

Radio test report

According to the standard:
CFR 47 FCC PART 15

Equipment under test:
Single Depth Soil Moisture Probe

FCC ID: 2AVO4-SDXXNAK

Company:
SENSOTERRA

Distribution: Mr PRIOUL

(Company: KERLINK)

Number of pages: 11

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			Name and Function	Visa
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DESIGNATION OF PRODUCT: Single Depth Soil Moisture Probe

Serial number (S/N): Sample 1: 9000000B (Radiated tests)

Reference / model (P/N): SD30AS-1

Software version: lpiot-refdes-1.5.4.

MANUFACTURER: SENSOTERRA
Science Park 106
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The Netherlands

COMPANY SUBMITTING THE PRODUCT:

Company: KERLINK

Address: 1, rue Jacqueline Auriol
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Responsible: Mr Prioul

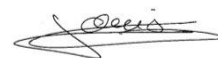
Person present during the tests: Mr Prioul (The first day)

DATE(S) OF TEST: From 16-Dec-19 to 19-Dec-19

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

TESTED BY: S. LOUIS

VISA:



WRITTEN BY: S. LOUIS

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1. INTRODUCTION

This report presents the results of radio test carried out on the following radio equipment: **Single Depth Soil Moisture Probe**, in accordance with normative reference.

The device under test integrates LoRa radio part.

2. PRODUCT DESCRIPTION

Class: B

Utilization: Residential

Antenna type and gain: integral metallic PIFA antenna / 3 dBi

Operating frequency Band: From 902 MHz to 928 MHz

Power source: 3.6Vdc Lithium Battery

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.

Hybrid System:

Frequency tested: 902.3 MHz, 908.7 MHz, 914.9 MHz for transmission
923.3 MHz, 925.1 MHz, 927.5 MHz for reception

Frequencies plan detailed transmitter:

Channel frequencies	LoRa bandwidth (KHz)	Number of channel	Channel width (KHz)
902,3+i*0,2MHz (i=0 à 63)	125	64	200

Frequencies plan detailed receiver:

Channel frequencies	LoRa bandwidth (KHz)	Number of channel	Channel width (KHz)
923,3+i*0.6MHz (i=0 à 7)	500	8	600

Number of channels: 64

Channel spacing: 200 kHz

Modulation: LoRa with spread factor: 7 and 10

DTS System:

Frequency tested: 903 MHz, 907.8 MHz, 914.2 MHz for transmission
923.3 MHz, 925.1 MHz, 927.5 MHz for reception

Frequencies plan detailed transmitter:

Channel frequencies	LoRa bandwidth (KHz)	Number of channel	Channel width (KHz)
$903+i*1,6\text{MHz}$ ($i=0$ à 7)	500	8	600

Frequencies plan detailed receiver:

Channel frequencies	LoRa bandwidth (KHz)	Number of channel	Channel width (KHz)
$923,3+i*0.6\text{MHz}$ ($i=0$ à 7)	500	8	600

Number of channels: 8

Channel spacing: 600 kHz

Modulation: LoRa with spread factor: 7 and 12

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 (2019) 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.

4. TEST METHODOLOGY

Radio performance tests procedures given in CFR 47 part 15:

Subpart B –Unintentional Radiators

Paragraph 107: conducted limits

Paragraph 109: radiated emission limits

Paragraph 111: antenna power conduction limits for receivers

5. TEST EQUIPMENT CALIBRATION DATES

Emitech Number	Model	Type	Last calibration	Calibration interval (years)	Next calibration due
0	BAT-EMC V3.17.0.25	Software	/	/	/
4088	R&S FSP40	Spectrum Analyzer	21/02/2018	2	21/02/2020
6884	Suhner 1.5m	Cable	30/03/2018	2	29/03/2020
8511	HP 8447D	Low-noise amplifier	15/03/2019	1	14/03/2020
8526	Schwarzbeck VHBB 9124	Biconical antenna	17/08/2018	3	16/08/2021
8535	EMCO 3115	Antenna	10/02/2017	3	10/02/2020
8543	Schwarzbeck UHALP 9108A	Log periodic antenna	17/08/2018	3	16/08/2021
8593	SIDT Cage 2	Anechoic chamber	/	/	/
8750	La Crosse Technology WS-9232	Meteo station	25/09/2018	2	24/09/2020
8896	ACQUISYS GPS8	Satellite synchronized frequency standard	/	/	/
12911	Huber + Suhner N-2m	cable	30/03/2018	2	29/03/2020
14736	MATURO	Turntable and mat controller MCU	/	/	/
14903	Fluke 177	Multimeter	28/02/2018	2	28/02/2020
15812	COMP-POWER PAM-118A	Low-noise amplifier 18GHz	04/09/2019	1	03/09/2020
15882	SUCOFLEX	cable N 5m	28/11/2018	2	27/11/2020

6. TESTS RESULTS SUMMARY

unintentional radiator (subpart B)

Test procedure	Description of test	Respected criteria?				Comment
		Yes	No	NAp	NAs	
FCC Part 15.107	CONDUCTED LIMITS			X		Supplied by battery
FCC Part 15.109	RADIATED EMISSION LIMITS	X				Class B
FCC Part 15.111	ANTENNA POWER CONDUCTED LIMITS FOR RECEIVER			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%.

Parameter	Emitech Uncertainty
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 < 26 GHz:	$\pm 5.16\text{ dB}$
AC Power Lines conducted emissions	$\pm 3.38\text{ dB}$
Temperature	$\pm 1\text{ }^{\circ}\text{C}$
Humidity	$\pm 5\text{ \%}$

8. RADIATED EMISSION LIMITS**Temperature (°C) :** 19.8**Humidity (%HR):** 52**Date :** December 16, 2019**Technician :** S. LOUIS**Standard:** FCC Part 15**Test procedure:** paragraph 109**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 on open area test site under 1 GHz and in anechoic chamber above 1 GHz.

When the system is tested in an open area test site (OATS), the EUT is placed on a rotating table, 0.8m from a ground plane.

When the system is tested in anechoic chamber, 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.

See photos in appendix 2.

Frequency range: From 30 MHz to 5 GHz / 5th harmonic of the highest frequency used (928MHz)**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: 10 meters (in open area test site) / 3 meters (in anechoic room)**Antenna height:** 1 to 4 meters (in open area test site) / 1.5 meter (in anechoic room)**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 device's radio modules are blocked in reception mode and all sensors are functional during tests.

We used for power source the internal battery of the equipment and we noted:

Voltage at the beginning of test (Vdc): 3.62

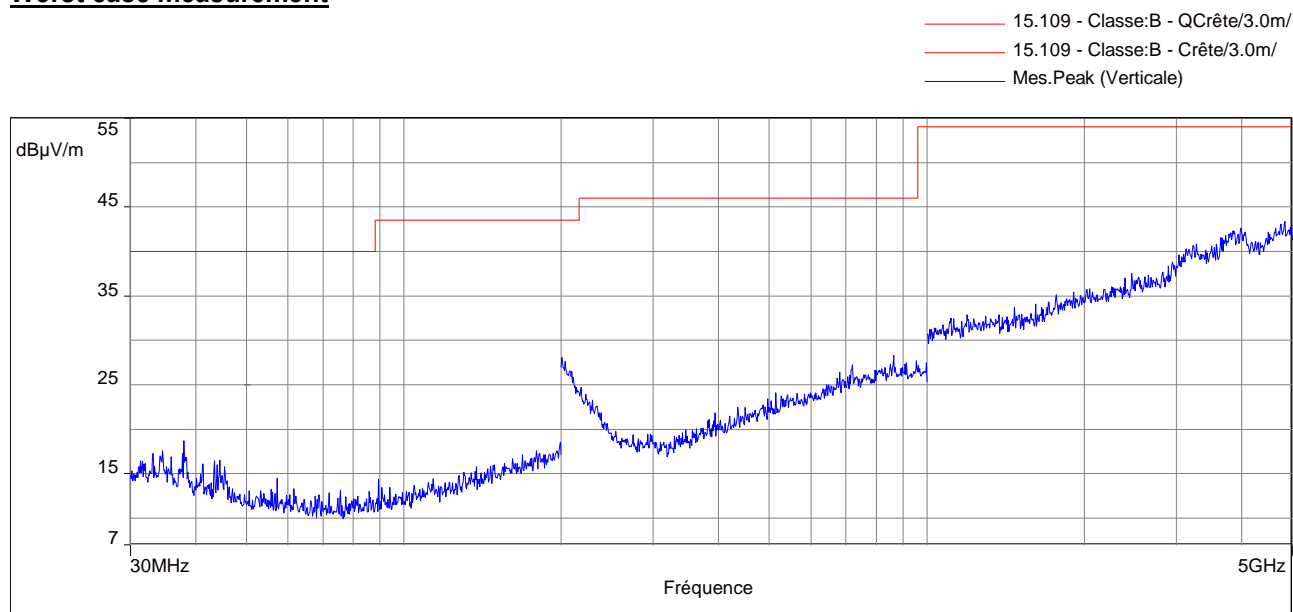
Voltage at the end of test (Vdc): 3.54

Percentage of voltage drop during the test (%): 2.21

Results:

Sample N° 1

Worst case measurement



Not any spurious has been detected.

Applicable limits: for 30 MHz ≤ F ≤ 88 MHz :	40 dBμV/m at 3 meters
for 88 MHz < F ≤ 216 MHz :	43.5 dBμV/m at 3 meters
for 216 MHz < F ≤ 960 MHz :	46 dBμV/m at 3 meters
Above 960 MHz :	54 dBμV/m at 3 meters

Note: any spurious which has more than 20 dB of margin compared to the applicable limit is not necessarily reported.

Test conclusion:

RESPECTED STANDARD

□□□ End of report □□□