



Test report issued under the responsibility of:
EMITECH MONTPELLIER laboratory
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RADIO TEST REPORT

FCC part 15.247
RSS-247_Issue 2, February 2017

Company : **AXIBLE TECHNOLOGIES**
Address..... : 425 RUE JEAN ROSTAND
BATIMENT IOT VALLEY
31670 LABEGE
FRANCE

Test item description. : **SMART MULTIPURPOSE TRACKER**
Trade Mark. : AXIBLE BY INTITEK
Manufacturer..... : AXIBLE TECHNOLOGIES
Model/Type reference..... : SMT V1.5-02
FCC ID..... : 2AK8579190014
Ratings..... : 2.7V to 3.6V

Testing Laboratory : **EMITECH MONTPELLIER laboratory**
Address..... : 145 rue de Massacan
34740 VENDARGUES
FRANCE

Report Reference No...... : **R412-19-103885-10A**
Test procedure. : FCC IC Certification
Diffusion..... : MR GUILLEUX
Applicant's name. : AXIBLE TECHNOLOGIES
Date of issue..... : February 12, 2021
Total number of pages..... : 43
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Modified page(s)..... : Creation
Compiled by..... : Morgan PATEY
Approved by (+ signature). : Olivier HEYER (Laboratory Manager)

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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 manufactured products of the tested sample.*

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REVISION HISTORY:

Revision	Date	Modified pages	Modifications
0	February 12, 2021	/	Creation

1. GENERAL INFORMATION

This document submits the results of Radio tests performed on the equipment **Smart Multipurpose Tracker SMT V1.5-02** (denominated hereafter E.U.T.: equipment under test) according to document(s) listed in §2 of this test report.

TESTING PROCEDURE AND TESTING LOCATION:					
Testing Location : EMITECH MONTPELLIER laboratory Address : 145 rue de Massacan 34740 VENDARGUES FRANCE Test procedure : FCC IC Certification Tested by : Morgan PATEY Test supervisor : None Date of receipt of test item : N/A Date (s) of performance of tests : September, from 17th to 27th of 2019					
APPLICANT'S GENERAL INFORMATION:					
Company name : AXIBLE TECHNOLOGIES Company address : 425 RUE JEAN ROSTAND BATIMENT IOT VALLEY 31670 LABEGE FRANCE Person(s) present during the tests : No representative for company attended the tests. Responsible : MR GUILLEUX					
GENERAL REMARKS:					
The test results presented in this report relate only to the object tested. The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report. "(see Enclosure #)" refers to additional information appended to the report. "(see appended table)" refers to a table appended to the report. Throughout this report the decimal separator is point.					
POSSIBLE TEST CASE VERDICTS:					
Test case does not apply to the test object .: N/A Test case not performed : N/P Test object does meet the requirement : P (Pass) Test object does not meet the requirement : F (Fail)					
DEFINITIONS AND ABBREVIATIONS:					
E.U.T.	Equipement under test	AE	Ancillary equipment	Pk	Peak detector
RBW	Resolution bandwidth	VBW	Video bandwidth	QP	Quasi-peak detector
OATS	Open area test site	FAR	Full anechoic room	Av	Average detector
VP	Vertical Polarization	HP	Horizontal Polarization	RMS	Root Mean Square
RF	Radio frequency	NTR	Nothing to report		

2. REFERENCE DOCUMENT(S)

NORMATIVE REFERENCES:

The following referenced documents are necessary for the application of the present test report.

FCC part 15

Code of federal regulations. Title 47- Telecommunication Chapter 1- Federal Communication Commission. Part 15- Radio frequency devices Subpart B- Unintentional Radiators. Limits and methods of measurement of radio disturbance. Characteristic of information technology equipment.

FCC part 15.247

Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850MHz. (frequency hopping and digitally modulated)

RSS-247_Issue 2, February 2017

Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence Exempt Local Area Network (LE-LAN) Devices

RSS/CNR-Gen, Issue 5, March 2019

Exigences générales et information relatives à la certification du matériel de radiocommunication

ANSI C 63.10:2013

American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

ANSI C 63.4:2014

American National Standard for Methods of measurement of Radio-Noise from low-voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

Although the product standard uses obsolete technical standards, the latest versions of standards achievable by the laboratory will be used for testing.

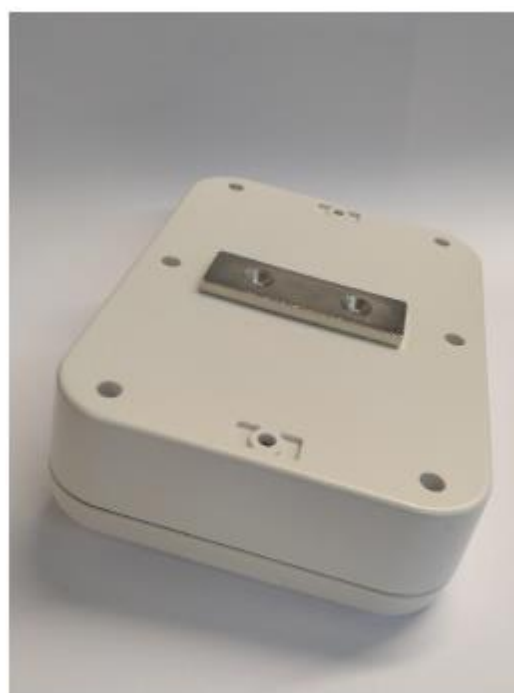
INFORMATIVE REFERENCES:

The following referenced documents are not necessary for the application of the present test report but they assist the user with regard to a particular subject area.

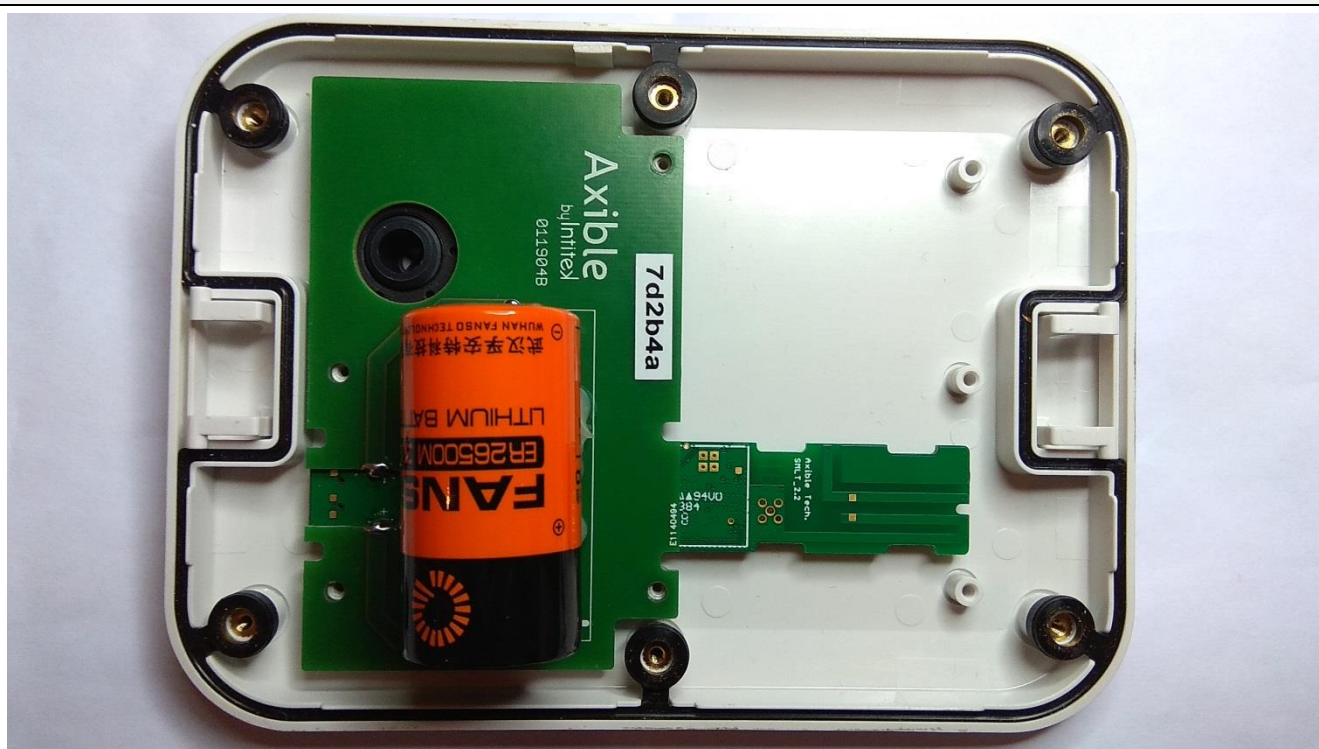
3.3. EUT General view



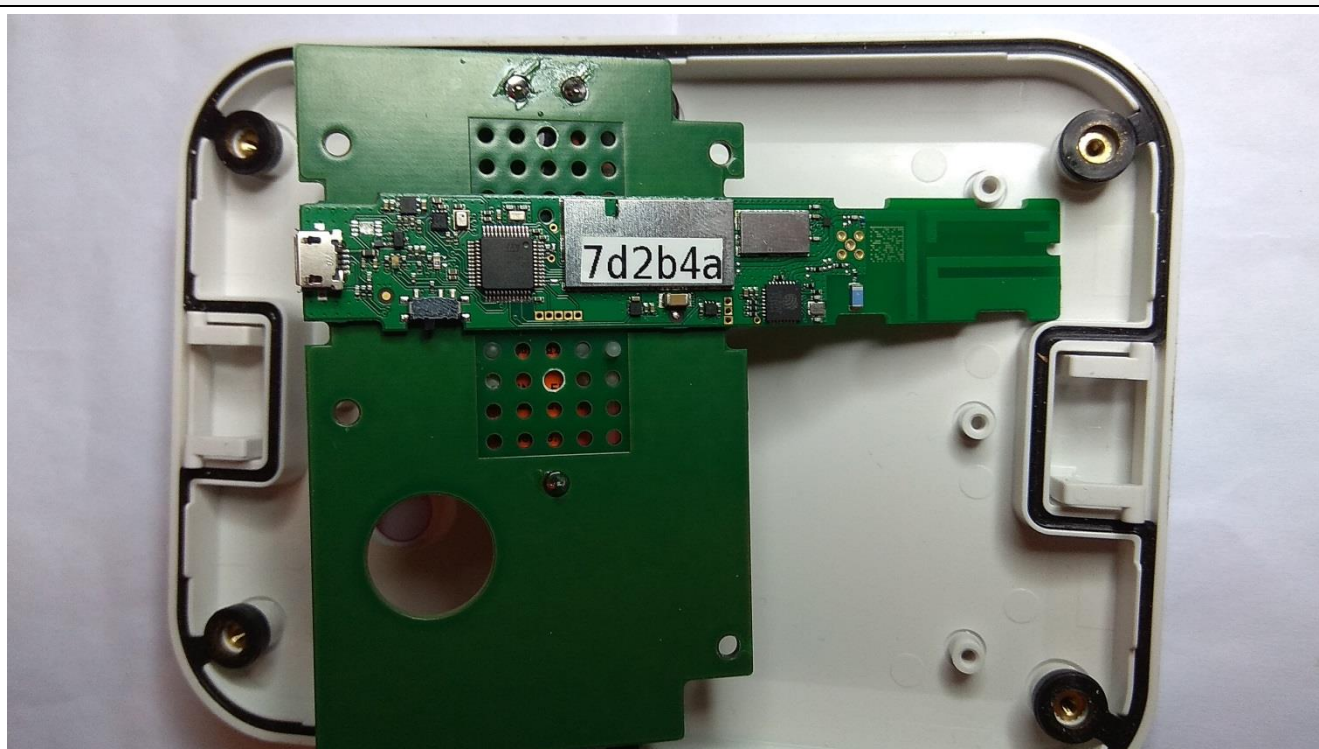
3.4. EUT General view (back)



3.5.EUT Electronic board



3.6.EUT Electronic board



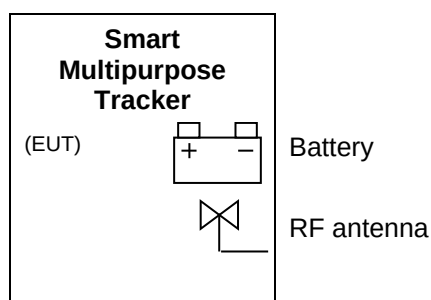
3.7. EUT Mechanical and Electrical Design

Power supply. : 3.6Vdc
Power supply range..... : 2.7V to 3.6V
Power type..... : Battery
Power (W)..... : <0.001
Nominal current (A). : <0.001
Dimensions (L x W x H) (m). : 0.110 x 0.150 x 0.046
Weight (kg). : 350g
Temperature range (°C). : -20 to +60
Ground bounding strap..... : No

Comments:

N/A

3.8. EUT Input/Output ports



PORT	NAME	TYPE	LENGHT	CABLE TYPE	COMMENTS
0	Main frame	N/E	N/A	Plastic	N/A
1	Battery	DC	N/A	N/A	3.6Vdc
2	RF antenna	RF	N/A	N/A	868MHz and 2.4GHz

AC/DC		AC		DC	
.....	AC/DC Converter port		Alternative current port		Discontinuous current port
:		:		:	
I/O		TP		RF	
.....	Input or Output port		Telecommunication port		Radio frequency port
:		:		:	
N/E					
.....	Non Electrical port				
:					

3.9. EUT Radio Specifications

a) GENERAL INFORMATIONS	
According to manufacturer's declarations :	
EUT type.....	Transceiver
Technology	SRD
Environmental profile.....	Data transmissions
Temperature range.....	Category I (General) (-20°C to +55°C)
Antenna type	Integral
Antenna Gain.....	Sigfox : 0 dBi
Comments: EUT includes a Wi-Fi module in RX MODE ONLY (No emissions).	
b) TRANSMITTER PARAMITERS (Tx)	
Frequency bands.....	Sigfox : 902.1 Mhz to 904.7 MHz (Center 902.2 MHz)
RF Power.....	Sigfox : 24 dBm (EIRP)
Number of channels / Separation.....	Multiple
Modulation type	DBPSK
Duty cycle	The device broadcasts each message 3 times on 3 different frequencies. Maximum On time 400 ms per channel. No new emission before 20 s.
Tested frequency.....	Sigfox : 902.13 MHz (Low channel) Sigfox : 903.38 MHz (Mid channel) Sigfox : 904.66 MHz (High channel)
c) RECEIVER PARAMETERS (Rx)	
Frequency bands.....	Sigfox : 905.1 MHz to 907.7 MHz (Center 905.2 MHz)
Category/Class	Category 2
Bandwidth.....	Sigfox : 905.1 MHz to 907.7 MHz (Center 905.2 MHz)

4. OPINION(S) AND INTERPRETATION(S)

TEST(S) PERFORMED	DEVIATION(S) TO TEST METHOD(S)
FCC part 15.209	N/A

Comments: N/A

5. RESULT SUMMARY

TEST DESIGNATION	SEVERITY	VERDICT	BASIC STANDARDS / COMMENTS
Subpart A - General			
- Labeling requirements	-	N/P	15.19 / see certification documents
- Information to user	-	N/P	15.21 / see certification documents
- Home-built devices	-	N/A	15.23
- Kits	-	N/A	15.25
- Special accessories	-	N/A	15.27
- Inspection by the Commission	-	N/A	15.29
- Measurement standards	-	PASS	15.31
- Test procedure for CPU boards and computer power supplies	-	N/A	15.32
- Frequency range of radiated measurements	-	PASS	15.33
- Measurement detector functions and bandwidths	-	PASS	15.35
- Transition provisions for compliance with the rules	-	PASS	15.37
Subpart B - Unintentional Radiators			
- Equipment authorization - SDoC	-	N/A	15.101 / Transmitter part is subject to Certification procedure
- CPU boards and power supplies used in personal computers	-	N/A	15.102
- Exempted device	-	N/A	15.103
- Information to the user	-	N/A	15.105
- Antenna power conduction limits for receivers	-	N/A	15.111
- Power line carrier systems	-	N/A	15.113
- TV interface devices, including cable system terminal devices	-	N/A	15.115
- Cable ready consumer electronics equipment	-	N/A	15.118
- Program blocking technology requirements for TV receivers	-	N/A	15.120
- Scanning receivers and frequency converters used with scanning receivers	-	N/A	15.121
- Labeling of digital cable ready products	-	N/A	15.123
Subpart C –Intentional radiators			
- Equipment authorization requirement		PASS	15.201 / Transmitter part is subject to Certification procedure
- Certified operating frequency range		N/A	15.202
- Antenna requirement		PASS	15.203 / Integral Antenna
- External radio frequency power amplifiers and antenna modifications		N/A	15.204
- Restricted bands of operation		PASS	15.205
- Conducted limits	Class B	N/A	15.207 / Battery powered equipment
- Radiated emission limits; general requirements	Class B	PASS	15.209
- Tunnel radio systems		N/A	15.211
- Modular transmitters		N/A	15.212
- Cable locating equipment		N/A	15.213
- Cordless telephones		N/A	15.214
- Additional provisions to the general radiated emission limits		PASS	15.215
Operation within the band 902-928MHz, 2400-2483.5MHz and 5725-5850MHz			15.247
- Frequency hopping and digitally modulated		-	a)
- Frequency hopping system		PASS	
- Digital modulation system		N/P	
- Maximum peak conducted output power		-	b)
- For hopping system in the 2400-2483.5 MHz and 5725-5850 MHz bands		N/A	
- For hopping system in the 902-928MHz band		PASS	
- For system using digital modulation in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands		N/P	
- Operation with directional antenna gains > 6 dBi		N/A	c)

TEST DESIGNATION	SEVERITY	VERDICT	BASIC STANDARDS / COMMENTS
- Out-of-band emissions - Power spectral density conducted - Hybrid system - Frequency hopping additional requirements - Frequency hopping intelligence - RF exposure compliance		PASS N/A N/A PASS PASS PASS	d) e) f) g) h) i)

Sample subject to the test complies for tests done with the requirements of the reference document(s) listed in §2 of this test report and, where applicable, with deviation(s) specified in this document.

To declare, or not, the compliance with the specifications, it was not explicitly taken account of uncertainty associated with the results.

TEST(S) PERFORMED	MODIFICATION(S)
FCC part 15.247	N/A

6. RF EXPOSURE

Radiated eirp measurement = 20.1dBm

Maximum antenna gain = N/A (*Integral*)

Maximum EIRP with integra: antenna gain = 102.3 mW (eirp) at 902.2125MHz

In accordance with KDB 447498 D01 General RF Exposure Guidance v06:

$PSD = EIRP / (4 * \pi * R^2) = 102.3 / (4 * \pi * (20 \text{ cm})^2) = 0.0203 \text{ mW/cm}^2$

Limit= 0.601 mW/cm² (f /1500 if 300<f< 1500 MHz)

7. MEASUREMENT UNCERTAINTY

PARAMETER	MAXIMAL EMITECH UNCERTAINTY	MINIMAL STANDARD UNCERTAINTY
Radio frequency	$\pm 1 \times 10^{-7}$	$\pm 1 \times 10^{-7}$
RF power, conducted		
RF power	$\pm 0.8\text{dB}$	$\pm 1 \text{ dB}$
Power spectral density	$\pm 2.3\text{dB}$	$\pm 3 \text{ dB}$
Occupied bandwidth		
RF power	$\pm 3.8 \%$	$\pm 5 \%$
Adjacent channel power	$\pm 1.6 \text{ dB}$	$\pm 3 \text{ dB}$
Sensibility of receiver (conducted)	$\pm 2.0 \text{ dB}$	$\pm 3 \text{ dB}$
Blocking	$\pm 4.0 \text{ dB}$	$\pm 4 \text{ dB}$
Transitoire		
Amplitude	$\pm 8.5 \%$	$\pm 20 \%$
At the frequency	$\pm 166 \text{ Hz}$	$\pm 250 \text{ Hz}$
Conducted emission (spurious)		
$f \leq 1 \text{ GHz}$	$\pm 0.8 \text{ dB}$	$\pm 3 \text{ dB}$
1 GHz - 12.75 GHz	$\pm 1.6 \text{ dB}$	
Radiated emission (PAR / PIRE / RNE)		
$f \leq 62.5 \text{ MHz}$	$\pm 5.1 \text{ dB}$	$\pm 6 \text{ dB}$
62.5 MHz - 1 GHz	$\pm 5.1 \text{ dB}$	$\pm 6 \text{ dB}$
1 GHz - 18 GHz	$\pm 5.2 \text{ dB}$	$\pm 6 \text{ dB}$
18 GHz – 26 GHz	$\pm 5.1 \text{ dB}$	$\pm 6 \text{ dB}$
26 GHz – 40 GHz	$\pm 5.4 \text{ dB}$	$\pm 6 \text{ dB}$
PIRE and power spectral density with diode	$\pm 5.2 \text{ dB}$	$\pm 6 \text{ dB}$
Radiated emission (magnetic field)		
9kHz – 30MHz	$\pm 3 \text{ dB}$	$\pm 6 \text{ dB}$
RF level for a given BER	$\pm 0.8 \text{ dB}$	$\pm 1.5 \text{ dB}$
Supply voltages	$\pm 3 \%$	$\pm 3 \%$
Temperature	$\pm 1 \text{ }^{\circ}\text{C}$	$\pm 1^{\circ}\text{C}$
Humidity	$\pm 5 \%$	$\pm 5 \%$
Time / Duty cycle	$\pm 4.4 \%$	$\pm 5 \%$
Adaptivity	$\pm 2.9 \text{ dB}$	/
Radiated emission (electric field for FCC standard)		
9kHz – 30MHz	$\pm 2.7 \text{ dB}$	/
30MHz – 1GHz	$\pm 5.0 \text{ dB}$	/
1GHz – 18GHz	$\pm 5.6 \text{ dB}$	/
18GHz – 26GHz	$\pm 5.7 \text{ dB}$	/
26GHz – 40GHz	$\pm 5.7 \text{ dB}$	/

For the calcul of expanded uncertainty, the confidence interval is 95 % (k=2).

8. TEST CONDITIONS AND RESULTS

8.1. Occupied Bandwidth

Reference standard:	FCC part 15 Radio part 15.247 and RSS-247
Test method:	ANSI C63.10: 2013
Test description: The occupied bandwidth (OBW) is the Frequency Range in which 99 % of the total mean power of a given emission falls. The residual part of the total power being denoted as β , which, in cases of symmetrical spectra, splits up into $\beta/2$ on each side of the spectrum. Unless otherwise specified, $\beta/2$ is taken as 0,5 %. The maximum occupied bandwidth includes all associated side bands above the appropriate emissions level. EUT is connected to a near field probe (relative measurement).	

TESTED PARAMETER	OBW	SEVERITY	RESULT TAB.	VERDICT
Sigfox – Low Channel	1.3428 kHz	-	EMI5993	PASS
Sigfox – Mid Channel	1.3393 kHz	-	EMI5994	PASS
Sigfox – High Channel	1.3389 kHz	-	EMI5995	PASS

LABORATORY PARAMETERS:	REQUIRED PRIOR TO THE TEST	DURING THE TEST
Ambient Temperature	15 to 35 °C	25.2°C
Relative Humidity	20 to 75 %	48.8 %
Atmospheric pressure	N/A	1015 hPa
Test method deviation: N/A		
Supplementary information: N/A		

TEST EQUIPMENT USED					
CATEGORY	BRAND	TYPE	IDENTIFIER	CAL. DATE	CAL. DUE
Antenna	Emitech	3.5 cm	4653		
Attenuator	Techniwave	TWSMA-20dB-18G-SMA	14676	21/09/2017	21/11/2019
Attenuator	Techniwave	TWSMA-20dB-18G-SMA	14677	21/09/2017	21/11/2019
Attenuator	Techniwave	TWSMA-20dB-18G-SMA	14679	21/09/2017	21/11/2019
Cable	SUCOFLEX	N-6,5m	14380	25/07/2019	25/09/2021
Cable	Radiall	SMA-0,5m	14888	23/02/2018	23/04/2020
Cable	Radiall	SMA-0,5m	14889	23/02/2018	23/04/2020
Cable	SMA	1m	15616	12/06/2018	12/08/2020
Cable	SMA	1m	15617	12/06/2018	12/08/2020
Cable	Radiall	SMA-1m	16563	30/07/2019	30/09/2021
Cable	Radiall	SMA-1m	16564	30/07/2019	30/09/2021
Climatic enclosure	CLIMATS	EXCAL 7714-HA	14261	19/09/2019	19/11/2020
Multimeter	Agilent Technologies	U1252A	6138	24/01/2018	24/03/2020
Power supply	TTi	PL303QMD	8496		
Spectrum analyzer	Rohde & Schwarz	FSW43	14830	28/12/2018	28/02/2020
Thermohygrometer	Bioblock Scientific	Météostar	0963	25/01/2019	25/03/2021

CATEGORY	BRAND	TYPE	IDENTIFIER	CAL. DATE	CAL. DUE
Thermohygrometer	Testo	608-H2	12268	27/11/2017	27/01/2020
Thermometer contactless	GHM Greisinger	GMH 3710	12968	11/02/2019	11/04/2020

Blank cells = Permanent validity

TEST SETUP PHOTO(S)



OCCUPIED BANDWIDTH - GRAPH	
SIGFOX – LOW CHANNEL	
EMI5993	
EUT mode:	Contunious Tx modulated mode
Test Date:	26/09/2019
Test Operator:	MPA

MultiView

Spectrum

Ref Level 0.00 dBm

RBW 300 Hz

Att 10 dB

SWT 33.4 ms

VBW 1 kHz

Mode Sweep

1 Occupied Bandwidth

M1[1]

-29.22 dBm

902.13810890 MHz

-10 dBm

-20 dBm

-30 dBm

-40 dBm

-50 dBm

-60 dBm

-70 dBm

-80 dBm

-90 dBm

CF 902.1381089 MHz

1001 pts

500.0 Hz/

Span 5.0 kHz

2 Marker Table

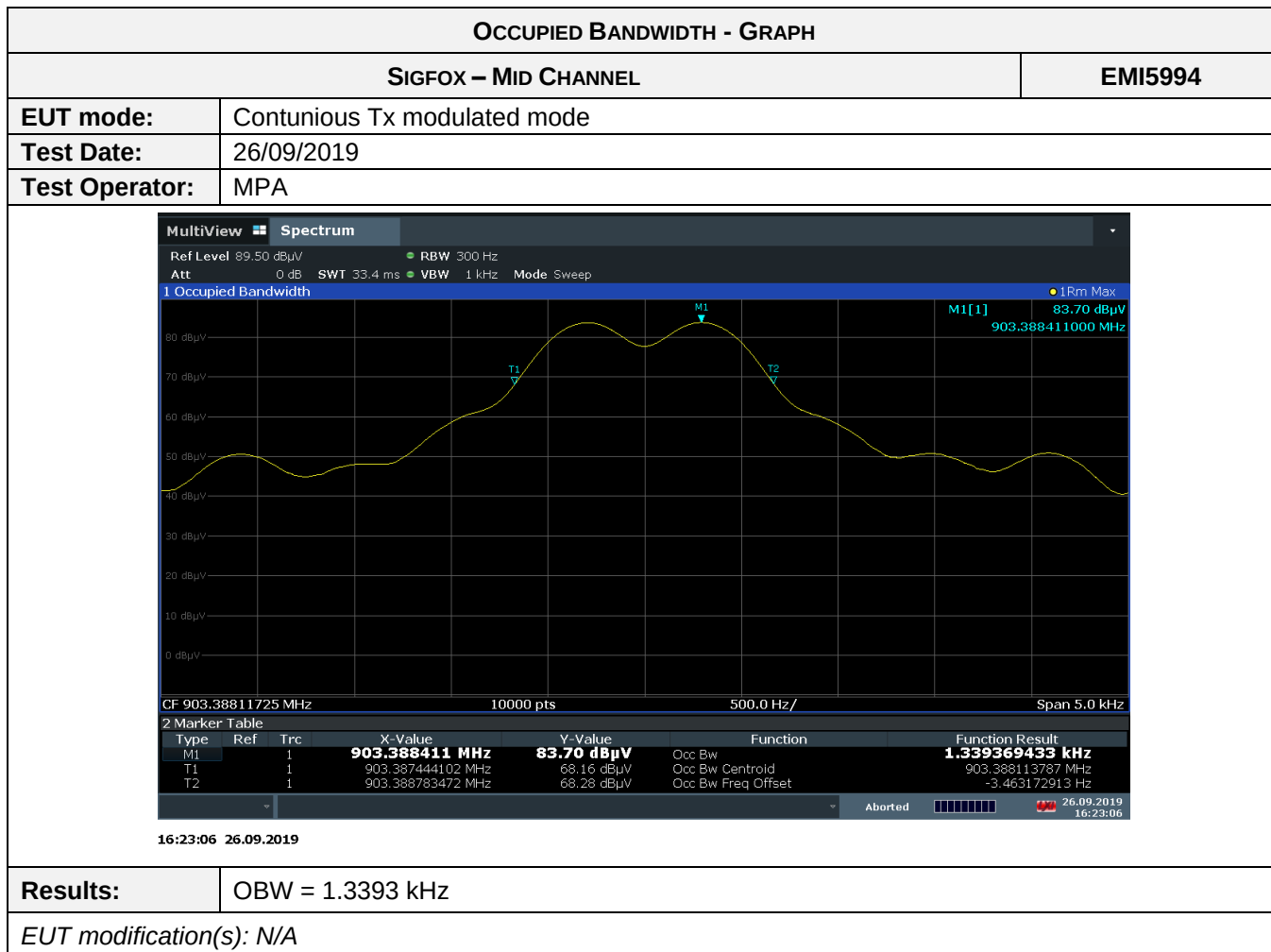
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1	1		902.1381089 MHz	-29.22 dBm	Occ Bw	1.342868481 kHz
T1	1		902.13743869 MHz	-38.82 dBm	Occ Bw Centroid	902.138110122 MHz
T2	1		902.13878156 MHz	-38.75 dBm	Occ Bw Freq Offset	1.221625686 Hz

Aborted

26.09.2019 15:59:16

15:59:17 26.09.2019

Results:	OBW = 1.3428 kHz
EUT modification(s): N/A	



OCCUPIED BANDWIDTH - GRAPH																													
SIGFOX – HIGH CHANNEL																													
EMI5995																													
EUT mode:	Contunious Tx modulated mode																												
Test Date:	26/09/2019																												
Test Operator:	MPA																												
MultiView Spectrum Ref Level 89.50 dBμV Att 0 dB SWT 33.4 ms VBW 1 kHz Mode Sweep 1 Occupied Bandwidth 80 dBμV 70 dBμV 60 dBμV 50 dBμV 40 dBμV 30 dBμV 20 dBμV 10 dBμV 0 dBμV CF 904.66314875 MHz 10000 pts 500.0 Hz/ Span 5.0 kHz 2 Marker Table <table><thead><tr><th>Type</th><th>Ref</th><th>Trc</th><th>X-Value</th><th>Y-Value</th><th>Function</th><th>Function Result</th></tr></thead><tbody><tr><td>M1</td><td>1</td><td></td><td>904.66314875 MHz</td><td>77.74 dBμV</td><td>Occ Bw</td><td>1.33981434 kHz</td></tr><tr><td>T1</td><td>1</td><td></td><td>904.662469076 MHz</td><td>68.18 dBμV</td><td>Occ Bw Centroid</td><td>904.663138983 MHz</td></tr><tr><td>T2</td><td>1</td><td></td><td>904.66380889 MHz</td><td>68.33 dBμV</td><td>Occ Bw Freq Offset</td><td>-9.766894102 Hz</td></tr></tbody></table> Aborted 26.09.2019 16:11:53		Type	Ref	Trc	X-Value	Y-Value	Function	Function Result	M1	1		904.66314875 MHz	77.74 dBμV	Occ Bw	1.33981434 kHz	T1	1		904.662469076 MHz	68.18 dBμV	Occ Bw Centroid	904.663138983 MHz	T2	1		904.66380889 MHz	68.33 dBμV	Occ Bw Freq Offset	-9.766894102 Hz
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result																							
M1	1		904.66314875 MHz	77.74 dBμV	Occ Bw	1.33981434 kHz																							
T1	1		904.662469076 MHz	68.18 dBμV	Occ Bw Centroid	904.663138983 MHz																							
T2	1		904.66380889 MHz	68.33 dBμV	Occ Bw Freq Offset	-9.766894102 Hz																							
Results:	OBW = 1.3389 kHz																												
EUT modification(s): N/A																													

8.2.20dB bandwidth, Carrier Frequency separation and Number of Hopping Channels

Reference standard:	FCC part 15 Radio part 15.247 and RSS-247
Test method:	FCC part 15.247 and RSS-247
Test description: a) (1) (i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz. Tests are done in max-hold mode in order to capture all channels.	

TESTED PARAMETER	RESULT	SEVERITY	RESULT TAB.	VERDICT
Number of channels	54	>50	EMI5564	PASS
Channels separation	25.742 kHz	>1.51kHz	EMI5565	PASS
20dB Bandwidth Low Channel	1.5085 kHz	<25.742 kHz	EMI5566	PASS
20dB Bandwidth Mid Channel	1.512 kHz	<25.742 kHz	EMI5567	PASS
20dB Bandwidth High Channel	1.51 kHz	<25.742 kHz	EMI5568	PASS
Occupation time	117.87ms on 20s	400ms	EMI5569	PASS

LABORATORY PARAMETERS:	REQUIRED PRIOR TO THE TEST	DURING THE TEST
Ambient Temperature	15 to 35 °C	See Graph(es)
Relative Humidity	20 to 75 %	See Graph(es)
Atmospheric pressure	N/A	See Graph(es)
Test method deviation: N/A		
Supplementary information: N/A		

TEST EQUIPMENT USED					
CATEGORY	BRAND	TYPE	IDENTIFIER	CAL. DATE	CAL. DUE
Antenna	Rohde & Schwarz	HL223	3126	13/06/2018	13/08/2021
Cable	SUCOFLEX	N-6,5m	14380	25/07/2019	25/09/2021
Cable	MegaPhase	N-3m	14853	12/02/2018	12/04/2020
Cable	TechniWAVE	N-0.23m	14893	23/02/2018	23/04/2020
Cable	MegaPhase	N-8m	15813	12/11/2018	12/01/2021
Cable	Huber + Suhner	SF102K	16041	28/02/2019	28/04/2021
Shielded enclosure	COMTEST	SAC 3m	14494		
Spectrum analyzer	Rohde & Schwarz	FSW43	14830	28/12/2018	28/02/2020
Thermohygrometer	Bioblock Scientific	Météostar	0963	25/01/2019	25/03/2021
Thermohygrometer	Testo	608-H2	12269	27/11/2017	27/01/2020

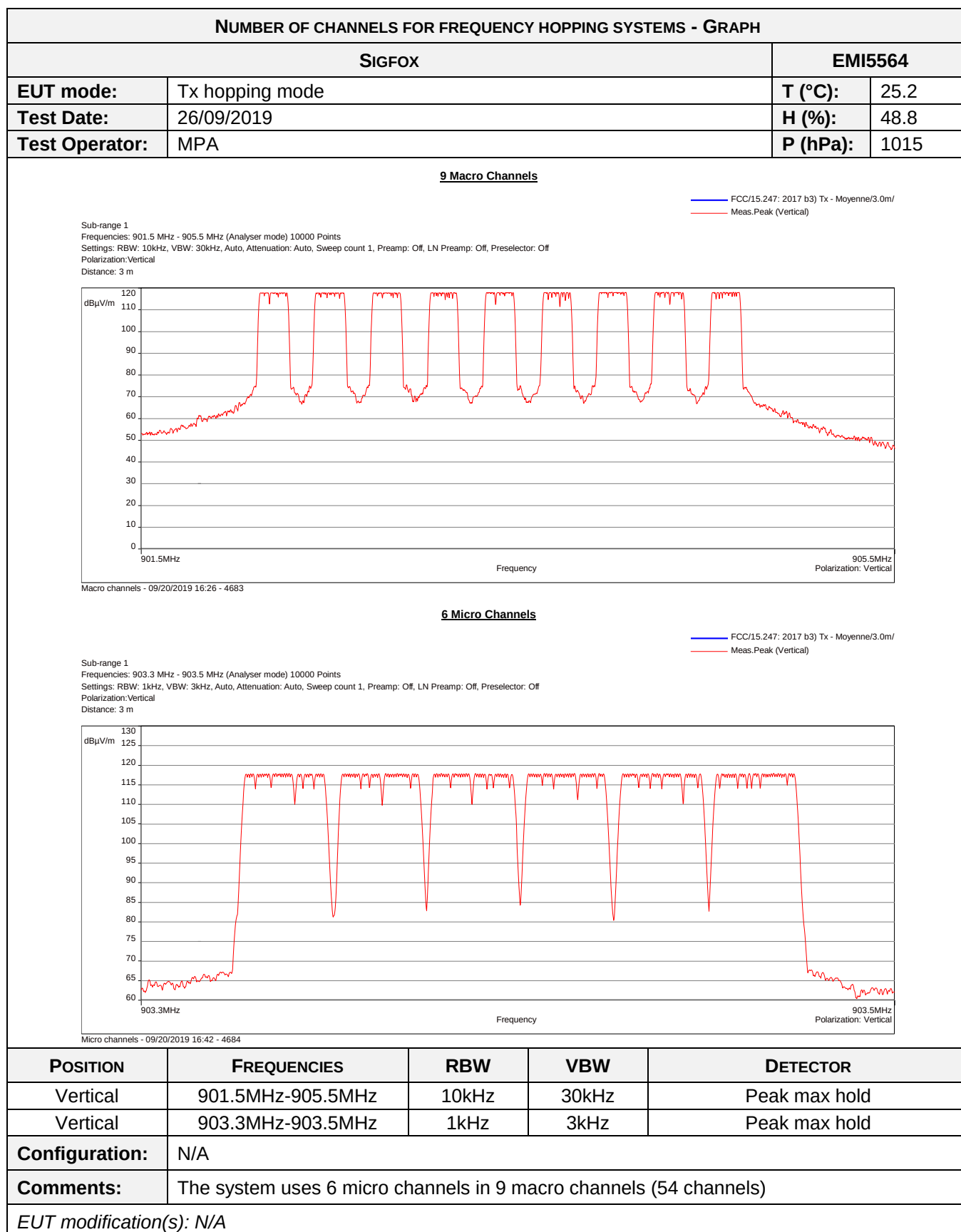
Blank cells = Permanent validity

TEST SETUP PHOTO(S)



TEST SETUP PHOTO(S)





CHANNEL SEPARATION FOR FREQUENCY HOPPING SYSTEMS - GRAPH			
SIGFOX		EMI5565	
EUT mode:	Tx hopping mode	T (°C):	25.2
Test Date:	26/09/2019	H (%):	48.8
Test Operator:	MPA	P (hPa):	1015
Description Sous-bande 1 Fréquences: 903.3 MHz - 903.5 MHz (Mode analyseur) 10000 Points Réglages: RBW: 1kHz, VBW: 3kHz, Auto, Atténuation : Auto, Nombre de Balayages : 1, Preamp : Off, LN Preamp : Off, Preselecteur: Off Polarisation: Verticale Distance: 3 m FCC/15.247: 2017 b3) - Classe: Tx - Moyenne/3.0m/ Mes. Peak (Verticale)			
Results :	The channels separation is 25.742 kHz.		
EUT modification(s): N/A			

20dB BANDWIDTH FOR FREQUENCY HOPPING SYSTEMS - GRAPH				
SIGFOX – LOW CHANNEL			EMI5566	
EUT mode:	Tx hopping mode		T (°C):	25.2
Test Date:	26/09/2019		H (%):	48.8
Test Operator:	MPA		P (hPa):	1015

MultiView ☒ Spectrum

Ref Level 0.00 dBm RBW 300 Hz
Att 10 dB SWT 33.4 ms VBW 1 kHz Mode Sweep

1 Frequency Sweep

1Rm Max

D3[1]

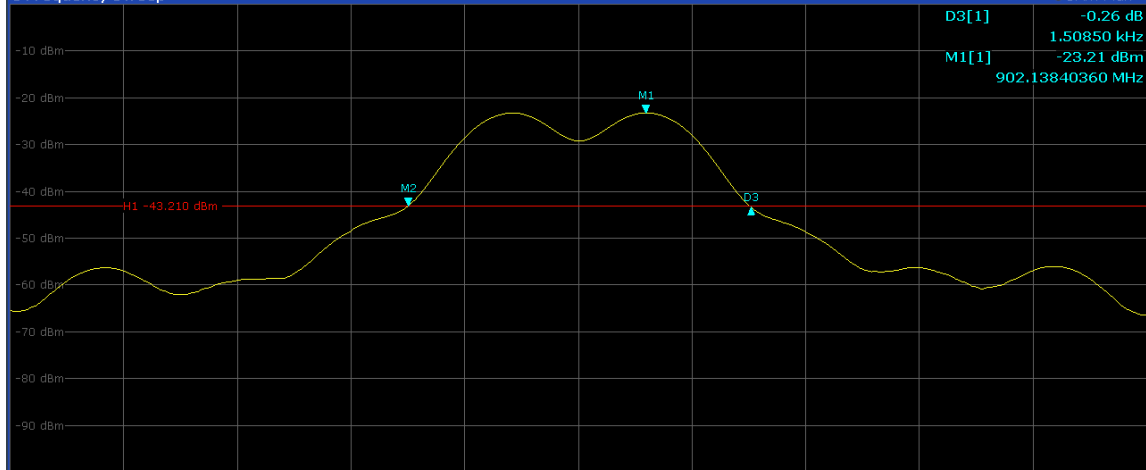
-0.26 dB

1.50850 kHz

M1[1]

-23.21 dBm

902.13840360 MHz



CF 902.1381089 MHz 1001 pts 500.0 Hz/ Span 5.0 kHz

2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	902.1384036 MHz	-23.21 dBm		
M2		1	902.1373596 MHz	-43.07 dBm		
D3	M2	1	1.5085 kHz	-0.26 dB		

Aborted

26.09.2019

16:00:42

16:00:43 26.09.2019

Results :	The 20dB bandwidth is 1.5085 kHz
EUT modification(s): N/A	

20dB BANDWIDTH FOR FREQUENCY HOPPING SYSTEMS - GRAPH				
SIGFOX – MID CHANNEL			EMI5567	
EUT mode:	Tx hopping mode		T (°C):	25.2
Test Date:	26/09/2019		H (%):	48.8
Test Operator:	MPA		P (hPa):	1015

MultiView ☒ Spectrum

Ref Level 89.50 dBµV
Att 0 dB SWT 33.4 ms RBW 300 Hz VBW 1 kHz Mode Sweep

1 Frequency Sweep

80 dBµV

70 dBµV

60 dBµV

50 dBµV

40 dBµV

30 dBµV

20 dBµV

10 dBµV

0 dBµV

H1 63.730 dBµV

M2

M1

D3

D3[1] 0.06 dB
1.512000 kHz
M1[1] 83.73 dBµV
903.388405000 MHz

CF 903.38811725 MHz

10000 pts

500.0 Hz/

Span 5.0 kHz

2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1	1		903.388405 MHz	83.73 dBµV		
M2	1		903.387352 MHz	63.73 dBµV		
D3	M2	1	1.512 kHz	0.06 dB		

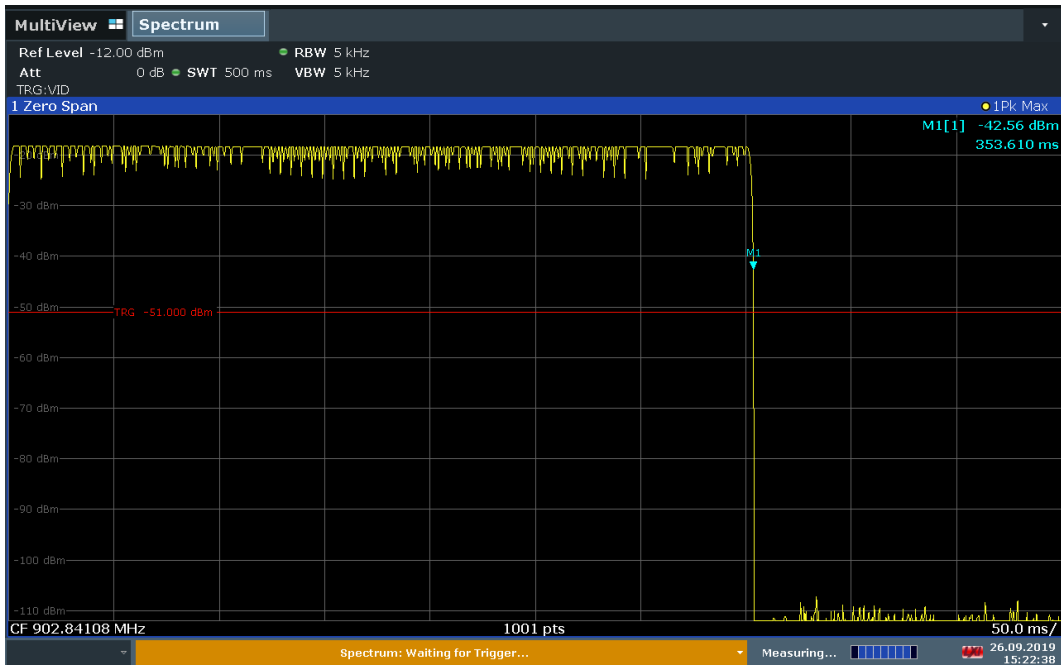
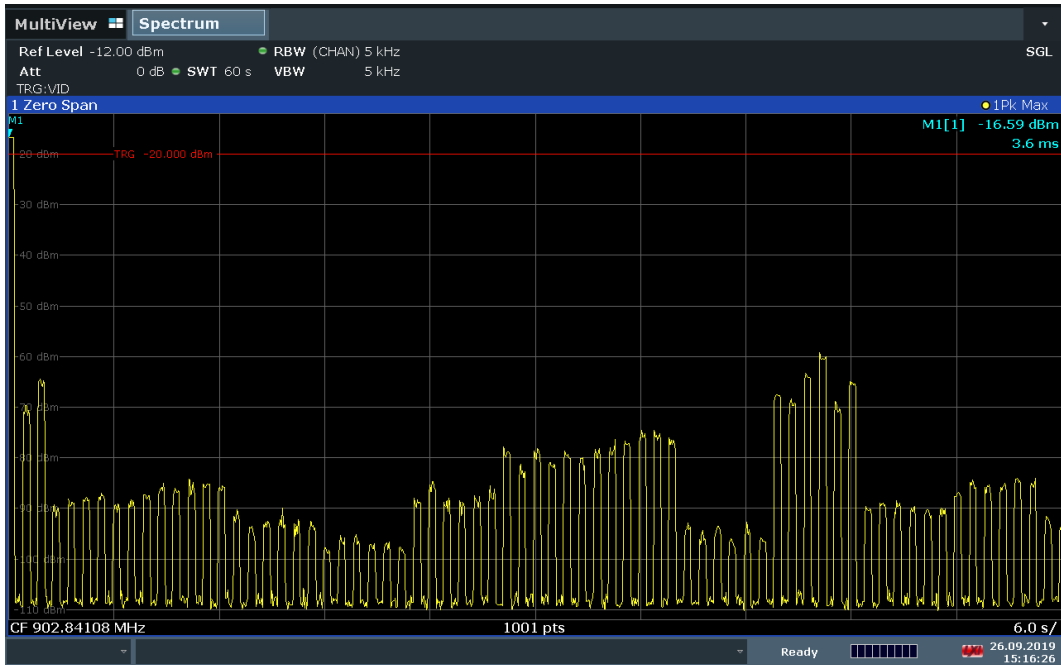
Measuring...

26.09.2019 16:20:33

16:20:33 26.09.2019

Results :	The 20dB bandwidth is 1.512 kHz
EUT modification(s): N/A	

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OCCUPATION TIME FOR FREQUENCY HOPPING SYSTEMS - GRAPH			
SIGFOX		EMI5569	
EUT mode:	Tx hopping mode	T (°C):	25.2
Test Date:	26/09/2019	H (%):	48.8
Test Operator:	MPA	P (hPa):	1015
 15:22:38 26.09.2019			
 15:16:26 26.09.2019			
Results:	The system uses 54 channels in any conditions and the averaging time of occupancy on any channel is less than 0.4 seconds within a period of 20 seconds: The channel occupation time measured is 353.6ms within a period bigger than 60s. In worst case the average time is 117.87ms wich is less than the standard limitation of 400ms.		

8.3. Maximum peak conducted power of the intentional radiator

Reference standard:	FCC part 15 Radio part 15.247 and RSS-247
Test method:	FCC part 15.247 and RSS-247
Test description: b) (2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section. EUT is connected to the measuring receiver via 50Ω attenuator(s). Only the highest levels are recorded. In case of an integral antenna measurement are done on a normalized test site by the substitution method. EUT is set on an insulating support at 150cm above the ground reference plane. The test antenna is oriented in the two polarizations (vertical and horizontal), and the product is rotated at 360° in the horizontal plane (See photo(s) for initial position of the EUT(0°)). If applicable the test antenna was raised and lowered through the specified range of height until a maximum signal level is detected. For portable equipments a research of maximum level is done on the 3 axes. Only the highest levels are recorded.	

TESTED CONFIGURATION	RESULTS	SEVERITY	RESULT TAB.	VERDICT
Low channel	See result tab	1W (30dBm)	EMI6021	PASS
Mid channel	See result tab	1W (30dBm)	EMI6021	PASS
High channel	See result tab	1W (30dBm)	EMI6021	PASS

LABORATORY PARAMETERS:	REQUIRED PRIOR TO THE TEST	DURING THE TEST
Ambient Temperature	15 to 35 °C	25.2 °C
Relative Humidity	20 to 75 %	52.4 %
Atmospheric pressure	N/A	1016 hPa
Test method deviation: N/A		
Supplementary information: N/A		

TEST EQUIPMENT USED					
CATEGORY	BRAND	TYPE	IDENTIFIER	CAL. DATE	CAL. DUE
Antenna	Rohde & Schwarz	HL223	3126	13/06/2018	13/08/2021
Attenuator	EMITECH	SUB.V3-V	14847	25/09/2019	25/11/2020
Attenuator	EMITECH	SUB.V3-H	14848	25/09/2019	25/11/2020
Cable	SUCOFLEX	N-6,5m	14380	25/07/2019	25/09/2021
Cable	MegaPhase	N-3m	14853	12/02/2018	12/04/2020
Cable	TechniWAVE	N-0.23m	14893	23/02/2018	23/04/2020
Cable	MegaPhase	N-8m	15813	12/11/2018	12/01/2021
Cable	Huber + Suhner	SF102K	16041	28/02/2019	28/04/2021
Converter		2.15	9988		
Shielded enclosure	COMTEST	SAC 3m	14494		
Spectrum analyzer	Rohde & Schwarz	FSW43	14830	28/12/2018	28/02/2020
Thermohygrometer	Bioblock Scientific	Météostar	0963	25/01/2019	25/03/2021
Thermohygrometer	Testo	608-H2	12269	27/11/2017	27/01/2020

Blank cells = Permanent validity

TEST SETUP PHOTO(S)



TEST SETUP PHOTO(S)



MAXIMUM CONDUCTED POWER - TABULATED RESULTS							
SIGFOX							EMI6021
Test Case	Temperature (°C)	Power supply (Vdc)	Frequency (MHz)	P _{conducted} (dBm)	Gain _{dBi}	P _{eirp} (dBm)	Limit _{eirp} (dBm)
Low Channel	+25	3.6	902.2125	-	N/A (integral antenna)	20.10	36
Low Channel	+25	3	902.2125	-		14.8	36
Mid Channel	+25	3.6	903.4125	-		19.8	36
Mid Channel	+25	3	903.4125	-		17.28	36
High Channel	+25	3.6	904.6125	-		19.6	36
High Channel	+25	3	904.6125	-		17.23	36
EUT MODIFICATIONS		OPERATOR		TEST DATE		RESULT TAB.	
N/A		MPA		26/09/2019		EMI6021	

$P_{erp} = P_{conducted} + \text{antenna Gain}_{dBd}$ with $\text{Gain}_{dBd} = \text{Gain}_{dBi} - 2.15dB$

$P_{erp} = P_{conducted} + \text{Gain}_{dBi} - 2.15dB$

$P_{eirp} = P_{erp} + 2.15dB$

$P_{eirp} = P_{conducted} + \text{Gain}_{dBi}$

In case of a dedicated antenna the antenna gain (in dB, i.e. relative to a dipole) is declared by the manufacturer.

8.4. Band-edge compliance of conducted emissions (Transmitter)

Reference standard:	FCC part 15 Radio part 15.247 and RSS-247
Test method:	FCC part 15.247 subclause d) and RSS-247
Test description: d) In any 100 kHz bandwidth outside the frequency band in which the intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Only the highest levels are recorded.	

TESTED CONFIGURATION	PARAMETER	SEVERITY	RESULT TAB.	VERDICT
Band Edge / Low channel	see graph	20dBc	EMI4687	PASS
Band Edge / High channel	see graph	20dBc	EMI4688	PASS

LABORATORY PARAMETERS:	REQUIRED PRIOR TO THE TEST	DURING THE TEST
Ambient Temperature	15 to 35 °C	see graph
Relative Humidity	20 to 75 %	see graph
Atmospheric pressure	N/A	see graph
Test method deviation: N/A		
Supplementary information: N/A		

TEST EQUIPMENT USED					
CATEGORY	BRAND	TYPE	IDENTIFIER	CAL. DATE	CAL. DUE
Antenna	Rohde & Schwarz	HL223	3126	13/06/2018	13/08/2021
Attenuator	EMITECH	SUB.V3-V	14847	25/09/2019	25/11/2020
Attenuator	EMITECH	SUB.V3-H	14848	25/09/2019	25/11/2020
Cable	SUCOFLEX	N-6,5m	14380	25/07/2019	25/09/2021
Cable	MegaPhase	N-3m	14853	12/02/2018	12/04/2020
Cable	TechniWAVE	N-0.23m	14893	23/02/2018	23/04/2020
Cable	MegaPhase	N-8m	15813	12/11/2018	12/01/2021
Cable	Huber + Suhner	SF102K	16041	28/02/2019	28/04/2021
Converter		2.15	9988		
Shielded enclosure	COMTEST	SAC 3m	14494		
Spectrum analyzer	Rohde & Schwarz	FSW43	14830	28/12/2018	28/02/2020
Thermohygrometer	Bioblock Scientific	Météostar	0963	25/01/2019	25/03/2021
Thermohygrometer	Testo	608-H2	12269	27/11/2017	27/01/2020

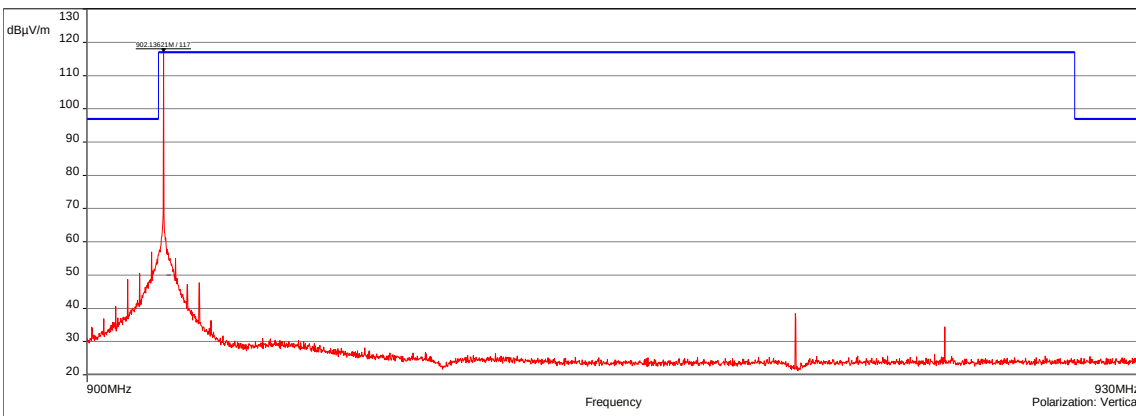
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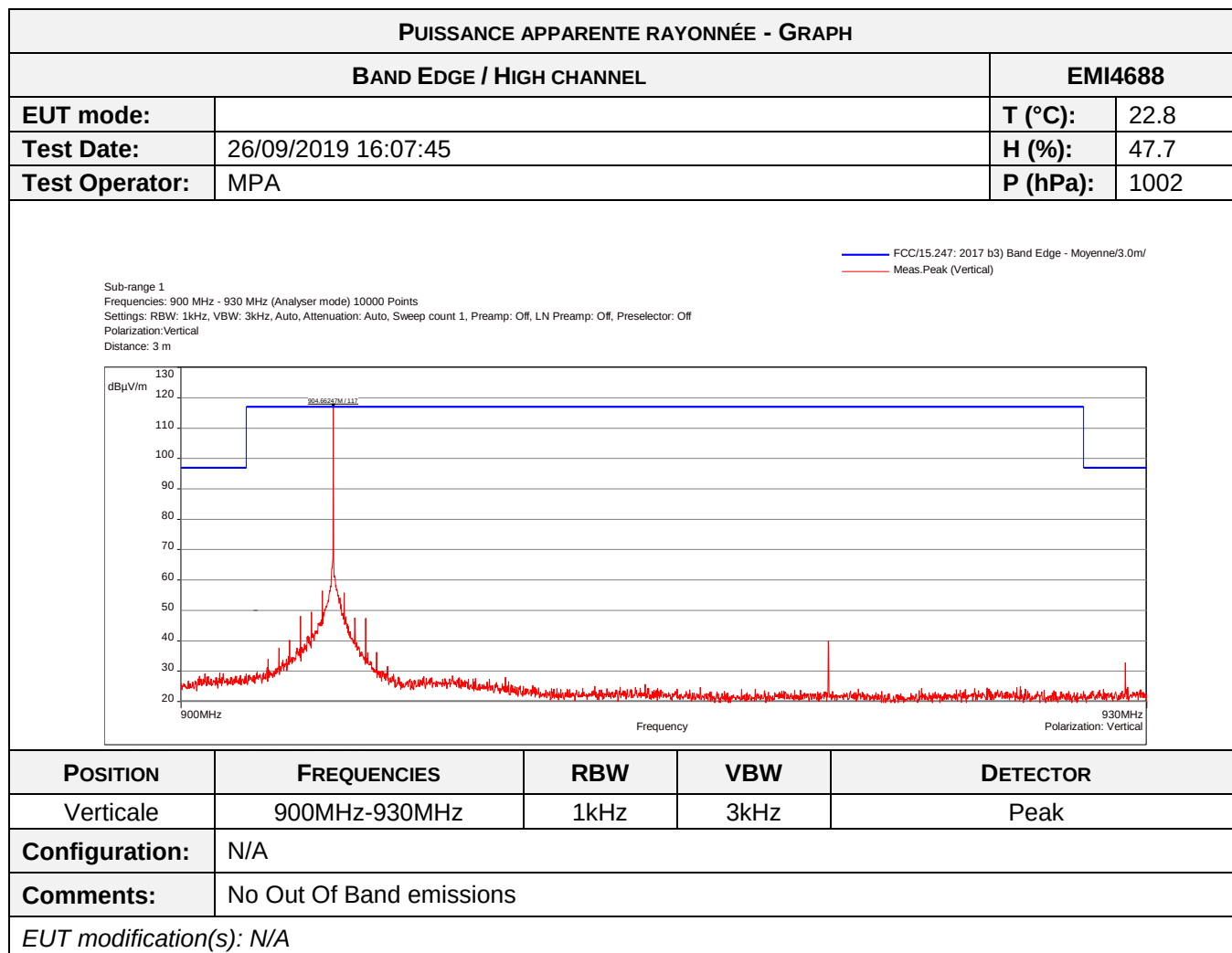
TEST SETUP PHOTO(S)



TEST SETUP PHOTO(S)



PUISSANCE APPARENTE RAYONNÉE - GRAPH				
BAND EDGE / LOW CHANNEL			EMI4687	
EUT mode:		T (°C):	22.8	
Test Date:	26/09/2019 15:57:37	H (%):	47.7	
Test Operator:	MPA	P (hPa):	1002	
Sub-range 1 Frequencies: 900 MHz - 930 MHz (Analyser mode) 10000 Points Settings: RBW: 1kHz, VBW: 3kHz, Auto, Attenuation: Auto, Sweep count 1, Preamp: Off, LN Preamp: Off, Preselector: Off Polarization: Vertical Distance: 3 m FCC/15.247: 2017 b3) Band Edge - Moyenne/3.0m/ Meas.Peak (Vertical)  900MHz 930MHz Polarization: Vertical				
POSITION	FREQUENCIES	RBW	VBW	DETECTOR
Verticale	900MHz-930MHz	1kHz	3kHz	Peak
Configuration:	N/A			
Comments:	No Out Of Band emissions			
EUT modification(s): N/A				



8.5. Radiated spurious emissions

Reference standard:	FCC part 15 Radio part 15.247 and RSS-247
Test method:	FCC part 15.109, 15.209, 15.205, 15.215 RSS-247, CNR Gen
General test setup: For $f < 30\text{MHz}$, EUT is set on an insulating support at 80cm above the ground reference plane. Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 3-meter in a semi-anechoic chamber. The EUT was rotated 360° in order to maximize radiated levels. Test antenna was oriented in 3 axes (0°, 45° and 90°). Final measurements (quasi-peak) were then performed in a 10-meter Open Area Test Site that complies to CISPR 16 in the same measurement conditions. For $f > 30\text{MHz}$, EUT is set on an insulating support at 80cm above the ground reference plane (150cm for $f > 1\text{GHz}$). Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 3-meter. The EUT was rotated 360° about its azimuth with the receive antenna located at various heights in horizontal and vertical polarities. Final measurements (quasi-peak or average) were then performed in a semi-anechoic chamber or Open Area Test Site that complies to CISPR 16. The EUT was rotated 360° about its azimuth and adjusting the receive antenna height from 1 to 4 m. All frequencies were investigated, where applicable. For portable equipments a research of maximum level is done on the 3 axes. Only the highest levels are recorded.	

TESTED CONFIGURATION	PARAMETER	SEVERITY	RESULT TAB.	VERDICT
Tx Hopping mode / Rx mode (Wi-Fi)	9kHz-12.75GHz	15.209	-	PASS

LABORATORY PARAMETERS:	REQUIRED PRIOR TO THE TEST	DURING THE TEST
Ambient Temperature	15 to 35 °C	See Graph(es)
Relative Humidity	20 to 75 %	See Graph(es)
Atmospheric pressure	N/A	See Graph(es)

Test method deviation: N/A

Supplementary information:

From 9 kHz to 30MHz: limit indicated on the curves is calculated with 40 dB/decade extrapolation factor and 51.5 dB conversion factor.

From 30MHz to 1GHz Quasi peak limit provided is the limit given in §15.209.

Above 1GHz average limit in restricted bands §15.205 is 54dB μ V/m. Otherwise, the limit is 20dB under carrier emission level at 3m without averaging.

TEST EQUIPMENT USED					
CATEGORY	BRAND	TYPE	IDENTIFIER	CAL. DATE	CAL. DUE
Software	Nexio		0000		
Antenna	Rohde & Schwarz	HFH2-Z2	5825	20/09/2017	20/11/2019
Antenna	Electro Metrics	BIA-30HF	0824	13/06/2018	13/08/2021
Antenna	ETS-Lindgren	3117	5456	24/07/2019	24/09/2022
Antenna	Rohde & Schwarz	HL223	3126	13/06/2018	13/08/2021
Cable	Huber + Suhner	SF102K	16041	28/02/2019	28/04/2021
Cable	Huber + Suhner	SF102K	16041	28/02/2019	28/04/2021

CATEGORY	BRAND	TYPE	IDENTIFIER	CAL. DATE	CAL. DUE
Cable	TechniWAVE	N-0.23m	14895	23/02/2018	23/04/2020
Cable	TechniWAVE	N-0.23m	14898	23/02/2018	23/04/2020
Cable	STORM MICROWAVE	N-1.5m	10263	29/10/2018	29/12/2020
Cable	MegaPhase	TM18-N1N1-118	12842	09/05/2018	09/07/2020
Cable	MegaPhase	N-3m	14853	12/02/2018	12/04/2020
Cable	H&S	SF104N	15897	25/06/2019	25/08/2021
Cable	MegaPhase	N-5m	14855	12/02/2018	12/04/2020
Cable	SUCOFLEX	N-6,5m	14380	19/01/2017	19/03/2020
Cable	MegaPhase	N-8m	15813	12/11/2018	12/01/2021
Shielded enclosure	RAY PROOF	C.V2	1423		
Shielded enclosure	COMTEST	SAC 3m	14494	14/02/2017	14/04/2020
Filter	Micro-Tronics	HPM18865	12843	08/06/2018	08/08/2020
Turntable	Maturo	NCD	14657		
Turntable	INN-CO	CO3000 & DS1200S	11571		
Preamplifier	IMPULSE	CA118-546ACN	9169	29/10/2018	29/12/2019
Receiver	Rohde & Schwarz	ESI	9704	15/02/2019	15/04/2020
Receiver	Rohde & Schwarz	FSW43	14830	28/12/2018	28/02/2020
Receiver	Rohde & Schwarz	FSW43	14830	28/12/2018	28/02/2020
Thermohygrometer	Testo	608-H1	7562	25/01/2019	25/03/2021
Thermohygrometer	Testo	608-H2	12269	27/11/2017	27/01/2020

BAT-EMC software version: V3.18.0.26

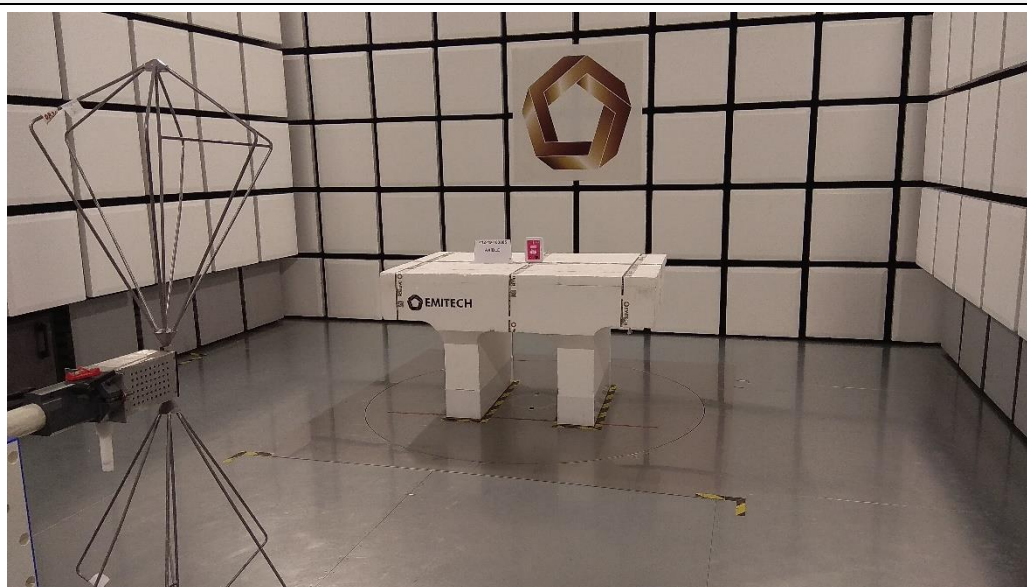
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TEST SETUP PHOTO(S) RADIATED EMISSIONS POSITIONS

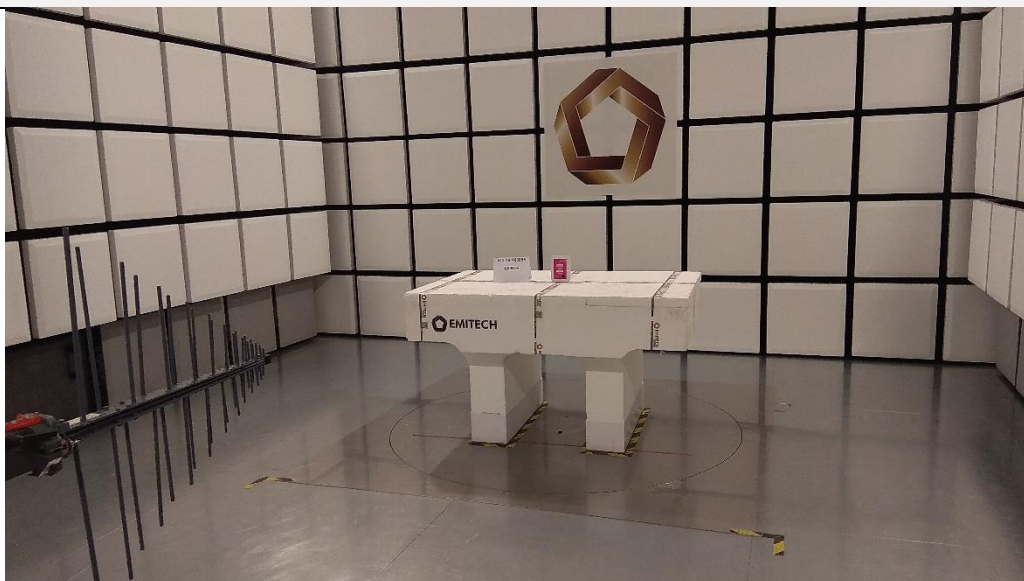

TEST SETUP PHOTO(S) RADIATED EMISSIONS (9kHz-30MHz)



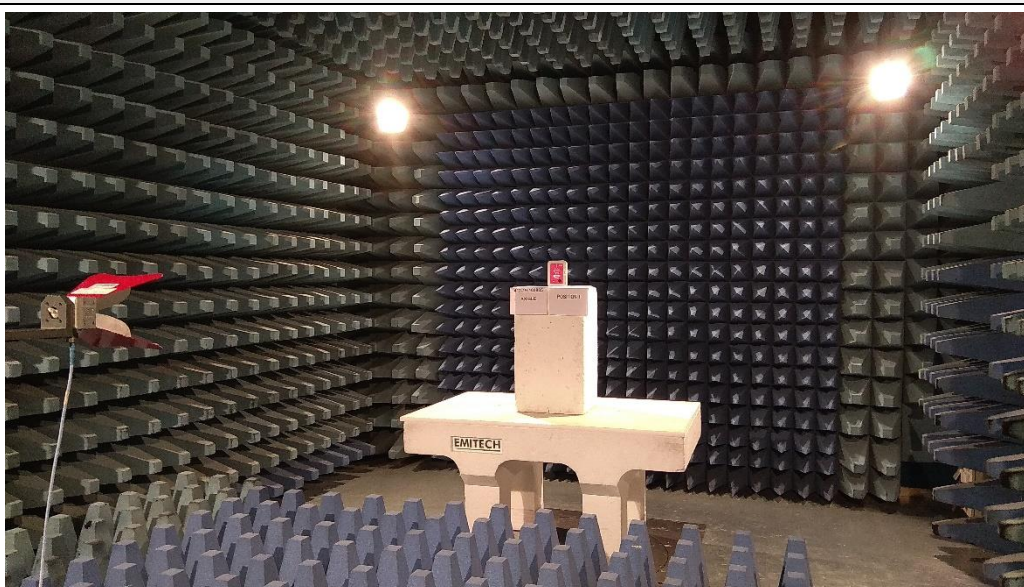
TEST SETUP PHOTO(S) RADIATED EMISSIONS (30MHz-1GHz)

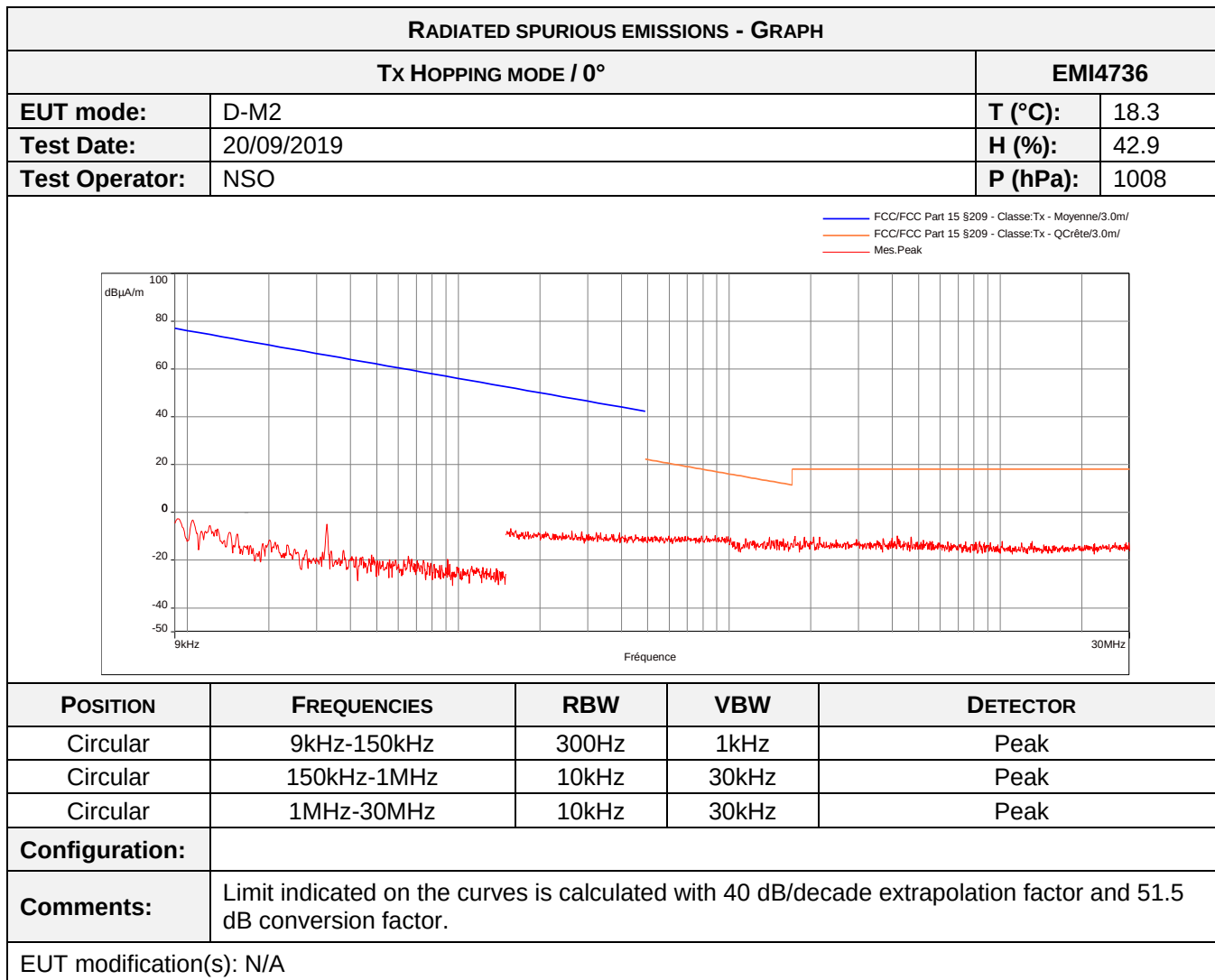


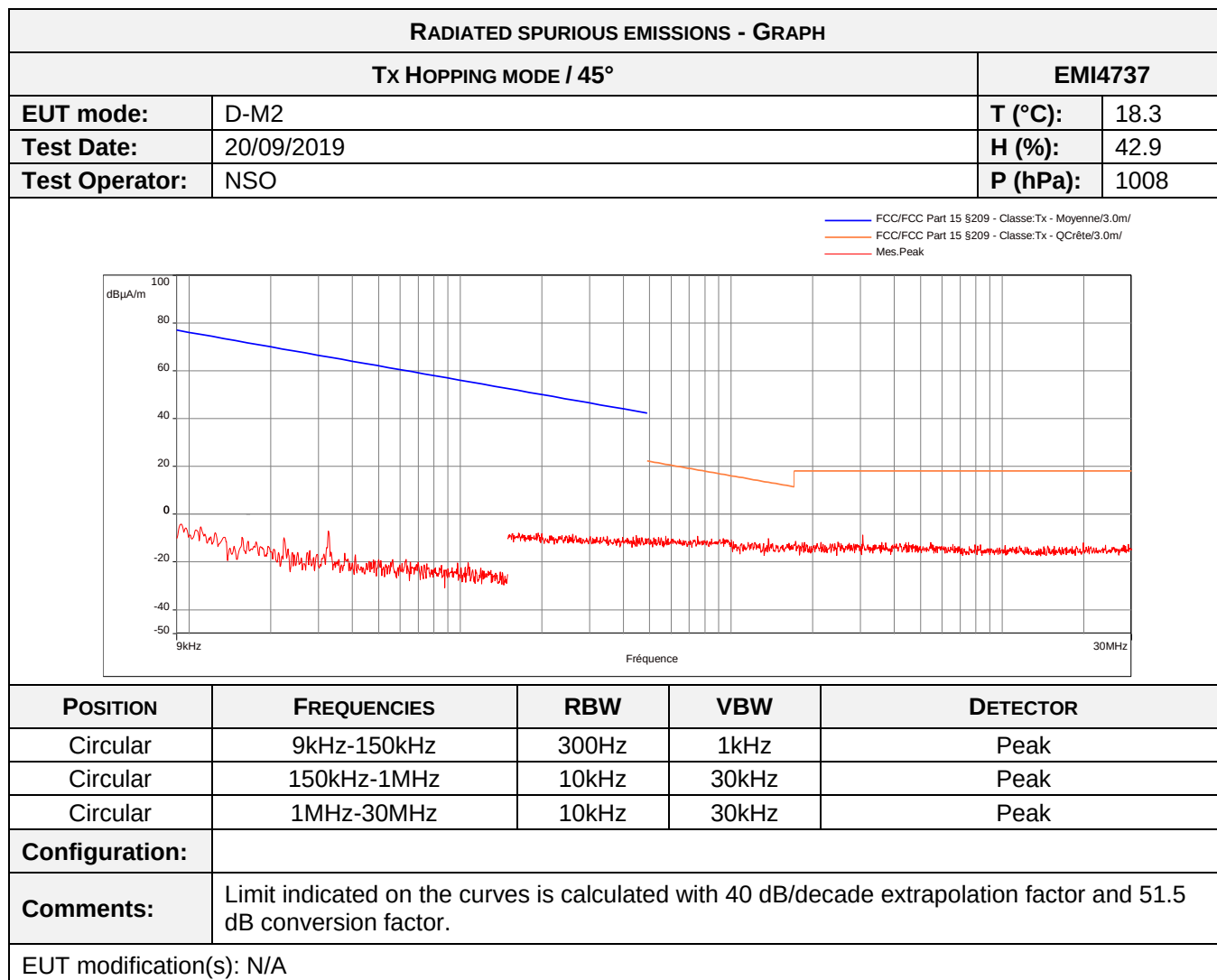
TEST SETUP PHOTO(S) RADIATED EMISSIONS (30MHz-1GHz)

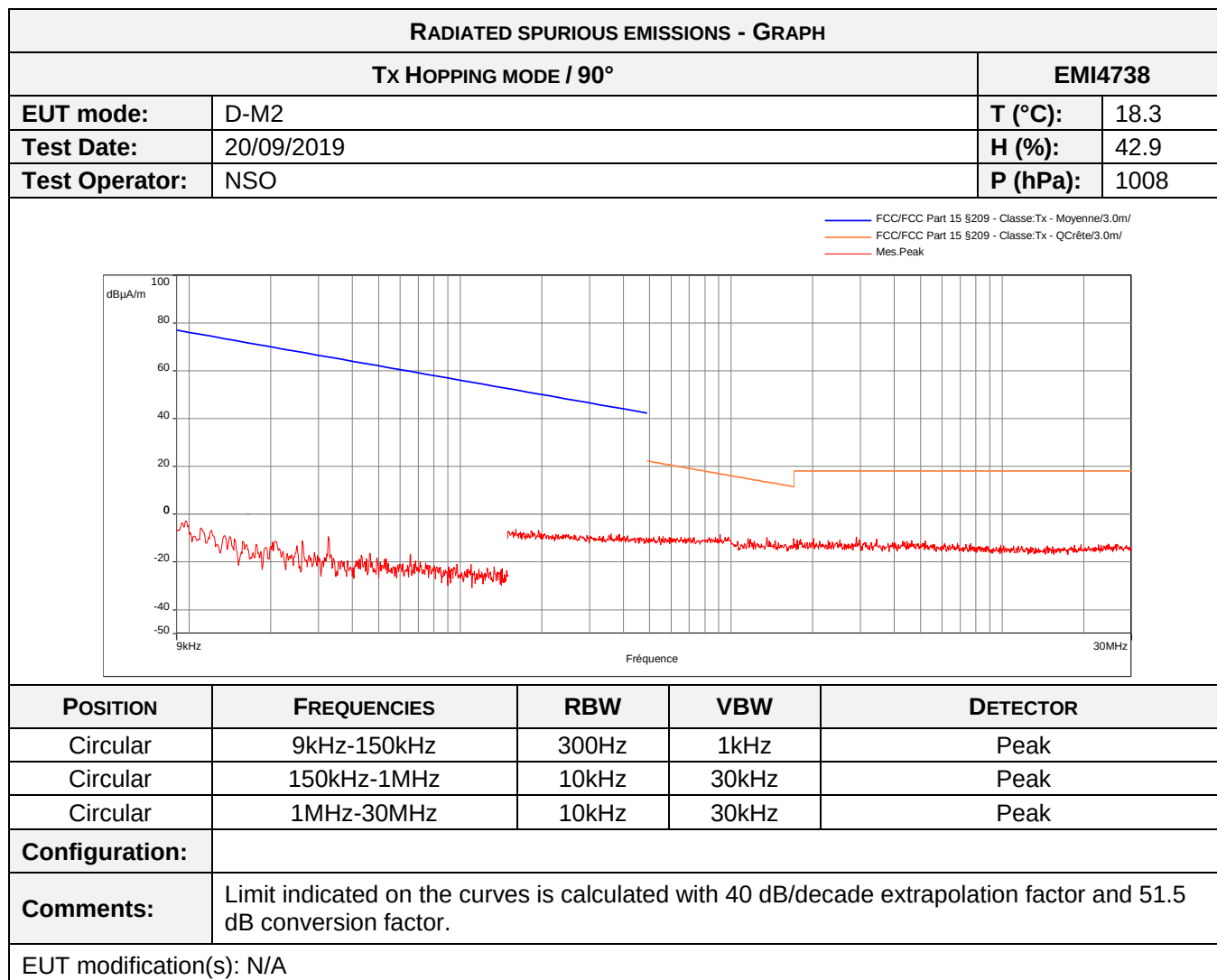


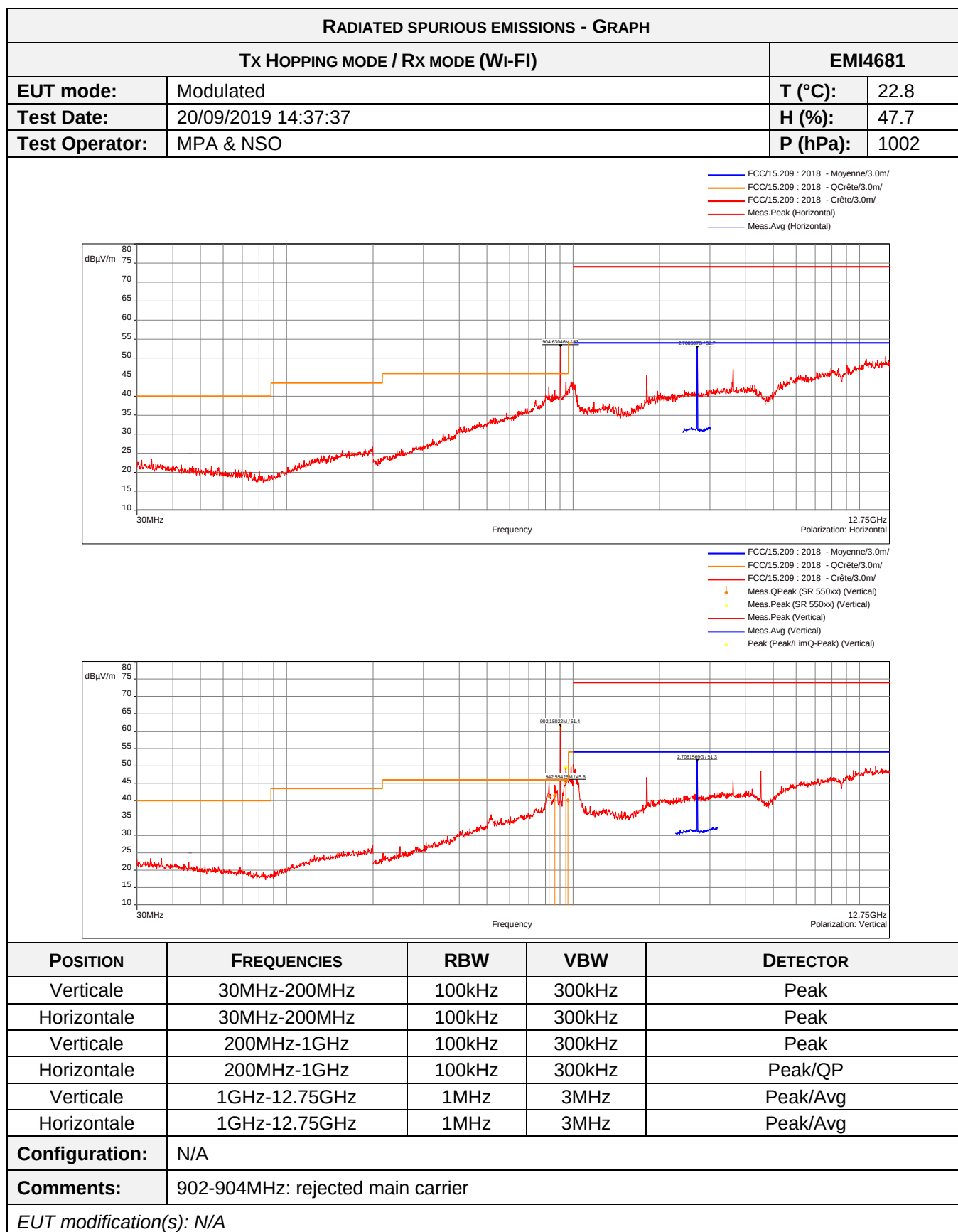
TEST SETUP PHOTO(S) RADIATED EMISSIONS (1GHz-12.75GHz)











TX MODE HOPPING MODE / RX MODE (Wi-Fi)					
Frequency (MHz)	Polarisation	Peak (dBµV/m)	QP (dBµV/m)	QP Limit (dBµV/m)	Margin (dB)
824.30243	Vertical	46.37	41.22	46	-4.78
863.426343	Vertical	46.1	41.56	46	-4.44
942.554255	Vertical	49.63	45.56	46	-0.44
957.835784	Vertical	46.25	40.08	46	-5.92

8.6. Measurement of Frequency Stability §15.215 (C) And RSS-GEN

Reference standard:	FCC part 15 Radio part 15.215 c)
Test method:	FCC part 15 Radio part 15.215 c) and RSS Gen
General test setup: The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation. EUT is set inside the climatic enclosure. EUT is connected to a near field probe (relative measurement).	

TEST CASE	EUT MODE	SEVERITY	RESULT TAB.	VERDICT
Tx mode	Permanent emission mode	902-928 MHz	See tab below	PASS

LABORATORY PARAMETERS:	REQUIRED PRIOR TO THE TEST	DURING THE TEST
Ambient Temperature	15 to 35 °C	N/A
Relative Humidity	20 to 75 %	N/A
Atmospheric pressure	N/A	N/A
Test method deviation: N/A		
Supplementary information: EUT power supply is replaced by a stabilized power supply.		

TEST EQUIPMENT USED					
CATEGORY	BRAND	TYPE	IDENTIFIER	CAL. DATE	CAL. DUE
Antenna	Emitech	3.5 cm	4653		
Attenuator	Techniwave	TWSMA-20dB-18G-SMA	14676	21/09/2017	21/11/2019
Attenuator	Techniwave	TWSMA-20dB-18G-SMA	14677	21/09/2017	21/11/2019
Attenuator	Techniwave	TWSMA-20dB-18G-SMA	14679	21/09/2017	21/11/2019
Cable	SUCOFLEX	N-6,5m	14380	25/07/2019	25/09/2021
Cable	Radiall	SMA-0,5m	14888	23/02/2018	23/04/2020
Cable	Radiall	SMA-0,5m	14889	23/02/2018	23/04/2020
Cable	SMA	1m	15616	12/06/2018	12/08/2020
Cable	SMA	1m	15617	12/06/2018	12/08/2020
Cable	Radiall	SMA-1m	16563	30/07/2019	30/09/2021
Cable	Radiall	SMA-1m	16564	30/07/2019	30/09/2021
Climatic enclosure	CLIMATS	EXCAL 7714-HA	14261		
Multimeter	Agilent Technologies	U1252A	6138	24/01/2018	24/03/2020
Power supply	TTi	PL303QMD	8496		
Thermohygrometer	Bioblock Scientific	Météostar	0963	25/01/2019	25/03/2021
Thermohygrometer	Testo	608-H2	12268	27/11/2017	27/01/2020
Thermometer contactless	GHM Greisinger	GMH 3710	12968	11/02/2019	11/04/2020

Blank cells = Permanent validity

TEST SETUP PHOTO(S)

FREQUENCY STABILITY - TABULATED RESULTS

SIGFOX				EMI6021
Test Case	Temperature (°C)	Power supply (Vdc)	Frequency (MHz)	Frequency error (Hz)
Low Channel	+25	3.6	902.112766	0
Low Channel	+25	3	902.112738	-22
Mid Channel	+25	3.6	903.3878916	0
Mid Channel	+25	3	903.3878786	-13
High Channel	+25	3.6	904.6630824	0
High Channel	+25	3	904.612595	-13
Low Channel	-20	3.6	902.112659	-107
Low Channel	-20	3	902.112658	-108
Mid Channel	-20	3.6	903.3879659	74
Mid Channel	-20	3	903.3879559	64
High Channel	-20	3.6	904.6630864	4
High Channel	-20	3	904.6630864	4
Low Channel	+50	3.6	902.1126541	-112
Low Channel	+50	3	902.1126531	-113
Mid Channel	+50	3.6	903.3879659	74
Mid Channel	+50	3	903.3879559	64
High Channel	+50	3.6	904.6630864	4
High Channel	+50	3	904.6630864	4
EUT MODIFICATIONS		OPERATOR	TEST DATE	RESULT TAB.
N/A		MPA	26/09/2019	EMI6021

End of test report