

RR051-20-102528-3-A Ed. 0

**Radio test report**

**According to the standard:**  
CFR 47 FCC PART 15  
RSS GEN – Issue 5

**Equipment under test:**  
**MEMS DATA CAPTURE WAND+**

**FCC ID: FI5-WAN02-1**

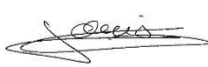
**IC NUMBER: 5056A-WAN021**

**Company:**  
**MICHELIN NORTH AMERICA (US) INC.**  
**MICHELIN NORTH AMERICA (CANADA) INC.**

**Distribution:** Mr CHANAL

**(Company:** EXOTIC SYSTEMS)

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**DESIGNATION OF PRODUCT:** MEMS DATA CAPTURE WAND+

**Serial number (S/N):** 20:72:31:7D:54:53 - radiated sample  
20:6A:31:80:54:53 conducted sample

Reference / model (P/N): Zone 2

**Software version:** Pack 2.0.4

**MANUFACTURER:** MICHELIN NORTH AMERICA INC.

**COMPANY CERTIFYING THE PRODUCT FOR TESTS:**

For FCC

**Company:** MICHELIN NORTH AMERICA (US) INC.

**Address:** One Parkway South  
Greenville, SC 29615  
United States

**Responsible:** Mr Flaker

For ISED

**Company:** MICHELIN NORTH AMERICA (CANADA) INC.

**Address:** 2863 Granton Road  
New Glasgow NS B2H 5C6  
Canada

**Responsible:** Mr Flaker

**COMPANY SUBMITTING THE PRODUCT FOR TESTS:**

**Company:** EXOTIC SYSTEMS

**Address:** 29 RUE GEORGES BESSE  
63100 CLERMONT FERRAND  
FRANCE

**Responsible:** Mr CHANAL

**DATES OF TEST:** From 16-Nov-20 to 19-Nov-20

**TESTING LOCATION:** EMITECH ANGERS laboratory at JUIGNE SUR LOIRE (49) FRANCE

FCC Accredited under US-EU MRA Designation Number: FR0009  
Test Firm Registration Number: 873677

ISED Accredited under CANADA-EU MRA Designation Number: FR0001  
Industry Canada Registration Number: 4452A

**TESTED BY:** T. LEDRESSEUR

**VISA:**



**WRITTEN BY:** T. LEDRESSEUR

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## 1. INTRODUCTION

This report presents the results of radio test carried out on the following radio equipment: **WAND**, in accordance with normative reference.

The equipment under test integrates:

- Bluetooth Low Energy radio function
- RFID UHF radio module operational at 920 MHz,
- RFID radio module operational at 125 kHz.
- Receiver at 433 MHz

This report concerns only the RFID part.

## 2. PRODUCT DESCRIPTION

Category of equipment (ISED):	I
Class:	B
Utilization:	Industrial use, but tested with class B limit
Antenna type and gain:	0 dBi / integral antenna
Operating frequency range:	125kHz
Number of channels:	1
Channel spacing:	Not concerned
Modulation:	ASK
Power source:	Internal battery 7.4Vdc, rechargeable with AC/DC adapter

### Test frequencies:

125kHz

Power level, frequency range and channels characteristics are not user adjustable.  
The details pictures of the product and the circuit boards are joined with this file.

The product is functional during the charge.

### **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 (2020)	Radio Frequency Devices
ANSI C63.10	2013 Procedures for Compliance Testing of Unlicensed Wireless Devices.
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 C – Intentional Radiators

- Paragraph 203: Antenna requirement
- Paragraph 205: restricted bands of operation
- Paragraph 207: Conducted limits
- Paragraph 209: Radiated emission limits; general requirements

Radio performance tests procedures given in RSS-Gen:

- Paragraph 2 - Purpose and Application
- Paragraph 3 - Normative Reference Publications
- Paragraph 4 - Application for an Exemption
- Paragraph 6 - Test Site Facilities
- Paragraph 8 - Licence-exempt Radio Apparatus

**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	/	/	/
1406	EMCO 6502	Loop antenna	24/04/2020	1	24/04/2021
4088	R&S FSP40	Spectrum Analyzer	04/05/2020	2	04/05/2022
7011	California instruments 1251RP	Power source	(1)	(1)	(1)
7566	Testo 608-H1	Meteo station	22/09/2020	2	22/09/2022
8508	California instruments 1251RP	Power source	(1)	(1)	(1)
8528	Schwarzbeck VHA 9103	Biconical antenna	09/03/2019	3	08/03/2022
8578	N-2GHz	Cable	11/06/2020	2	11/06/2022
8590	RG214 N-5m	Cable	25/02/2020	2	24/02/2022
8635	R&S EZ-25	High-pass filter	02/08/2018	3	01/08/2021
8707	R&S ES17	Test receiver	29/06/2020	1	29/06/2021
8719	Thurbly Thandar Instruments 1600	LISN	26/02/2020	2	25/02/2022
8732	Emitech	OATS	03/07/2019	3	02/07/2022
8750	La Crosse Technology WS-9232	Meteo station	22/09/2020	2	22/09/2022
8783	EMCO 3147	Log periodic antenna	09/03/2019	3	08/03/2022
8855	EMITECH	Turntable and mat controller	/	/	/
8896	ACQUISYS GPS8	Satellite synchronized frequency standard	/	/	/
10651	Absorber sheath current	Emitech	25/02/2020	2	24/02/2022
10788	Emitech	Outside room Hors cage	/	/	/
14831	Fluke 177	Multimeter	25/02/2020	2	24/02/2022
17008	Rohde & Schwarz ESW 44	Test receiver	05/03/2020	2	05/03/2022
-	RS Commander	Software	/	/	/

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

<b>6. TESTS RESULTS SUMMARY</b>
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**6.1 CFR 47 part 15 requirements (subpart C)**

Test procedure	Description of test	Respected criteria?				Comment
		Yes	No	NAp	NAs	
FCC Part 15.203	ANTENNA REQUIREMENT	X				Note 1
FCC Part 15.205	RESTRICTED BANDS OF OPERATION	X				
FCC Part 15.207	CONDUCTED LIMITS	X				
FCC Part 15.209	RADIATED EMISSION LIMITS; general requirements	X				

NAp: Not Applicable    NAs: Not Asked

Note 1: Integral antenna.

**6.2 RSS-Gen requirements**

Test procedure	Description of test	Criteria respected ?				Comment
		Yes	No	NAp	NAs	
Paragraph 2	Purpose and Application	X				
Paragraph 3	Normative Reference Publications	X				
Paragraph 4	Application for an Exemption			X		
Paragraph 6	Test Site Facilities	X				
Paragraph 8	Licence-exempt Radio Apparatus					
§ 8.1	Measurement Bandwidths and Detector Functions	X				
§ 8.2	Amplifiers	X				
§ 8.3	Transmitter Antenna for Licence-Exempt Radio Apparatus	X				
§ 8.4	User Manual Notice for Licence-Exempt Radio Apparatus	X				
§ 8.5	Measurement of Licence-Exempt Devices On-Site (in-situ)			X		
§ 8.6	Operating Frequency Range of Devices in Master/Slave Networks			X		
§ 8.7	Radio Frequency Identification (RFID) Devices	X				
§ 8.8	AC Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus	X				
§ 8.9	Transmitter Emission Limits for Licence-Exempt Radio Apparatus	X				
§ 8.10	Restricted Frequency Bands	X				
§ 8.11	Frequency Stability for Licence-Exempt Transmitters			X		

NAp: Not Applicable

NAs: Not Asked



**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%.

<b>Parameter</b>	<b>Emitech Uncertainty</b>
RF power, conducted	$\pm 0.75\text{dB}$
Radiated emission valid to 26 GHz	
F < 62.5 MHz:	$\pm 5.14\text{ dB}$
62.5 MHz < F < 1 GHz:	$\pm 5.13\text{ dB}$
1 GHz < F < 40 GHz:	$\pm 5.16\text{ dB}$
AC Power Lines conducted emissions	$\pm 3.38\text{ dB}$
Temperature	$\pm 1\text{ }^\circ\text{C}$
Humidity	$\pm 5\%$

**8. AC CONDUCTED EMISSION****Temperature (°C) :** 21**Humidity (%HR):** 45**Date :** November 17, 2020**Technician :** T. LEDRESSEUR**Standard:** FCC Part 15  
RSS-Gen**Test procedure:**

For FCC Part 15: Paragraph 15.207

For RSS-Gen: Paragraph 8.8

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:**

The device's radio modules are next blocked in continuous modulated transmission mode, at the highest output power level at which the transmitter is intended to operate.

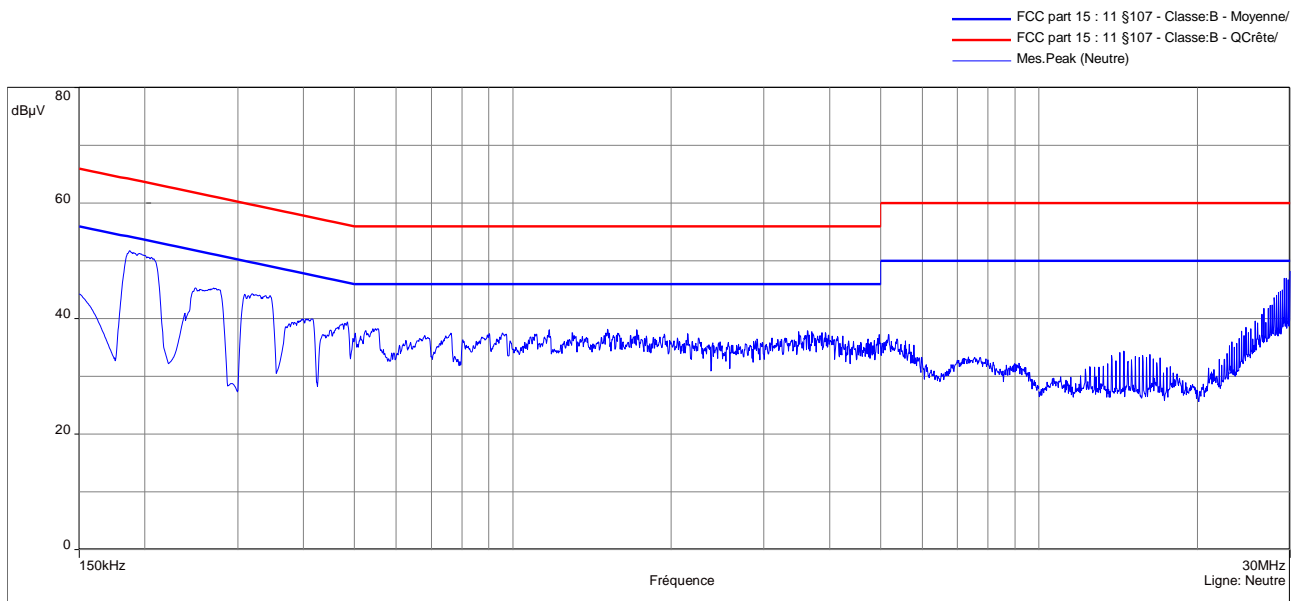
**Results:**

Sample N° 1

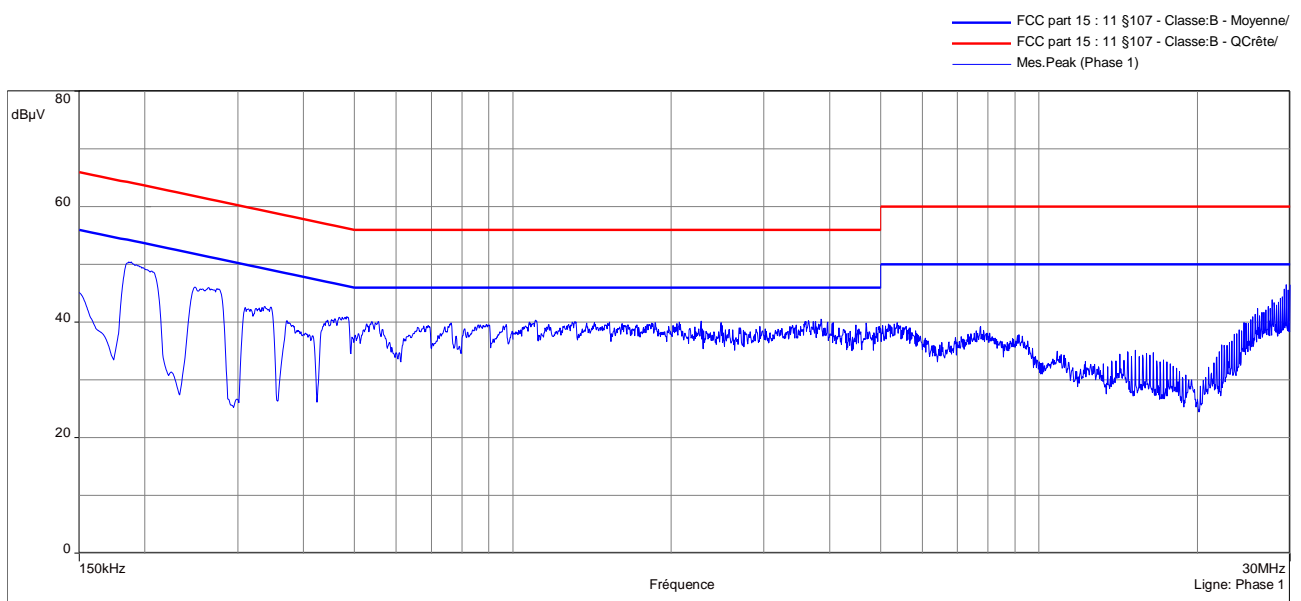
**Measurement on the mains power supply:**

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

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

Frequency	Quasi-peak	QP Limit	QP margin	Frequency	Average	Average Limit	Average margin
(MHz)	(dB $\mu$ V)	(dB $\mu$ V)	(dB)	(MHz)	(dB $\mu$ V)	(dB $\mu$ V)	(dB)
0.187	46.56	64.2	17.61	0.187	26.8	54.2	27.37
0.206	45.61	63.4	17.77	0.206	27.32	53.4	26.06
0.272	40.58	61.0	20.47	0.272	26.56	51.0	24.49
0.320	39.04	59.7	20.67	0.320	24.1	49.7	25.61
0.346	38.62	59.1	20.45	0.346	22.19	49.1	26.88
29.750	41.06	60.0	18.94	29.750	21.04	50.0	28.96
30.000	41.41	60.0	18.59	30.000	21.54	50.0	28.46

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

Frequency	Quasi-peak	QP Limit	QP margin	Frequency	Average	Average Limit	Average margin
(MHz)	(dB $\mu$ V)	(dB $\mu$ V)	(dB)	(MHz)	(dB $\mu$ V)	(dB $\mu$ V)	(dB)
0.188	47.26	64.1	16.85	0.188	27.37	54.1	26.74
0.207	45.32	63.3	17.99	0.207	25.23	53.3	28.08
0.264	40.45	61.3	20.85	0.264	26.7	51.3	24.60
0.347	37.28	59.0	21.75	0.347	20.73	49.0	28.30
0.484	36.64	56.3	19.63	0.484	19.84	46.3	26.43
3.855	35.24	56.0	20.76	3.855	20.77	46.0	25.23
29.250	41.26	60.000	18.740	29.250	23.6	50.000	26.400
29.502	40.67	60.0	19.33	29.502	23.52	50.0	26.48

**Test conclusion:**

RESPECTED STANDARD

**9. OCCUPIED BANDWIDTH**

Temperature (°C) : 21

Humidity (%HR): 45

Date : November 17, 2020

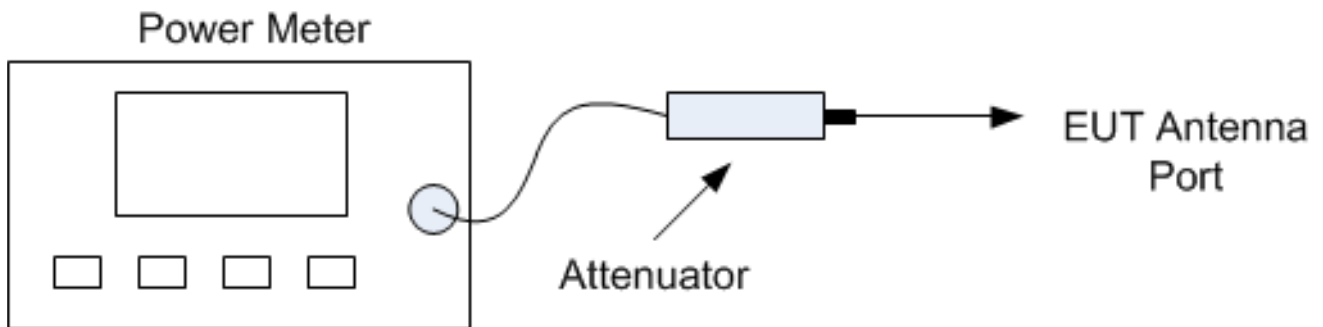
Technician : T. LEDRESSEUR

 Standard: FCC Part 15  
 RSS-247

**Test procedure:**

Method of paragraphs 6.9.3 of ANSI C63.10 (99% Measurement)

Method of paragraphs 6.9.2 of ANSI C63.10 (20dB Measurement)

**Test set up:**
Conducted test

Setting:

<b>Measure</b>	<b>99%</b>
<b>Center frequency</b>	The centre frequency of the channel under test
<b>Detector</b>	Peak
<b>Span</b>	1.5 to 5 times the OBW
<b>RBW</b>	1% to 5% of the OBW
<b>VBW</b>	3 x RBW
<b>Trace</b>	Max hold
<b>Sweep</b>	Auto

**Test operating condition of the equipment:**

The equipment under test is blocked in continuous modulated transmission mode, at the +27dBm output power setting.

Power source: 120 Vac by an external power supply

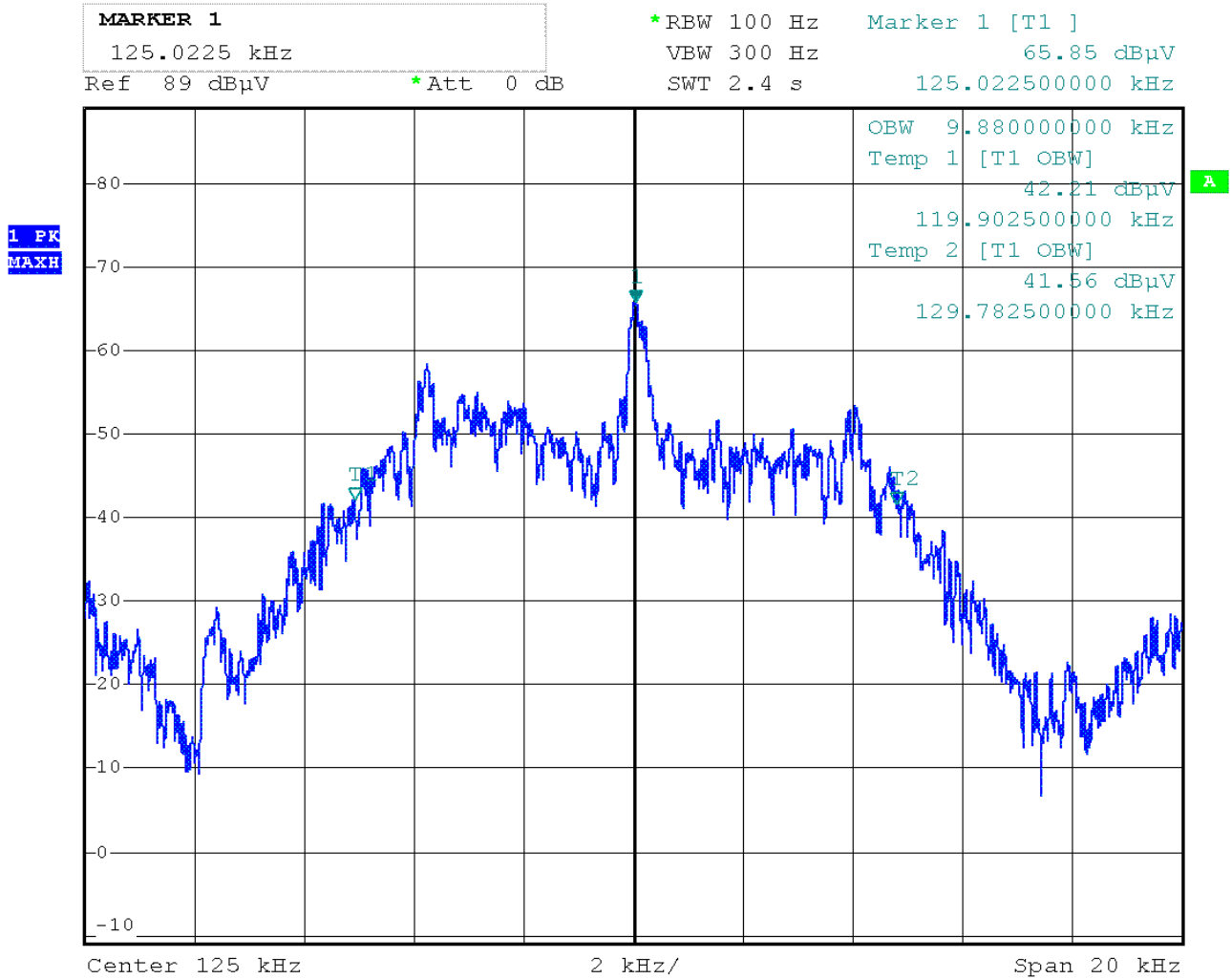
Percentage of voltage variation during the test (%):

 $\pm 1$

**Results:**

Sample N° 1

99% bandwidth



Measure realized for reporting only

**Test conclusion:**

RESPECTED STANDARD

**10. RADIATED EMISSION LIMITS; GENERAL REQUIREMENTS****Temperature (°C) :** 20**Humidity (%HR):** 43**Date :** November 18, 2020**Technician :** T. LEDRESSEUR**Standard:** FCC Part 15  
RSS-GEN**Test procedure:** For FCC Part 15: paragraph 209  
For RSS-GEN: paragraph 8.9  
Method of § 6.4 of ANSI C63.10  
Method of § 6.5 of ANSI C63.10**Test set up:**

First an exploratory radiated measurement was performed. During this phase the product is oriented in three orthogonal planes.

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

The system is tested in an open area test site (OATS). The EUT is placed on a rotating table, 0.8 m from a ground plane. Zero degree azimuth corresponds to the front of the equipment under test.

See photos in Test setup document

**Frequency range:** From 9 kHz to 1 GHz**Detection mode:** Quasi-peak(F < 1 GHz)

Except for the frequency bands 9-90kHz, 110-490kHz. Radiated emission limits in these three bands are based on measurements employing an average detector

**Bandwidth:** 200Hz (9 kHz < F < 150kHz)  
9 kHz (150 kHz < F < 30MHz)  
120 kHz (30 MHz < F < 1 GHz)**Distance of antenna:** 10 meters (in open area test site)**Antenna height:** 1 to 4 meters (in open area test site)**Antenna polarization:** vertical and horizontal (only the highest level is recorded)**Equipment under test operating condition:**

The equipment under test is blocked in continuous modulated transmission mode, at the +27dBm output power setting.

Power source: 120 Vac by an external power supply

Percentage of voltage variation during the test (%):

± 1

**Results:**
Sample N° 1:
**Sample N° 1: Carrier** = 125 kHz

Frequencies (kHz)	Detector P: Peak Av: Average	Field strength at 10 meters dB $\mu$ V/m <sup>(1)</sup>	Field strength at 300 meters dB $\mu$ V/m <sup>(2)</sup>	Limits 300m dB $\mu$ V/m	Margin (dB)
125	P	79.35	22.46	45.67	23.21
125	Av	78.02	22.17	25.67	3.5

With antenna height: 100 cm; Azimuth: 275°; Polarization antenna: Parallel° - Position 2

- (1) Field strength measured at 10 meters  
 (2) Field strength extrapolated at 300 meters using 40dB/decade fall off

**Sample 1: Harmonics and spurious:**

Frequencies (kHz)	Detector P: Peak Av: Average	Field strength at 10 meters dB $\mu$ V/m <sup>(3)</sup>	Field strength at 300 meters dB $\mu$ V/m <sup>(4)</sup>	Limits 300m dB $\mu$ V/m	Margin (dB)
250	P	46.02	-13.06	39.65	52.71
250	Av	45.76	-13.32	19.65	32.97

- (3) Noise Floor measured at 10 meters  
 (4) Noise Floor extrapolated at 300 meters using 40dB/decade fall off

Frequencies (kHz)	Detector P: Peak Av: Average	Field strength at 10 meters dB $\mu$ V/m	Field strength at 300 meters dB $\mu$ V/m	Limits 300m dB $\mu$ V/m	Margin (dB)
375	P	41.96	-17.12	36.12	53.24
375	Av	41.75	-17.33	16.12	33.45

Frequencies (kHz)	Detector P: Peak Av: Average	Field strength at 10 meters dB $\mu$ V/m <sup>(5)</sup>	Field strength at 30 meters dB $\mu$ V/m <sup>(6)</sup>	Limits 30m dB $\mu$ V/m	Margin (dB)
500	QP	33.16	14.08	33.62	19.54

- (5) Noise Floor measured at 10 meters  
 (6) Noise Floor extrapolated at 300 meters using 40dB/decade fall off

Applicable limits: for  $9 \text{ kHz} \leq F \leq 490 \text{ kHz}$  : 2400/F(kHz) at 300 meters  
 for  $490 \text{ kHz} < F \leq 1.705 \text{ MHz}$  : 24000/F(kHz) at 30 meters  
 for  $1.705 \text{ MHz} < F \leq 30 \text{ MHz}$  : 29.5 dB $\mu$ V/m at 30 meters  
 for  $30 \text{ MHz} < F \leq 88 \text{ MHz}$  : 40 dB $\mu$ V/m at 3 meters  
 for  $88 \text{ MHz} < F \leq 216 \text{ MHz}$  : 43.5 dB $\mu$ V/m at 3 meters  
 for  $216 \text{ MHz} < F \leq 960 \text{ MHz}$  : 46 dB $\mu$ V/m at 3 meters  
 Above 960 MHz : 54 dB $\mu$ V/m at 3 meters

**Test conclusion:**

RESPECTED STANDARD

□□□ End of report, (1) appendix to be forwarded □□□



## APPENDIX 1: Test equipment list

### AC conducted emissions

TYPE	MANUFACTURER	EMITECH NUMBER
Outside room Hors cage	Emitech	10788
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Test receiver ESW44	Rohde & Schwarz	17008
LISN 1600	Thurbly Thandar Instruments	8719
High-pass filter EZ-25	Rohde & Schwarz	8635
Absorber sheath current	Emitech	10651
Cable N-5m RG214	GYL Technologies	8590
Power source 1251RP	California instruments	7011
Multimeter 177	Fluke	14831
Meteo station WS-9232	La Crosse Technology	8750
Software	BAT-EMC V3.18.0.26	0000

### Occupied bandwidth

TYPE	MANUFACTURER	EMITECH NUMBER
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Spectrum Analyzer FSP40	Rohde & Schwarz	4088
Power source 1251RP	California instruments	7011
Multimeter 177	Fluke	14831
Meteo station WS-9232	La Crosse Technology	8750
Software	RS Commander	-

### Radiated emission limits; general requirements

TYPE	MANUFACTURER	EMITECH NUMBER
Open test site	EMITECH	8732
Turntable and mat controller	EMITECH	8855
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Test receiver ESI7	Rohde & Schwarz	8707
Loop antenna 6502	EMCO	1406
Biconical antenna VHA 9103	Schwarzbeck	8528
Log periodic antenna 3147	EMCO	8783
Cable	EMITECH	8578
Power source 1251RP	California instruments	8508
Multimeter 177	Fluke	14831
Meteo station 608-H1	Testo	7566
Software	BAT-EMC V3.17.0.25	0000