FCC Part 15C TEST REPORT

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OBJECT	FCC Part15C	
CUSTOMER	PROTOS GmbH	
EQUIPMENT UNDER TEST - DESCRIPTION	Bluetooth Headset	
MODEL	BTCOM	

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Tested by *(Name + Signature)*	MARCO NICOLE' *Test engineer*	Documento firmato da: NICOLE' MARCO 15.03.2024 15:03:55 UTC
Verified by *(Name + Signature)*	ANDREA CUPIDO *Lab Manager*	Documento firmato da: CUPIDO ANDREA 18.03.2024 07:47:44 UTC
Approved and issued by *(Name + Signature)*	ALESSANDRO ZUCCATO *Lab Director*	Documento firmato da: ZUCCATO ALESSANDRO 18.03.2024 11:33:35 UTC

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History sheet of test Report			
Report Number	**Rev.**	**Date**	**Description of modification**

1 OBJECT OF THE TESTS

The objective of the tests is the evaluation of the conformity of the EUT to the requirements of the standards and test methods specified on par. 4 of present Test Report.

2 IDENTIFICATION

2.1 Laboratory

Name : Kiwa Creiven S.r.l.
Street: Corso Spagna, 12
City : 35127 Padova - ITALY
Phone : +39.049.8704036
Fax: +39.049.8707037
E-mail : info.creiven@kiwa.com
FCC Designation number: IT0016
ISED CAB Identifier: IT0007

2.2 Customer

Customer: PROTOS GmbH
Street: Herrschaftswiesen 11
City: 6842 Koblach - Austria
Phone: +43 59 50 50-200
Refer to : Anton Armin Pfanner

3 EQUIPMENT UNDER TEST (EUT)

3.1 EUT identification (declared under responsibility of the customer)

EUT Description: Bluetooth Headset
Model: BTCOM
Code: --
Serial N°: P2P4Z, P2P41
Software release: 2.1
Size: 220 x 110 x 40 [mm]
Supply voltage: 4.1 V c.c.
Rated Electrical Power: 0.41 W
Rated input current: 400 mA
FCC ID: 2A98QBTCOM

3.2 EUT classifications

The manufacture declared the following classification:

Object	Descriptions
Operating Frequency	2,4 – 2,4835 GHz
Equipment type	BLE
Channel spacing	2 MHz (BLE)
Number of Channels	40 for BLE
Antenna Type	Integrated antenna PIFA
Antenna Peak Gain	1.3 dBi
Frequency Hopping Spread Spectrum	YES
Extreme Temperature Range	0°C ÷ +50°C
Manufacturer declaration	03005LP
Adaptive / non-adaptive equipment	☐ non-adaptive Equipment ☒ adaptive Equipment without the possibility to switch to a non-adaptive mode ☐ adaptive Equipment which can also operate in a non-adaptive mode

3.3 EUT additional information

Object	Descriptions
Classification of installation and use	☐ Stand-alone ☒ Combined Equipment (Equipment where the radio part is fully integrated within another type of equipment) ☐ Plug-in radio device (Equipment intended for a variety of host systems) ☐ Other
Means for connection to the supply:	☐ Supply cord fitted with a plug ☐ Supply cord without plug (for permanently connection to fixed wiring) ☒ Appliance inlet ☐ Appliance provided with a set of terminals allowing the connection of cables or fixed wiring
Date of receipt of test item	2023-02-06
Date(s) of performance of tests	See the data specified in test results details

3.4 EUT cables

The EUT has been configured by the manufacturer with the following input / output cables:

Classification	Description	Cable		note
		Shielded	Specified max. length	
DC power port (used only for the recharge)	d.c. input cable	☐	☐ none ☒ ≤ 1m ☐ ≤ 3m ☐ ≤ 10m ☐ ≤ 30m	type of power source: ☐ Internal Power Supply ☐ External Power Supply or AC/DC adapter ☒ Battery ☐ Other

3.5 EUT Auxiliary Equipments (AEs)

To ensure the correct functioning of the EUT, it has been necessary to make use of the following auxiliary equipment (AE):

Auxiliary Equipment AE N°01

Description : DC power supply
Model: LABPS3003
Manufacturer: VELLEMAN

Auxiliary Equipment AE N°02

Description : Laptop + debugger
Model: --
Manufacturer: ASUS

3.6 Sampling and adopted criteria

Equipment used for testing was selected by the customer. Sampling criteria adopted by the customer is unknown to Kiwa Creiven laboratory.

3.7 EUT documents

The following documentations have been provided by the customer

Kiwa Creiven document reference	Descriptions
03005LP	Manufacturer declaration

4 STANDARDS AND TEST METHODS

4.1 Reference standards

DOCUMENT	DATE	OBJECT
ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

Note: **KDB 558074 D01 v05r02 taken into consideration.**

4.1.1 Test summary

The following table specifies the tests required by the reference standard and test performed on EUT.

TEST	FCC Rule	Note	Results
6 dB (DTS) & 20 dB Bandwidth	***§15.247 (a)(2) §15.215 (c)***	---	***Complies***
Dwell Time	***§15.247 (a)(1)(iii)***	---	***Complies***
Peak Output Power (Conduction)	***§15.247 (b)(3)***	---	***Complies***
Spurious Emissions (Radiation)	***§15.209***	---	***Complies***
Band edge measurement	***§15.247 (d)***	---	***Complies***
Power spectral density	***§15.247 (e)***	---	***Complies***
Power-line conducted emissions	***§15.207***	---	***Complies***

4.2 Test methods

DOCUMENT	DATE	METHOD	ACCREDIA accreditation	Test Sequence (See Note 1)
C63.10	2013	Channel Separation	Yes	02
C63.10	2013	Minimum Hopping Channel	Yes	04
C63.10	2013	6 dB (DTS) & 20 dB Bandwidth	Yes	03
C63.10	2013	Dwell Time	Yes	08
C63.10	2013	Peak Output Power (Conduction)	Yes	05
C63.10	2013	Spurious Emissions (Radiation)	Yes	01
C63.10	2013	Band edge measurement	Yes	07
C63.10	2013	Power spectral density	Yes	06
C63.10	2013	Standard test method for ac power-line conducted emissions from unlicensed wireless devices	Yes	09

Note :
1) The tests have been carried out in the order specified in this column

4.3 Deviation from test methods

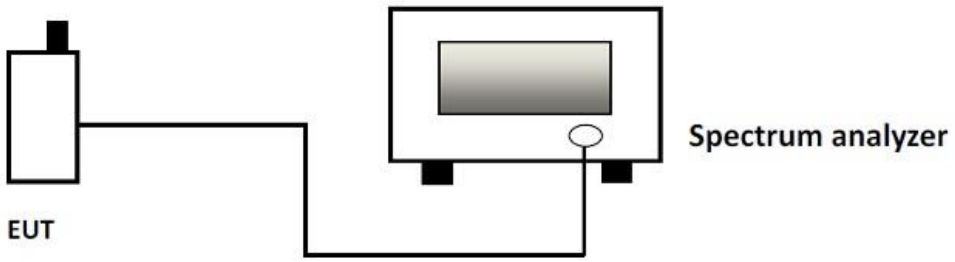
None.

5 EUT OPERATING CONDITIONS DURING TESTS

The EUT was set to function as indicated in Table 1, in compliance with the manufacturer's prescriptions and with that which is stated in the applied standards, test methods and procedures.

OPERATING CONDITION	DESCRIPTION OF FUNCTIONING
TX04	EUT details : during the test the EUT • was powered at 4.1 Vdc • was in continuous working state/ Device operated in standard continuous transmit mode (Cont TX function) • **Lowest** frequency activated (2402 MHz) – **BLE** • Was set **Length** to **37** • Was set **Bit pattern** to **0** • AE details : during the test the Auxiliary Equipment (AE), connected to EUT, was : • AE N°01 connected to Power supply of EUT • AE N°02 connected only to set the device
TX05	EUT details : during the test the EUT • was powered at 4.1 Vdc • was in continuous working state/ Device operated in standard continuous transmit mode (Cont TX function) • **Medium** frequency activated (2442 MHz) – **BLE** • Was set **Length** to **37** • Was set **Bit pattern** to **0** • AE details : during the test the Auxiliary Equipment (AE), connected to EUT, was : • AE N°01 connected to Power supply of EUT • AE N°02 connected only to set the device
TX06	EUT details : during the test the EUT • was powered at 4.1 Vdc • was in continuous working state/ Device operated in standard continuous transmit mode (Cont TX function) • **Highest** frequency activated (2480 MHz) – **BLE** • Was set **Length** to **37** • Was set **Bit pattern** to **0** • AE details : during the test the Auxiliary Equipment (AE), connected to EUT, was : • AE N°01 connected to Power supply of EUT • AE N°02 connected only to set the device
OC09	EUT details : during the test the EUT • was in recharge mode (AE N°01 powered with 120V @60Hz) • Radio transmission not activated • AE details : during the test the Auxiliary Equipment (AE), connected to EUT, was : • EUT connected via USB to AE N°02

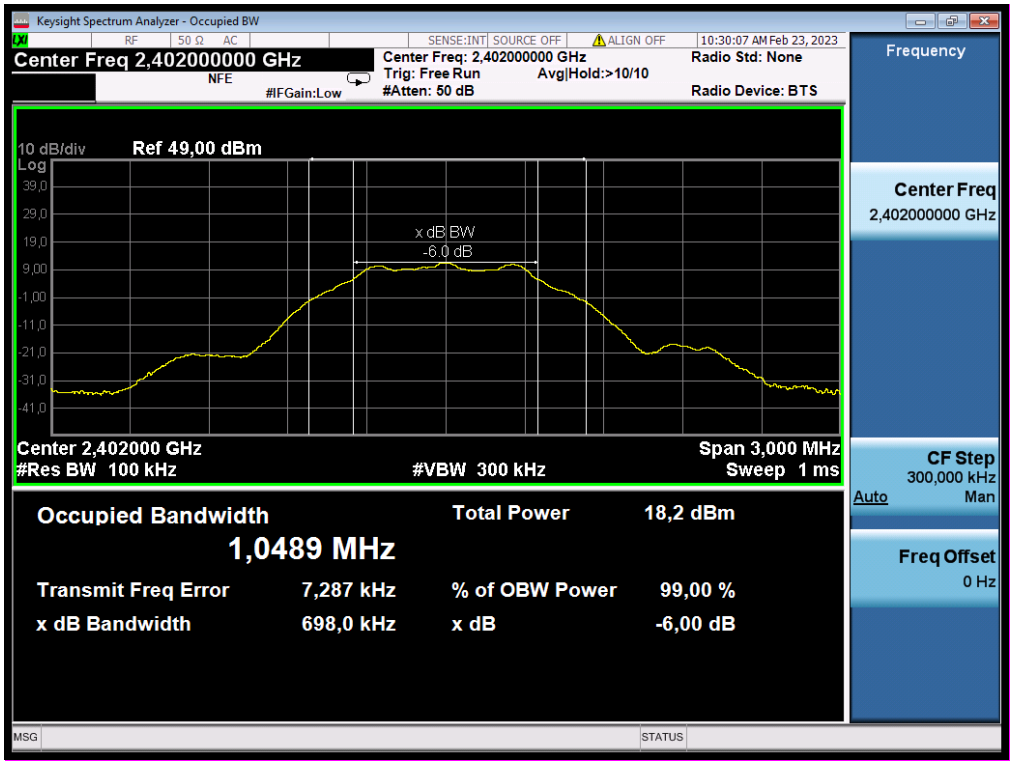
6 TEST RESULTS

Test method:	**FCC part 15 C - §15.247 (a)(2) & §15.215 (c)** **6 dB (DTS) & 20 dB Bandwidth** For details see par. 4 of this report	
Operator	Marco Nicolè	
Test Date	2023-02-23	
Test Temperature	21 °C	
Test Humidity	30 %	
Test Pressure	1001 hPa	
Electrical wiring	*Cable*	*Length [m]*
	D.c. input cable	3.0
Operating conditions	TX04; TX05; TX06 See par. 5 of this report	
Auxiliary equipment (AE)	See par. 3.5 of this report	
Limits	The minimum 6 dB bandwidth shall be at least 500 kHz.	
Test set up		
Test instrumentations	See Annex B	
Measurement Uncertainty (k=2)	See Annex F	

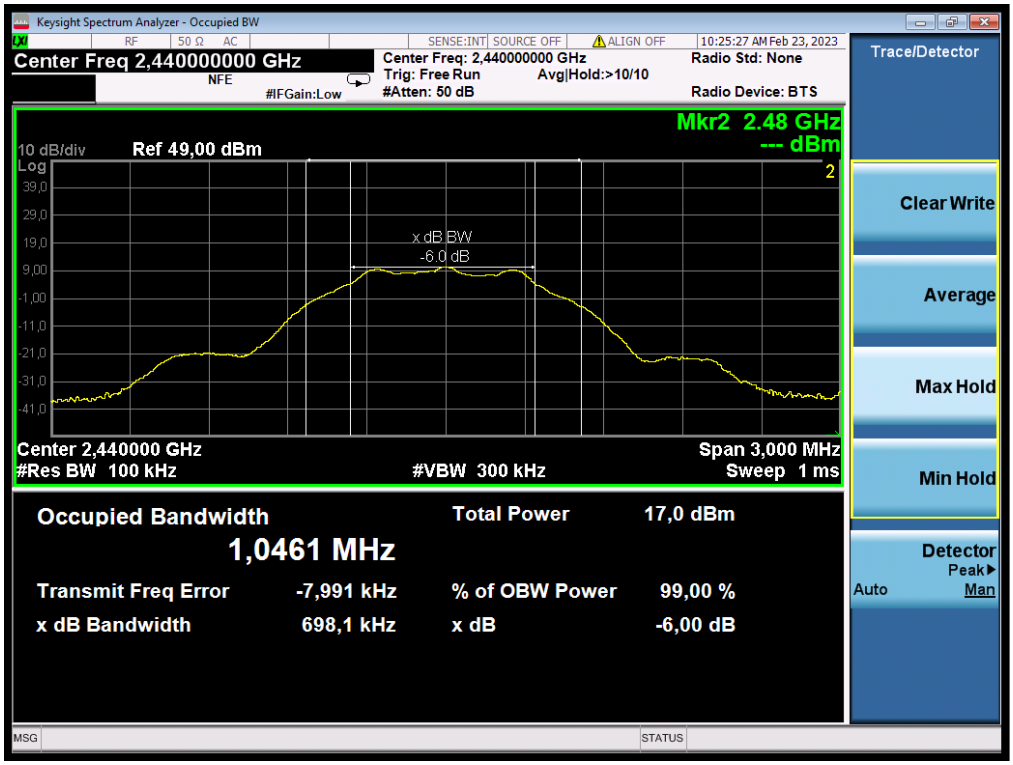
Operating condition	6 dB bandwidth	LIMIT	RESULT
TX04	698.0 kHz	At least 500 kHz	**COMPLIES**
TX05	698.1 kHz	At least 500 kHz	**COMPLIES**
TX06	693.3 kHz	At least 500 kHz	**COMPLIES**

Test Procedure	Use the following spectrum analyser settings: RBW = 100kHz VBW ≥ 3 x RBW Sweep = auto Detector function = peak Trace = max hold The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 6 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 6 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation.
EUT modification during this test	None

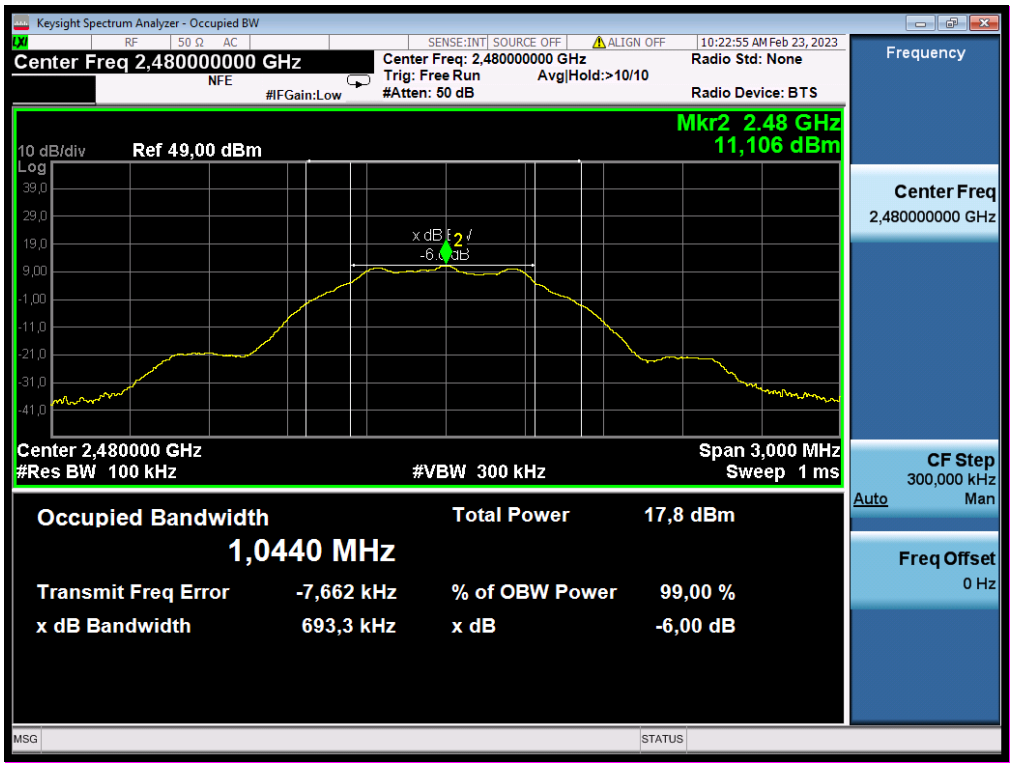
Test result TX04

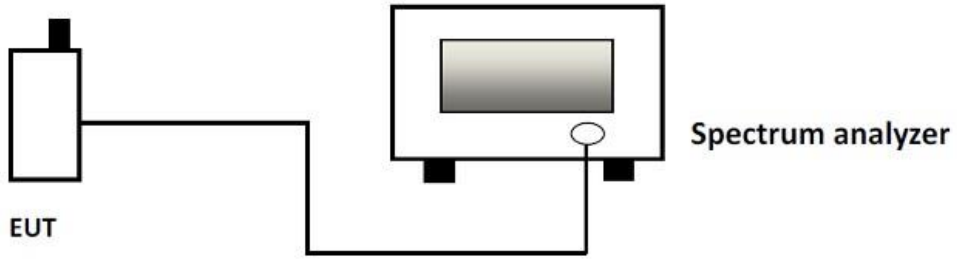


Test result TX05



Test result TX06

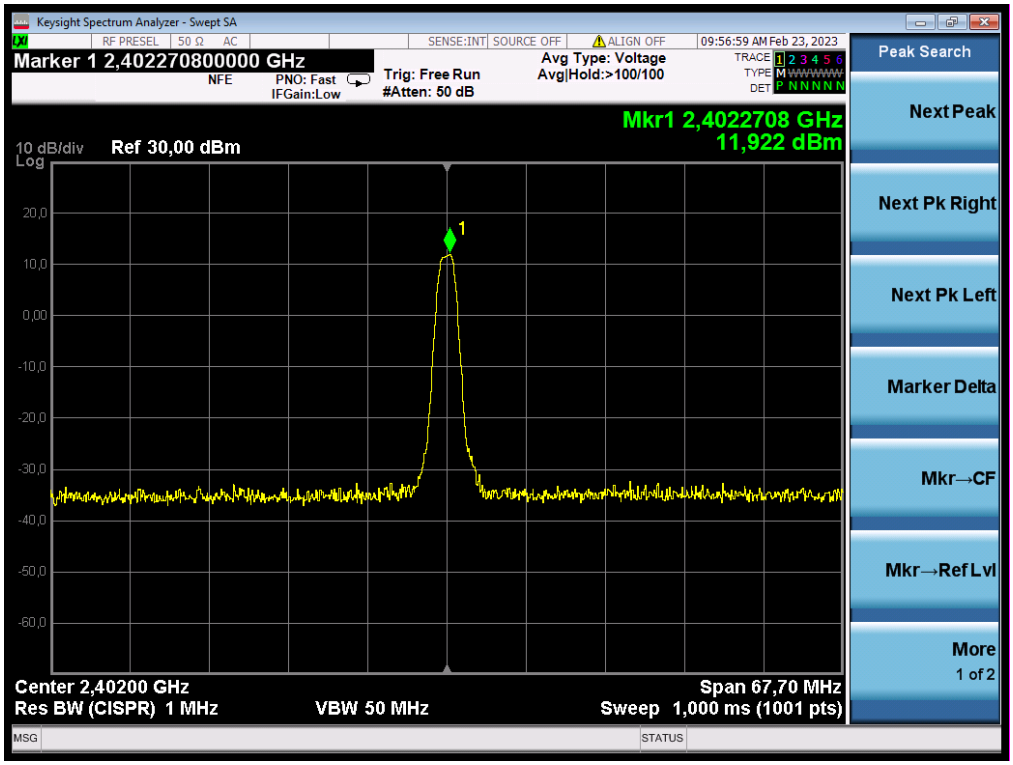


Test method:	**FCC part 15 C - §15.247 (b)(3)** **Peak Output Power** For details see par. 4 of this report	
Operator	Marco Nicolè	
Test Date	2023-02-23	
Test Temperature	21 °C	
Test Humidity	30 %	
Test Pressure	1001 hPa	
Electrical wiring	*Cable*	*Length [m]*
	D.c. input cable	3.0
Operating conditions	TX04; TX05; TX06 See par. 5 of this report	
Auxiliary equipment (AE)	See par. 3.5 of this report	
Limits	For systems using digital modulation in the 2400–2483.5 MHz bands: - 1 Watt (for device with channels > 75) - 0.125 Watt (for device with channels < 75)	
Test set up		
Test instrumentations	See Annex B	
Measurement Uncertainty (k=2)	See Annex F	

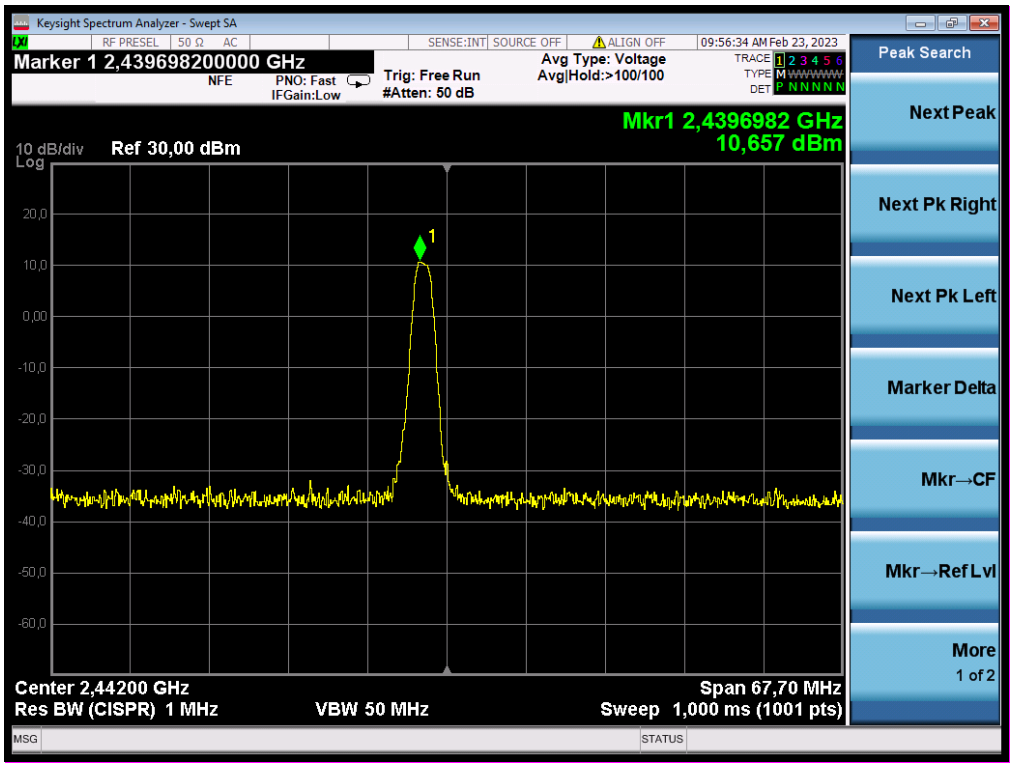
OPERATING CONDITION	FREQUENCY [MHz]	Peak Power [dBm]	LIMIT [dBm]	LIMIT [W]	RESULT
TX04	2402	+11.922	+20.969	1	**COMPLIES**
TX05	2441	+10.657	+20.969	1	**COMPLIES**
TX06	2480	+11.189	+20.969	1	**COMPLIES**

Test Procedure	The measurement will be conducted at three channels: Bluetooth: Low, middle and High, Set the spectrum analyzer as RBW = 1MHz, VBW =50MHz, Span = >10MHz, Sweep=auto Detector = Peak, Trace mode = max hold
EUT modification during this test	None

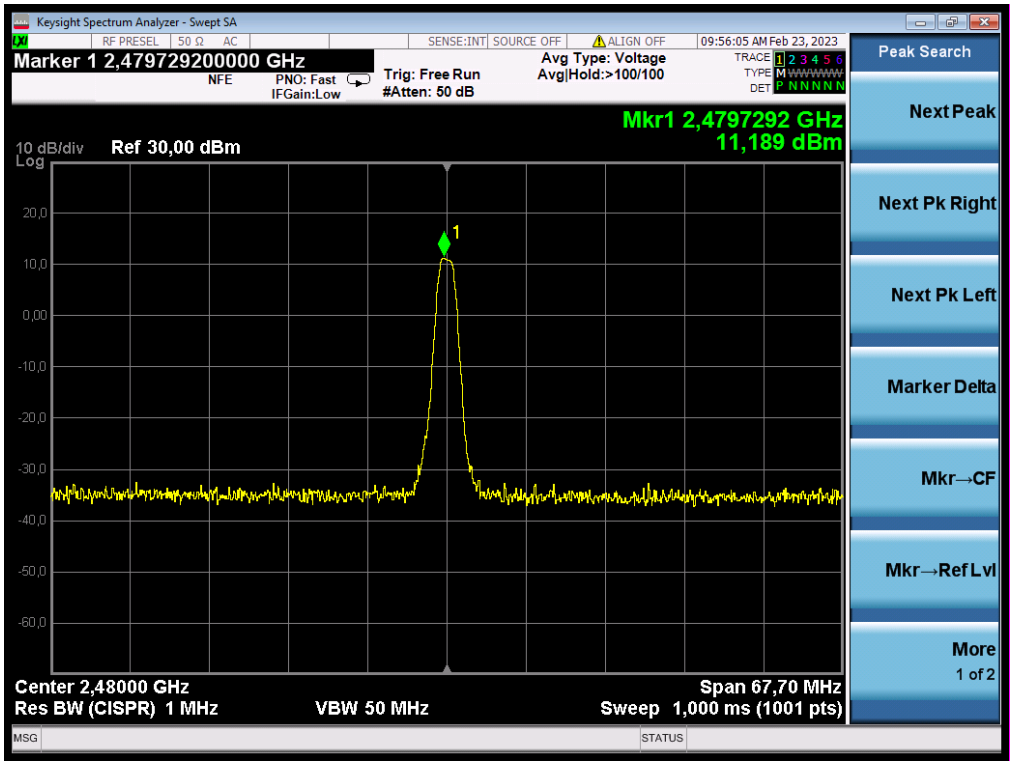
Test result TX04

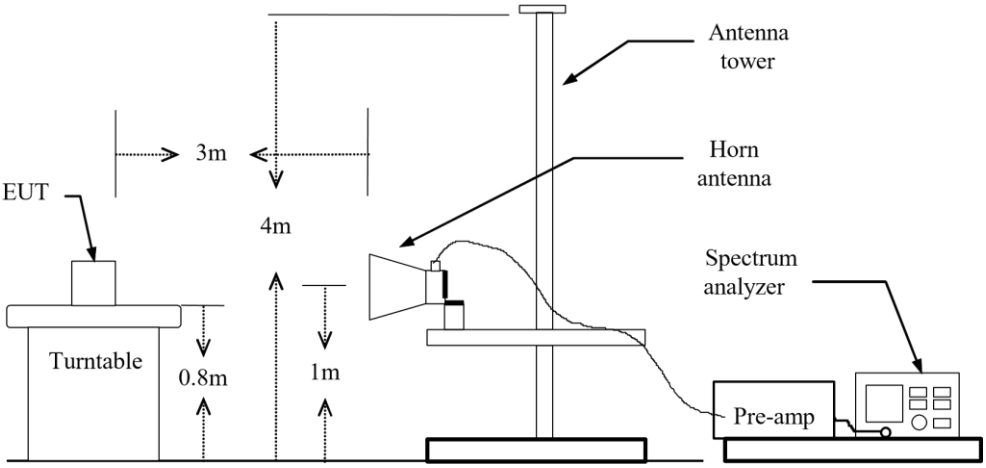


Test result TX05

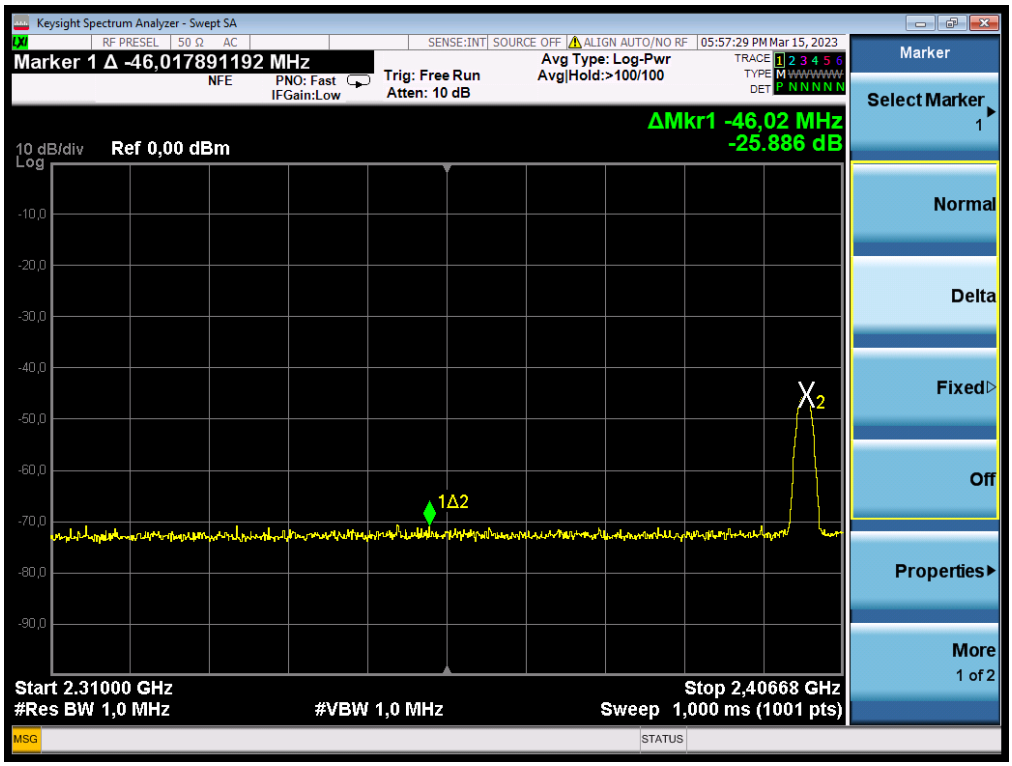


Test result TX06

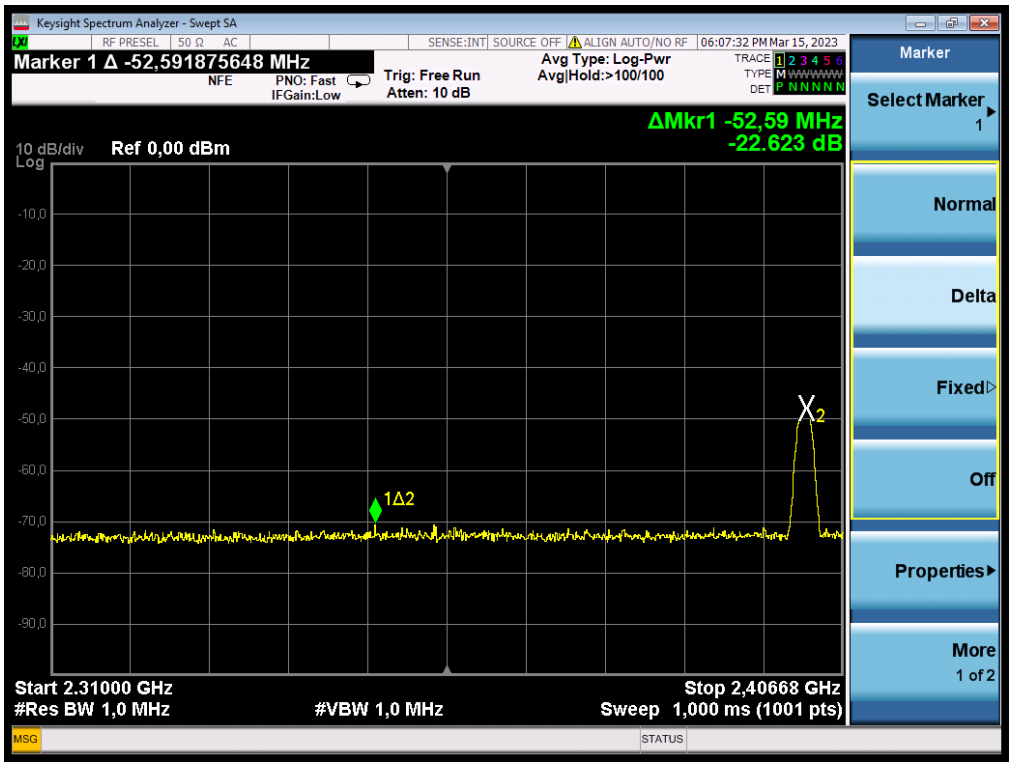


Test method:	**FCC part 15 C - §15.247 (d)** **Band Edge measurement** For details see par. 4 of this report	
Operator	Marco Nicolè	
Test Date	2023-03-22	
Test Temperature	22 °C	
Test Humidity	35 %	
Test Pressure	1007 hPa	
Electrical wiring	*Cable*	*Length [m]*
	a.c. input cable	3.0
Operating conditions	TX04; TX06 See par. 5 of this report	
Auxiliary equipment (AE)	See par. 3.5 of this report	
Limits	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. 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).	
Test set up		
Measuring distance in the anechoic chamber	3 m	
Test instrumentations	See Annex B	
Measurement Uncertainty (k=2)	See Annex F	
Result	**COMPLIES**	
Test Procedure	The EUT is placed on a turntable, which is 1.5 m above the ground plane. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission. Set the spectrum analyser in the following setting in order to capture the lower and upper band-edges of the emission: RBW=VBW=1MHz / Sweep=AUTO Repeat the procedures in the other POLARIZATION.	
Note	The worst condition between X, Y and Z axis was checked	
EUT modification during this test	None	

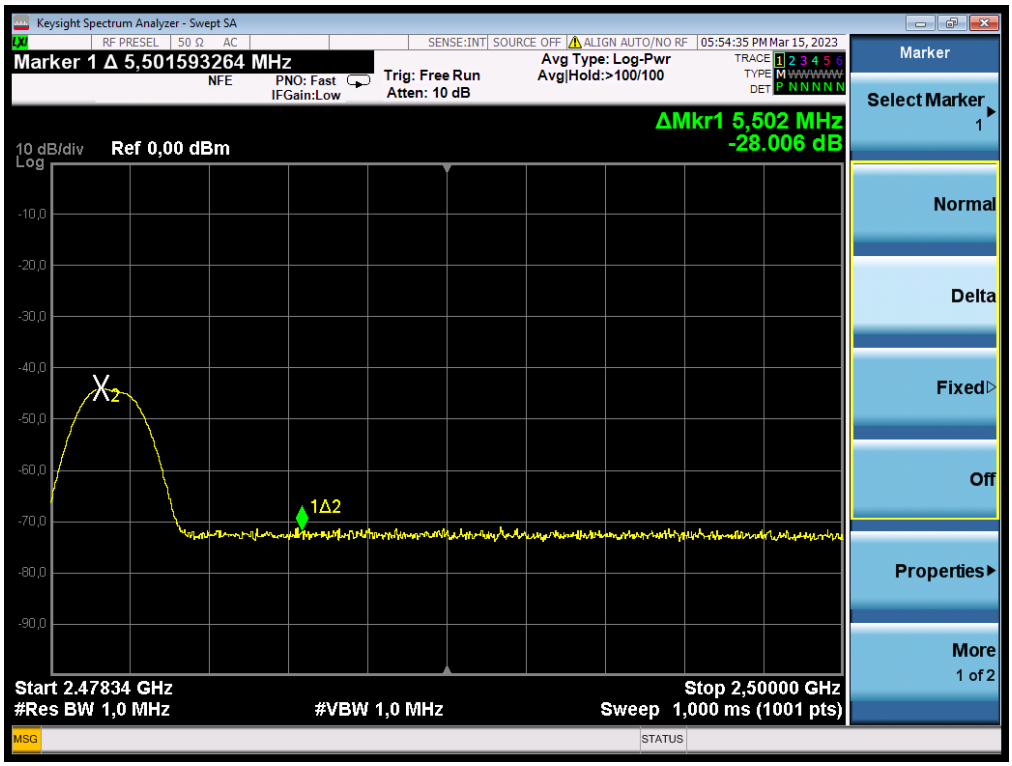
Test result TX04 – BAND EDGE LEFT SIDE
Vertical polarization



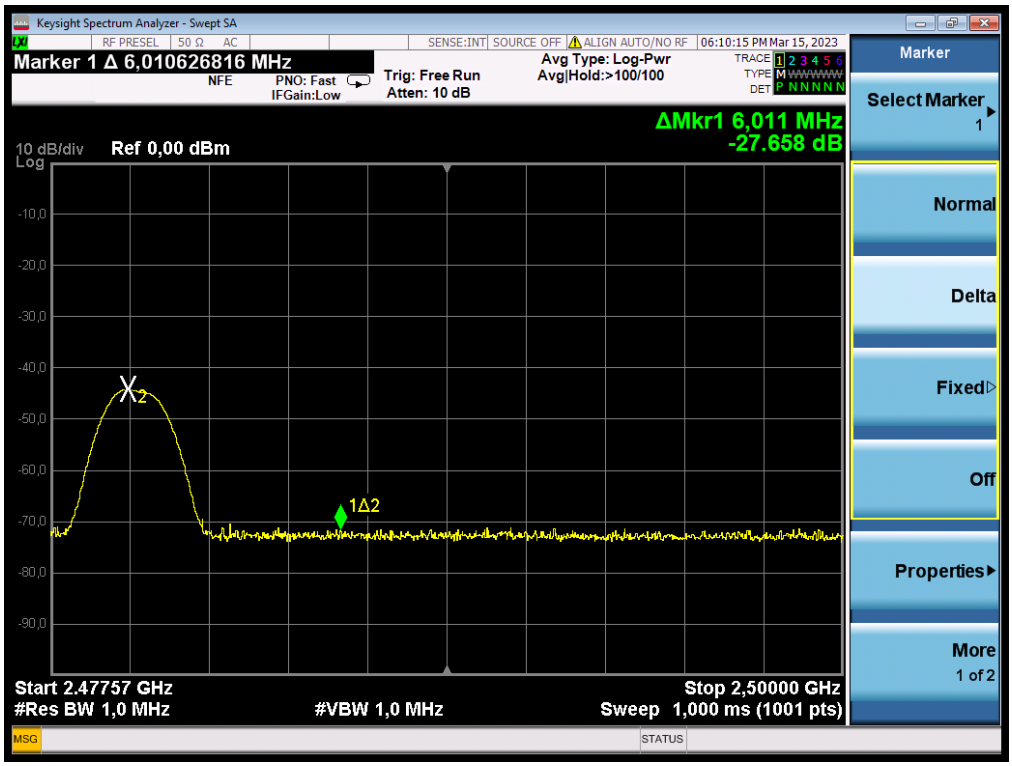
Test result TX04 – BAND EDGE LEFT SIDE
Horizontal polarization



Test result TX06 – BAND EDGE RIGHT SIDE
Vertical polarization



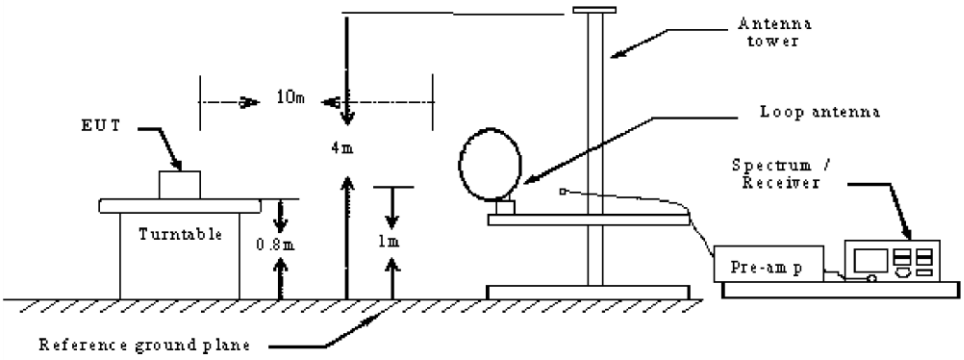
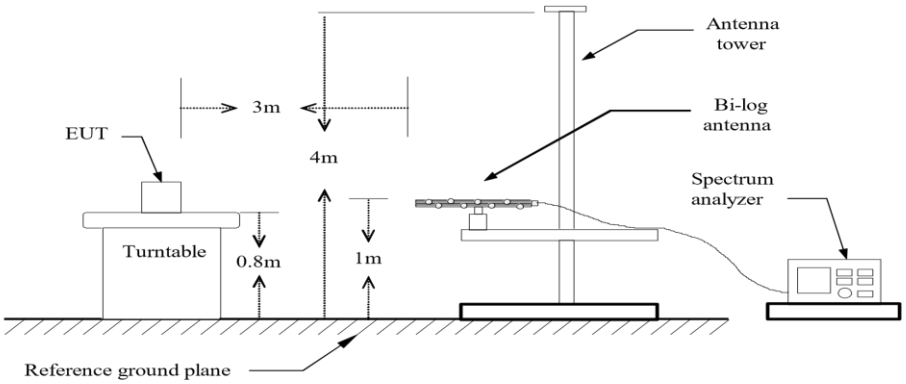
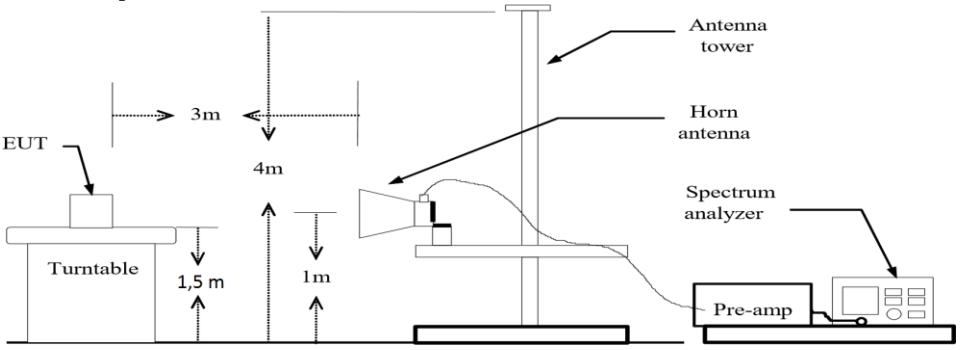
Test result TX06 – BAND EDGE RIGHT SIDE
Horizontal polarization



Test method:	**FCC part 15 C - § 15.209** **Spurious Emission (Radiation)** For details see par. 4 of this report
Operator	Marco Nicolè
Test Date	2023-02-23
Test Temperature	23 °C
Test Humidity	35 %
Test Pressure	1009 hPa
EUT Classification	None.
Electrical wiring	*Cable* — *Length [m]* d.c. input cable — 1.5
Operating conditions	TX04; TX05; TX06 See par. 5 of this report
Auxiliary equipment (AE)	See par. 3.5 of this report
Limits	

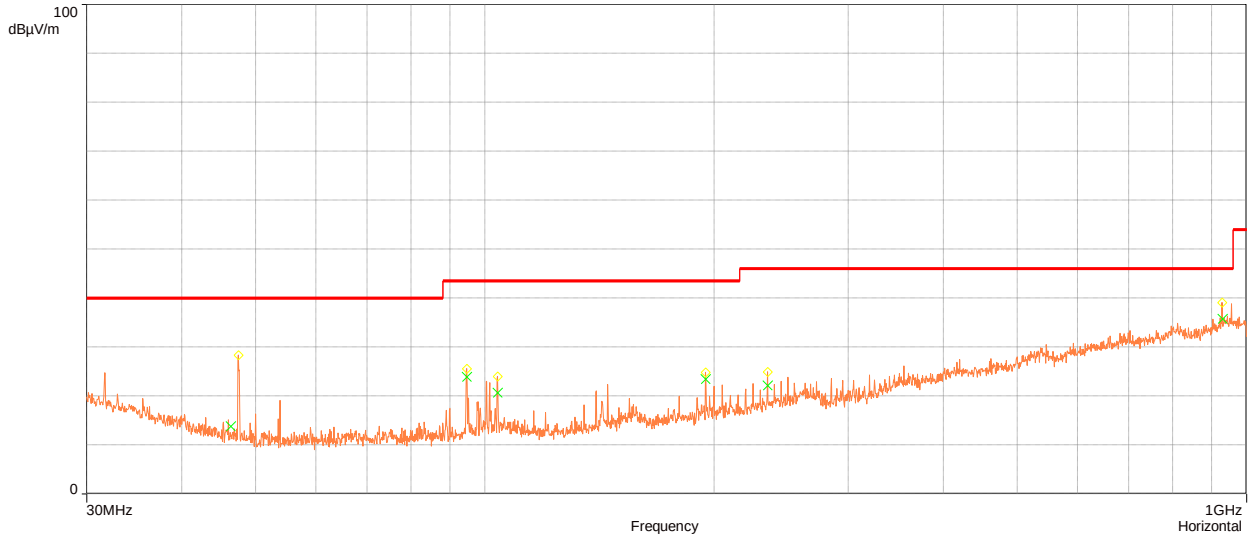
Frequency (MHz)	Limits (dBuV/m)	Detector	Measured distance (m)
30~88	40	PK	3
88~216	43.5	PK	
216-960	46	PK	
Above 960	54	PK	

Frequency (GHz)	Limits (dBuV/m)	Detector	Measured distance (m)
1 - 40	54	AVG	3
1-40	74	PK	3

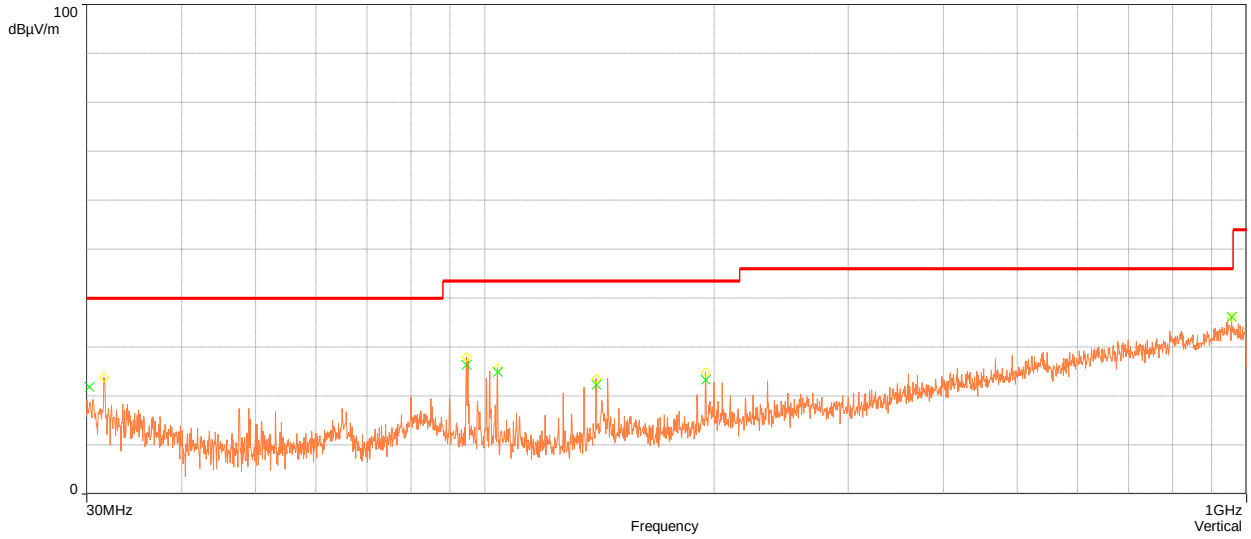
Test set up	Radiated Spurious Measurement: below 30MHz  Radiated Spurious Measurement: below 1GHz  Radiated Spurious Measurement: above 1GHz 
Frequency range	from 30 MHz up through the 10th harmonic
Measuring distance in the anechoic chamber	3 m
Test instrumentations	See Annex B
Measurement Uncertainty (k=2)	See Annex F

Test Procedure	**Radiated Emission (30 MHz – 1000 MHz) :** The preliminary radiated emissions measurement were carried out. The preliminary radiated measurements were performed at the measurement distance that specified for compliance to determine the emission characteristics of the EUT. The EUT configuration (in X, Y and Z axis), cable configuration and mode of operation were determined for producing the maximum level of emissions. These configurations were used for the final radiated emissions measurements. The measurement is carried out using a spectrum analyser or receiver. The Quasi-peak detector is used and RBW is set to 120kHz .The antenna height and turn table rotation is adjusted until the maximum power value is founded on spectrum analyser or receiver. **Radiated Emission (Above 1 GHz) :** The preliminary radiated emissions measurement were carried out. The preliminary radiated measurements were performed at the measurement distance that specified for compliance to determine the emission characteristics of the EUT. The EUT configuration (in X, Y and Z axis), cable configuration and mode of operation were determined for producing the maximum level of emissions. These configurations were used for the final radiated emissions measurements. The measurement is carried out using a spectrum analyser or receiver. The spectrum analyser scans from 1GHz to 25GHz (higher than the 10th harmonic of the carrier). The peak detector is used for Peak limit and RBW is set to 1MHz ,VBW ≥ 3RBW. The peak detector is used for Average limit and RBW is set to 1MHz ,VBW is not smaller than 1/T, T = to the shortest pulse width. The antenna height and turn table rotation is adjusted until the maximum power value is founded on spectrum analyser or receiver.
Note	The worst condition between X, Y and Z axis was checked
EUT modification during this test	None

Horizontal polarization
TX04
Range 30 MHz – 1 GHz

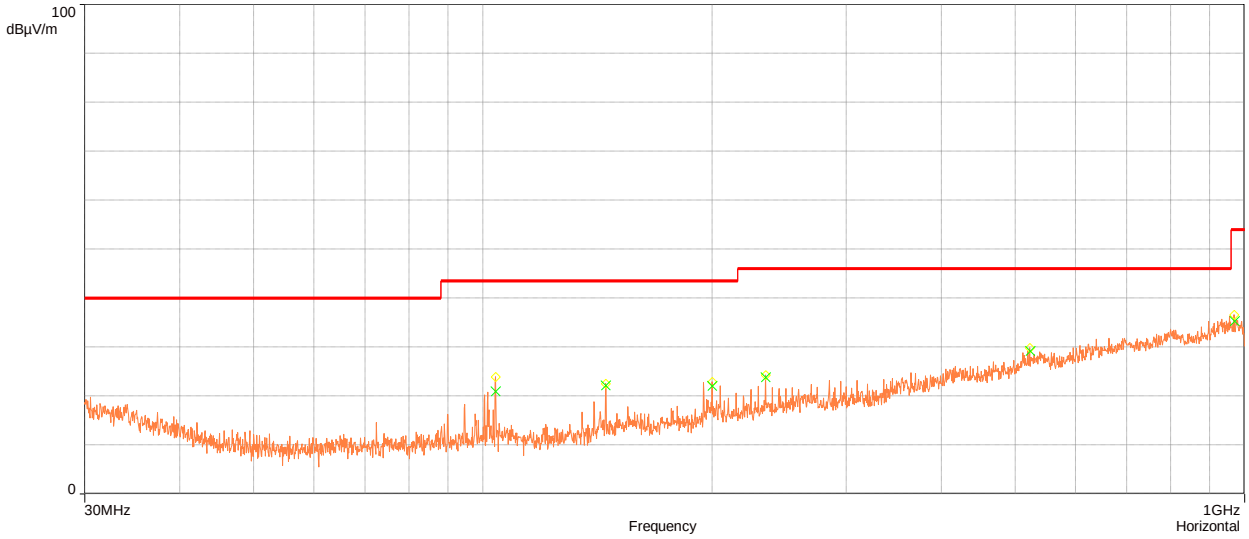


Vertical polarization
TX04
Range 30 MHz – 1 GHz

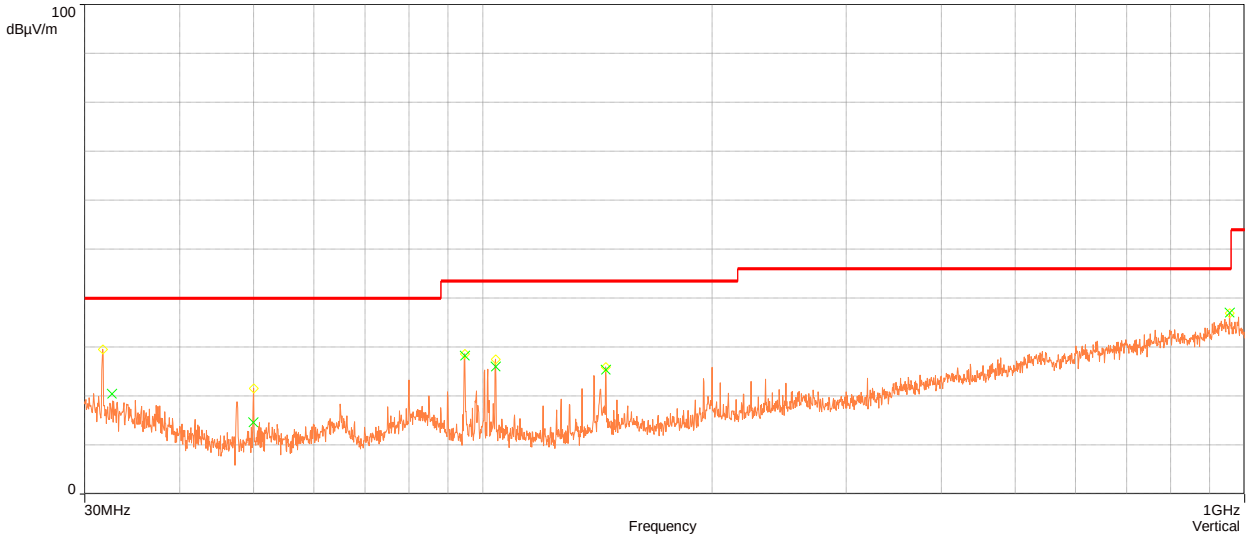


Frequency (MHz)	SR	Peak (dBµV/m)	QPeak (dBµV/m)	LimQPeak (dBµV/m)	Delta (dB)	Polarization	Height (m)	Angle (deg)
46.3555	1	28.32	13.83	40.00	-26.17	Horizontal	3.38	240.20
94.6155	1	25.55	23.86	43.52	-19.66	Horizontal	3.77	120.40
103.955	1	23.99	20.69	43.52	-22.83	Horizontal	2.71	60.30
194.995	1	24.86	23.46	43.52	-20.06	Horizontal	1.21	330.30
235.0555	1	24.92	22.13	46.00	-23.87	Horizontal	1.37	60.30
930.515	1	39.12	35.72	46.00	-10.28	Horizontal	1.04	150.30
30.215	2	23.78	21.88	40.00	-18.12	Vertical	1.00	359.80
94.5555	2	27.98	26.39	43.52	-17.13	Vertical	1.00	150.30
103.9155	2	25.73	24.95	43.52	-18.57	Vertical	1.00	89.90
140.035	2	23.56	22.28	43.52	-21.24	Vertical	1.00	180.30
194.995	2	24.94	23.38	43.52	-20.14	Vertical	1.00	150.30
955.8955	2	36.07	36.21	46.00	-9.79	Vertical	1.00	300.30

Horizontal polarization
TX05
Range 30 MHz – 1 GHz

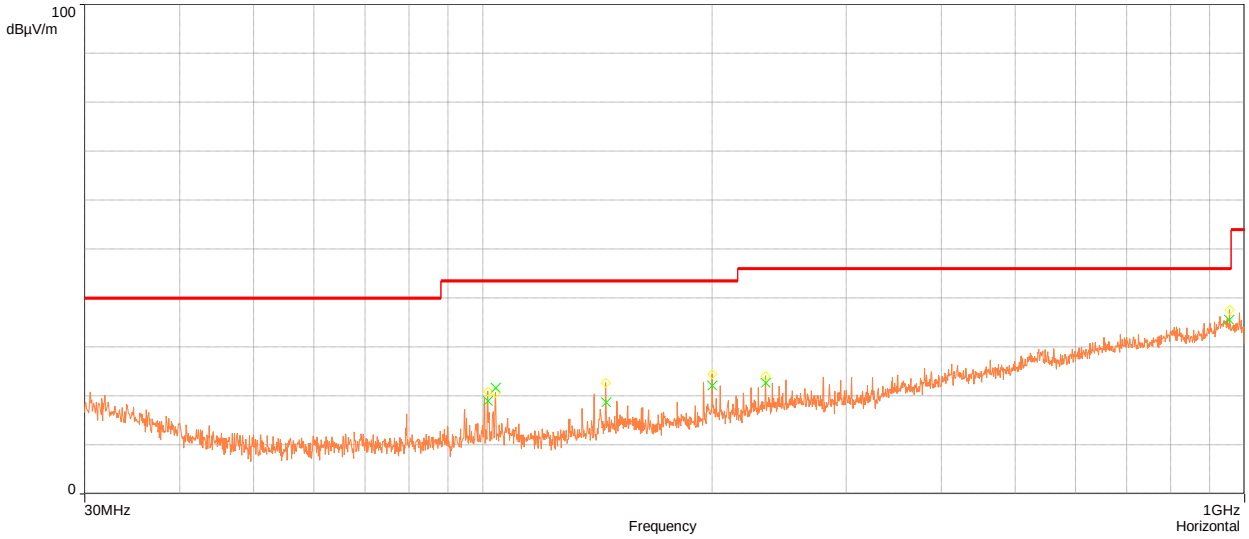


Vertical polarization
TX05
Range 30 MHz – 1 GHz

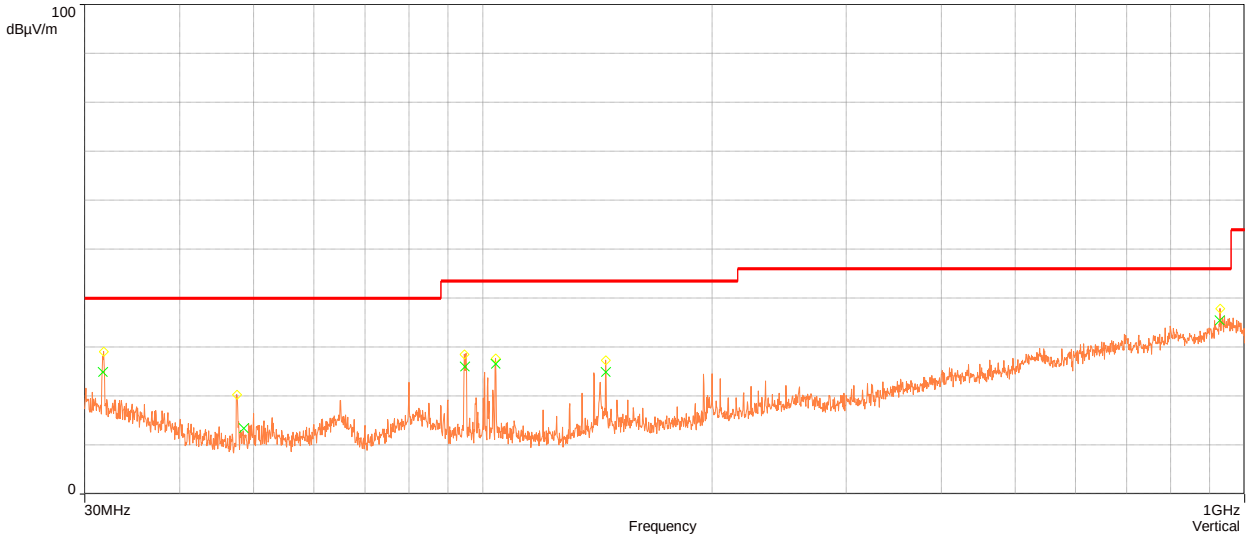


Frequency (MHz)	SR	Peak (dBµV/m)	QPeak (dBµV/m)	LimQPeak (dBµV/m)	Delta (dB)	Polarization	Height (m)	Angle (deg)
103.8555	1	23.93	20.91	43.52	-22.61	Horizontal	1.00	30.30
145.0155	1	22.54	22.10	43.52	-21.42	Horizontal	1.00	60.00
199.9755	1	22.88	22.04	43.52	-21.48	Horizontal	1.00	60.00
235.015	1	24.23	23.85	46.00	-22.15	Horizontal	1.00	60.00
522.955	1	29.81	29.14	46.00	-16.86	Horizontal	1.00	300.20
969.7555	1	36.60	35.30	54.00	-18.70	Horizontal	1.00	330.40
32.5755	2	29.58	20.49	40.00	-19.51	Vertical	1.00	300.40
49.935	2	21.63	14.63	40.00	-25.37	Vertical	1.00	90.20
94.615	2	28.60	28.22	43.52	-15.30	Vertical	1.00	60.30
103.9155	2	27.54	26.03	43.52	-17.49	Vertical	1.00	240.30
145.015	2	25.94	25.34	43.52	-18.18	Vertical	1.00	150.30
955.855	2	36.97	37.01	46.00	-8.99	Vertical	1.00	210.20

Horizontal polarization
TX06
Range 30 MHz – 1 GHz

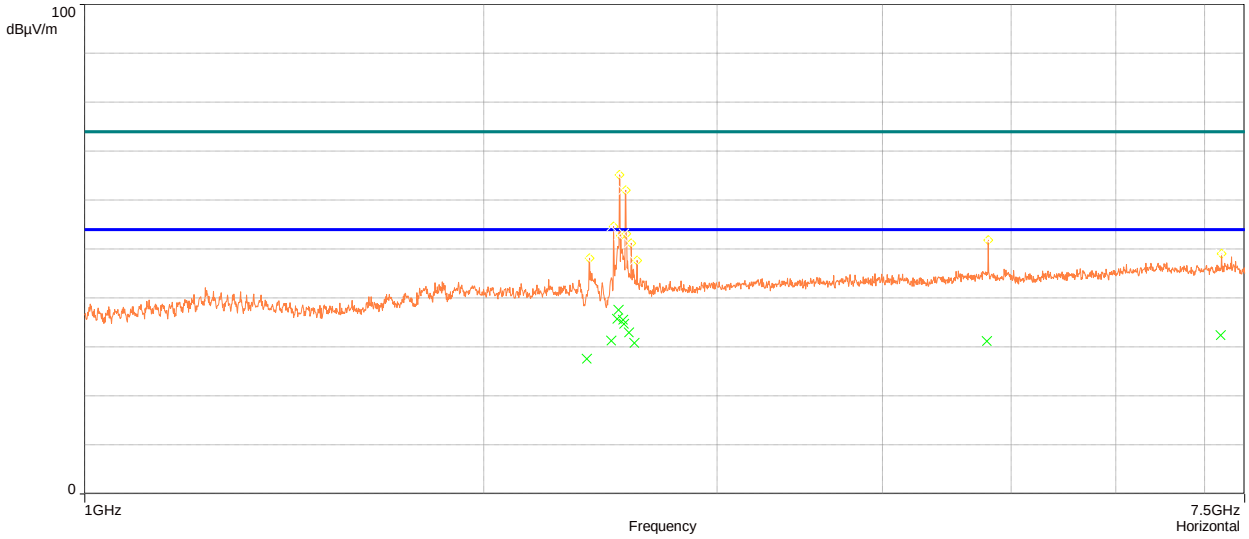


Vertical polarization
TX06
Range 30 MHz – 1 GHz

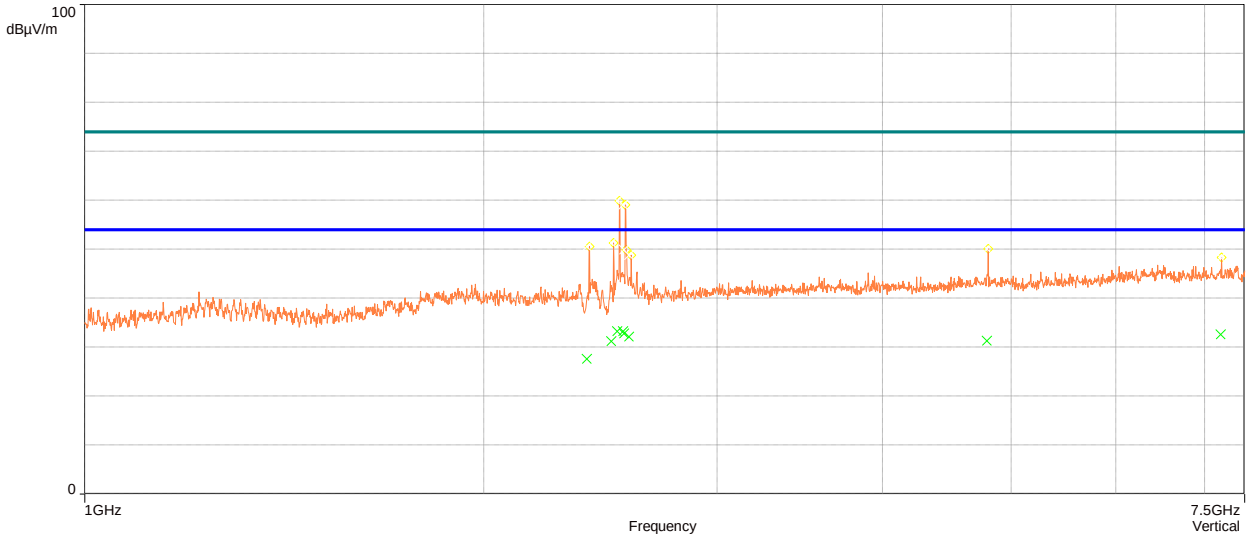


Frequency (MHz)	SR	Peak (dBµV/m)	QPeak (dBµV/m)	LimQPeak (dBµV/m)	Delta (dB)	Polarization	Height (m)	Angle (deg)
101.4555	1	20.94	18.94	43.52	-24.58	Horizontal	1.00	30.30
103.915	1	20.63	21.70	43.52	-21.82	Horizontal	1.00	300.30
145.055	1	22.72	18.74	43.52	-24.78	Horizontal	1.00	90.20
199.9755	1	24.46	22.14	43.52	-21.38	Horizontal	1.00	30.30
235.0155	1	24.09	22.66	46.00	-23.34	Horizontal	1.00	30.30
954.4555	1	37.63	35.52	46.00	-10.48	Horizontal	1.00	60.40
31.7	2	29.11	24.92	40.00	-15.08	Vertical	1.00	210.20
48.5155	2	20.33	13.43	40.00	-26.57	Vertical	1.00	270.20
94.655	2	28.57	26.05	43.52	-17.47	Vertical	1.00	30.30
103.9155	2	27.65	26.55	43.52	-16.97	Vertical	1.00	210.20
145.015	2	27.33	24.89	43.52	-18.63	Vertical	1.00	150.30
927.9755	2	37.85	35.50	46.00	-10.50	Vertical	1.00	180.30

Horizontal polarization
TX04
Range 1 GHz – 7.5 GHz

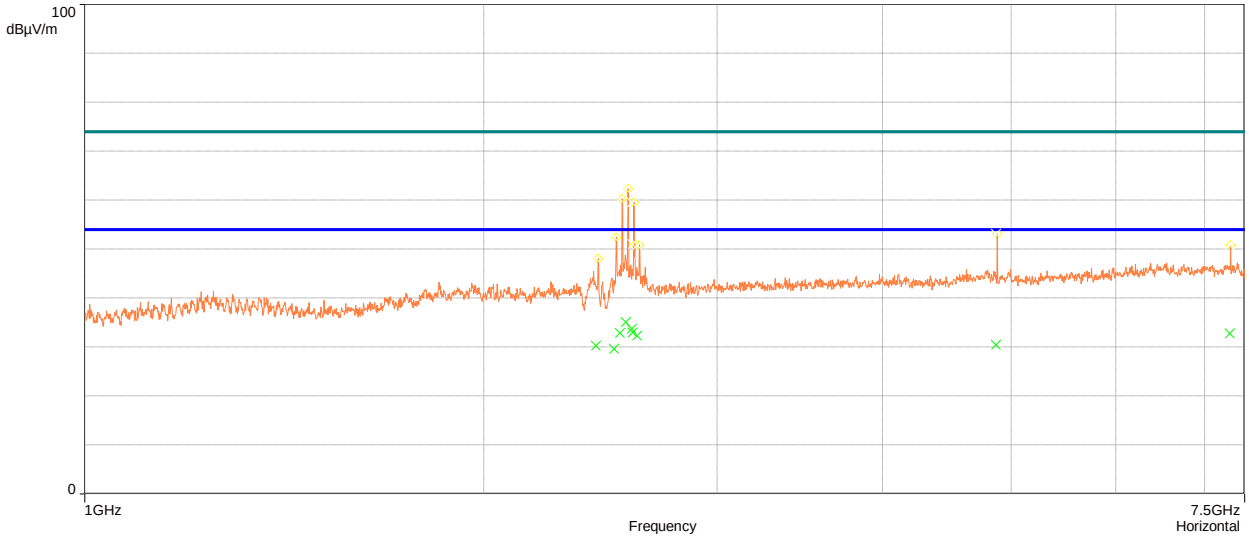


Vertical polarization
TX04
Range 1 GHz – 7.5 GHz

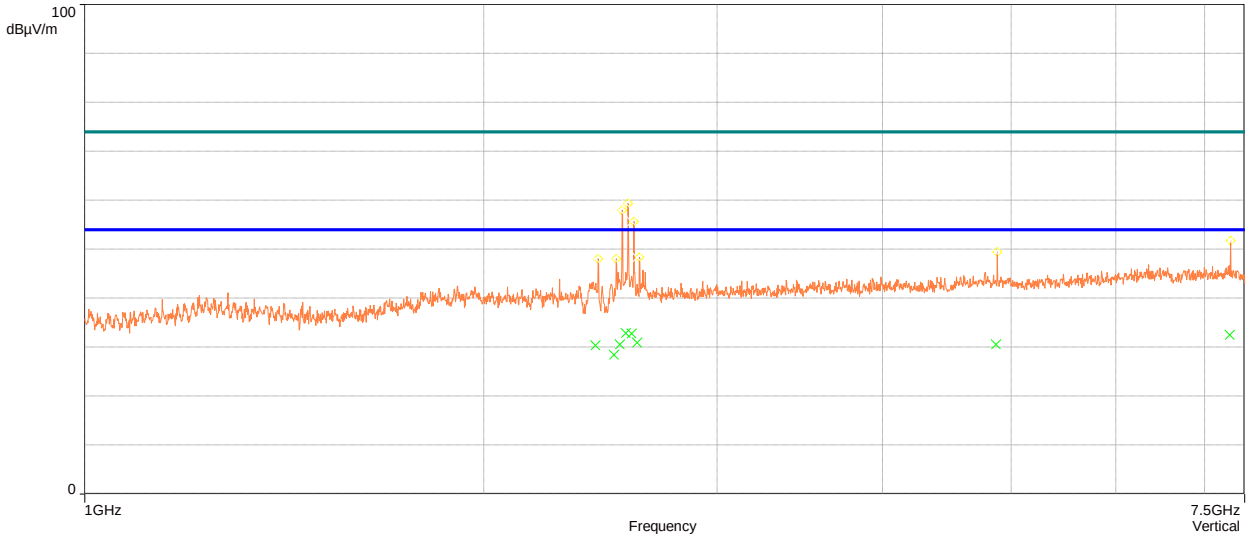


Frequency (MHz)	SR	Peak (dBµV/m)	LimPeak (dBµV/m)	Delta (dB)	CISPR AVG (dBµV/m)	Lim AVG (dBµV/m)	Delta AVG (dB)	Angle (deg)
2391.5	1	48.19	74.00	46.39	27.61	54.00	26.39	90.10
2495.5	1	54.59	74.00	42.69	31.31	54.00	22.69	329.90
2521	1	65.20	74.00	38.23	35.77	54.00	18.23	329.90
2527	1	52.74	74.00	36.39	37.61	54.00	16.39	329.90
2547.5	1	62.05	74.00	38.45	35.55	54.00	18.45	329.90
2551	1	53.16	74.00	39.28	34.72	54.00	19.28	329.90
2573	1	51.26	74.00	41.02	32.98	54.00	21.02	329.90
2599	1	47.74	74.00	43.17	30.83	54.00	23.17	60.00
4793.5	1	51.83	74.00	42.75	31.25	54.00	22.75	300.10
7195.5	1	49.09	74.00	41.55	32.45	54.00	21.55	240.20
2391.5	2	50.53	74.00	46.36	27.64	54.00	26.36	240.20
2495	2	51.31	74.00	42.79	31.20	54.00	22.80	240.20
2521	2	59.87	74.00	40.78	33.22	54.00	20.78	240.20
2547	2	59.06	74.00	40.74	33.26	54.00	20.74	240.20
2551	2	49.92	74.00	41.18	32.82	54.00	21.18	240.20
2573	2	48.85	74.00	41.85	32.15	54.00	21.85	210.20
4793.5	2	50.12	74.00	42.74	31.26	54.00	22.74	120.30
7196	2	48.32	74.00	41.38	32.62	54.00	21.38	180.30

Horizontal polarization
TX05
Range 1 GHz – 7.5 GHz

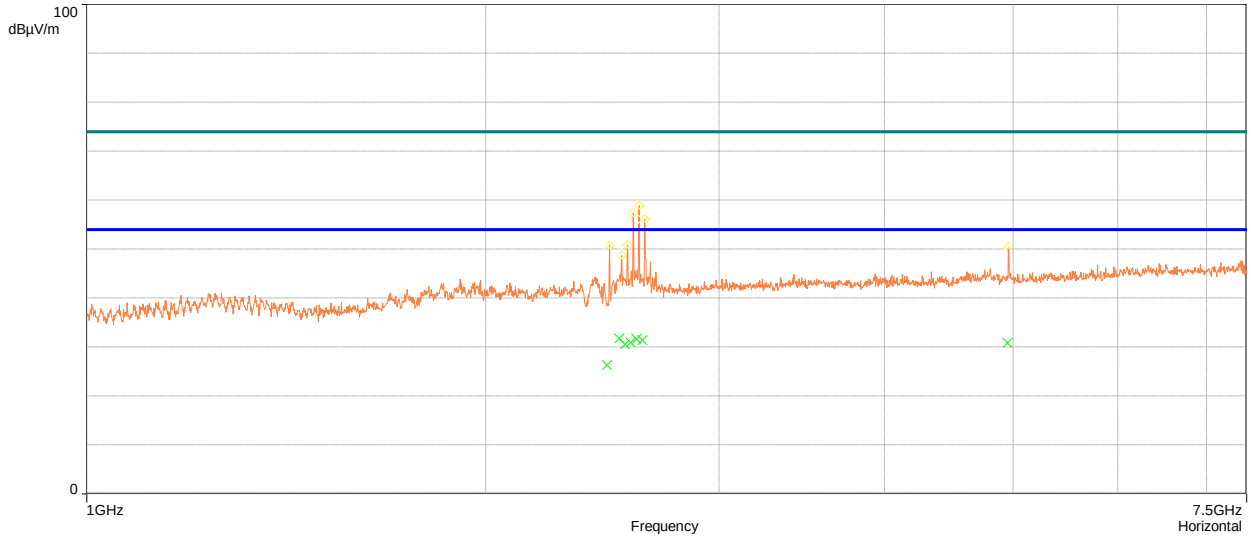


Vertical polarization
TX05
Range 1 GHz – 7.5 GHz

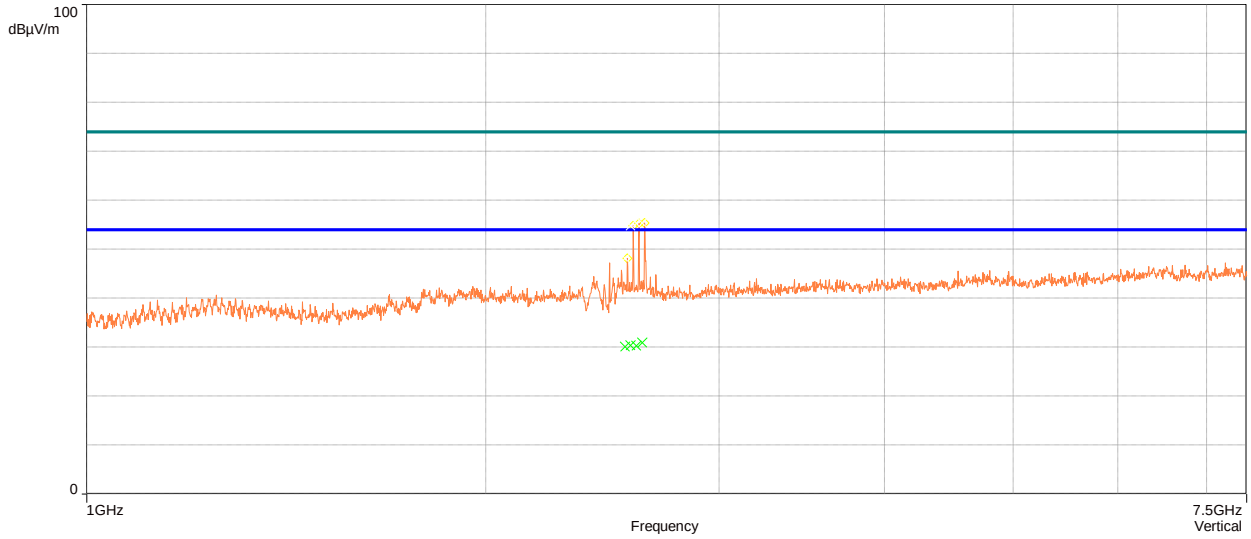


Frequency (MHz)	SR	Peak (dBµV/m)	LimPeak (dBµV/m)	Delta (dB)	CISPR AVG (dBµV/m)	Lim AVG (dBµV/m)	Delta AVG (dB)	Angle (deg)
2429	1	48.05	74.00	43.72	30.27	54.00	23.73	330.10
2507	1	52.45	74.00	44.39	29.61	54.00	24.39	330.10
2533	1	60.30	74.00	41.13	32.87	54.00	21.13	330.10
2559	1	62.28	74.00	38.88	35.12	54.00	18.88	330.10
2585	1	59.50	74.00	40.32	33.68	54.00	20.32	330.10
2589	1	51.01	74.00	41.07	32.93	54.00	21.07	330.10
2610.5	1	50.83	74.00	41.69	32.31	54.00	21.69	330.10
4868.5	1	53.15	74.00	43.49	30.51	54.00	23.49	359.90
7308.5	1	50.86	74.00	41.21	32.79	54.00	21.21	240.30
2428.5	2	48.11	74.00	43.66	30.34	54.00	23.66	90.10
2507	2	48.06	74.00	45.59	28.41	54.00	25.59	240.30
2532.5	2	57.93	74.00	43.41	30.59	54.00	23.41	210.20
2559	2	59.37	74.00	41.11	32.89	54.00	21.11	210.20
2585	2	55.69	74.00	41.23	32.77	54.00	21.23	210.20
2610.5	2	48.32	74.00	43.05	30.95	54.00	23.05	240.30
4869	2	49.49	74.00	43.46	30.54	54.00	23.46	120.30
7308.5	2	51.73	74.00	41.48	32.52	54.00	21.48	359.70

Horizontal polarization
TX06
Range 1 GHz – 7.5 GHz

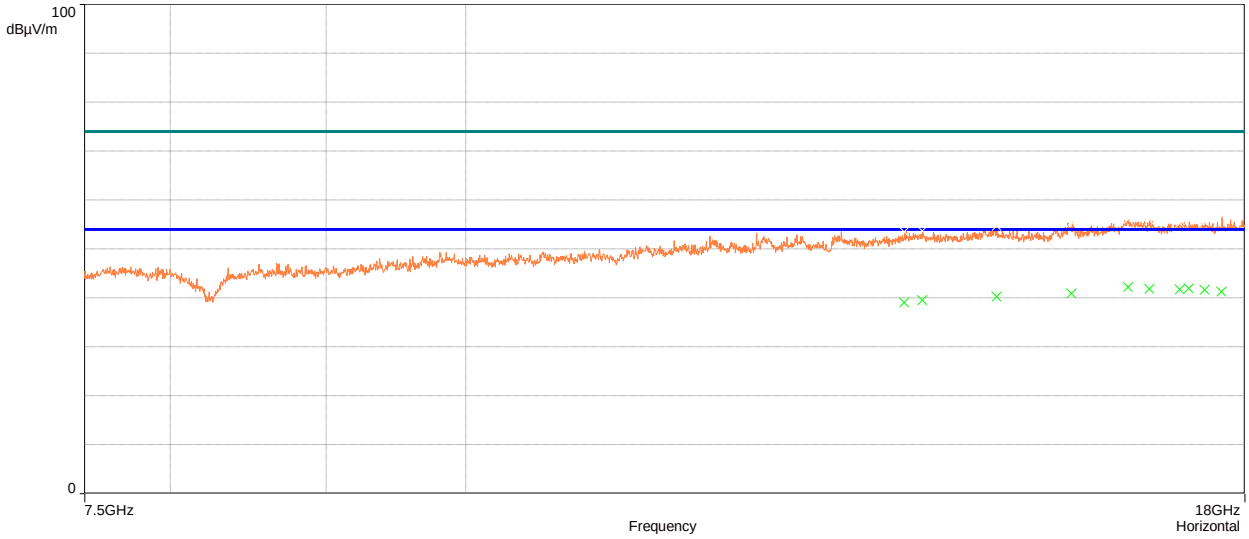


Vertical polarization
TX06
Range 1 GHz – 7.5 GHz

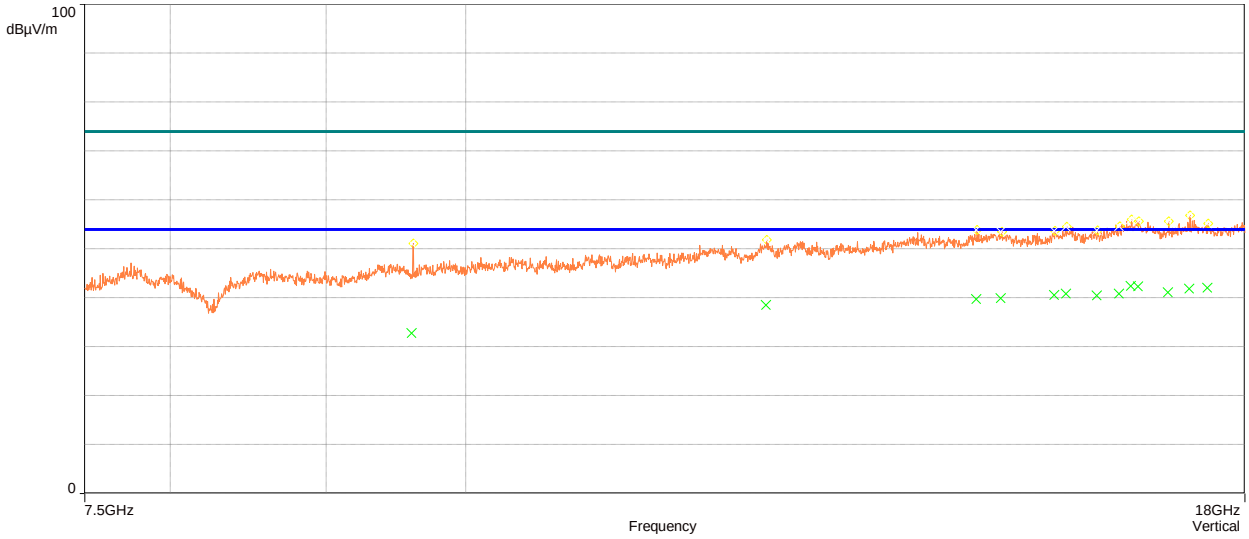


Frequency (MHz)	SR	Peak (dBµV/m)	LimPeak (dBµV/m)	Delta (dB)	CISPR AVG (dBµV/m)	Lim AVG (dBµV/m)	Delta AVG (dB)	Angle (deg)
2468.5	1	50.74	74.00	47.69	26.31	54.00	27.69	330.10
2521.5	1	48.71	74.00	42.27	31.73	54.00	22.27	330.10
2547	1	50.87	74.00	43.45	30.55	54.00	23.45	330.10
2572.5	1	57.35	74.00	43.03	30.97	54.00	23.03	330.10
2599	1	58.87	74.00	42.34	31.66	54.00	22.34	330.10
2625	1	56.13	74.00	42.63	31.37	54.00	22.63	330.10
4948.5	1	50.48	74.00	43.16	30.84	54.00	23.16	359.80
2546.5	2	48.20	74.00	43.91	30.08	54.00	23.92	240.30
2572.5	2	54.83	74.00	43.63	30.37	54.00	23.63	210.10
2599	2	55.29	74.00	43.74	30.26	54.00	23.74	240.30
2625	2	55.36	74.00	43.07	30.93	54.00	23.07	240.30

Horizontal polarization
TX04
Range 7.5 GHz – 18 GHz

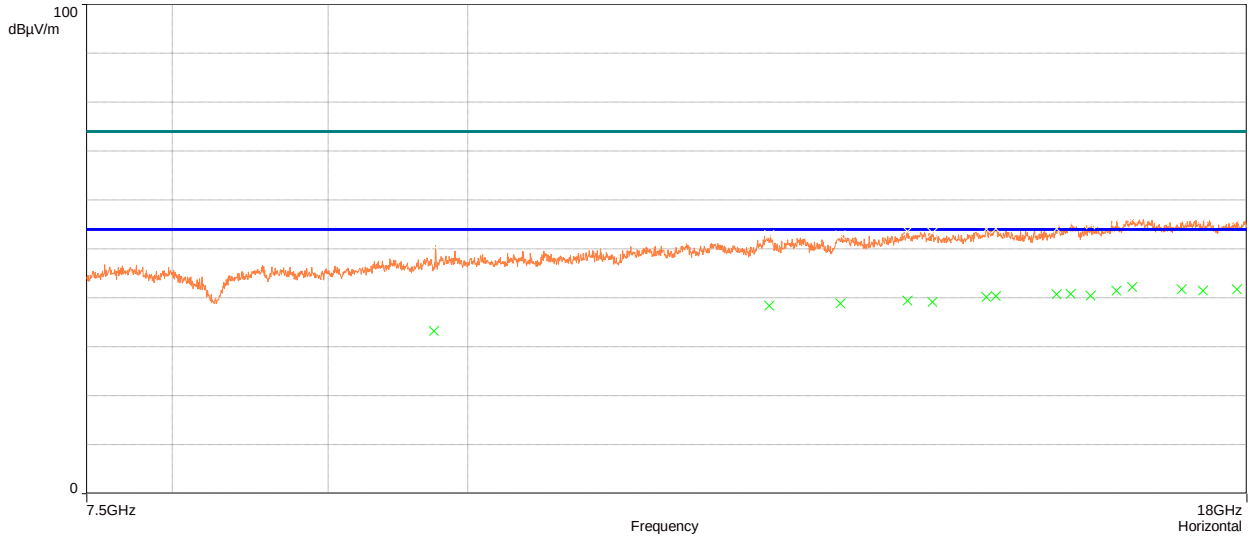


Vertical polarization
TX04
Range 7.5 GHz – 18 GHz

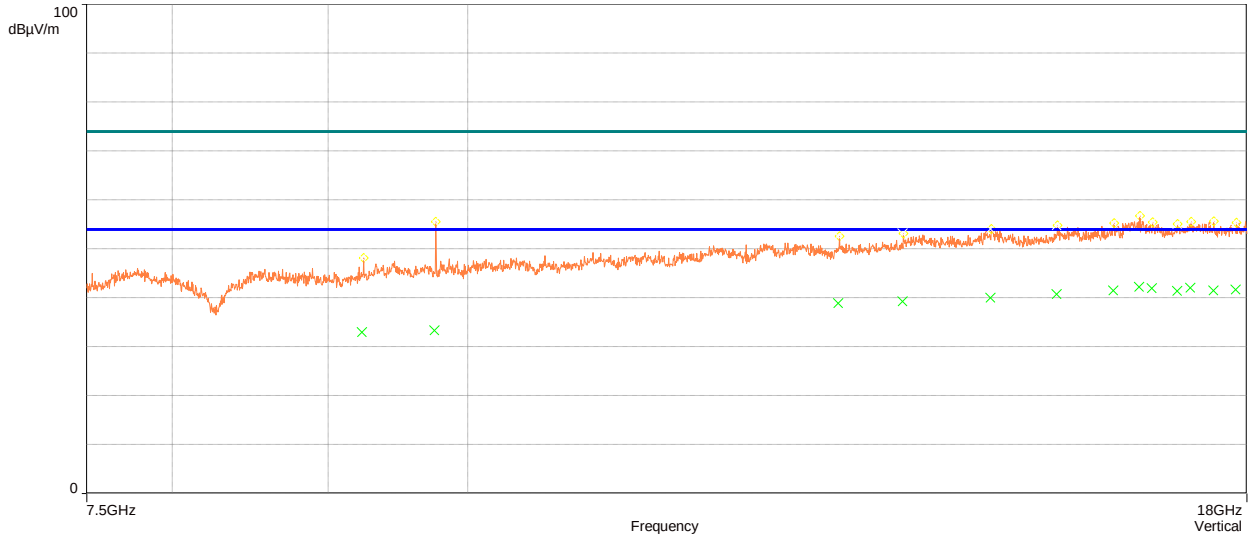


Frequency (MHz)	SR	Peak (dBµV/m)	LimPeak (dBµV/m)	Delta (dB)	CISPR AVG (dBµV/m)	Lim AVG (dBµV/m)	Delta AVG (dB)	Angle (deg)
13918	1	53.50	74.00	34.91	39.09	54.00	14.91	29.90
14108	1	53.75	74.00	34.43	39.57	54.00	14.43	180.30
14925.5	1	54.70	74.00	33.70	40.30	54.00	13.70	300.30
15793	1	55.51	74.00	33.02	40.98	54.00	13.02	180.30
16482.5	1	56.09	74.00	31.75	42.25	54.00	11.75	359.90
16747.5	1	55.90	74.00	32.14	41.86	54.00	12.14	120.30
17135	1	55.33	74.00	32.21	41.79	54.00	12.21	270.30
17252	1	55.92	74.00	32.03	41.97	54.00	12.03	210.10
17463.5	1	55.53	74.00	32.33	41.67	54.00	12.33	120.30
17684	1	56.72	74.00	32.68	41.32	54.00	12.68	359.90
9598	2	51.09	74.00	41.22	32.78	54.00	21.22	359.90
12538	2	51.82	74.00	35.47	38.53	54.00	15.47	30.00
14694	2	53.88	74.00	34.27	39.73	54.00	14.27	60.20
14972	2	53.55	74.00	34.07	39.93	54.00	14.07	359.90
15586	2	53.67	74.00	33.40	40.60	54.00	13.40	180.20
15727	2	54.57	74.00	33.16	40.84	54.00	13.16	270.00
16096.5	2	53.84	74.00	33.57	40.43	54.00	13.57	120.30
16365.5	2	54.61	74.00	33.17	40.83	54.00	13.17	359.90
16514.5	2	56.05	74.00	31.55	42.45	54.00	11.55	210.10
16604.5	2	55.70	74.00	31.64	42.36	54.00	11.64	150.20
16984	2	55.67	74.00	32.89	41.11	54.00	12.89	60.20
17260.5	2	56.88	74.00	32.12	41.88	54.00	12.12	210.10
17497	2	55.23	74.00	31.97	42.03	54.00	11.97	60.20

Horizontal polarization
TX05
Range 7.5 GHz – 18 GHz

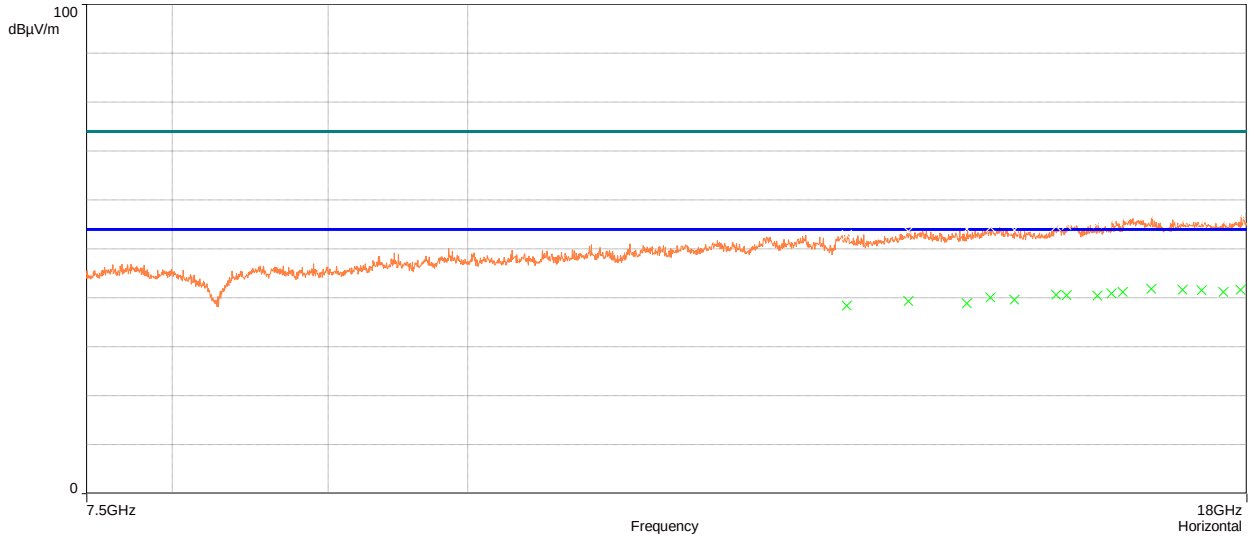


Vertical polarization
TX05
Range 7.5 GHz – 18 GHz

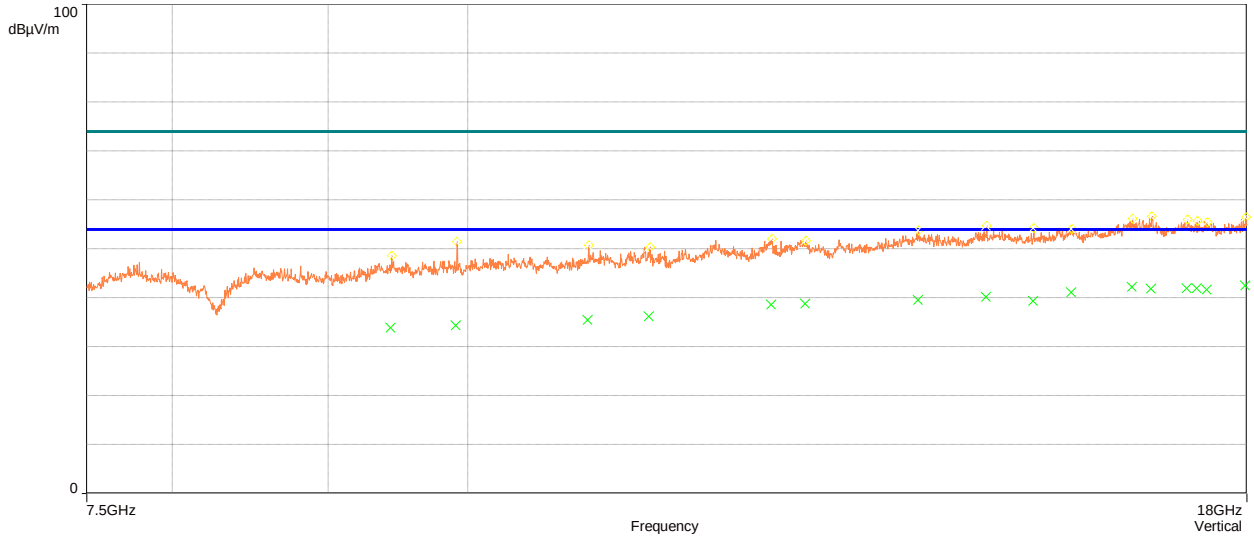


Frequency (MHz)	SR	Peak (dBµV/m)	LimPeak (dBµV/m)	Delta (dB)	CISPR AVG (dBµV/m)	Lim AVG (dBµV/m)	Delta AVG (dB)	Angle (deg)
9747.5	1	50.68	74.00	40.76	33.24	54.00	20.76	90.20
12553	1	52.88	74.00	35.58	38.42	54.00	15.58	150.30
13245.5	1	52.78	74.00	35.09	38.91	54.00	15.09	90.20
13932.5	1	53.61	74.00	34.51	39.49	54.00	14.51	210.10
14198.5	1	53.37	74.00	34.81	39.19	54.00	14.81	120.30
14785	1	54.07	74.00	33.83	40.17	54.00	13.83	300.30
14893.5	1	54.15	74.00	33.66	40.34	54.00	13.66	359.90
15593.5	1	54.13	74.00	33.27	40.73	54.00	13.27	150.30
15757	1	55.42	74.00	33.12	40.88	54.00	13.12	240.30
15999.5	1	54.97	74.00	33.51	40.49	54.00	13.51	210.10
16314.5	1	55.91	74.00	32.53	41.47	54.00	12.53	90.20
16507	1	56.11	74.00	31.74	42.26	54.00	11.74	30.10
17138	1	55.93	74.00	32.23	41.77	54.00	12.23	240.30
17412	1	56.16	74.00	32.47	41.53	54.00	12.47	30.10
17865.5	1	55.84	74.00	32.20	41.80	54.00	12.20	210.10
9230.5	2	48.14	74.00	41.01	32.99	54.00	21.01	120.30
9748	2	55.61	74.00	40.68	33.32	54.00	20.68	359.90
13223.5	2	52.57	74.00	35.07	38.93	54.00	15.07	300.10
13880.5	2	53.18	74.00	34.78	39.22	54.00	14.78	330.20
14830	2	54.10	74.00	33.96	40.04	54.00	13.96	30.10
15592	2	54.82	74.00	33.29	40.71	54.00	13.29	180.30
16275.5	2	55.30	74.00	32.55	41.45	54.00	12.55	300.10
16595.5	2	56.74	74.00	31.77	42.23	54.00	11.77	60.30
16752.5	2	55.49	74.00	32.07	41.93	54.00	12.07	180.30
17074	2	55.07	74.00	32.58	41.42	54.00	12.58	300.10
17249.5	2	55.53	74.00	32.00	42.00	54.00	12.00	60.30
17547.5	2	55.68	74.00	32.54	41.46	54.00	12.54	300.10
17847.5	2	55.42	74.00	32.30	41.70	54.00	12.30	330.20

Horizontal polarization
TX06
Range 7.5 GHz – 18 GHz

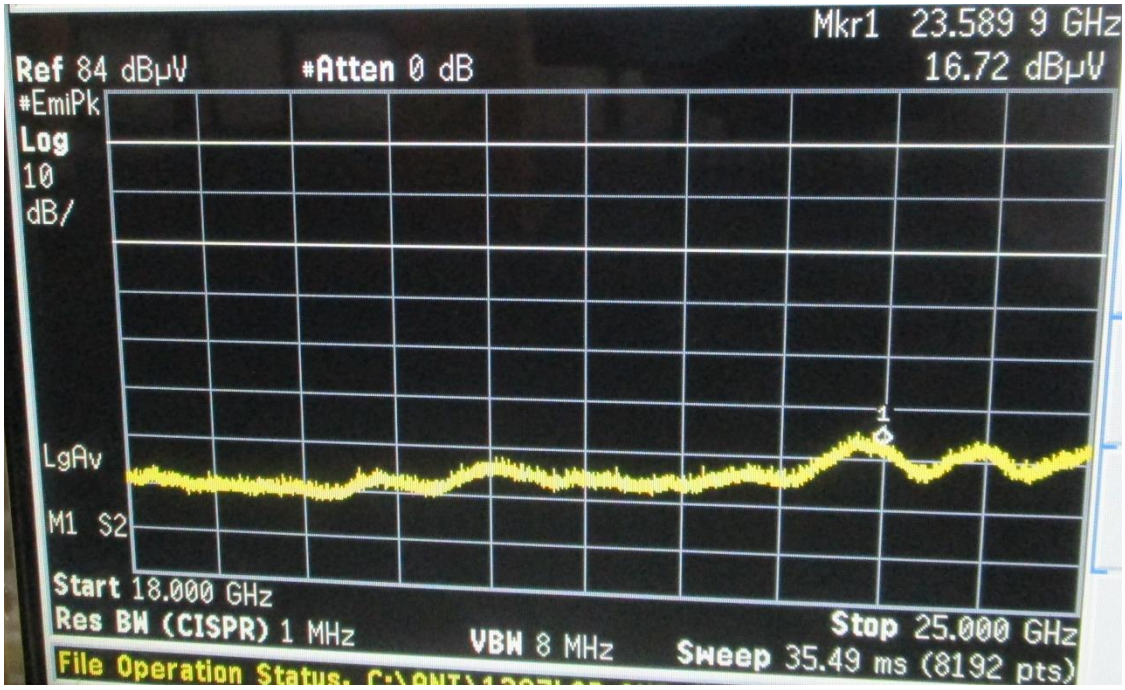


Vertical polarization
TX06
Range 7.5 GHz – 18 GHz

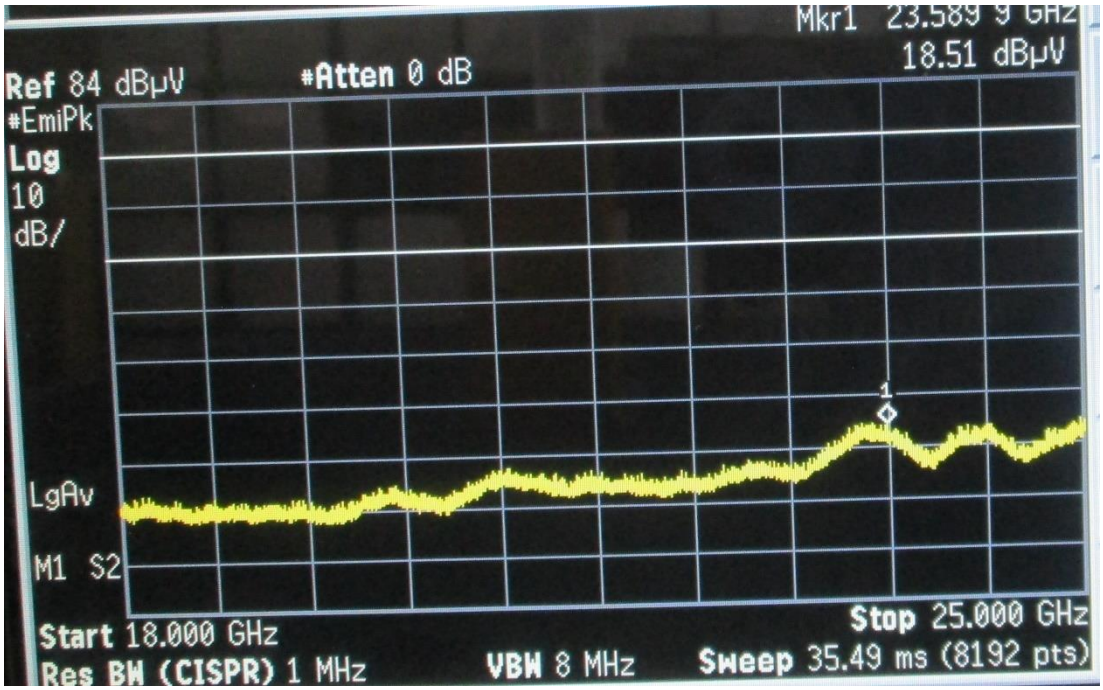


Frequency (MHz)	SR	Peak (dBµV/m)	LimPeak (dBµV/m)	Delta (dB)	CISPR AVG (dBµV/m)	Lim AVG (dBµV/m)	Delta AVG (dB)	Angle (deg)
13307	1	52.88	74.00	35.59	38.41	54.00	15.59	0.00
13944	1	53.62	74.00	34.59	39.41	54.00	14.59	60.30
14570	1	54.09	74.00	35.09	38.91	54.00	15.09	330.20
14830	1	54.42	74.00	33.92	40.08	54.00	13.92	90.20
15105	1	53.87	74.00	34.37	39.63	54.00	14.37	30.00
15585.5	1	54.62	74.00	33.37	40.63	54.00	13.37	30.00
15707	1	54.89	74.00	33.47	40.53	54.00	13.47	150.30
16081.5	1	55.20	74.00	33.52	40.48	54.00	13.52	90.20
16248.5	1	55.74	74.00	33.04	40.96	54.00	13.04	330.20
16391.5	1	56.27	74.00	32.78	41.22	54.00	12.78	240.20
16746	1	56.63	74.00	32.10	41.90	54.00	12.10	210.10
17147	1	55.71	74.00	32.31	41.69	54.00	12.31	240.20
17394	1	55.47	74.00	32.44	41.56	54.00	12.44	210.10
17681.5	1	55.60	74.00	32.78	41.22	54.00	12.78	330.20
17913	1	56.83	74.00	32.32	41.68	54.00	12.32	90.20
9431.5	2	48.60	74.00	40.09	33.91	54.00	20.09	60.30
9908	2	51.51	74.00	39.64	34.36	54.00	19.64	359.60
10945	2	50.75	74.00	38.52	35.48	54.00	18.52	120.30
11461	2	50.33	74.00	37.79	36.21	54.00	17.79	300.20
12569	2	52.01	74.00	35.40	38.60	54.00	15.40	359.60
12894.5	2	51.64	74.00	35.20	38.80	54.00	15.20	60.30
14041.5	2	53.84	74.00	34.48	39.52	54.00	14.48	60.30
14781	2	54.69	74.00	33.81	40.19	54.00	13.81	29.90
15319	2	54.24	74.00	34.60	39.40	54.00	14.60	270.20
15764	2	54.10	74.00	32.88	41.12	54.00	12.88	270.20
16505.5	2	56.25	74.00	31.73	42.27	54.00	11.73	150.30
16743.5	2	56.72	74.00	32.15	41.85	54.00	12.15	359.60
17200.5	2	56.02	74.00	32.02	41.98	54.00	12.02	330.30
17331.5	2	55.79	74.00	32.05	41.95	54.00	12.05	330.30
17462	2	55.49	74.00	32.34	41.66	54.00	12.34	150.30
17977	2	56.46	74.00	31.47	42.53	54.00	11.47	300.20

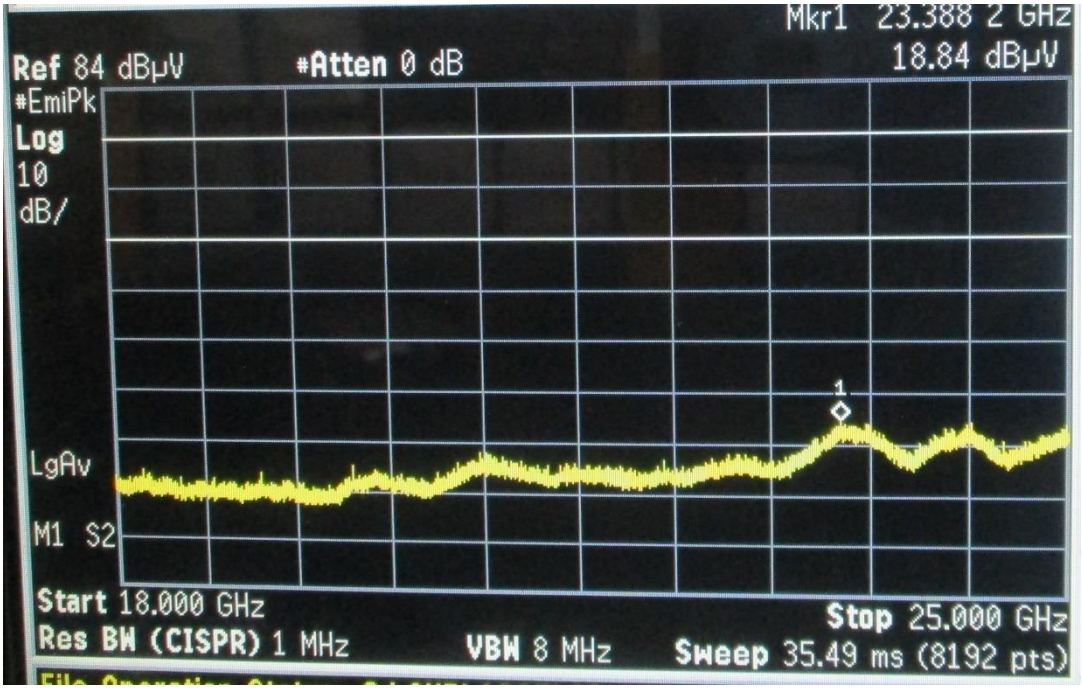
Horizontal polarization
TX04
Range 18 GHz – 25 GHz



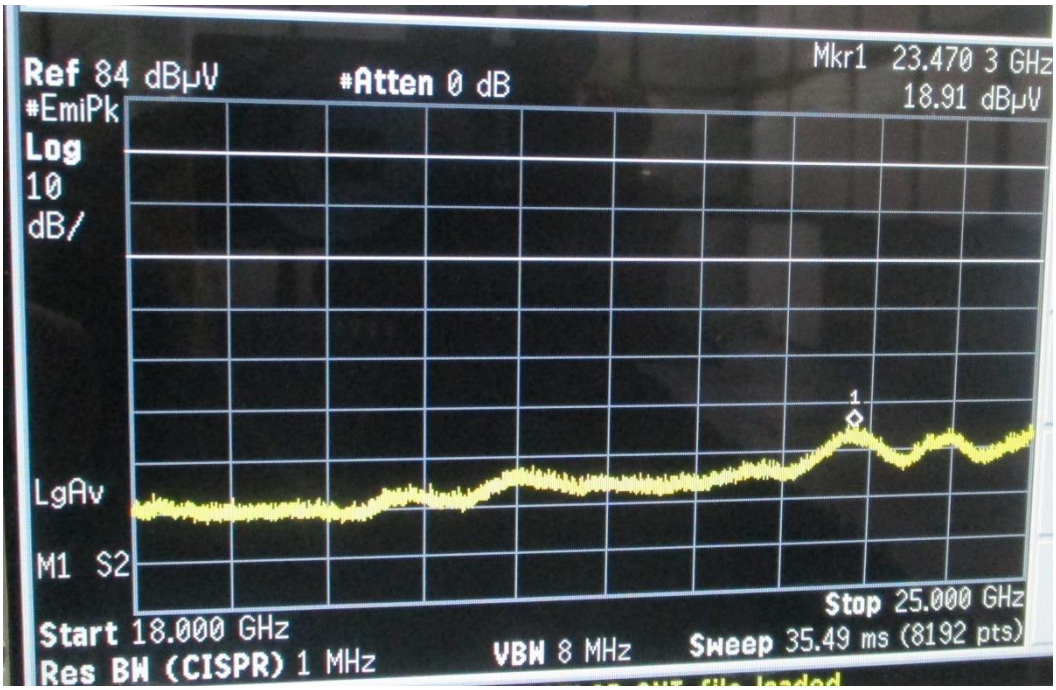
Vertical polarization
TX04
Range 18 GHz – 25 GHz



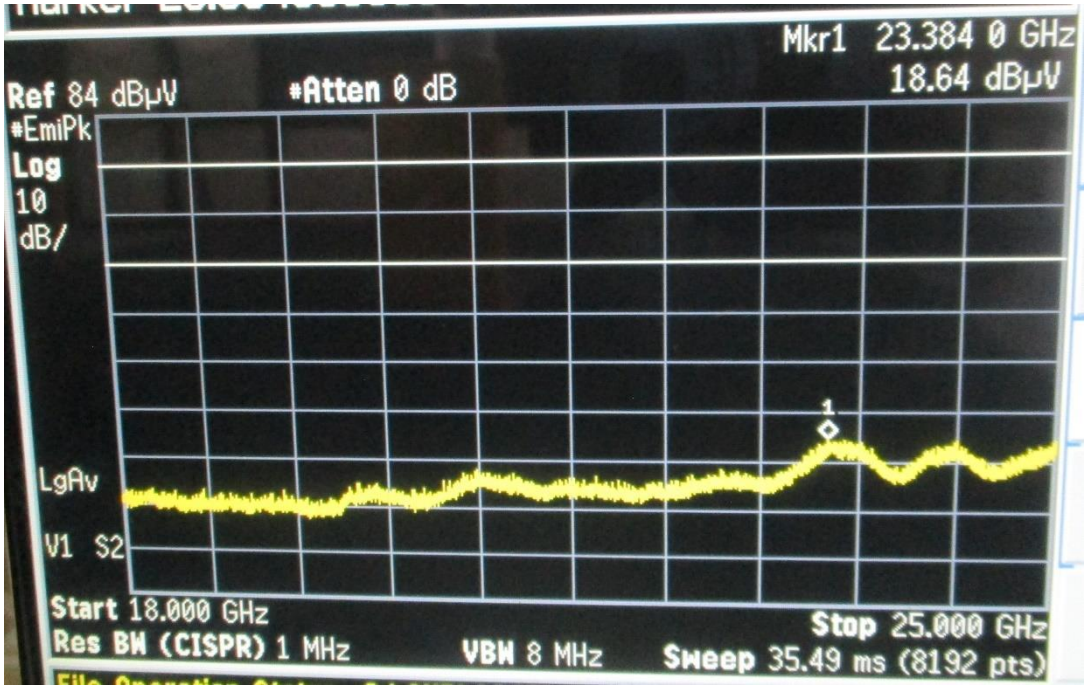
Horizontal polarization
TX05
Range 18 GHz – 25 GHz



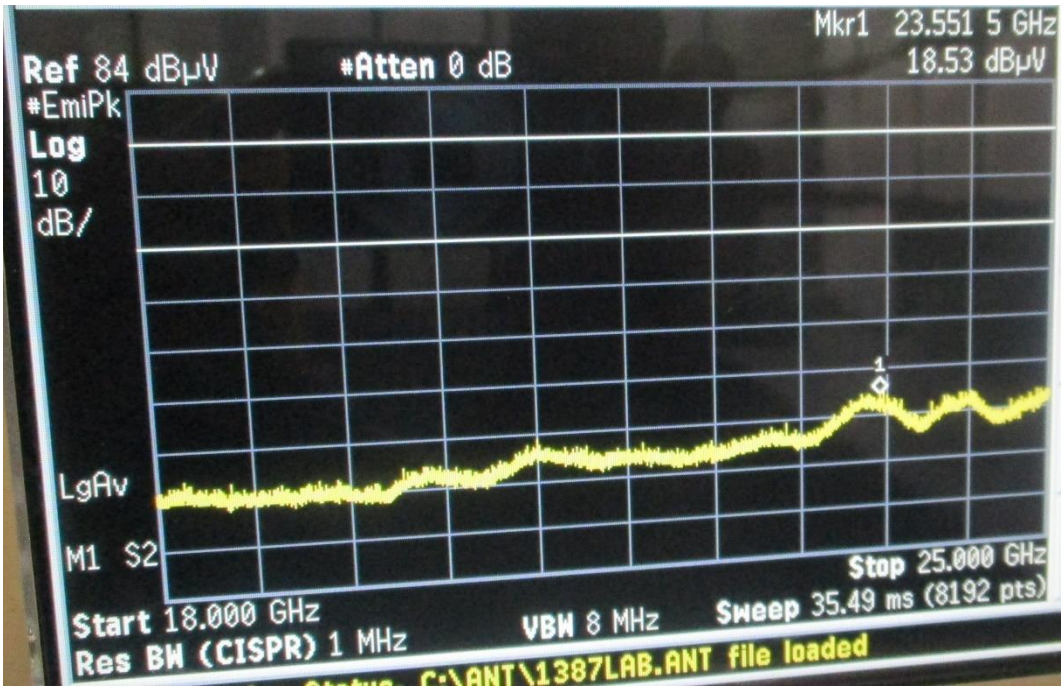
Vertical polarization
TX05
Range 18 GHz – 25 GHz

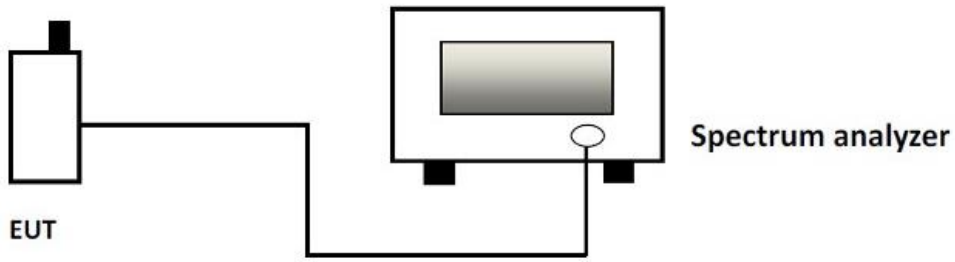


Horizontal polarization
TX06
Range 18 GHz – 25 GHz



Vertical polarization
TX06
Range 18 GHz – 25 GHz

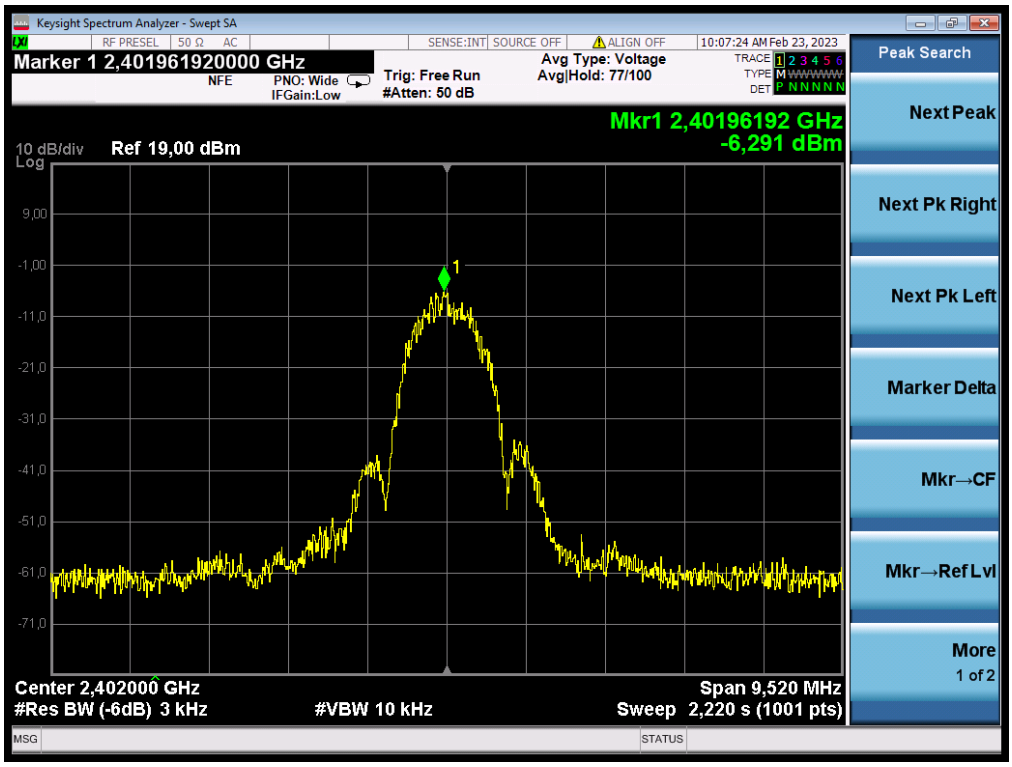


Test method:	**FCC part 15 C - §15.247 (e)** **Power spectral density** For details see par. 4 of this report	
Operator	Marco Nicolè	
Test Date	2023-03-22	
Test Temperature	23 °C	
Test Humidity	41 %	
Test Pressure	1009 hPa	
Electrical wiring	*Cable*	*Length [m]*
	D.c. input cable	3.0
Operating conditions	TX04; TX05; TX06; See par. 5 of this report	
Auxiliary equipment (AE)	See par. 3.5 of this report	
Limits	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	
Test set up		
Test instrumentations	See Annex B	
Measurement Uncertainty (k=2)	See Annex F	

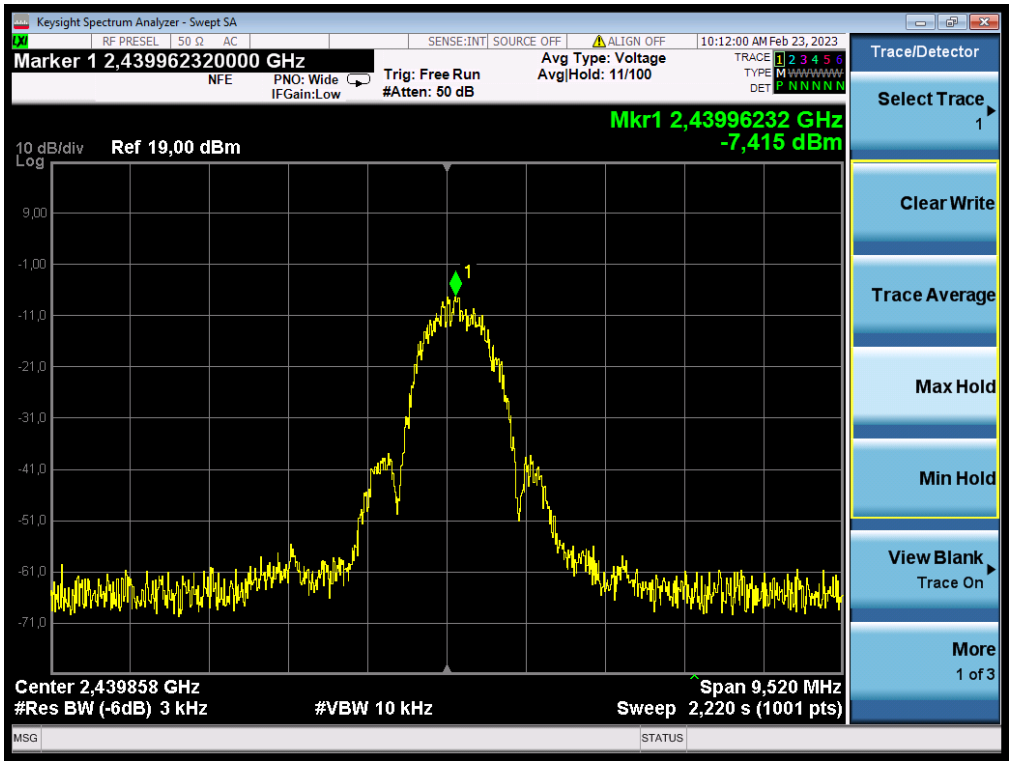
Test result	**Operative condition**	**Frequency [MHz]**	**Amplitude [dBm]**	**Limit [dBm]**	**RESULT**
4	TX04	2402	-6.291	+8	**COMPLIES**
5	TX05	2441	-7.415	+8	**COMPLIES**
6	TX06	2480	-7.139	+8	**COMPLIES**

Test Procedure	Use the following spectrum analyser settings: Set analyzer center frequency to DTS channel center frequency. Set the span to 1.5 times the DTS bandwidth. Set the RBW to 3 kHz ≤ RBW ≤ 100 kHz. Set the VBW ≥ [3 × RBW]. Detector = peak. Sweep time = auto couple. Trace mode = max hold. Allow trace to fully stabilize. Use the peak marker function to determine the maximum amplitude level within the RBW. If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.
EUT modification during this test	None

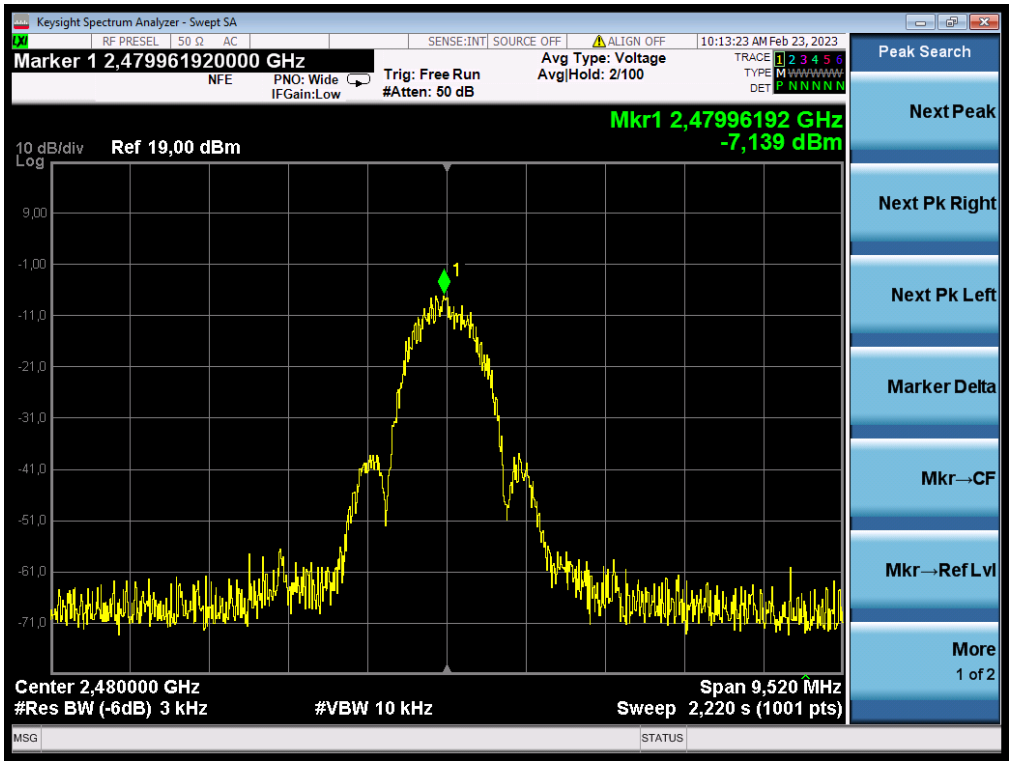
Test result TX04



Test result TX05



Test result TX06

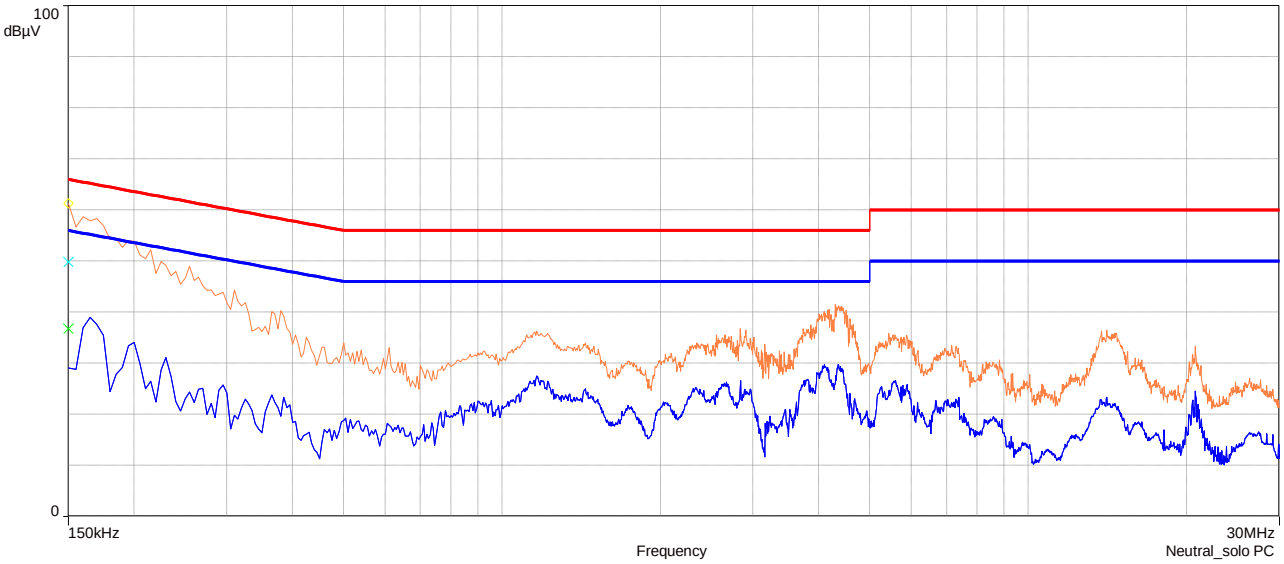


Test method:	**FCC part 15 C - § 15.207** **Standard test method for ac power-line conducted emissions from unlicensed wireless devices** For details see par. 4 of this report	
Operator	Marco Nicolè	
Test Date	2023-04-12	
Test Temperature	21 °C	
Test Humidity	32 %	
Test Pressure	996 hPa	
Electrical wiring	*Cable*	*Length [m]*
	USB cable	0.2
	Ac input cable (power supply of laptop)	1.3
Operating conditions	OC09 See par. 6 of this report	
Additional information	None	
Auxiliary equipment (AE)	See par. 3.4 of this report	
Frequency range	150 kHz ÷ 30 MHz	
Test set up	☐ Floor standing set up ☒ Table top set up	
Test method	The EUT is placed on the table, which is 0.8 m above ground plane. According to the requirements in Section 13.1.3 of ANSI C63.4 Conducted emission from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-peak and average detector modes	
Port	A.C. Input - LISN measurements	
Test instrumentations	See Annex B	
Measurement Uncertainty (k=2)	See Annex F	
EUT modification during this test	None	
Result	**COMPLIES**	
Note	The measure was performed to understand which is the contribution of the device under test when it is connect to the laptop. So, for first was measure only the laptop, and then the laptop with the headphone connected to the USB port.	

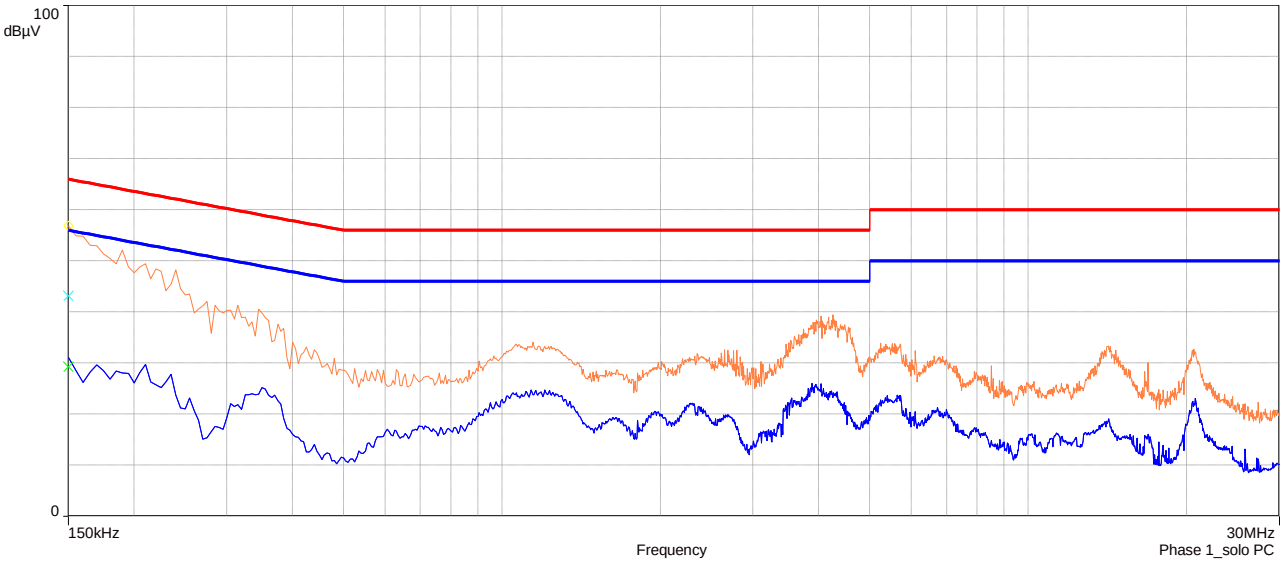
TEST GRAPHS AND MEASUREMENTS

All traces have been acquired with PK Peak detector (orange trace) and AVG Average detector (blue trace)
If PK trace exceeds QP Quasi-Peak limit, QP measurements are performed at discrete frequencies where the limit is exceeded. Measurement time for QP measurements is 15 s.
If the general level of the disturbance is not steady, also the AVG disturbance voltage level is observed for 15 s per frequency; results are reported in a specific table below the graph.

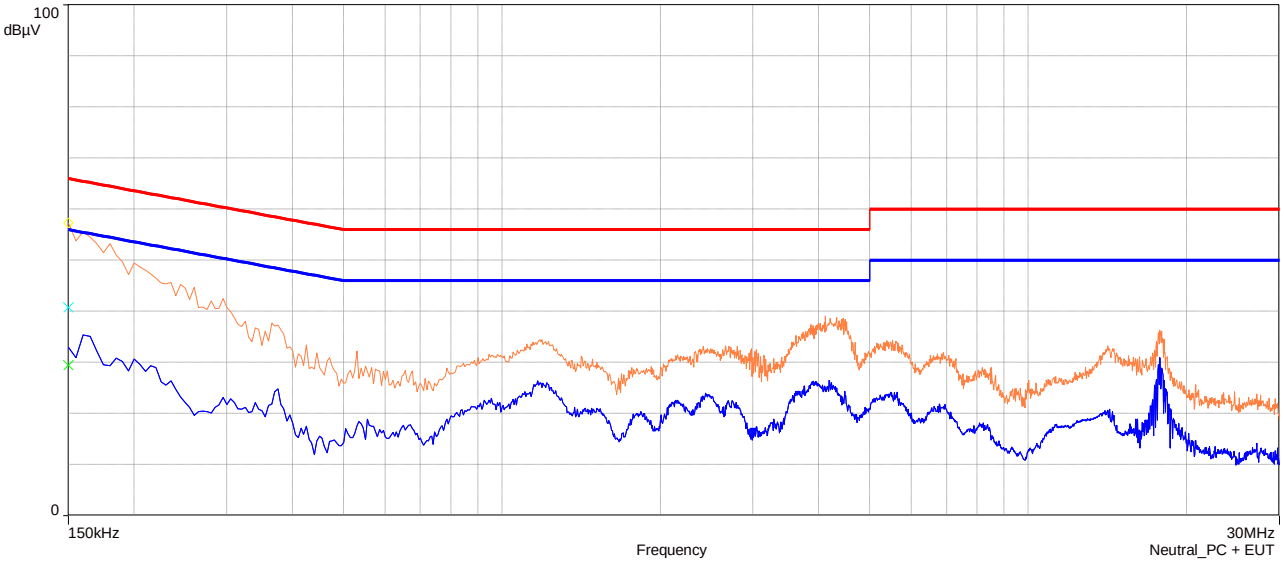
Measurement 01
A.C. Input - LISN measurements
Line: Neutral
Operating Condition: Groundnoise (EUT not connected, AE02 on)



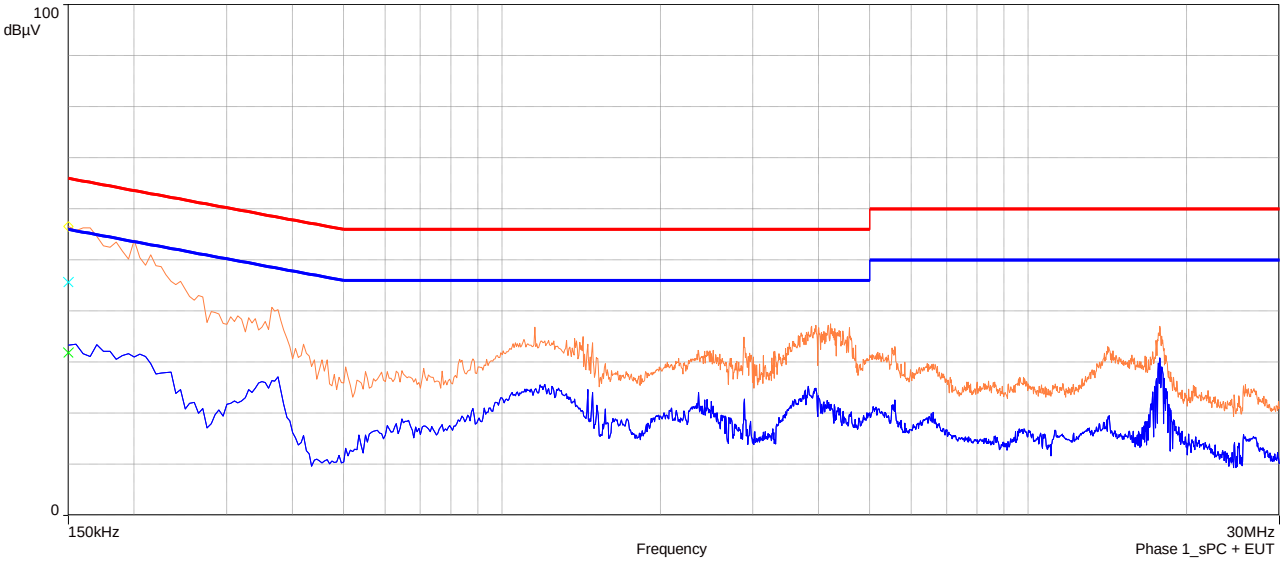
Measurement 02
A.C. Input - LISN measurements
Line: Phase 1
Operating Condition: Groundnoise (EUT not connected, AE02 on)



Measurement 03
A.C. Input - LISN measurements
Line: Neutral
Operating Condition: OC09



Measurement 04
A.C. Input - LISN measurements
Line: Phase 1
Operating Condition: OC09



Frequency (MHz)	SR	AVG (dBµV)	QPeak (dBµV)	Lim AVG (dBµV)	Lim QPeak (dBµV)	AVG Margin (dB)	QPeak Margin (dB)	Line
0.15	1	36.73	49.83	56.00	66.00	-19.27	-16.17	Neutral
0.15	2	29.24	43.19	56.00	66.00	-26.76	-22.81	Phase 1
0.15	3	29.41	40.79	56.00	66.00	-26.59	-25.21	Neutral
0.15	4	31.86	45.69	56.00	66.00	-24.14	-20.31	Phase 1

7 EUT MODIFICATIONS

None.

Annex B Test instrumentations

FCC Part15

Description	Manufacturer	Model	Identifier	Cal data	Cal due
EMI Receiver - PSA Spectrum Analyzer	Agilent Technologies	E4446A	740/LAB Rapporto 5817	2022-08-09	2023-08-09
Antenna - Horn Antenna 18 GHz ÷ 40 GHz	ETS-LINDGREN	3116	779/LAB Rapporto 5178	2020-11-03	2023-11-03
Antenna - BiConiLog Antenna 30MHz÷ 6 GHz	ETS-LINDGREN	3142E	1508/LAB Rapporto 5222	2020-12-18	2023-12-18
Pre-Amplifier 18 GHz ÷ 40 GHz	Spin Electronics	PRE-1840-35	759/LAB Rapporto 5325	2021-03-25	2023-03-25
RF Cable - set of RF cables 769/LAB + 791/LAB + 938/LAB + Pre-Amplifier 758/LAB with cables			803/LAB Rapporto 5661	2022-04-06	2023-04-06
RF cable - set of RF cables (760/LAB + 804/LAB + 805/LAB)			806/LAB Rapporto 5662	2022-04-06	2023-04-06
Antenna - Horn Antenna 1 GHz ÷ 18 GHz	ETS-LINDGREN	3117	778/LAB Rapporto 5177	2020-11-03	2023-11-03
LISN 32A	ROHDE&SCHWARZ	ESH2-Z5	033L/CS Rapporto 5765	2022-07-14	2023-07-14
Software BAT-EMC	Nexio	BAT-EMC	1910/LAB	--	--
RF Cable - N-N 5m	INTERCOND	M17/74 RG 213	225/LAB Rapporto 5818	2022-08-31	2023-08-31

Annex B Test instrumentations

RF Cable - N-N 1,8m	Siva Cables Italy	RG 58A/U	243/LAB Rapporto 5819	2022-08-31	2023-08-31
Filter PB	G. De PAOLI	BPF.0.15-30MHz	268/LAB Rapporto 5820	2022-08-31	2023-08-31
Pulse Limiter ESH3-Z2	ROHDE&SCHWARZ Gmbh	ESH3-Z2	528/LAB Rapporto 5821	2022-08-31	2023-08-31
EMI Receiver - MXE	Keysight Technologies	N9038A	1444/LAB Rapporto 5985	2023-03-01	2024-02-29
RF cable - set of RF cables (771/LAB + 791/LAB + 937/LAB)			802/LAB Rapporto 5990	2023-01-27	2024-01-27
EMI Receiver	ROHDE&SCHWARZ	ESHS10 9kHz...30MHz	030L/CS Rapporto 5687	2022-05-19	2023-05-19

Annex D Auxiliary instrumentations

Application	*Description*	*Manufacturer*	*Model*	*Identifier*	*Cal. data*	*Cal. due*
Monitoring of environmental conditions	Climatic Sensor (pri site) - 739/LAB Emission Anec	HW group	HWg-STE	1299/LAB	2022-07-25	2023-07-25
Monitoring of environmental conditions	Climatic Sensor (pri site) - 051L/CS Shielded Cham	HW group	HWg-STE	1300/LAB	2022-07-25	2023-07-25
Monitoring of environmental conditions	Pressure Transducer	COMET	T7410	1530/LAB	2021-10-14	2023-10-14
Distance monitoring	Metro Laser	Leica	DISTO A2	1094/LAB	2021-11-11	2023-11-11

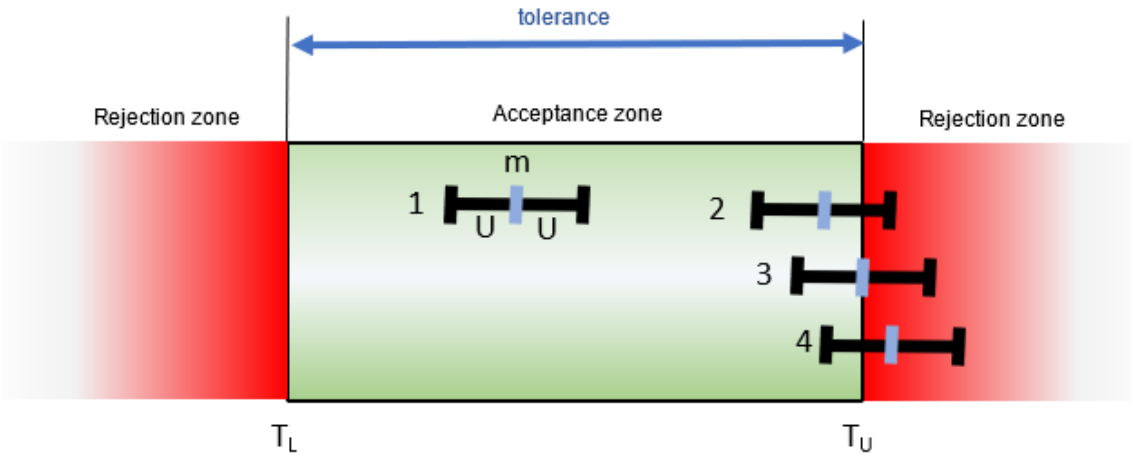
Annex F Compliance Decision Rule and measurements uncertainty

F1: Decision Rule

- A decision rule defines the role of uncertainty in assessing the conformity of measured values with respect to specification limits.
- The Kiwa Creiven decision rule uses the “simple acceptance” method minimizing the “supplier risk” (type 1 risk or alpha risk), that is the risk of refusing a compliant product.
- The probability distribution of the measurement uncertainty is assumed to be Gaussian,

Nomenclature

- m: measured value
- P: probability of correct acceptation, (1-P: probability of refusing a compliant product)
- Tu: upper tolerance limit
- TL: lower tolerance limit
- Tolerance: interval of width equal to Tu - TL



Case	Decision Rule	Note
Case 1, 2, 3	Measurement complies with specifications	• **$T_L \leq m \leq Tu$**; the probability **P** of correct acceptation is: 50% **≤ P ≤** 100%
Case 4	Measurement NOT complies with specifications	• **m>Tu (**or **m<T_L):** the probability **P** of correct acceptation is lower than 50%

Note about qualitative tests: The uncertainty balance is applicable only to tests whose result is numerical. For the qualitative tests, are verified the tolerance and repeatability of the quantities that stimulate the EUT. Tolerances and repeatability of these quantities are part of the instrumentation calibration.

In accordance with:

- IEC Guide 115 Application of uncertainty of measurement to conformity assessment activities in the electrotechnical sector
- ILAC-G8 Guidelines on the Reporting of Compliance with Specification
- JGCM guide 106

Annex F Compliance Decision Rule and measurements uncertainty

F.2 Measurements uncertainty

Frequency Readout – Conducted Test	*Uncertainty (k=2)*
Test Uncertainty [kHz]	10.3
Frequency Readout – Radiated Test	
Test Uncertainty [kHz]	10.6
Effective radiated power ERP (30 MHz to 1000 MHz)	
Test Uncertainty [dB]	6.4
Effective radiated power EIRP (above 1 GHz)	
Test Uncertainty [dB]	6.6
Radiated receiver blocking tests (above 1 GHz)	
Test Uncertainty [dB]	4.9
Conducted spurious emissions	
Test Uncertainty [dB]	3.3
Radiated spurious emissions	
Test Uncertainty [dB]	5.8
Channel power	
Test Uncertainty [dB]	2.6
Adjacent channel power	
Test Uncertainty [dB]	2.2
RF Output power (EIRP)	
Test Uncertainty [dB]	2.3
Occupied Channel Bandwidth	
Test Uncertainty [Hz]	[span/600]