



Test report issued under the responsibility of:
EMITECH LYON laboratory
MRA US-EU Designation Number: FR0013
Canadian CAB Identifier : FR0007

RADIO TEST REPORT

FCC part 15.247
RSS-247_Issue 2, February 2017

Company: **INSIGHT SIP**
Address.....: 13 chemin de la halte
06130 GRASSE
FRANCE

Test item description: **LoRa and bluetooth low energy module with integrated antenna**
Trade Mark: InsightSIP
Manufacturer: InsightSIP
Model/Type reference.....: ISP4520-US
FCC ID.....: 2AAQS-ISP4520US
IC: 1136A-ISP4520
Ratings.....: 1.8Vdc to 3.6Vdc

Testing Laboratory: **EMITECH LYON laboratory**
Address.....: ZI de Mi-Plaine
7 rue Georges Méliès
69680 CHASSIEU
FRANCE

Report Reference No: **R120-19-105 133-01-4_A**
Test procedure: FCC IC Certification
Diffusion.....: Mr MOREL
Applicant's name: INSIGHT SIP
Date of issue.....: 29/01/2021
Total number of pages.....: 58
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Modified page(s).....: Creation
Compiled by.....: T VINAY
Approved by (+ signature): O HEYER (Laboratory Manager)



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the whole manufactured products of the tested sample.*



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This document submits the results of Radio tests performed on the equipment **LoRa and bluetooth low energy module with integrated antenna ISP4520-US** (denominated hereafter E.U.T.: equipment under test) according to document(s) listed in §2 of this test report.

Testing Laboratory	EMITECH LYON laboratory
Address.....	ZI de Mi-Plaine
	7 rue Georges Méliès
	69680 CHASSIEU
	FRANCE
Test procedure.	FCC IC Certification
Tested by	T VINAY
Test supervisor	None
Date of receipt of test item.....	N/A
Date (s) of performance of tests	From 31 st March to 07 th April of 2020
	The 3 rd July of 2020
	The 26 th of August of 2020
	The 7 th of January of 2021

Company name..... : INSIGHT SIP
Company address. : 13 chemin de la halte
 06130 GRASSE
 FRANCE
Person(s) present during the tests. : No representative for company attended the tests.
Responsible. : Mr MOREL

**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.

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)

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 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

3. EQUIPMENT TECHNICAL DESCRIPTION

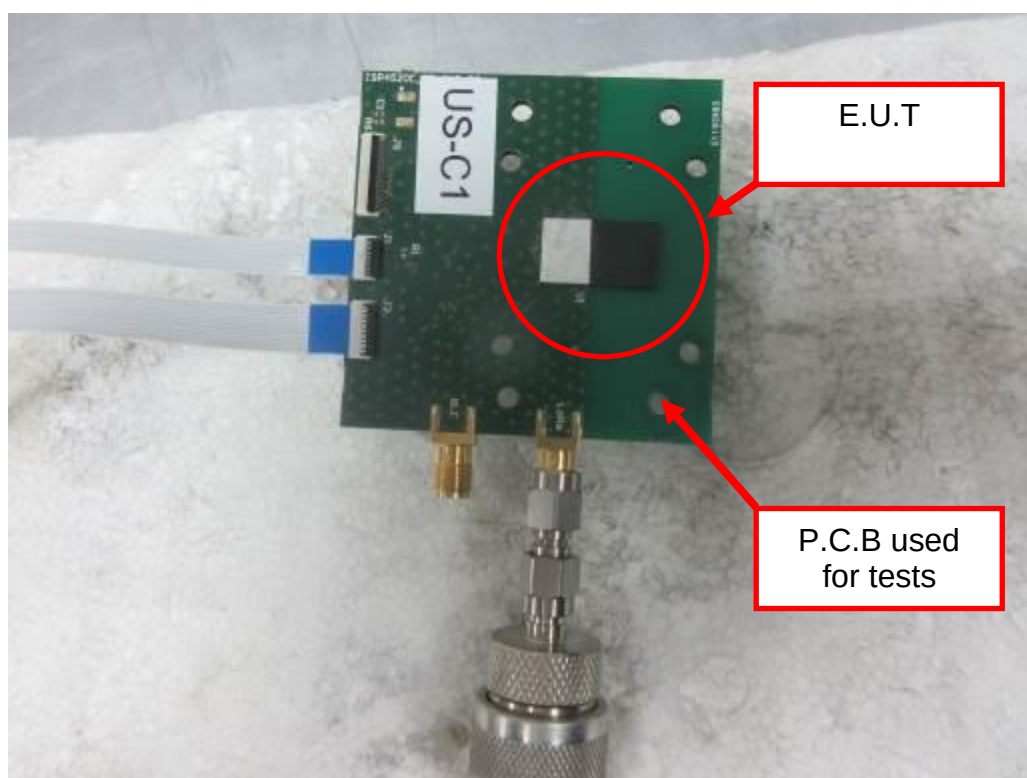
3.1. Test Conditions

Test item description. : LoRa and bluetooth low energy module with integrated antenna
Model/Type reference..... : ISP4520-EU
Trade Mark. : InsightSIP
FCC ID..... : 2AAQS-ISP4520US
IC. : 1136A-ISP4520
Serial number (S/N)..... : Non applicable
Part number (P/N). : Non applicable
Software version..... : BLE : DTM
LoRa : custom test FW
Firmware version. : BLE : DTM
LoRa : custom test FW
Type of sample. : Standard equipment
Function(s)..... : LoRa and bluetooth low energy module with integrated antenna
Manufacturer name. : InsightSIP
Address..... : Village d'entreprise Green Side
400 Avenue Roumanille
BP 309
06906 SOPHIA ANTIPOLIS

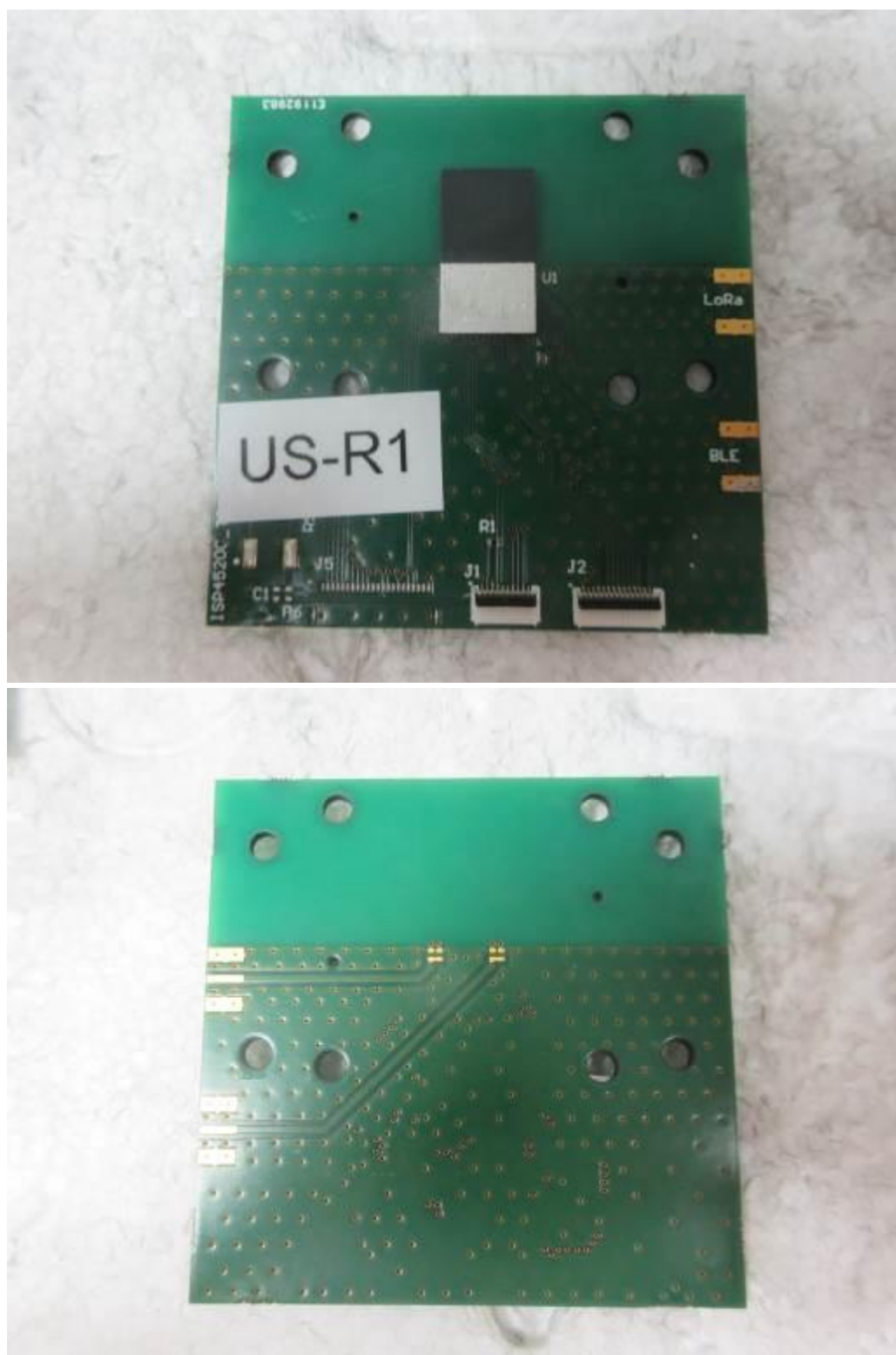
General product information:

N/A

3.2. EUT General view



3.3. SRD Antenna + PCB



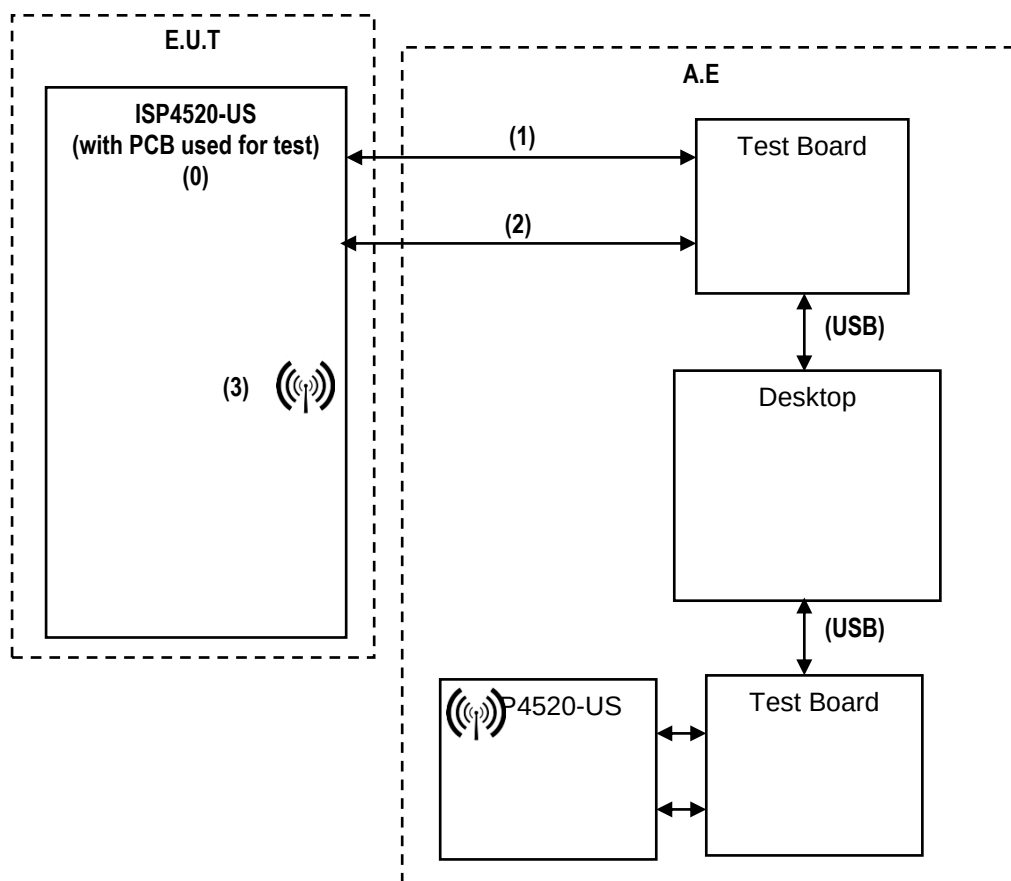
3.4. EUT Mechanical and Electrical Design

Power supply. : 3.3 Vdc
Power supply range. : 1.8Vdc to 3.6Vdc
Power type. : USB
Power (W). : 0.400
Nominal current (A). : 0.120
Dimensions (L x W x H) (m). : 0.0098 x 0.0172 x 0.0017
Weight (kg). : 0.062
Temperature range (°C). : -30 to 85
Ground bounding strap. : No

Comments:

N/A

3.5. EUT Input/Output ports



PORT	NAME	TYPE	LENGHT	CABLE TYPE	COMMENTS
0	Main frame	N/E	N/A	Metallic/ceramic	
1	Control cable 1	DC and I/O	L = 20cm	Unshielded	This cable is not part of the EUT. He is only present for EUT tests
2	Control cable 2	DC and I/O	L = 20cm	Unshielded	This cable is not part of the EUT. He is only present for

EUT tests					
3	RF Antennas	RF	N/E	N/E	BLE and LoRa

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

3.6. Supporting Equipment Used During Test

Sample subject to the tests was tested with following equipment.

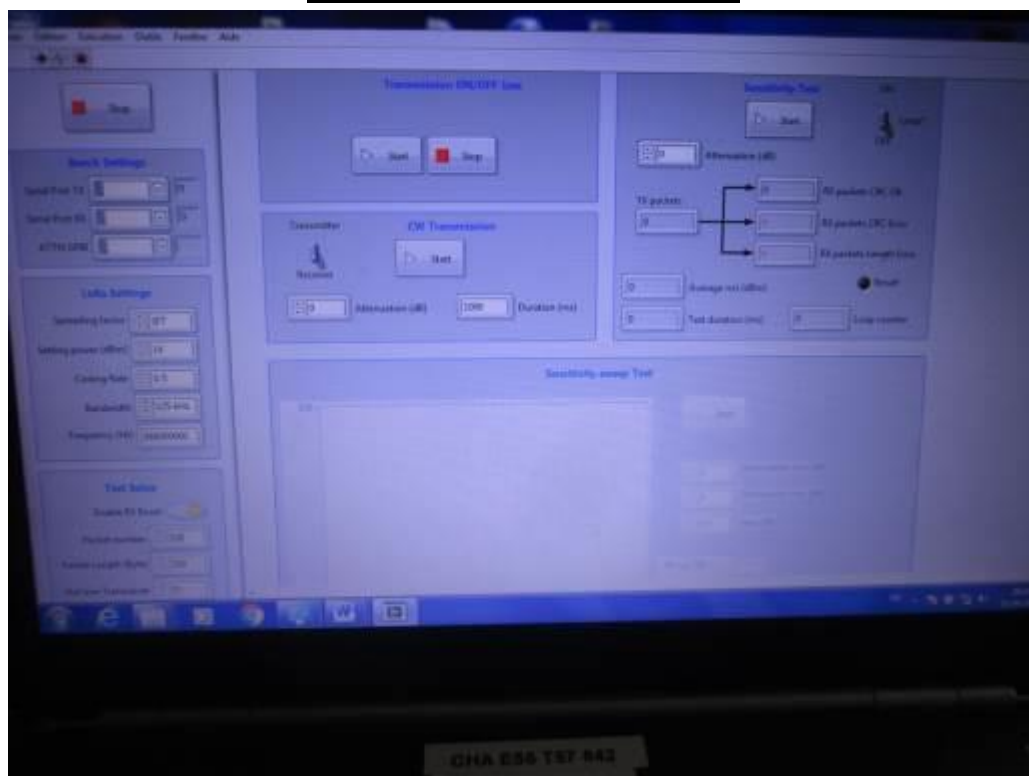
PRODUCT TYPE	MANUFACTURER	MODEL	N°EMITECH / COMMENTS
Desktop Interface board with RF module	DELL Insight SIP	N/A	Provided by the customer

(EA)

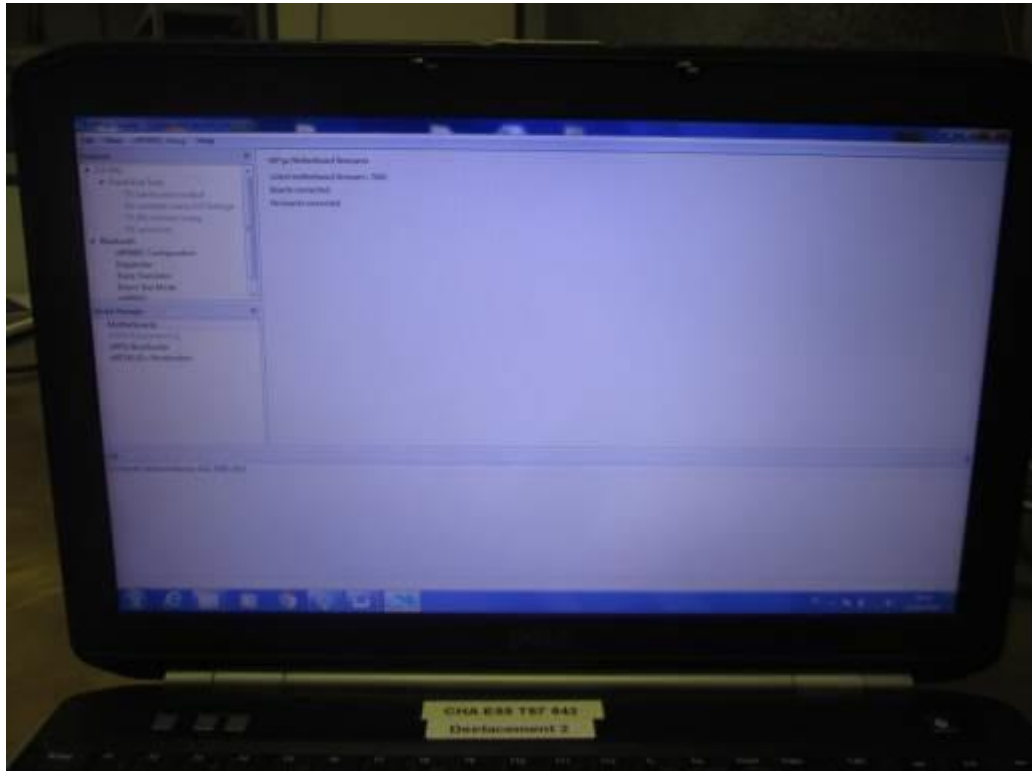
Desktop



HMI LoRa tester (Insight software)



HMI Bluetooth Low Energy (nRFgo Studio – Nordic semi conductor)



Interface board with RF module



3.7. EUT Radio Specifications

a) GENERAL INFORMATIONS	
According to manufacturer's declarations :	
EUT type.....	: Transmitter
Technology	: BLE
Environmental profile.....	: Data transmission
Temperature range.....	: -30/+85 °C
Antenna type	: Integral
Antenna Gain.....	: 6dBi (Max)
Comments:	
N/A	
b) TRANSMITTER PARAMITERS (Tx)	
Frequency bands.....	: 2400 – 2483.5 MHz
RF Power.....	: 1mW max (standard value)
Number of channels / Separation.....	: 40 / 2MHz
Modulation type	: GFSK
Duty cycle	: N/C
Tested frequency.....	: 2402 MHz, 2426MHz, 2480 MHz (DSSS)
c) RECEIVER PARAMETERS (Rx)	
Frequency bands.....	: 2400 – 2483.5 MHz (DSSS)
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		NA	a)
- Digital modulation system		PASS	a) BW > 500kHz
- 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		N/A	b)
- For system using digital modulation in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands		PASS	b) BW > 500kHz
- Operation with directional antenna gains > 6 dBi		N/A	c)
- Out-of-band emissions		PASS	d)
- Power spectral density conducted		PASS	e)
- Hybrid system		N/A	f)
- Frequency hopping additional requirements		N/P	g) See certification documents
- Frequency hopping intelligence		N/P	h) See certification documents
- 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 = -1.958dBm

Maximum antenna gain = 6dBi

Maximum EIRP with antenna gain of 6dBi = 0.64 mW (eirp) at 2402 MHz

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

$PSD = EIRP / (4 * \pi * R^2) = 0.64 / (4 * \pi * (20 \text{ cm})^2) = 0.00013 \text{ mW/cm}^2$

Limit= 0.61 mW/cm² (f /1500 if 300<f< 1500 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	$\pm 1 \text{ }^{\circ}\text{C}$	$\pm 1^{\circ}\text{C}$
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

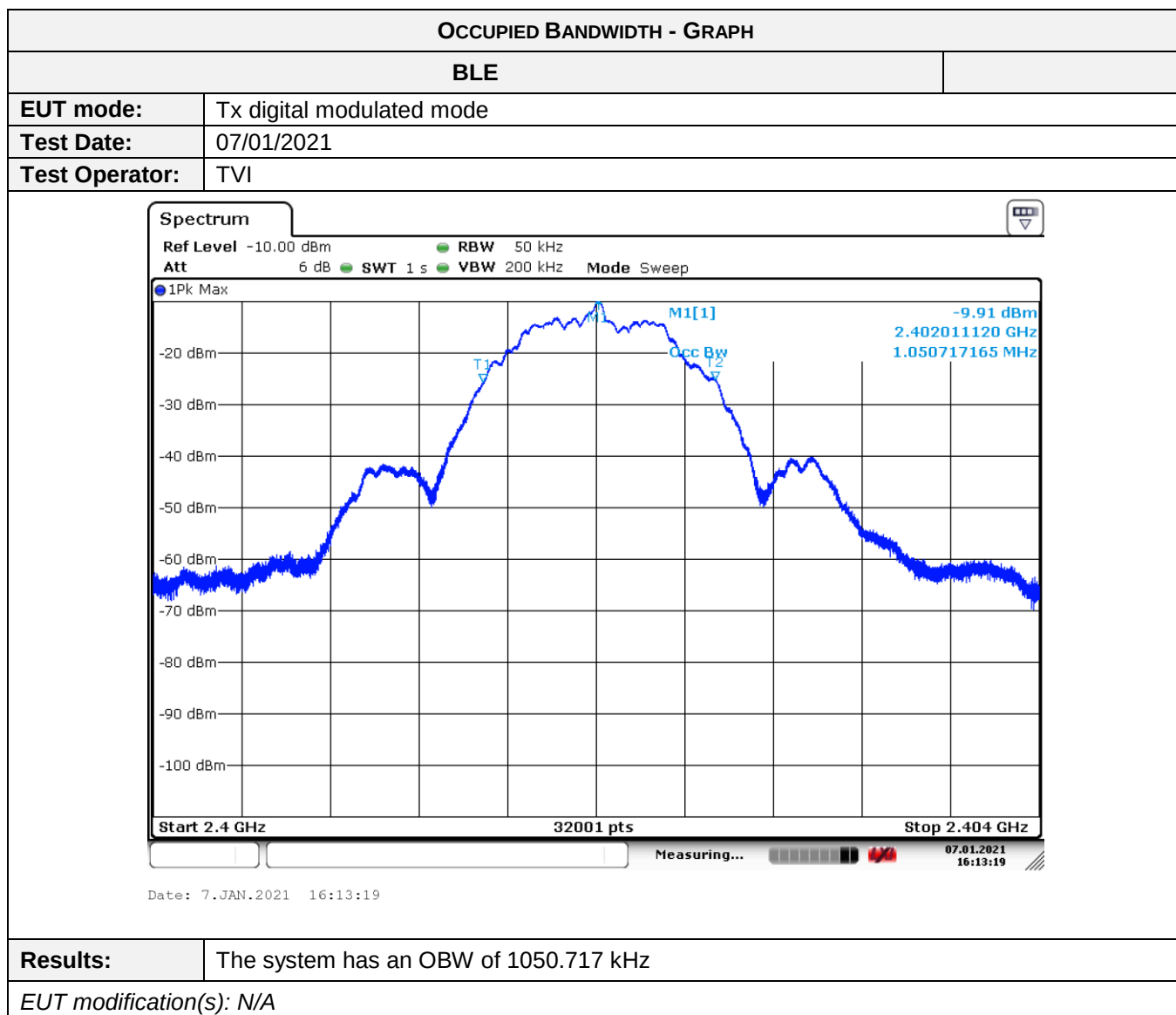
Reference standard:	FCC part 15 Radio part 15.247 and RSS-247
Test method:	FCC part 15.247 and RSS-247
Test description: The occupied bandwidth (OBW) is the Frequency Range in which 99 % of the total mean power of a given emission falls. The residual part of the total power being denoted as β, which, 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).	

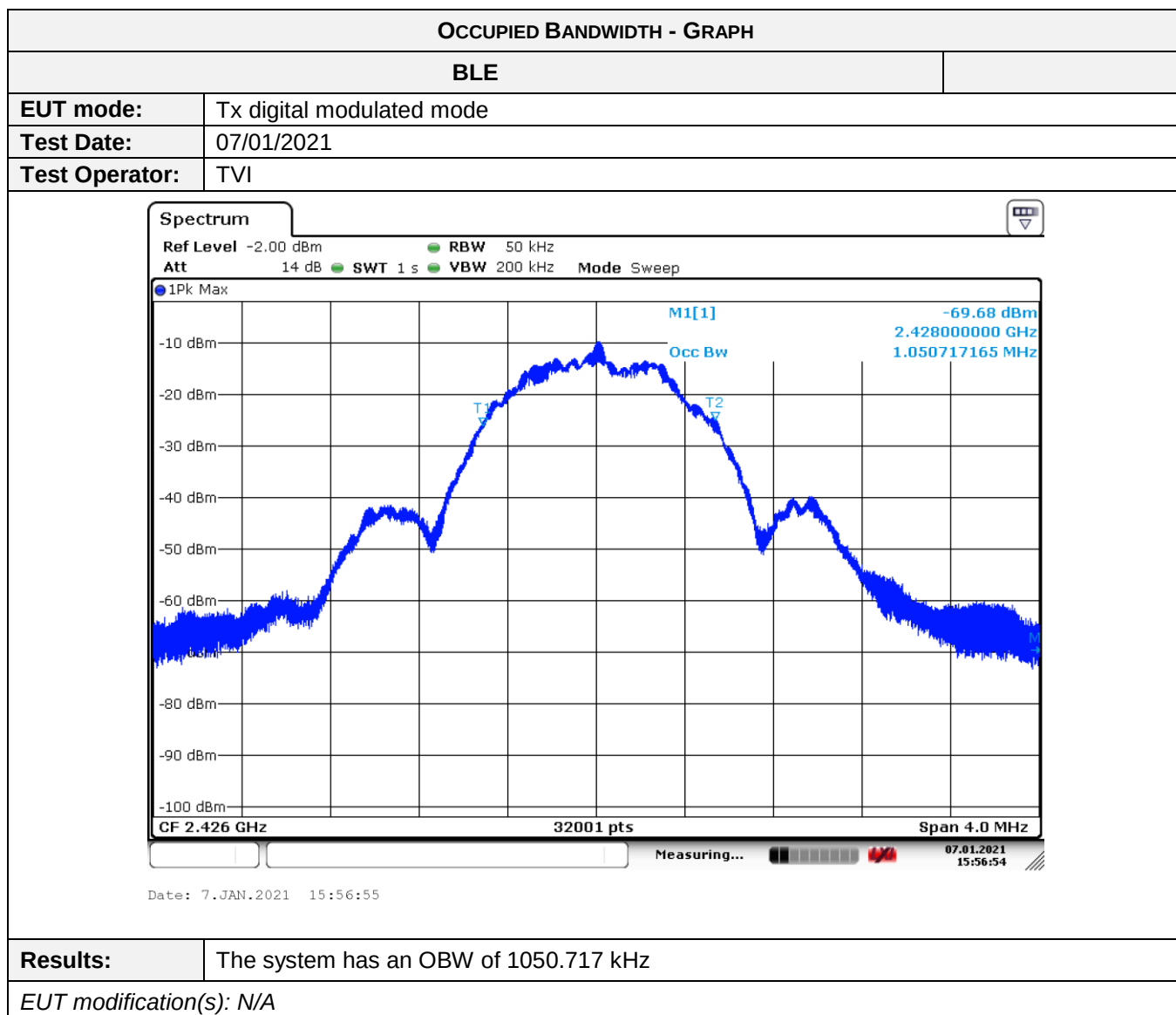
TESTED PARAMETER	OBW	SEVERITY	RESULT TAB.	VERDICT
BLE, lowest channel	1.05 MHz	>500kHz	/	PASS
BLE, central channel	1.05 MHz	>500kHz	/	PASS
BLE, highest channel	1.05 MHz	>500kHz	/	PASS

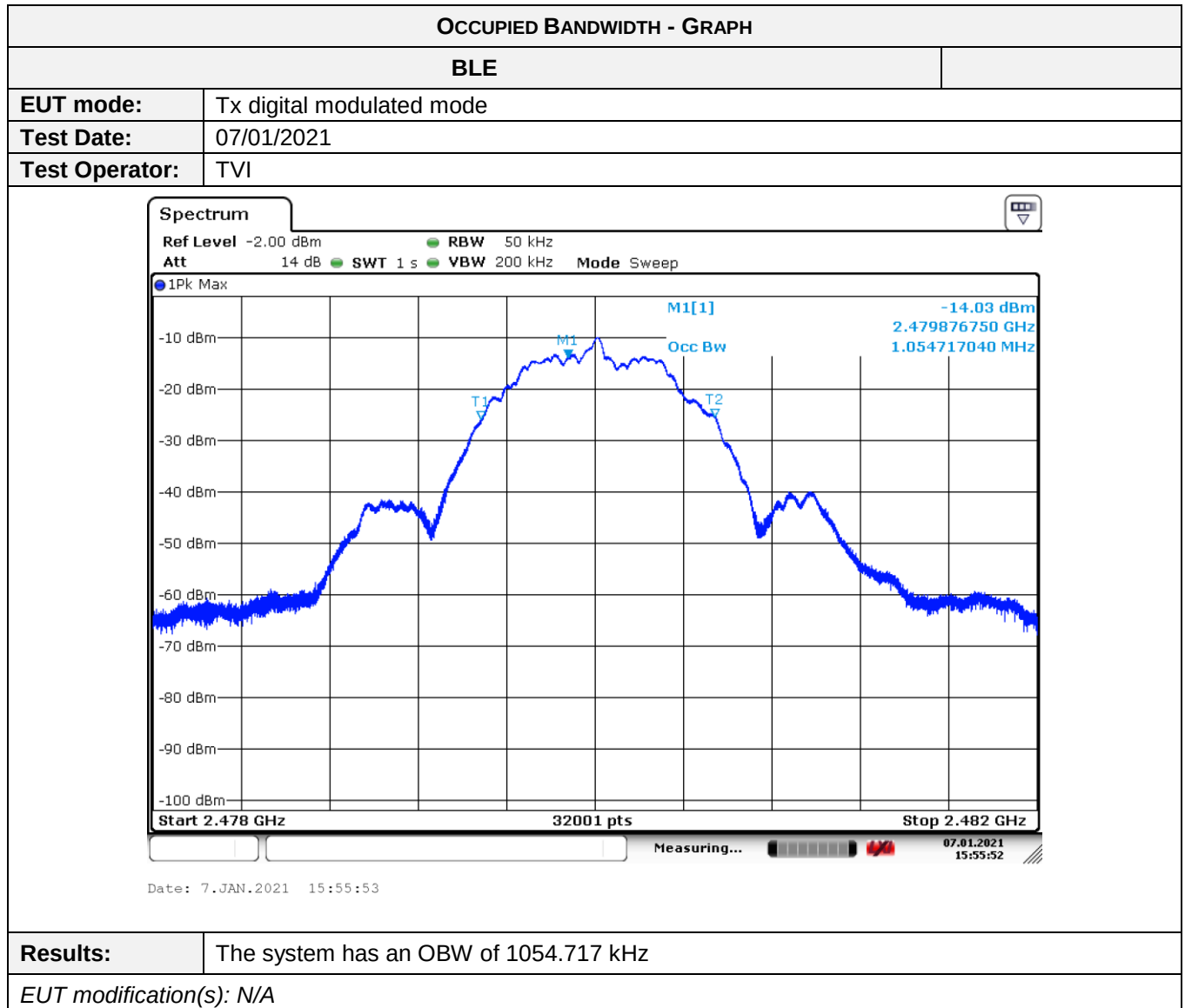
LABORATORY PARAMETERS:	REQUIRED PRIOR TO THE TEST	DURING THE TEST
Ambient Temperature	15 to 35 °C	16.4 °C
Relative Humidity	20 to 75 %	31.7 %
Atmospheric pressure	N/A	994 hPa
Test method deviation: N/A		
Supplementary information: N/A		

TEST EQUIPMENT USED					
CATEGORY	BRAND	TYPE	IDENTIFIER	CAL. DATE	CAL. DUE
Spectrum Analyzer	Rohde & Schwarz	FSV40	15776	23/12/2019	23/02/2021
Cable	H&S	N-1m	15931	04/12/2018	04/02/2021
Attenuator	Narda	6dB	6549	18/06/2019	18/08/2021

Blank cells = Permanent validity







7.2.6dB, 20dB bandwidth, Carrier Frequency separation and Number of 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) (2): Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 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.	

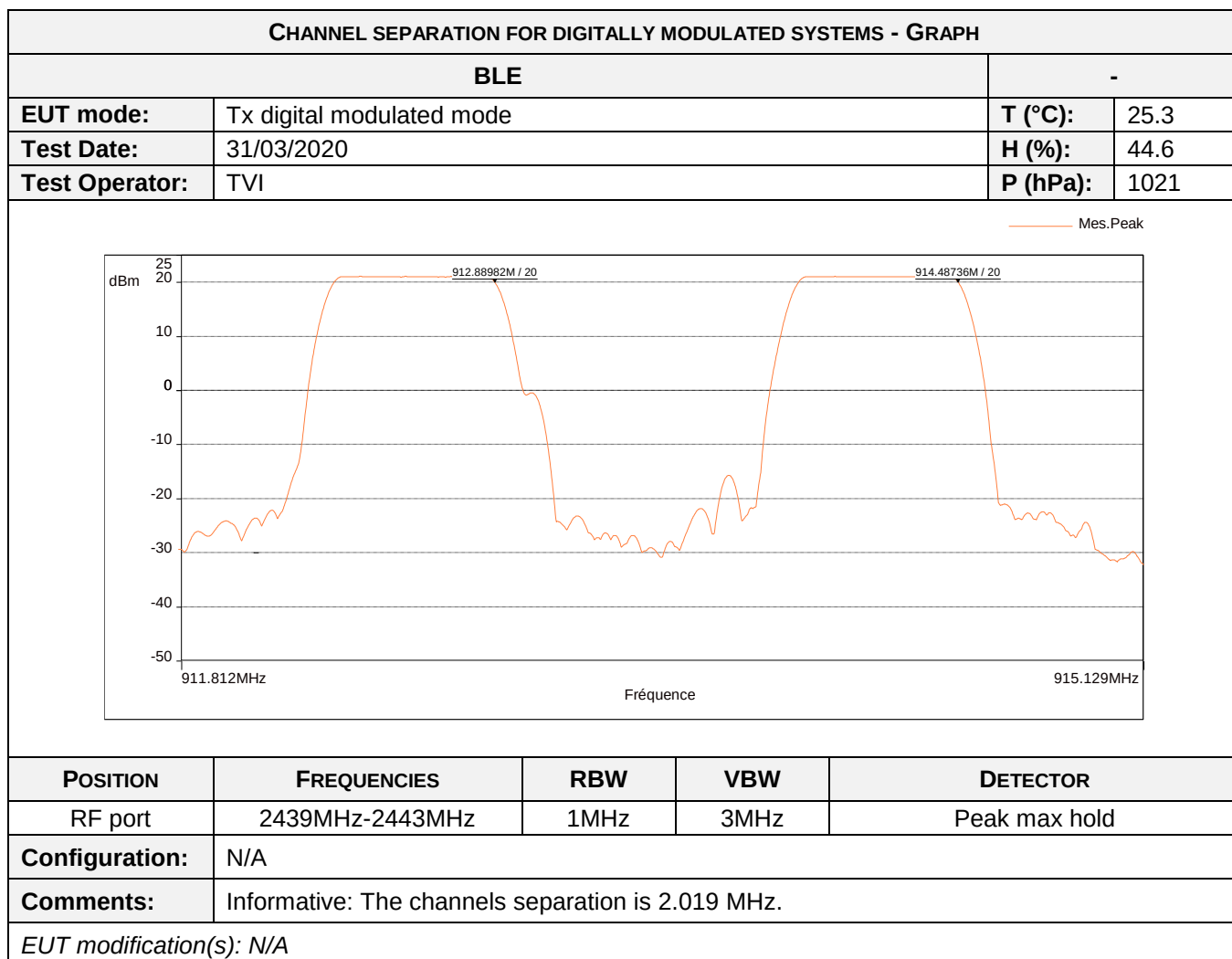
TESTED PARAMETER	RESULT	SEVERITY	RESULT TAB.	VERDICT
Number of channels	40	informative	/	PASS
Channels separation	2.0MHz	informative	/	PASS
6dB Bandwidth	> 675.073 kHz	>500kHz	/	PASS
20dB Bandwidth	> 1182.432 kHz	>500kHz	/	PASS

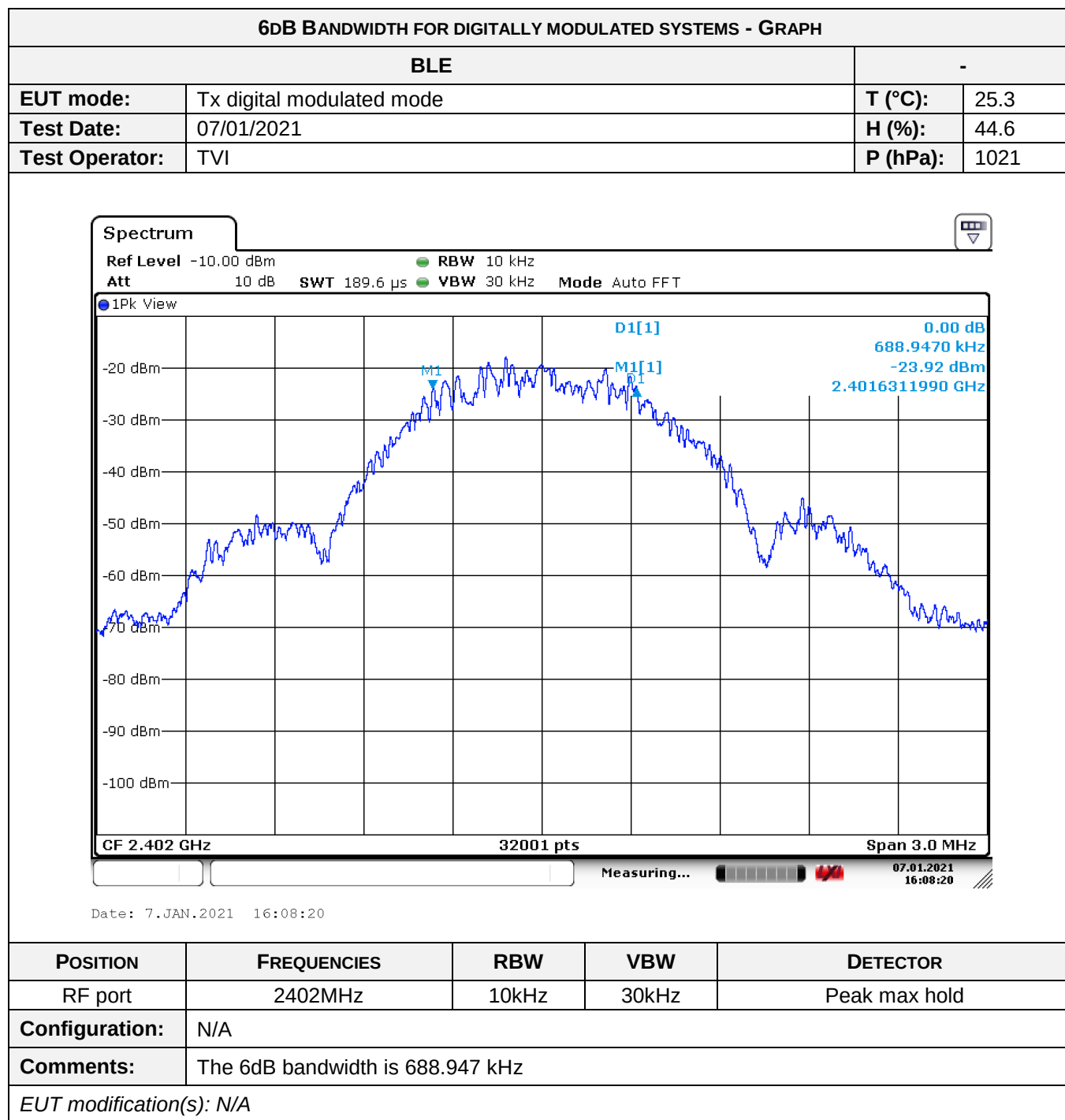
LABORATORY PARAMETERS:	REQUIRED PRIOR TO THE TEST	DURING THE TEST
Ambient Temperature	15 to 35 °C	See Graph(es)
Relative Humidity	20 to 75 %	See Graph(es)
Atmospheric pressure	N/A	See Graph(es)
Test method deviation: N/A		
Supplementary information: N/A		

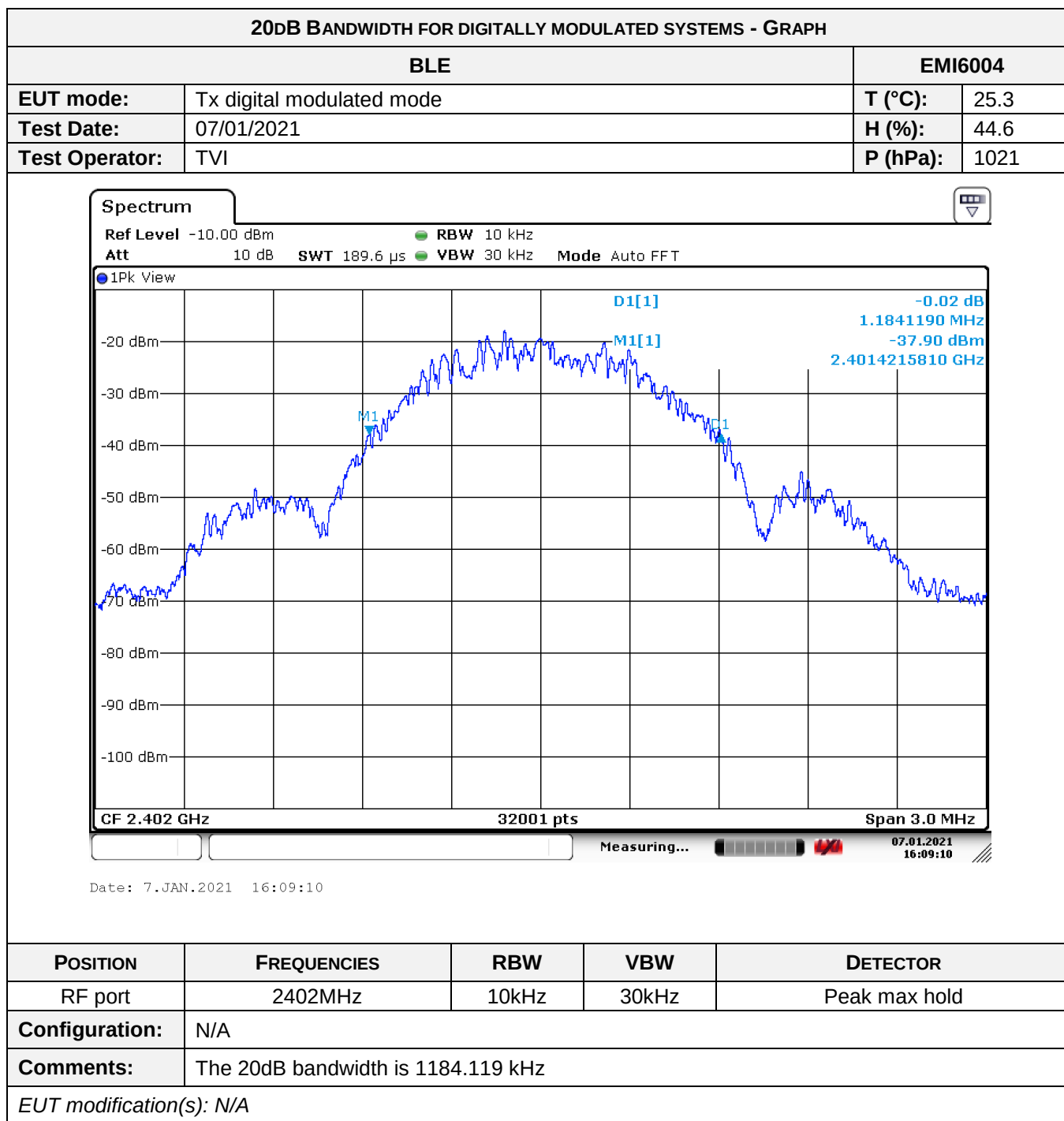
TEST EQUIPMENT USED					
CATEGORY	BRAND	TYPE	IDENTIFIER	CAL. DATE	CAL. DUE
Spectrum Analyzer	Rohde & Schwarz	FSV40	15776	23/12/2019	23/02/2021
Cable	H&S	N-1m	15931	04/12/2018	04/02/2021
Attenuator	Narda	6dB	6549	18/06/2019	18/08/2021

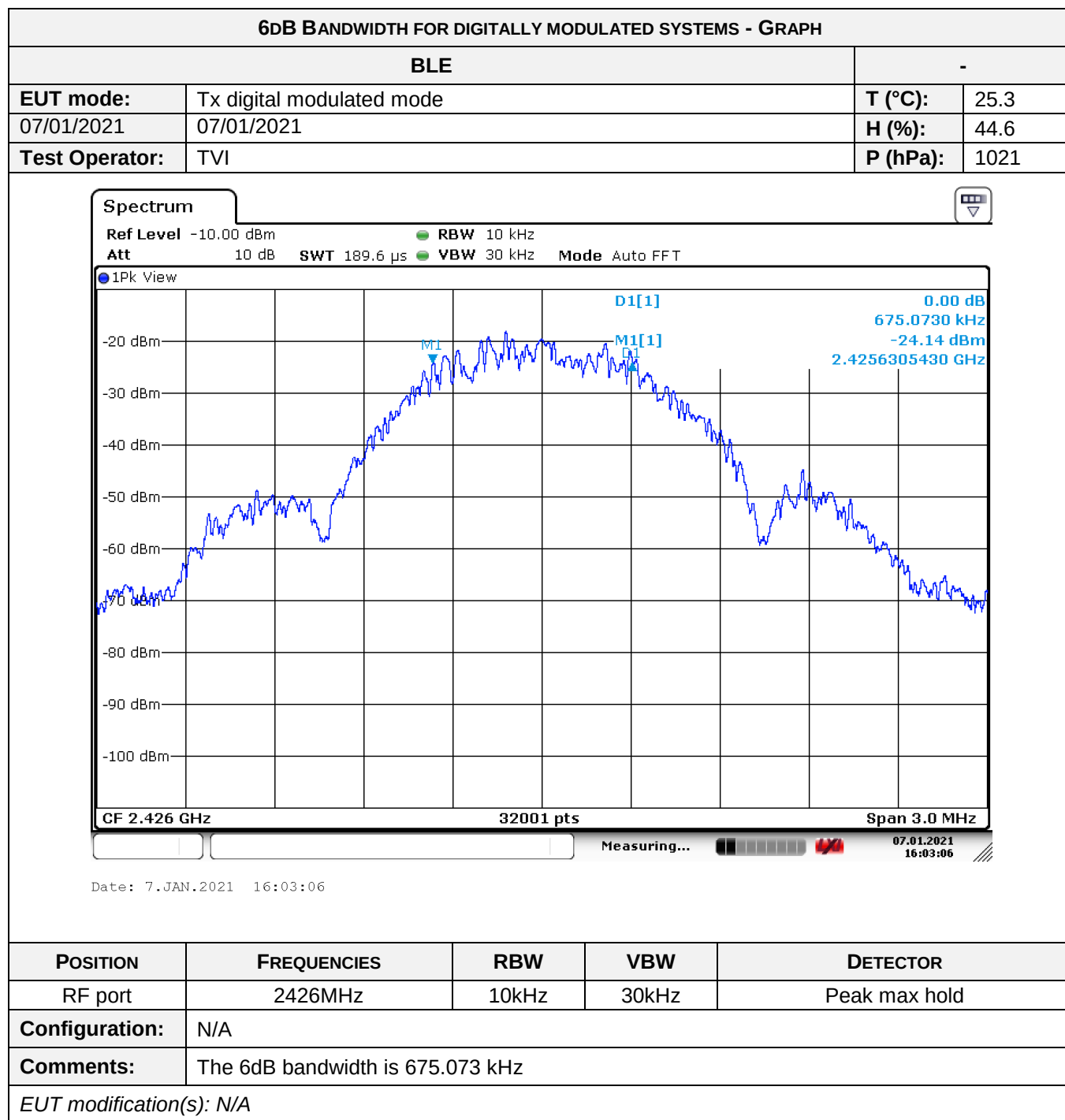
Blank cells = Permanent validity

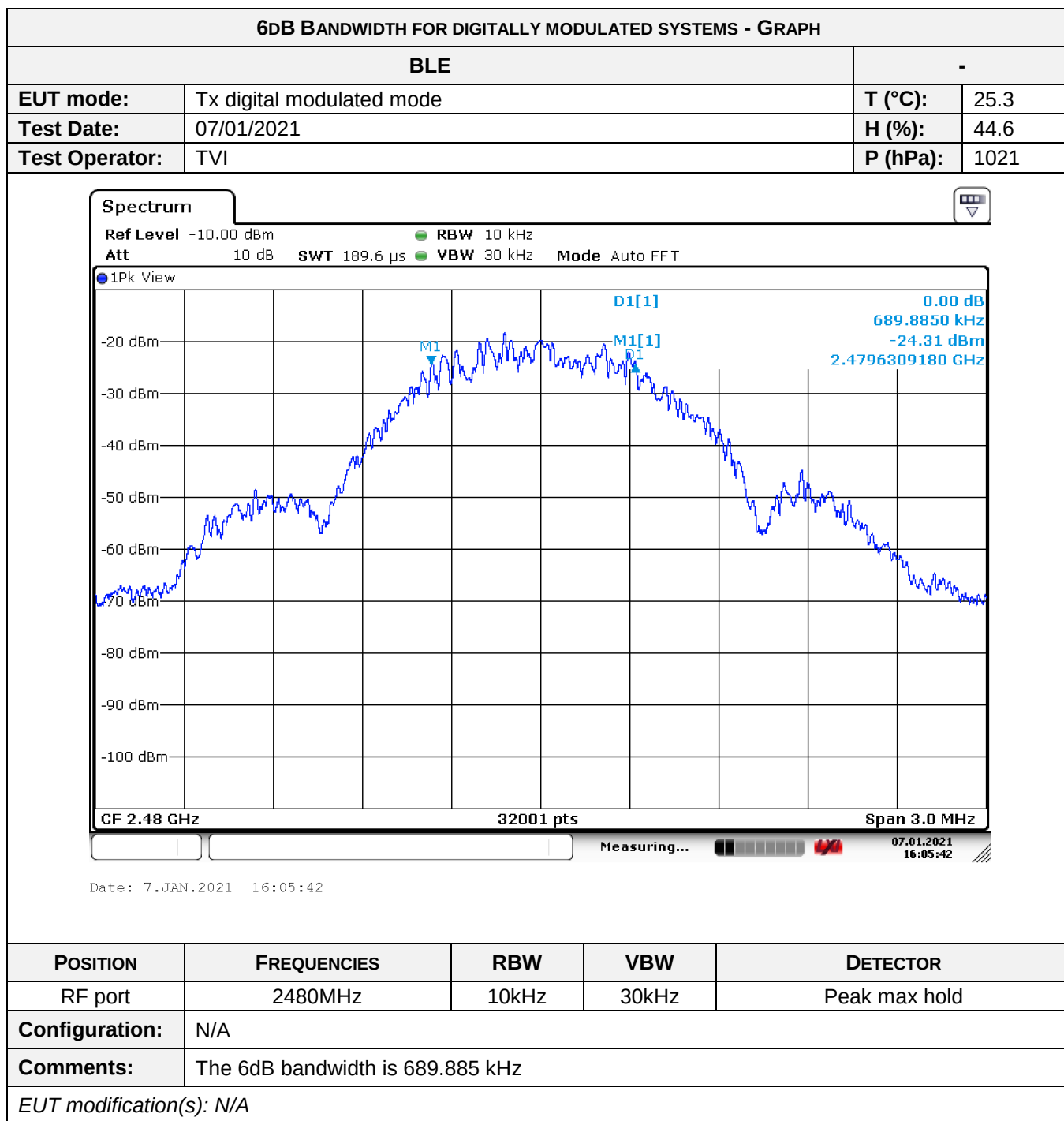
NUMBER OF CHANNELS FOR DIGITALLY MODULATED SYSTEMS - GRAPH			
BLE		I	
EUT mode:	Tx digital modulated mode	T (°C):	25.3
Test Date:	31/03/2020	H (%):	44.6
Test Operator:	TVI	P (hPa):	1021
<			

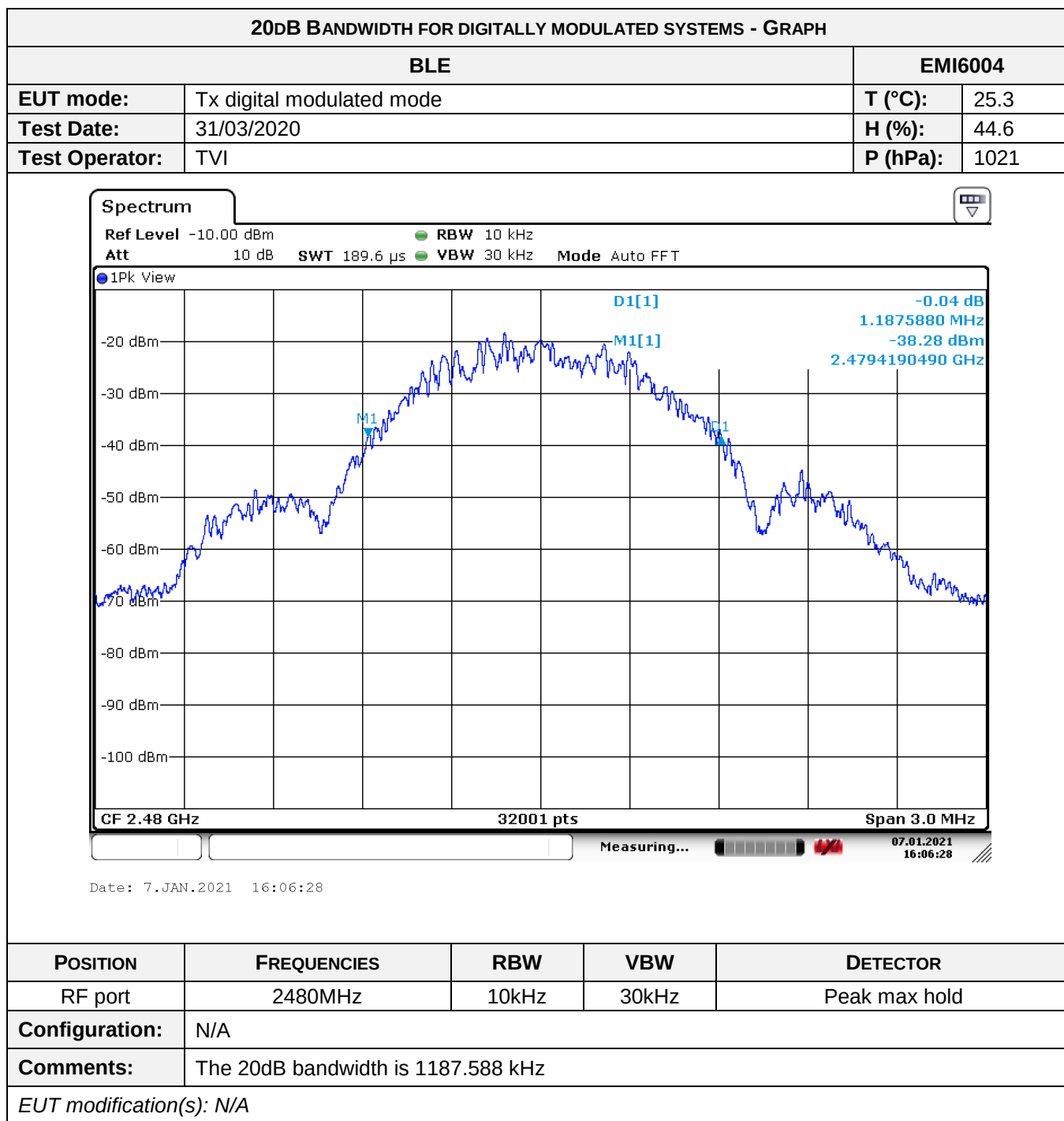












7.3. Maximum peak conducted power of the intentional radiator

Reference standard:	FCC part 15 Radio part 15.247 and RSS-247
Test method:	FCC part 15.247 and RSS-247
Test description: b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode. 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 – BLE	-1.955 dBm	1W (30dBm)		PASS
Central channel – BLE	-2.128 dBm	1W (30dBm)		PASS
High channel – BLE	-2.371 dBm	1W (30dBm)		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
Spectrum Analyzer	Agilent Technologies	N9010A	11316	14/05/2019	14/07/2020
Cable	H&S	N-1m	15931	04/12/2018	04/02/2021
Attenuator	Narda	6dB	6549	18/06/2019	18/08/2021

Blank cells = Permanent validity

PUISSANCE MOYENNE CONDUITE - TABULATED RESULTS				
LoRA 500KHz				-
Frequency (MHz)	P _{conducted} (dBm)	Gain _{dBi}	P _{eirp} (dBm)	Limit _{eirp} (dBm)
2402	-1.958	6dBi (Max)	4.042	36
2426	-2.128	6dBi (Max)	3.872	36
2480	-2.372	6dBi (Max)	3.628	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 99.3 dB μ V/m.

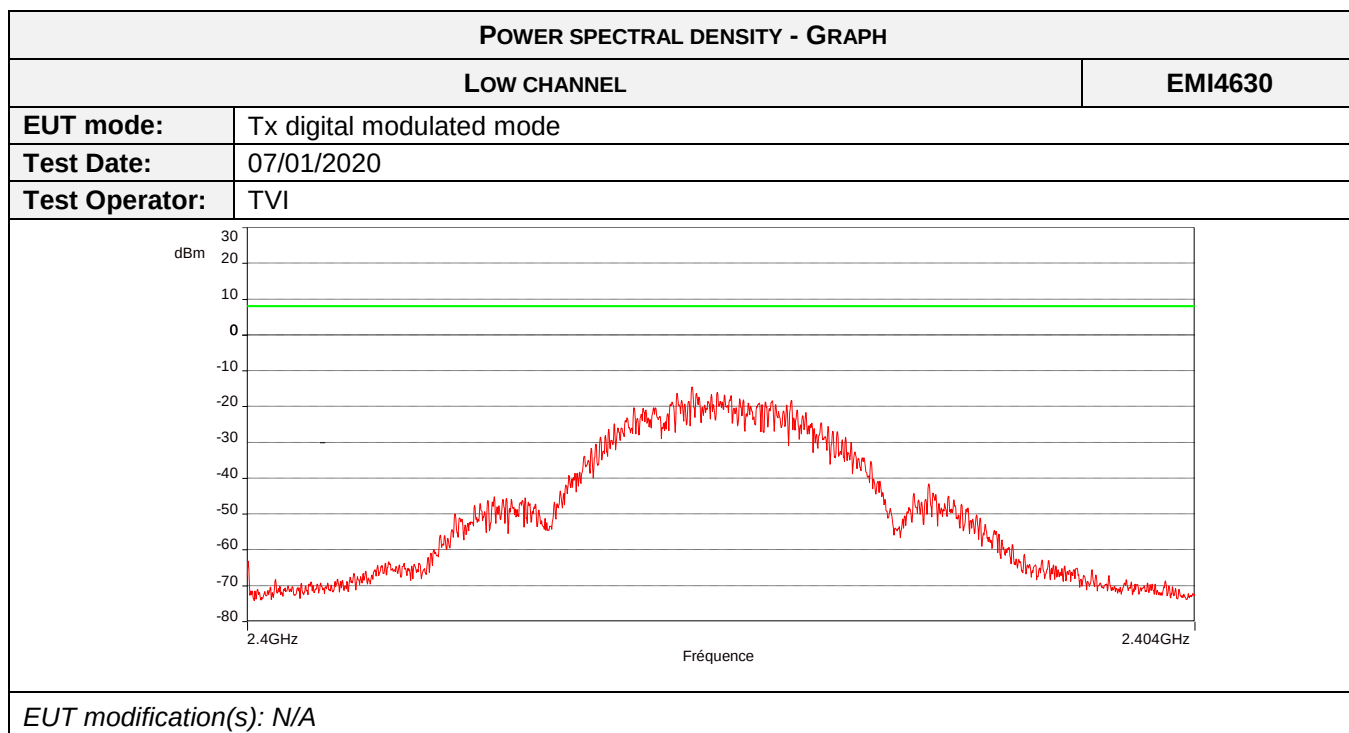
7.4. Power spectral density

Reference standard:	FCC part 15 Radio part 15.247 and RSS-247
Test method:	FCC part 15.247 and RSS-247
Test description: e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density. EUT is connected to the measuring receiver via 50Ω attenuator(s). Only the highest levels are recorded.	

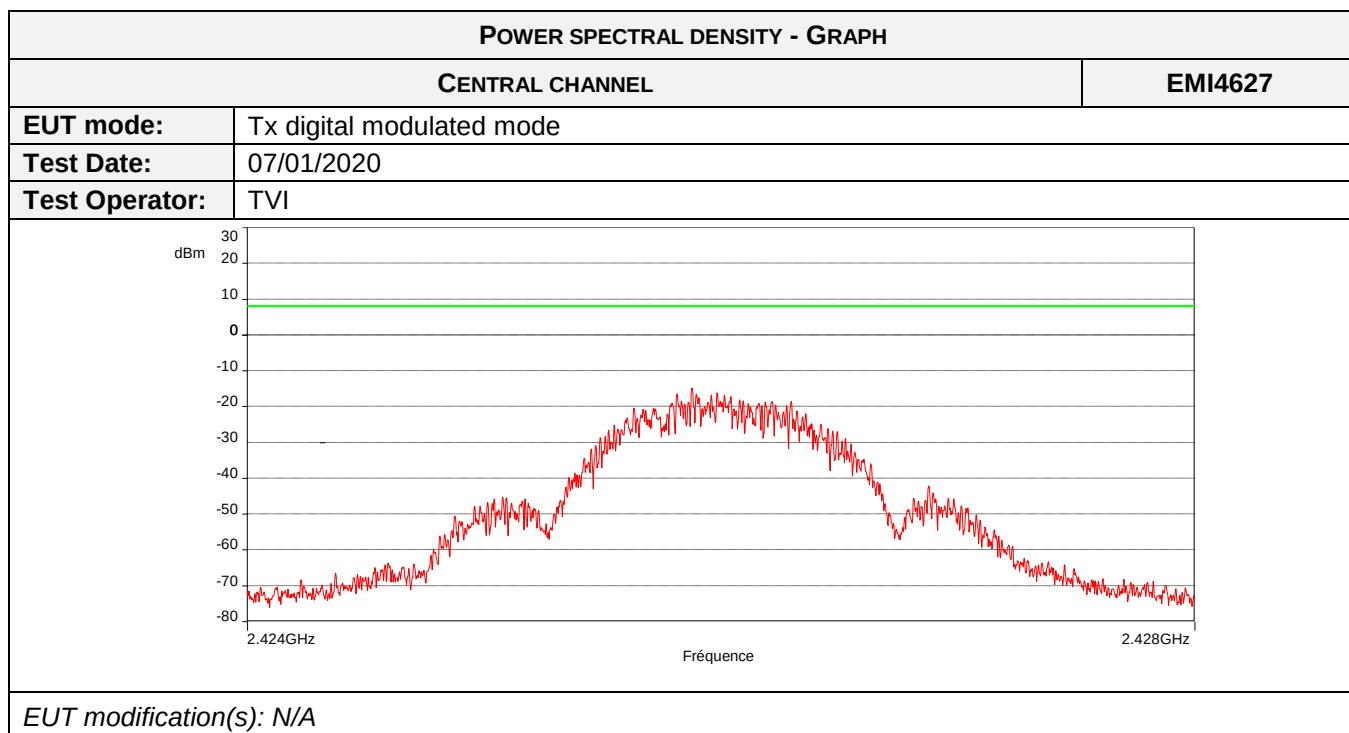
TESTED CHANNEL	PARAMETER	SEVERITY	RESULT TAB.	VERDICT
Low, central and high channels	BLE	8dBm/3kHz	EMI4573	PASS

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		

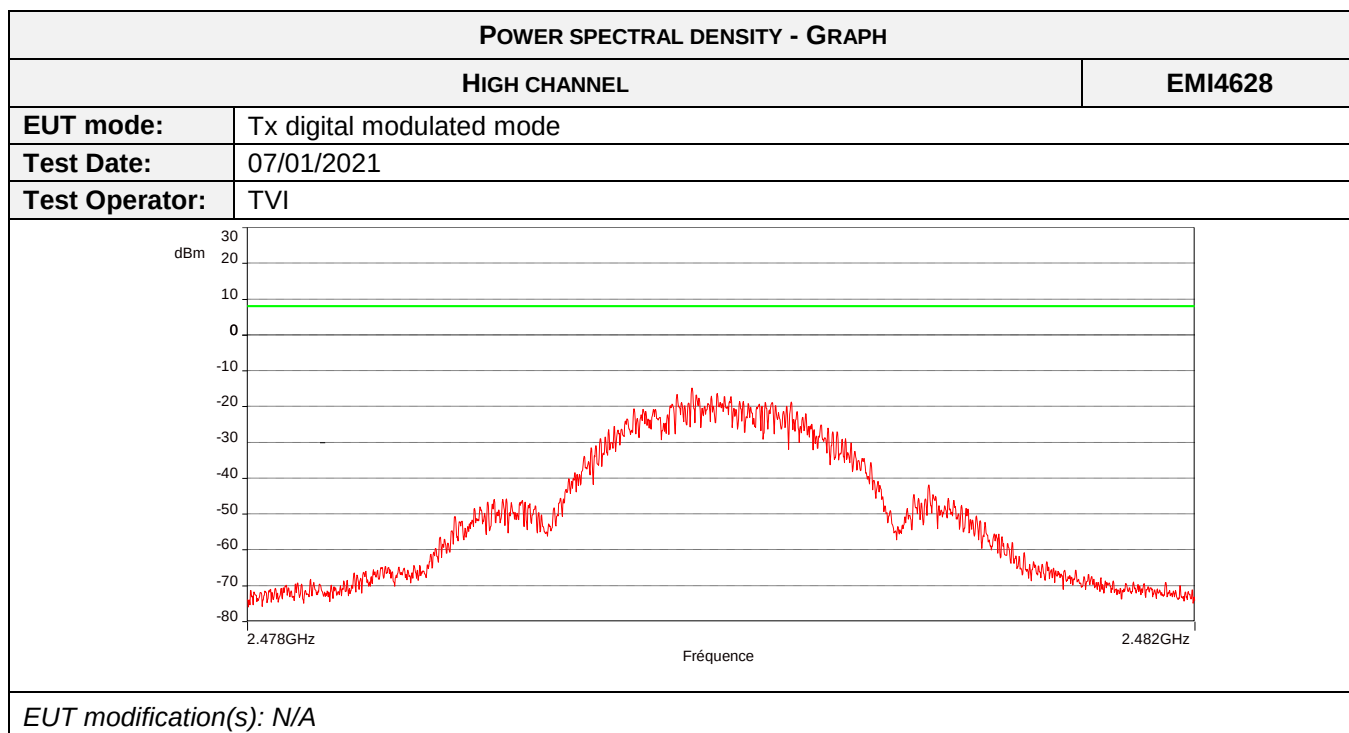
TEST EQUIPMENT USED					
CATEGORY	BRAND	TYPE	IDENTIFIER	CAL. DATE	CAL. DUE
Cable	HYTEM	N-7m	10134	29/01/2019	29/03/2021
Spectrum Analyzer	Rohde & Schwarz	FSV40	15776	23/12/2019	23/02/2021



MAXIMUM EFFECTIVE RADIATED POWER SPECTRAL DENSITY - TABULATED RESULTS			
LOW CHANNEL			EMI4630
Frequency	Frequency Fc	Level (dBm/3kHz)	Limit (dBm/3kHz)
2402MHz	N/A	-14.6	8



MAXIMUM EFFECTIVE RADIATED POWER SPECTRAL DENSITY - TABULATED RESULTS			
LOW CHANNEL			EM4627
Frequency	Frequency Fc	Level (dBm/3kHz)	Limit (dBm/3kHz)
2426MHz	N/A	-15.0	8



MAXIMUM EFFECTIVE RADIATED POWER SPECTRAL DENSITY - TABULATED RESULTS			
LOW CHANNEL			EMI4628
Frequency	Frequency Fc	Level (dBm/3kHz)	Limit (dBm/3kHz)
2480MHz	N/A	-15.0	8

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

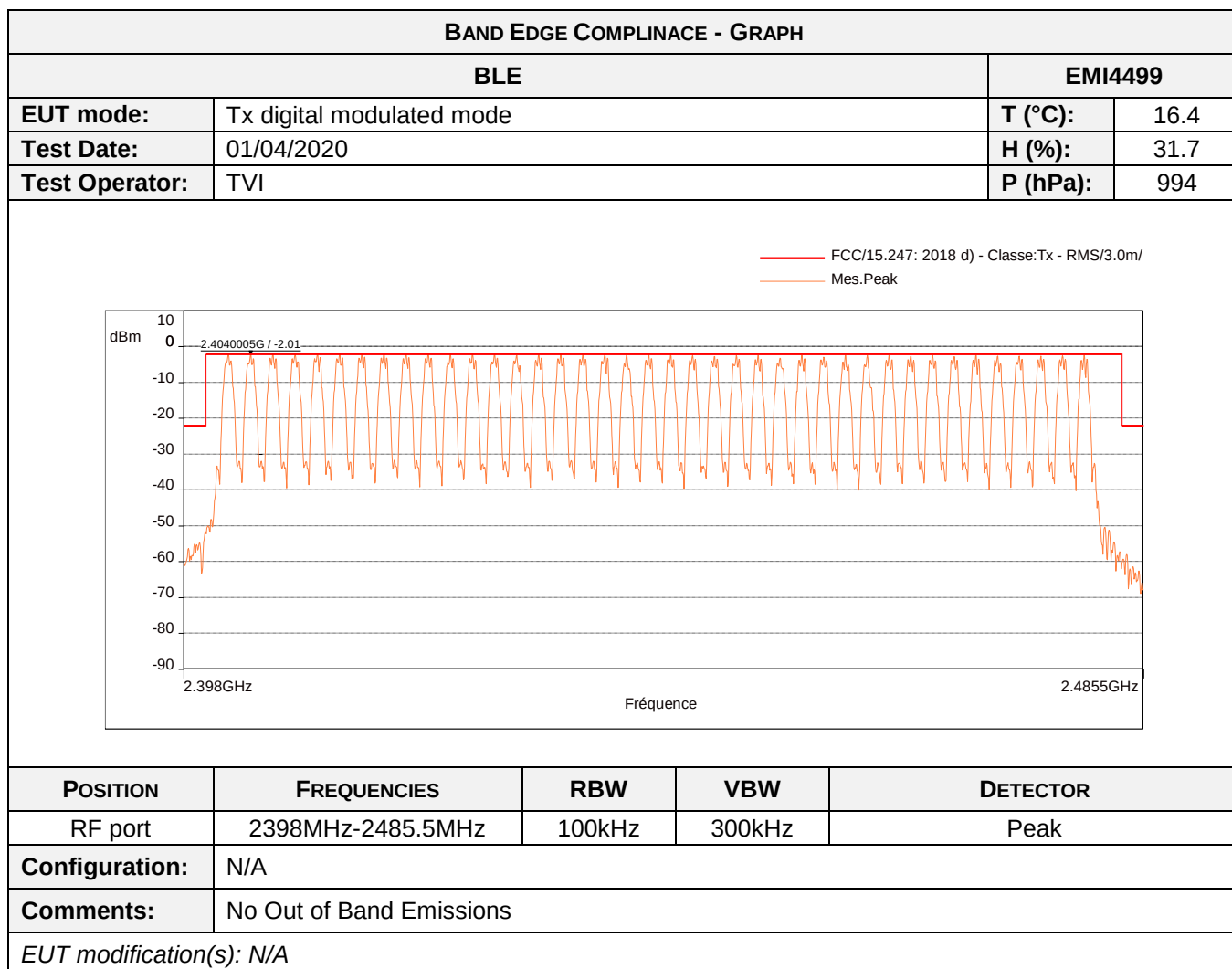
Reference standard:	FCC part 15 Radio part 15.247 and RSS-247
Test method:	FCC part 15.247 subclause d) and RSS-247
Test description: d) In any 100 kHz bandwidth outside the frequency band in which the intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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
BLE	2398 – 2485.5 MHz	20dBc	EMI4499	PASS

LABORATORY PARAMETERS:	REQUIRED PRIOR TO THE TEST	DURING THE TEST
Ambient Temperature	15 to 35 °C	16.4
Relative Humidity	20 to 75 %	31.7
Atmospheric pressure	N/A	994
Test method deviation: N/A		
Supplementary information: N/A		

TEST EQUIPMENT USED					
CATEGORY	BRAND	TYPE	IDENTIFIER	CAL. DATE	CAL. DUE
Spectrum Analyzer	Agilent Technologies	N9010A	11316	14/05/2019	14/07/2020
Cable	H&S	N-1m	15931	04/12/2018	04/02/2021
Attenuator	Narda	6dB	6549	18/06/2019	18/08/2021

Blank cells = Permanent validity



7.6. 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
BLE Tx	9kHz-30MHz	15.209	See below	PASS
BLE Tx	30MHz-1GHz	15.209	See below	PASS
BLE Tx	1GHz-12.5GHz	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 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
Cable	HYTEM	N-7m	10134	29/01/2019	29/03/2021
Preamplifier	Agilent Technologies	8449B	10262	11/05/2020	11/07/2021
Spectrum Analyzer	Agilent Technologies	N9010A	11316	14/05/2020	14/07/2021
Filter	Micro-Tronics	High pass	14038	04/10/2018	04/12/2021
Cable	H&S	N-5m	15909	04/12/2018	04/02/2021
Horn Antenna	Schwarzbeck	9120B	6970	17/01/2018	17/03/2021
Cable	HYTEM	N-6m	7695	04/10/2018	04/12/2020
Log periodic antenna	Emco	3146A	5609	26/08/2020	26/10/2023
Biconic antenna	Rohde & Schwarz	HK116	6118	26/08/2020	26/10/2023
Preamplifier	RFPA	RF30400-27-LNA	6136	04/05/2020	04/07/2021
Cable	/	N-10m	7537	20/09/2018	20/11/2020
Cable	HYTEM	N-10.5m	7655	21/09/2018	21/11/2020
Attenuator	Weinschel Associated	WA1W/6-3-34	14006	21/09/2018	21/11/2021
Cable	H&S	N-3m	15202	05/05/2020	05/07/2022
Antenna	Emco	6502	6155	25/01/2019	25/03/2021
Cable	H&S	BNC	16008	14/01/2019	14/03/2021
Cable	H&S	BNC	16009	14/01/2019	14/03/2021
Cable	H&S	BNC	16016	14/01/2019	14/03/2021
Converter		-51.5dB	9997		
Receiver	Rohde & Schwarz	FSV40	15776	23/12/2019	23/02/2021
Software	Nexio		0000		

Blank cells = Permanent validity

RADIATED SPURIOUS EMISSIONS - TABULATED RESULTS				
TX MODE / LOWEST, CENTRAL & HIGHEST CHANNELS				
Frequency (MHz)	Position / Polarization	Peak Level (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
31.0	Pos 1 / Vertical	39.5 (QP)	40.0	0.5
47.2	Pos 1 / Vertical	37.4 (QP)	40.0	2.6
120.0	Pos 1 / Vertical	36.6	43.5	6.9
240.0	Pos 1 / Vertical	37.3	46.0	8.7
480.0	Pos 1 / Vertical	41.5	46.0	4.5
960.1	Pos 1 / Vertical	47.8	54.0	6.2
120.0	Pos 1 / Horizontal	38.7	43.5	14.8
480.0	Pos 1 / Horizontal	38.7	46.0	7.3
720.0	Pos 1 / Horizontal	39.2	46.0	6.8
960.1	Pos 1 / Horizontal	50.4	54.0	3.6
1884	Pos 1 / Vertical	47.0	54.7 (1)	7.7
12415	Pos 1 / Vertical	47.3	54.0	6.7
1889	Pos 1 / Horizontal	45.5	54.7 (1)	9.2
4896	Pos 1 / Horizontal	51.2	54.7 (1)	3.5
12394	Pos 1 / Horizontal	47.3	54.0	6.7
31.4	Pos 2 / Vertical	37.3 (QP)	40.0	2.7
46.7	Pos 2 / Vertical	35.4 (QP)	40.0	4.6

RADIATED SPURIOUS EMISSIONS - TABULATED RESULTS				
TX MODE / LOWEST, CENTRAL & HIGHEST CHANNELS				
Frequency (MHz)	Position / Polarization	Peak Level (dBμV/m)	Peak Limit (dBμV/m)	Margin (dB)
120.0	Pos 2 / Vertical	36.7	43.5	6.8
240.0	Pos 2 / Vertical	37.6	46.0	8.4
480.0	Pos 2 / Vertical	40.1	46.0	5.9
960.1	Pos 2 / Vertical	47.7	54.0	6.3
33.1	Pos 2 / Horizontal	32.5	40.0	7.5
120.0	Pos 2 / Horizontal	38.0	43.5	5.5
300.0	Pos 2 / Horizontal	36.9	46.0	9.1
719.7	Pos 2 / Horizontal	40.2	46.0	5.8
960.1	Pos 2 / Horizontal	46.3	54.0	7.7
1889	Pos 2 / Vertical	45.1	54.7 (1)	9.6
4953	Pos 2 / Vertical	50.4	54.7 (1)	4.3
12391	Pos 2 / Vertical	47.3	54.0	6.7
12391	Pos 2 / Horizontal	47.1	54.0	6.9
31.4	Pos 3 / Vertical	37.2 (QP)	40.0	2.8
46.7	Pos 3 / Vertical	36.1 (QP)	40.0	3.9
120.0	Pos 3 / Vertical	36.6	43.5	6.9
240.0	Pos 3 / Vertical	37.6	46.0	9.4
480.0	Pos 3 / Vertical	40.3	46.0	5.7
960.1	Pos 3 / Vertical	48.1	54.0	5.9
32.8	Pos 3 / Horizontal	32.2	40.0	7.8
120.0	Pos 3 / Horizontal	37.9	43.5	5.6
300.0	Pos 3 / Horizontal	37.3	46.0	8.7
960.1	Pos 3 / Horizontal	46.4	54.0	7.6
1891	Pos 3 / Vertical	47.2	54.7 (1)	7.5
12396	Pos 3 / Vertical	47.3 (Av)	54.0	6.7
1198	Pos 3 / Horizontal	41.2	54.7 (1)	13.5

V= Vertical H=Horizontal

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

Note 1 : The limit outside the restricted bands are 30 dB below the carrier power.

The lowest power of the carrier is 84.7 dBμV/m, so limit is 54.7 dBμV/m.

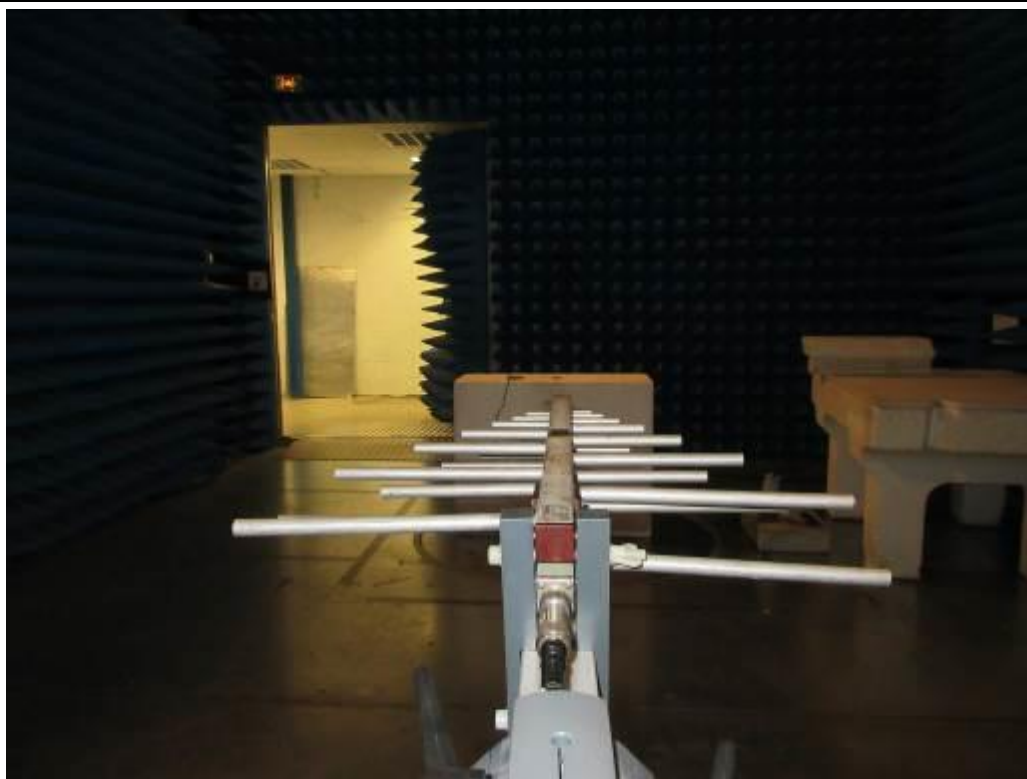
TEST SETUP PHOTO(S) RADIATED EMISSIONS ($F < 30\text{MHz}$)



TEST SETUP PHOTO(S) RADIATED EMISSIONS (F>1GHz)



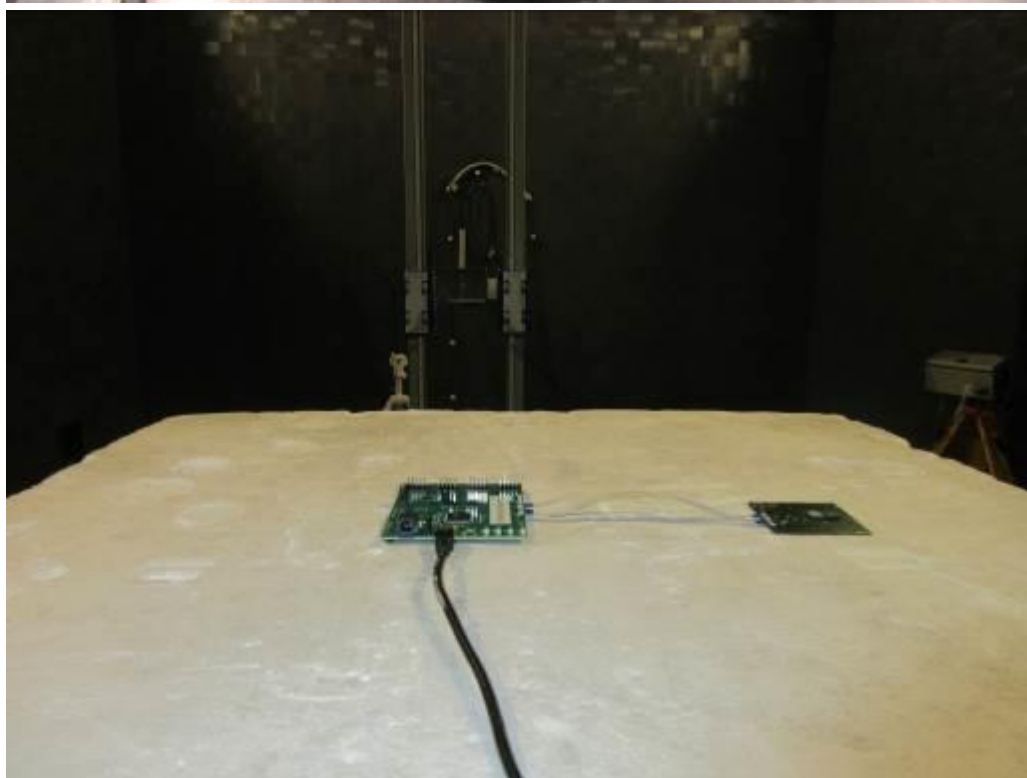
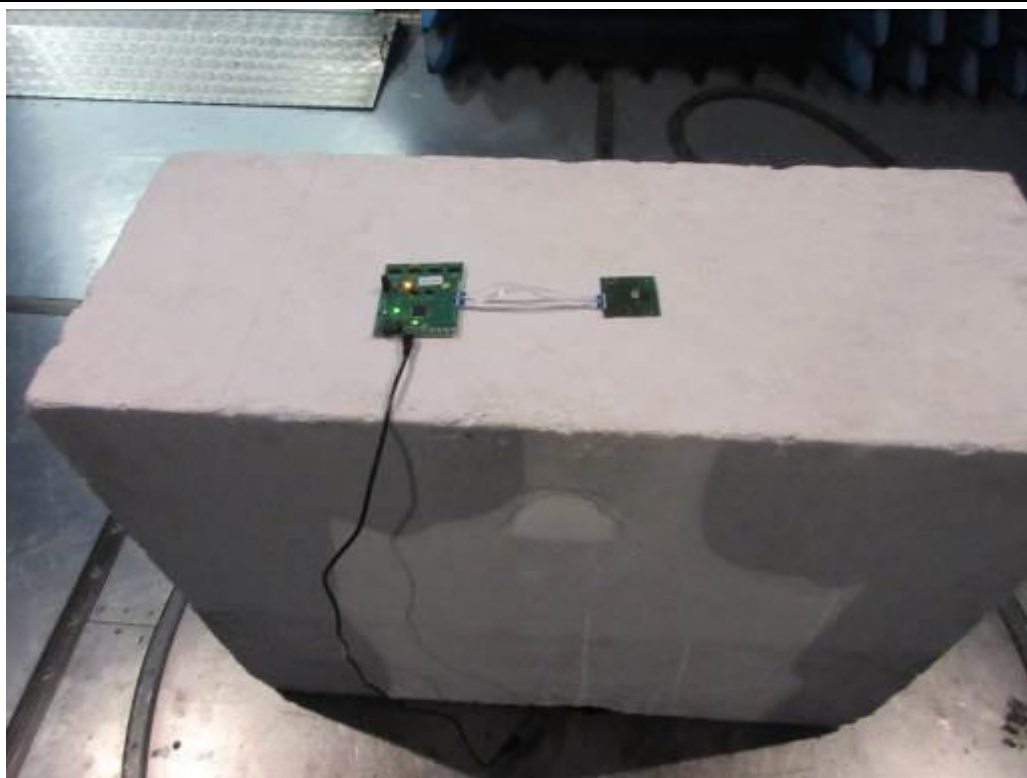
TEST SETUP PHOTO(S) RADIATED EMISSIONS (300MHz>F>1GHz)



TEST SETUP PHOTO(S) RADIATED EMISSIONS (3MHz>F>300MHz)



TEST SETUP PHOTO(S) RADIATED EMISSIONS – POSITION 1

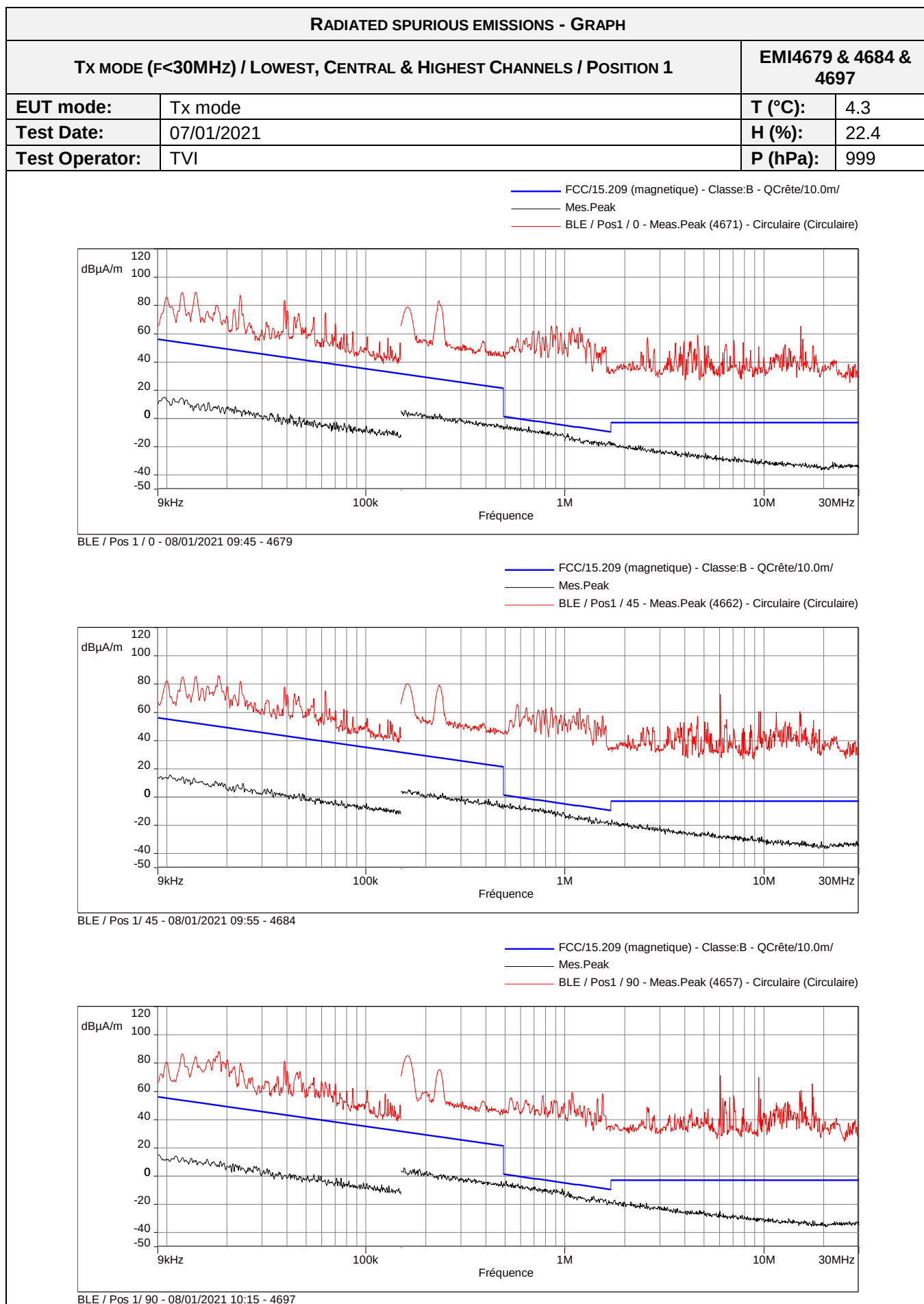


TEST SETUP PHOTO(S) RADIATED EMISSIONS – POSITION 2



TEST SETUP PHOTO(S) RADIATED EMISSIONS – POSITION 3

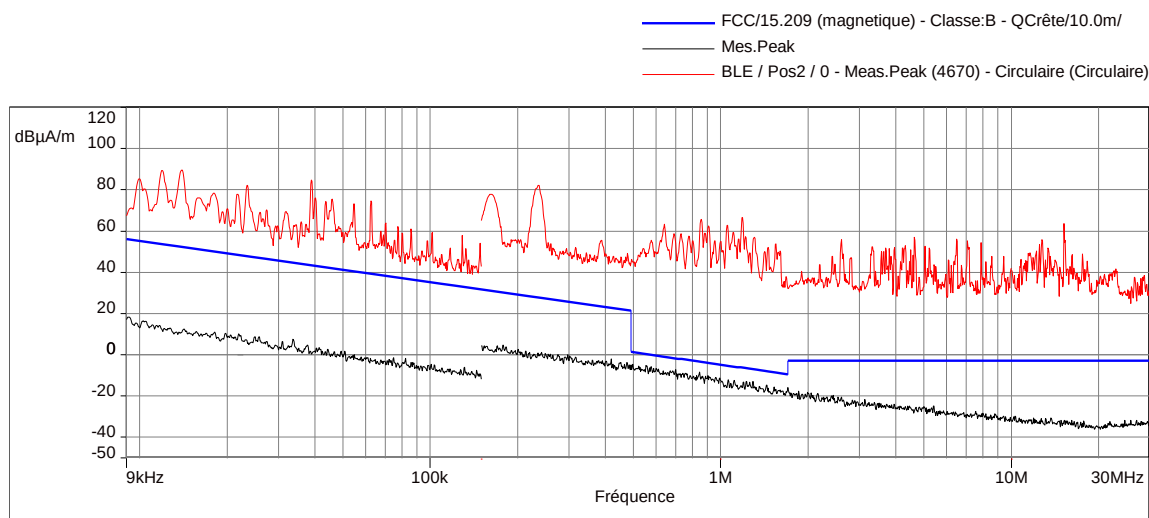




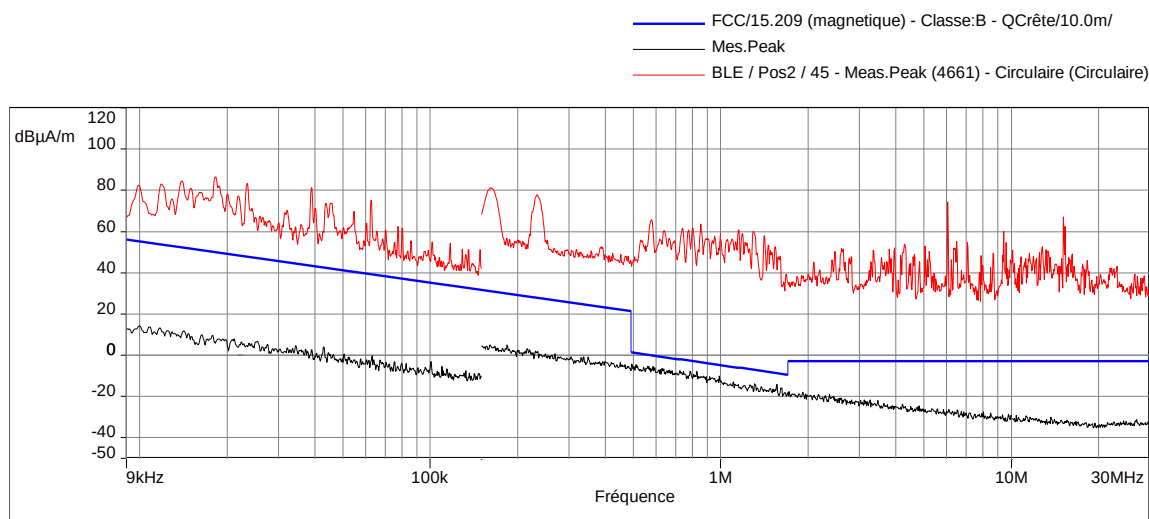
RADIATED SPURIOUS EMISSIONS - GRAPH				
TX MODE (F<30MHz) / LOWEST, CENTRAL & HIGHEST CHANNELS / POSITION 1				EMI4679 & 4684 & 4697
POSITION	FREQUENCIES	RBW	VBW	DETECTOR
0°	9kHz-150kHz	200Hz	1kHz	Peak
0°	150kHz-1MHz	9kHz	30kHz	Peak
0°	200MHz-1GHz	9kHz	30kHz	Peak
45°	9kHz-150kHz	200Hz	1kHz	Peak
45°	150kHz-1MHz	9kHz	30kHz	Peak
45°	200MHz-1GHz	9kHz	30kHz	Peak
90°	9kHz-150kHz	200Hz	1kHz	Peak
90°	150kHz-1MHz	9kHz	30kHz	Peak
90°	200MHz-1GHz	9kHz	30kHz	Peak
Configuration:	N/A			
Comments:	The EUT was placed in sweep mode, from the first to the last. The black graphs represent the level measured in FAR, used to know which peak come from the EUT and which come from the environment. No spurious detected			
EUT modification(s): N/A				

RADIATED SPURIOUS EMISSIONS - GRAPH

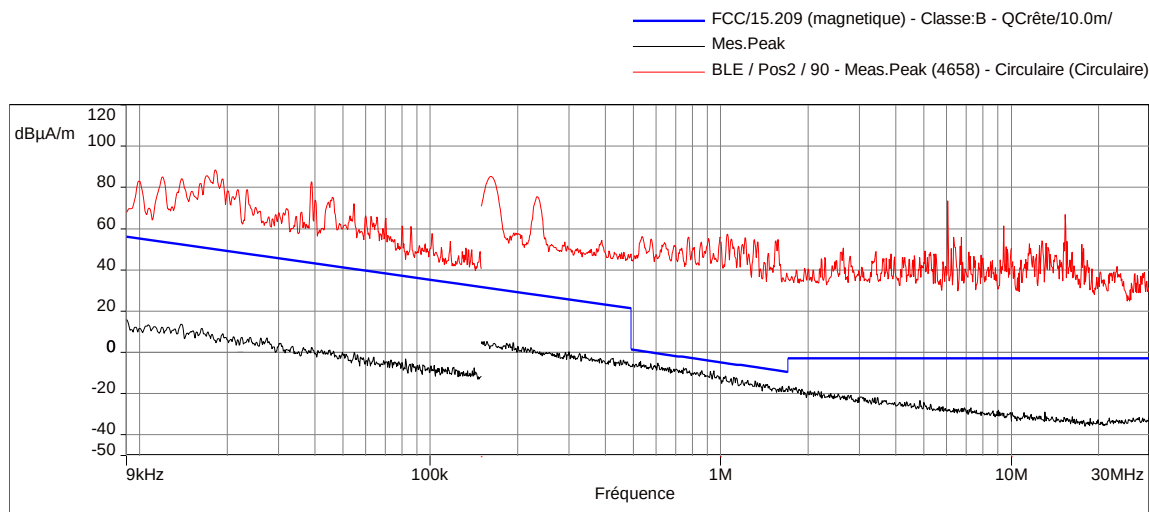
TX MODE (F<30MHz) / LOWEST, CENTRAL & HIGHEST CHANNELS / POSITION 2		EMI4680 & 4683 & 4698	
EUT mode:	Tx mode	T (°C):	4.3
Test Date:	07/01/2021	H (%):	22.4
Test Operator:	TVI	P (hPa):	999



BLE / Pos2 / 0 - 08/01/2021 09:48 - 4680



BLE / Pos2 / 45 - 08/01/2021 10:57 - 4683



BLE / Pos2 / 90 - 08/01/2021 10:16 - 4698

RADIATED SPURIOUS EMISSIONS - GRAPH				
TX MODE (F<30MHz) / LOWEST, CENTRAL & HIGHEST CHANNELS / POSITION 2				EMI4680 & 4683 & 4698
POSITION	FREQUENCIES	RBW	VBW	DETECTOR
0°	9kHz-150kHz	200Hz	1kHz	Peak
0°	150kHz-1MHz	9kHz	30kHz	Peak
0°	200MHz-1GHz	9kHz	30kHz	Peak
45°	9kHz-150kHz	200Hz	1kHz	Peak
45°	150kHz-1MHz	9kHz	30kHz	Peak
45°	200MHz-1GHz	9kHz	30kHz	Peak
90°	9kHz-150kHz	200Hz	1kHz	Peak
90°	150kHz-1MHz	9kHz	30kHz	Peak
90°	200MHz-1GHz	9kHz	30kHz	Peak
Configuration:	N/A			
Comments:	The EUT was placed in sweep mode, from the first to the last. The black graphs represent the level measured in FAR, used to know which peak come from the EUT and which come from the environment. No spurious detected			
EUT modification(s): N/A				

RADIATED SPURIOUS EMISSIONS - GRAPH

TX MODE (F<30MHz) / LOWEST, CENTRAL & HIGHEST CHANNELS / POSITION 3

EMI4681 & 4682 & 4699

EUT mode: Tx mode

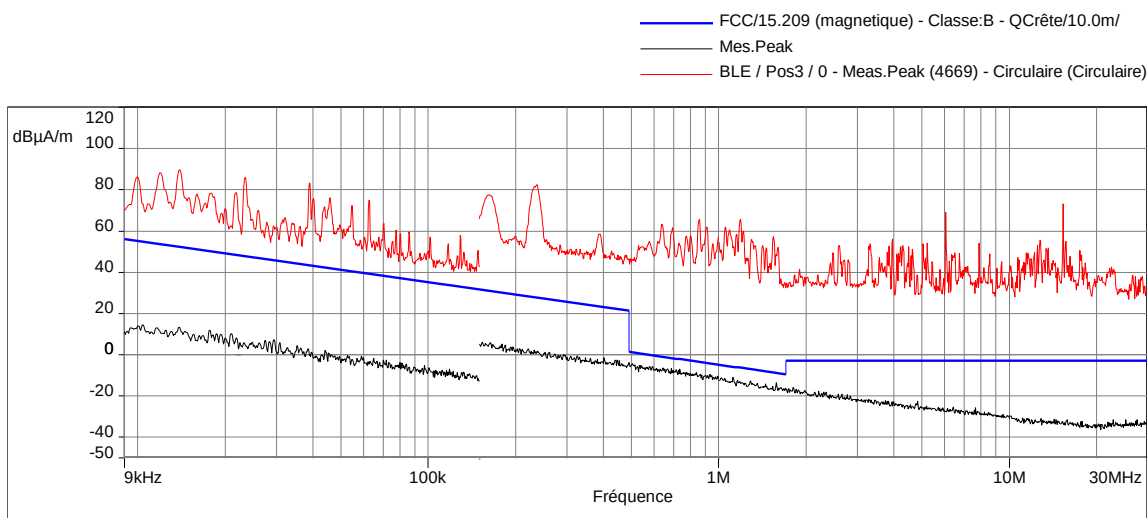
T (°C): 4.3

Test Date: 07/01/2021

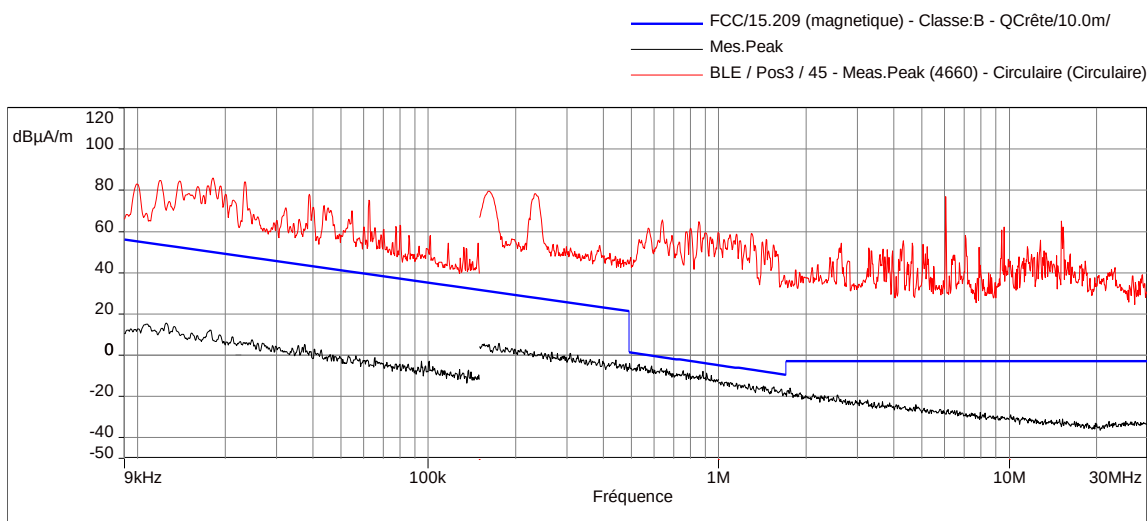
H (%): 22.4

Test Operator: TVI

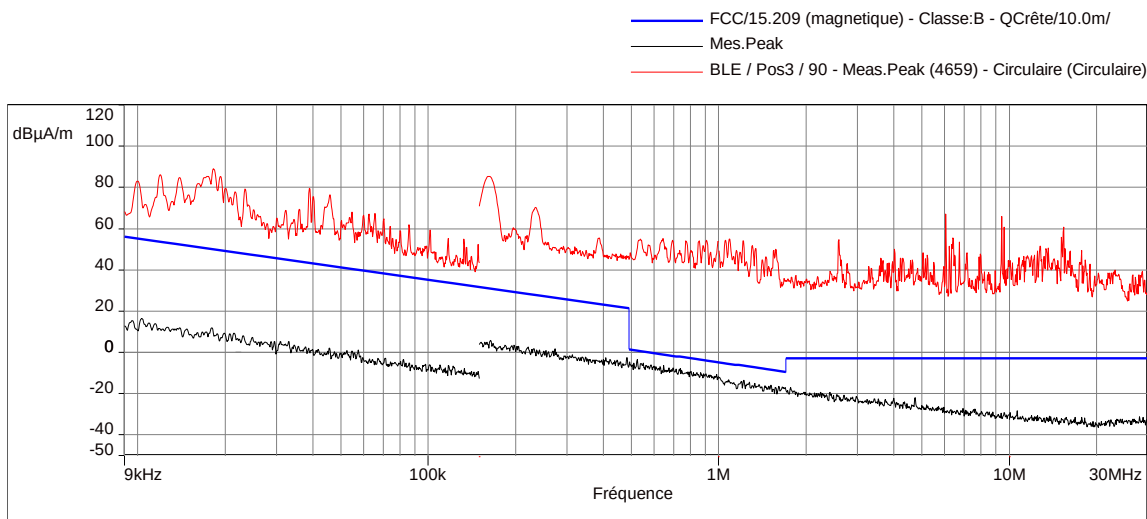
P (hPa): 999



BLE / Pos3 / 0 - 08/01/2021 09:49 - 4681

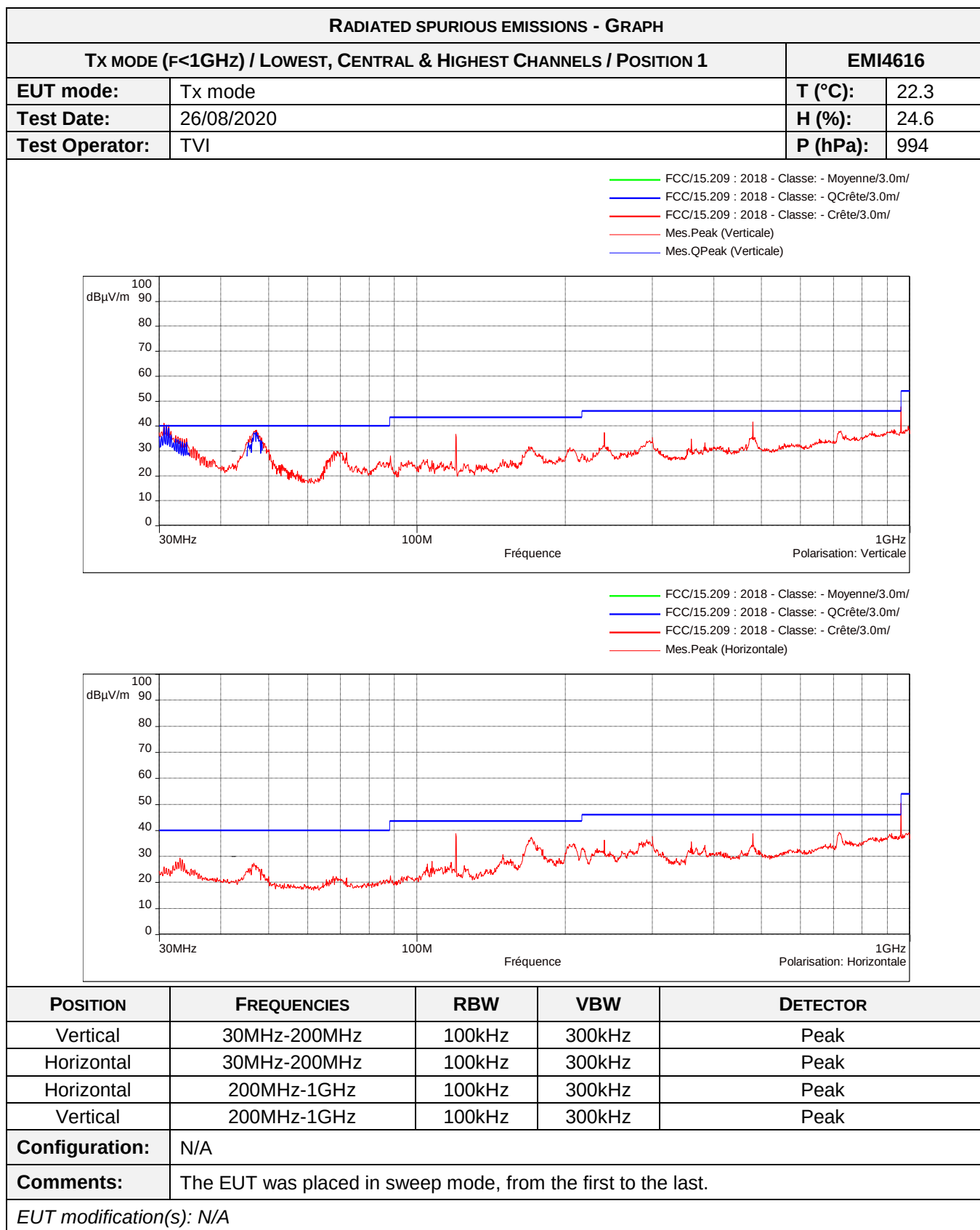


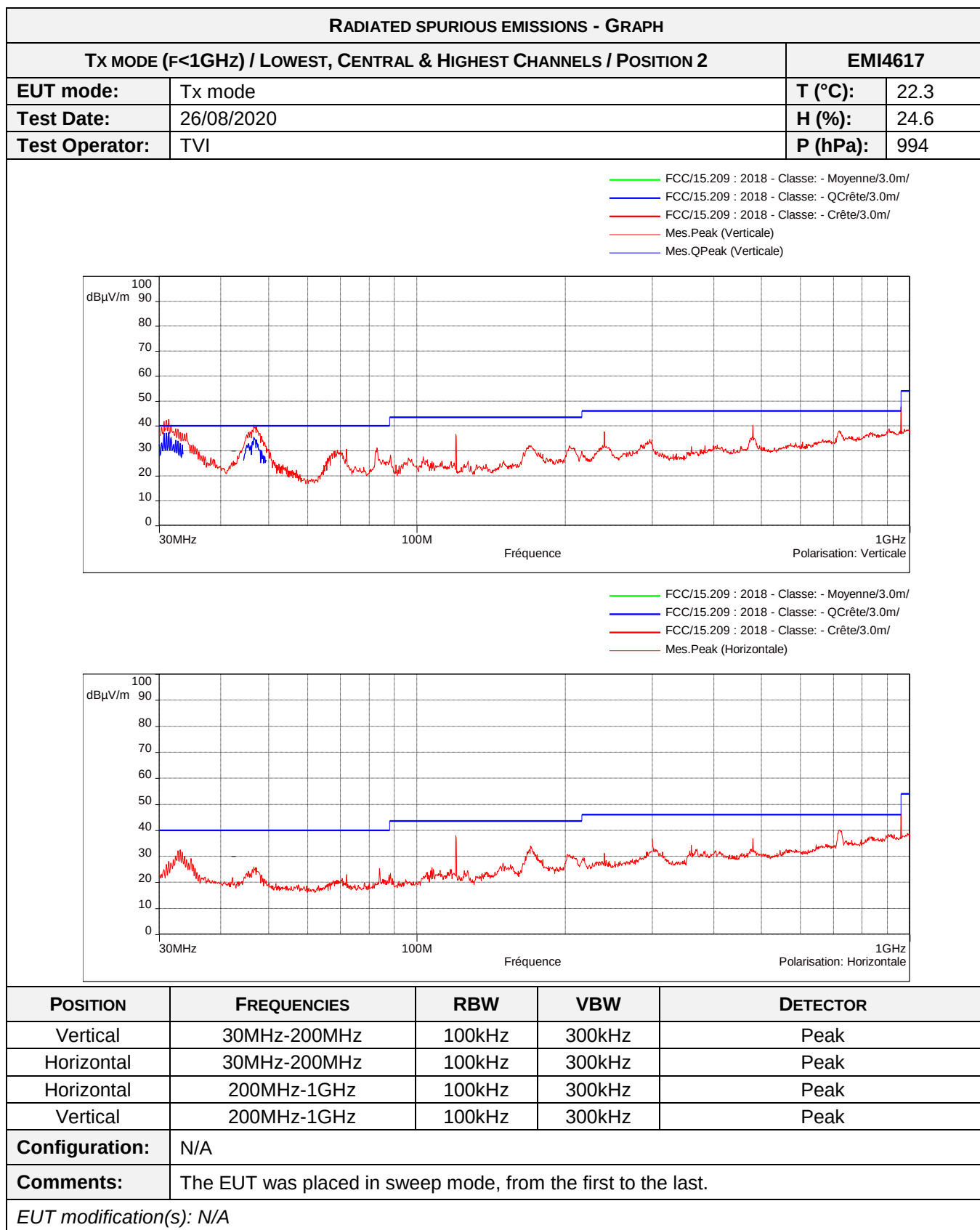
BLE / Pos3 / 45 - 08/01/2021 09:53 - 4682

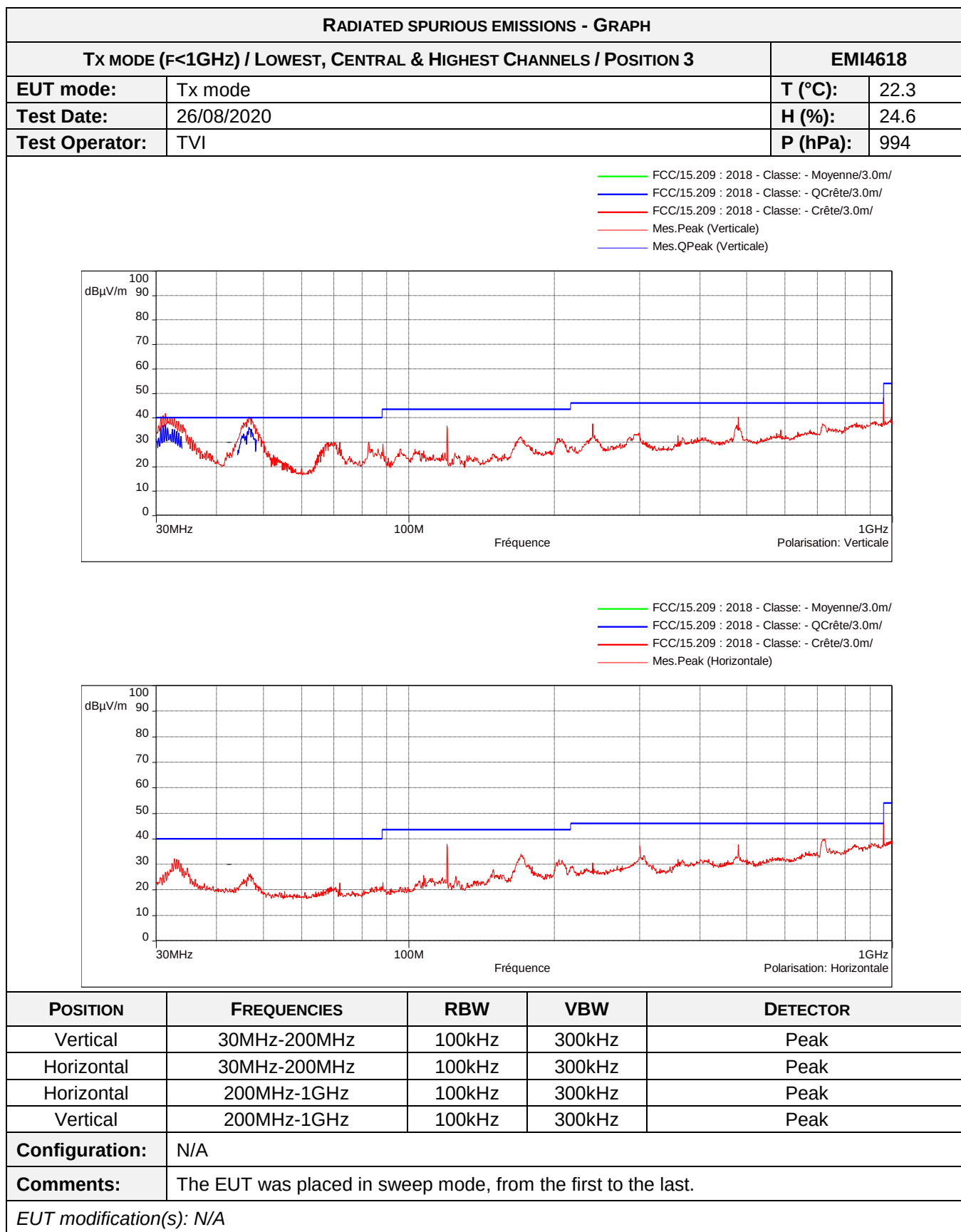


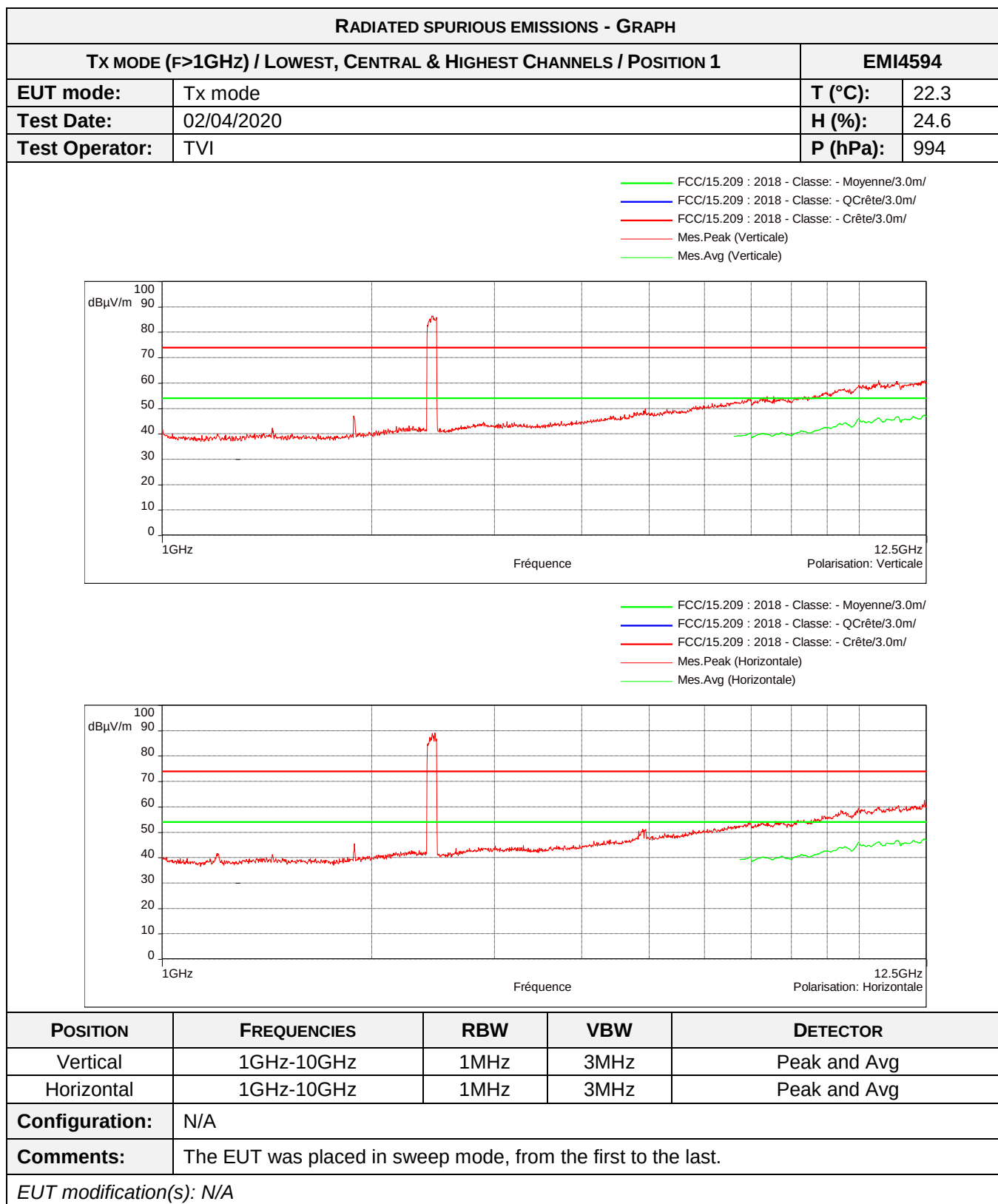
BLE / Pos3 / 90 - 08/01/2021 10:17 - 4699

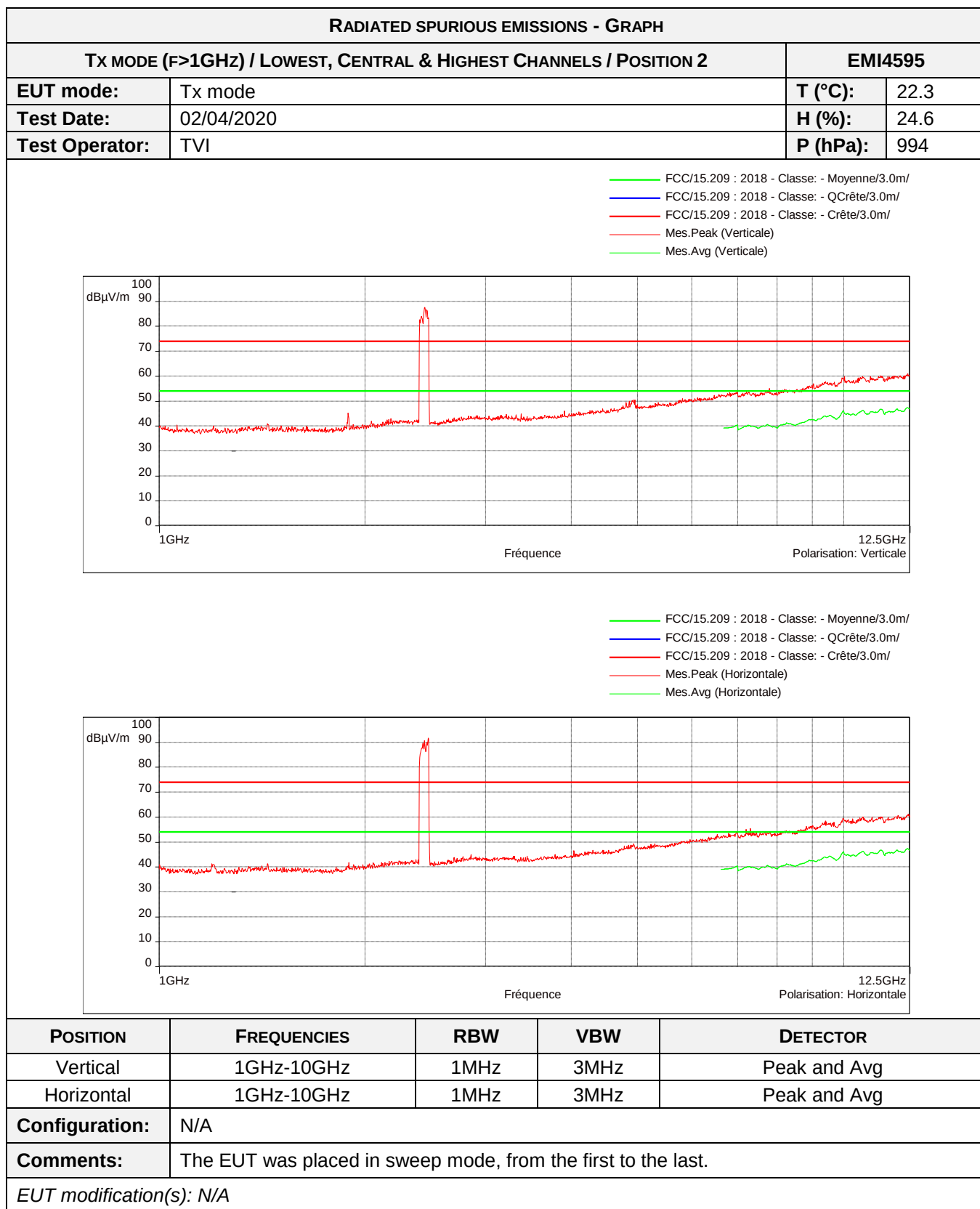
RADIATED SPURIOUS EMISSIONS - GRAPH				
TX MODE (F<30MHz) / LOWEST, CENTRAL & HIGHEST CHANNELS / POSITION 3				EMI4681 & 4682 & 4699
POSITION	FREQUENCIES	RBW	VBW	DETECTOR
0°	9kHz-150kHz	200Hz	1kHz	Peak
0°	150kHz-1MHz	9kHz	30kHz	Peak
0°	200MHz-1GHz	9kHz	30kHz	Peak
45°	9kHz-150kHz	200Hz	1kHz	Peak
45°	150kHz-1MHz	9kHz	30kHz	Peak
45°	200MHz-1GHz	9kHz	30kHz	Peak
90°	9kHz-150kHz	200Hz	1kHz	Peak
90°	150kHz-1MHz	9kHz	30kHz	Peak
90°	200MHz-1GHz	9kHz	30kHz	Peak
Configuration:	N/A			
Comments:	The EUT was placed in sweep mode, from the first to the last. The black graphs represent the level measured in FAR, used to know which peak come from the EUT and which come from the environment. No spurious detected			
EUT modification(s): N/A				

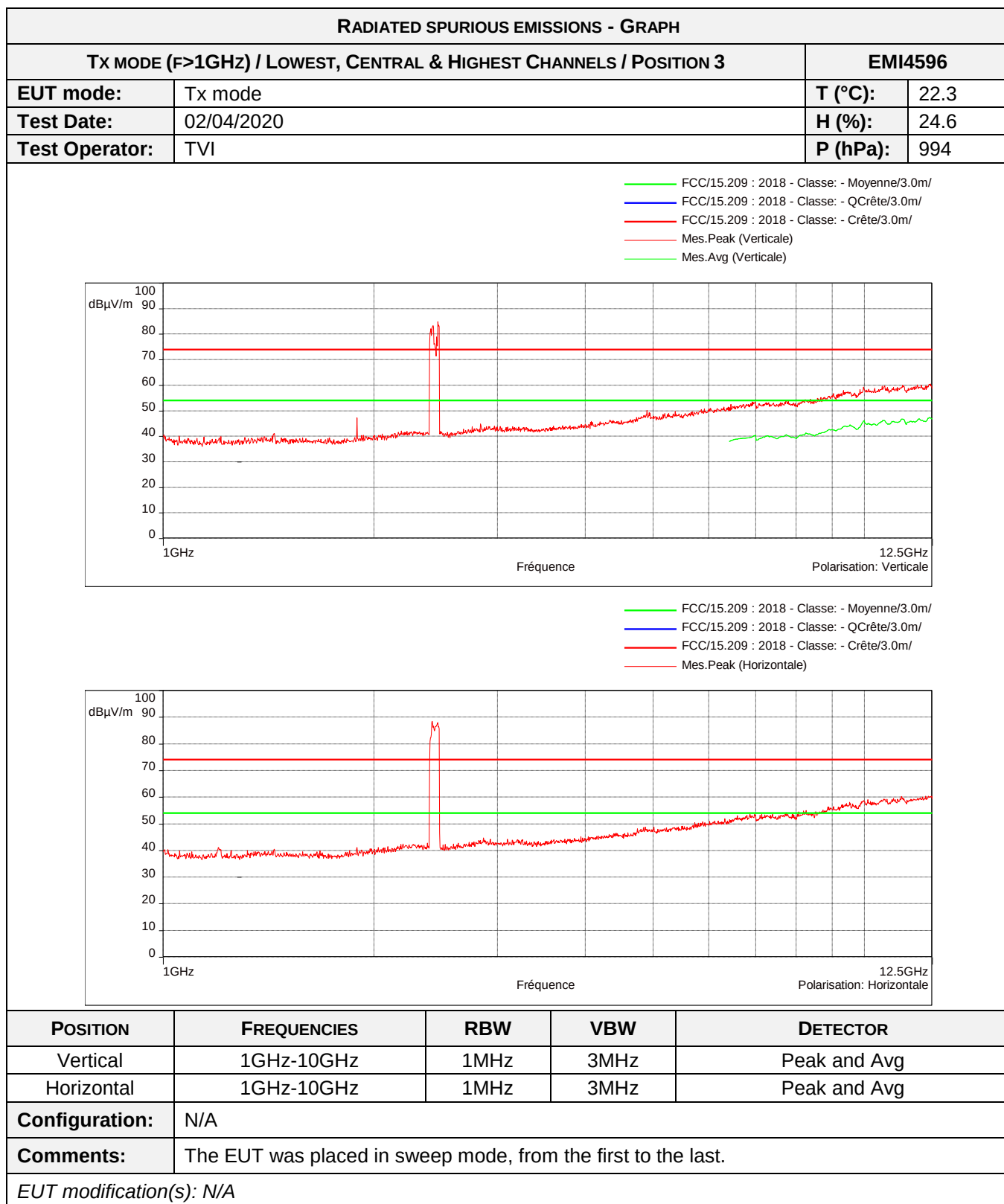












7.7. Measurement of Frequency Stability §15.215 (C) And RSS-GEN

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	BLE	-	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
Spectrum Analyzer	Agilent Technologies	N9010A	11316	14/05/2019	14/07/2020
Cable	H&S	N-1m	15931	04/12/2018	04/02/2021
Software	Nexio		0000		
Thermohygrometer	Testo	608-H1	15790	12/11/2018	12/01/2021
Climatic chamber	CLIMATIS	EXCAL 4014-TA	12398	04/03/2020	04/05/2022

BAT-EMC software version: V3.18.0.26
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	3.3 (1)	2402,001026	-
Extremes tests conditions / Low channel	-30	3.3 (1)	2402,001714	0.688
Extremes tests conditions / Low channel	85	3.3 (1)	2402,002718	1,692
Normal conditions / Central channel	25	3.3 (1)	2426.001045	-
Extremes tests conditions / Central channel	-30	3.3 (1)	2426.001702	0.657
Extremes tests conditions / Central channel	85	3.3 (1)	2426.002147	1.102
Normal conditions / High channel	25	3.3 (1)	2480,001036	-
Extremes tests conditions / High channel	-30	3.3 (1)	2480,001627	0.591
Extremes tests conditions / High channel	85	3.3 (1)	2480,002733	1,697

Note 1 : The voltage of the EUT is provided by an EA, which regulate the voltage of the EUT. Modifying the voltage of provided would only modify the voltage of the EA, and not the EUT.

EUT MODIFICATIONS	OPERATOR	TEST DATE	RESULT TAB.
N/A	TVI	03/04/2020	-

End of test report