EMITECH GROUPE

RR-030-PTC-15-101289-1-A

"This report cancels and replaces the test report N° RR-030-PTC-15-101289-1-A Edition 0"

RADIO Test Report

According to the standard:
FCC 47 CFR PART 15 : 2015 (§15.231)

Equipment under test:
Transceiver for SAW sensors
Type: HTR01-2AW

Company:
SENSEOR

FCC accredited: FR0004
FCC ID: 2AEGUHTR01-2AW

DISTRIBUTION: Mr. TOURETTE **(Company:** SENSEOR)

Number of pages: 34 with 4 annexes

Ed.	Date	Modified pages	Written by Name	Written by Visa	Technical Verification and Quality Approval Name	Technical Verification and Quality Approval Visa
1	09/06/15	1 ; 2 ; 4 ; 7 ; 9 ; 11 ; 13 ; 14 ; 15 ; 16 ; 17	B. PELLERIN	BPe	F_Lheureux.	Lheureux.

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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 production of the item tested.

TEST CERTIFICATION FOR:	FCC Certification
***NAME OF THE EQUIPMENT UNDER TEST*:**	Transceiver for SAW sensors Type: HTR01-2AW
Serial number:	Prototype
Reference / model (P/N):	-
Software version:	-
NAME OF THE MANUFACTURER:	SENSEOR
ADDRESS OF THE APPLICANT:	
Company:	SENSEOR
Address:	Le Navigator Bâtiment B 505 route des Lucioles 06560 VALBONNE FRANCE
Person in charge:	Mr. TOURETTE
DATE OF TESTS:	09/03/2015
TESTS LOCATION:	EMITECH Laboratory at Montigny-le-Bretonneux (78) FRANCE
TESTS OPERATORS:	B.PELLERIN / A.BERNARD

TABLE OF CONTENTS

1. INTRODUCTION

This document presents the results of Electromagnetic Compatibility tests performed on the equipment **«Transceiver for SAW sensors -Type: HTR01-2AW**» according to reference documents listed below.

2. *REFERENCE DOCUMENTS*

FCC 47 CFR Part 15: 2015
Code of Federal Regulations
Title 47- Telecommunication
Chapter 1- Federal Communication Commission
Part 15- Radio frequency devices

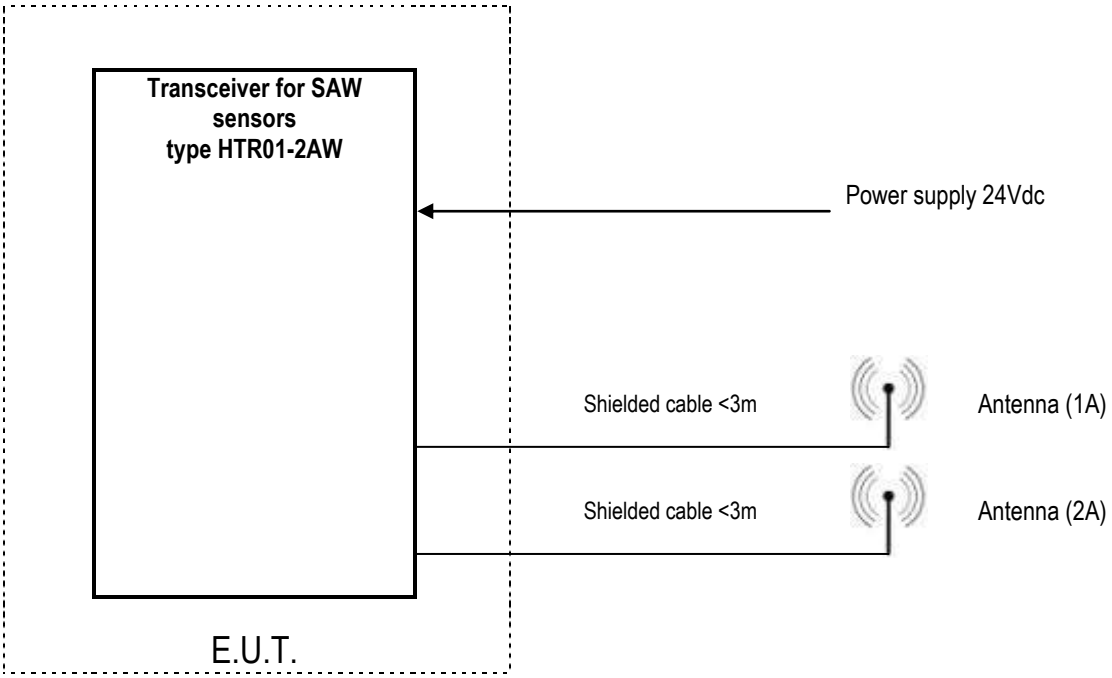
ANSI C63.4: 2003
Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronics Equipment in the range of 9 kHz to 40 GHz.

3. PRODUCT DESCRIPTION

Antenna type and gain:	external antenna (x2)
Operating frequency range:	from 430 MHz to 450 MHz
Power source:	24Vdc
Software power setting:	-

Modification of the equipment during the tests: No

E.U.T. is made in plastic enclosure. It is powered to 24Vdc. It allows to make a statement of temperature in several point of the cell and to send these information to a gateway.



4. TESTS AND CONCLUSION

The following table summarizes test results of the EUT.

Subpart B of the standard FCC part 15 – Unintentional radiators

Test procedure	Designation of test	Test results				Comments
		Pass	Fail	N.A.	N.P.	
15.107	Measurement of conducted emission on AC mains ports			X		
15.109	Radiated emission limits	X				

Subpart C of the standard FCC part 15 – Intentional radiators

Test procedure	Designation of test	Test results				Comments
		Pass	Fail	N.A.	N.P.	
15.205	Restricted bands of operation	X				
15.207	Measurement of conducted emission on AC mains ports			X		
15.209	Radiated emission limits; general requirements	X				
15.215	Additional provisions to the general radiated emission limitations					
	(a) Alternative to general radiated emission limits			X		
	(b) Unwanted emissions outside of § 15.247 frequency bands			X		
	(c) 20 dB bandwidth and band-edge compliance			X		
15.231	Intentional radiated emissions					
	a) (1) automatically desactivate			X		
	a) (2) automatically activate			X		
	a) (3) total duration of transmissions			X		
	a) (4) alarm condition			X		
	a) (5) duration of transmissions for security systems			X		
	b) 40.66 – 40.70 MHz and above 70MHz	X				
	c) bandwith for devices above 70 MHz	X				
	d) bandwidth for devices 40.66–40.70 MHz with a frequency tolerance for temperature variation of – 20°C to + 50°C at normal supply voltage and for a variation in the primary supply voltage from 85% to 115% at a temperature of 20°C			X		
	e) device with a periodic rated other a)	X				

N.A.: Not Applicable
N.P.: Not Performed

5. TRANSMITTER OUTPUT POWER

Standard: FCC 47 CFR PART 15 : 2015

Section: 15.231 (e) for FCC

Test configuration:

The system is tested in normalized test site.

The test unit 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.

The level was maximised in antenna height, azimuth and polarization. The maximum level measured on the spectrum analyser was recorded.

Distance of antenna: 3 meters

Instrumentation test list:

CATEGORY	BRAND	TYPE	Nr EMITECH
Antenna	SCHAFFNER	Bilog CBL6143A	5647
Antenna mast	Maturo	MCU	8410
Antenna mast	Maturo	AM 4.0-O	8411
Cable	-	N-2m	2881
Cable	Telegartner	N-11m	7405
Cable	C&C	N-10m	11136
Receiver	Rohde & Schwarz	R&S ESRP7	10517
Shielded enclosure	SIDT	C.4	0549

Equipment under test operating condition:

EUT is in continuous transmission mode.

Measure conditions:

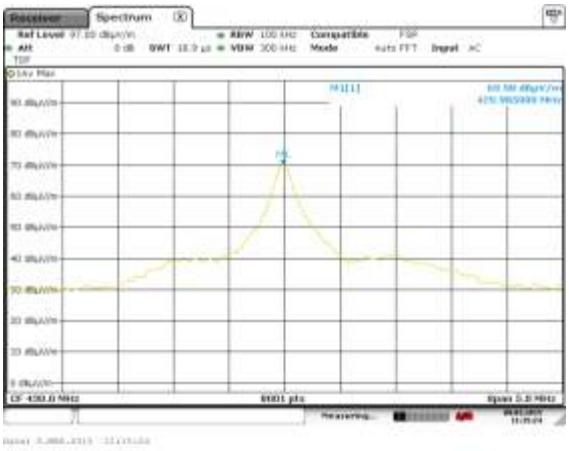
Ambient temperature (°C): 22
Relative humidity (%): 40

Resolution bandwidth: 100 kHz

Results:

Power source: 24Vdc

Channel frequency (MHz)	Measured Frequency (MHz)	Electro-magnetic field (dBµV/m)	Limit (dBµV/m)
430.000	429.985	69.98	72.7
440.000	439.980	71.96	73.1
450.000	449.980	72.29	73.4



Test conclusion: Complies with the requirements of the standards.

6. PERIODIC RATE

Standard: FCC 47 CFR PART 15 : 2014

Section: 15.231 (e) for FCC

Test configuration:

The system is tested in normalized test site.

The test unit 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.

The level was maximised in antenna height, azimuth and polarization.

Distance of antenna: 3 meters

Instrumentation test list:

CATEGORY	BRAND	TYPE	Nr EMITECH
Antenna	Schaffner	Bilog CBL6143A	5647
Antenna mast	Maturo	MCU	8410
Antenna mast	Maturo	AM 4.0-O	8411
Cable	-	N-2m	2881
Cable	Telegartner	N-11m	7405
Cable	C&C	N-10m	11136
Receiver	Rohde & Schwarz	R&S ESRP7	10517
Shielded enclosure	SIDT	C.4	549

Equipment under test operating condition:

EUT is in continuous transmission mode.

Measure conditions:

Ambient temperature (°C): 22
Relative humidity (%): 40

Results:

Power source: 24 Vdc

Transmission time (ms)	Limit (ms)
61.775	≤1000

Silent period time (s)	Limit
30.1	≥30 times of duration of the transmission and >10 seconds

Test conclusion: Complies with the requirements of the standards.

7. *20 dB BANDWIDTH*

Standard: FCC 47 CFR Part 15: 2015

Section: 15.231 (c) for FCC

Test configuration:

The system is tested in normalized test site.

The test unit 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.

Test equipment used:

CATEGORY	BRAND	TYPE	Nr EMITECH
Antenna	SCHAFFNER	Bilog CBL6143A	11136
Antenna mast	Maturo	MCU	5647
Antenna mast	Maturo	AM 4.0-O	0549
Cable	-	N-2m	2881
Cable	Telegartner	N-11m	7405
Cable	C&C	N-10m	8411
Receiver	Rohde & Schwarz	R&S ESRP7	8410
Shielded enclosure	SIDT	C.4	10517

Measurement conditions:

Resolution bandwidth: 100 kHz

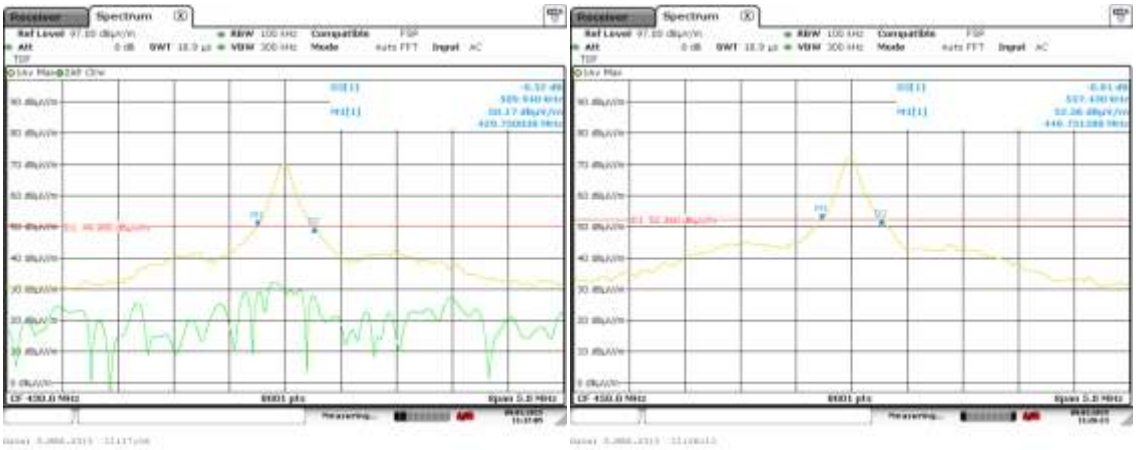
Video bandwidth: 300 kHz

Test operating conditions of the equipment:

The transmitter is in transmission with modulation.

Results:

Channel frequency (MHz)	Measured bandwith (MHz)	Limit	Limit (MHz)
430.00	0.5099	<0.25% of center fréquency	1.075
440.00	0.5212		
450.00	0.5374		



8. UNINTENTIONAL RADIATED EMISSIONS AND TRANSMITTER UNWANTED EMISSION IN THE BAND 9 KHz – 5 GHz

Standard: FCC 47 CFR PART 15 : 2015

Section: 15.205; 15.209 and 15.231 (e) for FCC

Equipment under test arrangement:

The equipment under test (EUT) is tested in normalized test site.

The EUT is placed on a non-conductive test table at 0.8 m above the horizontal metal ground plane.

For maximum meter reading at each frequency, the antenna height is adjusted between 1 m and 4 m above the ground plane. A 360 degrees rotation of the EUT is performed in vertical and horizontal polarization. The frequency azimuth and antenna height are presented in the table on the next pages.

The E.U.T. is blocked in continuous transmission.

Frequencies range: 9 kHz – 30 MHz
30 MHz - 1 GHz
1 GHz – 4.5 GHz

Detection mode: Quasi-peak for 9 kHz – 30 MHz
Quasi-peak for 30 MHz - 1 GHz
Average for 1 GHz – 4.5 GHz

Resolution bandwidth: 200 Hz for 9 kHz – 150 kHz
9 kHz for 150 kHz – 30 MHz
120 kHz for 30 MHz - 1 GHz
1 MHz for 1 GHz – 4.5 GHz

Measurement distance: 3 meters from 9 kHz to 30 MHz
3 meters from 30 MHz to 4.5 GHz

- Limit for emission radiated outside the frequency band, except the harmonics, shall be attenuated by at least 20 dB below the level of fundamental or the general radiated emission limits.

From 9 kHz to 30 MHz

Frequencies range	Limit (µV/m)
9 – 490 kHz	2400/F (F in kHz) *
490 – 1705 kHz	24000/F (F in kHz)**
1.705 – 30 MHz	30**

* Limits in µV/m can be extrapolated to 3 m using 40 dB / decade.
** Limits in µV/m can be extrapolated to 3 m using 20 dB / decade.

From 30 MHz to 4.5 GHz

Frequencies range (MHz)	Limit (dBµV/m)	(µV/m)
30 to 88	40.0	100
88 to 216	43.5	150
216 to 960	46.0	200
Above 960	54.0	500

From 40 MHz to 4.5 GHz

Frequencies range (MHz)	Limit (dBµV/m)	(µV/m)
40.66 – 40.70	40	100
70 to 130	34	50
130 to 174	34 to 43.5	50 to 150
174 to 260	43.5	150
260 to 470	43.5 to 54	150 to 500
Above 470	54	500

Instrumentation test list:

CATEGORY	BRAND	TYPE	Nr EMITECH
Antenna	Emco	Cornet 3115	0941
Antenna	Emco	Cadre Emco 6502	7179
Antenna	Schaffner	Bilog CBL6143A	5647
Antenna	Emco	Cornet 3115	11177
Antenna mast	Maturo	MCU	8411
Antenna mast	Maturo	AM 4.0-O	8410
Cable	Telegartner	N-11m	7405
Cable	-	N-2m	2881
Cable	C&C	N-10m	10517
Cable	C&C	N-6m	11136
Cable	C&C	N-2m	11172
Preamplifier	Mini-Circuits	RF	6368
Preamplifier	MITEQ	HF	3229
Receiver	Rohde & Schwarz	R&S ESRP7	10517
Shielded enclosure	SIDT	C.4	0549
Cable	C&C	N-2m	11176

Results:

Ambient temperature (°C): 22
Relative humidity (%): 40
Power source: 24 Vdc

Channel frequency 430 MHz

FREQUENCY (MHz)	Detector	Antenna height (cm)	Azimuth (degree)	Resolution bandwidth (kHz)	Polarization H: Horizontal V: Vertical	Field strength (dBµV/m)	Limits (dBµV/m)	Margin (dB)
85.00	Quasi-peak	120	0	100	V	28.7	40.0	13.3
115.55	Quasi-peak	100	286	100	V	33.9	43.5	9.6
119.60	Quasi-peak	100	46	100	H	28.8	43.5	14.7
152.00	Quasi-peak	241	203	100	H	30.3	43.5	13.2
156.10	Quasi-peak	100	23	100	V	32.4	43.5	11.1
1039.9	Average	140	350	1000	H	41.4	54.0	12.6
1699.9	Average	166	250	1000	V	34.5	54.0	19.5
2719.9	Average	120	159	1000	H	39.5	54.0	14.5
1039.9	Peak	140	350	1000	H	42.6	54.0	11.4
1699.9	Peak	166	250	1000	V	43.0	54.0	11.0
2719.9	Peak	120	159	1000	H	43.5	54.0	10.5

Channel frequency 440 MHz

FREQUENCY (MHz)	Detector	Antenna height (cm)	Azimuth (degree)	Resolution bandwidth (kHz)	Polarization H: Horizontal V: Vertical	Field strength (dBµV/m)	Limits (dBµV/m)	Margin (dB)
85.00	Quasi-peak	120	0	100	V	28.7	40.0	13.3
115.55	Quasi-peak	100	286	100	V	33.9	43.5	9.6
119.60	Quasi-peak	100	46	100	H	28.8	43.5	14.7
152.00	Quasi-peak	241	203	100	H	30.3	43.5	13.2
156.10	Quasi-peak	100	23	100	V	32.4	43.5	11.1
1039.9	Average	140	350	1000	H	41.1	54.0	12.9
1699.9	Average	166	250	1000	V	37.5	54.0	16.5
2719.9	Average	120	159	1000	V	34.7	54.0	19.3
1039.9	Peak	140	350	1000	V	42.4	54.0	10.6
1699.9	Peak	166	250	1000	V	49.6	54.0	4.4
2719.9	Peak	120	159	1000	H	38.5	54.0	15.5

Channel frequency 450 MHz

FREQUENCY (MHz)	Detector	Antenna height (cm)	Azimuth (degree)	Resolution bandwidth (kHz)	Polarization H: Horizontal V: Vertical	Field strength (dBµV/m)	Limits (dBµV/m)	Margin (dB)
85.00	Quasi-peak	120	0	100	V	28.7	40.0	13.3
115.55	Quasi-peak	100	286	100	V	33.9	43.5	9.6
119.60	Quasi-peak	100	46	100	H	28.8	43.5	14.7
152.00	Quasi-peak	241	203	100	H	30.3	43.5	13.2
156.10	Quasi-peak	100	23	100	V	32.4	43.5	11.1
1039.9	Average	140	350	1000	V	42.1	54.0	11.9
1699.9	Average	166	250	1000	V	40.5	54.0	13.2
2719.9	Average	120	159	1000	H	40.8	54.0	13.2
1039.9	Peak	140	350	1000	V	43.3	54.0	10.7
1699.9	Peak	166	250	1000	V	49.0	54.0	5.0
2719.9	Peak	120	159	1000	H	44.8	54.0	9.2

Test conclusion:

The equipment complies with the requirements of the standards.

9. RADIATED EMISSION LIMIT

Standard: FCC 47 CFR PART 15 : 2015

Section: 15.109 for FCC

Instrumentation test list:

CATEGORY	BRAND	TYPE	Nr EMITECH
Antenna	Emco	Cornet 3115	0941
Antenna	SCHAFFNER	Bilog CBL6143A	5647
Antenna	Emco	Cadre Emco 6502	7179
Cable		N-2m	2881
Cable	Telegartner	N-11m	7405
Cable	C&C	N-10m	11136
Cable	C&C	N-6m	11172
Cable	C&C	N-2m	11176
Cable	C&C	N-2m	11177
Antenna mast	Maturo	MCU	8410
Antenna mast	Maturo	AM 4.0-O	8411
Preamplifier	Mini-Circuits	RF	6368
Preamplifier	MITEQ	HF	3229
Receiver	Rohde & Schwarz	R&S ESRP7	10517
Shielded enclosure	SIDT	C.4	0549

Equipment under test arrangement:

The system is tested in normalized test site.
The test unit 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.

Frequency range: From 30 MHz to harmonic 5.

Bandwidth: 120 kHz (F<1 GHz)
1 MHz (F>1 GHz)

Detection mode: Quasi-peak (F < 1 GHz)
Average (F > 1 GHz)

Distance of antenna: 3 meters.

Antenna height: 1 to 4 meters

Antenna polarization: vertical and horizontal.

Operating mode during the test:

The E.U.T. is in standby mode.

Results:

Ambient temperature (°C): 22
Relative humidity (%): 40
Power source: 24 Vdc

No significant frequency has been found other than those given above between 30 MHz to 4.5 GHz.

Test conclusion: Standard respected

« □□□ *End of report, 4 annexes to be forwarded* □□□ »

ANNEX 1

ANTENNA FACTORS, INSERTION LOSSES AND AMPLIFIER VALUES

BILL OF MATERIAL

The test antenna used for the radiated emission between 9 kHz and 30 MHz is the active loop antenna n°7179. Antenna factors are given in table 1.

The test antenna used for the radiated emission between 30 MHz and 1 GHz is the biclog antenna n°5647Antenna factors are given in table 2.

The measuring receiver n°10517 used in the frequency range 30 MHz to 5 GHz has an integrated preamplifier.

The test cable used between 9 kHz and 30 MHz to connect the antennas to the receiver for measurements at a distance of 3 meters has losses given in table 3.

The test cable used between 30 MHz and 1 GHz to connect the antennas to the receiver for measurements at a distance of 3 meters has losses given in table 4.

The test antenna used for the radiated emission between 1 GHz and 18 GHz is the horn antenna n°0941. Factors are given in table 5.

The amplifier n°3229 used to connect the spectrum analyzer to the test cable has gain values given in the table 6.

The test cable used between 1 GHz and 26 GHz to connect the horn antenna to the amplifier for measurements at a distance of 3 meters has losses given in table 8.

Frequency (MHz)	Antenna factor (dB/m)	Frequency (MHz)	Antenna factor (dB/m)
0.009	26.3	0.8	9.9
0.01	25.6	1	10.0
0.015	22.8	1.5	10.1
0.02	21.0	2	10.1
0.03	18.7	3	10.0
0.05	15.4	5	10.0
0.08	12.8	8	9.8
0.1	11.8	10	9.7
0.15	10.5	15	9.2
0.2	9.9	20	8.5
0.3	9.7	25	7.4
0.5	9.7	30	5.6

TABLE 1 : ACTIVE LOOP ANTENNA

Frequency (MHz)	Antenna factor (dB/m)	Frequency (MHz)	Antenna factor (dB/m)
30	20.2	180	9.6
35	17.4	200	11.7
40	13.9	250	12.0
45	12.8	300	13.7
50	10.2	400	16.5
60	7.0	500	18.3
70	6.9	600	20.3
80	8.0	700	21.6
90	9.2	800	22.2
100	11.0	900	23.2
120	12.3	1000	23.7
140	11.4	-	-
160	10.9	-	-

TABLE 2 : BILOG ANTENNA

Frequency (MHz)	Loss (dB)	Frequency (MHz)	Loss (dB)
0.009	0.0	6.000	0.5
0.020	0.0	7.000	0.5
0.050	0.0	8.000	0.5
0.100	0.1	9.000	0.6
0.500	0.1	10.00	0.6
1.000	0.2	15.00	0.8
2.000	0.3	20.00	0.9
3.000	0.3	25.00	1.0
4.000	0.4	30.00	1.1
5.000	0.4	-	-

TABLE 3 : TEST CABLE FOR 3M MEASUREMENT INTO 9 kHz AND 30 MHz

Frequency (MHz)	Loss (dB)	Frequency (MHz)	Loss (dB)
30	0.7	250	1.8
40	0.7	300	2.1
50	0.9	400	2.3
60	0.9	500	2.5
70	0.9	600	3.0
80	0.9	700	3.4
90	1.1	800	3.6
100	1.1	900	3.9
150	1.4	1000	4.1
200	1.6	-	-

TABLE 4 : TEST CABLE FOR 3M MEASUREMENT INTO 30 MHz AND 1 GHz

Frequency (GHz)	Antenna factor (dB/m)	Frequency (GHz)	Antenna factor (dB/m)
1.0	23.7	10.0	37.6
1.5	25.0	10.5	37.8
2.0	27.5	11.0	38.1
2.5	28.8	11.5	38.3
3.0	29.8	12.0	38.8
3.5	31.2	12.5	38.8
4.0	32.5	13.0	39.4
4.5	32.5	13.5	40.0
5.0	33.5	14.0	40.1
5.5	34.1	14.5	40.6
6.0	34.1	15.0	40.6
6.5	34.4	15.5	39.7
7.0	35.4	16.0	39.3
7.5	36.6	16.5	39.9
8.0	36.6	17.0	41.4
8.5	37.0	17.5	45.1
9.0	37.1	18.0	46.3
9.5	37.2	-	-

TABLE 5 : HORN ANTENNA

Frequency (GHz)	Gain value (dB)	Frequency (GHz)	Gain value (dB)
1.0	33.4	13.0	32.5
1.5	33.7	14.0	31.6
2.0	33.9	15.0	33.0
2.5	34.0	16.0	33.5
3.0	33.9	17.0	33.9
4.0	34.3	18.0	34.3
5.0	35.2	19.0	34.4
6.0	34.7	20.0	32.9
7.0	34.0	21.0	33.2
8.0	33.7	22.0	34.3
9.0	31.8	23.0	34.6
9.5	31.1	24.0	34.4
10.0	30.5	25.0	34.5
10.5	30.7	26.0	32.5
11.0	31.1	-	-
12.0	32.4	-	-

TABLE 7 : AMPLIFIER GAIN VALUE

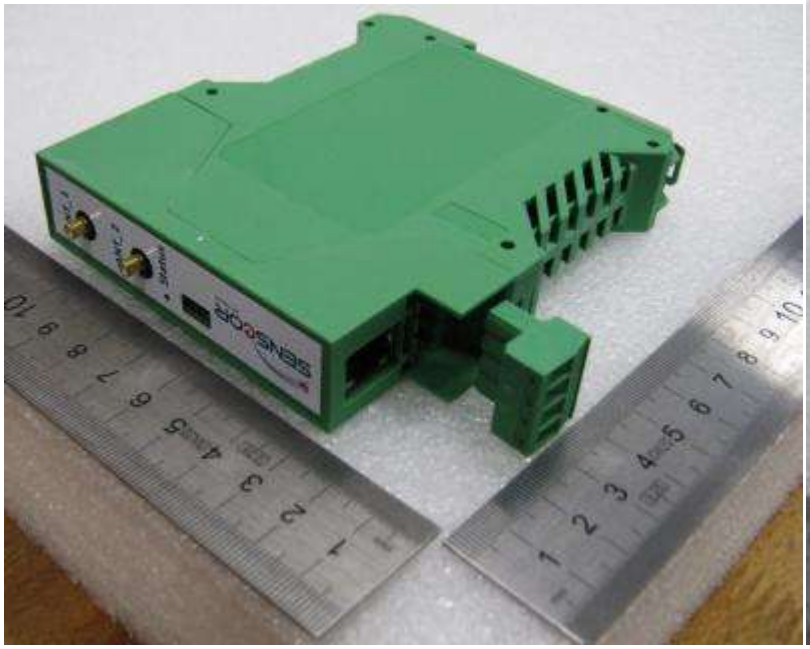
Frequency (GHz)	Loss (dB)	Frequency (GHz)	Loss (dB)
1.0	3.2	12.0	11.8
1.5	4.0	13.0	12.2
2.0	4.6	14.0	12.4
2.5	5.2	15.0	12.9
3.0	5.7	16.0	13.4
3.5	6.2	17.0	13.9
4.5	7.1	18.0	14.5
5	7.3	19.0	14.7
6	7.9	20.0	15.4
8	9.3	22.0	16.3
10	10.5	24.0	16.9
11.0	11.1	26.0	17.7

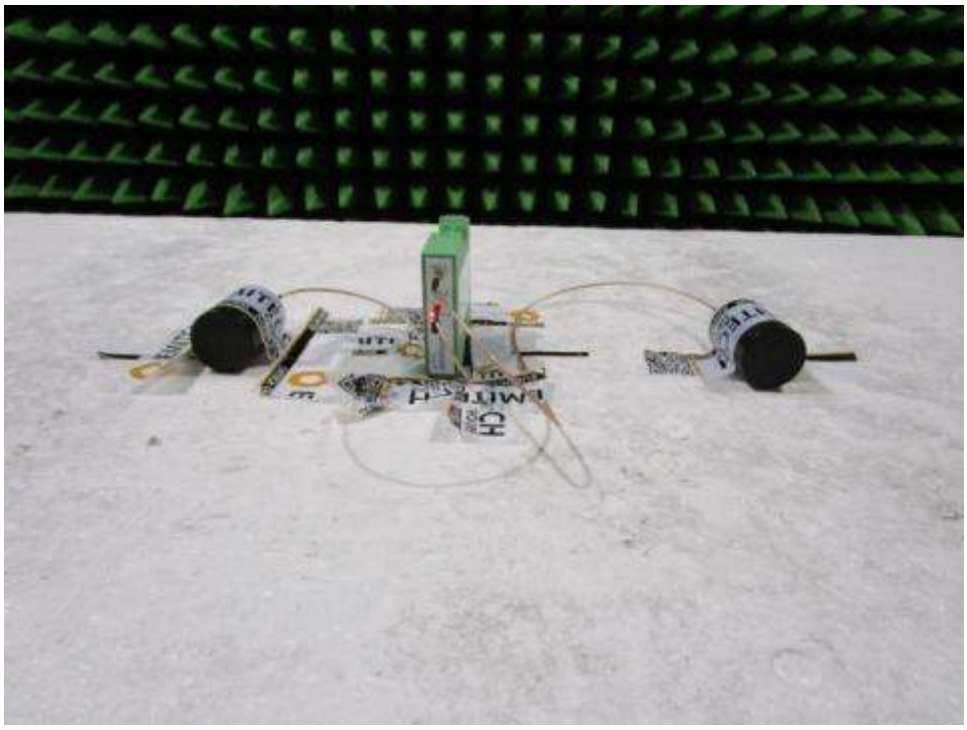
TABLE 8: TEST CABLE FOR 3M MEASUREMENT INTO 1 TO 26 GHz

ANNEX 2

EXTERNAL PHOTOGRAPHS

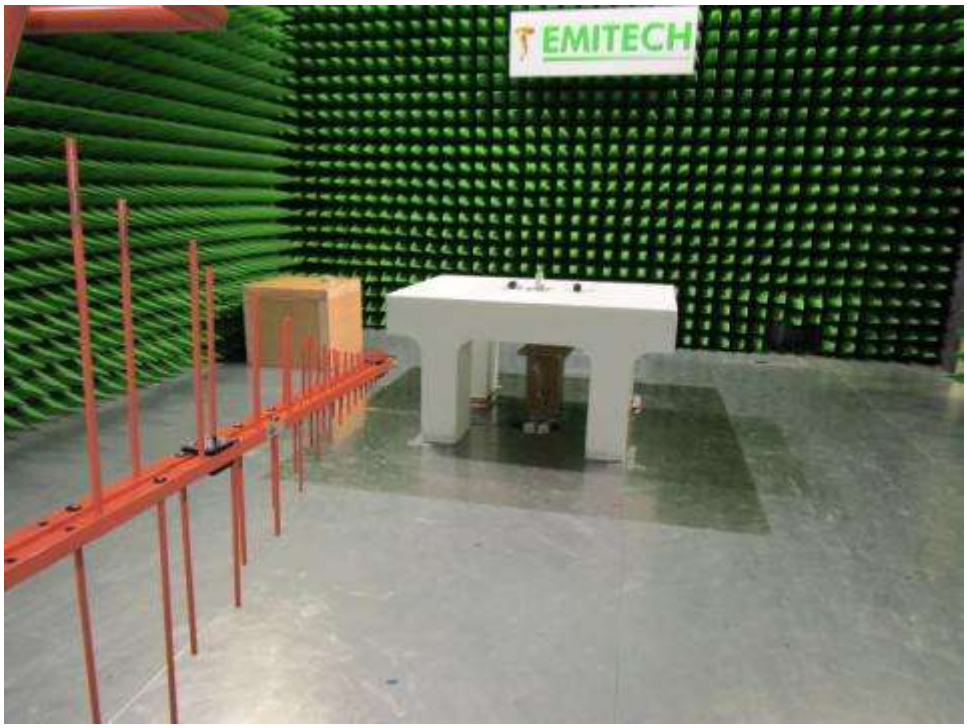

SENSEOR
all sense

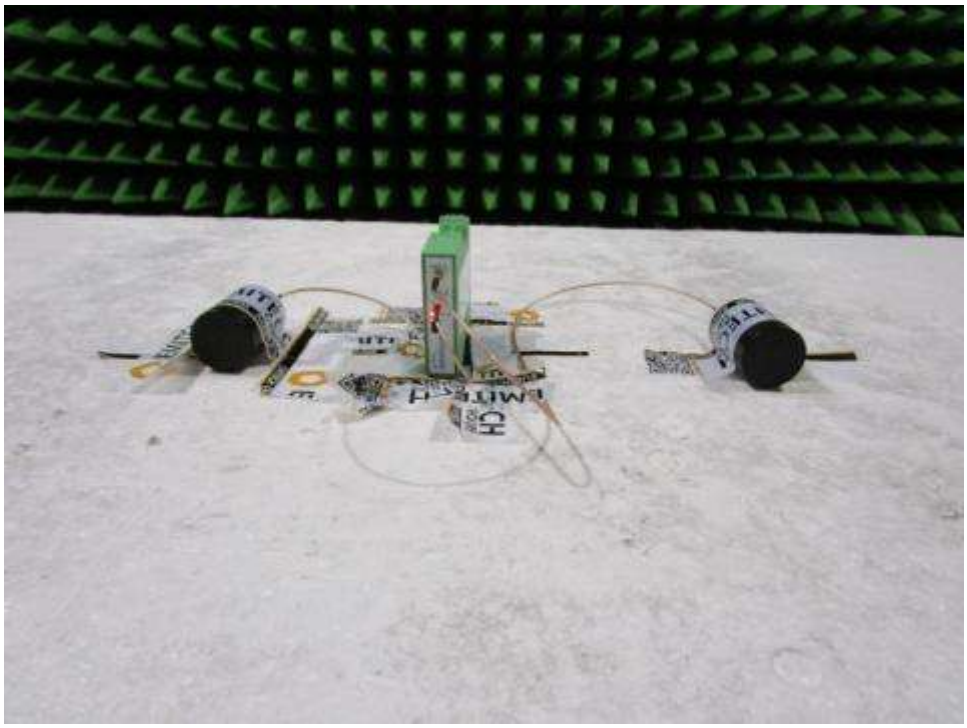


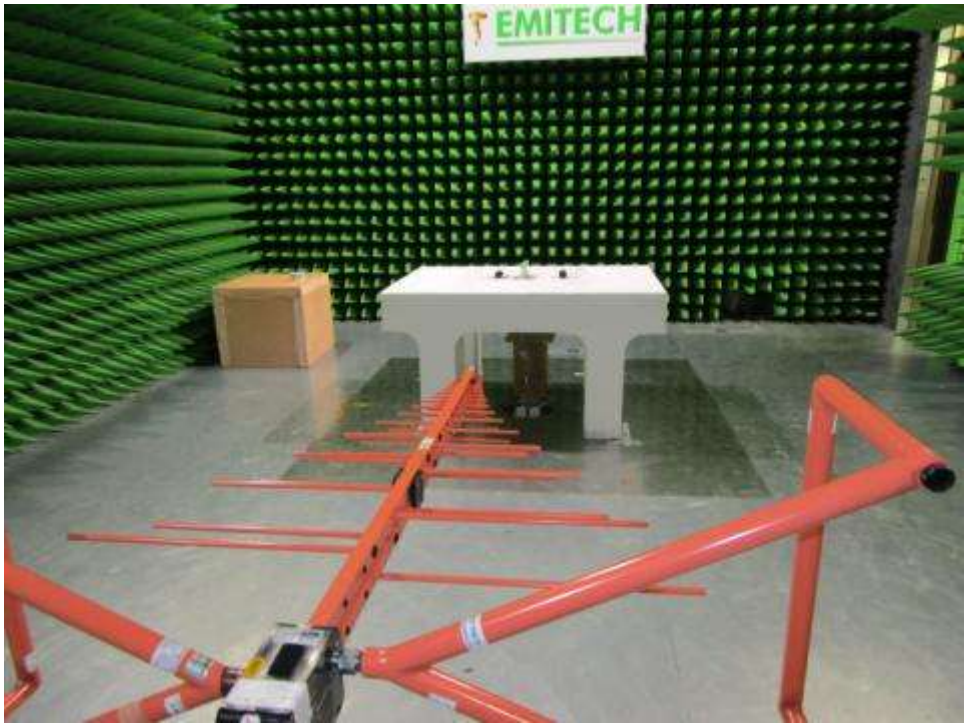


ANNEX 3

TEST SETUP PHOTOGRAPHS


EMITECH

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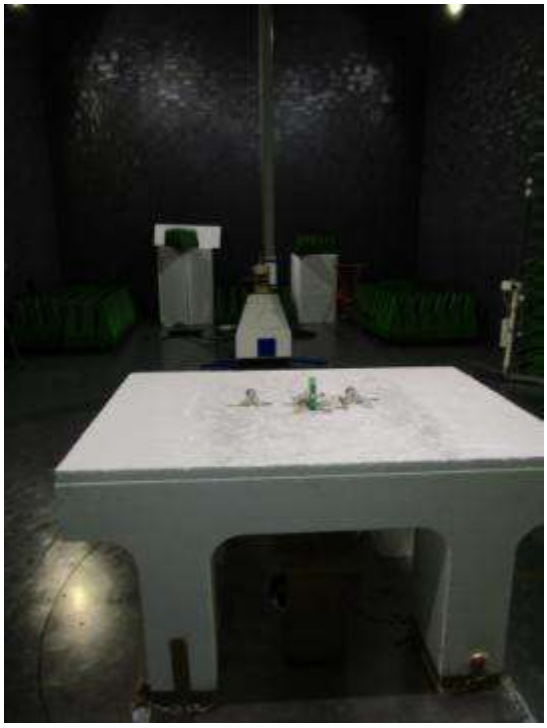


EMITEC

ANNEX 4

CALIBRATION DATES

N° EMITECH	LAST CALIBRATION	CALIBRATION DUE DATE
10517	18/09/2014	18/09/2016
2881	24/05/2014	24/05/2016
11136	10/03/2014	10/03/2016
7405	06/01/2014	06/01/2016
5647	25/02/2013	25/02/2017
10517	18/09/2014	18/09/2016
11176	28/03/2014	28/03/2016
7179	27/01/2015	27/01/2016
11177	28/03/2014	28/03/2016
3229	02/04/2015	02/04/2016
11172	28/03/2014	28/03/2016
0941	08/02/2012	08/02/2016
2881	24/05/2014	24/05/2016
11172	28/03/2014	28/03/2016