

RRA-EMIESS21F965INV-04Av0

Certification Radio test report

According to the standard:

CFR 47 FCC PART 15

ICES 003 – Issue 7

RSS GEN – Issue 5

Equipment under test:

G-1090 UAT RECEIVER

FCC ID: 2A23J-G1090

Company:

INVOLI

Distribution: Mr BELLIER

(Company: INVOLI)

Number of pages: 26 with 2 annexes

Ed.	Date	Modified Page(s)	Technical Verification and Quality Approval	
			Name and Function	Visa
0	22-Jan-24	Creation	JC. BOGA, Laboratory Manager	

Duplication of this document is only permitted for an integral photographic facsimile. It includes the number of pages referenced here above.

This document is the result of testing a specimen or a sample of the product submitted. It does not imply an assessment of the conformity of the whole manufactured products of the tested sample.

Information in italics are declared by the manufacturer/customer and are under his responsibility

DESIGNATION OF PRODUCT: *G-1090 UAT receiver*

Serial number (S/N): *AG-03-000518*

Reference / model (P/N): *G-1090 UAT receiver*

Software version: *1.9.4*

MANUFACTURER: *INVOLI*

COMPANY SUBMITTING THE PRODUCT:

Company: *INVOLI*

Address: Place de la gare 1
1003 LAUSANNE
SWITZERLAND

Responsible: Mr BELLIER

Person(s) present during the tests: Mr AMOROS

DATES OF TEST: From 2-Jan-24 to 9-Jan-24

TESTING LOCATION: EMITECH LYON laboratory at CHASSIEU (69) FRANCE
FCC Accredited under US-EU MRA Designation Number: FR0013
Test Firm Registration Number: 807590

ISED Accredited under CANADA-EU MRA Designation Number: FR0007
Industry Canada Registration Number: 4379D

TESTED BY: T. LEDRESSEUR

VISA:

A handwritten signature in black ink, appearing to be "T. Ledresseur", written over a horizontal line.

WRITTEN BY: T. LEDRESSEUR

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REVISIONS HISTORY

Revision	Date	Modified pages	Modifications
0	10-Jan-24	/	Creation

1. INTRODUCTION

This report presents the results of radio test carried out on the following radio equipment: **G-1090 UAT receiver**, in accordance with normative reference.

The equipment under test integrates:

- UAT receiver radio function,
- ADS-B receiver radio function,
- GNSS multifrequencies receiver.

This radio test report concerns the followings configurations:

- Verification measurement: Subpart B

2. PRODUCT DESCRIPTION

Class: Tested to respect class B limit

Power source: 48 Vdc by POE

Radio technology: UAT

Operating frequency: 978 MHz

Maximum antenna gain used with the equipment: 8dBi (declared by the applicant)

Radio technology: GNSS

Operational Frequency band used: band from 1559 MHz to 1610 MHz

Maximum antenna gain used with the equipment: 2dBi (declared by the applicant)

Radio technology: ADS-B

Operating frequency range: 1090 MHz

Maximum antenna gain used with the equipment: 5dBi (declared by the applicant)

3. NORMATIVE REFERENCE

The standards and testing methods related throughout this report are those listed below. They are applied on the whole test report even though the extensions (version, date and amendment) are not repeated.

CFR 47 FCC Part 15 (2024) Radio Frequency Devices

ANSI C63.4 2014
Methods of Measurement of Radio-Noise Emissions from Low-Voltage
Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

ICES-Gen Issue 1, July 2018
General Requirements for Compliance of Interference-Causing Equipment

ICES-003 Issue 7, October 2020
Information Technology Equipment (Including Digital Apparatus)

RSS-Gen Issue 5, April 2018
General Requirements for Compliance of Radio Apparatus

4. TEST METHODOLOGY

Radio performance tests procedures given in CFR 47 part 15:

Subpart A –General

Paragraph 19: labelling requirements
Paragraph 21: information to user

Subpart B –Unintentional Radiators

Paragraph 105: information to the user
Paragraph 107: conducted limits
Paragraph 109: radiated emission limits

Radio performance tests procedures given in RSS-Gen:

Paragraph 2 - General
Paragraph 3 - Normative publications and related documents
Paragraph 4 - Labelling requirements
Paragraph 5 - Receivers
Paragraph 6 - General administrative and technical requirements
Paragraph 7 - Receiver emissions limits

Radio performance tests procedures given in ANSI C63.4:

Paragraph 7 – AC power-line conducted emission measurements

5. TEST EQUIPMENT CALIBRATION DATES

Emitech Number	Model	Type	Last calibration	Calibration interval (years)	Next calibration due
0	BAT-EMC V3.18.0.26	Software	/	/	/
5609	EMCO 3146A	Log periodic antenna	14/12/2021	3	14/12/2024
5625	EMCO 3104	Biconical antenna	06/02/2023	3	06/02/2026
6217	Rohde & Schwarz ESH3-Z5	LISN	27/07/2023	1	27/07/2024
6290	HAEFELY PHF555	Power source	(1)	(1)	(1)
6970	Schwarzbeck BBHA 9120D	Antenna	16/12/2021	3	16/12/2025
7651	SIDT Cage	Anechoic chamber	/	/	/
8590	AEMC N-6m	Cable	23/02/2022	2	23/02/2024
10262	Agilent Technologies 8449B	Low-noise amplifier	25/08/2023	1	25/08/2024
10952	Agilent 34401A	Multimeter	21/07/2023	2	21/07/2025
11316	Agilent N9010A	Receiver	05/09/2023	1	05/09/2024
11855	EMITECH	Outside room	/	/	/
15775	RFPA INT-BA011000-25	Low-noise amplifier	06/03/2023	1	06/03/2024
15790	Testo 608-H1	Meteo station	27/10/2023	1	27/10/2024
15892	HUBER et SUHNER N 18GHz 3m	Cable	31/05/2023	2	31/05/2025
15905	HUBER et SUHNER N 18GHz 4.5m	Cable	31/05/2023	2	31/05/2025
15907	HUBER et SUHNER N 18GHz 3.5m	Cable	31/05/2023	2	31/05/2025
15934	HUBER et SUHNER N 18GHz 2.5m	Cable	31/05/2023	2	31/05/2025
17207	COM-POWER LIT-930A	Transient limiter	02/09/2021	3	02/09/2024
17829	Emitech	Absorber sheath current	01/06/2023	2	01/06/2025

(1) The equipment is not verified; instead, the output voltage is checked before each measurement with the calibrated multimeter.

6. TESTS RESULTS SUMMARY

6.1 CFR 47 part 15 requirements (subpart A)

Test procedure	Description of test	Respected criteria?				Comment
		Yes	No	NAP	NAs	
FCC Part 15.19	LABELLING REQUIREMENTS	X				see certification documents
FCC Part 15.21	INFORMATION TO USER	X				see certification documents

NAP: Not Applicable

NAs: Not Asked

6.2 CFR 47 part 15 requirements (subpart B)

Test procedure	Description of test	Respected criteria?				Comment
		Yes	No	NAP	NAs	
FCC Part 15.105	INFORMATION TO THE USER	X				see certification documents
FCC Part 15.107	CONDUCTED LIMITS	X				Class B
FCC Part 15.109	RADIATED EMISSION LIMITS	X				Class B

NAP: Not Applicable

NAs: Not Asked

6.3 ICES-003 requirements

Test Procedure ICES-003	Description of test	Criteria respected ?				Comment
		Yes	No	NAP	NAs	
§ 2.3	Normative reference	X				ANSI C63.4

NAP: Not Applicable

NAs: Not Asked

Test Procedure ANSI 63.4	Description of test	Criteria respected ?				Comment
		Yes	No	NAP	NAs	
§ 7	AC power-line conducted emission measurements	X				Class B
§ 8	Radiated emission measurements	X				Class B

NAP: Not Applicable

NAs: Not Asked

6.4 RSS-Gen requirements

Test procedure	Description of test	Criteria respected ?				Comment
		Yes	No	NAP	NAs	
Paragraph 2	General	X				
Paragraph 3	Normative publications and related documents	X				
Paragraph 4	Labelling requirements	X				see certification documents
Paragraph 5	Receivers	X				See § 7
Paragraph 6	General administrative and technical requirements	X				
Paragraph 7	Receiver Spurious Emission Limits					
§ 7.1	General	X				
§ 7.2	AC power-line conducted emissions limits	X				
§ 7.3	Receiver radiated emissions limits	X				
§ 7.4	Receiver conducted emissions limits			X		

7. MEASUREMENT UNCERTAINTY

To declare, or not, the compliance with the specifications, it was not explicitly taken into account of uncertainty associated with the result(s)

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

Parameter	Emitech Uncertainty
RF power, conducted	$\pm 0.8\text{dB}$
Radiated emission valid to 26 GHz	
9kHz – 30MHz	$\pm 2.7\text{ dB}$
30MHz – 1GHz	$\pm 5.0\text{ dB}$
1GHz – 18GHz	$\pm 5.3\text{ dB}$
18GHz – 40GHz	$\pm 6.1\text{ dB}$
AC Power Lines conducted emissions	$\pm 3.4\text{ dB}$
Temperature	$\pm 1\text{ }^{\circ}\text{C}$
Humidity	$\pm 5\text{ \%}$

8. AC CONDUCTED EMISSION**Temperature (°C) :** 18**Humidity (%HR):** 50**Date :** January 2, 2024**Technician :** T. LEDRESSEUR**Standard:** FCC Part 15
RSS-Gen**Test procedure:**

For FCC Part 15: Paragraph 15.107

For RSS-Gen: Paragraph 7.2

For ICES-003: § 3.2.1

Method of paragraph 7 of ANSI C63.4

Method of paragraph 6.2 of ANSI C63.10

Limits: Class B**Software used:** BAT-EMC V3.18.0.26**Test set up:**

The EUT is isolated and placed on a wooden table, 0.8 m over an horizontal reference plane and 0.4 m from a vertical reference plane. It is powered by an artificial main network placed on the ground reference plane.

The equipment is powered with the AC power operating voltage of 120 V / 60 Hz.

Frequency range: 150 kHz - 30 MHz**Detection mode:** Peak / Quasi-peak / Average**Bandwidth:** 10 kHz / 9 kHz**Equipment under test operating condition:**

First an exploratory ac power line conducted emission measurement was performed with peak detector.

The product is in charging mode.

The device's radio modules are blocked in reception mode.

This measure was realized with two different representative power source (POE)

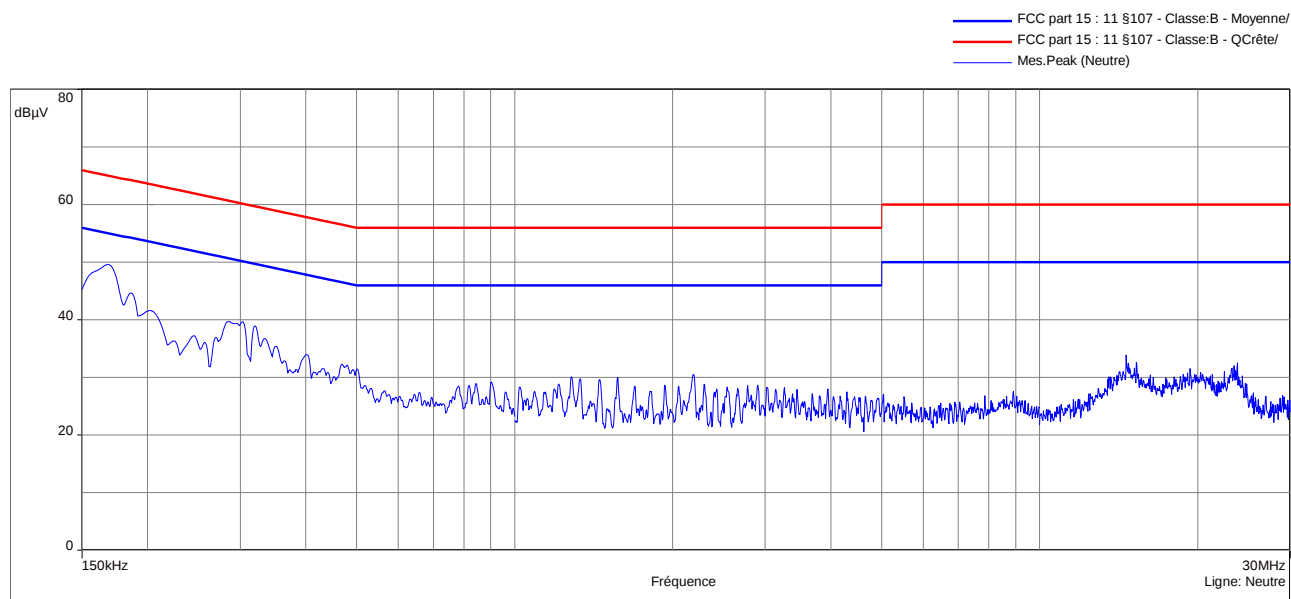
Results:

Sample N° 1: Power source used Netgear router + power source

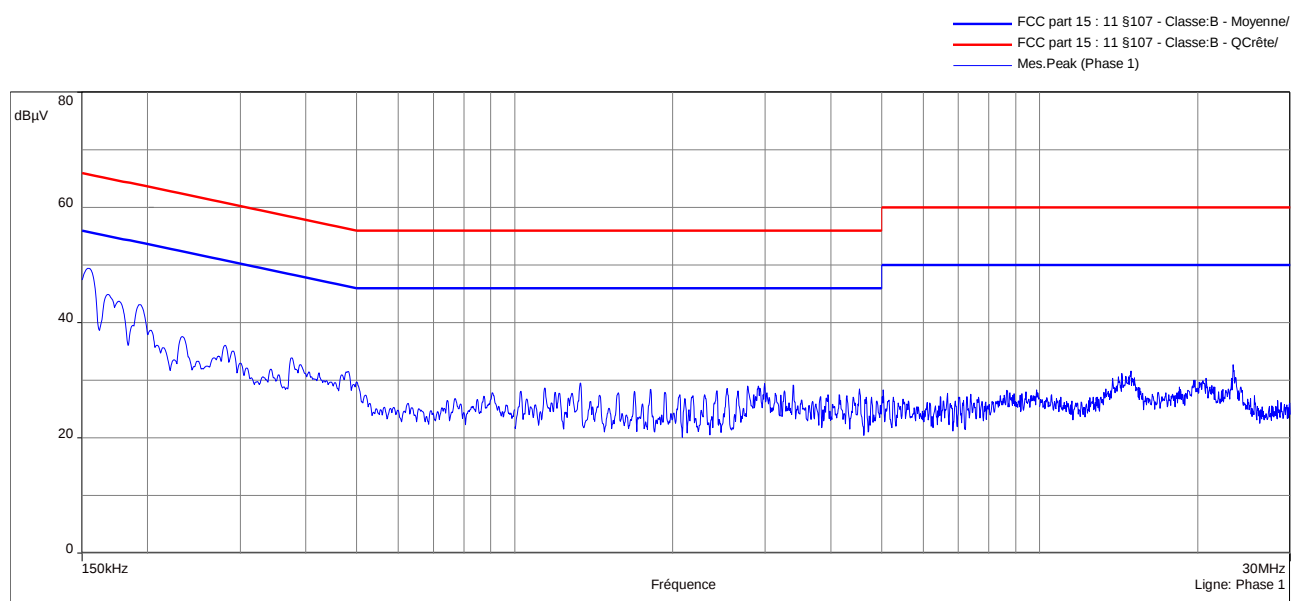
Measurement on the mains power supply:

The measurement is first realized with Peak detector.

Curve N° 1: measurement on the Neutral with peak detector



Curve N° 2: measurement on the Line with peak detector



The 6 most critical emissions are indicated below.

These results were measured with a Peak detector and compared directly with the Average limit (worst case)

Table N° 1: measurement on the Neutral, for the frequency range:

Frequency (MHz)	Average (dBμV)	Average Limit (dBμV)	Average margin (dB)
0.168022	49.58	55.06	5.47
0.320187	38.94	49.7	10.76
1.282628	30.08	46	15.92
1.450045	29.63	46	16.37
1.570657	29.99	46	16.01
2.189919	30.47	46	15.53

Table N° 2: measurement on the Line, for the frequency range:

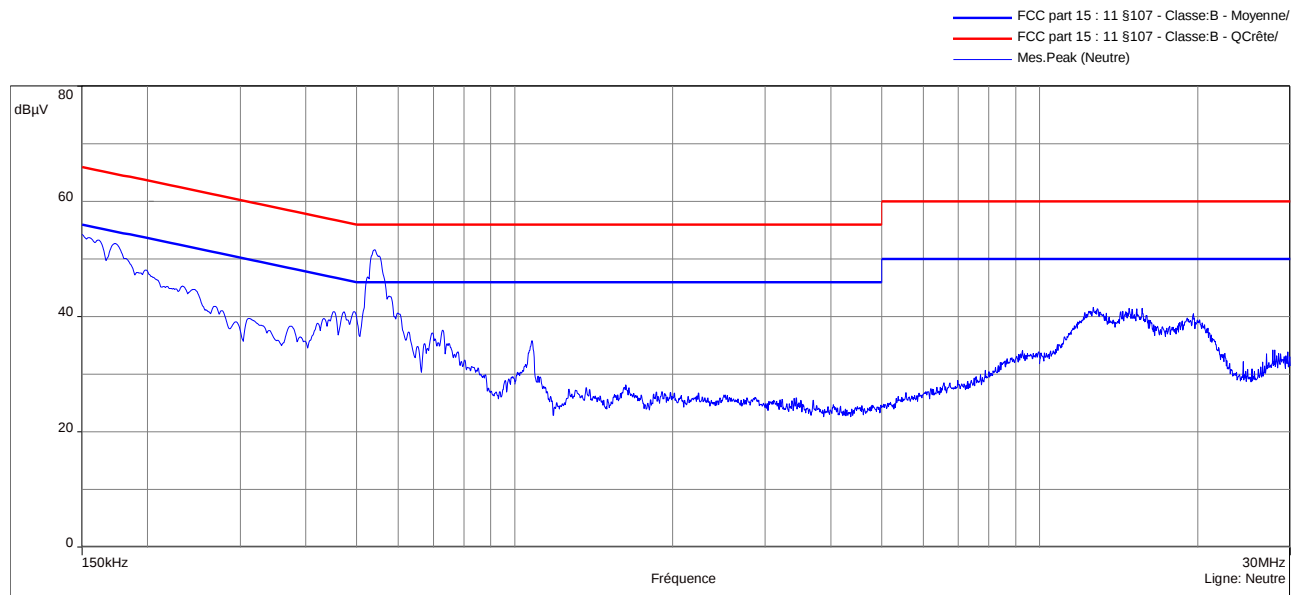
Frequency (MHz)	Average (dBμV)	Average Limit (dBμV)	Average margin (dB)
0.154420	49.44	55.76	6.32
0.168022	44.87	55.06	10.19
0.193184	43.13	53.9	10.77
1.141314	28.66	46	17.34
1.333933	29.51	46	16.49
2.540054	28.59	46	17.41

Sample N° 1: Power source VIVOTEC (AP-GIC-011A-095)

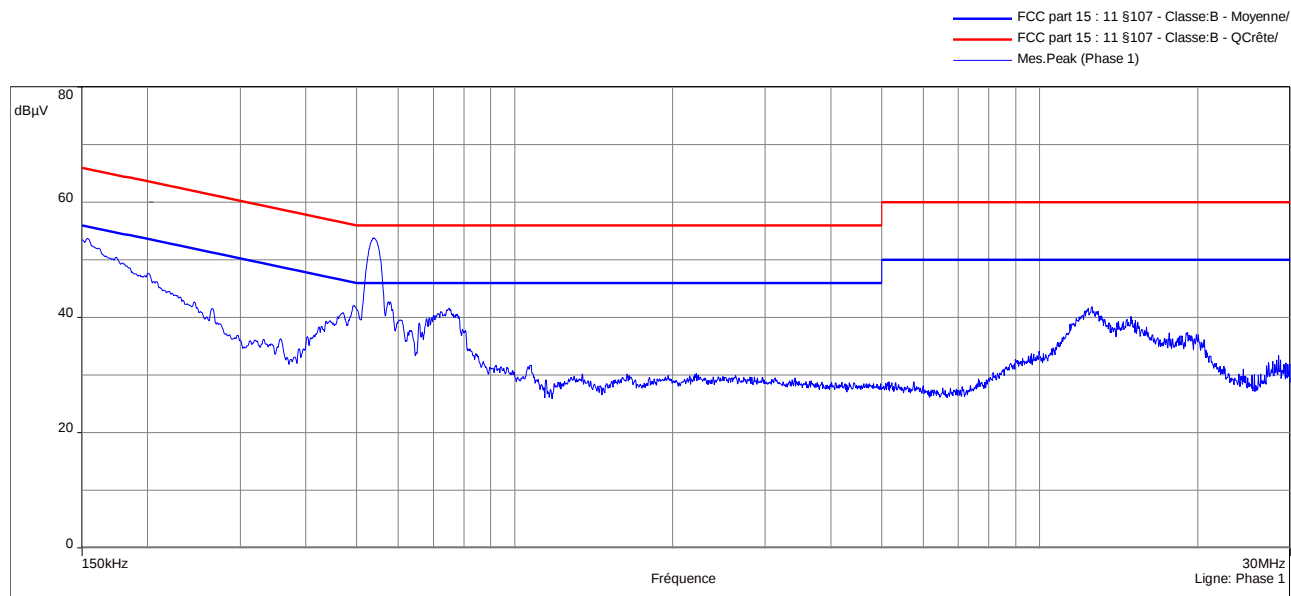
Measurement on the mains power supply:

The measurement is first realized with Peak detector.

Curve N° 3: measurement on the Neutral with peak detector



Curve N° 4: measurement on the Line with peak detector



The highest frequencies are then analyzed with Quasi-peak detector and Average detector

Table N° 3: measurement on the Neutral, for the frequency range:

Frequency (MHz)	Quasi-peak (dBμV)	QP Limit (dBμV)	QP margin (dB)
0.150765	52.63	65.96	13.33
0.155271	52.03	65.71	13.69
0.161646	51.4	65.38	13.98
0.530838	44.06	56	11.94
0.535344	45.44	56	10.56
0.542229	45.9	56	10.1

Frequency (MHz)	Average (dBμV)	Average Limit (dBμV)	Average margin (dB)
0.150000	54.28	44.98	56
0.154845	53.73	44.43	55.74
0.161136	53.28	43.98	55.41
0.537129	51.16	41.86	46
0.541634	51.61	42.31	46
0.546395	50.73	41.43	46

Table N° 4: measurement on the Line, for the frequency range:

Frequency (MHz)	Quasi-peak (dBμV)	QP Limit (dBμV)	QP margin (dB)
0.150000	51.56	66	14.44
0.154505	50.2	65.75	15.55
0.165217	49.33	65.2	15.87
0.534323	51.6	56	4.4
0.539849	52.38	56	3.62
0.544354	52.03	56	3.97

Frequency (MHz)	Average (dBμV)	Average Limit (dBμV)	Average margin (dB)
0.153230	41.51	55.82	14.31
0.157736	37.32	55.58	18.26
0.165217	39	55.2	16.2
0.532538	44.11	46	1.89
0.537044	44.64	46	1.36
0.544354	44.21	46	1.79

Test conclusion:

RESPECTED STANDARD

9. UNINTENTIONAL SPURIOUS EMISSIONS**Temperature (°C) :** 20.5**Humidity (%HR):** 45**Date :** January 8, 2024**Technician :** T. LEDRESSEUR**Standard:** FCC Part 15
RSS-Gen
ICES-003**Test procedure:**

For FCC Part 15: § 15.109

For RSS-Gen: § 7.3

For ICES-003: § 3.2.2

Method of paragraph 8 of ANSI C63.4

Limit class: Class B**Test set up:**

First an exploratory radiated measurement was performed. During this phase the product is oriented in these two normal positions.

Then the final measurement is realized with the product on the most critical orientation.

The measure is realized in anechoic chamber above.

Below 1 GHz, the EUT is placed on a rotating table, 0.8m from a ground plane.

Above 1 GHz, the EUT is placed on a rotating table, 1.5 m from a ground plane.

Zero degree azimuths correspond to the front of the device under test.

Frequency range: From 30 MHz to 10 GHz**Detection mode:** Quasi-peak ($F < 1$ GHz)Peak / Average ($F > 1$ GHz)**Bandwidth:** 120 kHz ($F < 1$ GHz)1 MHz ($F > 1$ GHz)**Distance of antenna:** 3 meters**Antenna height:** 1 to 4 meters**Antenna polarization:** vertical and horizontal (only the highest level is recorded)

Equipment under test operating condition:

First an exploratory radiated emission measurement was performed with peak detector.

The product is in charging mode.

The device's radio modules are blocked in reception mode.

Power source: 120 Vac by an external power supply

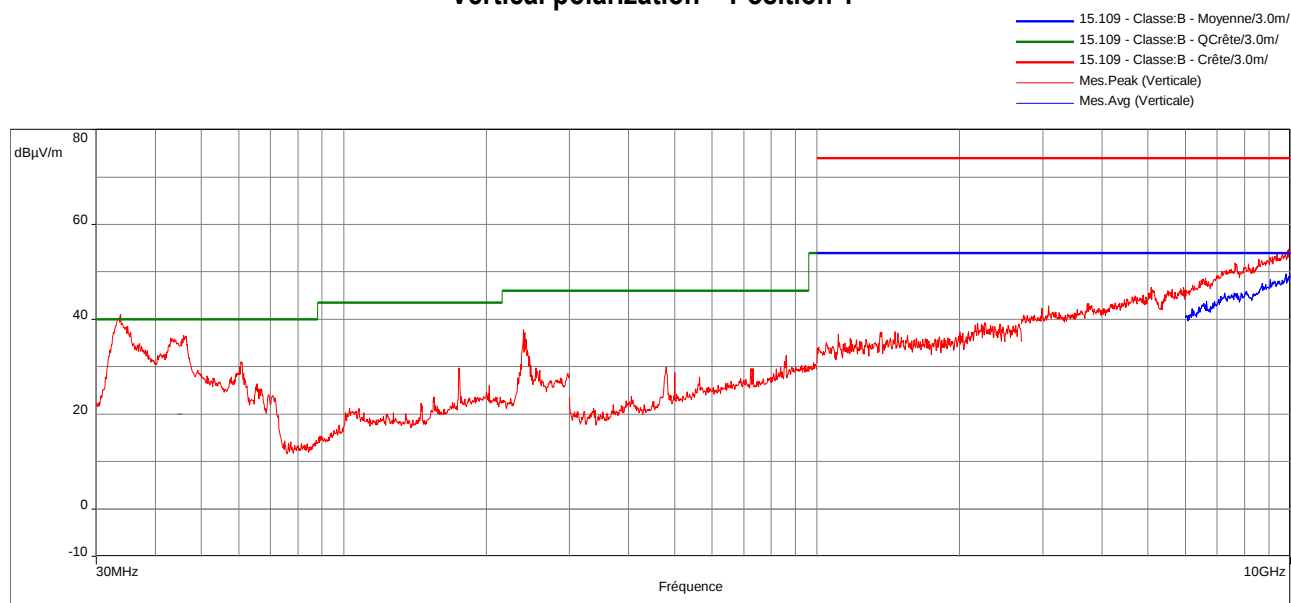
Percentage of voltage variation during the test (%): ± 1

This measure was realized only with the Power source VIVOTEC (AP-GIC-011A-095).

Results:

Sample N° 1

Vertical polarization – Position 1

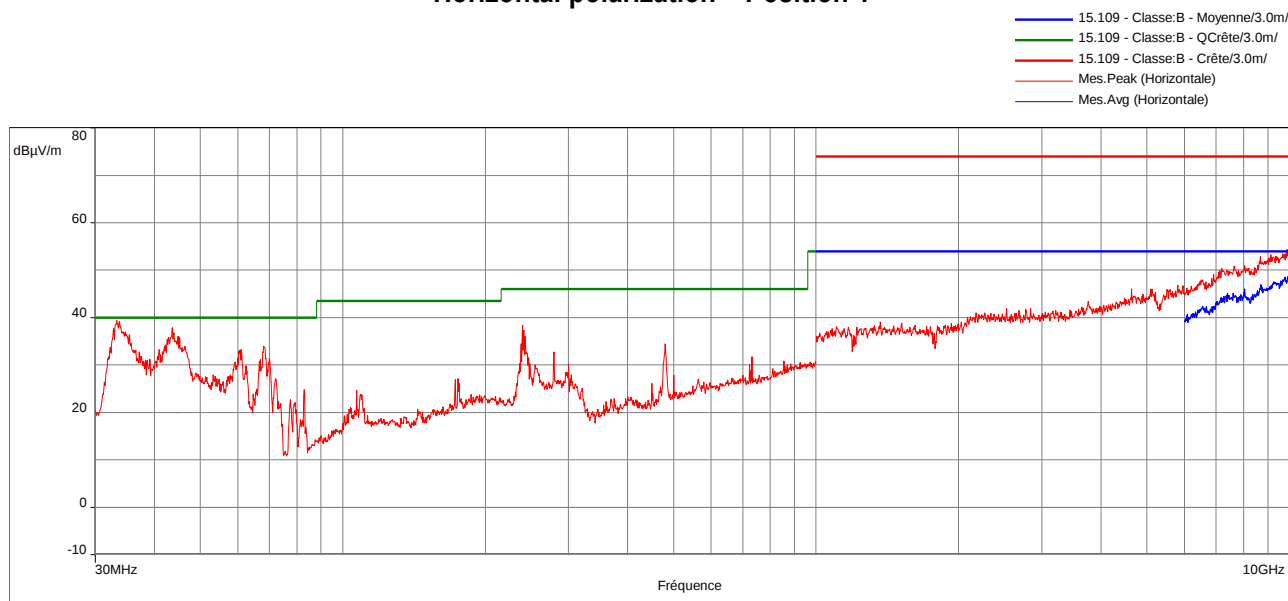


The 6 most critical emissions are indicated below.

Frequencies (MHz)	Detector P QP Av	RBW (kHz)	Field strength Measured at 3 m (dBμV/m)	Limits (dBμV/m)	Margin (dB)
33.753	QP	120	34.92	40.00	5.08
45.876	QP	120	31.59	40.00	8.41
60.645	QP	120	26.84	40.00	13.16
239.979	QP	120	33.73	46.00	12.27
240.843	QP	120	32.90	46.00	13.10
241.680	QP	120	33.18	46.00	12.82

P= Peak, QP=Quasi-peak, Av=Average

Horizontal polarization – Position 1

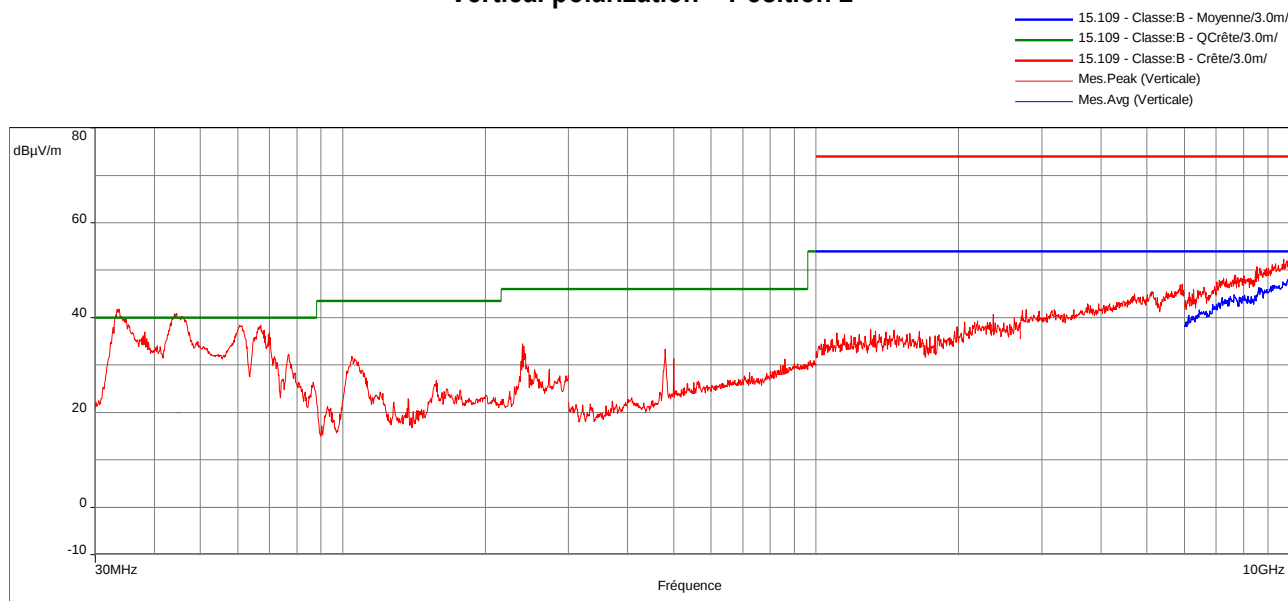


The 6 most critical emissions are indicated below.

Frequencies (MHz)	Detector P QP Av	RBW (kHz)	Field strength Measured at 3 m (dBμV/m)	Limits (dBμV/m)	Margin (dB)
33.294	QP	120	33.27	40.00	6.73
43.662	QP	120	32.84	40.00	7.16
61.050	QP	120	29.12	40.00	10.88
67.800	QP	120	27.15	40.00	12.85
68.124	QP	120	28.41	40.00	11.59
68.448	QP	120	28.05	40.00	11.95

P= Peak, QP=Quasi-peak, Av=Average

Vertical polarization – Position 2

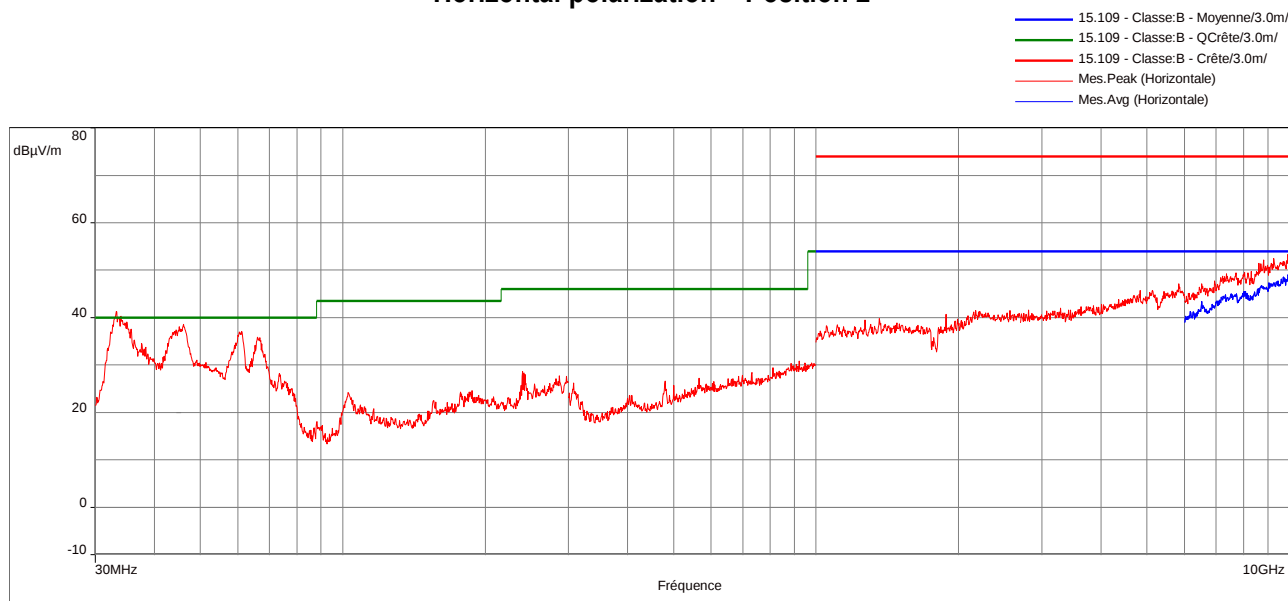


The 6 most critical emissions are indicated below.

Frequencies (MHz)	Detector P QP Av	RBW (kHz)	Field strength Measured at 3 m (dBμV/m)	Limits (dBμV/m)	Margin (dB)
33.672	QP	120	35.72	40.00	4.28
44.553	QP	120	35.88	40.00	4.12
60.618	QP	120	34.22	40.00	5.78
67.098	QP	120	32.84	40.00	7.16
76.926	QP	120	28.28	40.00	11.72
239.979	QP	120	30.46	46.00	15.54

P= Peak, QP=Quasi-peak, Av=Average

Horizontal polarization – Position 2



The 6 most critical emissions are indicated below.

Frequencies (MHz)	Detector P QP Av	RBW (kHz)	Field strength Measured at 3 m (dBμV/m)	Limits (dBμV/m)	Margin (dB)
33.240	QP	120	35.20	40.00	4.80
46.065	QP	120	33.51	40.00	6.49
61.212	QP	120	32.91	40.00	7.09
66.099	QP	120	30.27	40.00	9.73
239.979	QP	120	24.59	46.00	21.41
241.680	QP	120	24.34	46.00	21.66

P= Peak, QP=Quasi-peak, Av=Average

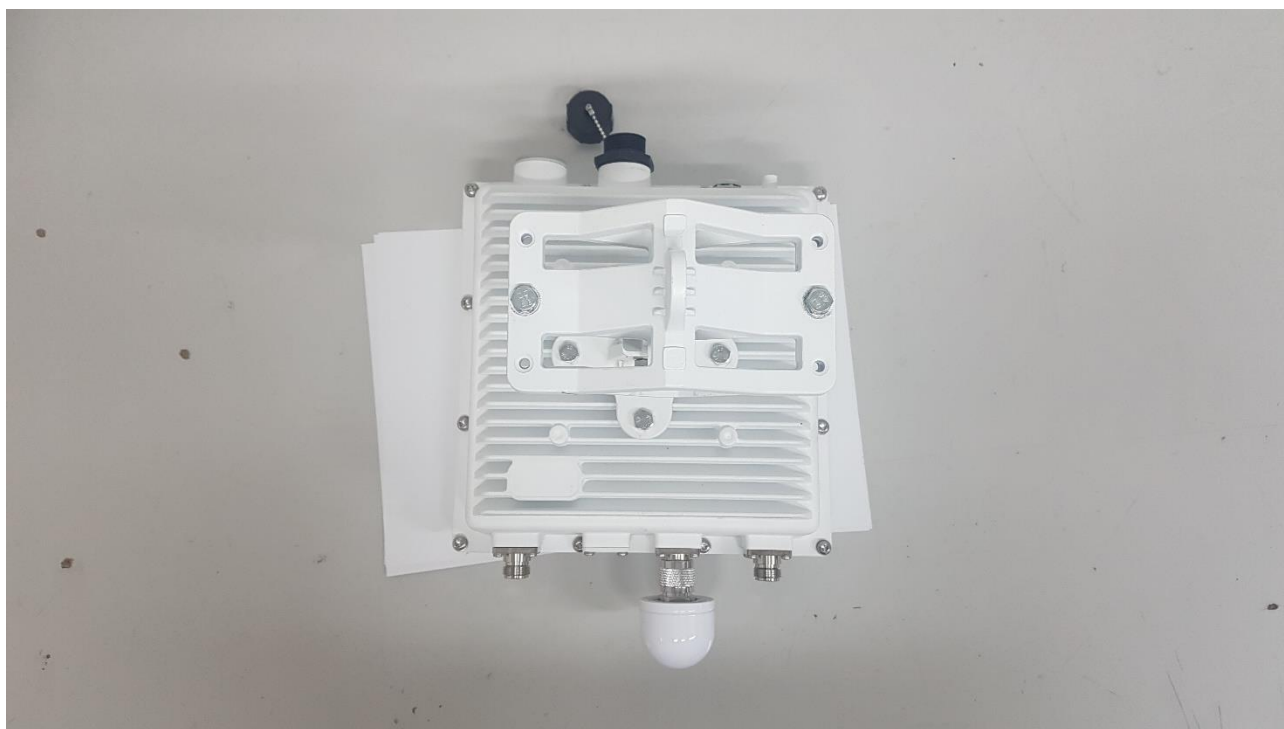
Applicable limits: for $30 \text{ MHz} \leq F \leq 88 \text{ MHz}$: 40 dBμV/m at 3 meters
for $88 \text{ MHz} < F \leq 216 \text{ MHz}$: 43.5 dBμV/m at 3 meters
for $216 \text{ MHz} < F \leq 960 \text{ MHz}$: 46 dBμV/m at 3 meters
Above 960 MHz : 54 dBμV/m at 3 meters

Test conclusion:

RESPECTED STANDARD

□□□ End of report, (2) appendixes to be forwarded □□□

APPENDIX 1: Photographies of the equipment under test



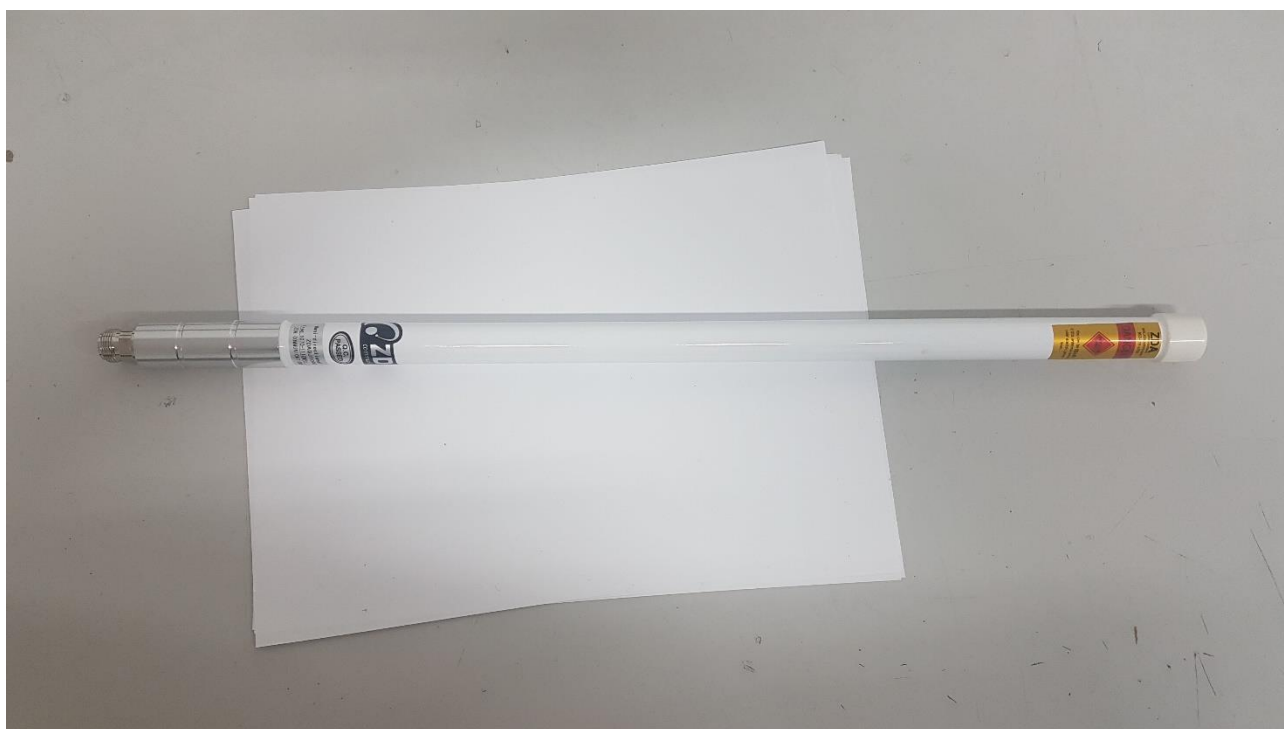
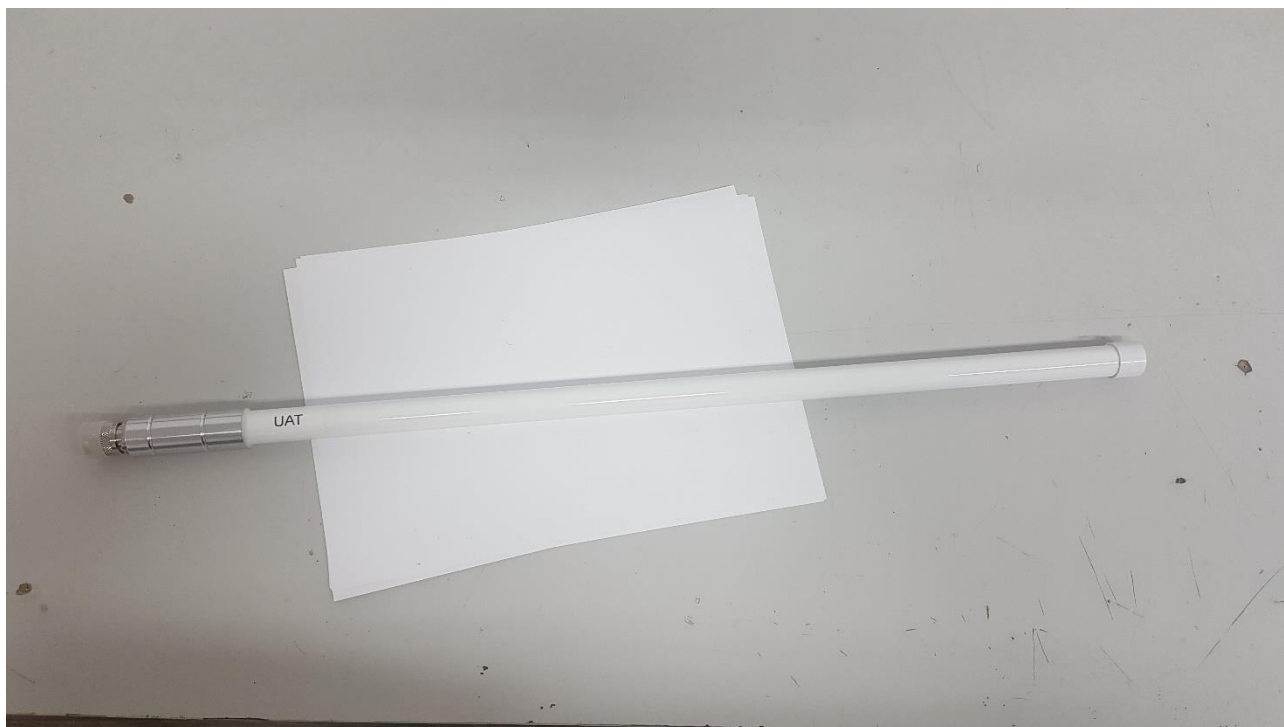


POE Vivotec



Netgear Router





APPENDIX 2: Test equipment list

AC Conducted emission

TYPE	MANUFACTURER	EMITECH NUMBER
Outside room	Emitech	11855
Test receiver N9010A	Agilent	11316
Transient limiter LIT-930A	COM-POWER	17207
LISN ESH3-Z5	Rohde & Schwarz	6217
Absorber sheath current	Emitech	17829
Cable N-6m	AEMC	8590
Power source PHF555	HAEFELY	6290
Multimeter 34401A	Agilent	10952
Meteo station 608-H1	Testo	15790
Software	BAT-EMC V3.18.0.26	0000

Unintentional spurious emission

TYPE	MANUFACTURER	EMITECH NUMBER
Anechoic Chamber	Siepel	7651
Test receiver N9010A	Agilent	11316
Biconical antenna 3104	EMCO	5625
Log periodic antenna 3146A	EMCO	5609
Antenna BBHA 9120D	Schwarzbeck	6970
Low-noise amplifier INT-BA011000-25	RFPA	15775
Low-noise amplifier 8449B	Agilent Technologies	10262
N-3M Cable	Huber + Suhner	15892
N-4.5M Cable	Huber + Suhner	15905
N-3.5M Cable	Huber + Suhner	15907
N-2.5M Cable	Huber + Suhner	15934
Power source PHF555	HAEFELY	6290
Multimeter 34401A	Agilent	10952
Meteo station 608-H1	Testo	15790
Software	BAT-EMC V3.18.0.26	0000