

RR051-16-102572-1-A Ed. 0

Certification Radio test report

According to the standard:
CFR 47 FCC PART 15

Equipment under test:
RF MODULE

Model:
SB

FCC ID: OQMSB

Company:
JAY ELECTRONIQUE

DISTRIBUTION: Mr REGAL

(Company: JAY ELECTRONIQUE)

Number of pages: 34 with 6 appendixes

Ed.	Date	Modified pages	Written by		Technical Verification and Quality Approval	
			Name	Visa	Name	Visa
0	17-NOV-2016	Creation	S. LOUIS	SL		

Duplication of this test report is only permitted for an integral photographic facsimile. It includes the number of pages referenced here above.
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.



DESIGNATION OF PRODUCT: RF MODULE

Serial number (S/N): Sample 1: 140074334
Sample 2: 140074335

Reference / model (P/N): SB

Software version: V0109

MANUFACTURER: JAY ELECTRONIQUE

COMPANY SUBMITTING THE PRODUCT:

Company: JAY ELECTRONIQUE

Address: ZAC LA BATIE
37, ALLEE CHAMPROND
38334 SAINT ISMIER CEDEX
FRANCE

Responsible: Mr REGAL

Person present during the tests: —

DATES OF TEST: From 22-SEPT-2016 to 07-OCT-2016

TESTING LOCATION: EMITECH ANGERS laboratory at JUIGNE SUR LOIRE (49) FRANCE
EMITECH ANGERS open area test site in JUIGNE SUR LOIRE (49)
FRANCE
21 rue de la Fuye
49610 Juigne sur Loire
France
FCC Accredited under US-EU MRA Designation Number: FR0009
Test Firm Registration Number: 873677

TESTED BY: S. LOUIS

CONTENTS

<i>TITLE</i>	<i>PAGE</i>
1. INTRODUCTION	4
2. PRODUCT DESCRIPTION	4
3. NORMATIVE REFERENCE	5
4. TEST METHODOLOGY	6
5. TEST EQUIPMENT CALIBRATION DATES	7
6. TESTS AND CONCLUSIONS	8
7. MEASUREMENT UNCERTAINTY	11
8. ADDITIONAL PROVISIONS TO THE GENERAL RADIATED EMISSION LIMITATIONS	12
9. FUNDAMENTAL AND HARMONICS FIELD STRENGTH	14
10. OUT OF BAND EMISSIONS	21

APPENDIX 1: Photos of the equipment under test

APPENDIX 2: Test set up

APPENDIX 3: Test equipment list

APPENDIX 4: Band edge

APPENDIX 5: 20dB Bandwidth

APPENDIX 6: 99% Bandwidth

1. INTRODUCTION

This document presents the result of RADIO test carried out on the following equipment: **RF module - Model SB**, used with different antennas in accordance with normative reference.

The device under test is a module.

2. PRODUCT DESCRIPTION

Class: B (residential)

Utilization: radio modules with or without integral antenna.

Antenna type and gain: 6 antennas type certified in this report (according to RD019-16-101078-1 Ed. 0)

Model	Connector	Type	Polarization	Gain (dBi)	Frequencies (MHz)	Other
FR05-S1-R-0-105	N/A	Chip Antenna	N/A	0	902-928	Validated Antenna
VUA10xBM	BNC - 50Ω	Tuned	Vertical	5	806-870	Ground plane required (60x60cm)
FLX-900/915-FME	FME femal - 50Ω	½ wave	Vertical	7*	820-960	
VUB884	BNC - 50Ω	¼ wave	Vertical	0	911-918	Validated Antenna
EDBS-PRO900-4-BNC	BNC male - 50Ω	¼ wave	Vertical	1.5	860-920	Ground plane required (16x16cm)
VUA001B	BNC - 50Ω	¼ wave	Vertical	2	890-960	

For the antennas described here after, since they are the same type as those listed above (provided the same manner to meet the manufacturer's specification in terms of minimum cable length and ground plane), they can be used without being listed in the Module certification in the OEM manual.

Model	Connector	Type	Polarization	Gain (dBi)	Frequencies (MHz)	Other
EDBS-PRO900-2-BNC	BNC male - 50Ω	½ wave	Vertical	0	860-920	Ground plane required (20x20cm)
VUA002B	BNC - 50Ω	½ wave	Vertical	3	860-960	
VUA10xBH	BNC - 50Ω	½ wave	Vertical	4	860-960	
VUA10xBV	BNC - 50Ω	¼ wave	Vertical	2	900-920	

Operating frequency range:	band from 911.8 MHz to 918.2 MHz
Number of channels:	64
Channel spacing:	100 kHz
Frequency generation:	Integrated fractional synthesis rate in the radio chip
Modulation:	FSK
Power source:	2.8 – 5.5Vdc

Power level, frequency range and channels characteristics are not user adjustable.
The details pictures of the product and the circuit boards are joined with this file.

3. NORMATIVE REFERENCE

The standards and testing methods related throughout this report are those listed below.
They are applied on the whole test report even though the extensions (version, date and amendment) are not repeated.

CFR 47 FCC Part 15 (2016) Radio Frequency Devices

ANSI C63.4 2014
Methods of measurement of Radio-Noise
Emissions from low-voltage Electrical and Electronic Equipment in the Range
of 9 kHz to 40 GHz.

ANSI C63.10 2013
Testing Unlicensed Wireless Devices.

4. TEST METHODOLOGY

Radio performance tests procedures given in CFR 47 part 15:

Subpart A –General

Paragraph 19: labelling requirements

Paragraph 21: information to user

Subpart B –Unintentional Radiators

Paragraph 105: information to the user

Paragraph 107: Conducted limits

Paragraph 109: Radiated emission limits

Paragraph 111: Antenna power conduction limits for receivers

Subpart C – Intentional Radiators

Paragraph 203: Antenna requirement

Paragraph 205: Restricted bands of operation

Paragraph 207: Conducted limits

Paragraph 209: Radiated emission limits; general requirements

Paragraph 212: Modular transmitters

Paragraph 215: Additional provisions to the general radiated emission limitations

Paragraph 249: Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5850 MHz and 24.0-24.25 GHz.

5. TEST EQUIPMENT CALIBRATION DATES

Emitech Number	Model	Type	Last verification	Next verification	Validity
0000	BAT-EMC V3.6.0.32	Software	/	/	/
1406	EMCO 6502	Loop antenna	27/01/2015	27/01/2017	27/03/2017
4088	R&S FSP40	Spectrum Analyzer	29/10/2015	29/10/2017	29/12/2017
7310	Filtek HP12/1200-5AA	High-pass filter	03/03/2016	03/03/2018	03/05/018
8511	HP 8447D	Low-noise amplifier	07/10/2015	07/10/2016	07/12/2016
8526	Schwarzbeck VHBB 9124	Biconical antenna	12/06/2015	12/06/2018	12/08/2018
8528	Schwarzbeck VHA 9103	Biconical antenna	15/03/2016	15/03/2019	15/05/2019
8535	EMCO 3115	Antenna	29/10/2012	29/10/2016	29/12/2016
8543	Schwarzbeck UHALP 9108A	Log periodic antenna	12/06/2015	12/06/2018	12/08/2018
8593	SIDT Cage 2	Anechoic chamber	/	/	/
8676	ISOTECH IDM106N	Multimeter	21/05/2015	21/05/2017	21/07/2017
8707	R&S ESI7	Test receiver	07/06/2016	07/06/2018	07/08/2018
8732	Emitech	OATS	18/02/2015	18/02/2018	18/04/2018
8749	La Crosse Technology WS-9232	Meteo station	03/09/2014	03/09/2016	03/11/2016
8750	La Crosse Technology WS-9232	Meteo station	03/09/2014	03/09/2016	03/11/2016
8775	Fontaine FTN 2515B	Power source	/	/	/
8783	EMCO 3147	Log periodic antenna	15/03/2016	15/03/2019	15/05/2019
8864	Champ libre Juigné. V3.5	Software	/	/	/
8896	ACQUISYS GPS8	Satellite synchronized frequency standard	/	/	/
10739	LUCIX Corp S005180M3201	Low-noise amplifier	20/01/2016	20/01/2017	20/03/2017

6. TESTS AND CONCLUSIONS

6.1 general

Test procedure	Description of test	Respected criteria?				Comment
		Yes	No	NAp	NAs	
FCC Part 15.19	LABELLING REQUIREMENTS	X				See certification documents
FCC Part 15.21	INFORMATION TO USER	X				See certification documents

NAp: Not Applicable

NAs: Not Asked

6.2 unintentional radiator (subpart B)

Test procedure	Description of test	Respected criteria?				Comment
		Yes	No	NAp	NAs	
FCC Part 15.105	INFORMATION TO THE USER	X				See certification documents
FCC Part 15.107	CONDUCTED LIMITS			X		Certification report
FCC Part 15.109	RADIATED EMISSION LIMITS			X		Certification report
FCC Part 15.111	ANTENNA POWER CONDUCTED LIMITS FOR RECEIVER			X		

NAp: Not Applicable

NAs: Not Asked

6.3 intentional radiator (subpart C)

Test procedure	Description of test	Respected criteria?				Comment
		Yes	No	NAP	NAs	
FCC Part 15.203	ANTENNA REQUIREMENT	X				Note 1
FCC Part 15.205	RESTRICTED BANDS OF OPERATION	X				
FCC Part 15.207	CONDUCTED LIMITS			X		Certification report Note 2
FCC Part 15.209	RADIATED EMISSION LIMITS; general requirements	X				Note 3
FCC Part 15.212	MODULAR TRANSMITTERS	X				Note 4
FCC part 15.215	ADDITIONAL PROVISIONS TO THE GENERAL RADIATED EMISSION LIMITATIONS					
	(a) Alternative to general radiated emission limits	X				
	(b) Unwanted emissions outside of §15.249 frequency bands	X				Note 5
	(c) 20 dB bandwidth and band-edge compliance	X				
FCC Part 15.249	OPERATION WITHIN THE BANDS 902-928 MHz, 2400-2483.5 MHz, 5725-5850 MHz AND 24.0-24.25 GHz					
	(a) Fundamental and harmonics field strength	X				
	(b) Fixed point-to-point operation			X		
	(c) Measurement distance	X				
	(d) Out-of-band emissions	X				
	(e) Field strength limits above 1 GHz	X				

NAP: Not Applicable

NAs: Not Asked

Note 1: Integral / dedicated antenna.

Note 2 The conducted emissions shall be performed in the final product.

Note 3: See FCC part 15.249 (d).

Note 4: Single modular transmitter.

The host devices of the certified modules shall be properly labeled to identify the module within.

Note 5: See FCC part 15.209. Unwanted emissions levels are all below the fundamental emission field strength level.

RF EXPOSURE:**For mobile or fixed application**

Maximum measured power = 93.95 dB μ V/m = 0.745 mW at 911.8MHz

with $P = (E \times d)^2 / (30 \times G_p)$ with $d = 3 \text{ m}$ and $G_p = 1$

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

$$PSD = EIRP / (4 \times \pi \times R^2)$$

$$\Rightarrow 0.745 / (4 \times \pi \times (20 \text{ cm})^2) = 0.148 \times 10^{-3} \text{ mW/cm}^2 \text{ (limit = 0.607 mW/cm}^2\text{)}$$

The equipment fulfils the requirements on power density for general population/uncontrolled exposure and therefore fulfils the requirements of 47 CFR §1.1310.

For portable application

Maximum measured power = 93.95 dB μ V/m = 0.745 mW at 911.8MHz

with $P = (E \times d)^2 / (30 \times G_p)$ with $d = 3 \text{ m}$ and $G_p = 1$

In accordance with KDB 447498 D01 General RF Exposure Guidance v06, Paragraph 4.3.1.

The product must respect the exclusion limit for 1-g extremity SAR (head and body).

$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \times [\sqrt{f(\text{GHz})}] \leq 3$$

According this formula:

$$\text{Min. test separation distance, mm} \geq [(\text{max. power of channel, including tune-up tolerance, mW}) \times \sqrt{f(\text{GHz})}] / 3$$

$$\text{Min. test separation distance, mm} \geq [0.745(\text{mW}) \times \sqrt{(0.9118)}] / 3$$

Min. test separation distance, mm $\geq 0.23 \text{ mm}$ (with a minimum value of 5 mm)

The product must respect the exclusion limit for 10-g extremity SAR.

$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \times [\sqrt{f(\text{GHz})}] \leq 7.5$$

According this formula:

$$\text{Min. test separation distance, mm} \geq [(\text{max. power of channel, including tune-up tolerance, mW}) \times \sqrt{f(\text{GHz})}] / 7.5$$

$$\text{Min. test separation distance, mm} \geq [0.745(\text{mW}) \times \sqrt{(0.9118)}] / 7.5$$

Min. test separation distance, mm $\geq 0.09 \text{ mm}$ (with a minimum value of 5 mm)

The equipment fulfils the requirements on power density for general population/uncontrolled exposure and therefore fulfils the requirements of 47 CFR §1.1310 at the distance greater than 5 mm between the user and the antenna

7. MEASUREMENT UNCERTAINTY

« To declare, or not, the compliance with the specifications, it was not explicitly taken into account of uncertainty associated with the result(s) »

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for normal distribution corresponds to a coverage probability of approximately 95%.

Parameter	Emitech Uncertainty
RF power, conducted	$\pm 0.75\text{dB}$
Radiated emission valid to 26 GHz	
F < 62.5 MHz:	$\pm 5.14\text{ dB}$
62.5 MHz < F < 1 GHz:	$\pm 5.13\text{ dB}$
1 GHz < F < 26 GHz:	$\pm 5.16\text{ dB}$
AC Power Lines conducted emissions	$\pm 3.38\text{ dB}$
Temperature	$\pm 1\text{ }^{\circ}\text{C}$
Humidity	$\pm 5\text{ \%}$

8. ADDITIONAL PROVISIONS TO THE GENERAL RADIATED EMISSION LIMITATIONS

Standard: FCC Part 15

Test procedure: Paragraph 15.215, 15.209 and 15.249

Test set up:

Test realized in anechoic chamber. All field strength measurements are correlated with the radiated maximum peak output power

Detection mode: Peak

Bandwidth: 100 kHz

Test operating condition of the equipment:

The equipment under test is blocked in continuous transmission mode, modulated by internal data signal, at the highest output power level which the transmitter is intended to operate.

Results:

Ambient temperature (°C): 21.2
Relative humidity (%): 37

Power source: We used for power source the external power supply regulated to 24Vdc of a TIMO Module Transceiver (see appendix 2).

Lower Band Edge: band from 900 MHz to 902 MHz

Upper Band Edge: band from 928 MHz to 930 MHz

Sample 2: with EDBS-PRO900-4-BNC antenna mounted on ground plane - Power Order = 3

Fundamental frequency (MHz)	Field Strength Level of fundamental (dBμV/m)	Detector (Peak or Average)	Frequency of maximum Band-edges Emission (MHz)	Delta Marker (dB)*	Calculated Max Out-of-Band Emission Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
911.8	93.95	Peak	901.92	-51.9	42.05**	74	31.95
918.2	93.53	Peak	928.08	-56.1	37.43**	74	36.57

* Marker-Delta method

** The peak level is lower than the average limit (54dBμV/m).

The 20 dB bandwidth curves are given in appendix 5; band-edge curves are given in appendix 4.

Test conclusion:

RESPECTED STANDARD

9. FUNDAMENTAL AND HARMONICS FIELD STRENGTH

Standard: FCC Part 15

Test procedure: paragraph 15.249 (a)

Test set up:

First an exploratory radiated measurement was performed. During this phase the product is oriented in three orthogonal planes.

Then the final measurement is realized with the product on the most critical orientation.

The measure is realized on open area test site under 1 GHz and in anechoic chamber above 1 GHz.

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

When the system is tested in anechoic chamber, the EUT is placed on a rotating table, 1.5m from a ground plane.

Zero degree azimuths correspond to the front of the device under test.

See photos in appendix 2.

Frequency range: From 30 MHz to 9182 MHz (10th harmonic of the highest fundamental frequency)

Detection mode: Quasi-peak ($F < 1 \text{ GHz}$) Peak / Average ($F > 1 \text{ GHz}$)

Bandwidth: 120 kHz ($30 \text{ MHz} < F < 1 \text{ GHz}$)
1 MHz ($F > 1 \text{ GHz}$)

Distance of antenna: 10 meters (in open area test site) / 3 meters (in anechoic room)

Antenna height: 1 to 4 meters (in open area test site) / 1.5 meter (in anechoic room)

Antenna polarization: vertical and horizontal (only the highest level is recorded)

Equipment under test operating condition:

The equipment under test is blocked in continuous transmission mode, modulated by internal data signal, at the highest output power level which the transmitter is intended to operate.

Results:

Ambient temperature (°C): 24.1
Relative humidity (%): 39

Power source: We used for power source the internal battery fully charged of a BETA Module Operator (see appendix 2).

Sample 1: with chip antenna - Power Order = 3

Channel 1

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	Azimuth (degree)	RBW (kHz)	Polarization H: Horizontal V: Vertical	Field strength Measured at 10 m (dB μ V/m)	Field strength Computed at 3 m (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
911.8	QP	112	295	120	H	82.52*	92.92	94	1.08
1823.5	P	150	81	100	H	—	40**	74	34
2735.5	P	150	84	100	H	—	44.1**	74	29.9

P= Peak, QP=Quasi-peak, Av=Average

* Fundamental emission

**the peak level is lower than the average limit (54dB μ V/m).

Channel 32

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	Azimuth (degree)	RBW (kHz)	Polarization H: Horizontal V: Vertical	Field strength Measured at 10 m (dB μ V/m)	Field strength Computed at 3 m (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
915	QP	114	151	120	H	83.25*	93.65	94	0.35
1830	P	150	81	100	H	—	39.9**	74	34.1
2745	P	150	84	100	H	—	43.5**	74	30.5

P= Peak, QP=Quasi-peak, Av=Average

* Fundamental emission

**the peak level is lower than the average limit (54dB μ V/m).

Channel 64

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	Azimuth (degree)	RBW (kHz)	Polarization H: Horizontal V: Vertical	Field strength Measured at 10 m (dB μ V/m)	Field strength Computed at 3 m (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
918.2	QP	104	290	120	H	82.57*	92.97	94	1.03
1836.5	P	150	81	100	H	—	38.4**	74	35.6
2754.5	P	150	84	100	H	—	43.4**	74	30.6

P= Peak, QP=Quasi-peak, Av=Average

* Fundamental emission

**the peak level is lower than the average limit (54dB μ V/m).

Results:

Power source: We used for power source the external power supply regulated to 24Vdc of a TIMO Module Transceiver (see appendix 2).

Sample 2: with VUA10XBM antenna mounted on a ground plane - Power Order = 3

Ambient temperature (°C): 27

Relative humidity (%): 43

Channel 1

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	Azimuth (degree)	RBW (kHz)	Polarization H: Horizontal V: Vertical	Field strength Measured at 10 m (dBμV/m)	Field strength Computed at 3 m (dBμV/m)	Limits (dBμV/m)	Margin (dB)
911.8	QP	215	38	120	V	78.7*	89.1	94	4.9
1823.5	P	150	0	100	H	—	38.4**	74	35.6
2735.5	P	150	0	100	H	—	41.9**	74	32.1

P= Peak, QP=Quasi-peak, Av=Average

* Fundamental emission

**the peak level is lower than the average limit (54dBμV/m).

Channel 32

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	Azimuth (degree)	RBW (kHz)	Polarization H: Horizontal V: Vertical	Field strength Measured at 10 m (dBμV/m)	Field strength Computed at 3 m (dBμV/m)	Limits (dBμV/m)	Margin (dB)
915	QP	217	219	120	V	80.05*	90.45	94	3.55
1830	P	150	335	100	V	—	38**	74	36
2745	P	150	335	100	V	—	43.2**	74	30.8

P= Peak, QP=Quasi-peak, Av=Average

* Fundamental emission

**the peak level is lower than the average limit (54dBμV/m).

Channel 64

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	Azimuth (degree)	RBW (kHz)	Polarization H: Horizontal V: Vertical	Field strength Measured at 10 m (dBμV/m)	Field strength Computed at 3 m (dBμV/m)	Limits (dBμV/m)	Margin (dB)
918.2	QP	215	328	120	V	79.20*	89.6	94	4.4
1836.5	P	150	0	100	H	—	38**	74	36
2754.5	P	150	335	100	V	—	41.7**	74	32.3

P= Peak, QP=Quasi-peak, Av=Average

* Fundamental emission

**the peak level is lower than the average limit (54dBμV/m).

Sample 2: with FLX-900/915-FME antenna - Power Order = 3

Ambient temperature (°C): 26.6
Relative humidity (%): 43

Channel 1

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	Azimuth (degree)	RBW (kHz)	Polarization H: Horizontal V: Vertical	Field strength Measured at 10 m (dBμV/m)	Field strength Computed at 3 m (dBμV/m)	Limits (dBμV/m)	Margin (dB)
911.8	QP	117	162	120	H	81.65*	92.05	94	1.95
1823.5	P	150	173	100	H	—	38.7**	74	35.3
2735.5	P	150	190	100	H	—	43.7**	74	30.3

P= Peak, QP=Quasi-peak, Av=Average

* Fundamental emission

**the peak level is lower than the average limit (54dBμV/m).

Channel 32

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	Azimuth (degree)	RBW (kHz)	Polarization H: Horizontal V: Vertical	Field strength Measured at 10 m (dBμV/m)	Field strength Computed at 3 m (dBμV/m)	Limits (dBμV/m)	Margin (dB)
915	QP	113	0	120	H	80.99*	91.39	94	2.61
1830	P	150	173	100	H	—	38.3**	74	35.7
2745	P	150	190	100	H	—	43.6**	74	30.4

P= Peak, QP=Quasi-peak, Av=Average

* Fundamental emission

**the peak level is lower than the average limit (54dBμV/m).

Channel 64

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	Azimuth (degree)	RBW (kHz)	Polarization H: Horizontal V: Vertical	Field strength Measured at 10 m (dBμV/m)	Field strength Computed at 3 m (dBμV/m)	Limits (dBμV/m)	Margin (dB)
918.2	QP	107	210	120	H	81.5*	91.9	94	2.1
1836.5	P	150	173	100	H	—	38.4**	74	35.6
2754.5	P	150	190	100	H	—	43.5**	74	30.5

P= Peak, QP=Quasi-peak, Av=Average

* Fundamental emission

**the peak level is lower than the average limit (54dBμV/m).

Sample 2: with VUB884 antenna - Power Order = 3

Ambient temperature (°C): 26.6
Relative humidity (%): 45

Channel 1

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	Azimuth (degree)	RBW (kHz)	Polarization H: Horizontal V: Vertical	Field strength Measured at 10 m (dBμV/m)	Field strength Computed at 3 m (dBμV/m)	Limits (dBμV/m)	Margin (dB)
911.8	QP	103	206	120	H	76.73*	87.13	94	6.87

P= Peak, QP=Quasi-peak, Av=Average

* Fundamental emission

Channel 32

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	Azimuth (degree)	RBW (kHz)	Polarization H: Horizontal V: Vertical	Field strength Measured at 10 m (dBμV/m)	Field strength Computed at 3 m (dBμV/m)	Limits (dBμV/m)	Margin (dB)
915	QP	100	214	120	H	77.34*	87.74	94	6.26

P= Peak, QP=Quasi-peak, Av=Average

* Fundamental emission

Channel 64

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	Azimuth (degree)	RBW (kHz)	Polarization H: Horizontal V: Vertical	Field strength Measured at 10 m (dBμV/m)	Field strength Computed at 3 m (dBμV/m)	Limits (dBμV/m)	Margin (dB)
918.2	QP	115	0	120	H	77.5*	87.9	94	6.1

P= Peak, QP=Quasi-peak, Av=Average

* Fundamental emission

Sample 2: with EDBS-PRO900-4-BNC antenna mounted on ground plane - Power Order = 3

Ambient temperature (°C): 26.7
Relative humidity (%): 43

Channel 1

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	Azimuth (degree)	RBW (kHz)	Polarization H: Horizontal V: Vertical	Field strength Measured at 10 m (dBμV/m)	Field strength Computed at 3 m (dBμV/m)	Limits (dBμV/m)	Margin (dB)
911.8	QP	100	166	120	H	83.55*	93.95	94	0.05
1823.5	P	150	165	100	H	—	41.7**	74	32.3
2735.5	P	150	171	100	H	—	48.1**	74	25.9

P= Peak, QP=Quasi-peak, Av=Average

* Fundamental emission

**the peak level is lower than the average limit (54dBμV/m).

Channel 32

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	Azimuth (degree)	RBW (kHz)	Polarization H: Horizontal V: Vertical	Field strength Measured at 10 m (dBμV/m)	Field strength Computed at 3 m (dBμV/m)	Limits (dBμV/m)	Margin (dB)
915	QP	100	215	120	H	83.29*	93.69	94	0.31
1830	P	150	165	100	H	—	40.9**	74	33.1
2745	P	150	171	100	H	—	48.3**	74	25.7

P= Peak, QP=Quasi-peak, Av=Average

* Fundamental emission

**the peak level is lower than the average limit (54dBμV/m).

Channel 64

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	Azimuth (degree)	RBW (kHz)	Polarization H: Horizontal V: Vertical	Field strength Measured at 10 m (dBμV/m)	Field strength Computed at 3 m (dBμV/m)	Limits (dBμV/m)	Margin (dB)
918.2	QP	100	199	120	H	83.13*	93.53	94	0.47
1836.5	P	150	165	100	H	—	39.5**	74	34.5
2754.5	P	150	171	100	H	—	47.2**	74	26.8

P= Peak, QP=Quasi-peak, Av=Average

* Fundamental emission

**the peak level is lower than the average limit (54dBμV/m).

Sample 2: with VUA001B antenna - Power Order = 3

Ambient temperature (°C): 26.8
Relative humidity (%): 44

Channel 1

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	Azimuth (degree)	RBW (kHz)	Polarization H: Horizontal V: Vertical	Field strength Measured at 10 m (dBμV/m)	Field strength Computed at 3 m (dBμV/m)	Limits (dBμV/m)	Margin (dB)
911.8	QP	110	158	120	H	82.48*	92.88	94	1.12
1823.5	P	150	327	100	V	—	35.4**	74	38.6
2735.5	P	150	0	100	V	—	37.9**	74	36.1

P= Peak, QP=Quasi-peak, Av=Average

* Fundamental emission / **the peak level is lower than the average limit (54dBμV/m).

Channel 32

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	Azimuth (degree)	RBW (kHz)	Polarization H: Horizontal V: Vertical	Field strength Measured at 10 m (dBμV/m)	Field strength Computed at 3 m (dBμV/m)	Limits (dBμV/m)	Margin (dB)
915	QP	291	153	120	H	81.65*	92.05	94	1.95
1830	P	150	327	100	V	—	35.2**	74	38.8
2745	P	150	0	100	V	—	37.5**	74	36.5

P= Peak, QP=Quasi-peak, Av=Average

* Fundamental emission / **the peak level is lower than the average limit (54dBμV/m).

Channel 64

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	Azimuth (degree)	RBW (kHz)	Polarization H: Horizontal V: Vertical	Field strength Measured at 10 m (dBμV/m)	Field strength Computed at 3 m (dBμV/m)	Limits (dBμV/m)	Margin (dB)
918.2	QP	300	165	120	H	81.69*	92.09	94	1.91
1836.5	P	150	327	100	V	—	35.4**	74	38.6
2754.5	P	150	0	100	V	—	37.8**	74	36.2

P= Peak, QP=Quasi-peak, Av=Average

* Fundamental emission / **the peak level is lower than the average limit (54dBμV/m).

Applicable limits: table 15.249 a)

Test conclusion:

RESPECTED STANDARD

10. OUT OF BAND EMISSIONS

Standard: FCC Part 15

Test procedure: paragraph 15.205
paragraph 15.209
paragraph 15.249 (d)

Test set up:

First an exploratory radiated measurement was performed. During this phase the product is oriented in three orthogonal planes.

Then the final measurement is realized with the product on the most critical orientation.

The measure is realized on open area test site under 1 GHz and in anechoic chamber above 1 GHz.

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

When the system is tested in anechoic chamber, the EUT is placed on a rotating table, 1.5m from a ground plane.

Zero degree azimuths correspond to the front of the device under test.

See photos in appendix 2.

Frequency range: From 9 kHz to 9182 MHz (10th harmonic of the highest fundamental frequency)

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

Bandwidth: 200 Hz ($9 \text{ kHz} < F < 150 \text{ kHz}$)
9 kHz ($150 \text{ kHz} < F < 30 \text{ MHz}$)
120 kHz ($30 \text{ MHz} < F < 1 \text{ GHz}$)
1 MHz ($F > 1 \text{ GHz}$)

Distance of antenna: 10 meters (in open area test site) / 3 meters (in anechoic room)

Antenna height: 1 to 4 meters (in open area test site) / 1.5 meter (in anechoic room)

Antenna polarization: vertical and horizontal (only the highest level is recorded)

Equipment under test operating condition:

The equipment under test is blocked in continuous transmission mode, modulated by internal data signal, at the highest output power level which the transmitter is intended to operate.

Results:

Ambient temperature (°C): 21.2
Relative humidity (%): 37

Power source: We used for power source the external power supply regulated to 24Vdc of a TIMO Module Transceiver. (see appendix 2)

Sample 2: with EDBS-PRO900-4-BNC antenna mounted on ground plane - Power Order = 3

Channel 1, 32 and 64

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	Azimuth (degree)	RBW (kHz)	Polarization H: Horizontal V: Vertical	Field strength Measured at 10 m (dBμV/m)	Field strength Computed at 3 m (dBμV/m)	Limits (dBμV/m) or (dBm)	Margin (dB)
30.9	QP	100	330	120	V	16.23	26.63	40	13.37
34.84	QP	307	358	120	H	14.66	25.06	40	14.94
37.07	QP	100	253	120	H	15.07	25.47	40	14.53
39.37	QP	242	359	120	V	21.92	32.32	40	7.68
41.63	QP	311	95	120	H	14.36	24.76	40	15.24
50.69	QP	100	45	120	V	10.81	21.21	40	18.79
81.82	QP	192	242	120	H	8.42	18.82	40	21.18
84.08	QP	320	100	120	H	11.71	22.11	40	17.89
144	QP	314	163	120	H	29.05	39.45	43.5	4.05
288	QP	342	12	120	H	30.1	40.5	43.5	3
432	QP	261	355	120	H	24.7	35.1	43.5	8.4

P= Peak, QP=Quasi-peak, Av=Average

Applicable limits:

for 9 kHz ≤ F ≤ 490 kHz :	2400/F(kHz) at 300 meters
for 490 kHz < F ≤ 1.705 MHz :	24000/F(kHz) at 30 meters
for 1.705 MHz < F ≤ 30 MHz :	29.5 dBμV/m at 30 meters
for 30 MHz < F ≤ 88 MHz :	40 dBμV/m at 3 meters
for 88 MHz < F ≤ 216 MHz :	43.5 dBμV/m at 3 meters
for 216 MHz < F ≤ 960 MHz :	46 dBμV/m at 3 meters
Above 960 MHz :	54 dBμV/m at 3 meters

Test conclusion:

RESPECTED STANDARD

□□□ End of report, 6 appendixes to be forwarded □□□

APPENDIX 1: Photos of the equipment under test

CONFIDENTIAL

APPENDIX 2: Test set up

CONFIDENTIAL

APPENDIX 3: Test equipment list

Additional provisions to the general radiated emission limitations

TYPE	MANUFACTURER	EMITECH NUMBER
Anechoic Chamber	EMITECH	8593
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Spectrum Analyzer FSP40	Rohde & Schwarz	4088
Log periodic antenna UHALP 9108A	Schwarzbeck	8543
Power source FTN 2515B	Fontaine	8775
Multimeter IDM106N	ISOTECH	8676
Meteo station WS-9232	La Crosse Technology	8750
Software	BAT-EMC V3.6.0.32	0000

Fundamental and harmonics field strength

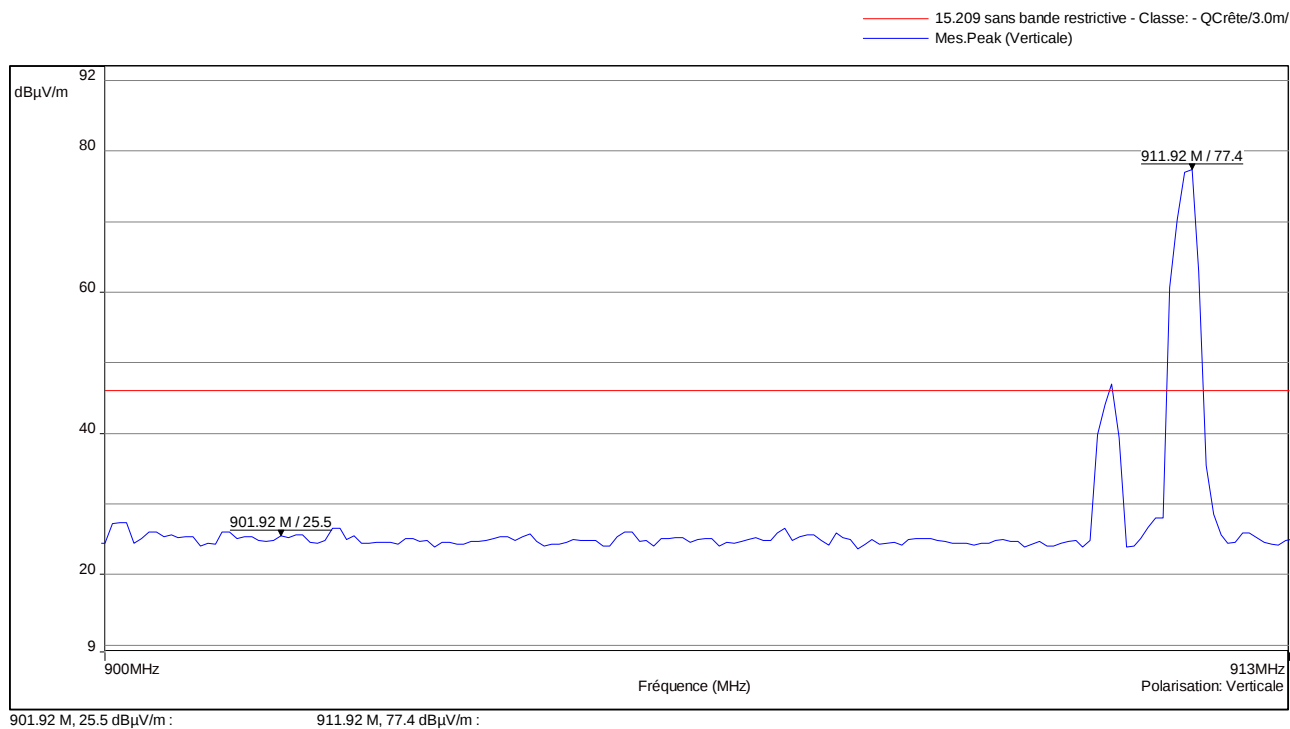
TYPE	MANUFACTURER	EMITECH NUMBER
Open test site	EMITECH	8732
Anechoic Chamber	EMITECH	8593
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Test receiver ESI7	Rohde & Schwarz	8707
Spectrum Analyzer FSP40	Rohde & Schwarz	4088
Log periodic antenna 3147	EMCO	8783
Antenna 3115	EMCO	8535
Low-noise amplifier S005180M3201	LUCIX Corp.	10739
High pass filter HP12/1200-5AA	Filtek	7310
Power source FTN 2515B	Fontaine	8775
Multimeter IDM106N	ISOTECH	8676
Meteo station WS-9232	La Crosse Technology	8749
Meteo station WS-9232	La Crosse Technology	8750
Software	BAT-EMC V3.6.0.32	0000
Software	Champ libre Juigné. V3.4	8864

Out-of-band emissions

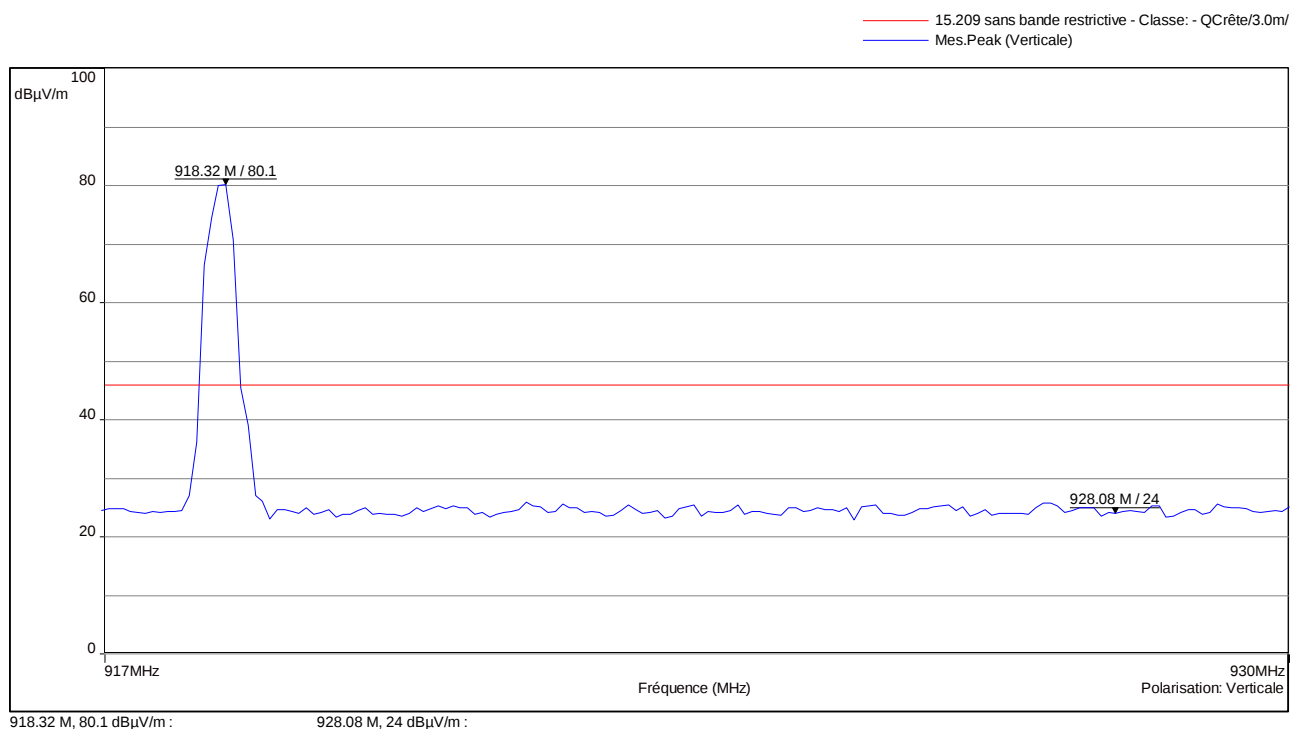
TYPE	MANUFACTURER	EMITECH NUMBER
Open test site	EMITECH	8732
Anechoic Chamber	EMITECH	8593
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Test receiver ESI7	Rohde & Schwarz	8707
Spectrum Analyzer FSP40	Rohde & Schwarz	4088
Loop antenna 6502	EMCO	1406
Biconical antenna VHBB 9124	Schwarzbeck	8526
Biconical antenna VHA 9103	Schwarzbeck	8528
Log periodic antenna UHALP 9108A	Schwarzbeck	8543
Log periodic antenna 3147	EMCO	8783
Antenna 3115	EMCO	8535
Low-noise amplifier 8447D	Hewlett Packard	8511
Low-noise amplifier S005180M3201	LUCIX Corp.	10739
High pass filter HP12/1200-5AA	Filtek	7310
Power source FTN 2515B	Fontaine	8775
Multimeter IDM106N	ISOTECH	8676
Meteo station WS-9232	La Crosse Technology	8749
Meteo station WS-9232	La Crosse Technology	8750
Software	BAT-EMC V3.6.0.32	0000
Software	Champ libre Juigné. V3.4	8864

APPENDIX 4: Band edge

Lower Band Edge – Worst case measurement

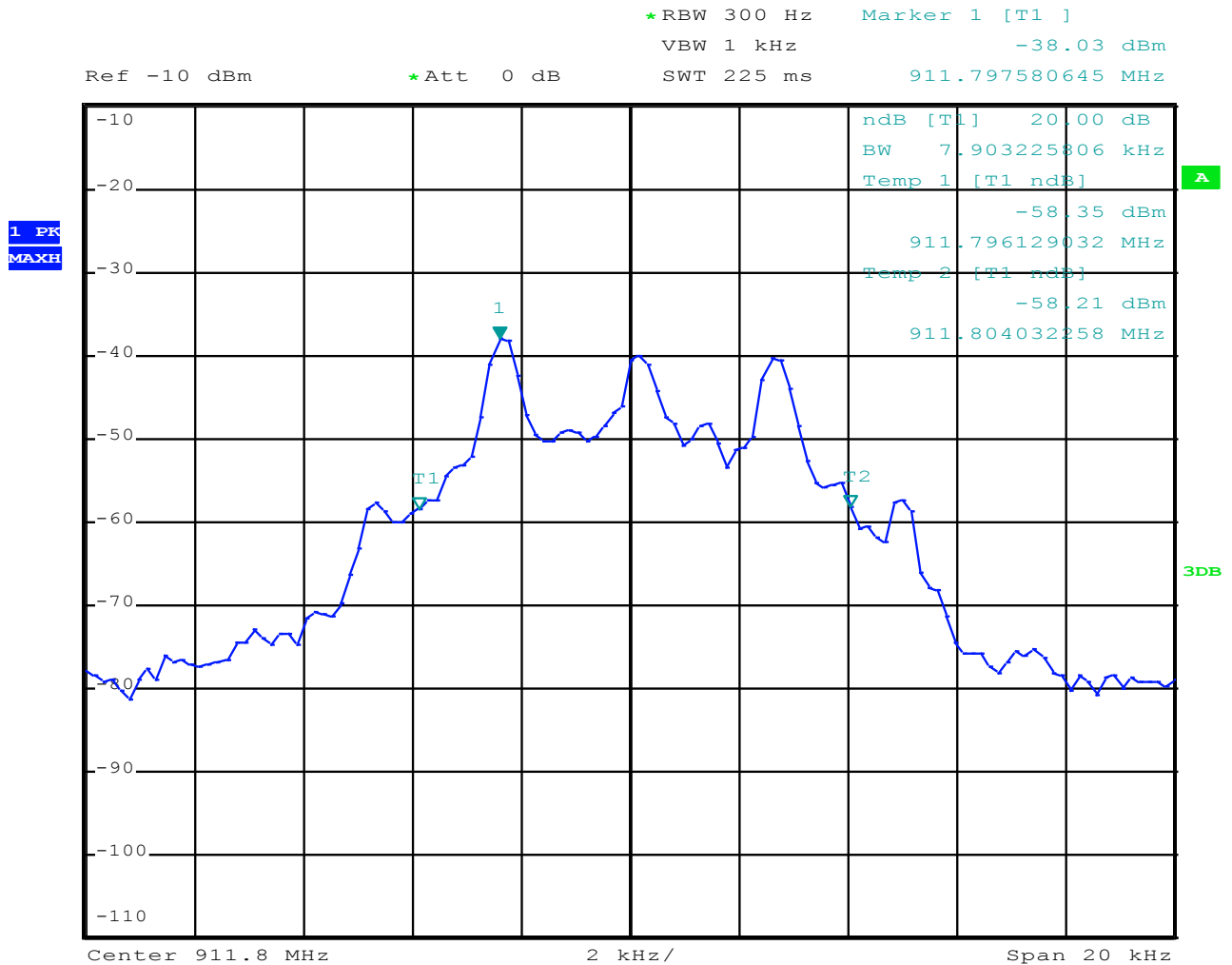


Upper Band Edge – Worst case measurement

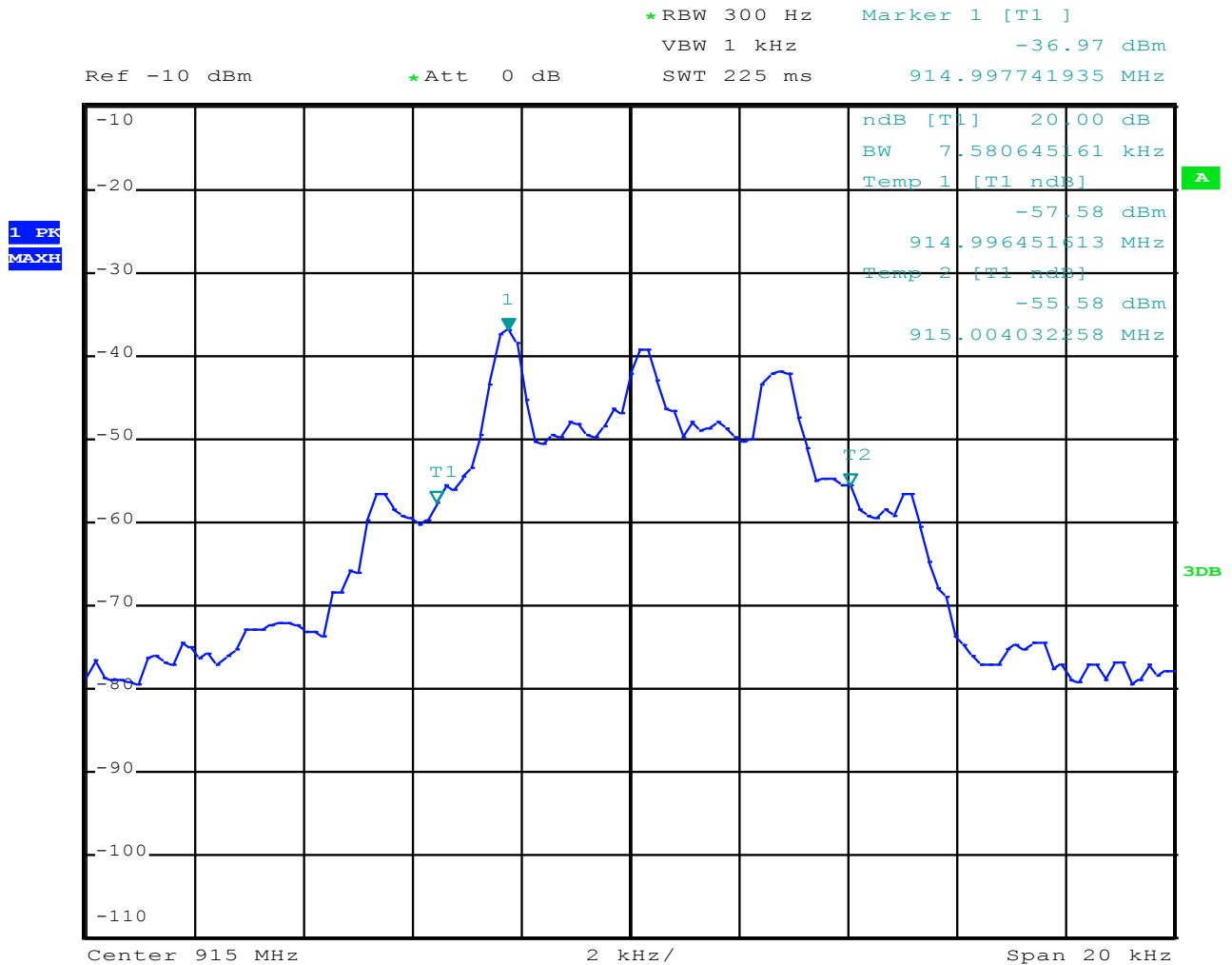


APPENDIX 5: 20 dB bandwidth

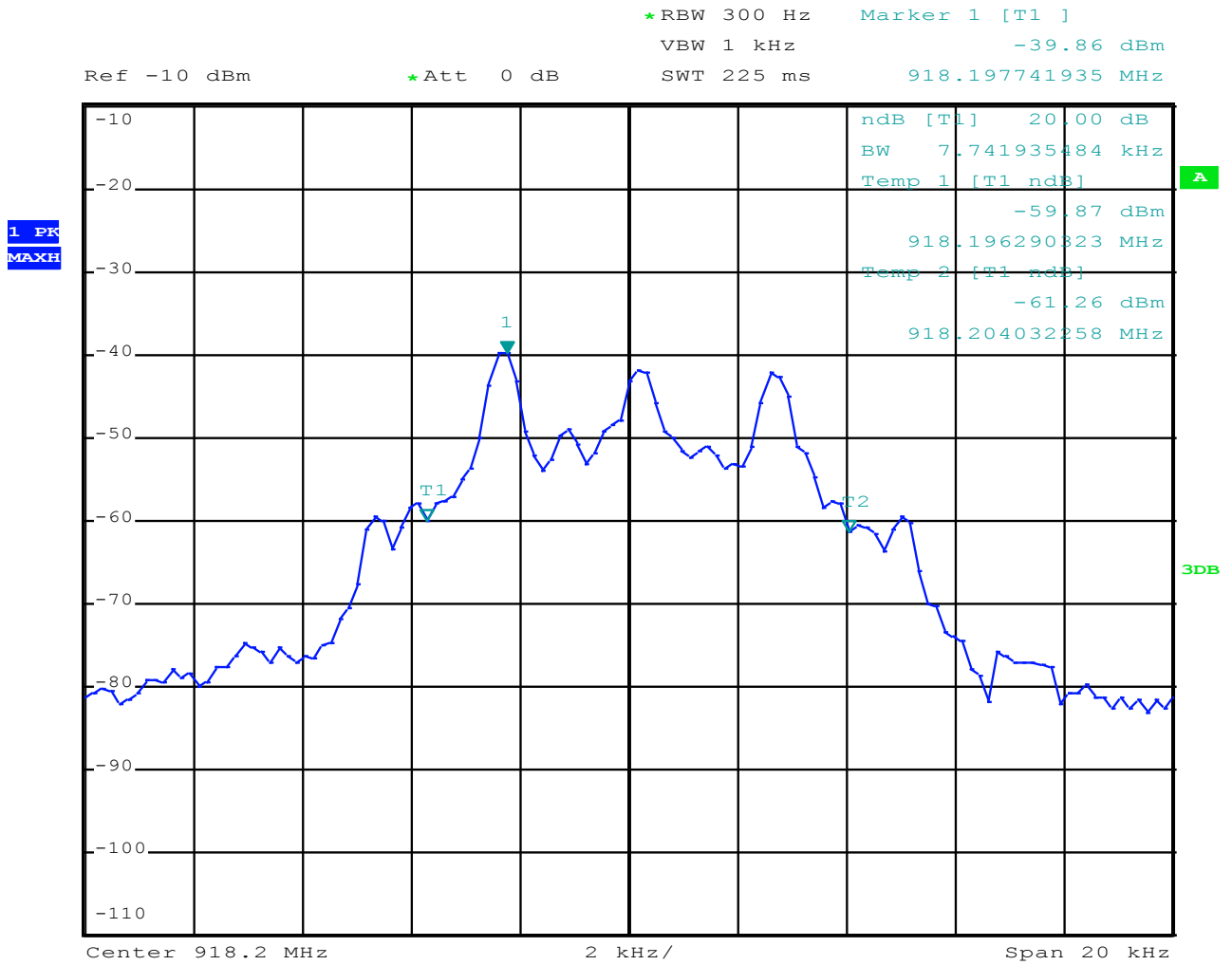
Channel 1



Channel 32

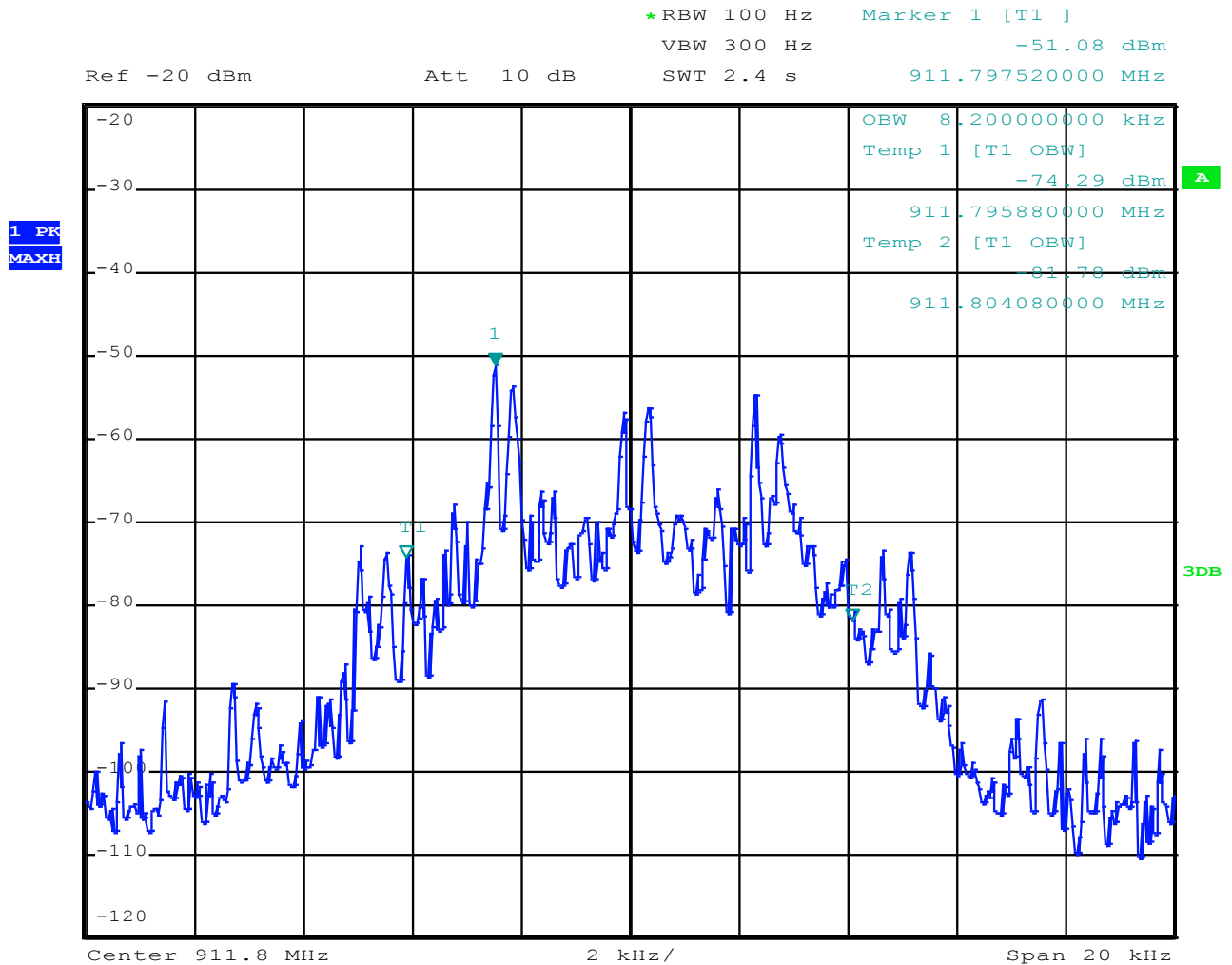


Channel 64

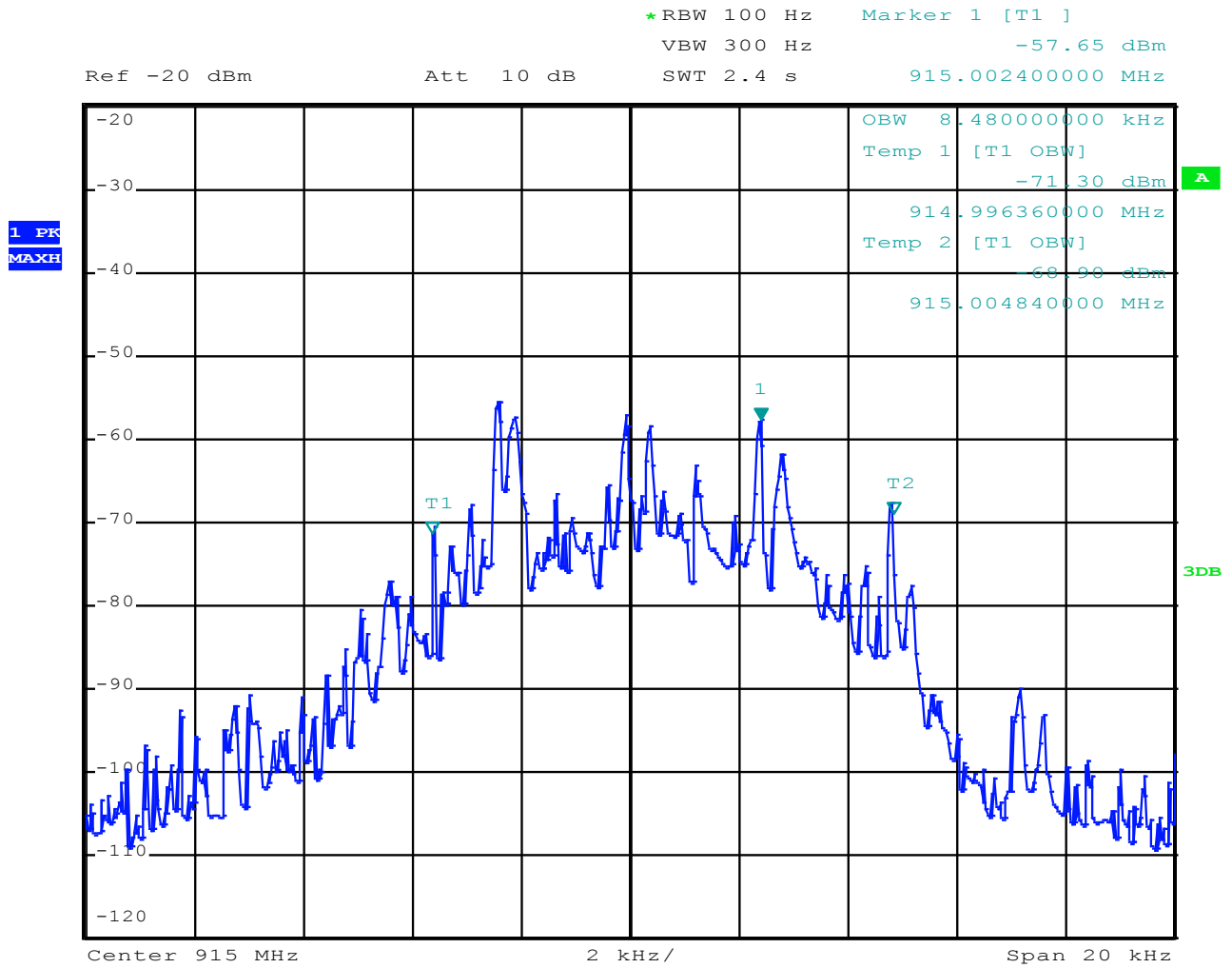


APPENDIX 6: 99% bandwidth

Channel 1



Channel 32



Channel 64

