



Test report issued under the responsibility of:
EMITECH MONTPELLIER laboratory
MRA US-EU Designation Number: FR0006
IC Assigned Code: 4379C

RADIO TEST REPORT

FCC part 15.247
RSS-247_Issue 2, February 2017

Company: **ADVEEZ SAS**
Address.....: 12 rue Michel Labrousse
Bâtiment 6
31100 TOULOUSE
FRANCE

Test item description: **Tracking system**
Trade Mark: ADVEEZ SAS
Manufacturer: ADVEEZ SAS
Model/Type reference.....: OTM
FCC ID.....: R8T-OTM
IC: 21312-OTM
Ratings.....: 3.6 Vdc (internal battery pack of 8000mAh)

Testing Laboratory: **EMITECH MONTPELLIER laboratory**
Address.....: 145 rue de Massacan BP80025
34741 VENDARGUES Cedex
FRANCE

Report Reference No.: **R410-17-105371-1A**
Test procedure: FCC IC Certification
Diffusion.....: Mr ASRA
Applicant's name: ADVEEZ SAS
Date of issue.....: 23/07/2018
Total number of pages.....: 51
Revision.....: 3
Modified page(s).....: Remove of DSSS part
Compiled by.....: Fabien MOINACHE
Approved by (+ signature).....: David MONTAULON (Technical 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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1. GENERAL INFORMATION

This document submits the results of Radio tests performed on the equipment **Tracking system OTM** (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 Laboratory : EMITECH MONTPELLIER laboratory & Open Area Test Site in SALINELLES (30) Address : 145 rue de Massacan BP80025 34741 VENDARGUES Cedex FRANCE Test procedure. : FCC IC Certification Tested by : Fabien MOINACHE and Morgan PATEY Test supervisor : David MONTAULON Date of receipt of test item : N/A Date (s) of performance of tests : October 18th and 19th of 2017			
APPLICANT'S GENERAL INFORMATION:			
Company name : ADVEEZ SAS Company address. : 12 rue Michel Labrousse Bâtiment 6 31100 TOULOUSE FRANCE Person(s) present during the tests. : Mr ASRA Responsible. : Mr ASRA			
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. This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory. Throughout this report the decimal separator is point.			
POSSIBLE TEST CASE VERDICTS:			
Test case does not apply to the test object. : N/A Information not communicated. : N/C Test case not performed..... : N/P Test object does meet the requirement..... : P (Pass) Test object does not meet the requirement.. : F (Fail) Test object was not subjected to all tests..... : I (Inconclusive)			
DEFINITIONS AND ABBREVIATIONS:			
E.U.T.	Equipment under test	AE	Ancillary equipment
RBW	Resolution bandwidth	VBW	Video bandwidth
OATS	Open area test site	FAR	Full anechoic room
RF	Radio frequency	NTR	Nothing to report
SRD	Short Range Device	GPS	Global Positioning System

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 4, November 2014

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

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.

3.1. Test Conditions

Test item description.	: Tracking system
Model/Type reference.....	: OTM
Trade Mark.	: ADVEEZ SAS
FCC ID.....	: R8T-OTM
IC.	: 21312-OTM
Serial number (S/N).....	: ADM_P_073_08
Part number (P/N).	: None
Software version.	: Not communicated
Firmware version.	: Not communicated
Type of sample.	: Pre-serial
Function(s).....	: OTM allows to locate and/or to follow an object (vehicle or other) while being energy self-sufficient (i.e. alimentation by battery-powered). Module communicates position information and some alerts to the server thought LPWAN (Low Power Wide Area Network). To guarantee the greatest autonomy, the device is only activated when movement is detected by the accelerometer. Outside of movement periods, the module is in standby mode.
Manufacturer name.	: ADVEEZ SAS
Address.....	: 12 rue Michel Labrousse Bâtiment 6 31100 TOULOUSE

General product information:

N/A

3.2. EUT Marking Plate



3.3. EUT Internal view



3.4. EUT Integral SRD antenna



3.5. EUT SRD Antenna + PCB



3.6. EUT GPS Antenna



3.7. EUT Electronic board



3.8. EUT Internal view



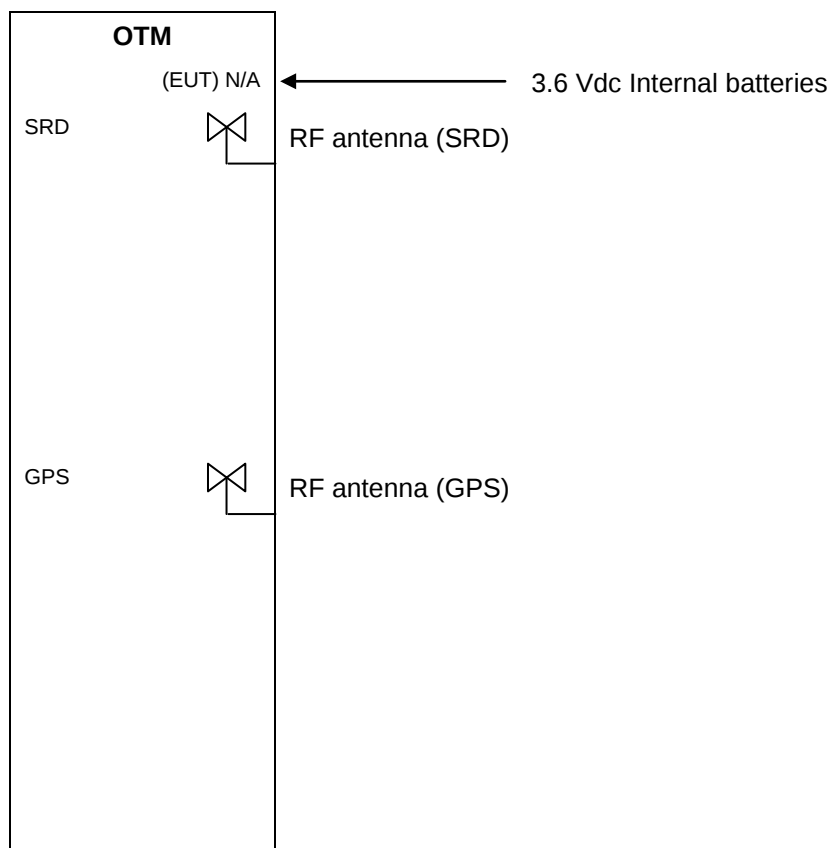
3.9. EUT Mechanical and Electrical Design

Power supply.	: 3.6 Vdc (internal battery pack of 8000mAh)
Power supply range.....	: 3.6 Vdc (internal battery pack of 8000mAh)
Power type.....	: Battery powered
Power (W).....	: N/A
Nominal current (A).	: N/A
Dimensions (L x W x H) (m).	: 0.16m x 0.08m x 0.04m
Weight (kg).	: N/C
Temperature range (°C).	: -20/+50°C
Ground bounding strap.....	: No

Comments:

Device also includes a GPS module wich is activated during all the tests.

3.10. EUT Input/Output ports



PORT	NAME	TYPE	LENGTH	CABLE TYPE	COMMENTS
0	Main frame	N/E	N/A	Plastic	
1	3.6 Vdc Internal batteries	DC	N/A	N/A	
2	RF antenna (SRD)	RF	N/A	N/A	
3	RF antenna (GPS)	RF	N/A	N/A	

AC/DC : AC/DC Converter port

AC.....: Alternative current port

DC: Discontinuous current port

I/O.....: Input or Output port

TP: Telecommunication port

RF.....: Radio frequency port

N/E: Non Electrical port

3.11. Supporting Equipment Used During Test

Sample subject to the tests was tested with following equipment.

PRODUCT TYPE	MANUFACTURER	MODEL	N°EMITECH / COMMENTS
N/A	N/A	N/A	N/A

3.12. EUT Radio Specifications

a) GENERAL INFORMATIONS	
According to manufacturer's declarations :	
EUT type.....	: Transmitter
Technology	: SRD
Environmental profile.....	: Data transmission
Temperature range.....	: -20/+50 °C
Antenna type	: Integral
Antenna Gain.....	: 6dBi (Max)
Comments:	
Device also includes a GPS module wich is activated during all the tests.	
b) TRANSMITTER PARAMITERS (Tx)	
Frequency bands.....	: 902MHz-928MHz
RF Power.....	: 1W max (standard value)
Number of channels / Separation.....	: 64 for FHSS/200kHz 8 for DSSS/1.6MHz (See test report R410-17-105371-2A Ed.0)
Modulation type	: LORA
Duty cycle	: N/C
Tested frequency.....	: 902.3MHz-914.9MHz (FHSS)
c) RECEIVER PARAMETERS (Rx)	
Frequency bands.....	: 902.3MHz-914.9MHz (FHSS)
Category/Class	: pointless
Bandwidth	: pointless

4. RESULT SUMMARY

TEST DESIGNATION	SEVERITY	VERDICT	BASIC STANDARDS / COMMENTS
SUBPART A - GENERAL			
Labeling requirements		PASS	15.19 / See certification documents
Information to user		PASS	15.21 / See certification documents
Home-built devices		N/A	15.23
Kits		N/A	15.25
Special Accessories		PASS	15.27 / See certification documents
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 / See certification documents
SUBPART B – UNINTENTIONAL RADIATORS			
Equipment authorization			15.101
- Verification		N/A	
- Declaration of Conformity		N/A	
CPU boards and power supplies used in personal computers		N/A	15.102
Exempted device		N/A	15.103
Information to the user		PASS	15.105 / See certification documents
Conducted limits		N/A	15.107 / Battery powered equipment
Radiated emission limits	Class B	PASS	15.109
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
TV broadcast receivers		N/A	15.117
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			

TEST DESIGNATION	SEVERITY	VERDICT	BASIC STANDARDS / COMMENTS
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 / Dedicated integral antenna
External radio frequency power amplifiers and antenna modifications		N/A	15.204
Restricted bands of operation		PASS	15.204
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	a) (1) BW = 125kHz
- Digital modulation system		N/P	a) (2) See test report R410-105371-2A Ed.0
- Maximum peak conducted output power		-	b)
- For hopping system in the 2400-2483.5 MHz and 5725-5850 MHz bands		N/A	b) (1)
- For hopping system in the 902-928MHz band		PASS	b) (2) BW = 125kHz
- For system using digital modulation in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands		N/P	b) (3) See test report R410-105371-2A Ed.0
- Operation with directional antenna gains > 6 dBi		N/A	c)
- Out-of-band emissions		PASS	d)
- Power spectral density conducted		N/P	e) See test report R410-105371-2A Ed.0
- Hybrid system		N/A	f)
- Frequency hopping additional requirements		PASS	g)
- Frequency hopping intelligence		PASS	h)
- RF exposure compliance		PASS	i)

Sample subject to the test complies 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.

Opinion(s) and interpretation(s): N/A

5. RF EXPOSURE

Conducted measurement = 9.379dBm

Maximum antenna gain = 6dBi

Maximum EIRP with antenna gain of 6dBi = 34.67 mW (eirp) at 902.3MHz

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

$PSD = EIRP / (4 \cdot \pi \cdot R^2) = 162.2 / (4 \cdot \pi \cdot (20 \text{ cm})^2) = 0.00689 \text{ mW/cm}^2$

Limit = 0.61 mW/cm² ($f / 1500$ if $300 < f < 1500 \text{ MHz}$)

6. 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	$\pm 1.2 \%$	$\pm 5 \%$
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	$\pm 5.4 \text{ dB}$	$\pm 6 \text{ dB}$
Radiated emission (magnetic field)		
9kHz – 30MHz	$\pm 2.7 \text{ dB}$	$\pm 6 \text{ dB}$
Supply voltages	$\pm 3 \%$	$\pm 3 \%$
Temperature	$\pm 1 \text{ }^\circ\text{C}$	$\pm 1 \text{ }^\circ\text{C}$
Humidity	$\pm 5 \%$	$\pm 5 \%$
Time / Duty cycle	$\pm 4.4 \%$	$\pm 5 \%$
Radiated emission (electric field for FCC standard)		
9kHz – 30MHz	$\pm 2.7 \text{ dB}$	/
30MHz – 1GHz	$\pm 5.2 \text{ dB}$	/
1GHz – 18GHz	$\pm 5.3 \text{ dB}$	/
18GHz – 26GHz	$\pm 5.5 \text{ dB}$	/
26GHz – 40GHz	$\pm 5.5 \text{ dB}$	/

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

7. TEST CONDITIONS AND RESULTS

7.1. Occupied Bandwidth

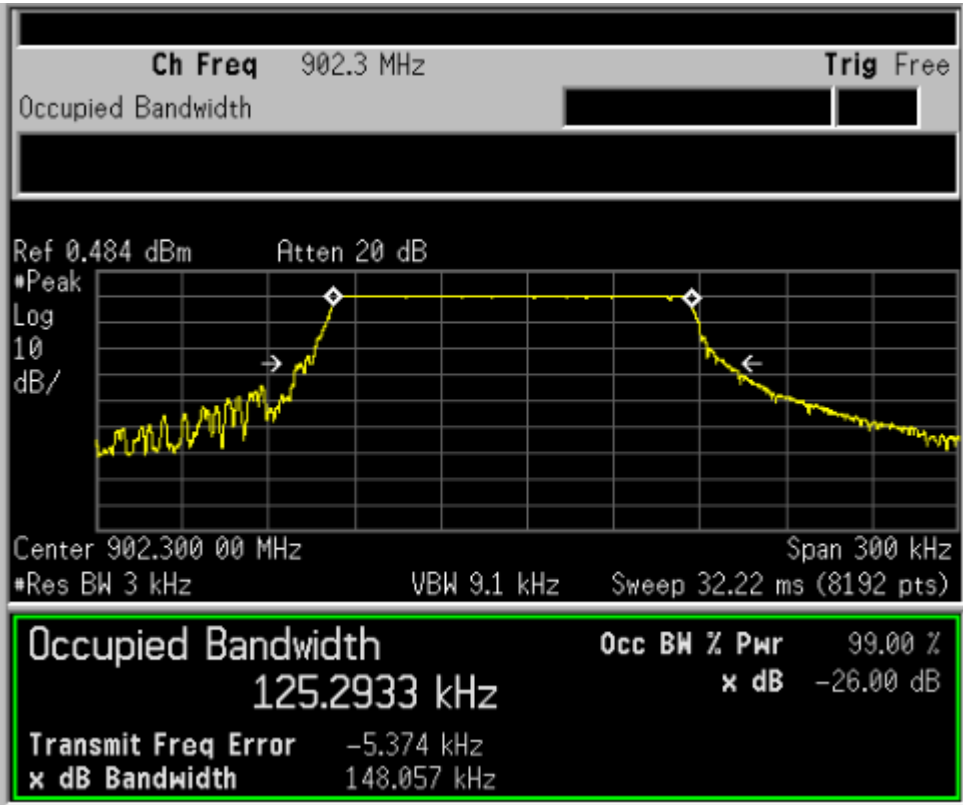
Reference standard:	FCC part 15 Radio part 15.247 and RSS-247
Test method:	FCC part 15.247 and RSS-247
Test description: The occupied bandwidth (OBW) is the Frequency Range in which 99 % of the total mean power of a given emission falls. The residual part of the total power being denoted as β, which, 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 and the frequency error or drift under extreme test conditions. EUT is connected to the measuring receiver via 50Ω attenuator(s).	

TESTED PARAMETER	OBW	SEVERITY	RESULT TAB.	VERDICT
Lora 125kHz	125.2933kHz	<OCW	EMI5993	PASS

LABORATORY PARAMETERS:	REQUIRED PRIOR TO THE TEST	DURING THE TEST
Ambient Temperature	15 to 35 °C	25.3°C
Relative Humidity	20 to 75 %	44.6 %
Atmospheric pressure	N/A	1021 hPa
Test method deviation: N/A		
Supplementary information: N/A		

TEST EQUIPMENT USED					
CATEGORY	BRAND	TYPE	IDENTIFIER	CAL. DATE	CAL. DUE
Attenuator	Radiall	R412710124	4390	25/11/2015	25/01/2018
Attenuator	Radiall	R412720124	4391	25/11/2015	25/01/2018
Cable	STORM MICROWAVE	N-1.5m	10263	05/10/2016	05/12/2018
Receiver	Agilent Technologies	E4440A	5824	11/01/2016	11/03/2018
Shielded enclosure	RAY PROOF	C.V1	1123		
Thermohygrometer	Bioblock Scientific	Météostar	0963	27/12/2016	27/02/2019
Thermohygrometer	Testo	608-H1	7561	27/12/2016	27/02/2019

Blank cells = Permanent validity

OCCUPIED BANDWIDTH - GRAPH	
LORA 125KHz	
EMI5993	
EUT mode:	Tx hopping mode
Test Date:	19/10/2017
Test Operator:	FMO
 Ch Freq 902.3 MHz Trig Free Occupied Bandwidth Ref 0.484 dBm Atten 20 dB *Peak Log 10 dB/ Center 902.300 00 MHz Span 300 kHz *Res BW 3 kHz VBW 9.1 kHz Sweep 32.22 ms (8192 pts) Occupied Bandwidth Occ BW % Pwr 99.00 % 125.2933 kHz x dB -26.00 dB Transmit Freq Error -5.374 kHz x dB Bandwidth 148.057 kHz	
Results:	The system has an OBW of 125.2933 kHz
EUT modification(s): N/A	

7.2.20dB bandwidth, Carrier Frequency separation and Number of Hopping Channels

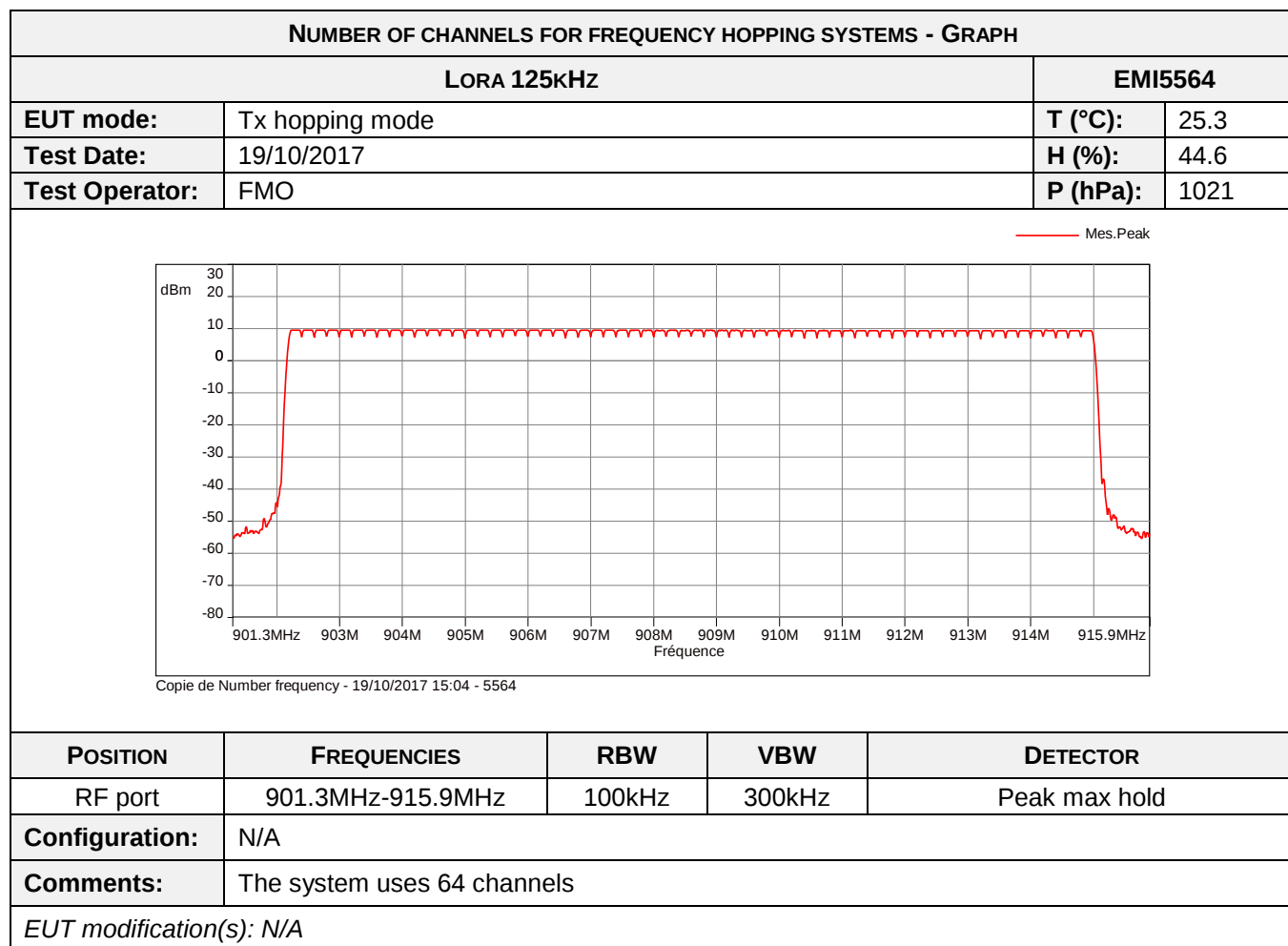
Reference standard:	FCC part 15 Radio part 15.247 and RSS-247
Test method:	FCC part 15.247 and RSS-247
Test description: a) (1) (i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping 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. EUT is connected to the measuring receiver via 50Ω attenuator(s). Tests are done in max-hold mode in order to capture all channels.	

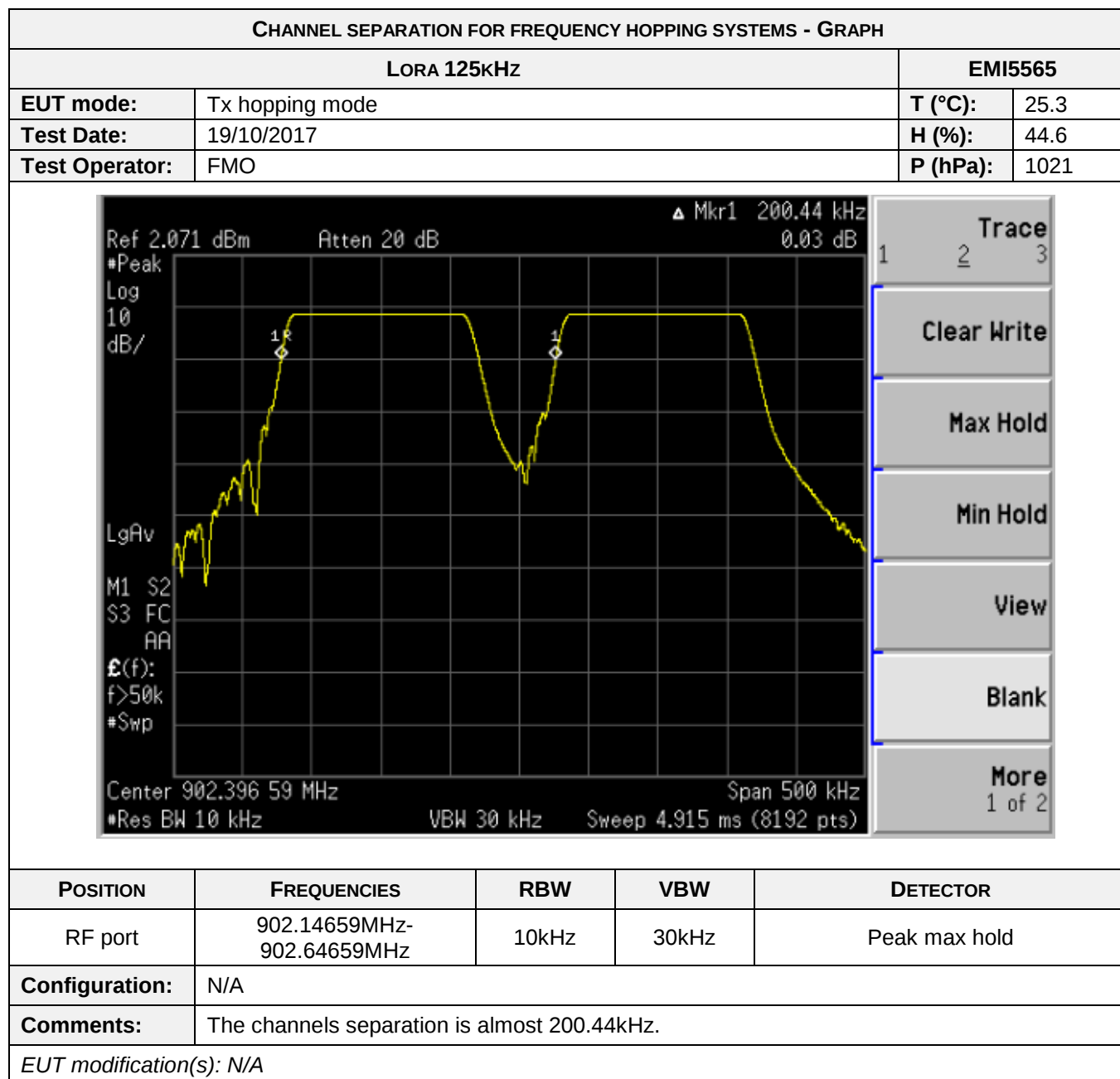
TESTED PARAMETER	RESULT	SEVERITY	RESULT TAB.	VERDICT
Number of channels	64	>50	EMI5564	PASS
Channels separation	200.44	>139.10kHz	EMI5565	PASS
6dB Bandwidth	126.71kHz	-	EMI5566	PASS
20dB Bandwidth	139.10kHz	<200.44kHz	EMI5567	PASS
Occupation time	53.77ms on 20s	400ms	EMI5568	PASS

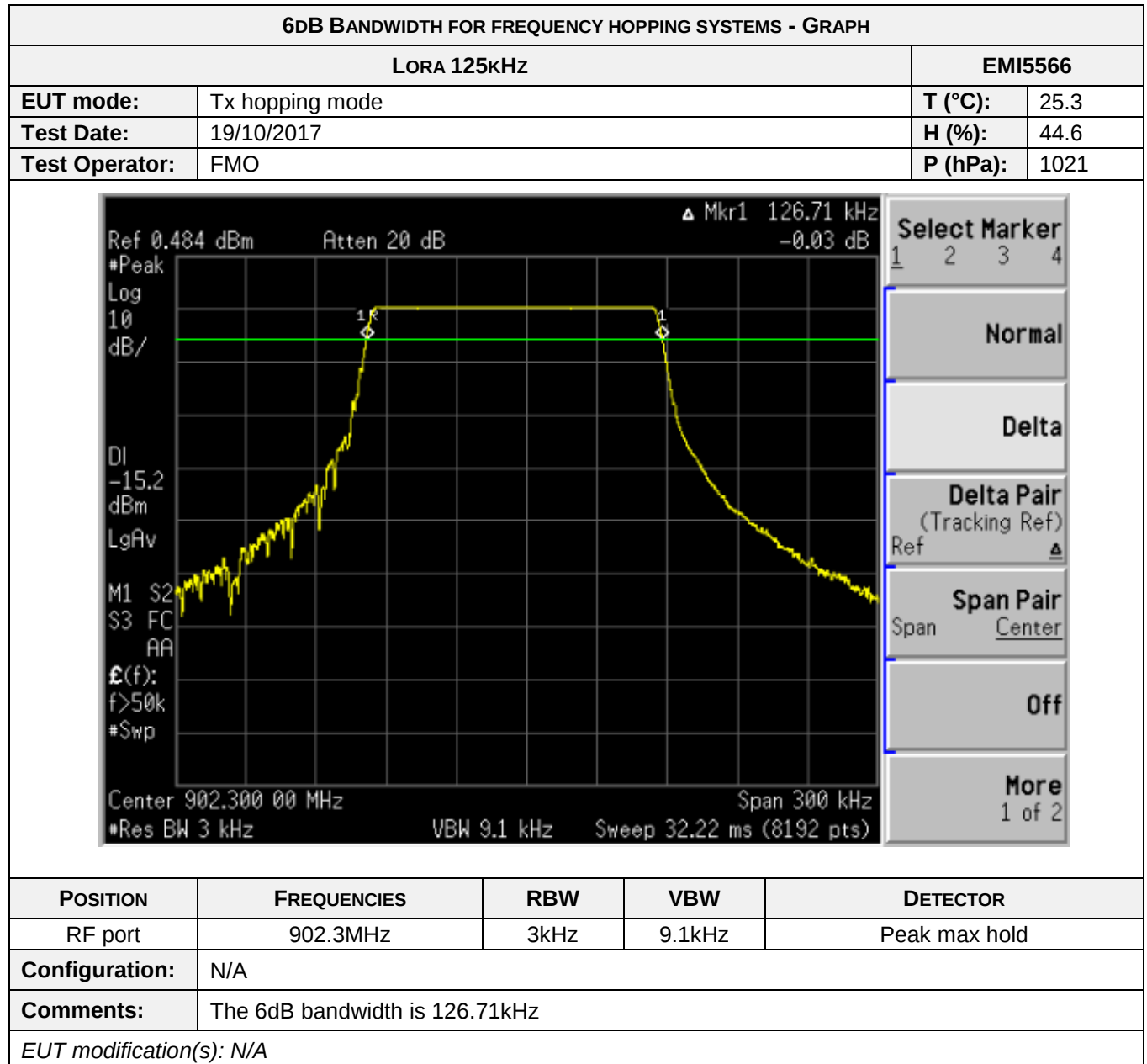
LABORATORY PARAMETERS:	REQUIRED PRIOR TO THE TEST	DURING THE TEST
Ambient Temperature	15 to 35 °C	See Graph(es)
Relative Humidity	20 to 75 %	See Graph(es)
Atmospheric pressure	N/A	See Graph(es)
Test method deviation: N/A		
Supplementary information: N/A		

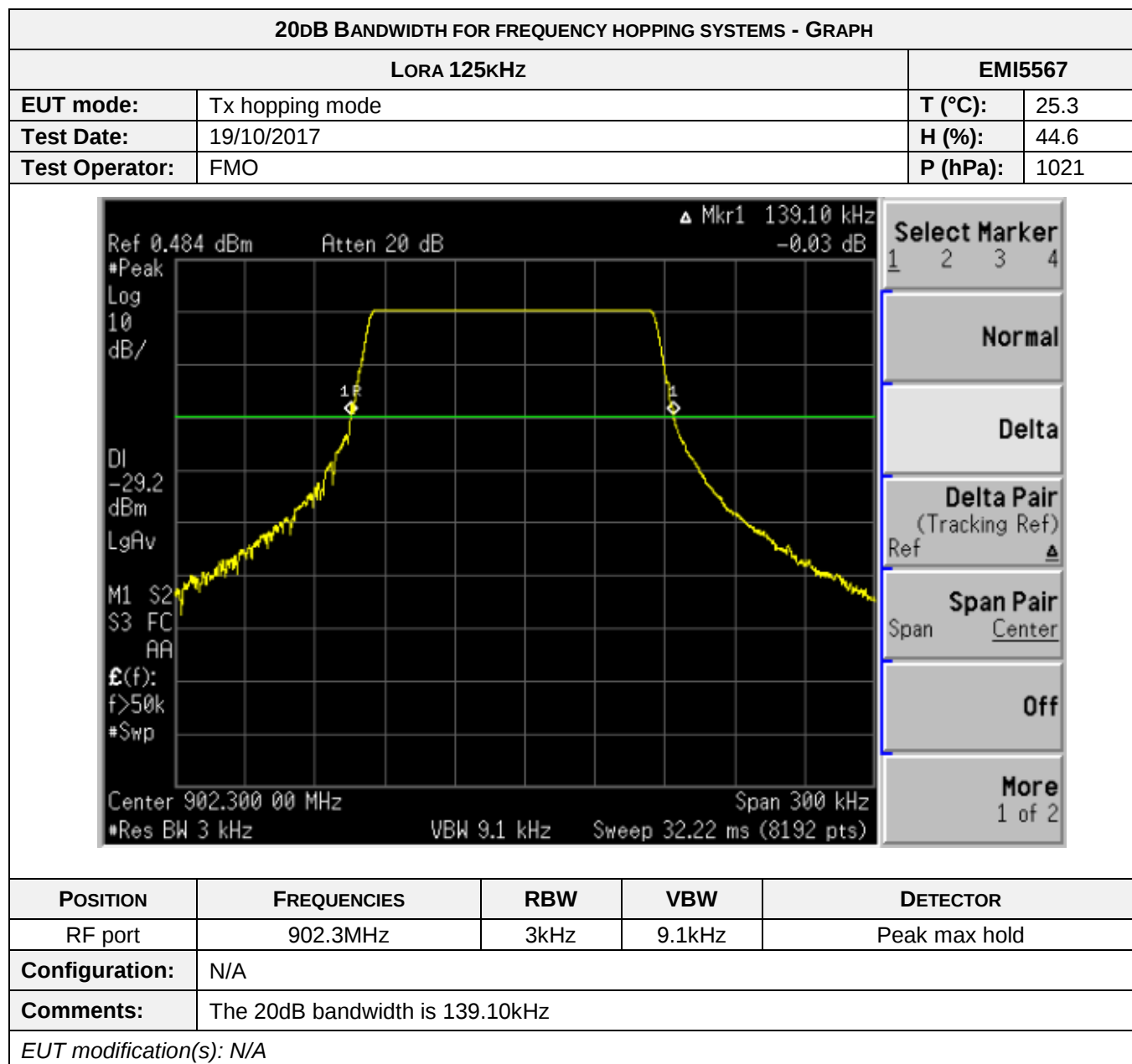
TEST EQUIPMENT USED					
CATEGORY	BRAND	TYPE	IDENTIFIER	CAL. DATE	CAL. DUE
Attenuator	Radiall	R412710124	4390	25/11/2015	25/01/2018
Attenuator	Radiall	R412720124	4391	25/11/2015	25/01/2018
Cable	STORM MICROWAVE	N-1.5m	10263	05/10/2016	05/12/2018
Receiver	Agilent Technologies	E4440A	5824	11/01/2016	11/03/2018
Shielded enclosure	RAY PROOF	C.V1	1123		
Thermohygrometer	Bioblock Scientific	Météostar	0963	27/12/2016	27/02/2019
Thermohygrometer	Testo	608-H1	7561	27/12/2016	27/02/2019

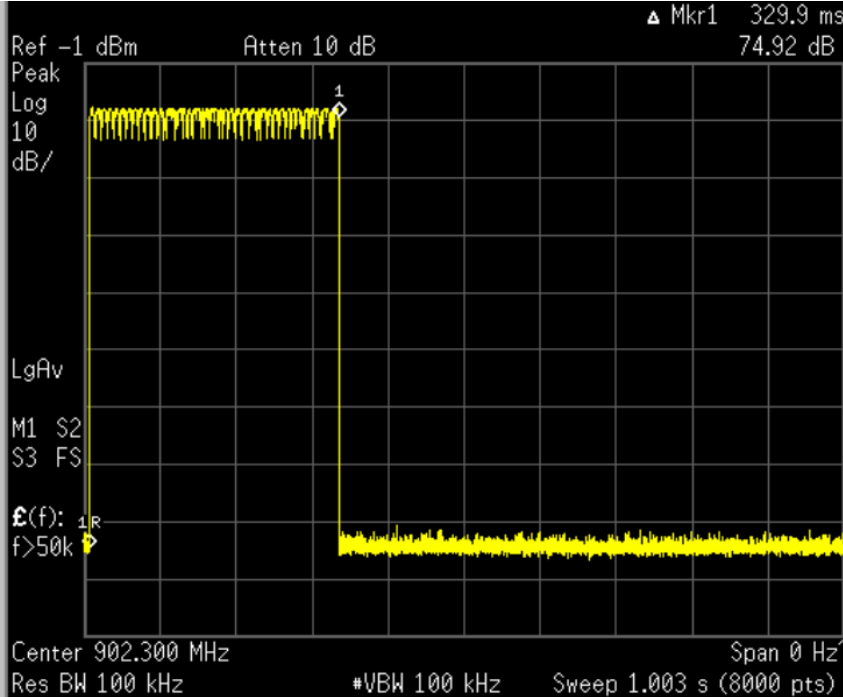
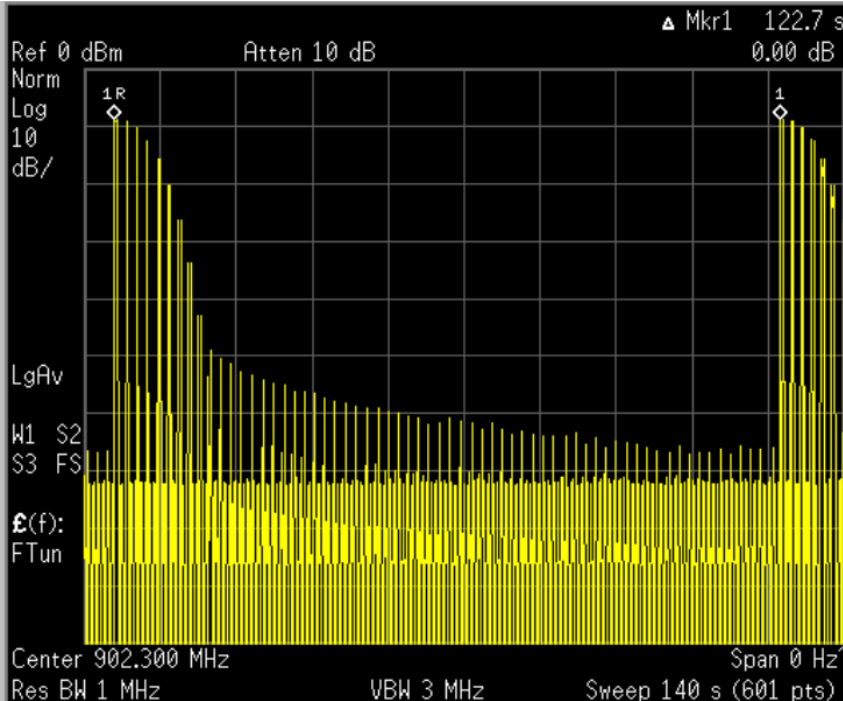
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OCCUPATION TIME FOR FREQUENCY HOPPING SYSTEMS - GRAPH			
LORA 125KHz			EMI5567
EUT mode:	Tx hopping mode	T (°C):	25.3
Test Date:	19/10/2017	H (%):	44.6
Test Operator:	FMO	P (hPa):	1021
 Ref -1 dBm Atten 10 dB Peak Log 10 dB/ LgAv M1 S2 S3 FS f(f): 1R f>50k Center 902.300 MHz Res BW 100 kHz #VBW 100 kHz Sweep 1.003 s (8000 pts) Span 0 Hz Δ Mkr1 329.9 ms 74.92 dB Select Marker 1 2 3 4 Normal Delta Delta Pair (Tracking Ref) Ref Δ Span Pair Span Center Off More 1 of 2			
 Ref 0 dBm Atten 10 dB Norm Log 10 dB/ LgAv W1 S2 S3 FS f(f): FTun Center 902.300 MHz Res BW 1 MHz VBW 3 MHz Sweep 140 s (601 pts) Span 0 Hz Δ Mkr1 122.7 s 0.00 dB Select Marker 1 2 3 4 Normal Delta Delta Pair (Tracking Ref) Ref Δ Span Pair Span Center Off More 1 of 2			
Results:	The system uses 64 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 measurement during a long transmission gives 329.9ms every 122.7s on each channel, so the average time within a period of 20 second is 53.77ms which is less than the 400ms limit.		

7.3. 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.	

TESTED CONFIGURATION	RESULTS	SEVERITY	RESULT TAB.	VERDICT
Low channel – LoRa 125kHz	9.379 dBm	1W (30dBm)	EMI6021	PASS
High channels – LoRa 125kHz	9.128 dBm	1W (30dBm)	EMI6021	PASS

LABORATORY PARAMETERS:	REQUIRED PRIOR TO THE TEST	DURING THE TEST
Ambient Temperature	15 to 35 °C	25.3 °C
Relative Humidity	20 to 75 %	44.6 %
Atmospheric pressure	N/A	1021 hPa
Test method deviation: N/A		
Supplementary information: N/A		

TEST EQUIPMENT USED					
CATEGORY	BRAND	TYPE	IDENTIFIER	CAL. DATE	CAL. DUE
Attenuator	Radiall	R412710124	4390	25/11/2015	25/01/2018
Attenuator	Radiall	R412720124	4391	25/11/2015	25/01/2018
Cable	STORM MICROWAVE	N-1.5m	10263	05/10/2016	05/12/2018
Receiver	Agilent Technologies	E4440A	5824	11/01/2016	11/03/2018
Shielded enclosure	RAY PROOF	C.V1	1123		
Thermohygrometer	Bioblock Scientific	Météostar	0963	27/12/2016	27/02/2019
Thermohygrometer	Testo	608-H1	7561	27/12/2016	27/02/2019

Blank cells = Permanent validity

TEST SETUP PHOTO(S)



PUISSANCE MOYENNE CONDUITE - TABULATED RESULTS

LoRA 125kHz				EMI6021
Frequency (MHz)	P _{conducted} (dBm)	Gain _{dBi}	P _{eirp} (dBm)	Limit _{eirp} (dBm)
902.3	9.379	6dBi (Max)	15.379	36
914.9	9.128	6dBi (Max)	15.128	36

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

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

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

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

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

Using the formula $E_{(V/m)} = \sqrt{(30P_{dBm}G_{dBi})/d_{(m)}}$ where P is the conducted power and G the maximum antenna gain. Equivalent maximum E-field should be approximatively of 110.61dBμV/m.

7.4. 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. EUT is connected to the measuring receiver via 50Ω attenuator(s). Only the highest levels are recorded.	

TESTED CONFIGURATION	PARAMETER	SEVERITY	RESULT TAB.	VERDICT
Lora / 125kHz	900MHz-930MHz	20dBc	EMI6021	PASS

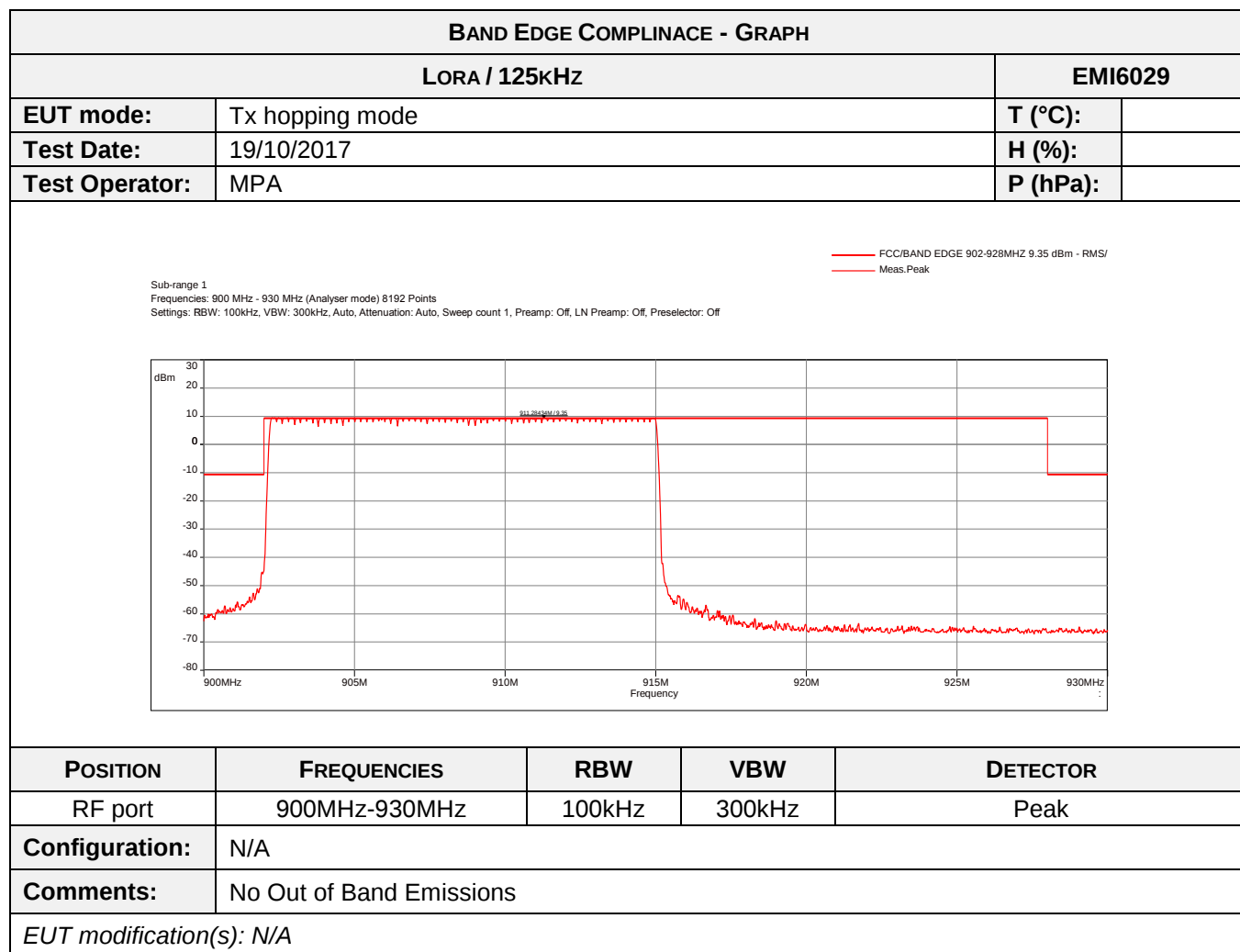
LABORATORY PARAMETERS:	REQUIRED PRIOR TO THE TEST	DURING THE TEST
Ambient Temperature	15 to 35 °C	23.2°C
Relative Humidity	20 to 75 %	56.7 %
Atmospheric pressure	N/A	1010 hPa
Test method deviation: N/A		
Supplementary information: N/A		

TEST EQUIPMENT USED					
CATEGORY	BRAND	TYPE	IDENTIFIER	CAL. DATE	CAL. DUE
Attenuator	Radiall	R412710124	4390	25/11/2015	25/01/2018
Attenuator	Radiall	R412720124	4391	25/11/2015	25/01/2018
Cable	STORM MICROWAVE	N-1.5m	10263	05/10/2016	05/12/2018
Receiver	Agilent Technologies	E4440A	5824	11/01/2016	11/03/2018
Shielded enclosure	RAY PROOF	C.V1	1123		
Thermohygrometer	Bioblock Scientific	Météostar	0963	27/12/2016	27/02/2019
Thermohygrometer	Testo	608-H1	7561	27/12/2016	27/02/2019

Blank cells = Permanent validity

TEST SETUP PHOTO(S)





7.5. 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
Lora Tx mode 125kHz, Rx mode	9kHz-150kHz	15.209	See below	PASS
Lora Tx mode 125kHz, Rx mode	150kHz-30MHz	15.209	See below	PASS
Lora Tx mode 125kHz, Rx mode	30MHz-1GHz	15.209	See below	PASS
Lora Tx mode 125kHz, Rx mode	1GHz-10GHz	15.209	See below	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 54dBμV/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
Antenna	ETS-Lindgren	3117	8387	10/02/2017	10/04/2018
Antenna	Rohde & Schwarz	HFH2-Z2	5825	20/09/2017	20/11/2019
Antenna	Electro Metrics	BIA-30HF	1107	25/04/2015	25/06/2018
Antenna	Rohde & Schwarz	HL 223	1137	25/04/2015	25/06/2018
Cable	MegaPhase	TM18-N1N1-197	12840	05/04/2016	05/06/2018
Cable	MegaPhase	TM18-N1N1-118	12841	05/04/2016	05/06/2018
Cable	MegaPhase	TM18-N1N1-118	12842	05/04/2016	05/06/2018
Cable	SUCOFLEX	N-6,5m	14380	18/01/2017	18/03/2019
Cable	SUCOFLEX	N-6,5m	14379	18/01/2017	18/03/2019
Cable	Huber + Suhner	N-10m	8472	16/02/2017	16/04/2019
Cable	Huber + Suhner	N-20m	8385	11/10/2017	11/10/2019
Filter	Wainwright Instruments	WTRCTV5-700-1000-20-60	12838	04/04/2016	04/06/2018
Filter	Micro-Tronics	HPM18865	12843	04/04/2016	04/06/2018
Preamplifier	Techniwave	APS16-0087	14040	25/08/2016	25/10/2017
Open area test site	EMITECH	Salinelles	3482	10/10/2017	10/12/2020
Receiver	Agilent Technologies	E4440A	5824	11/01/2016	11/03/2018
Shielded enclosure	COMTEST	SAC 3m	14494	15/02/2017	15/04/2018
Shielded enclosure	RAY PROOF	C.V2	1423	06/07/2016	06/09/2019
Thermohygrometer	Bioblock Scientific	Météostar	0963	27/12/2016	27/02/2019
Thermohygrometer	Testo	608-H1	7561	27/12/2016	27/02/2019

Blank cells = Permanent validity

RADIATED SPURIOUS EMISSIONS - TABULATED RESULTS				
TX MODE / LOW CHANNEL				
Frequency (MHz)	Position / Polarization	Peak Level (dBμV/m)	Peak Limit (dBμV/m)	Margin (dB)
1804.3	AXE 1 / H	66	74	-8
2705.3	AXE 1 / H	64.1	74	-9.9
3608.5	AXE 1 / H	62.2	74	-11.8
5411.5	AXE 1 / H	49.6	74	-24.4
6314.7	AXE 1 / H	52.8	74	-21.2
7216.8	AXE 1 / H	57.4	74	-16.6
1804.3	AXE 1 / V	60.9	74	-13.1
2706.4	AXE 1 / V	58.3	74	-15.7
3607.4	AXE 1 / V	55.2	74	-18.8
5412.6	AXE 1 / V	52.5	74	-21.5
6312.5	AXE 1 / V	59.2	74	-14.8
7216.8	AXE 1 / V	58.8	74	-15.2
8118.9	AXE 1 / V	52.8	74	-21.2
1804.3	AXE 2 / H	61.1	74	-12.9
2705.3	AXE 2 / H	59.9	74	-14.1
3608.5	AXE 2 / H	54.4	74	-19.6
5411.5	AXE 2 / H	52.7	74	-21.3
6314.7	AXE 2 / H	60.9	74	-13.1
7216.8	AXE 2 / H	57.8	74	-16.2
8116.7	AXE 2 / H	52.6	74	-21.4

RADIATED SPURIOUS EMISSIONS - TABULATED RESULTS				
TX MODE / LOW CHANNEL				
Frequency (MHz)	Position / Polarization	Peak Level (dBμV/m)	Peak Limit (dBμV/m)	Margin (dB)
9018.8	AXE 2 / H	56.4	74	-17.6
9920.9	AXE 2 / H	54.4	74	-19.6
1804.3	AXE 2 / V	62.8	74	-11.2
2706.4	AXE 2 / V	63.5	74	-10.5
3607.4	AXE 2 / V	56.9	74	-17.1
5412.6	AXE 2 / V	49.9	74	-24.1
6312.5	AXE 2 / V	49.5	74	-24.5
7216.8	AXE 2 / V	54.1	74	-19.9
8118.9	AXE 2 / V	55.7	74	-18.3
9019.9	AXE 2 / V	52.5	74	-21.5
1804.3	AXE 3 / H	63.4	74	-10.6
2705.3	AXE 3 / H	61.3	74	-12.7
3608.5	AXE 3 / H	57.7	74	-16.3
4510.6	AXE 3 / H	50.7	74	-23.3
6314.7	AXE 3 / H	53.4	74	-20.6
7216.8	AXE 3 / H	57.7	74	-16.3
1804.3	AXE 3 / V	65.1	74	-8.9
2706.4	AXE 3 / V	65.2	74	-8.8
3607.4	AXE 3 / V	60.4	74	-13.6
5412.6	AXE 3 / V	52	74	-22
6312.5	AXE 3 / V	60.5	74	-13.5
7216.8	AXE 3 / V	60.1	74	-13.9
8118.9	AXE 3 / V	54.8	74	-19.2
9019.9	AXE 3 / V	56.2	74	-17.8

V= Vertical H=Horizontal

Spurious which has more than 20 dB of margin compared to the applicable limit is not necessarily reported

RADIATED SPURIOUS EMISSIONS - TABULATED RESULTS				
TX MODE / HIGH CHANNEL				
Frequency (MHz)	Position / Polarization	Peak Level (dBμV/m)	Peak Limit (dBμV/m)	Margin (dB)
1855.9	AXE 1 / H	68.2	74	-5.8
2783.3	AXE 1 / H	62.8	74	-11.2
3711.8	AXE 1 / H	60.5	74	-13.5
5566.5	AXE 1 / H	53.7	74	-20.3
6496	AXE 1 / H	55.8	74	-18.2
7422.3	AXE 1 / H	62.6	74	-11.4
1885.9	AXE 1 / V	63.9	74	-10.1
2784.4	AXE 1 / V	55.6	74	-18.4
3711.8	AXE 1 / V	55.7	74	-18.3
5567.6	AXE 1 / V	57.8	74	-16.2
6494.9	AXE 1 / V	58.8	74	-15.2
7424.5	AXE 1 / V	61.5	74	-12.5
1855.9	AXE 2 / H	62.6	74	-11.4
2783.3	AXE 2 / H	56.6	74	-17.4
3711.8	AXE 2 / H	54.5	74	-19.5

RADIATED SPURIOUS EMISSIONS - TABULATED RESULTS				
TX MODE / HIGH CHANNEL				
Frequency (MHz)	Position / Polarization	Peak Level (dBμV/m)	Peak Limit (dBμV/m)	Margin (dB)
5566.5	AXE 2 / H	54.8	74	-19.2
6496	AXE 2 / H	58.2	74	-15.8
7422.3	AXE 2 / H	60	74	-14
8234.3	AXE 2 / H	53.4	74	-20.6
1885.9	AXE 2 / V	68.9	74	-5.1
2784.4	AXE 2 / V	63.3	74	-10.7
3711.8	AXE 2 / V	60.3	74	-13.7
5567.6	AXE 2 / V	50.3	74	-23.7
6494.9	AXE 2 / V	53.3	74	-20.7
7424.5	AXE 2 / V	59.9	74	-14.1
1855.9	AXE 3 / H	62.6	74	-11.4
2783.3	AXE 3 / H	56.6	74	-17.4
3711.8	AXE 3 / H	54.5	74	-19.5
5566.5	AXE 3 / H	54.8	74	-19.2
6496	AXE 3 / H	58.2	74	-15.8
7422.3	AXE 3 / H	60	74	-14
8234.3	AXE 3 / H	53.4	74	-20.6
1885.9	AXE 3 / V	68.9	74	-5.1
2784.4	AXE 3 / V	63.3	74	-10.7
3711.8	AXE 3 / V	60.3	74	-13.7
5567.6	AXE 3 / V	50.3	74	-23.7
6494.9	AXE 3 / V	53.3	74	-20.7
7424.5	AXE 3 / V	59.9	74	-14.1

V= Vertical H=Horizontal

Spurious which has more than 20 dB of margin compared to the applicable limit is not necessarily reported

RADIATED SPURIOUS EMISSIONS - TABULATED RESULTS					
TX MODE / LOW CHANNEL					
Frequency (MHz)	Position / Polarization	Peak Level (dBμV/m)	Avg Level (dBμV/m)	Avg Limit (dBμV/m)	Margin (dB)
1804.3	AXE 1 / H	66	31.99	54	-22.01
2705.3	AXE 1 / H	64.1	-	78.9	-14.8
3608.5	AXE 1 / H	62.2	-	78.9	-16.7
5411.5	AXE 1 / H	49.6	-	78.9	-29.3
6314.7	AXE 1 / H	52.8	36.9	54	-17.1
7216.8	AXE 1 / H	57.4	37.6	54	-16.4
1804.3	AXE 1 / V	60.9	39.3	54	-14.7
2706.4	AXE 1 / V	58.3	-	78.9	-20.6
3607.4	AXE 1 / V	55.2	-	78.9	-23.7
5412.6	AXE 1 / V	52.5	-	78.9	-26.4
6312.5	AXE 1 / V	59.2	37.1	54	-16.9
7216.8	AXE 1 / V	58.8	38.5	54	-15.5
8118.9	AXE 1 / V	52.8	-	78.9	-26.1
1804.3	AXE 2 / H	61.1	31.7	54	-22.3
2705.3	AXE 2 / H	59.9	-	78.9	-19
3608.5	AXE 2 / H	54.4	-	78.9	-24.5
5411.5	AXE 2 / H	52.7	-	78.9	-26.2

RADIATED SPURIOUS EMISSIONS - TABULATED RESULTS					
TX MODE / LOW CHANNEL					
Frequency (MHz)	Position / Polarization	Peak Level (dBμV/m)	Avg Level (dBμV/m)	Avg Limit (dBμV/m)	Margin (dB)
6314.7	AXE 2 / H	60.9	37.3	54	-16.7
7216.8	AXE 2 / H	57.8	38.7	54	-15.3
8116.7	AXE 2 / H	52.6	-	78.9	-26.3
9018.8	AXE 2 / H	56.4	-	78.9	-22.5
9920.9	AXE 2 / H	54.4	-	78.9	-24.5
1804.3	AXE 2 / V	62.8	32	54	-22
2706.4	AXE 2 / V	63.5	-	78.9	-15.4
3607.4	AXE 2 / V	56.9	-	78.9	-22
5412.6	AXE 2 / V	49.9	-	78.9	-29
6312.5	AXE 2 / V	49.5	37.03	54	-16.97
7216.8	AXE 2 / V	54.1	38.9	54	-15.1
8118.9	AXE 2 / V	55.7	-	78.9	-23.2
9019.9	AXE 2 / V	52.5	-	78.9	-26.4
1804.3	AXE 3 / H	63.4	32	54	-22
2705.3	AXE 3 / H	61.3	-	78.9	-17.6
3608.5	AXE 3 / H	57.7	-	78.9	-21.2
4510.6	AXE 3 / H	50.7	-	78.9	-28.2
6314.7	AXE 3 / H	53.4	37.05	54	-16.95
7216.8	AXE 3 / H	57.7	38.6	54	-15.4
1804.3	AXE 3 / V	65.1	32.3	78.9	-46.6
2706.4	AXE 3 / V	65.2	-	78.9	-13.7
3607.4	AXE 3 / V	60.4	-	78.9	-18.5
5412.6	AXE 3 / V	52	-	78.9	-26.9
6312.5	AXE 3 / V	60.5	37.02	54	-16.98
7216.8	AXE 3 / V	60.1	38.5	54	-15.5
8118.9	AXE 3 / V	54.8	-	78.9	-24.1
9019.9	AXE 3 / V	56.2	-	78.9	-22.7

V= Vertical H=Horizontal

Spurious which has more than 20 dB of margin compared to the applicable limit is not necessarily reported

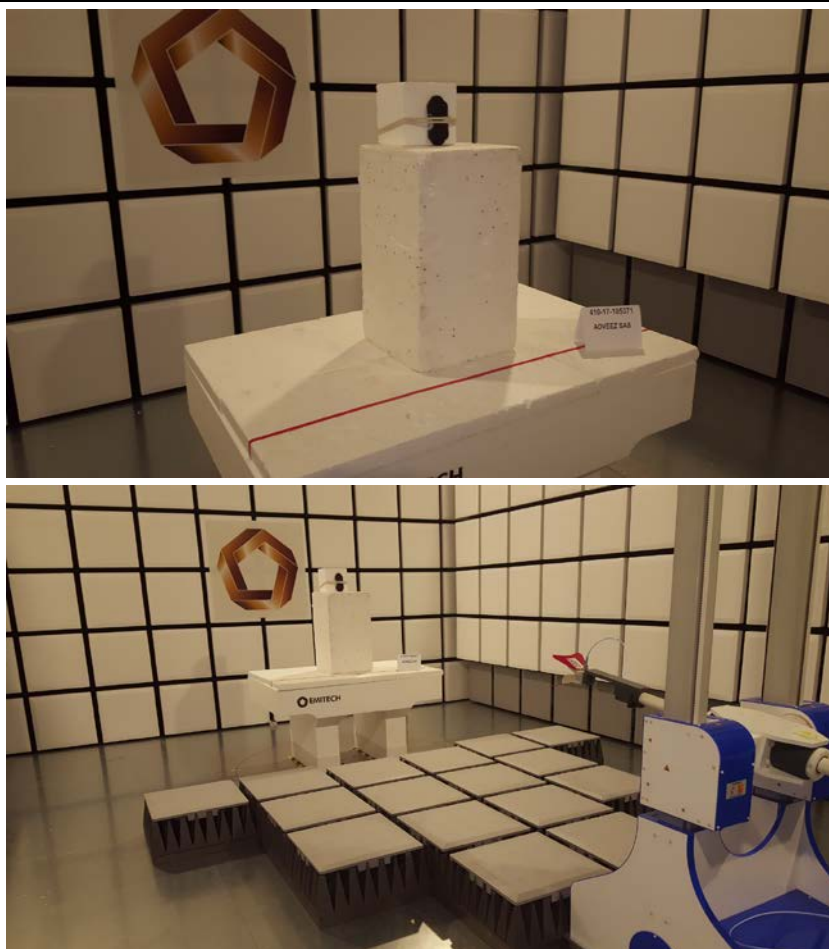
RADIATED SPURIOUS EMISSIONS - TABULATED RESULTS					
TX MODE / HIGH CHANNEL					
Frequency (MHz)	Position / Polarization	Peak Level (dBμV/m)	Avg Level (dBμV/m)	Avg Limit (dBμV/m)	Margin (dB)
1855.9	AXE 1 / H	68.2	31.04	54	-22.96
2783.3	AXE 1 / H	62.8		78.3	-15.5
3711.8	AXE 1 / H	60.5		78.3	-17.8
5566.5	AXE 1 / H	53.7	50.92	54	-3.08
6496	AXE 1 / H	55.8	36.01	54	-17.99
7422.3	AXE 1 / H	62.6		78.3	-15.7
1885.9	AXE 1 / V	63.9	33.01	54	-20.99
2784.4	AXE 1 / V	55.6		78.3	-22.7
3711.8	AXE 1 / V	55.7		78.3	-22.6
5567.6	AXE 1 / V	57.8	36.04	54	-17.96
6494.9	AXE 1 / V	58.8	37.09	54	-16.91
7424.5	AXE 1 / V	61.5		78.3	-16.8
1855.9	AXE 2 / H	62.6	31.08	54	-22.92

RADIATED SPURIOUS EMISSIONS - TABULATED RESULTS					
TX MODE / HIGH CHANNEL					
Frequency (MHz)	Position / Polarization	Peak Level (dBμV/m)	Avg Level (dBμV/m)	Avg Limit (dBμV/m)	Margin (dB)
2783.3	AXE 2 / H	56.6		78.3	-21.7
3711.8	AXE 2 / H	54.5		78.3	-23.8
5566.5	AXE 2 / H	54.8	36.05	54	-17.95
6496	AXE 2 / H	58.2	37.03	54	-16.97
7422.3	AXE 2 / H	60		78.3	-18.3
8234.3	AXE 2 / H	53.4		78.3	-24.9
1885.9	AXE 2 / V	68.9	31.07	54	-22.93
2784.4	AXE 2 / V	63.3		78.3	-15
3711.8	AXE 2 / V	60.3		78.3	-18
5567.6	AXE 2 / V	50.3	36.06	54	-17.94
6494.9	AXE 2 / V	53.3	37.07	54	-16.93
7424.5	AXE 2 / V	59.9		54	5.9
1855.9	AXE 3 / H	62.6	31.04	54	-22.96
2783.3	AXE 3 / H	56.6		78.3	-21.7
3711.8	AXE 3 / H	54.5		78.3	-23.8
5566.5	AXE 3 / H	54.8		78.3	-23.5
6496	AXE 3 / H	58.2		78.3	-20.1
7422.3	AXE 3 / H	60		78.3	-18.3
8234.3	AXE 3 / H	53.4		78.3	-24.9
1885.9	AXE 3 / V	68.9	31.06	54	-22.94
2784.4	AXE 3 / V	63.3		78.3	-15
3711.8	AXE 3 / V	60.3		78.3	-18
5567.6	AXE 3 / V	50.3	36.05	54	-17.95
6494.9	AXE 3 / V	53.3	37.03	54	-16.97
7424.5	AXE 3 / V	59.9		78.3	-18.4

V= Vertical H=Horizontal

Spurious which has more than 20 dB of margin compared to the applicable limit is not necessarily reported

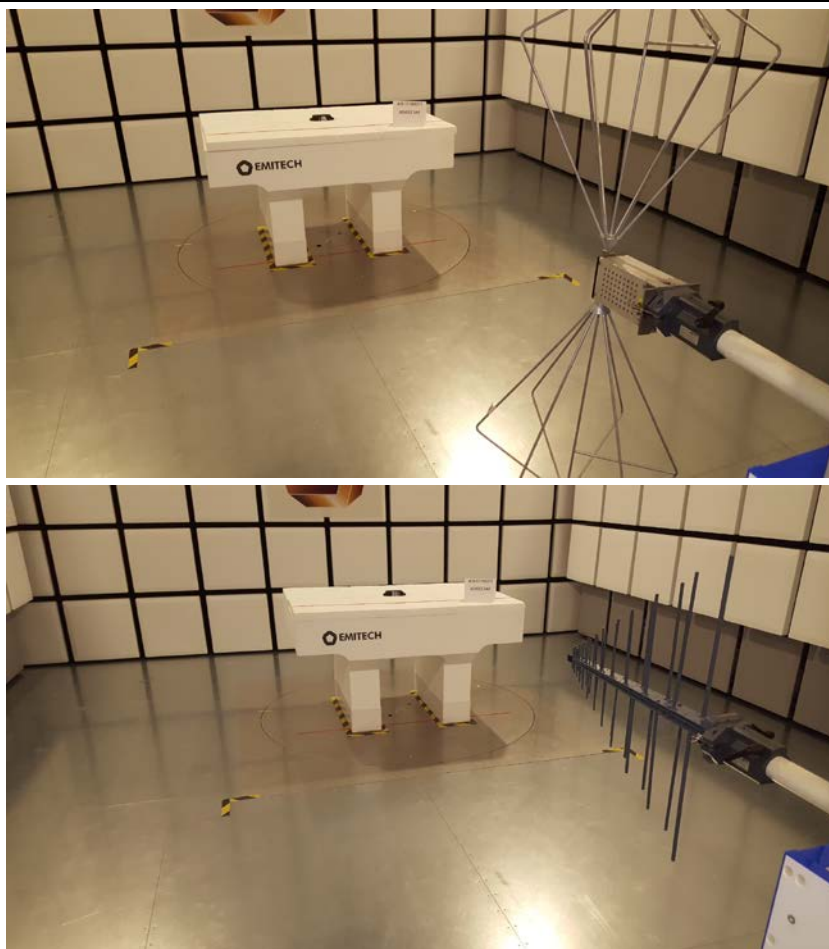
TEST SETUP PHOTO(S) RADIATED EMISSIONS ($F > 1\text{GHz}$)



TEST SETUP PHOTO(S) RADIATED EMISSIONS POSITIONS

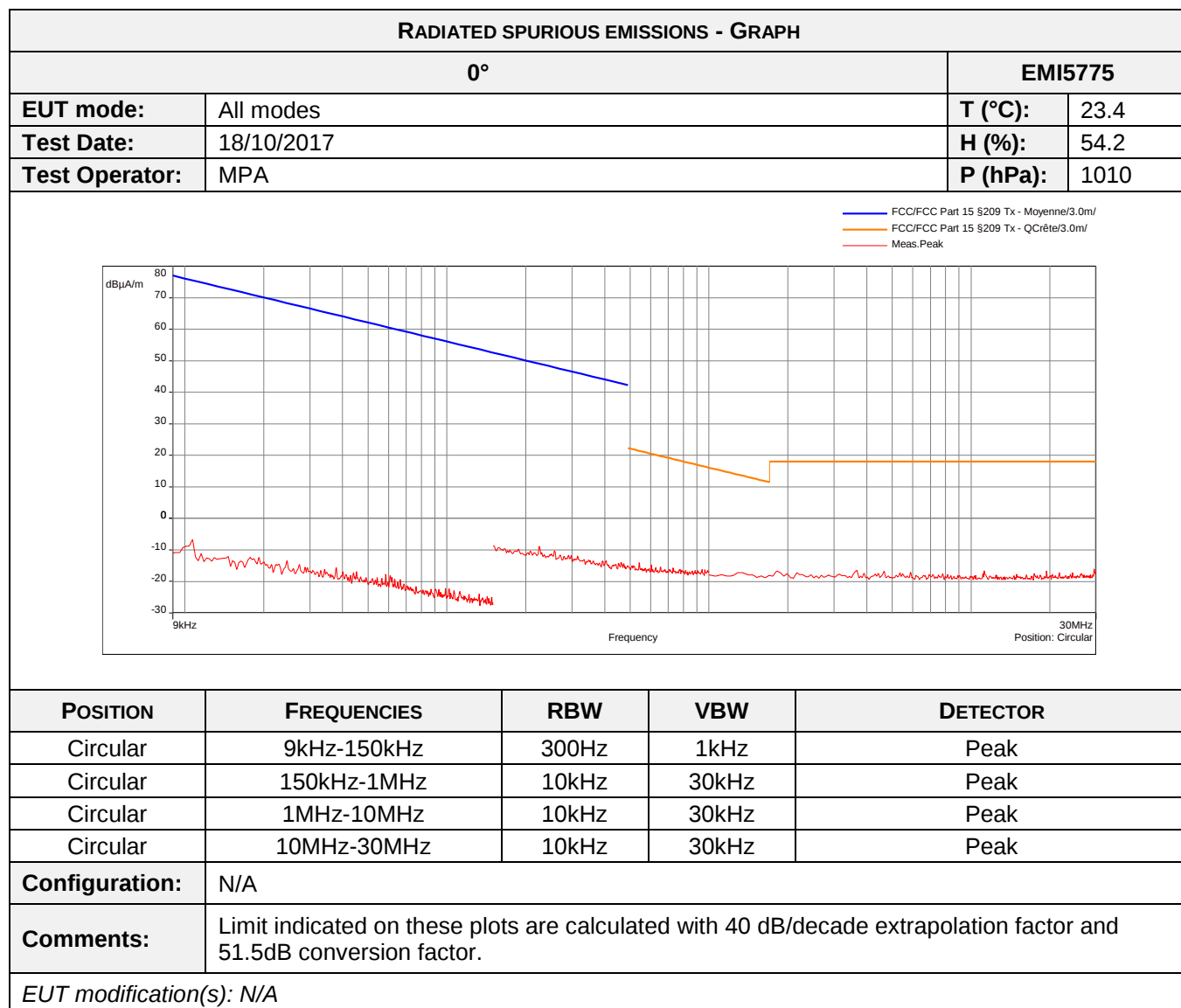


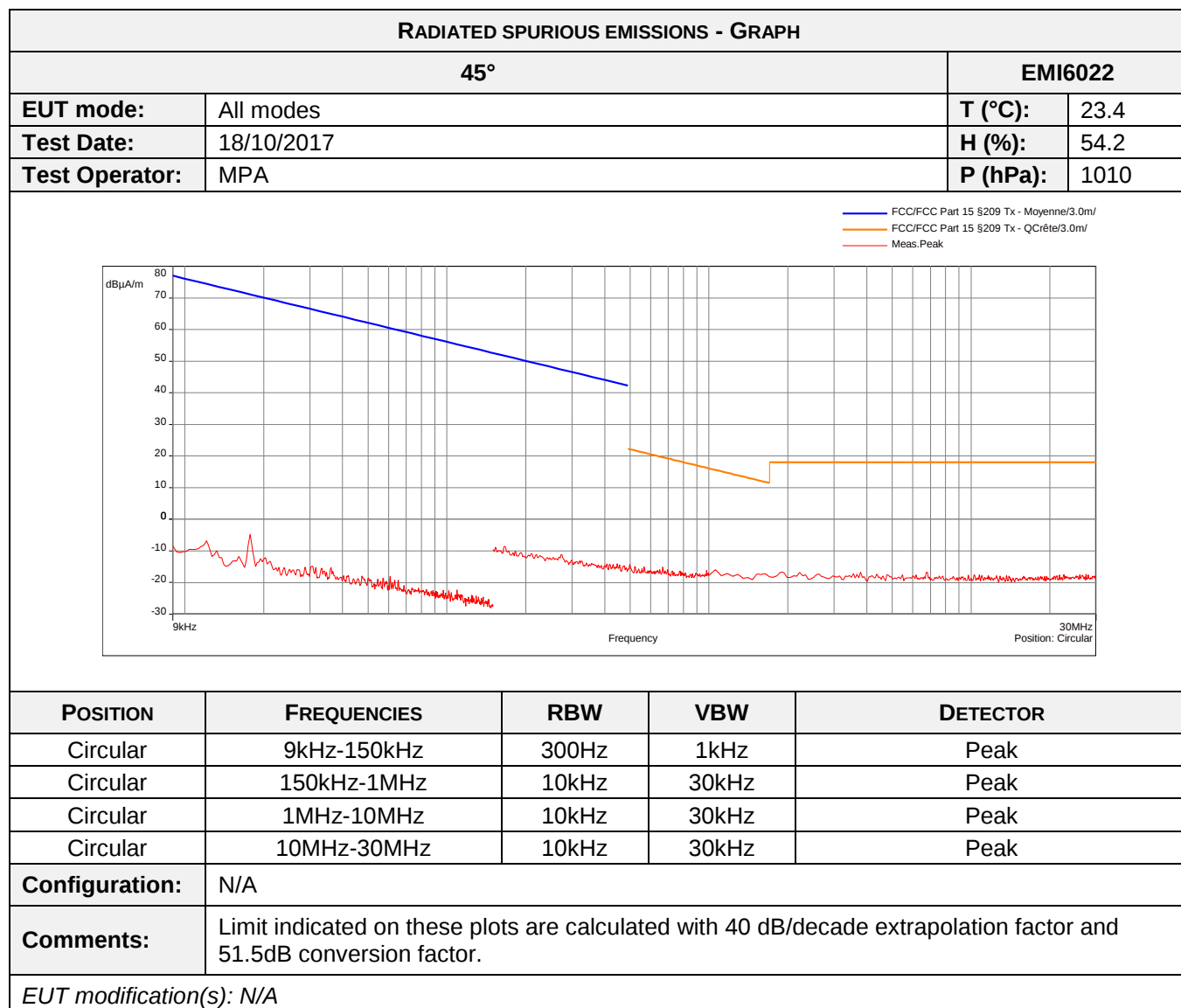
TEST SETUP PHOTO(S) RADIATED EMISSIONS (30MHz-1GHz)

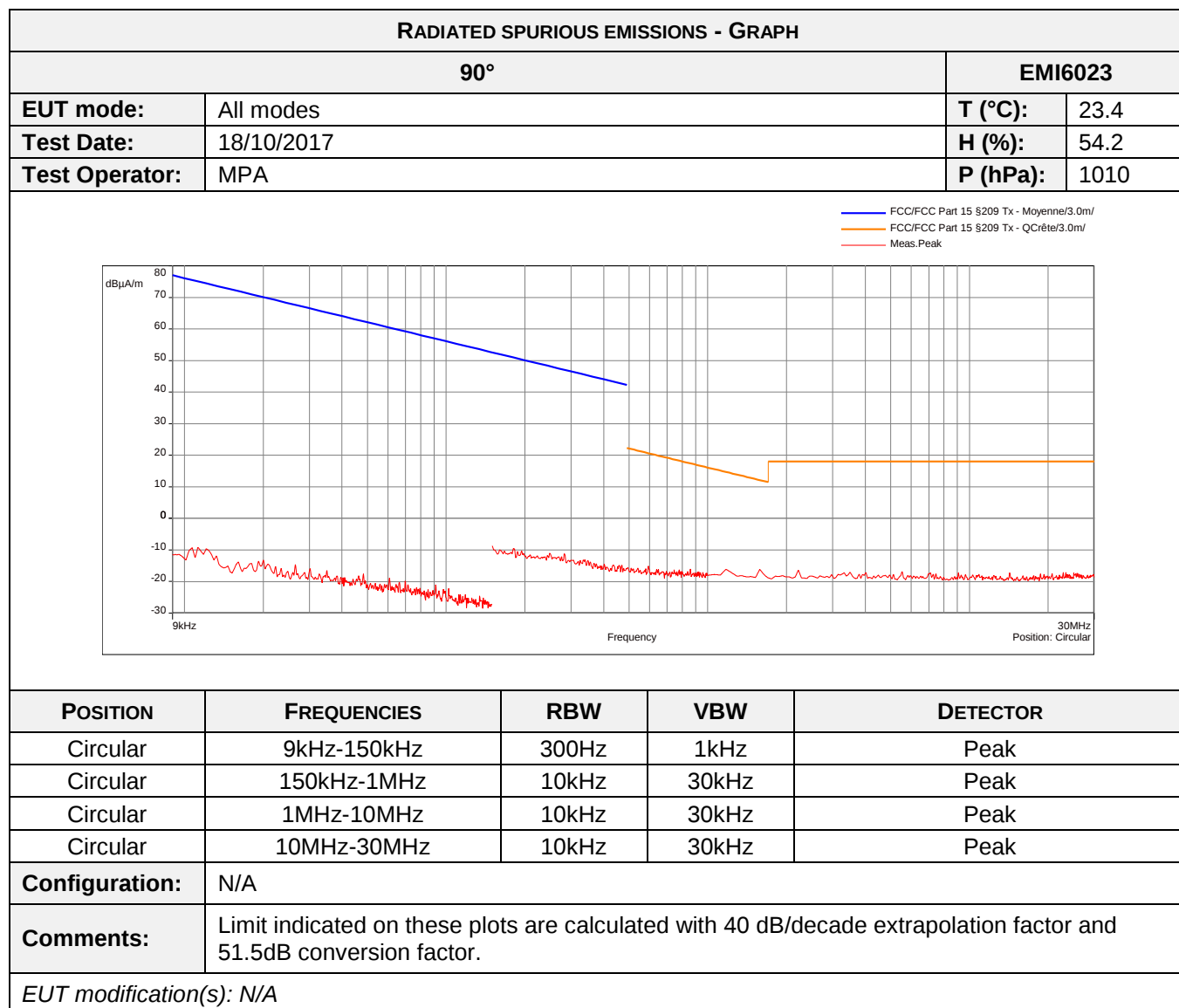


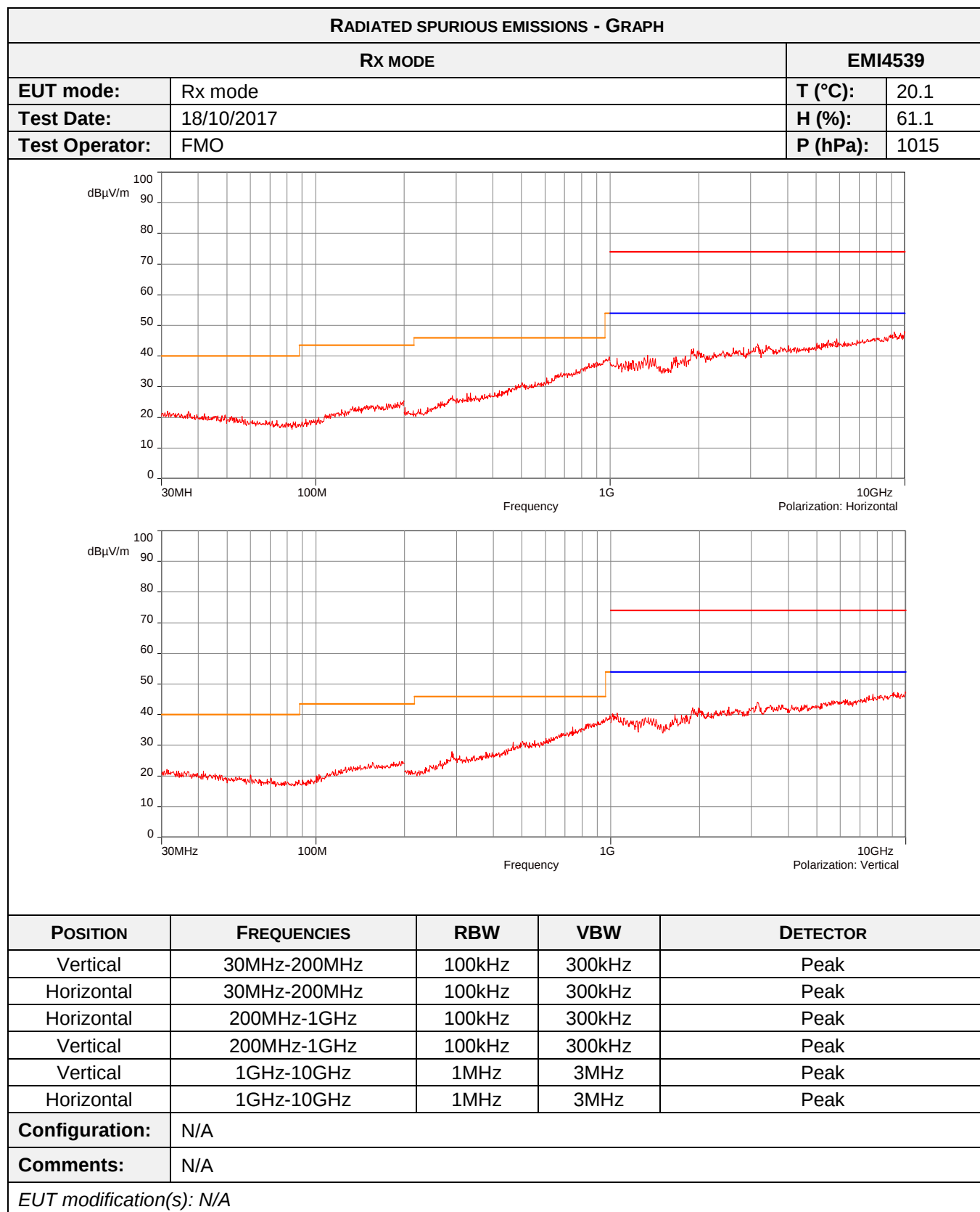
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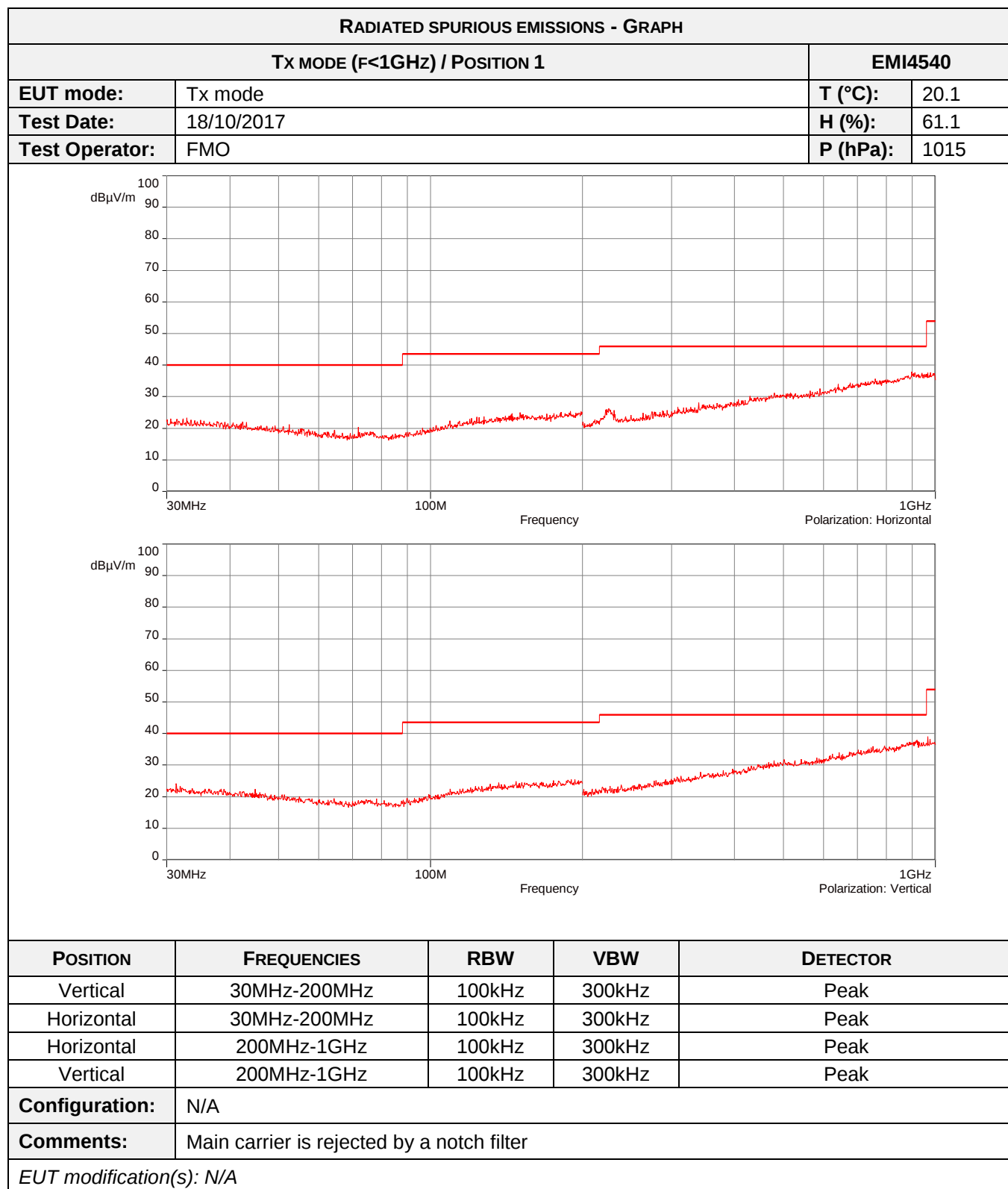


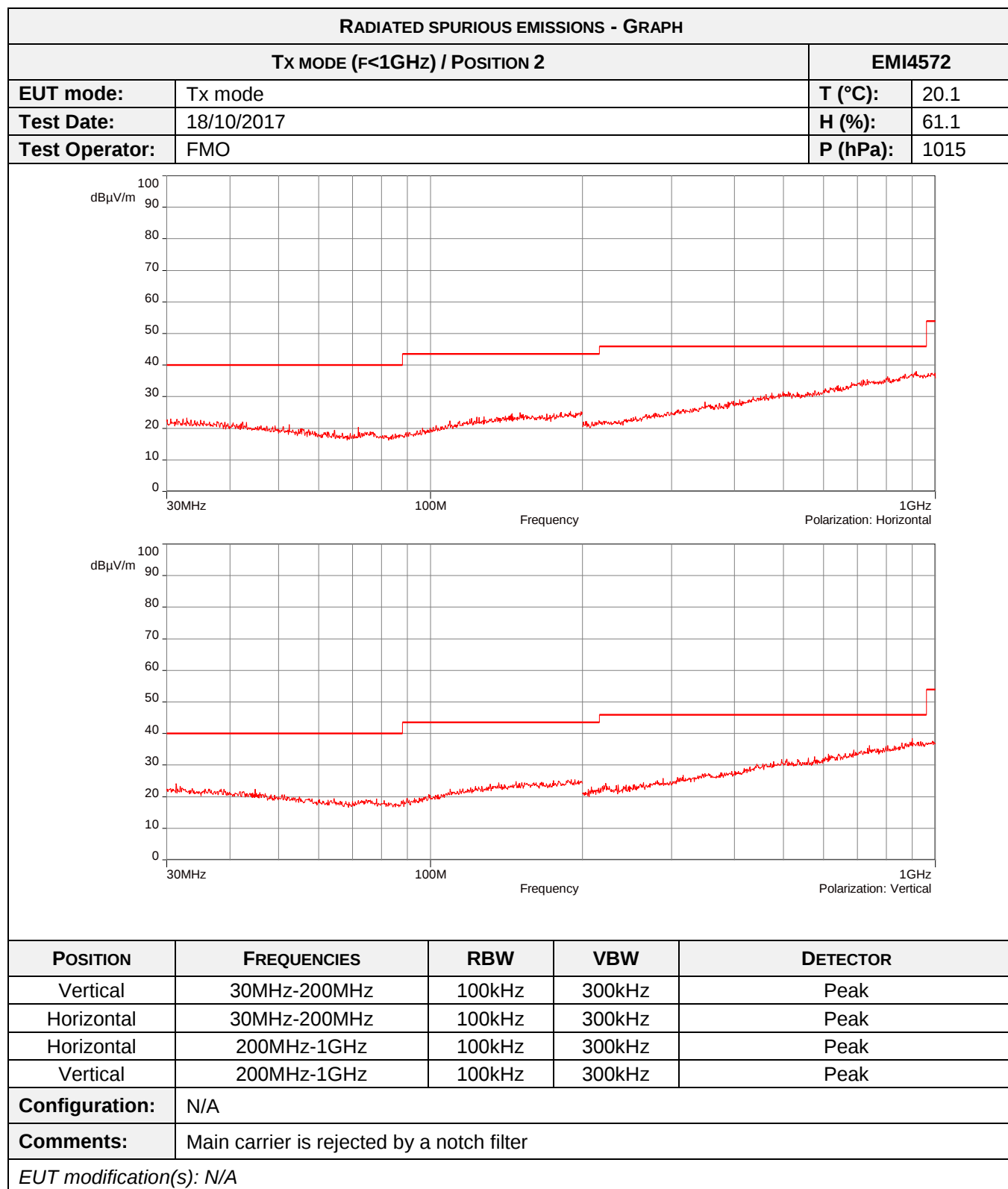


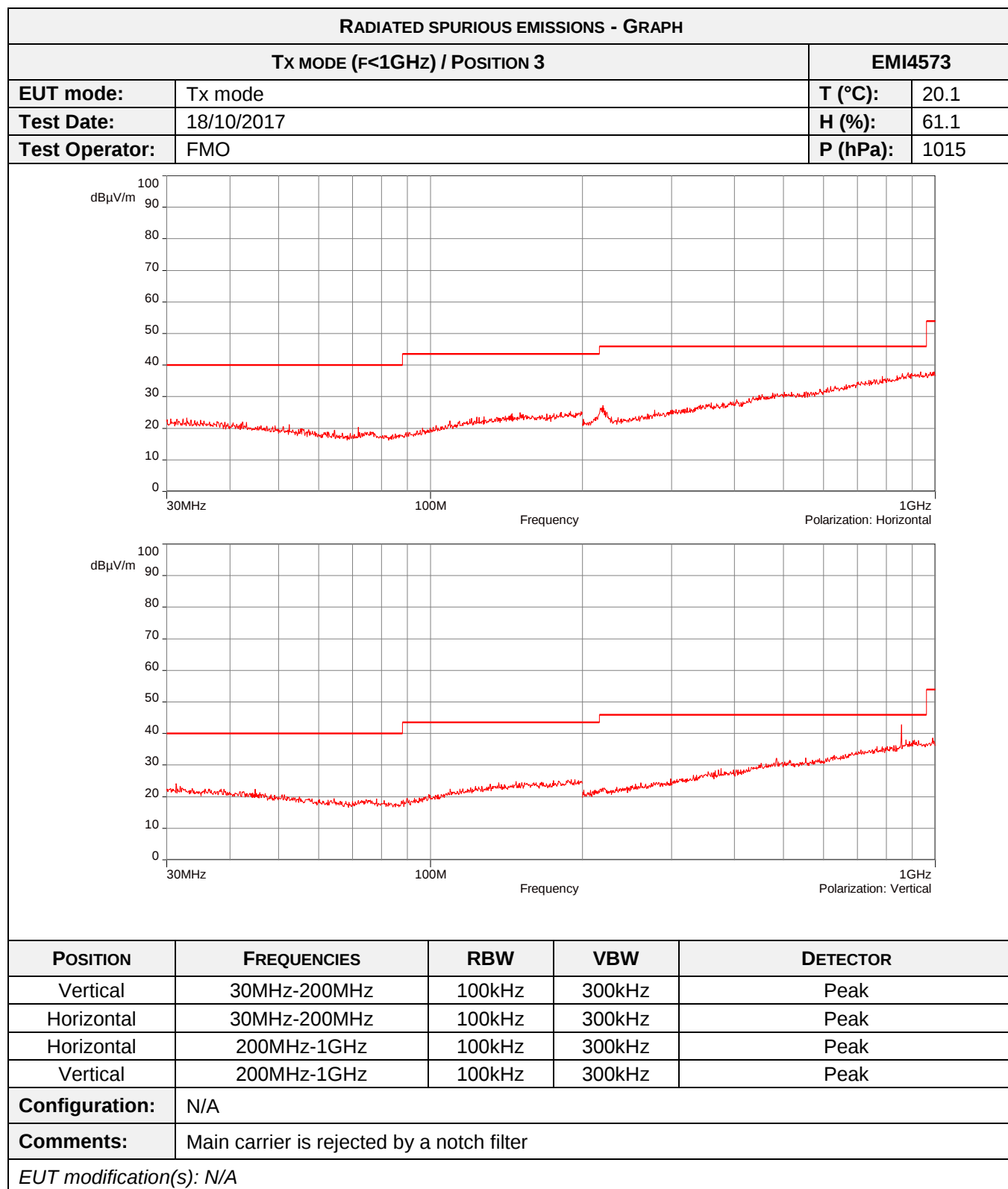


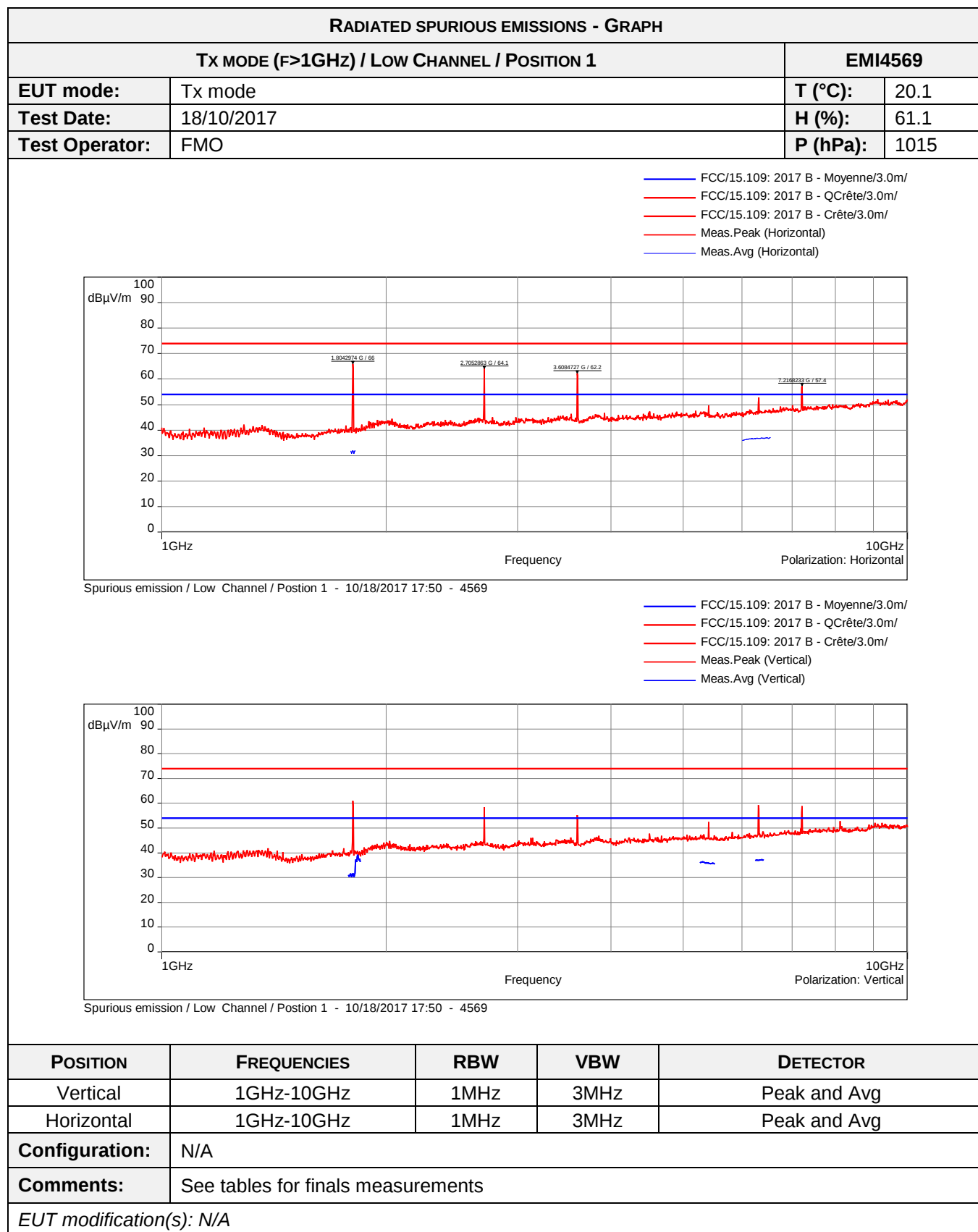


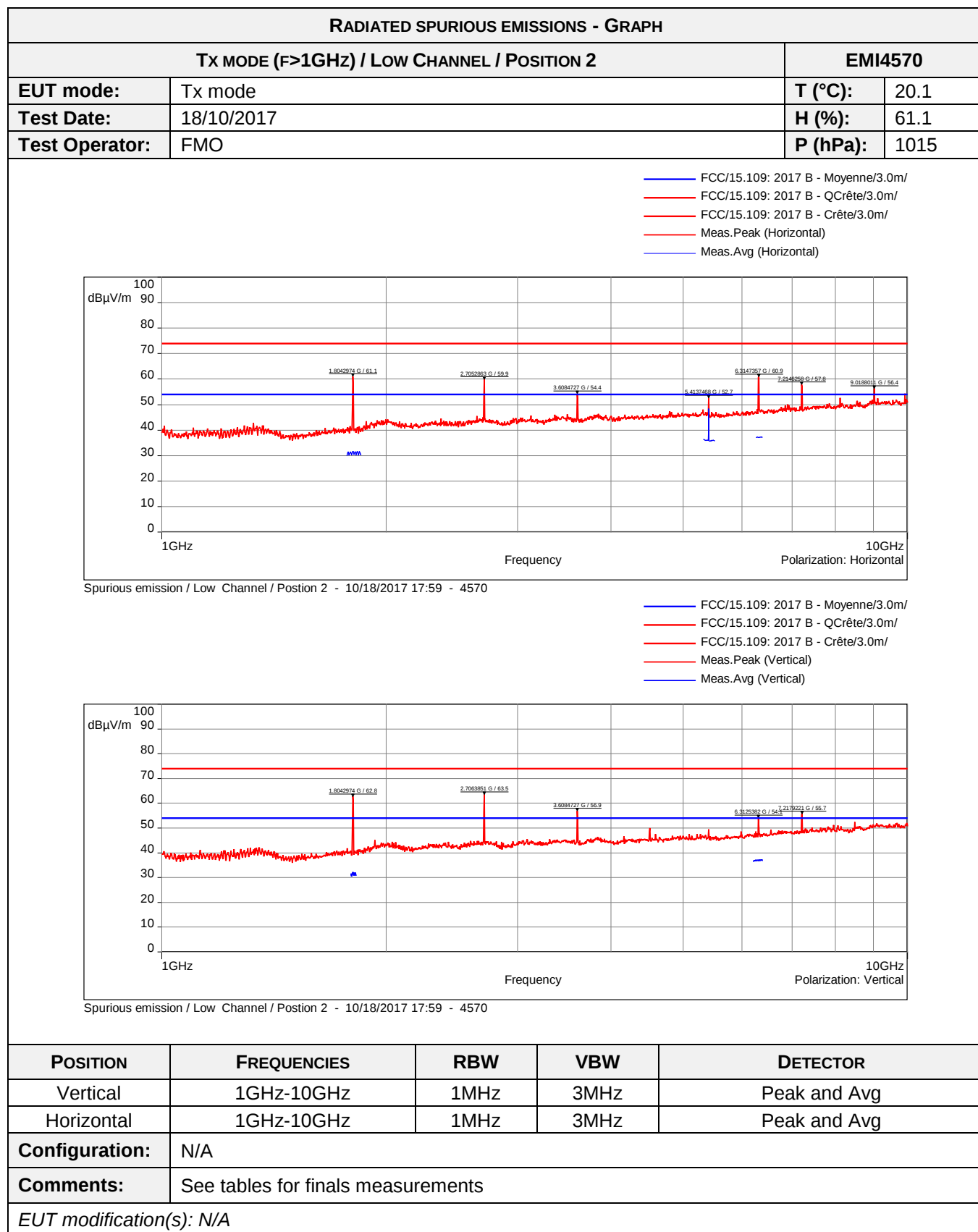


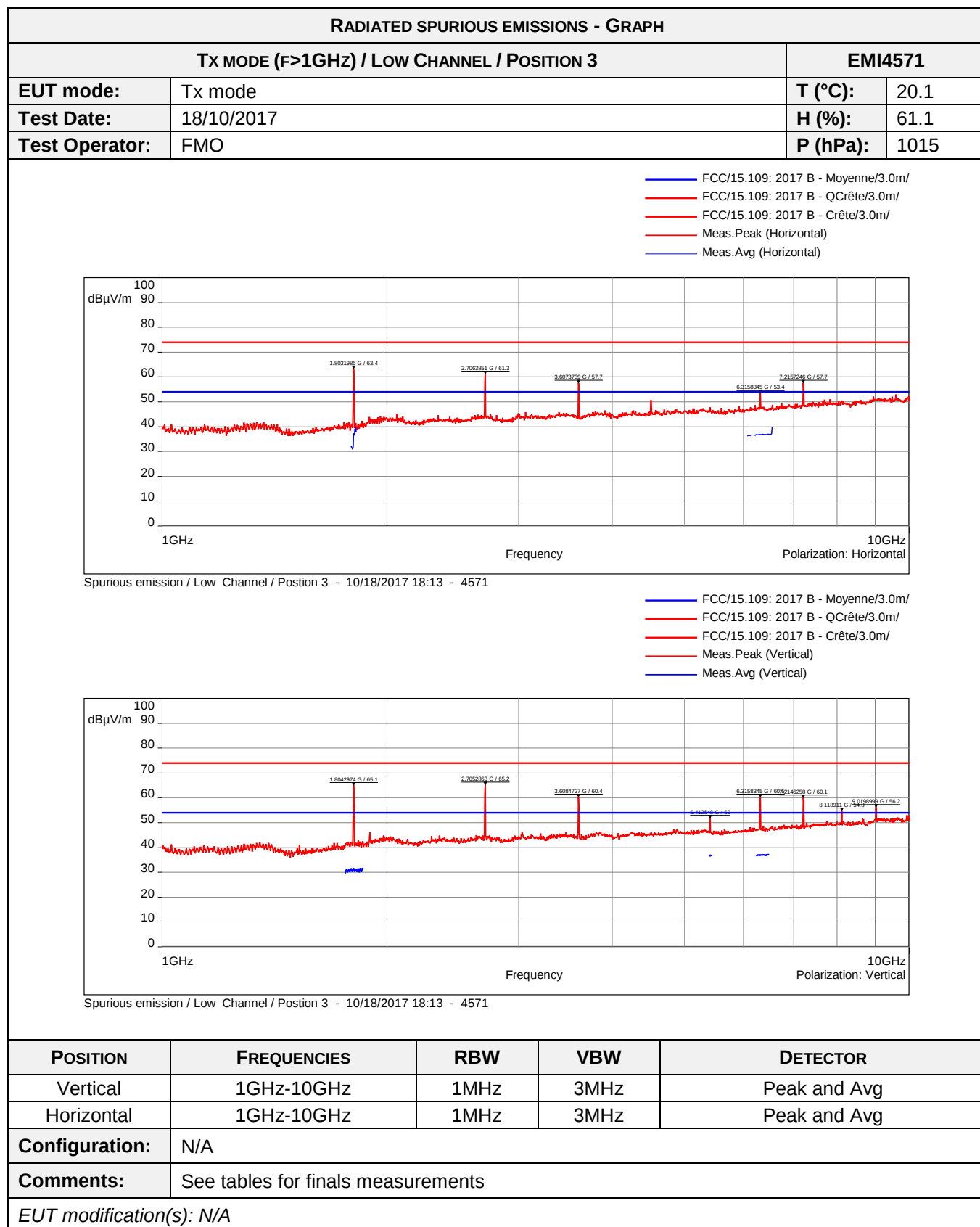


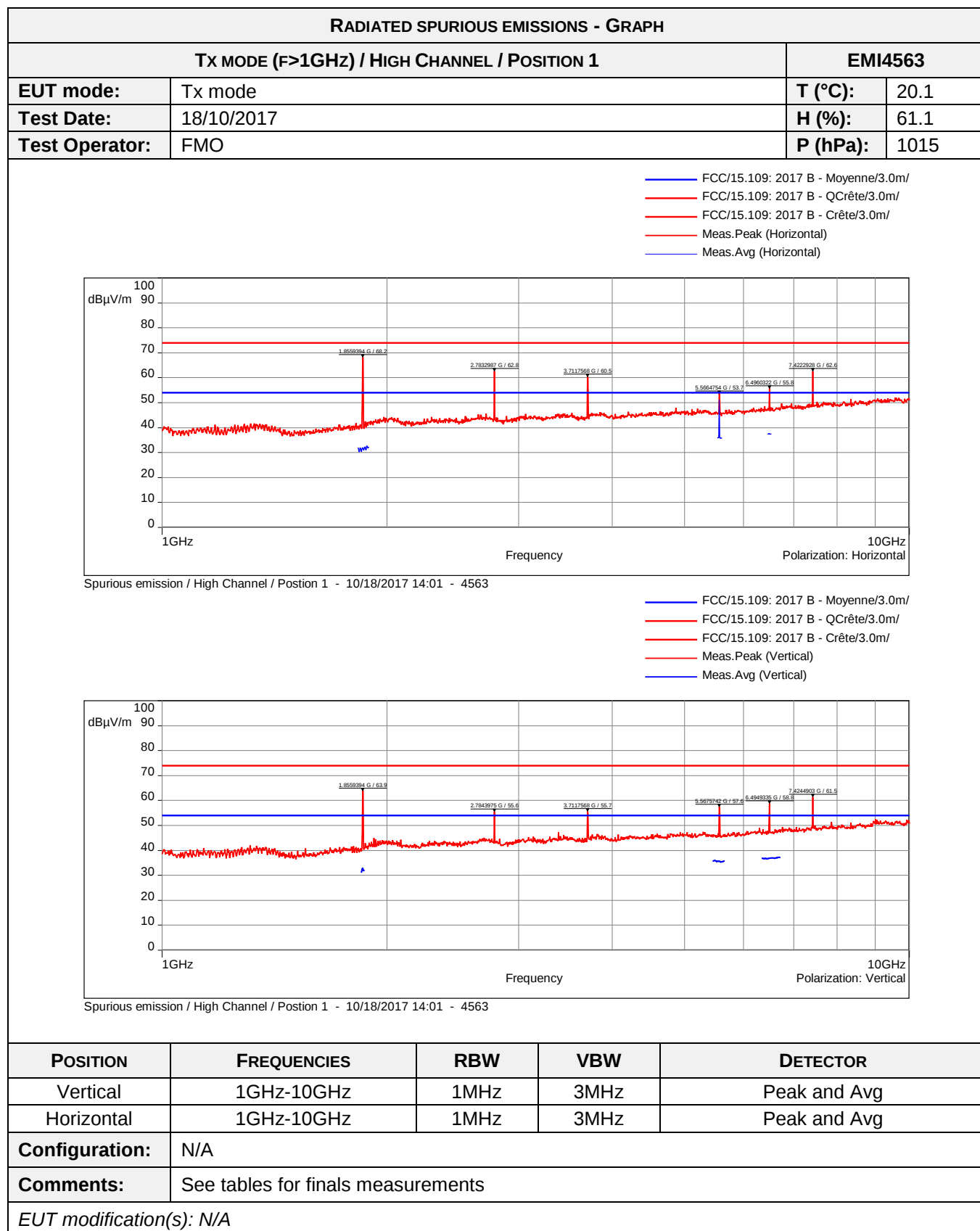


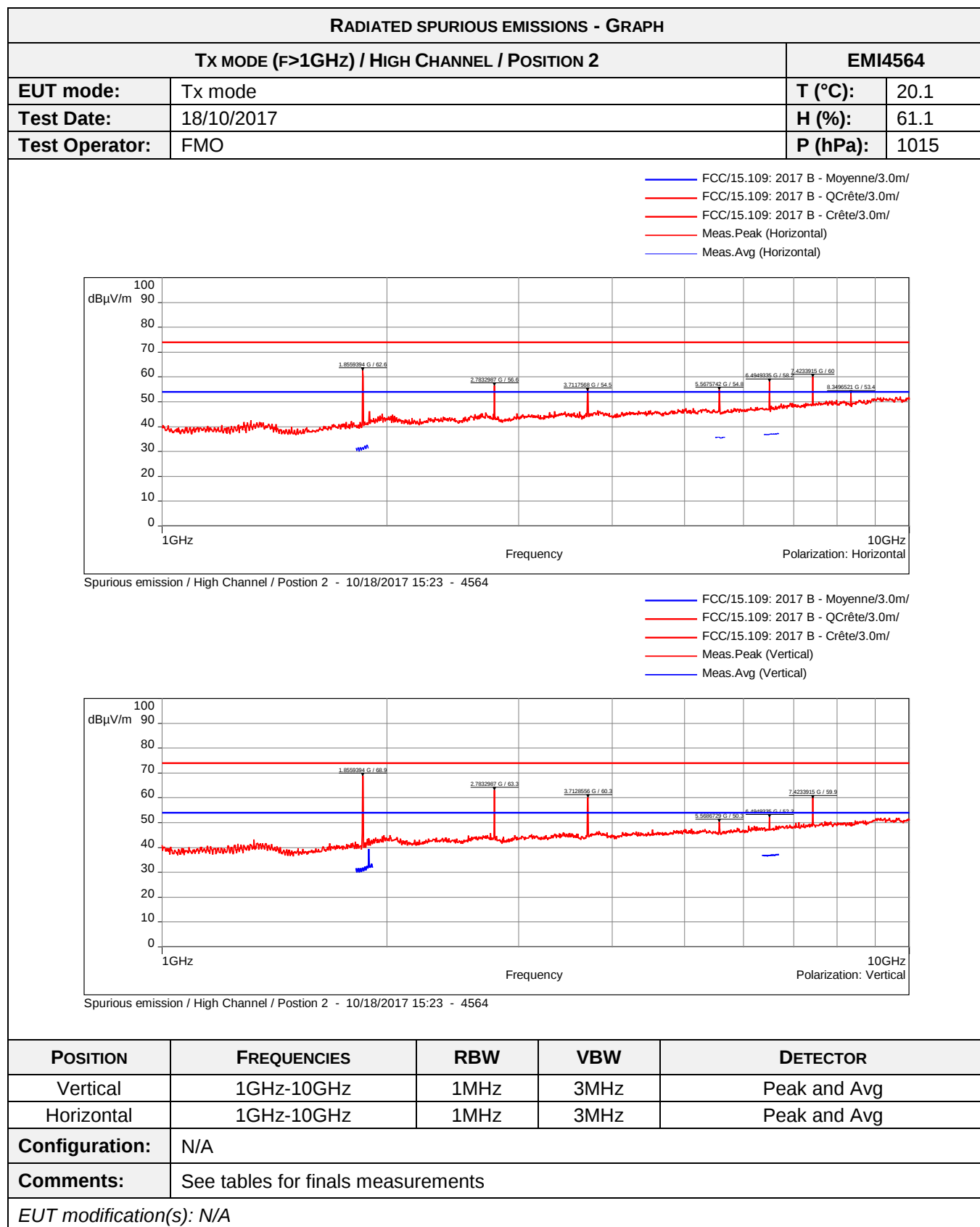


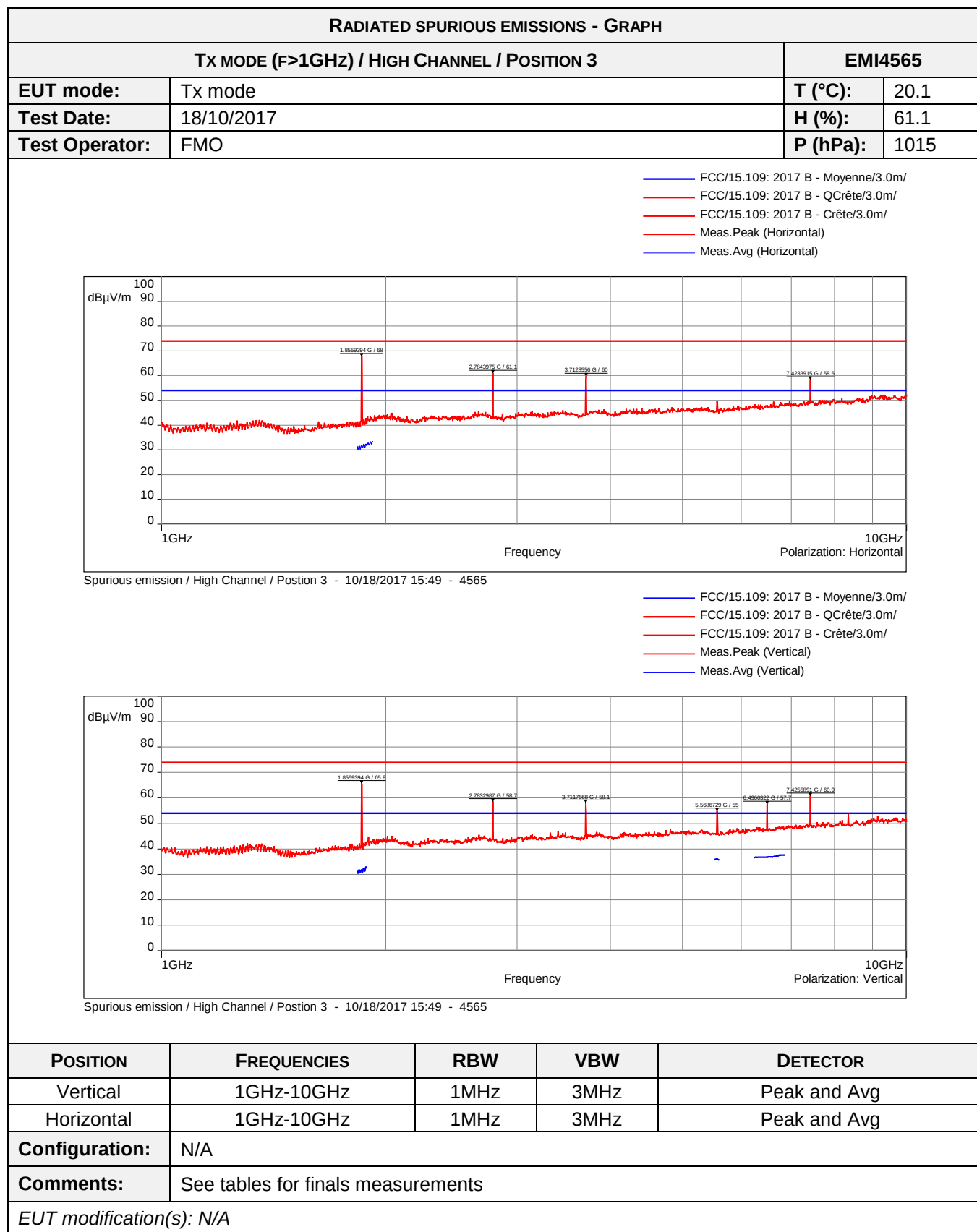












7.6. Measurement of Frequency Stability §15.215 (C) And RSS-GEN

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 the measuring receiver via 50Ω attenuator(s).	

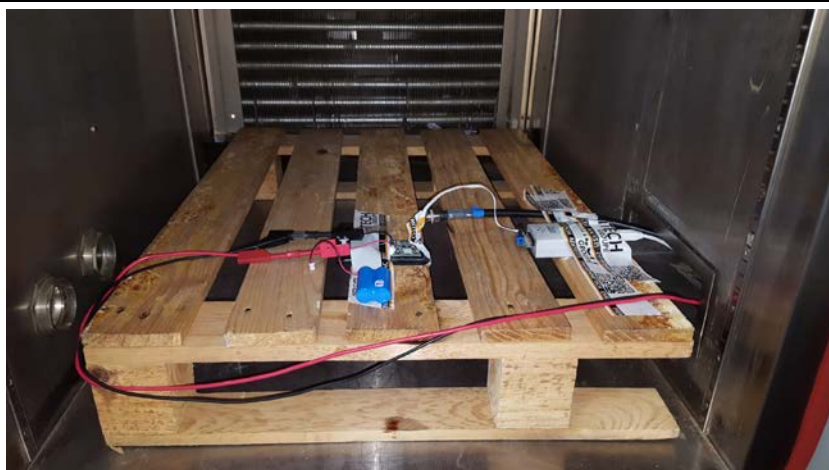
TEST CASE	EUT MODE	SEVERITY	RESULT TAB.	VERDICT
Tx mode	Permanent emission mode	902-928 MHz	-	PASS

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
Attenuator	Radiall	R412710124	4390	25/11/2015	25/01/2018
Attenuator	Radiall	R412720124	4391	25/11/2015	25/01/2018
Cable	STORM MICROWAVE	N-1.5m	10263	05/10/2016	05/12/2018
Climatic enclosure	CLIMATS	10489	14261		
Digital thermometer	GHM Greisinger	GMH 3710	12968	31/01/2017	31/03/2018
Receiver	Agilent Technologies	E4440A	5824	11/01/2016	11/03/2018
Shielded enclosure	RAY PROOF	C.V1	1123		
Thermohygrometer	Bioblock Scientific	Météostar	0963	27/12/2016	27/02/2019
Thermohygrometer	Testo	608-H1	7561	27/12/2016	27/02/2019

Blank cells = Permanent validity

TEST SETUP PHOTO(S)



EFFECTIVE RADIATED POWER - TABULATED RESULTS

Test Case	Temperature (°C)	Power supply (Vdc)	Frequency (MHz)	Frequency error (kHz)
Normal conditions / Low channel	25	3.6	902.309584	-
Extremes tests conditions / Low channel	-20	3.6	902.307495	-2.089
Extremes tests conditions / Low channel	55	3.6	902.308451	-1.133
Normal conditions / High channel	25	3.6	914.906248	-
Extremes tests conditions / High channel	-20	3.6	914.903959	-2.289
Extremes tests conditions / High channel	55	3.6	914.904916	-1.332

EUT MODIFICATIONS	OPERATOR	TEST DATE	RESULT TAB.
N/A	FMO	19/10/2017	-

End of test report