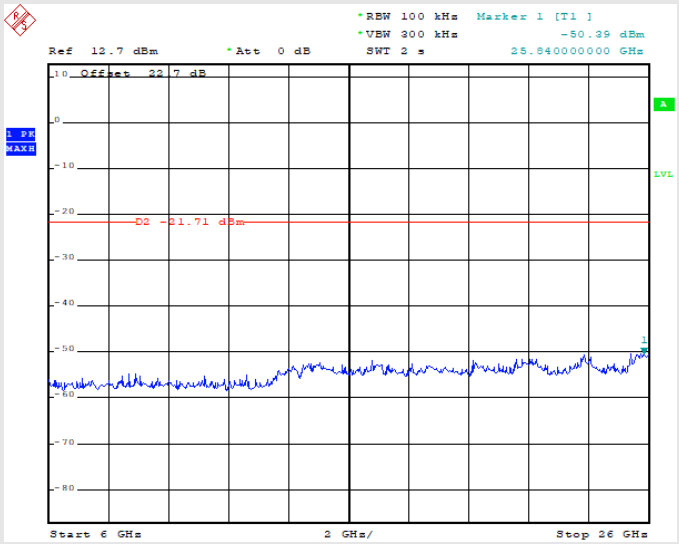
Frequency range: 30MHz – 1GHz



Frequency range: 1GHz – 6GHz



Frequency range: 6GHz –26GHz



TEST **7.**	**TRANSMITTER RADIATED EMISSIONS < 1GHZ**
REFERENCE DOCUMENT	**According to $ 15.247 (d) and $ 15.209 (a)** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 Db below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 Db instead of 20 Db. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

• **TEST LOCATION**	Semi-Anechoic Chamber					
• **DISTANCE OF MEASUREMENT**	3m					
• **TYPE OF MEASUREMENT**	Radiated					
• **TEST EQUIPMENT USED FOR TEST**	**Instrument**	**Manufacturer**	**Model**	**Serial n°**	**Calibrated On**	**Due to**
	MXE Emi Receiver	Keysight	N9038A	MY57290150	07/2021	07/2022
	Semi-Anechoic Chamber	Siemens	B83117-D6019-T232	003-005-134/94C	02/2022	02/2023
	Loop antenna	Rohde & Schwarz	HFH 2-Z2	841801/012	03/2020	03/2023
	Bi-log antenna	Chase	CBL6111C	2717	03/2022	03/2025
	Software EMC	Rohde & Schwarz	EMC32-E	V 8.40.0	N.A.	
• **TESTED PORT**	Enclosure					
• **TEST METHOD**	ANSI C63.10:2013 section 6.5					
• **FREQUENCY RANGE**	9kHz – 1GHz					
• **LIMITS**	Acc. To ref. Std.					
• **UNCERTAINTY OF MEASURE**	Level of confidence = 95% (k=2) Expanded uncertainty 9kHz – 30MHz = 4,24 dB Expanded uncertainty 30MHz – 1GHz = 5,72 dB					

TEST CONDITIONS	REQUIRED	MEASURED
Ambient temperature	**23°C ± 5°C**	24 °C
Ambient humidity	**25 - 75%rH**	45%
Pressure	**85 - 106kPa (860mbar - 1060mbar)**	960 mbar

OPERATING CONDITION :**#1, #2, #3**

RESULT: **WITHIN THE LIMITS**

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MEASUREMENT PARAMETER		
Frequency Range:	**9kHz – 30MHz**	**30MHz – 1GHz**
Resolution bandwidth:	200Hz	100kHz
Video bandwidth:	1kHz	300kHz
Span:	See plots below	See plots below
Sweep time	Auto couple	Auto couple
Detector:	Peak	Peak
Trace-Mode:	Max. hold	Max. hold

TEST DESCRIPTION

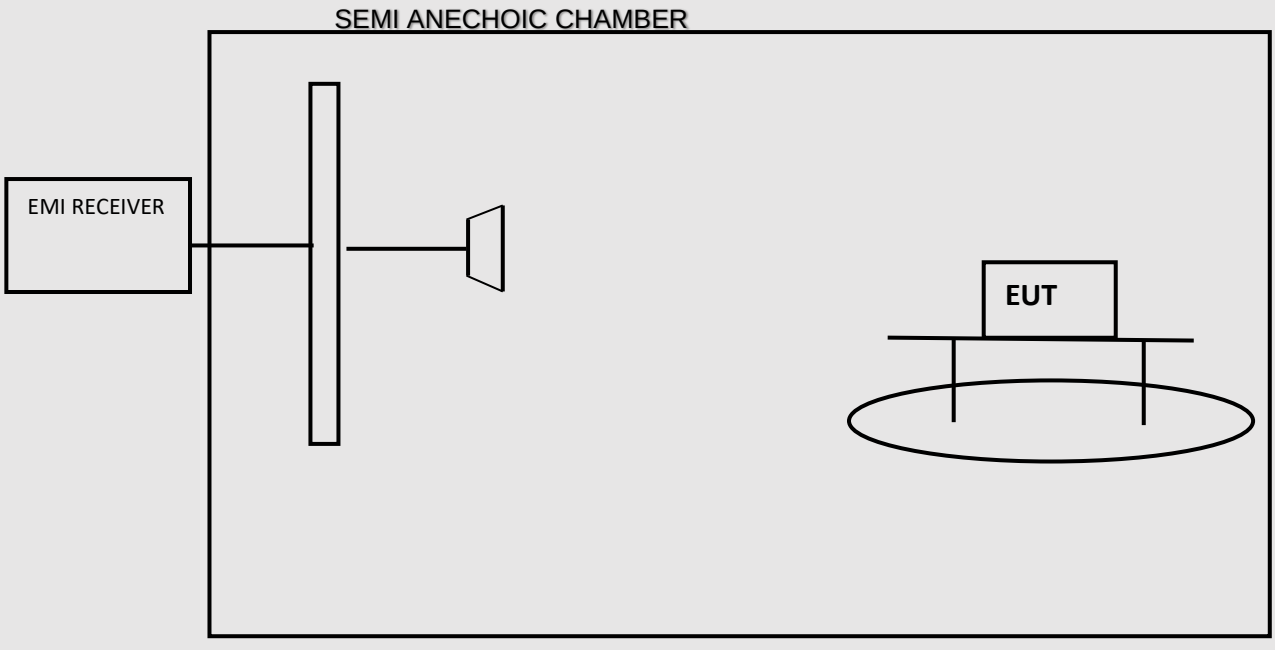
Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously - rotating, remotely - controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency.

The EUT is placed at test table height is 80 cm above the reference ground plane.

Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m~4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3m.

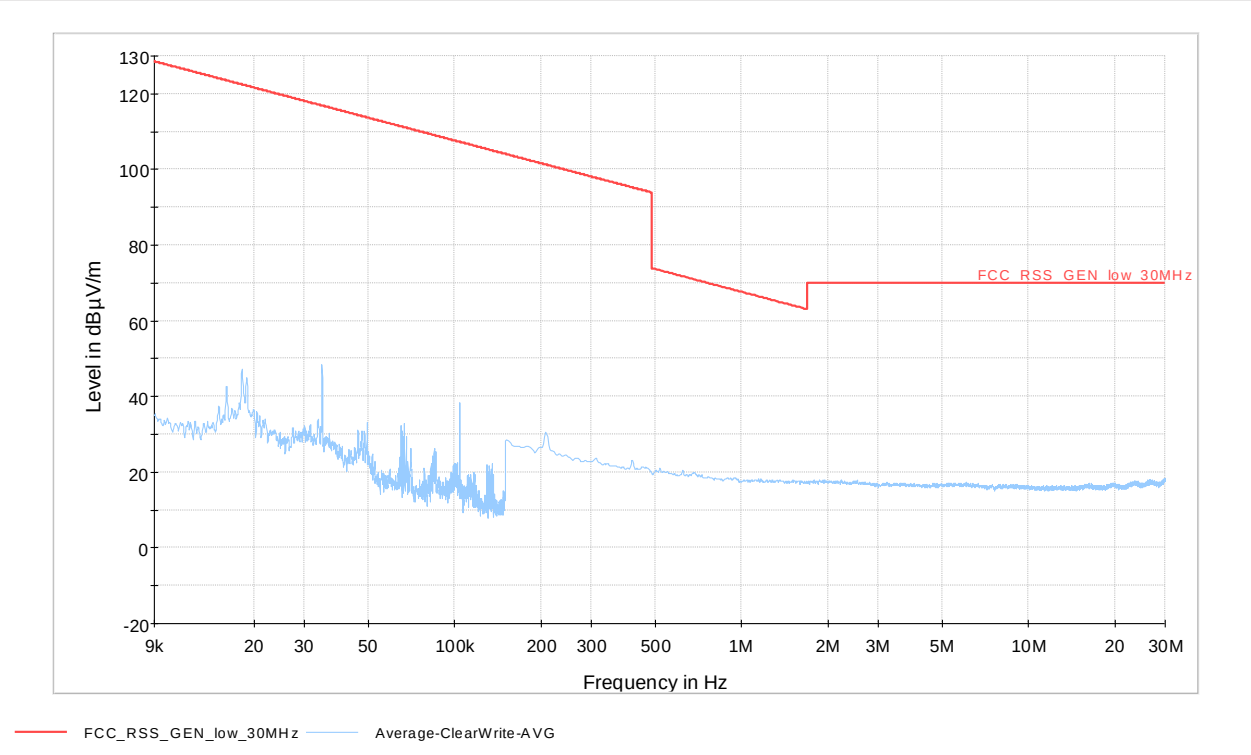
This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

TEST SETUP BLOCK DIAGRAM



TEST RESULTS

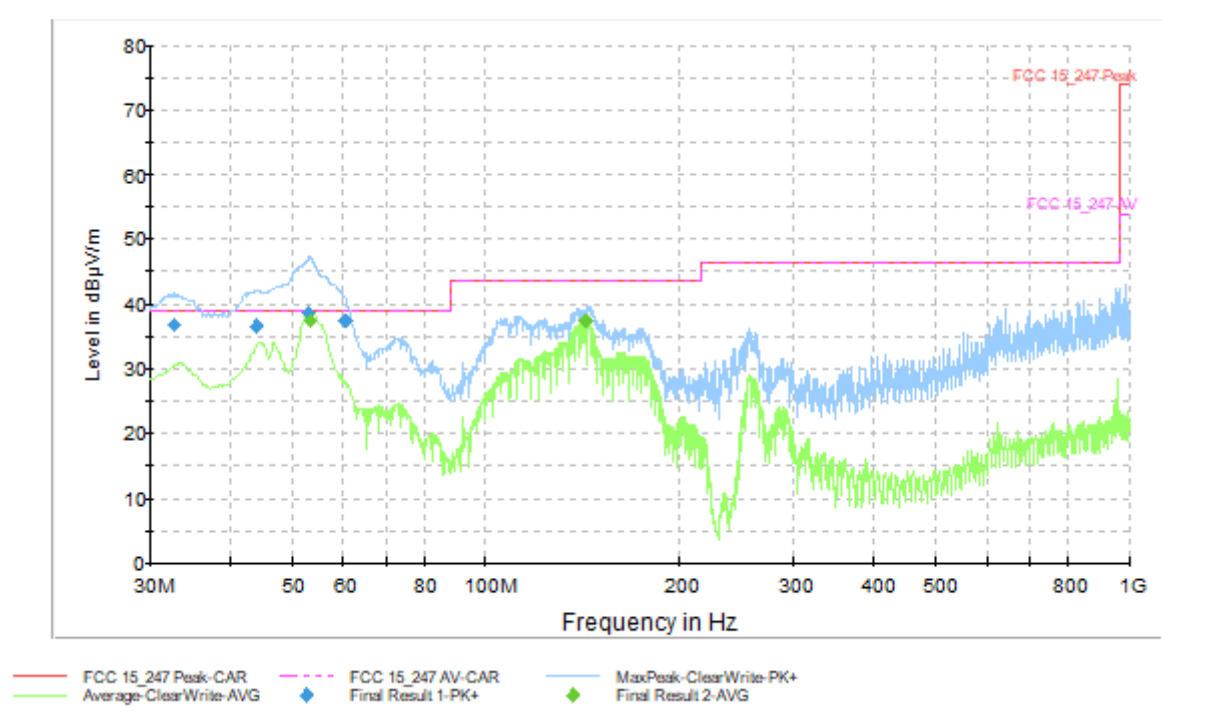
Channel 0	
RX Antenna Polarization: ---	**Frequency Range: 9kHz – 30MHz**



Final Result:

All emissions are below 10dB from the limit, for this reason no further assessments were carried out on the individual points

Channel 0	
RX Antenna Polarization: Vertical	**Frequency Range: 30MHz – 1GHz**



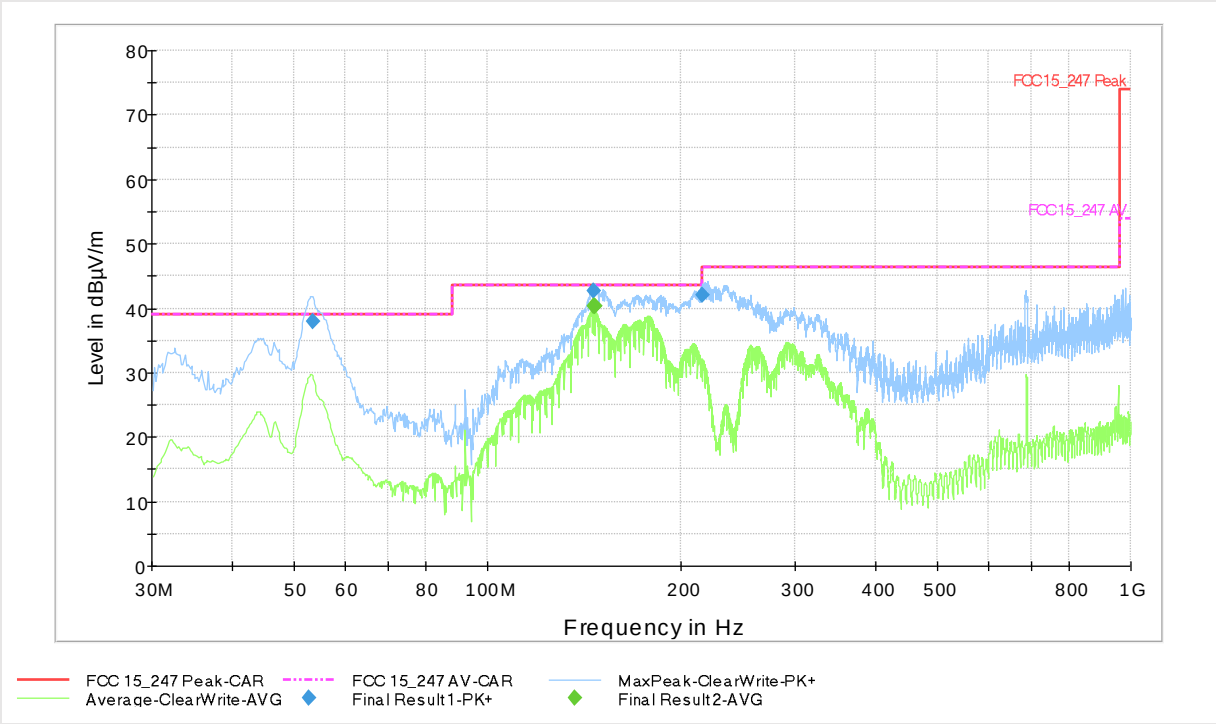
Final Result Quasi Peak:

Frequency (MHz)	QuasiPeak (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
32.820000	36.5	99.8	277.0	2.50	39.00
43.980000	36.1	99.8	-8.0	290	39.00
53.280000	38.5	99.8	82.0	0.50	39.00
60.540000	37.3	123.8	7.0	1.70	39.00

Final Result Average:

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
53.310000	37.4	121.8	0.0	1.60	39.00
143.370000	37.3	99.7	262.0	6.20	43.50
143.670000	37.3	99.8	264.0	6.20	43.50

Channel 0	
RX Antenna Polarization: Horizontal	**Frequency Range: 30MHz – 1GHz**



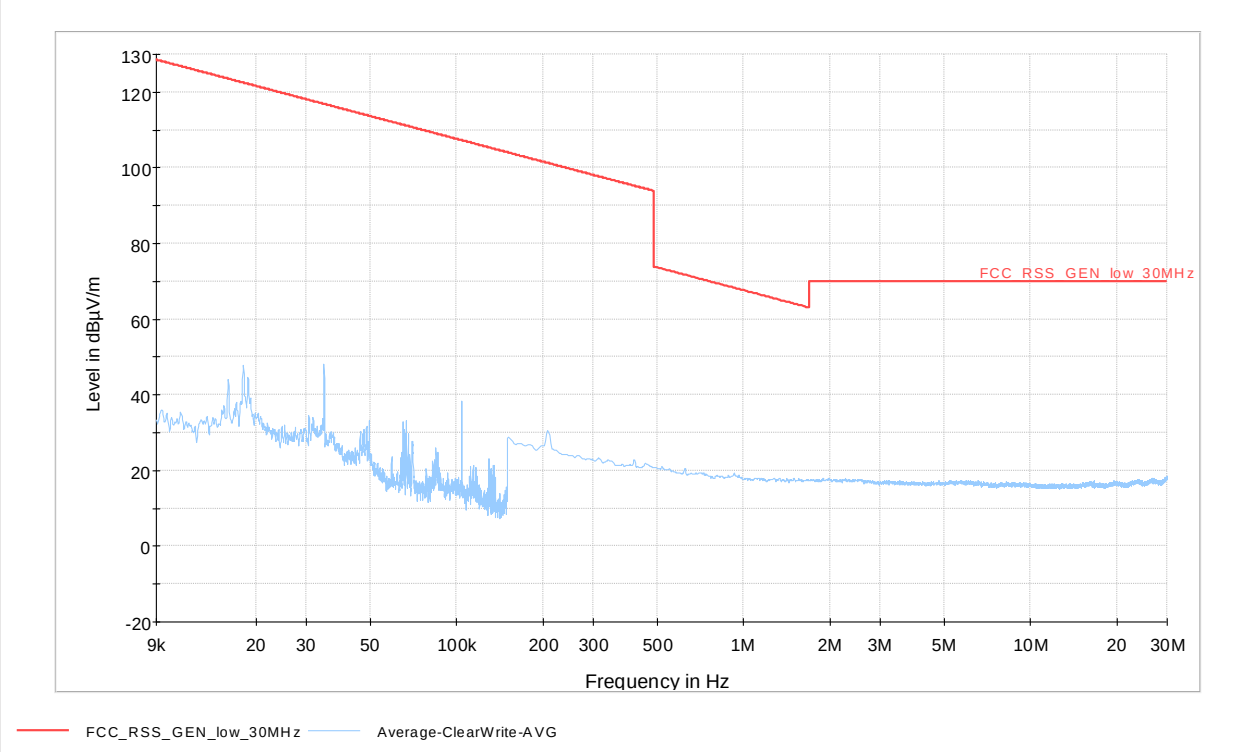
Final Result Quasi Peak:

Frequency (MHz)	QuasiPeak (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
53.310000	38.0	259.8	277.0	1.00	39.00
146.070000	42.7	232.7	268.0	0.80	43.50
215.610000	42.0	99.7	187.0	1.50	43.50

Final Result Average:

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
146.070000	40.3	233.7	262.0	3.20	43.50
146.370000	40.3	230.8	262.0	3.20	43.50
146.670000	40.3	231.7	262.0	3.20	43.50

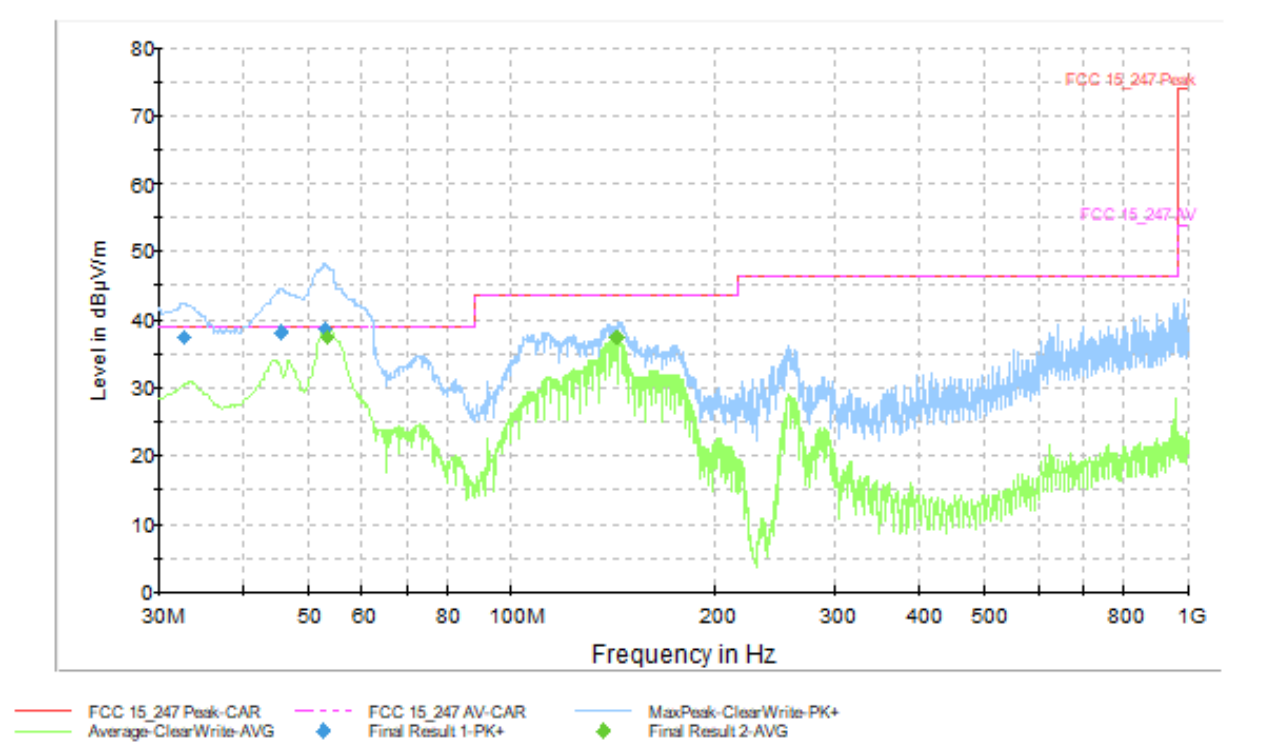
Channel 19	
RX Antenna Polarization: ---	**Frequency Range: 9kHz – 30MHz**



Final Result:

All emissions are below 10dB from the limit, for this reason no further assessments were carried out on the individual points

Channel 19	
RX Antenna Polarization: Vertical	**Frequency Range: 30MHz – 1GHz**



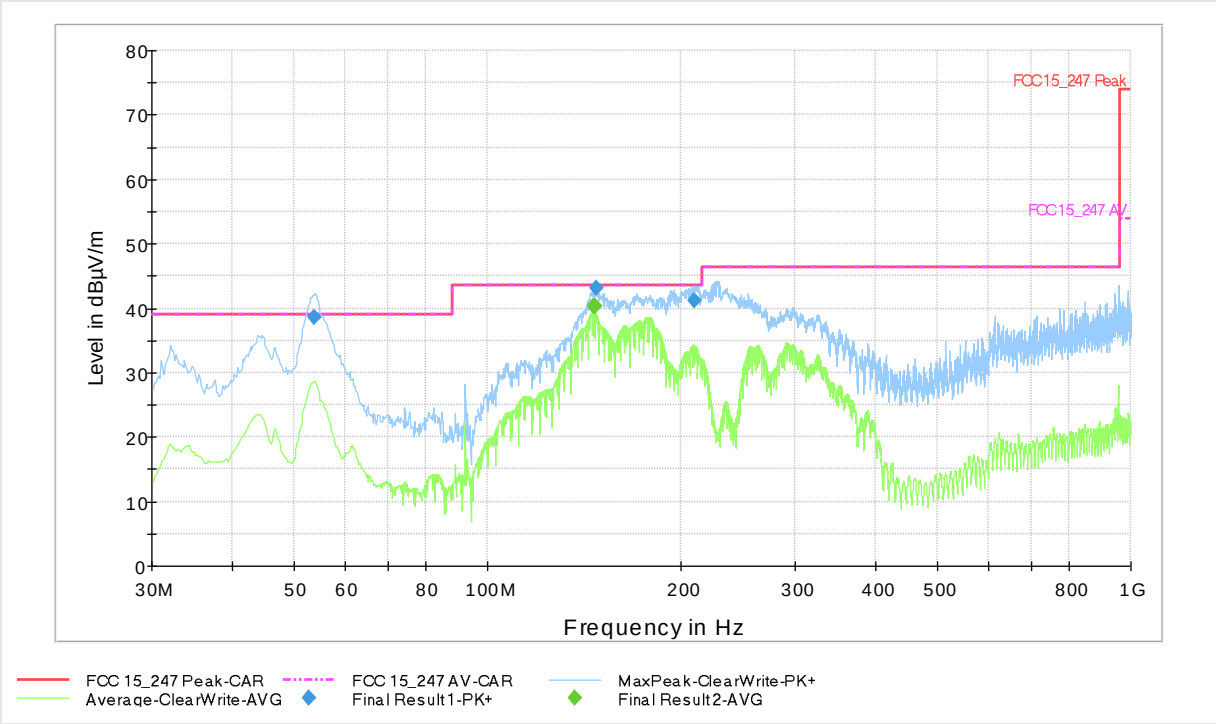
Final Result Quasi Peak:

Frequency (MHz)	QuasiPeak (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
32.820000	37.2	99.8	277.0	1.80	39.00
45.620000	38.1	99.8	-8.0	0.90	39.00
53.280000	38.5	99.8	82.0	0.50	39.00

Final Result Average:

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
53.310000	37.4	121.8	0.0	1.60	39.00
143.370000	37.3	99.7	262.0	6.20	43.50
143.670000	37.3	99.8	264.0	6.20	43.50

Channel 19	
RX Antenna Polarization: Horizontal	**Frequency Range: 30MHz – 1GHz**



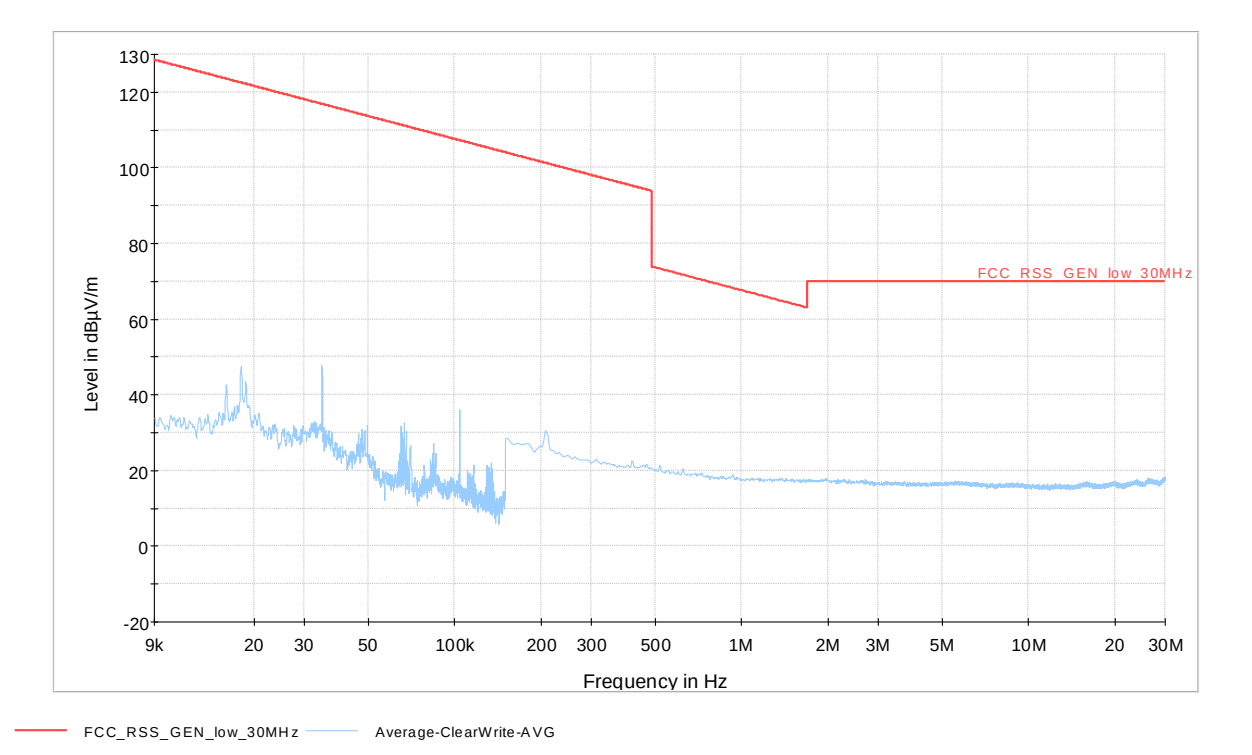
Final Result Quasi Peak:

Frequency (MHz)	QuasiPeak (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
53.760000	38.5	259.7	277.0	0.50	39.00
147.270000	43.2	231.9	266.0	0.30	43.50
209.580000	41.2	99.7	187.0	2.30	43.50

Final Result Average:

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
146.070000	40.4	204.8	262.0	3.10	43.50
146.370000	40.2	254.8	262.0	3.30	43.50
146.670000	40.4	206.8	264.0	3.10	43.50

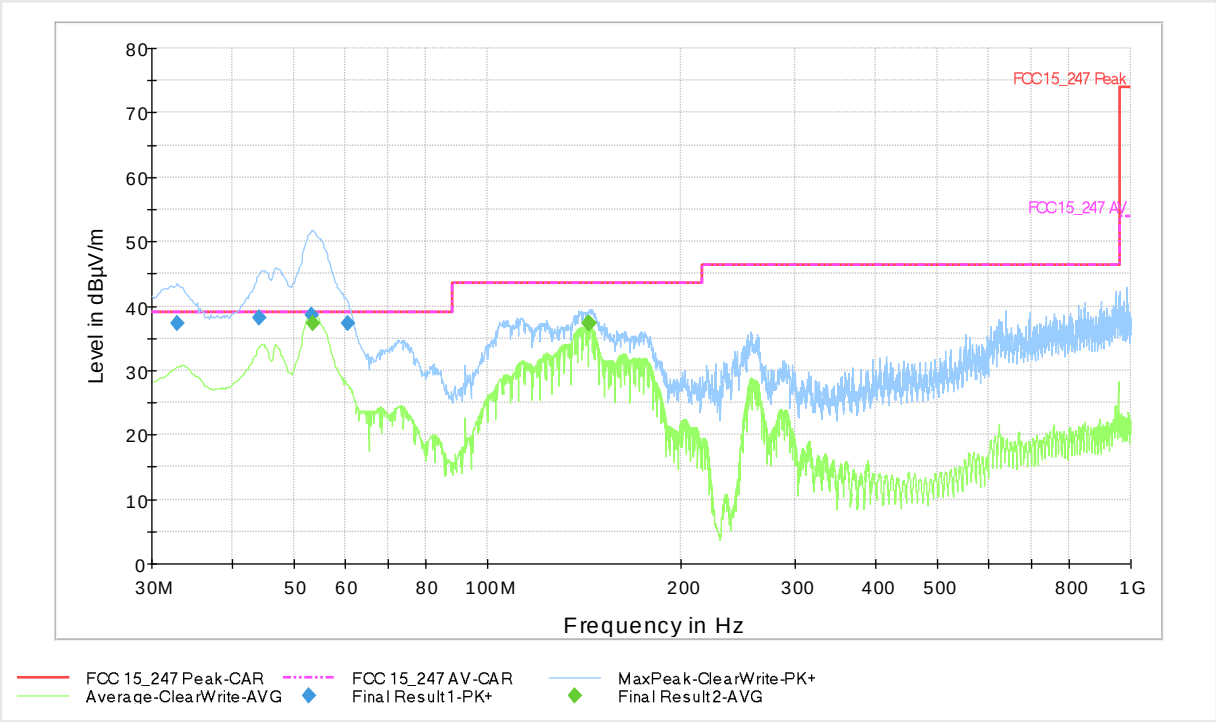
Channel 39	
RX Antenna Polarization: ---	**Frequency Range: 9kHz – 30MHz**



Final Result:

All emissions are below 10dB from the limit, for this reason no further assessments were carried out on the individual points

Channel 39	
RX Antenna Polarization: Vertical	**Frequency Range: 30MHz – 1GHz**



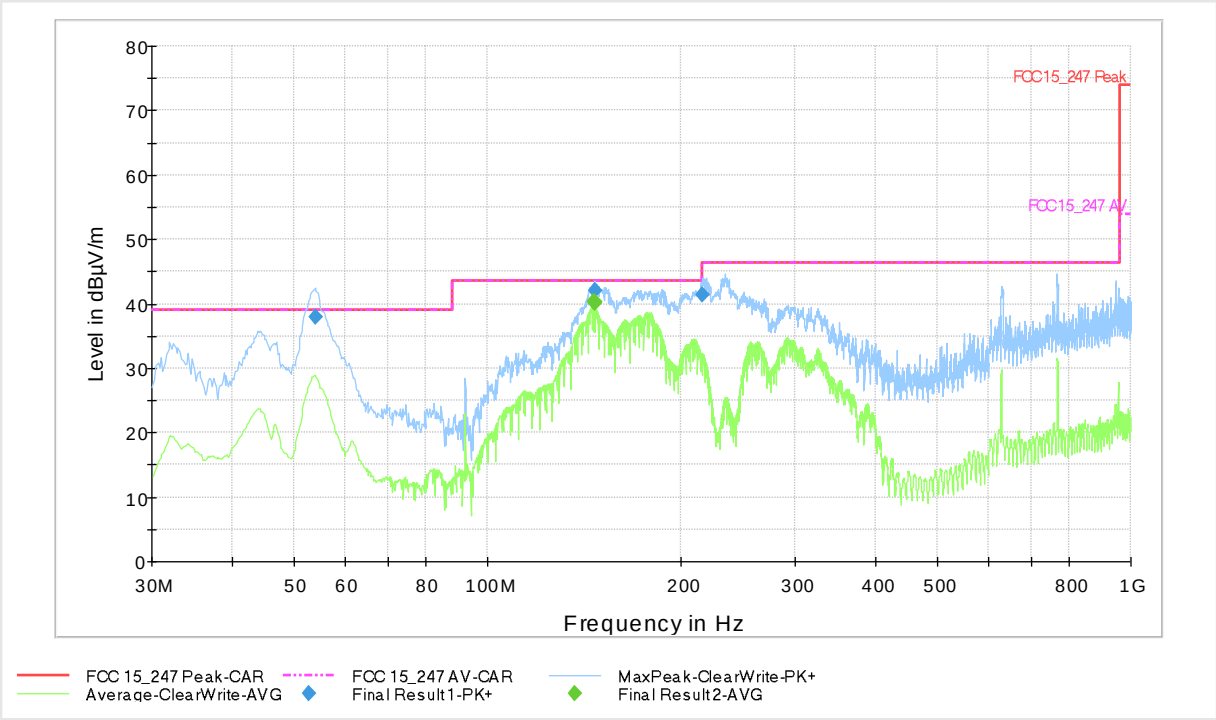
Final Result Quasi Peak:

Frequency (MHz)	QuasiPeak (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
32.820000	37.2	99.8	277.0	1.80	39.00
43.980000	38.1	99.8	-8.0	0.90	39.00
53.280000	38.5	99.8	82.0	0.50	39.00
60.540000	37.3	123.8	7.0	1.70	39.00

Final Result Average:

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
53.310000	37.4	121.8	0.0	1.60	39.00
143.370000	37.3	99.7	262.0	6.20	43.50
143.670000	37.3	99.8	264.0	6.20	43.50

Channel 39	
RX Antenna Polarization: Horizontal	**Frequency Range: 30MHz – 1GHz**



Final Result Quasi Peak:

Frequency (MHz)	QuasiPeak (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
53.940000	37.9	263.8	266.0	1.10	39.00
146.370000	42.1	179.8	262.0	1.40	43.50
215.940000	41.4	99.8	175.0	2.10	43.50

Final Result Average:

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
146.070000	40.3	205.8	262.0	3.20	43.50
146.370000	40.2	232.8	266.0	3.30	43.50
146.670000	40.2	204.8	262.0	3.30	43.50

TEST **8.**	**TRANSMITTER RADIATED EMISSIONS > 1GHZ**
REFERENCE DOCUMENT	**According to $ 15.247 (d) and $ 15.209 (a)** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 Db below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 Db instead of 20 Db. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

• **TEST SETUP**	Acc. To ref. Std.					
• **TEST LOCATION**	Semi-Anechoic Chamber					
• **DISTANCE OF MEASUREMENT**	3m					
• **TYPE OF MEASUREMENT**	Radiated					
• **TEST EQUIPMENT USED FOR TEST**	**Instrument**	**Manufacturer**	**Model**	**Serial n°**	**Calibrated On**	**Due to**
	MXE Emi Receiver	Keysight	N9038A	MY57290150	07/2021	07/2022
	Semi-Anechoic Chamber	Siemens	B83117-D6019-T232	003-005-134/94C	02/2022	02/2023
	Horn antenna	Electro Metrics	EM-6961	100437	10/2020	10/2023
	Horn antenna + Low Noise Preamplifier	Bonn Elektronic	BLMA 1840-1A	262WL80452	04/2021	04/2023
	High pass filter	Waineright	WHK 2,8/15G	1	10/2021	10/2023
	Software EMC	Rohde & Schwarz	EMC32-E	V 8.40.0	N.A.	
• **TESTED PORT**	Antenna					
• **TEST METHOD**	ANSI C63.10:2013 section 6.6					
• **FREQUENCY RANGE**	1GHz – 10GHz					
• **LIMITS**	Acc. To ref. Std.					
• **UNCERTAINTY OF MEASURE**	Level of confidence = 95% (k=2) Expanded uncertainty 1GHz – 18GHz = 5,15 dB Expanded uncertainty 18GHz – 26GHz = 5,82 dB					

TEST CONDITIONS	REQUIRED	MEASURED
Ambient temperature	**23°C ± 5°C**	24 °C
Ambient humidity	**25 - 75%rH**	45%
Pressure	**85 - 106kPa (860mbar - 1060mbar)**	960 mbar

OPERATING CONDITION: **#1, #2, #3**

RESULT: **WITHIN THE LIMITS**

MEASUREMENT PARAMETER 1GHz - 10GHz	
Resolution bandwidth:	1MHz
Video bandwidth:	3MHz
Span:	See plots below
Sweep time	Auto couple
Detector:	Peak
Trace-Mode:	Max. hold

TEST DESCRIPTION

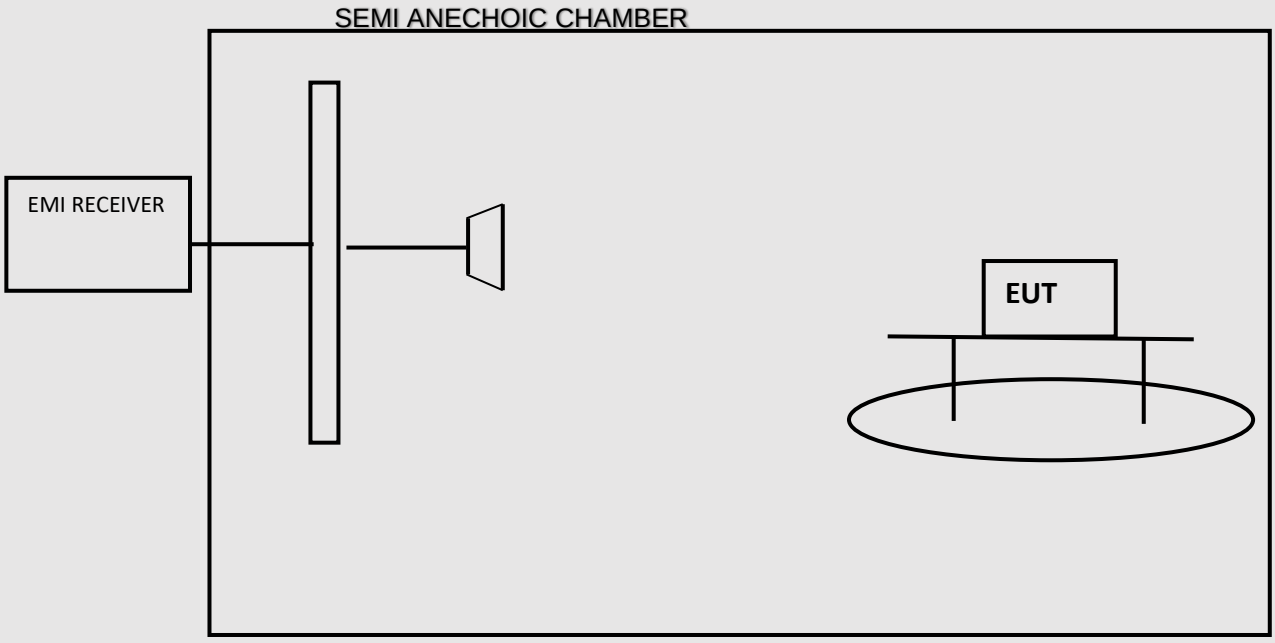
Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously - rotating, remotely - controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency.

The EUT is placed at test table height is 1.5 m

Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m~4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3m.

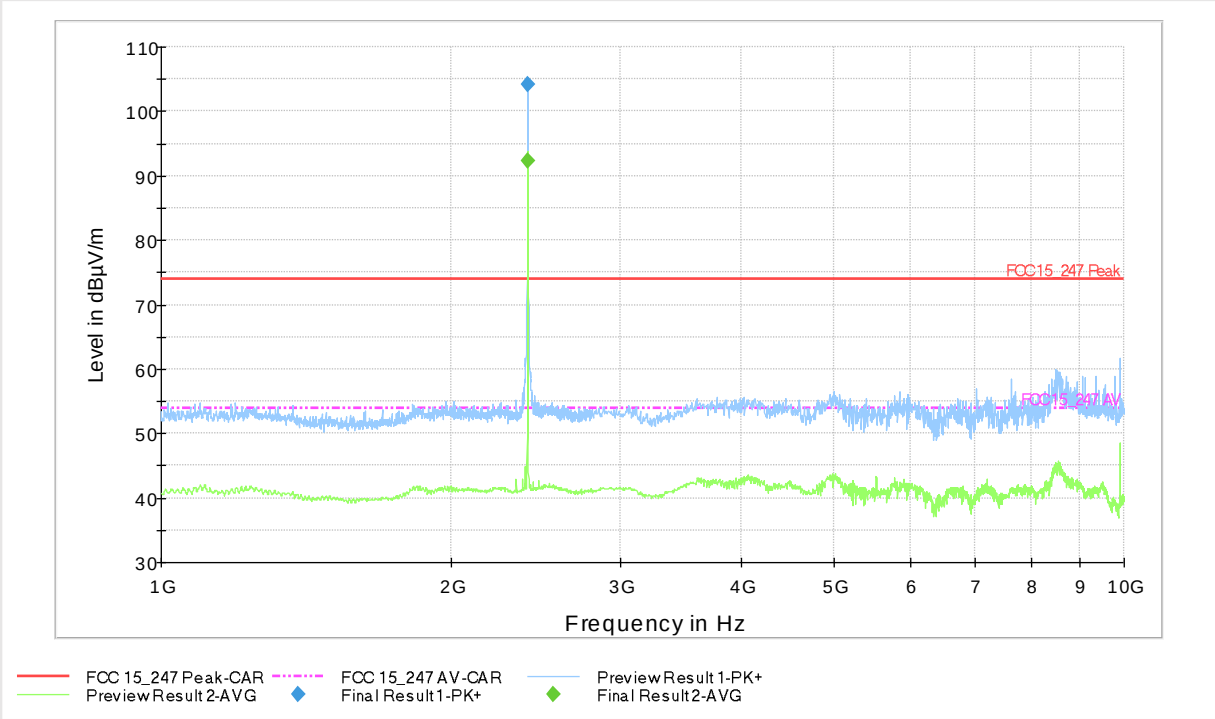
This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

TEST SETUP BLOCK DIAGRAM



TEST RESULTS

Channel 0	
RX Antenna Polarization: Vertical	**Frequency Range: 1GHz – 10GHz**



Final Result Peak:

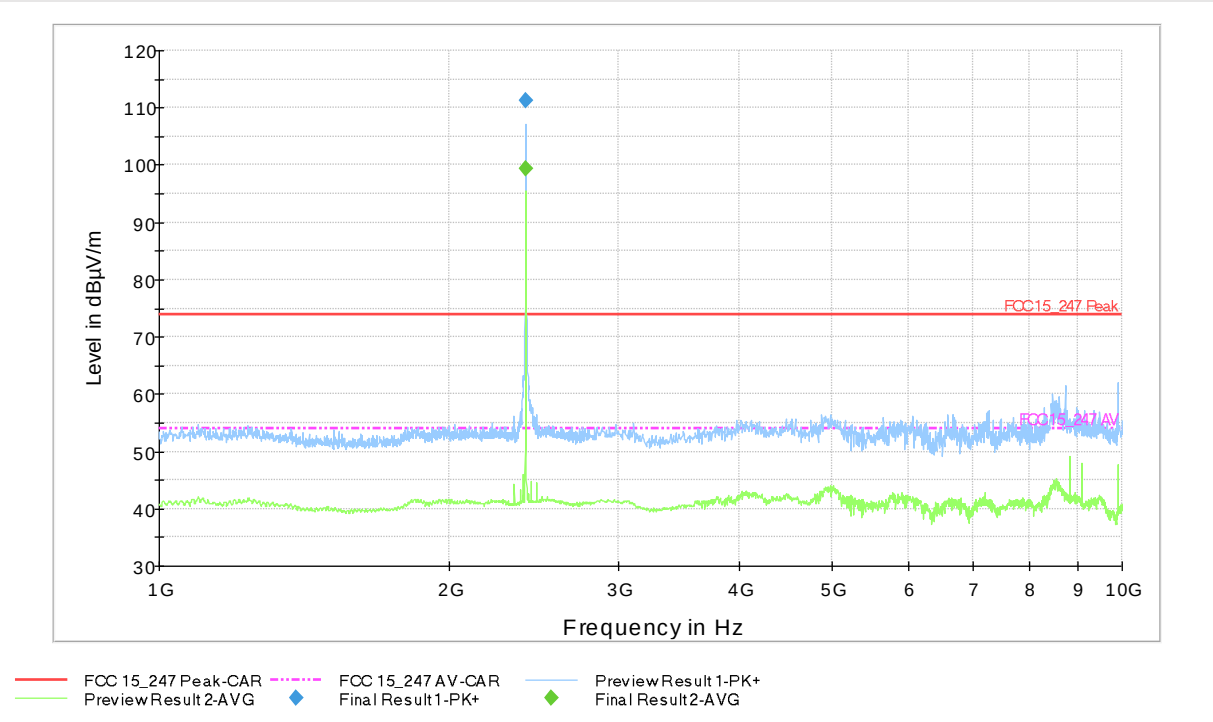
Frequency (MHz)	MaxPeak (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
2402.000000	104.3	106.8	85.0	-30.30	74.00

Final Result Average:

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
2402.000000	92.3	106.9	84.0	-38.30	54.00

Note: Peaks out of limits are due to the BLE carrier.

Channel 0	
RX Antenna Polarization: Horizontal	**Frequency Range: 1GHz – 10GHz**



Final Result Peak:

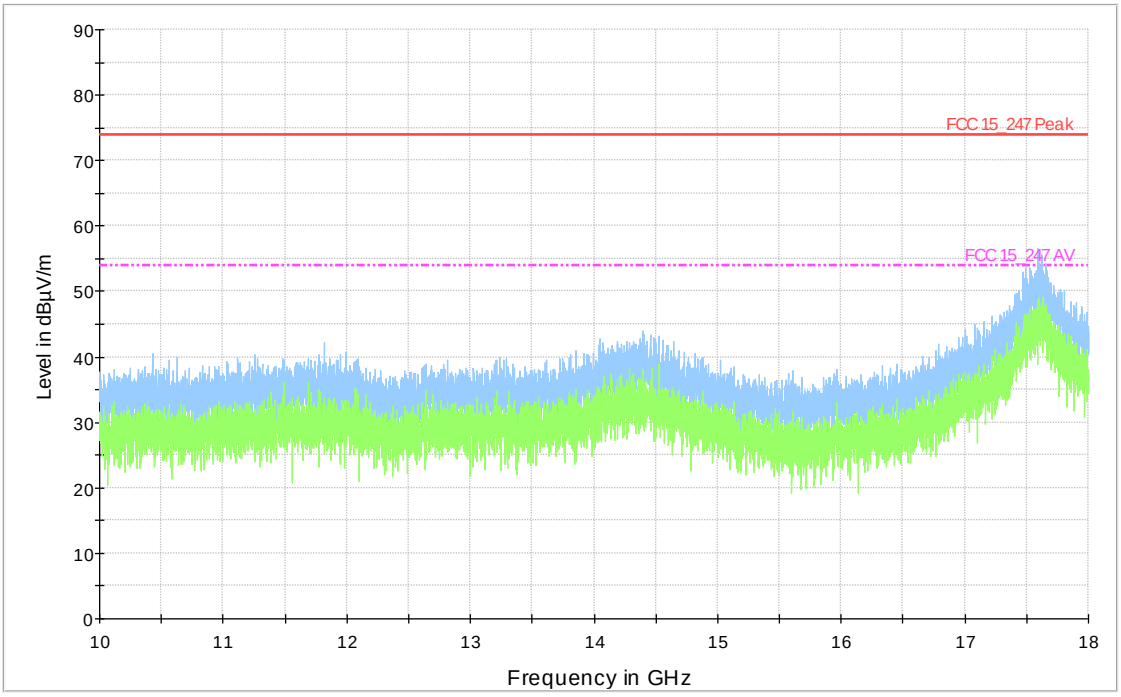
Frequency (MHz)	MaxPeak (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
2402.000000	111.2	222.6	262.0	-37.20	74.00

Final Result Average:

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
2402.000000	99.3	222.6	262.0	-45.30	54.00

Note: Peaks out of limits are due to the BLE carrier.

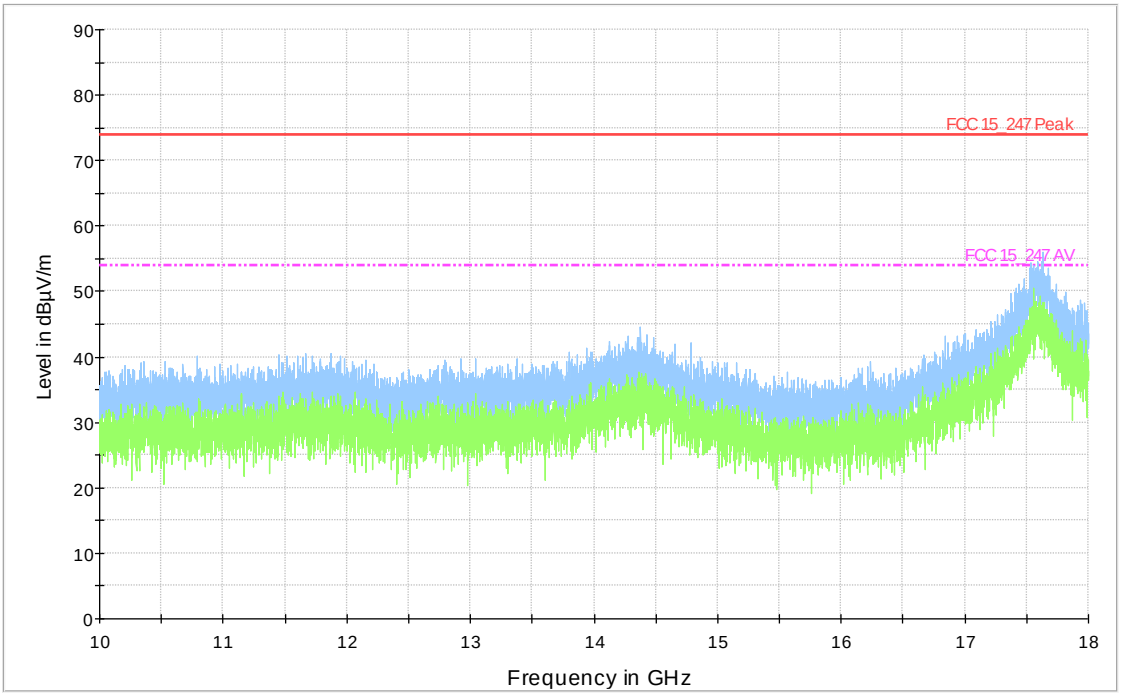
Channel 0	
RX Antenna Polarization: Vertical	**Frequency Range: 10GHz – 18GHz**



Final Result:

All emissions are below 10dB from the limit, for this reason no further assessments were carried out on the individual points

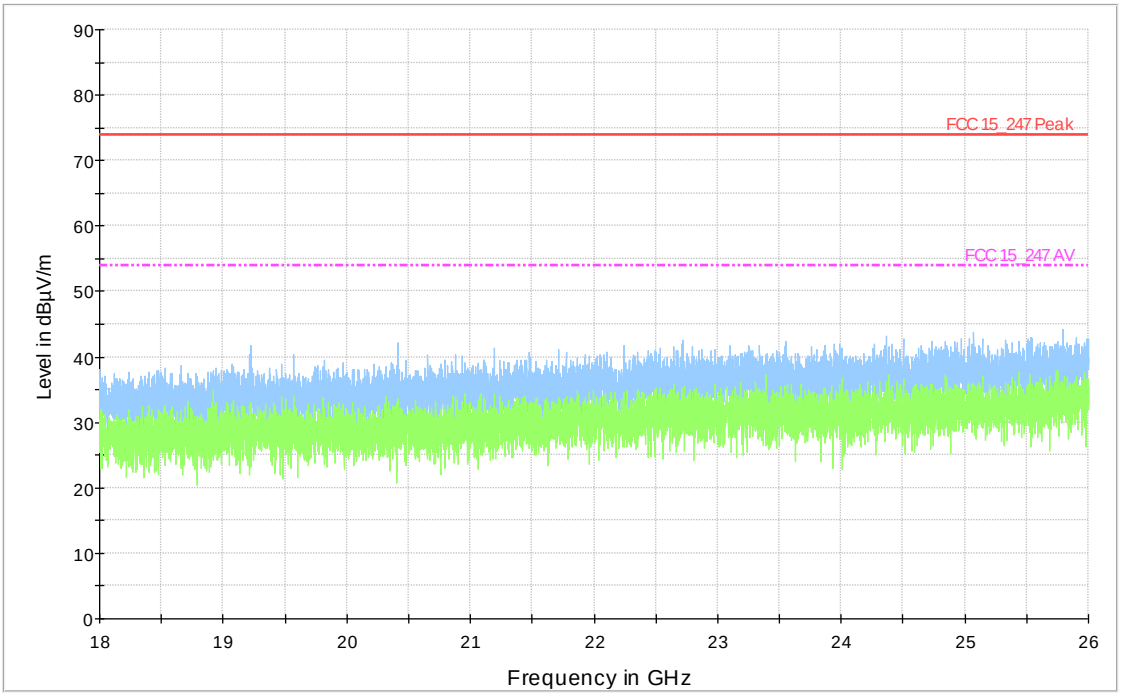
Channel 0	
RX Antenna Polarization: Horizontal	**Frequency Range: 10GHz – 18GHz**



Final Result:

All emissions are below 10dB from the limit, for this reason no further assessments were carried out on the individual points

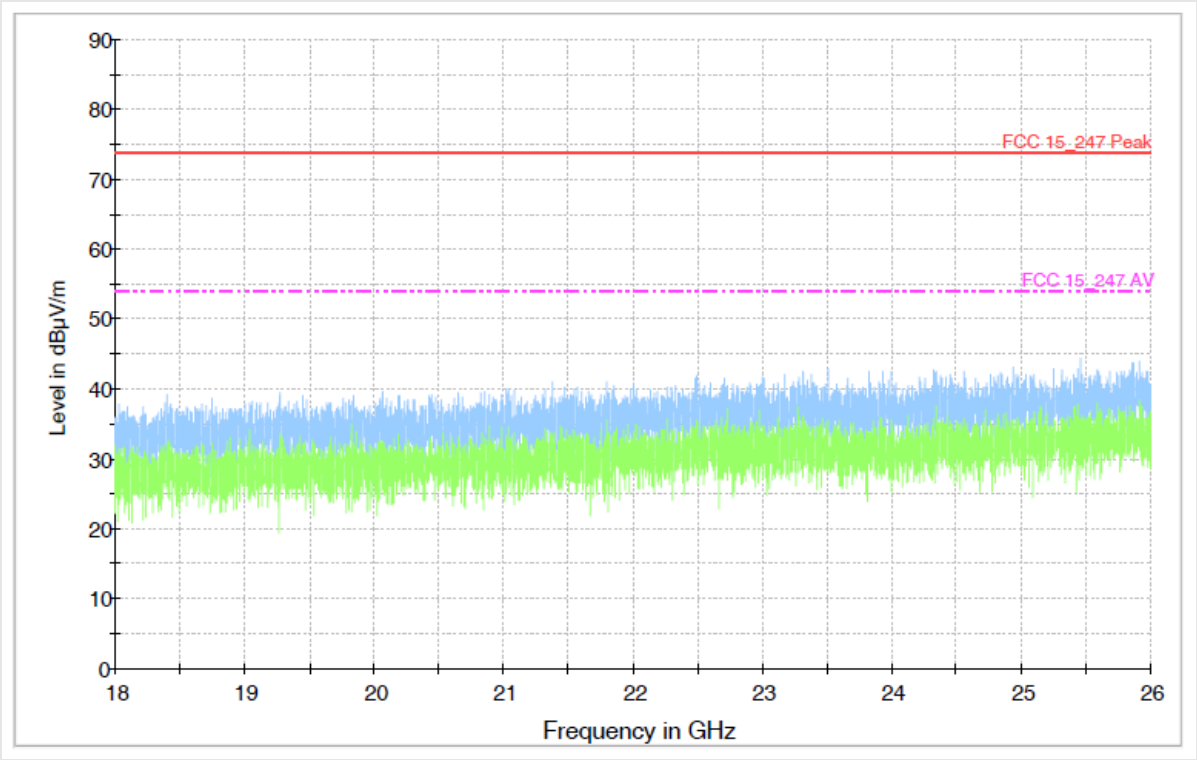
Channel 0	
RX Antenna Polarization: Vertical	**Frequency Range: 18GHz – 26GHz**



Final Result:

All emissions are below 10dB from the limit, for this reason no further assessments were carried out on the individual points

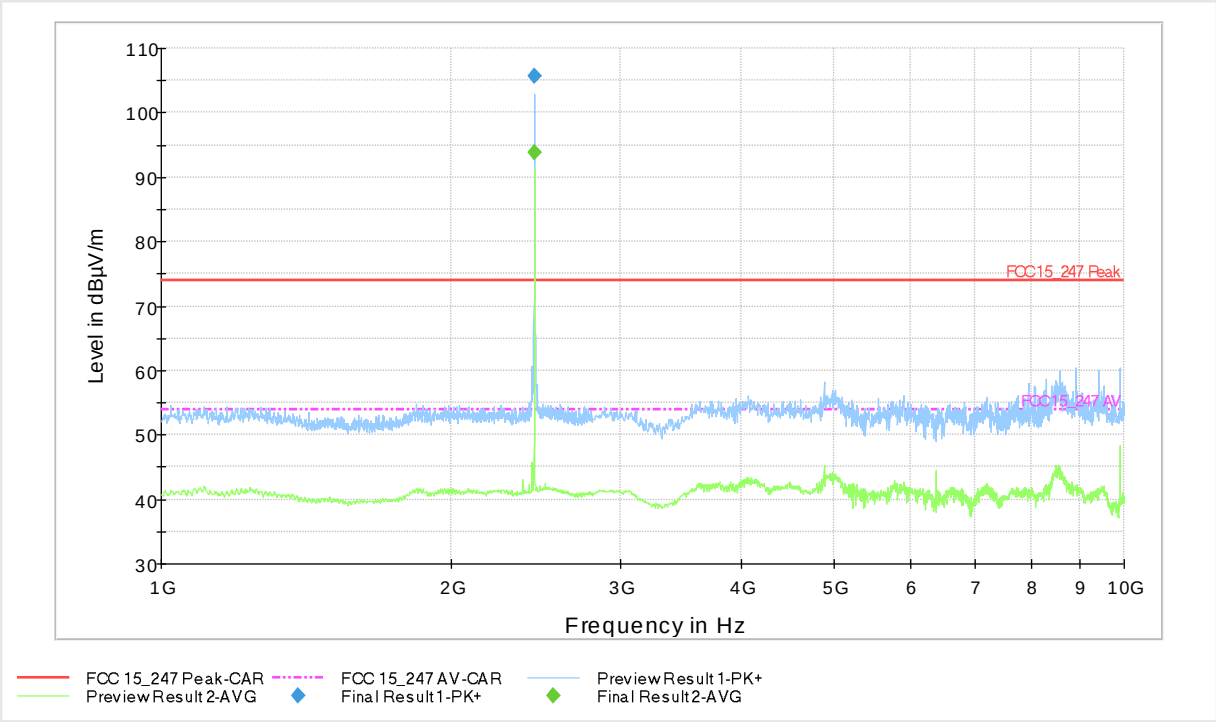
Channel 0	
RX Antenna Polarization: Horizontal	**Frequency Range: 18GHz – 26GHz**



Final Result:

All emissions are below 10dB from the limit, for this reason no further assessments were carried out on the individual points

Channel 19	
RX Antenna Polarization: Vertical	**Frequency Range: 1GHz – 10GHz**



Final Result Peak:

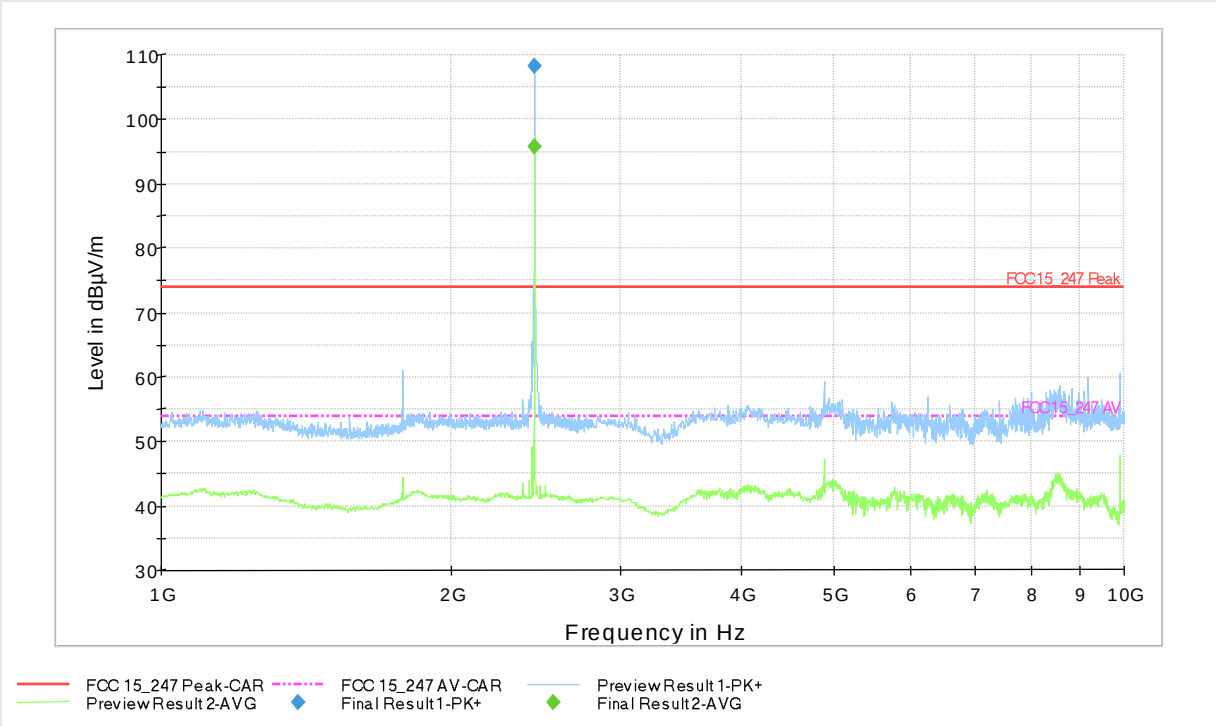
Frequency (MHz)	MaxPeak (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
2440.000000	105.6	106.9	97.0	-31.60	74.00

Final Result Average:

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
2440.000000	93.8	106.9	97.0	-39.80	54.00

Note: Peaks out of limits are due to the BLE carrier.

Channel 19	
RX Antenna Polarization: Horizontal	**Frequency Range: 1GHz – 10GHz**



Final Result Peak:

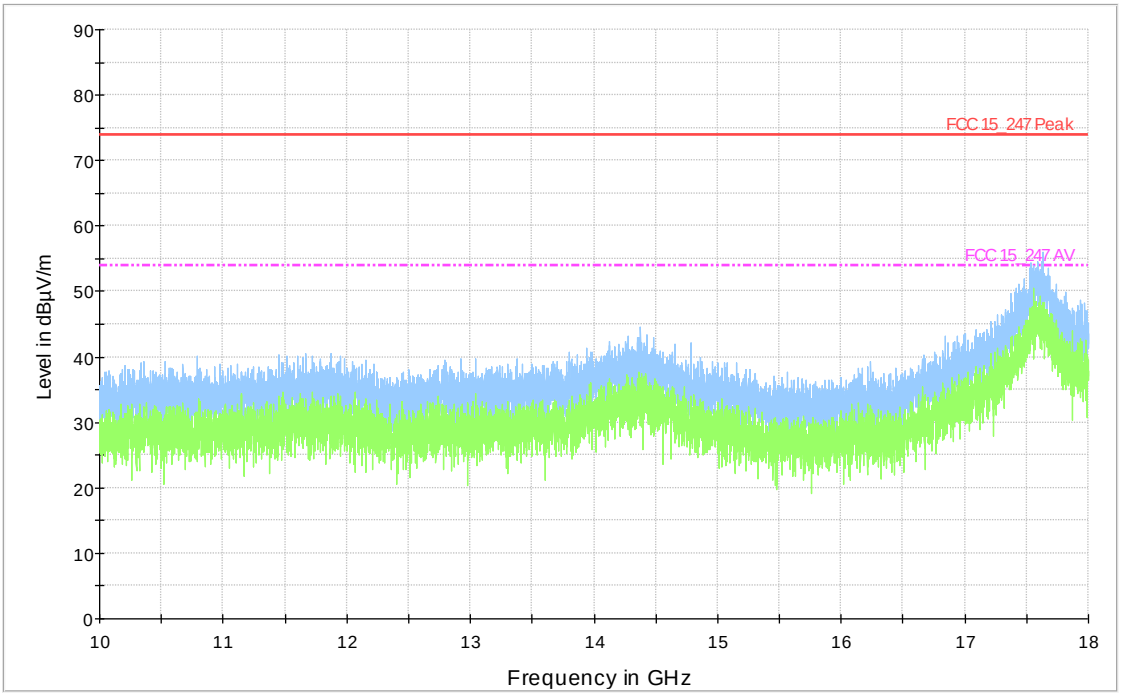
Frequency (MHz)	MaxPeak (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
2440.000000	108.2	247.5	266.0	-34.20	74.00

Final Result Average:

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
2440.000000	95.8	246.6	266.0	-41.80	54.00

Note: Peaks out of limits are due to the BLE carrier.

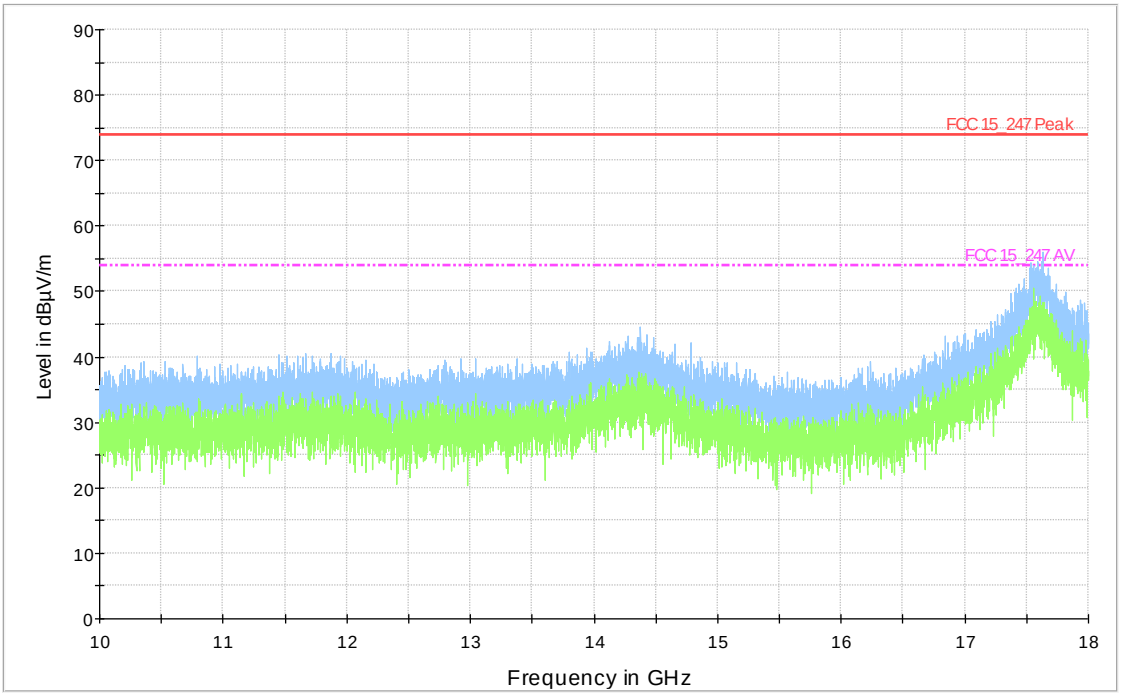
Channel 19	
RX Antenna Polarization: Vertical	**Frequency Range: 10GHz – 18GHz**



Final Result:

All emissions are below 10dB from the limit, for this reason no further assessments were carried out on the individual points

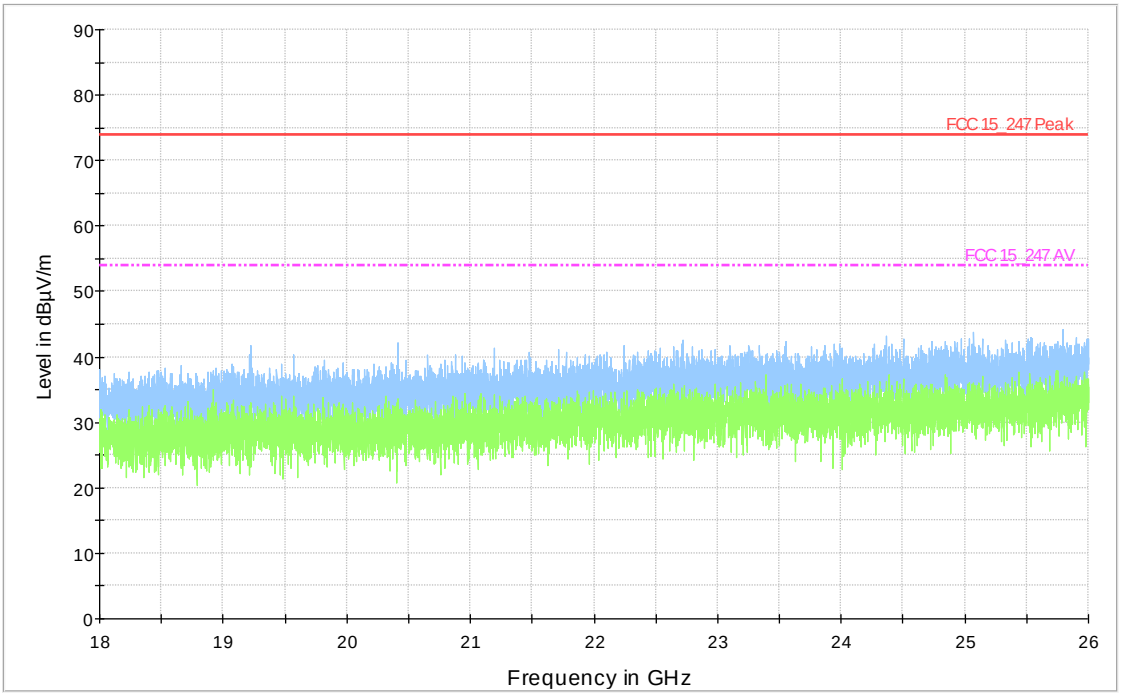
Channel 19	
RX Antenna Polarization: Horizontal	**Frequency Range: 10GHz – 18GHz**



Final Result:

All emissions are below 10dB from the limit, for this reason no further assessments were carried out on the individual points

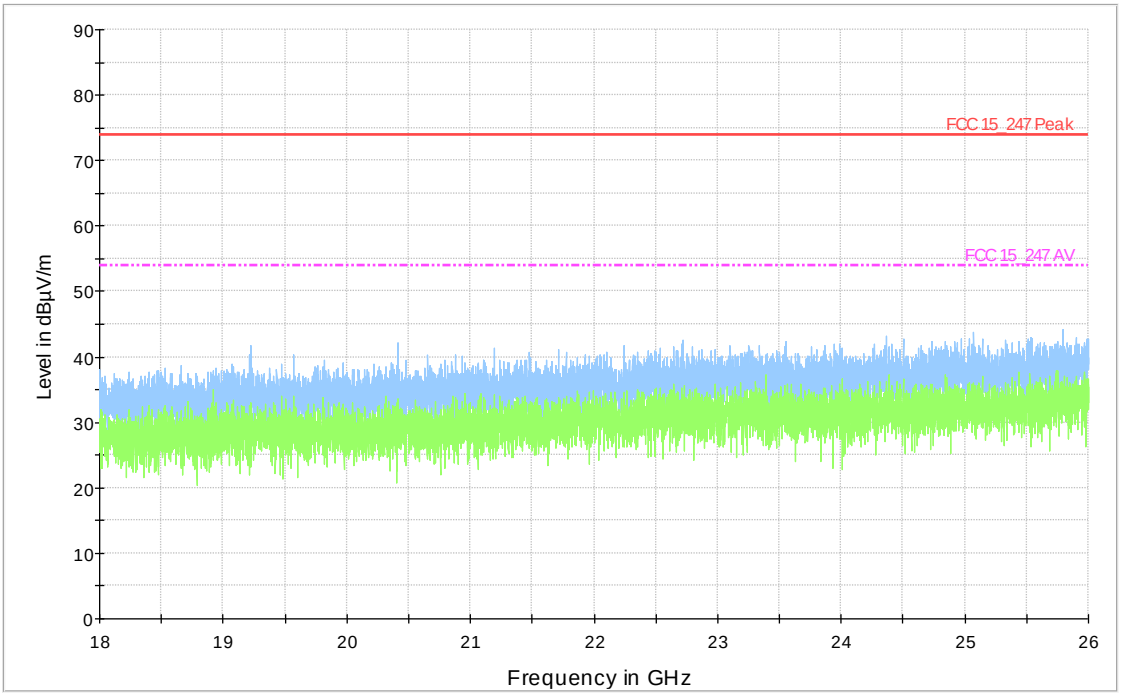
Channel 19	
RX Antenna Polarization: Vertical	**Frequency Range: 18GHz – 26GHz**



Final Result:

All emissions are below 10dB from the limit, for this reason no further assessments were carried out on the individual points

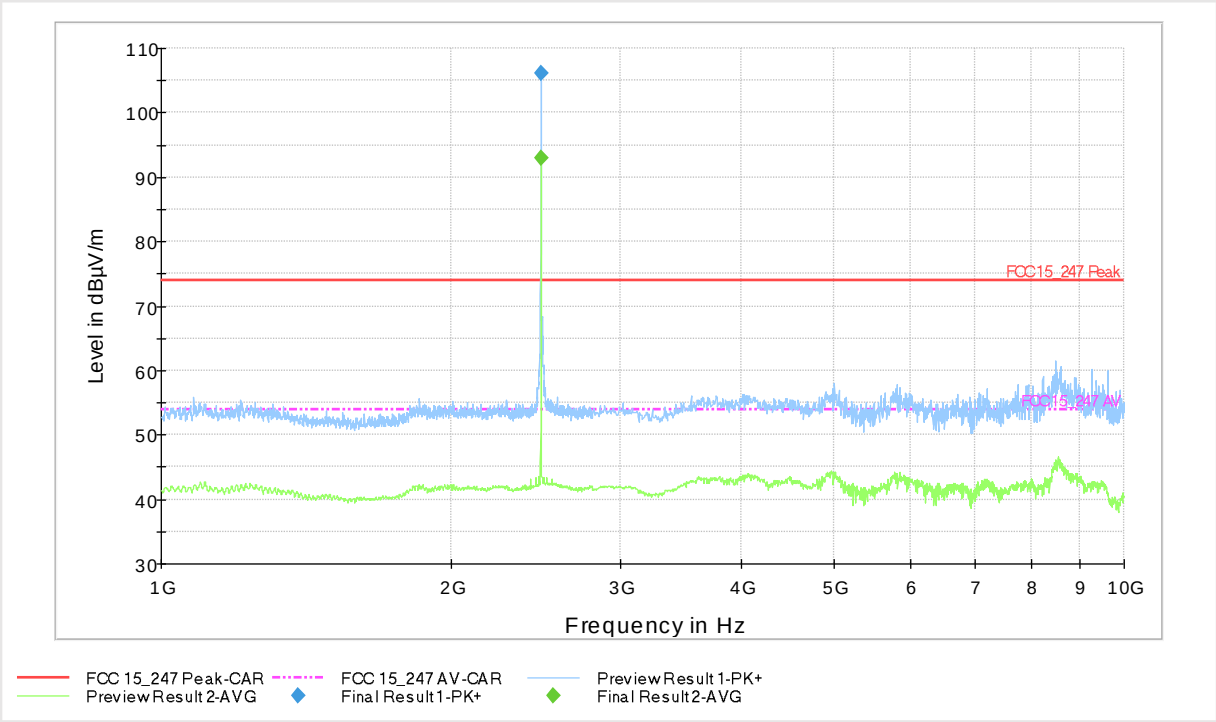
Channel 19	
RX Antenna Polarization: Horizontal	**Frequency Range: 18GHz – 26GHz**



Final Result:

All emissions are below 10dB from the limit, for this reason no further assessments were carried out on the individual points

Channel 39	
RX Antenna Polarization: Vertical	**Frequency Range: 1GHz – 10GHz**



Final Result Peak:

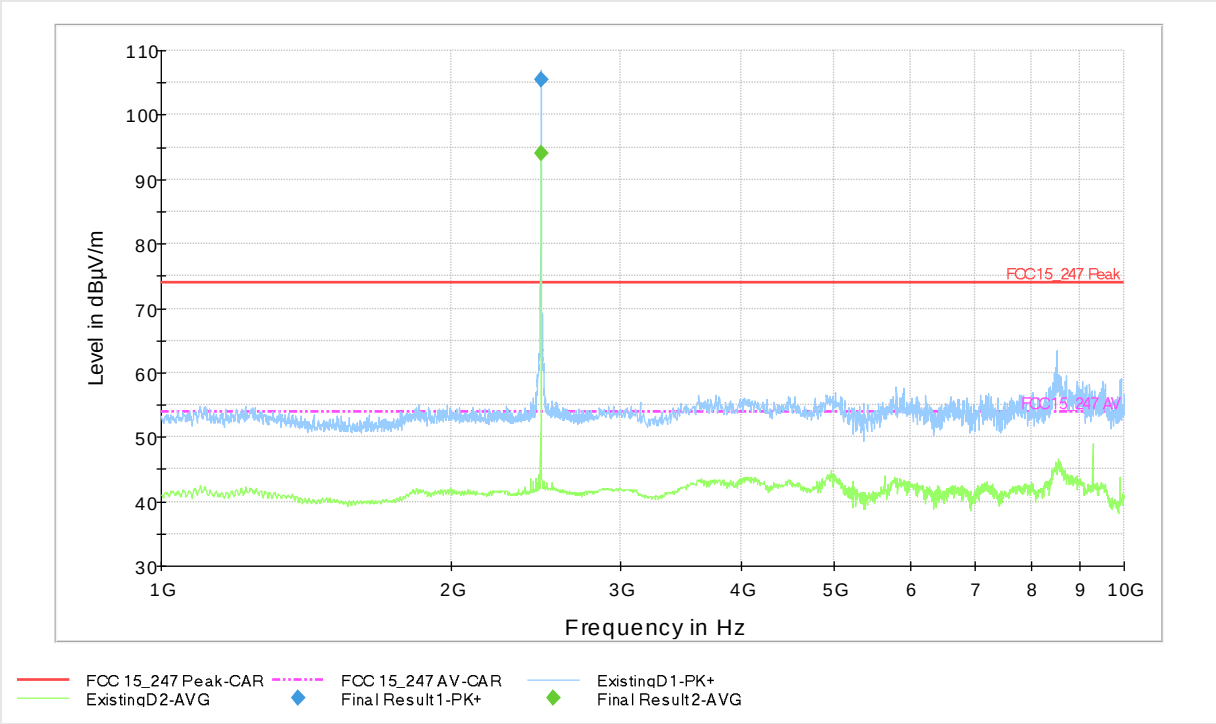
Frequency (MHz)	MaxPeak (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
2480.000000	106.2	106.9	97.0	-32.20	74.00

Final Result Average:

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
2480.000000	92.9	106.8	97.0	-38.90	54.00

Note: Peaks out of limits are due to the BLE carrier.

Channel 39	
RX Antenna Polarization: Horizontal	**Frequency Range: 1GHz – 10GHz**



Final Result Peak:

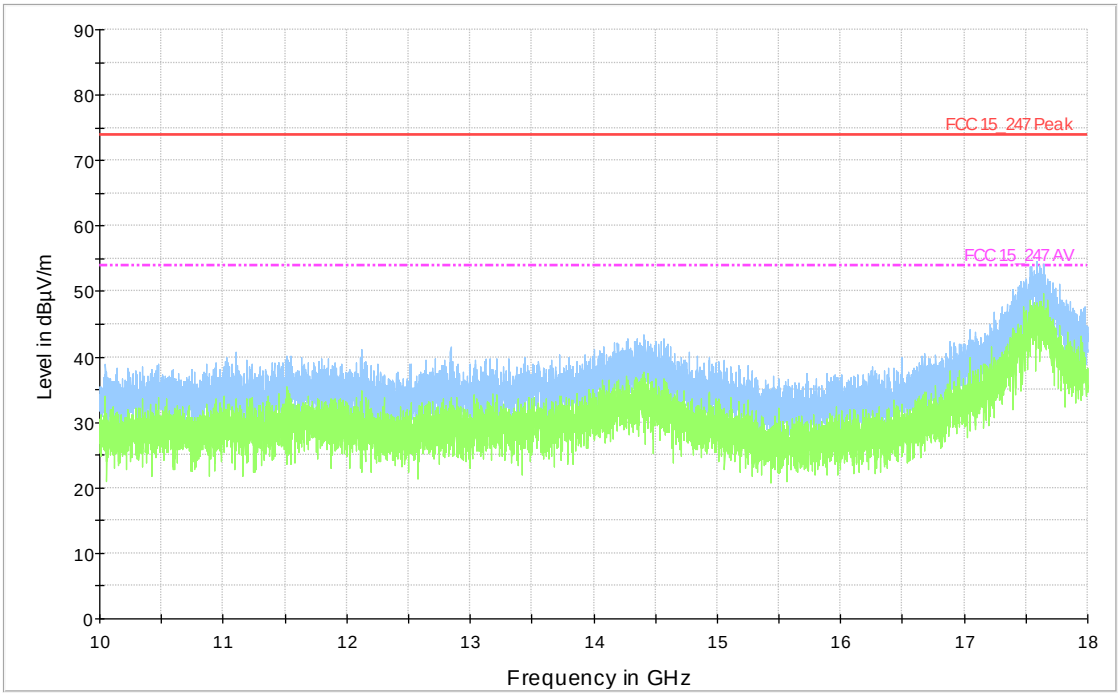
Frequency (MHz)	MaxPeak (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
2480.000000	105.5	200.6	277.0	-31.50	74.00

Final Result Average:

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Azimuth (deg)	Margin (dB)	Limit (dBµV/m)
2480.000000	94.1	226.7	277.0	-40.10	54.00

Note: Peaks out of limits are due to the BLE carrier.

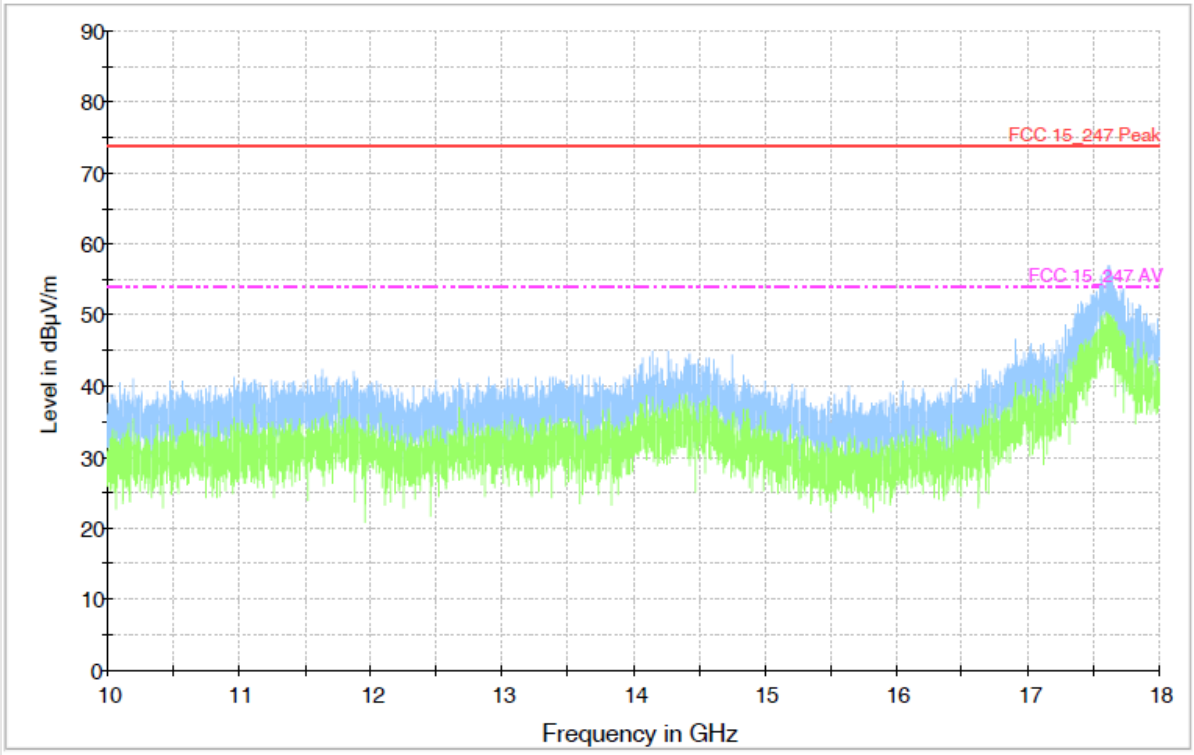
Channel 39	
RX Antenna Polarization: Vertical	**Frequency Range: 10GHz – 18GHz**



Final Result:

All emissions are below 10dB from the limit, for this reason no further assessments were carried out on the individual points

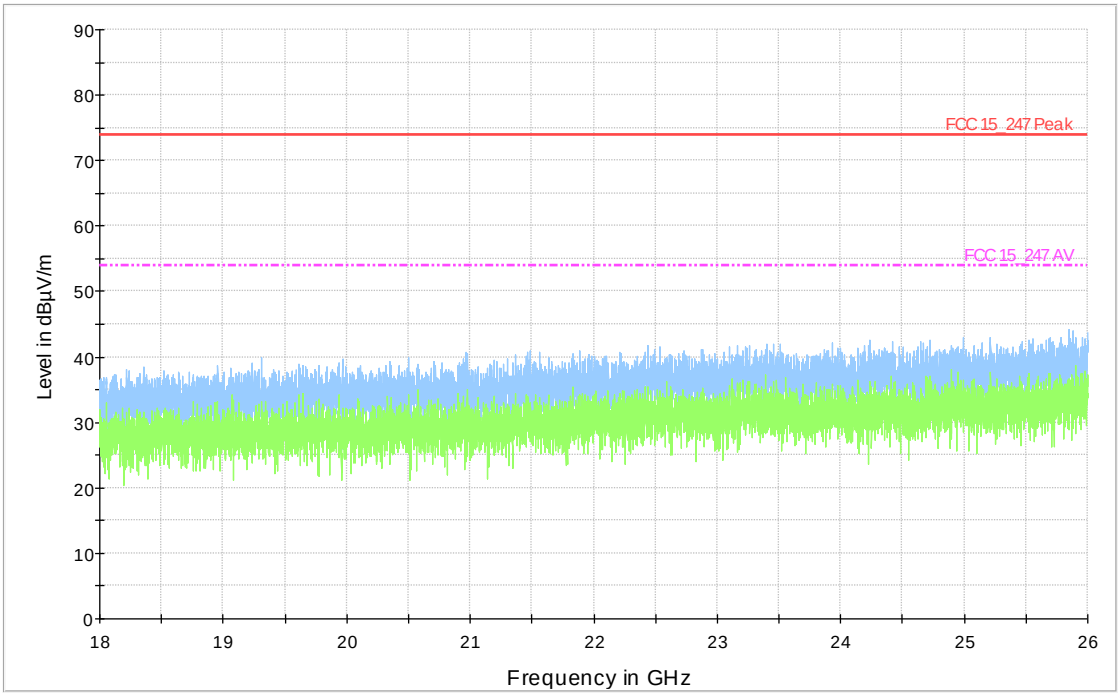
Channel 39	
RX Antenna Polarization: Horizontal	**Frequency Range: 10GHz – 18GHz**



Final Result:

All emissions are below 10dB from the limit, for this reason no further assessments were carried out on the individual points

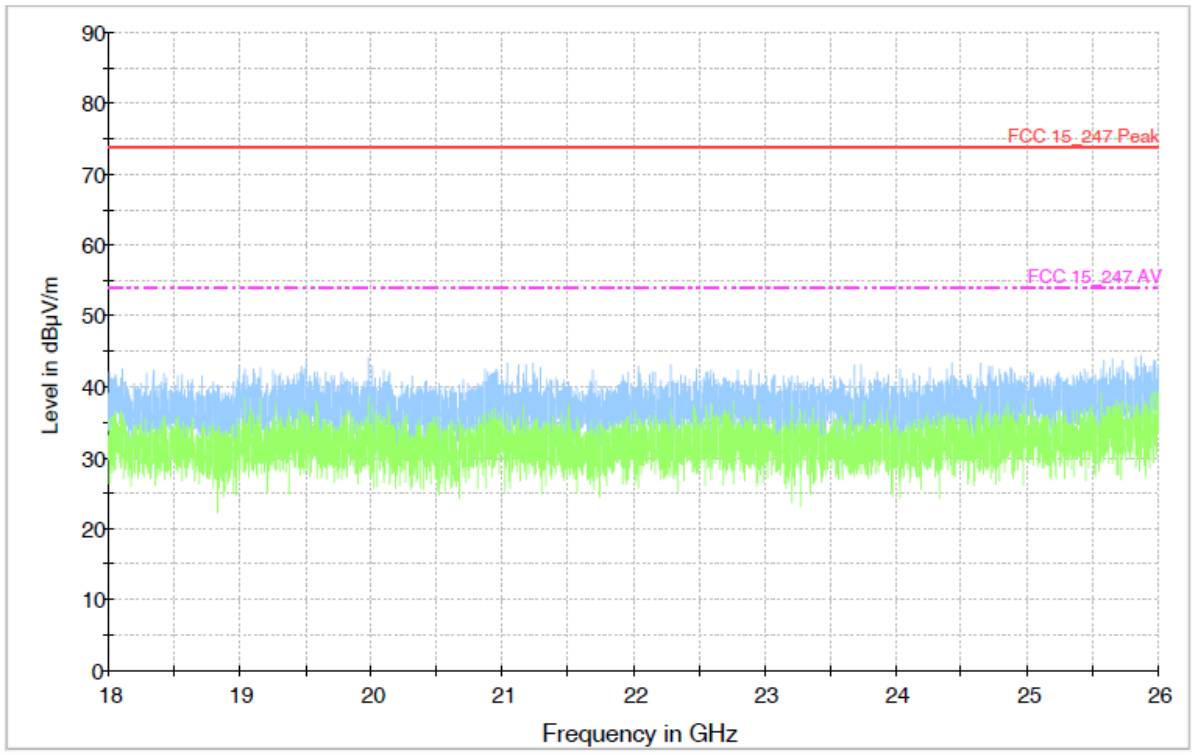
Channel 39	
RX Antenna Polarization: Vertical	**Frequency Range: 18GHz – 26GHz**



Final Result:

All emissions are below 10dB from the limit, for this reason no further assessments were carried out on the individual points

Channel 39	
RX Antenna Polarization: Horizontal	**Frequency Range: 18GHz – 26GHz**



Final Result:

All emissions are below 10dB from the limit, for this reason no further assessments were carried out on the individual points

TEST **9.**	**CONDUCTED EMISSION TEST**
REFERENCE DOCUMENT	**FCC Cfr 47 part 15 - Subpart C - §15.207**

• **TEST SETUP**	According to ref. std.					
• **TEST LOCATION**	Semi-Anechoic Chamber					
• **TEST EQUIPMENT USED FOR TEST**	**Instrument**	**Manufacturer**	**Model**	**Serial n°**	**Calibrated On**	**Due to**
	MXE Emi Receiver	Keysight	N9038A	MY57290150	07/2021	07/2022
	Semi-Anechoic Chamber	Siemens	B83117-D6019-T232	003-005-134/94C	02/2022	02/2023
	Stabilized Power Supply	Spitzenberger+ Spies	PAS5000	A154201/00595	05/2022	05/2024
	LISN	Rohde & Schwarz	ESH3-Z5	838576/009	02/2022	02/2023
	Software EMC	Rohde & Schwarz	EMC32-E/S	V 8.40.0	N.A.	
	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100837	07/2021	07/2023
• **TESTED PORT**	AC power port					
• **FREQUENCY RANGE**	150kHz - 30MHz					
• **LIMITS**	According to ref. std.					
• **UNCERTAINTY OF MEASURE**	Level of confidence = 95% (k=2) Expanded uncertainty 150kHz – 30 MHz = 2,81 dB					

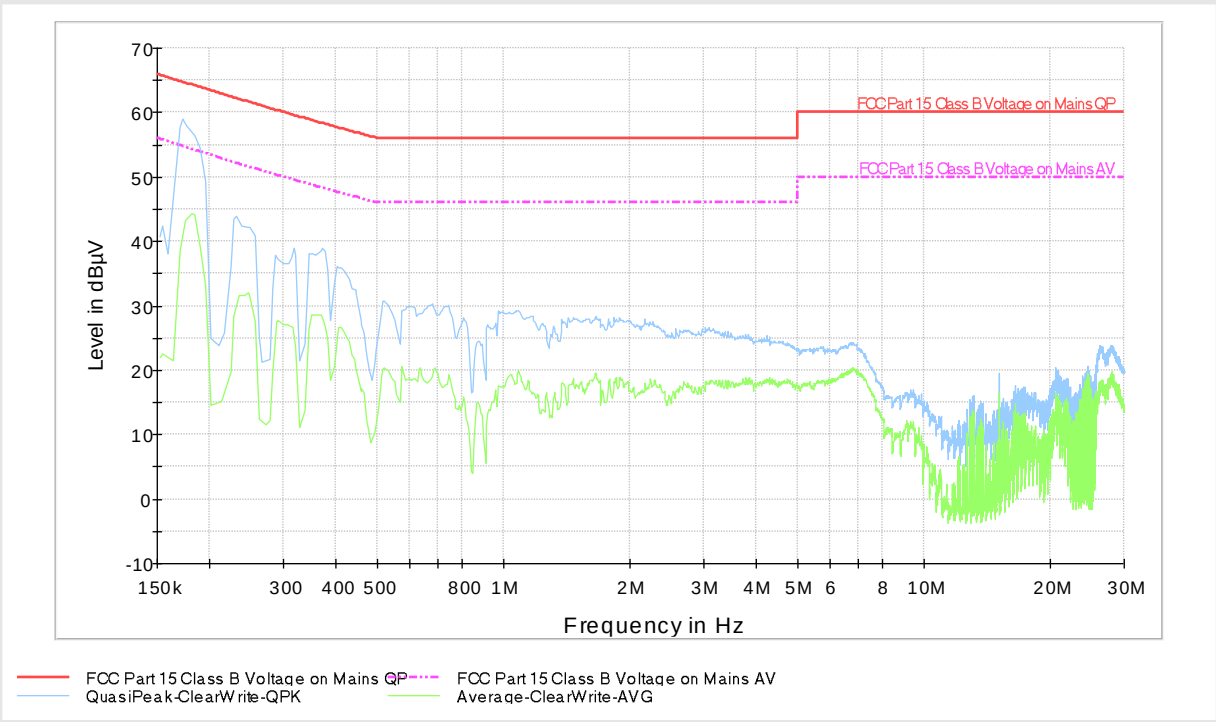
TEST CONDITIONS	REQUIRED	MEASURED
Ambient temperature	**23°C ± 5°C**	24 °C
Ambient humidity	**25 - 75%rH**	45%
Pressure	**85 - 106kPa (860mbar - 1060mbar)**	960 mbar
Voltage		115V ~ 60Hz

OPERATING CONDITION: **#1**

RESULT: **WITHIN THE LIMITS**

TEST RESULTS

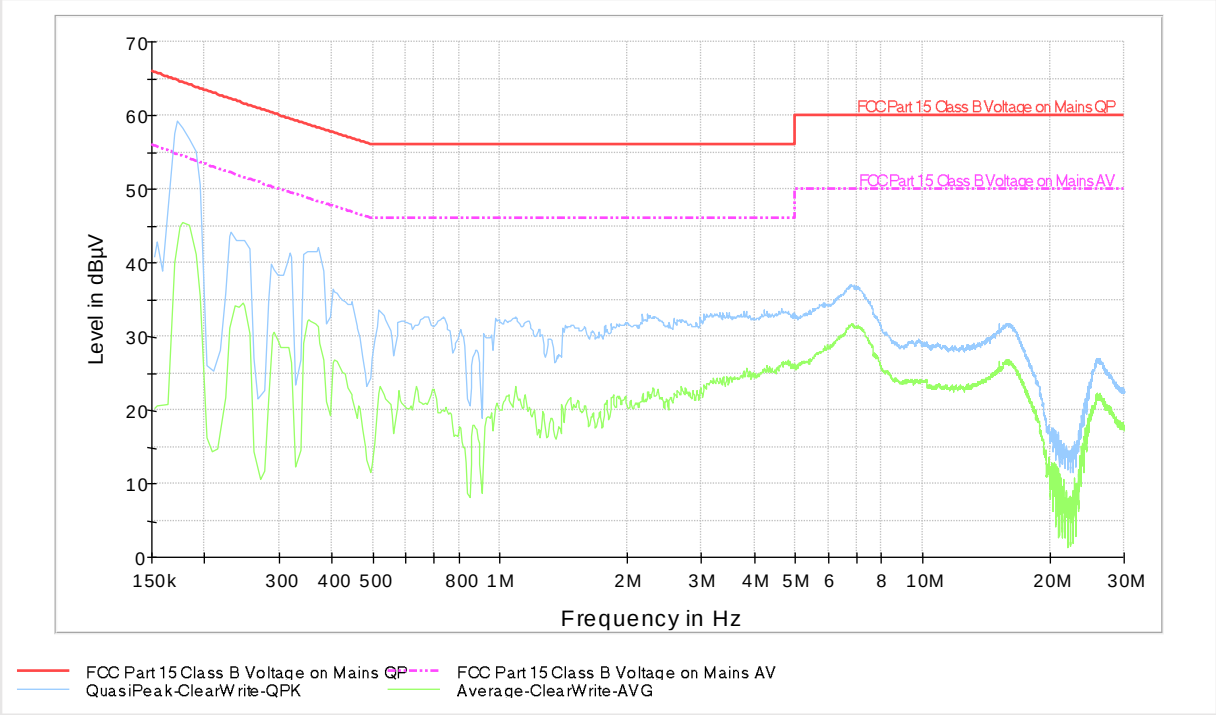
Frequency Range: 150MHz – 30MHz	Line L



Final Result:

Note: All emissions are below 10dB from the limit, for this reason no further assessments were carried out on the individual points

Frequency Range: 150MHz – 30MHz	Line N



Final Result:

Note: All emissions are below 10dB from the limit, for this reason no further assessments were carried out on the individual points

END OF TEST REPORT