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TEST REPORT

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Version: 02

Subject Electromagnetic compatibility tests according to the standards:
FCC CFR 47 Part 15, Subpart B
ANSI C63.4 / ANSI C63.4a

Issued to DROTEK
Z.A. du Ruisseau / Route de Folcarde
31290 – AVIGNONET-LAURAGAIS
France

Apparatus under test

Product	Drone
Trade mark	DROTEK
Manufacturer	DROTEK
Model under test	IOSTAR
Serial number	RF sample
FCCID	2BAB7IOSTAR
IC	NC

Conclusion See Test Program chapter

Test date	January 17, 2023
Test location	LCIE Grenoble
FCC Test site	FR0008 - 197516
ISED Test site	FR0008 - 6500A
Sample receipt date	January 17, 2023
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PUBLICATION HISTORY

Version	Date	Author	Modification
01	January 17, 2023	Akram HAKKARI	Creation of the document
02	July 05, 2023	Akram HAKKARI	Adding FCC ID

Each new edition of this test report replaces and cancels the previous edition. The control of the old editions of report is under responsibility of client.



SUMMARY

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1. TEST PROGRAM

Standard:

- ✓ FCC Part 15, Subpart B (Digital Devices)
- ✓ ICES-003 (2020)

1.1.1. Requirements for disturbance emissions – Class B

EMISSION TEST	LIMITS			RESULTS (Comments)
Limits for conducted disturbance 150kHz-30MHz FCC §15.107 / ICES-003	Access: AC power			NA
	Frequency	Quasi-peak	Average	
	150-500kHz	66 to 56 dBµV	56 to 46 dBµV	
	0.5-5MHz	56 dBµV	46 dBµV	
	5-30MHz	60 dBµV	50 dBµV	
Radiated emissions 30MHz-1GHz FCC §15.109	Access: Enclosure port of ancillary equipment			PASS
	Frequency	Quasi-peak @3m		
	30MHz-88MHz	40.0 dBµV/m		
	88MHz-216MHz	43.5 dBµV/m		
	216MHz-960MHz	46.0 dBµV/m		
Radiated emissions 30MHz-1GHz ICES-003	Access: Enclosure port of ancillary equipment			PASS
	Frequency	Quasi-peak @3m		
	30MHz-88MHz	40.0 dBµV/m		
	88MHz-216MHz	43.5 dBµV/m		
	216MHz-230MHz	46.0 dBµV/m		
	230MHz-960MHz	47.0 dBµV/m		
Radiated emissions 1GHz-18GHz* FCC §15.109 / ICES-003	Access: Enclosure port of ancillary equipment			PASS
	Frequency	Peak @3m	Average @3m	
	1- 18GHz	74.0 dBµV/m	54.0 dBµV/m	

NA: Not Applicable / NP: Not Performed, not requested by the customer (It cannot be taken into account for the declaration of conformity)

^D: Divergence, the last version is used to make it possible to test the product with the standard which describes the current state of the art and thus to answer as well as possible his environment of final use.

***§15.33:** The highest internal source of a testing device is defined like more the highest frequency generated or used in the testing device or on which the testing device works or agrees.

- If the highest frequency of the internal sources of the testing device is lower than 108 MHz, measurement must be only performed until 1GHz.
- If the highest frequency of the internal sources of the testing device ranges between 108 MHz and 500 MHz, measurement must be only performed until 2GHz.
- If the highest frequency of the internal sources of the testing device ranges between 500 MHz and 1 GHz, measurement must be only performed until 5GHz.

If the highest frequency of the internal sources of the testing device is above 1 GHz, measurement must be only performed until 5 times the highest frequency or 40 GHz, while taking smallest of both.

Special condition for intentional radiator:

- For a composite system comprised of a digital device using a clock frequency of 1 GHz as the highest frequency for the digital logic and an intentional radiator operating at 2.4 GHz, the composite is required to be investigated to the upper frequency of 24 GHz (in this case, 10 times the intentional radiator frequency is the higher frequency).
- For a composite system comprised of a digital device using a clock frequency of 2 GHz as the highest frequency for the digital logic and an intentional radiator operating at 913 MHz, the composite is required to be investigated to the upper frequency of 10 GHz (in this case, 5 times the unintentional radiator clock frequency is the higher frequency).


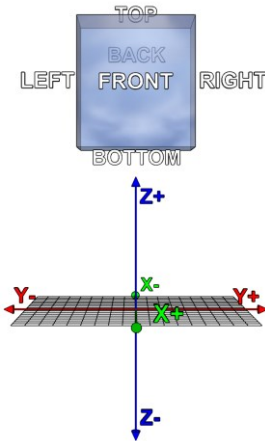

2. EQUIPMENT UNDER TEST: CONFIGURATION (DECLARED BY PROVIDER)

2.1. INFORMATIONS

All the motors are on and the RF fonctions are too (TX/RX ZIGBEE and RX wifi)

2.2. HARDWARE IDENTIFICATION (EUT AND AUXILIARIES)

Equipment under test (EUT):

Model under test :	IOSTAR
Serial Number:	RF sample
<div style="display: flex; justify-content: space-between;">  <div style="text-align: right;">  </div> </div> <div style="text-align: center; margin-top: 10px;">  </div>	
Dimensions:	19cm x 19cm x 5.2cm (Length x Width x Height)
Type :	Air



Power supply:

During all the tests, EUT is supplied by V_{nom} : **8.4VDC**

For measurement with different voltage, it will be presented in test method.

Name	Type	Rating	Reference / Sn	Comments
Supply1	Battery	8.4V	-	-

NC: Not communicated by provider

Inputs/outputs - Cable:

Access	Type	Length used (m)	Declared <3m	Shielded	Comments
No input nor output					

NC: Not communicated by provider

Auxiliary equipment used during test:

Type	Reference	Sn	Comments
Laptop	-	-	/
Programmation electronic carte	partie ST-Link d'une devboard STM32	-	/

NC: Not communicated by provider

Equipment information relative to communication radio:

Type of RF technology	Reference	Model	TX/RX
Zigbee	XB3-24DMCM-J	802.15.4 IoT 2400MHz 1000Kbps 34-Pin SMD	TX/RX
Wi-Fi	LBEE5HY1MW-230	Bluetooth, WiFi 802.11a/b/g/n/ac, Bluetooth v4.2 Transceiver Module 2.4GHz, 5GHz Antenna Not Included Surface Mount	RX
GPS	ZED-F9P-00B-02	Ublox dual band RTK F9P GNSS receiver	RX



2.3. EUT CONFIGURATION

Hardware information			
Highest internal frequency (PLL, Quartz, Clock, Microprocessor...):	F_{Highest}:	216 MHz	MHz
Firmware (if applicable):	V. :	NC	
Software (if applicable):	V. :	2.5.0	
Time necessary for the EUT to be exercised and to respond:	Dwell:	1	s

NC: Not communicated by provider

Running mode n°1:

Setup:

"The LED is on and the four motors are running. The Zigbee (Xbee) is only on RX and the Wi-Fi in on TX and RX are operating and exchanging data with the GCS (Ground Control Station). The GNSS is set on RX"

2.4. EQUIPMENT MODIFICATIONS DURING THE TESTS

None



2.5. FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follow:

$$FS = RA + AF + CF - AG$$

Where
FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Factor
AG = Amplifier Gain

2.6. TEST DISTANCE EXTRAPOLATION – FCC/ISED

The field strength is extrapolated to the new measurement distance using formula from FCC Part15.31 (f) and §6.5-6.6 RSS-GEN:

Below 30MHz,

$$FS_{\text{limit}} = FS_{\text{max}} - 40 \log \left(\frac{d_{\text{limit}}}{d_{\text{measure}}} \right)$$

Above 30MHz,

$$FS_{\text{limit}} = FS_{\text{max}} - 20 \log \left(\frac{d_{\text{limit}}}{d_{\text{measure}}} \right)$$

Where:

FS_{limit} is the calculation of field strength at the limit distance, expressed in dBμV/m

FS_{max} is the measured field strength, expressed in dBμV/m

d_{measure} is the distance of the measurement point from the EUT

d_{limit} is the reference limit distance

2.7. CALIBRATION DATE

The calibration intervals are extended at 12+2 months. This extended interval is based on the fact that there is sufficient calibration data to statistically establish a trend or based on experience of use of the test equipment to assure good measurement results for a longer period

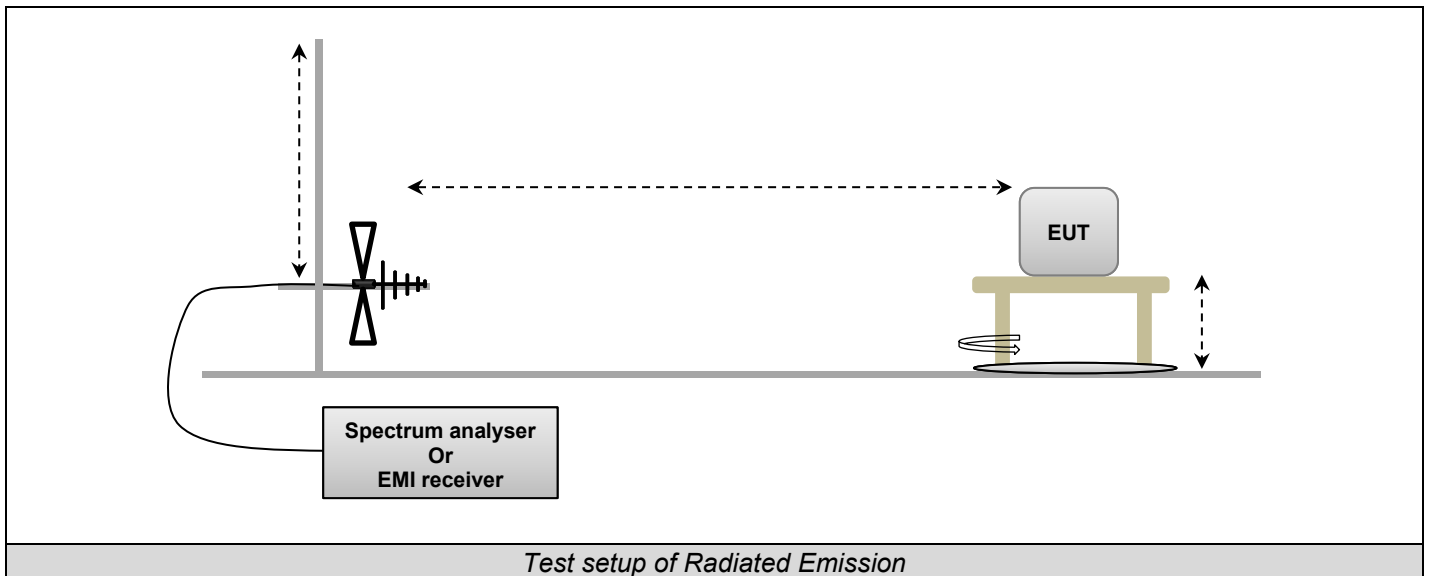
3. MEASUREMENT OF RADIATED EMISSION

3.1. TEST CONDITIONS

Date of test : January 17, 2023
 Test performed by : Nicolas BILLAUD & Mounir BOUAMARA
 Atmospheric pressure (hPa) : 998
 Relative humidity (%) : 43
 Ambient temperature (°C) : 23

3.2. TEST SETUP

The EUT and auxiliaries are set 80cm above the ground on the non-conducting table (Table-top equipment).
 The EUT is powered by V_{nom} .



Same setup is used in semi anechoic chamber during pre-characterization, with a distance of 3m between EUT and antenna.





Photo on OATS

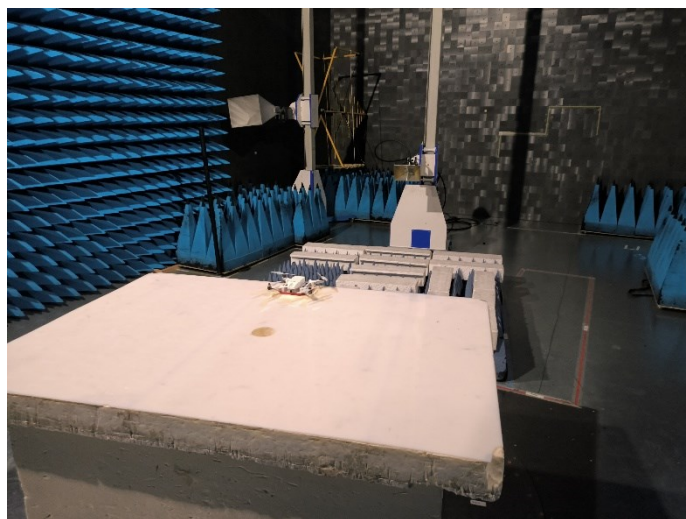
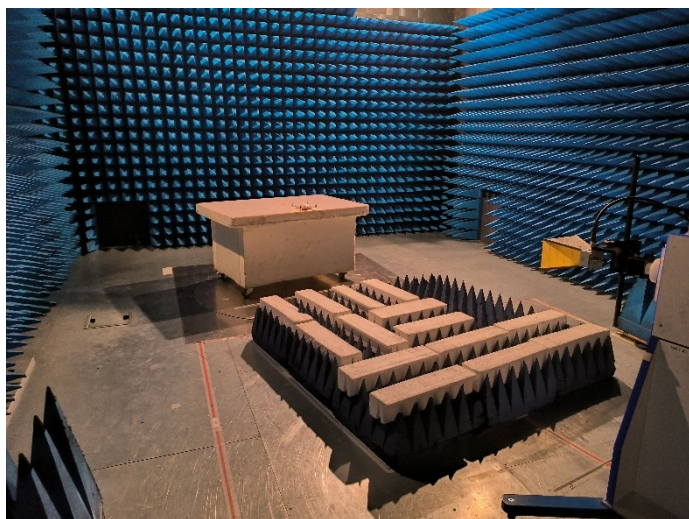


Photo in anechoic chamber – Frequency



3.3. TEST METHOD

3.3.1. 30MHz –1GHz

Pre-qualification measurement

A pre-scan of all the setup has been performed in a 3 meters semi-anechoic chamber. Test is performed with antenna centered on EUT in horizontal (H) and vertical (V) polarization, continuous linear turntable azimuth search was performed with 360 degrees range. Measurements are performed on all axis of EUT used in normal configuration. The pre-characterization graphs are obtained in PEAK detection.

Qualification

The installation of EUT is identical than for pre-qualification measurements. Test is performed in horizontal (H) and vertical (V) polarization and the height antenna is varied from 1m to 4m. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurements are performed on all axis of EUT used in normal configuration. A summary of the worst case emissions found in all test configurations and modes is shown.

3.3.2. 1GHz – 26GHz:

Pre-qualification measurement

A pre-scan of all the setup has been performed in a 3 meters full anechoic chamber. Test is performed with antenna centered on EUT in horizontal (H) and vertical (V) polarization, continuous linear turntable azimuth search was performed with 360 degrees range. Measurements are performed on all axis of EUT used in normal configuration. The pre-characterization graphs are obtained in PEAK and AVERAGE detection.

Qualification

The installation of EUT is identical for pre-characterization measurements. Test is performed in horizontal (H) and vertical (V) polarization and the height antenna is on mast, varied from 1m to 4m.

Continuous linear turntable azimuth search was performed with 360 degrees range. Measurements are performed on all axis of EUT used in normal configuration. A summary of the worst case emissions found in all test configurations and modes is shown.



3.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	Manufacturer	Model	Identifier	Cal_Date	Cal_Due
Amplifier 100kHz - 18GHz	LCIE SUD EST	—	A7085027	11/20	03/23
Antenna Bi-log	ROHDE & SCHWARZ	HL562E	C2040287	06/21	06/23
Antenna horn 18GHz	EMCO	3115	C2042027	04/22	04/25
Antenna mast (Cage#1)	MATURO Gmbh	AM 4.0	F2000407		
BAT EMC	NEXIO	v3.21.0.32	L1000115		
Cable 0.75m	SUCOFLEX	18GHz	A5329920	05/22	05/23
Cable 2.2m N	SUCOFLEX	SF118A/2x11N/2.2M	A5329989	05/22	05/23
CALCUL_FACTEURS	LCIE SUD EST	V4	L2000035		
Comb EMR HF	YORK	CGE01	A3169114		
Diameter 2m / Height 2.5m	LCIE	VSWR 1GHz - 18GHz	D3044016_VSWR	09/22	09/25
Emission Cable	SUCOFLEX	18GHz	A5329899	03/22	03/23
Radiated emission comb generator	BARDET	—	A3169050		
Receiver / Analyser	ROHDE & SCHWARZ	ESCI	A2642017	04/21	04/23
Semi-Anechoic chamber #1	SIEPEL	ANE	D3044016_ANE	03/21	03/24
Semi-Anechoic chamber #1	SIEPEL	—	D3044016	07/22	07/23
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	09/20	01/23
Table C1/OATS	MATURO Gmbh	—	F2000437		
Table C2/OATS	LCIE	—	F2000438		
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	01/21	01/23
Turntable chamber (Cage#1)	MATURO Gmbh	TT 2.0 SI	F2000406		
Turntable controller (Cage#1)	MATURO Gmbh	Control Unit	F2000408		
Horn Antenna	ELECTRO-METRICS	EM-6969	C2040286	05/21	05/24
Spectrum analyzer	ROHDE & SCHWARZ	FSV 40	A4060059	11/21	11/23
Cable 1m 40GHz	INTELLICONNECT	C-KPKP-1503-1M	A5329987	04/21	08/22
Antenna horn 40GHz	SCHWARZBECK	BBHA 9170	C2042028	06/22	06/25

3.1. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

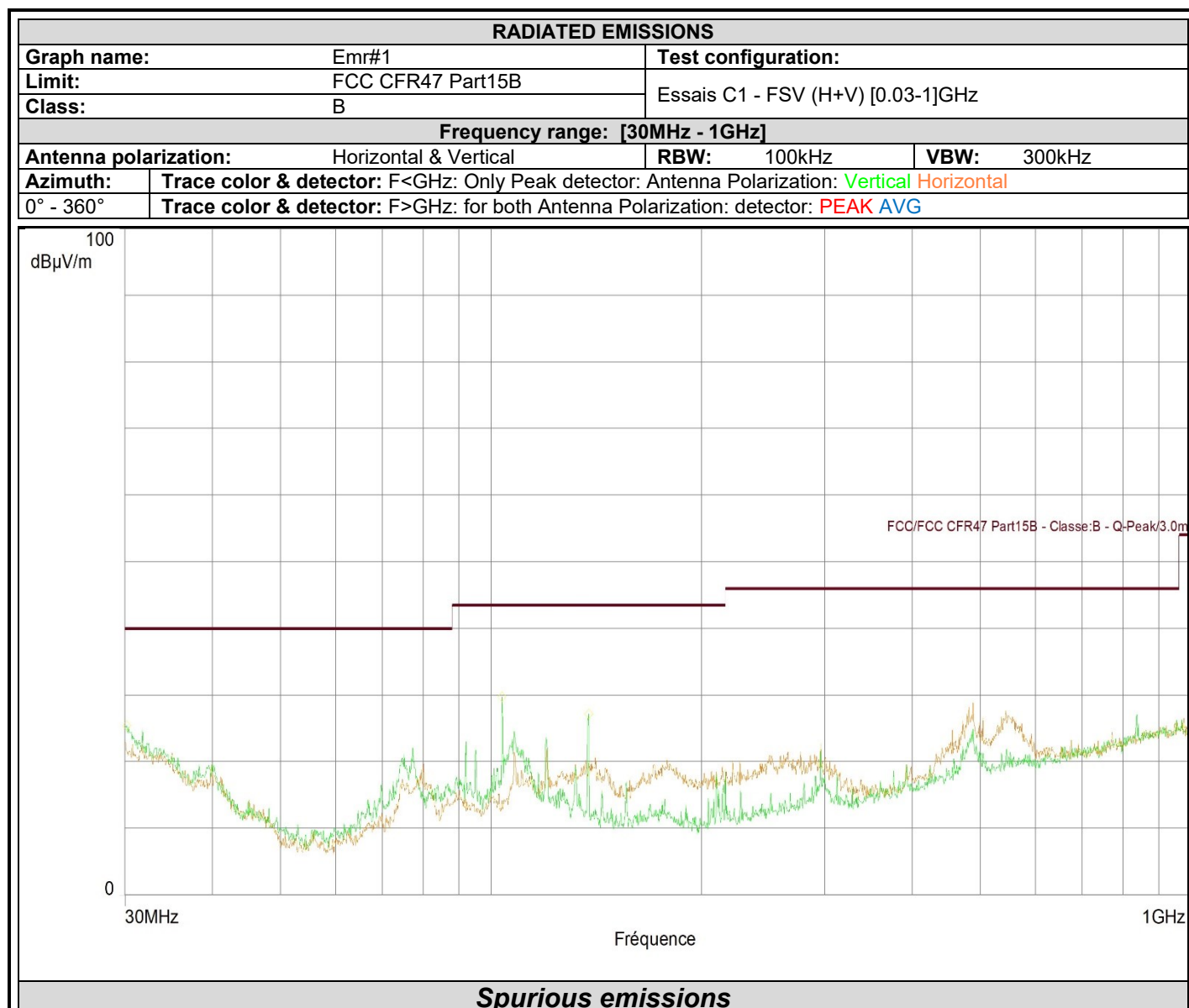
None

3.2. TEST RESULTS – RUNNING MODE N°1

3.2.1. 30MHz –1GHz

Pre-qualification measurement

Graph identifier	Polarization	EUT position	Comments	
Emr# 1	Vertical & Horizontal	Axis XY	/	See below



Frequency (MHz)	Peak (dBµV/m)	Lim.Q-Peak (dBµV/m)	Height	Polarization	Correction (dB)
30.153	25.4	40.0	1.6	Vertical	-6.7
103.763	29.7	43.5	1.6	Vertical	-14.6
137.882	27.1	43.5	1.6	Vertical	-15.6



Qualification

The frequency list is created from the results obtained during the pre-qualification.
Measurements are performed using a QUASI-PEAK detection.

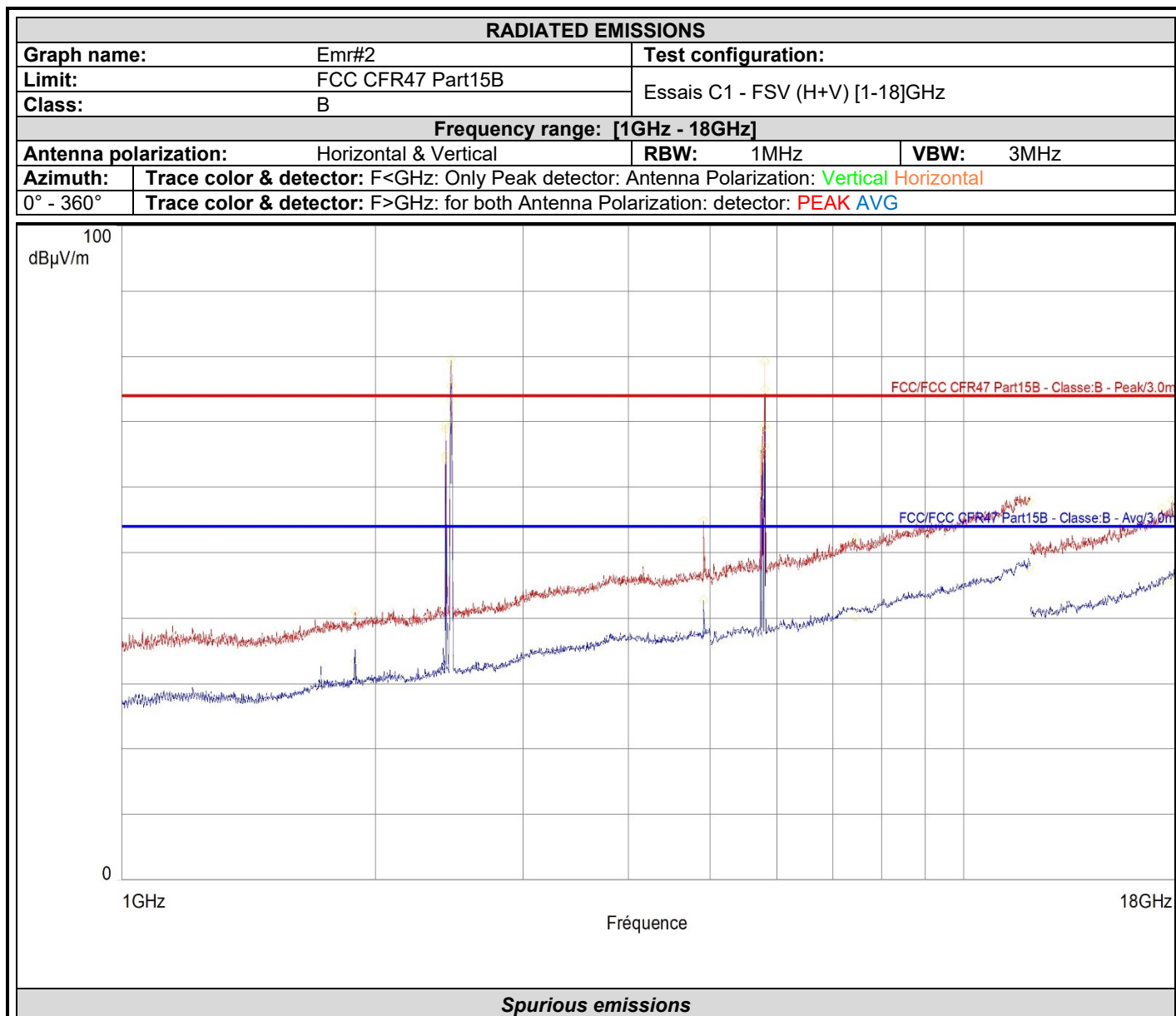
Test Frequency (MHz)	Meter Reading dB(μ V)	Detector (Pk/QP/Av)	Polarity (V/H)	Azimuth (Degrees)	Antenna Height (cm)	Gain/Loss Factor (dB)	Transducer Factor (dB)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
30.1530	5.6	QP	V	0	1	-	14.2	19.8	40.0	-20.2
103.7630	8.0	QP	V	0	1	-	13.5	21.5	43.5	-22.0
137.8820	6.3	QP	V	0	1.5	-	17.2	23.5	43.5	-20.0



3.2.2. 1GHz - 26GHz

Pre-qualification measurement

Graph identifier	Polarization	EUT position	Comments
Emr# 2	Vertical & Horizontal	Axis XY	See below



Frequency (MHz)	Peak (dBμV/m)	Lim.Peak (dBμV/m)	Avg (dBμV/m)	Lim.Avg (dBμV/m)	Height	Polarization	Correction (dB)
1894.250	40.9	74.0	33.5	54.0	1.0	Horizontal	3.5
2424.375*	68.9	74.0	64.9	54.0	1.0	Horizontal	4.8
2460.500*	79.5	74.0	75.5	54.0	1.0	Horizontal	4.9
5751.844*	65.9	74.0	58.8	54.0	1.0	Horizontal	12.4
5779.188*	69.2	74.0	62.4	54.0	1.0	Horizontal	12.4
5809.375*	79.3	74.0	69.3	54.0	1.0	Horizontal	12.4
17215.500	56.7	74.0	45.5	54.0	1.0	Horizontal	22.9



Frequency (MHz)	Peak (dBμV/m)	Lim.Peak (dBμV/m)	Avg (dBμV/m)	Lim.Avg (dBμV/m)	Height	Polarization	Correction (dB)
17953.500	57.9	74.0	46.3	54.0	1.0	Horizontal	25.0
2424.375*	69.6	74.0	64.2	54.0	1.0	Vertical	4.8
2460.500*	73.2	74.0	69.4	54.0	1.0	Vertical	4.9
4915.125	54.8	74.0	42.8	54.0	1.0	Vertical	11.5
5768.250*	64.7	74.0	56.9	54.0	1.0	Vertical	12.4
5809.594*	75.0	74.0	66.3	54.0	1.0	Vertical	12.4
7437.969	52.3	74.0	40.3	54.0	1.0	Vertical	16.2
11958.000	57.9	74.0	47.8	54.0	1.0	Vertical	24.2
17716.875	58.0	74.0	45.8	54.0	1.0	Vertical	23.2
17946.750	57.8	74.0	46.0	54.0	1.0	Vertical	24.9

*Carrier frequency Wifi 2.4GHz & 5GHz

Qualification

The frequency list is created from the results obtained during the pre-qualification. Measurements are performed using a PEAK and AVERAGE detection.

****No frequency observed**

3.2.1. 18GHz - 26GHz

****No frequency observed**

3.3. CONCLUSION

The sample of the equipment **IOSTAR**, Sn : **RF sample**, tested in the configuration presented in this test report **satisfies** to requirements of the product family standard applied (See §Test Program) for radiated emissions.

4. UNCERTAINTIES CHART

Type de mesure / Kind of measurement	Incertitude élargie laboratoire / Wide uncertainty laboratory (k=2) $\pm x$	Incertitude limite du CISPR / CISPR uncertainty limit $\pm y$
Mesure du champ électrique rayonné en cage de Faraday semi-anéchoïque de 30MHz à 1GHz <i>Measurement of radiated electric field in half-anechoic Faraday room From 30MHz to 1GHz</i>	6.3dB	6.3dB
Mesure du champ électrique rayonné en cage de Faraday anéchoïque de 1GHz à 6GHz <i>Measurement of radiated electric field in full-anechoic Faraday room From 1GHz to 6GHz</i>	5.2dB	5.2dB
Mesure du champ électrique rayonné en cage de Faraday anéchoïque de 6GHz à 18GHz <i>Measurement of radiated electric field in full-anechoic Faraday room From 6GHz to 18GHz</i>	5.5dB	5.5dB
Mesure du champ électrique rayonné sur le site en espace libre de Moirans 30MHz – 1GHz. <i>Measurement of radiated electric field on the Moirans open area test site 30MHz – 1GHz.</i>	6.3dB	6.3dB

Les valeurs d'incertitudes calculées du laboratoire étant inférieures aux valeurs d'incertitudes limites établies par le CISPR, la conformité de l'échantillon est établie directement par les niveaux limites applicables. Ce tableau regroupe l'ensemble des incertitudes maximales pour les essais réalisables dans le laboratoire, qu'ils aient été ou non réalisés dans le cadre du présent rapport / *The uncertainty values calculated by the laboratory are lower than limit uncertainty values defined by the CISPR. The conformity of the sample is directly established by the applicable limits values. This table includes all uncertainties maximum feasible for testing in the laboratory, whether or not made in this report*

Note - L'incertitude de mesure instrumentale est déterminée selon la CISPR 16-4-2. / *The instrumentation measurement uncertainty is determined according to CISPR16-4-2*