

Certification Radio test report

According to the standard:
CFR 47 FCC PART 15

Equipment under test:
Single Depth Soil Moisture Probe

FCC ID: 2AVO4-SDXXNAK

Company:
SENSOTERRA

Distribution: Mr PRIOUL

(Company: KERLINK)

Number of pages: 67 with 8 annexes

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DESIGNATION OF PRODUCT: Single Depth Soil Moisture Probe

Serial number (S/N): Sample 1: 9000000B (Radiated tests)
Sample 2: 9000000C (Conducted tests)

Reference / model (P/N): SD30AS-1

Software version: lpiot-refdes-1.5.4.

MANUFACTURER: SENSOTERRA
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COMPANY SUBMITTING THE PRODUCT:

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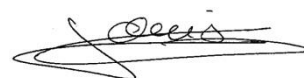
Person(s) present during the tests: Mr Prioul (The first day)

DATE(S) OF TEST: From 16-Dec-19 to 18-Dec-19

TESTING LOCATION: EMITECH ANGERS laboratory at JUIGNE SUR LOIRE (49) FRANCE
FCC Accredited under US-EU MRA Designation Number: FR0009
Test Firm Registration Number: 873677

TESTED BY: S. LOUIS

VISA:



WRITTEN BY: S. LOUIS

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1. INTRODUCTION

This report presents the results of radio test carried out on the following radio equipment: **Single Depth Soil Moisture Probe**, in accordance with normative reference.

The device under test integrates LoRa part.

This report concerns only LoRa 125kHz Bandwidth (hybrid system)

2. PRODUCT DESCRIPTION

Class: B

Utilization: Residential

Antenna type and gain: integral metallic PIFA antenna / 3 dBi

Power adjusted by software: The power level is tuned to reach max power (22dBm)

Operating frequency band: From 902 MHz to 928 MHz

Frequency tested: 902.3 MHz, 908.7 MHz, 914.9 MHz for transmission
923.3 MHz, 925.1 MHz, 927.5 MHz for reception

Frequencies plan detailed transmitter:

Channel frequencies	LoRa bandwidth (KHz)	Number of channel	Channel width (KHz)
902,3+i*0,2MHz (i=0 à 63)	125	64	200

Frequencies plan detailed receiver:

Channel frequencies	LoRa bandwidth (KHz)	Number of channel	Channel width (KHz)
923,3+i*0.6MHz (i=0 à 7)	500	8	600

Number of channels: 64

Channel spacing: 200 kHz

Modulation: LoRa with spread factor: 7 and 10

Power source: 3.6Vdc Lithium Battery

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 (2019) Radio Frequency Devices

ANSI C63.10 2013
Procedures for Compliance Testing of Unlicensed Wireless Devices.

447498 D01 General RF RF Exposure procedures and equipment authorization policies for mobile and
Exposure Guidance v06 portable equipment

4. TEST METHODOLOGY

Radio performance tests procedures given in CFR 47 part 15:

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 215: Additional provisions to the general radiated emission limitations

Paragraph 247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

5. TEST EQUIPMENT CALIBRATION DATES

Emitech Number	Model	Type	Last calibration	Calibration interval (years)	Next calibration due
0	BAT-EMC V3.17.0.25	Software	/	/	/
1406	EMCO 6502	Loop antenna	17/04/2019	1	16/04/2020
4087	Filtek LP03/1000-7GH	Low Pass Filter	29/03/2018	2	28/03/2020
4088	R&S FSP40	Spectrum Analyzer	21/02/2018	2	21/02/2020
4393	Wainwright WLJS800-C11/60EE	Low Pass Filter	29/03/2018	2	28/03/2020
6884	Suhner 1.5m	Cable	29/03/2018	2	28/03/2020
7310	Filtek HP12/1200-5AA	High-pass filter	29/03/2018	2	28/03/2020
8511	HP 8447D	Low-noise amplifier	14/03/2019	1	13/03/2020
8526	Schwarzbeck VHBB 9124	Biconical antenna	16/08/2018	3	15/08/2021
8535	EMCO 3115	Antenna	10/02/2017	3	10/02/2020
8543	Schwarzbeck UHALP 9108A	Log periodic antenna	16/08/2018	3	15/08/2021
8552	Aéroxflex 30dB 25W	Attenuator	03/09/2019	2	02/09/2021
8593	SIDT Cage 2	Anechoic chamber	/	/	/
8742	R&S NRV-Z52	Sensor	11/04/2018	2	10/04/2020
8750	La Crosse Technology WS-9232	Meteo station	24/09/2018	2	23/09/2020
8896	ACQUISYS GPS8	Satellite synchronized frequency standard	/	/	/
8972	K&L Microwave 500-1000MHz	Notch filter	/	/	/
10771	EMCO 3117	Antenna	28/11/2019	3	27/11/2022
12911	Huber + Suhner N-2m	cable	29/03/2018	2	28/03/2020
14736	MATURO	Turntable and mat controller MCU	/	/	/
14903	Fluke 177	Multimeter	28/02/2018	2	28/02/2020
15812	COMP-POWER PAM-118A	Low-noise amplifier 18GHz	03/09/2019	1	02/09/2020
15882	SUCOFLEX	cable N 5m	27/11/2018	2	26/11/2020

6. TESTS RESULTS SUMMARY

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		Supplied by battery
FCC Part 15.209	RADIATED EMISSION LIMITS; general requirements	X				Note 2
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 §15.247 frequency bands	X				Note 3
	(c) 20 dB bandwidth and band-edge compliance	X				
FCC Part 15.247	OPERATION WITHIN THE BANDS 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz					
	(a) (1) Hopping systems			X		
	(a) (2) Digital modulation techniques			X		
	(b) Maximum peak output power	X				Note 4
	(c) Operation with directional antenna gains > 6 dBi			X		
	(d) Intentional radiator	X				
	(e) Peak power spectral density	X				
	(f) Hybrid system	X				Note 5 Note 6
	(g) Frequency hopping requirements	X				LoRa protocol
	(h) Frequency hopping intelligence	X				LoRa protocol
	(i) RF exposure compliance	X				

NAP: Not Applicable

NAs: Not Asked

Note 1: Integral antenna

Note 2: See FCC part 15.247 (d).

Note 3: See FCC part 15.209. Unwanted emissions levels are all below the fundamental emission field strength level.

Note 4: Conducted measurement performed.

Note 5: The transceiver used LoRa protocol.

The frequency hopping system uses 64 channels.

Each frequency is used equally on the average by the transmitter.

With Spread Factor 7:

The timing by channel is 47.4ms (see appendix 6).

During 64 channels $\times 0.4 \text{ s} = 25.6 \text{ s}$, any channel is used 3 times, then $3 \times 47.4\text{ms} = 142.2\text{ms}$, thus the average time of occupancy on any channel is less than 400 ms within a period of 0.4 seconds multiplied by the number of hopping channels employed, in normal operating mode.

Number of channels	Observation period (0.4s * Nbr of channel) (s)	Maximal Duration of each burst (ms)	Number of burst repetition during observation period	average time of occupancy on any channel (s)	Limits (s)
64	25.6	47.4	3	0.142	0.4

With Spread Factor 10:

The timing by channel is 368ms (see appendix 8).

During 64 channels $\times 0.4 \text{ s} = 25.6 \text{ s}$, any channel is used 1 time, then $1 \times 368\text{ms} = 368\text{ms}$, thus the average time of occupancy on any channel is less than 400 ms within a period of 0.4 seconds multiplied by the number of hopping channels employed, in normal operating mode.

Number of channels	Observation period (0.4s * Nbr of channel) (s)	Maximal Duration of each burst (ms)	Number of burst repetition during observation period	average time of occupancy on any channel (s)	Limits (s)
64	25.6	368	1	0.368	0.4

Note 6:

The maximum 99% bandwidth of the equipment is 126.4 kHz (see appendix 4).

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**Temperature (°C) :** 19.9**Humidity (%HR):** 51**Date :** December 17, 2019**Technician :** S. LOUIS**Standard:** FCC Part 15**Test procedure:** Paragraph 15.215**Test set up:**

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

Test operating condition of the equipment:

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

We used for power source the internal battery of the equipment and we noted:

Voltage at the beginning of test (Vdc): 3.62

Voltage at the end of test (Vdc): 3.54

Percentage of voltage drop during the test (%): 2.21

Results:

Lower Band Edge: From 900 MHz to 902 MHz

Upper Band Edge: From 928 MHz to 930 MHz

Sample N° 2 Spread Factor 7

Fundamental frequency (MHz)	Field Strength Level of fundamental (dBμV/m)	Detector (Peak or Average)	Frequency of maximum Band-edges Emission (MHz)	Delta Marker (dB) (1)	Calculated Max Out-of-Band Emission Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
902.3	120.30	Average	901.984	42.22	78.08	90.30	12.22
914.9	120.32	Average	928.24	62.52	57.80	90.32	32.52

(1) Marker-Delta method

Band-edge curves are given in appendix 4.

Sample N° 2 Spread Factor 10

Fundamental frequency (MHz)	Field Strength Level of fundamental (dBμV/m)	Detector (Peak or Average)	Frequency of maximum Band-edges Emission (MHz)	Delta Marker (dB) (1)	Calculated Max Out-of-Band Emission Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
902.3	120.31	Average	901.992	48.32	71.99	90.31	18.32
914.9	120.31	Average	928.200	63.84	56.47	90.32	33.85

(1) Marker-Delta method

Band-edge curves are given in appendix 4.

Test conclusion:

RESPECTED STANDARD

9. MAXIMUM CONDUCTED (AVERAGE) OUTPUT POWER**Temperature (°C) :** 19.8**Humidity (%HR):** 52**Date :** December 16, 2019**Technician :** S. LOUIS**Standard:** FCC Part 15**Test procedure:** paragraph 15.247 (b)

AVGPM method (using a gated RF average-reading power meter) of paragraph 11.9.2.3.1 of ANSI C63.10

Test set up:Conducted test

The measure is realized in conducted mode with a calibrated average reading power meter. (11.9.2.3.1 of ANSI C63.10).

Equipment under test operating condition:

The equipment under test is blocked in continuous modulated transmission mode.
The power level is tuned to reach max power (Psoftware adjusted to 22).

We used for power source the internal battery of the equipment and we noted:

Voltage at the beginning of test (Vdc): 3.62

Voltage at the end of test (Vdc): 3.54

Percentage of voltage drop during the test (%): 2.21

Results:

Conducted test:

Sample N° 2 Low Channel (F = 902.3 MHz) – SF7

	Maximum conducted output power (1)		Limit (W)
	(dBm)	(W)	
Nominal supply voltage:	22.07	0.161	1

Declared maximum antenna gain: 3 dBi

Sample N°2 Central Channel (F = 908.7 MHz) – SF7

	Maximum conducted output power (1)		Limit (W)
	(dBm)	(W)	
Nominal supply voltage:	22.11	0.163	1

Declared maximum antenna gain: 3 dBi

Sample N°2 High Channel (F = 914.9 MHz) – SF7

	Maximum conducted output power (1)		Limit (W)
	(dBm)	(W)	
Nominal supply voltage:	22.09	0.162	1

Declared maximum antenna gain: 3 dBi

Conducted test:

Sample N° 2 Low Channel (F = 902.3 MHz) – SF10

	Maximum conducted output power (1)		Limit (W)
	(dBm)	(W)	
Nominal supply voltage:	22.08	0.161	1

Declared maximum antenna gain: 3 dBi

Sample N°2 Central Channel (F = 908.7 MHz) – SF10

	Maximum conducted output power (1)		Limit (W)
	(dBm)	(W)	
Nominal supply voltage:	22.09	0.162	1

Declared maximum antenna gain: 3 dBi

Sample N°2 High Channel (F = 914.9 MHz) – SF10

	Maximum conducted output power (1)		Limit (W)
	(dBm)	(W)	
Nominal supply voltage:	22.08	0.161	1

Declared maximum antenna gain: 3 dBi

Test conclusion:

RESPECTED STANDARD

10. INTENTIONAL RADIATOR**Temperature (°C) :** 19.8**Humidity (%HR):** 52**Date :** December 16, 2019**Technician :** S. LOUIS**Standard:** FCC Part 15**Test procedure:** paragraph 15.205, paragraph 15.209, paragraph 15.247 (d)

Emissions in non-restricted frequency bands method of paragraph 11.11 of ANSI C63.10

Emissions in restricted frequency bands method of paragraph 11.12 of ANSI C63.10

Test set up:

First an exploratory radiated measurement was performed.

During this phase the product is oriented in these two normal positions.

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, 1.5 m 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 10GHz (10th harmonic of the highest fundamental frequency (928MHz)**Detection mode:** Quasi-peak ($F < 1 \text{ GHz}$)Peak / Average ($F > 1 \text{ GHz}$)**Bandwidth:** 200Hz ($9 \text{ kHz} < F < 150\text{kHz}$)
9 kHz ($150 \text{ kHz} < F < 30\text{MHz}$)
120 kHz ($30 \text{ MHz} < F < 1 \text{ GHz}$)
100 kHz / 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 modulated transmission mode.
The power level is tuned to reach max power. (P Software adjusted to 22).

We used for power source the internal battery of the equipment and we noted:

Voltage at the beginning of test (Vdc): 3.62

Voltage at the end of test (Vdc): 3.54

Percentage of voltage drop during the test (%): 2.21

Results:

Sample N° 1 Low Channel – SF7

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength (dBμV/m)	Limits (dBμV/m)	Margin (dB)
2706.7 (1)	P	150	1000	2	H	44.8 (2)	74	29.2
3609.4 (1)	P	150	1000	2	V	43.7 (2)	74	30.3
4511.6 (1)	P	150	1000	1	V	42.8 (2)	74	31.2
5414.4 (1)	P	150	1000	1	V	46.9 (2)	74	27.1
6316.8	P	150	100	2	V	47.8	90.3	42.5
7219.2	P	150	100	1	V	52.3	90.3	38.0
8120.6 (1)	P	150	1000	2	H	50.0 (2)	74	24.0

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

(1) Restricted bands of operation in 15.205

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

Sample N° 1 Low Channel – SF10

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength (dBμV/m)	Limits (dBμV/m)	Margin (dB)
2706.9 (1)	P	150	1000	2	H	47.0 (2)	74	27.0
3609.4 (1)	P	150	1000	2	V	43.6 (2)	74	30.4
4511.5 (1)	P	150	1000	1	V	43.7 (2)	74	30.3
5414.4 (1)	P	150	1000	1	V	48.0 (2)	74	26.0
6316.8	P	150	100	2	V	48.6	90.3	41.7
7219.2	P	150	100	2	H	54.8	90.3	35.5
9023 (1)	P	150	1000	1	V	50.8	74	23.2

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

(1) Restricted bands of operation in 15.205

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

Sample N° 1 Central Channel – SF7

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength (dBμV/m)	Limits (dBμV/m)	Margin (dB)
2725.9 (1)	P	150	1000	2	H	43.5 (2)	74	30.5
3634.6 (1)	P	150	1000	2	V	44.0 (2)	74	30.0
5450.8 (1)	P	150	1000	1	V	47.1 (2)	74	26.9
6359.9	P	150	100	1	V	49.4	90.3	40.9
7268.8 (1)	P	150	1000	1	V	48.5 (2)	74	25.5
8177.4 (1)	P	150	1000	2	H	49.3 (2)	74	24.7

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

(1) Restricted bands of operation in 15.205

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

Sample N° 1 Central Channel – SF10

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength (dBμV/m)	Limits (dBμV/m)	Margin (dB)
1817.2	P	150	100	2	H	48.2	90.3	42.1
2725.9 (1)	P	150	1000	2	H	48.2 (2)	74	25.8
3634.8 (1)	P	150	1000	1	H	43.8 (2)	74	30.2
4542.8 (1)	P	150	1000	1	V	44.6 (2)	74	29.4
5450.8 (1)	P	150	1000	1	V	48.2 (2)	74	25.8
6359.6	P	150	100	1	V	52.7	90.3	37.6
7268.8 (1)	P	150	1000	1	V	57.8	74	16.2
7268.8 (1)	Av	150	1000	1	V	54.0	54	0.0
8177.4 (1)	P	150	1000	2	H	49 (2)	74	25.0

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

(1) Restricted bands of operation in 15.205

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

Sample N° 1 High Channel – SF7

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength (dBμV/m)	Limits (dBμV/m)	Margin (dB)
2745.4 (1)	P	150	1000	2	H	49.3 (2)	74	24.7
3660.1 (1)	P	150	1000	2	V	44.3 (2)	74	29.7
5489.4 (1)	P	150	1000	1	V	50.6 (2)	74	23.4
6404.8	P	150	100	1	V	52.4	90.3	37.9
7318.8 (1)	P	150	1000	1	V	55.9	74	18.1
7318.8 (1)	Av	150	1000	1	V	52.0	54	2.0
8234.1 (1)	P	150	1000	2	H	49.6 (2)	74	24.4

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

(1) Restricted bands of operation in 15.205

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

Sample N° 1 High Channel – SF10

Frequencies (MHz)	Detector P QP Av	Antenna height (cm)	RBW (kHz)	Position	Polarization H: Horizontal V: Vertical	Field strength (dBμV/m)	Limits (dBμV/m)	Margin (dB)
2745.4 (1)	P	150	1000	2	H	46.8 (2)	74	27.2
3660.1 (1)	P	150	1000	2	V	44.7 (2)	74	29.3
5489.4 (1)	P	150	1000	1	V	50.0 (2)	74	24.0
6404.8	P	150	100	2	H	51.6	90.3	38.7
7318.8 (1)	P	150	1000	1	V	56.3	74	17.7
7318.8 (1)	Av	150	1000	1	V	52.4	54	1.6
8234.1 (1)	P	150	1000	2	H	50.0 (2)	74	24.0

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

(1) Restricted bands of operation in 15.205

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

Applicable limits: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

The highest level recorded in a 100 kHz bandwidth is 120.3 dB μ V/m on central channel.

So the applicable limit is 90.3 dB μ V/m.

In addition, radiated emissions which fall in the restricted band, as defined in section 15.205 (a), must also comply with the radiated emission limits specified in section 15.209 (a) (see section 15.205 (c)).

Test conclusion:

RESPECTED STANDARD

11. MAXIMUM CONDUCTED POWER DENSITY**Temperature (°C) :** 19.8**Humidity (%HR):** 52**Date :** December 16, 2019**Technician :** S. LOUIS**Standard:** FCC Part 15**Test procedure:** paragraph 15.247 (e), paragraph 15.247 (f)
AVGPSD-1 of paragraph 11.10.3 of ANSI C63.10**Test set up:**

The measure is realized in conducted mode with an analyser.

Resolution bandwidth:	3 kHz
Video bandwidth:	10 kHz
Span:	At least 1.5 x OBW
Detector:	RMS
Sweep points:	At least 2 x SPAN/RBW
Sweep time:	Auto
Trace:	Average detector RMS
Trace Number:	At least 100 traces

Then the peak marker function is used.

Equipment under test operating condition:

The equipment under test is blocked in continuous modulated transmission mode.
The power level is tuned to reach max power (Psoftware adjusted to 22).

We used for power source the internal battery of the equipment and we noted:

Voltage at the beginning of test (Vdc):	3.62
Voltage at the end of test (Vdc):	3.54
Percentage of voltage drop during the test (%):	2.21

Results:

Sample N° 2 Low Channel (F = 902.3 MHz) – SF7

	Maximum conducted power density (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage: 3.6	7.58	8

Declared maximum antenna gain: 3 dBi

See curve in appendix 8

Sample N°2 Central Channel (F = 908.7 MHz) – SF7

	Maximum conducted power density (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage: 3.6	7.97	8

Declared maximum antenna gain: 3 dBi

See curve in appendix 8

Sample N°2 High Channel (F = 914.9 MHz) – SF7

	Maximum conducted power density (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage: 3.6	7.88	8

Declared maximum antenna gain: 3 dBi

See curve in appendix 8

Sample N° 2 Low Channel (F = 902.3 MHz) – SF10

	Maximum conducted power density (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage: 3.6	7.98	8

Declared maximum antenna gain: 3 dBi

See curve in appendix 8

Sample N°2 Central Channel (F = 908.7 MHz) – SF10

	Maximum conducted power density (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage: 3.6	7.38	8

Declared maximum antenna gain: 3 dBi

See curve in appendix 8

Sample N°2 High Channel (F = 914.9 MHz) – SF10

	Maximum conducted power density (dBm / 3 kHz)	Limit (dBm / 3 kHz)
Nominal supply voltage: 3.6	7.61	8

Declared maximum antenna gain: 3 dBi

See curve in appendix 8

Test conclusion:

RESPECTED STANDARD

□□□ End of report, 8 annexes to be forwarded □□□

APPENDIX 1: Test equipment list

Additional provisions to the general radiated emission limitations

TYPE	MANUFACTURER	EMITECH NUMBER
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Spectrum Analyzer FSP40	Rohde & Schwarz	4088
Attenuator 30dB 25W	Aeroflex	8552
Multimeter 177	Fluke	14903
Meteo station WS-9232	La Crosse Technology	8750
Software	GPIBShot V2.4	-

Maximum conducted (average) output power

TYPE	MANUFACTURER	EMITECH NUMBER
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Spectrum Analyzer FSP40	Rohde & Schwarz	4088
Attenuator 30dB 25W	Aeroflex	8552
Powermeter NRV-Z52	Rohde & Schwarz	8742
Multimeter 177	Fluke	14903
Meteo station WS-9232	La Crosse Technology	8750

Intentional radiator

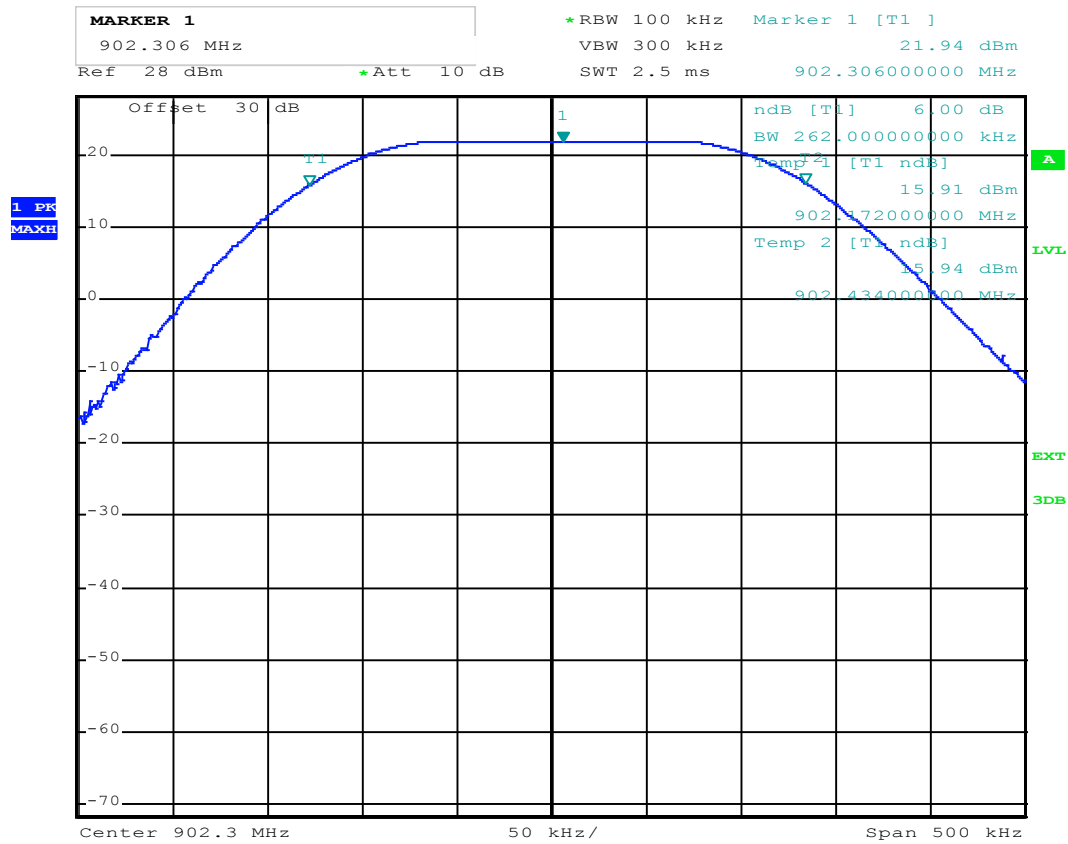
TYPE	MANUFACTURER	EMITECH NUMBER
Anechoic Chamber	EMITECH	8593
Turntable controller 1060C	MATURO	14736
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Spectrum Analyzer FSP40	Rohde & Schwarz	4088
Loop antenna 6502	EMCO	1406
Biconical antenna VHBB 9124	Schwarzbeck	8526
Log periodic antenna UHALP 9108A	Schwarzbeck	8543
Antenna 3115	EMCO	8535
Antenna 3117	ETS-Lindgren	10771
Low-noise amplifier 8447D	Hewlett Packard	8511
Low-noise amplifier PAM-118A	COM-POWER	15812
N-1.5M Cable	Huber + Suhner	6884
N-2M Cable	Huber + Suhner	12911
N-5M Cable	SUCOFLEX	15882
Notch filter 500-1000MHz	K&L Microwave	8972
Low pass filter WLJS800-C11/60EE	Wainwright	4393
Low pass filter LP03/1000-7GH	Filtek	4087
High pass filter HP12/1200-5AA	Filtek	7310
Multimeter 177	Fluke	14903
Meteo station WS-9232	La Crosse Technology	8750
Software	BAT-EMC V3.17.0.25	0000

Maximum conducted power density

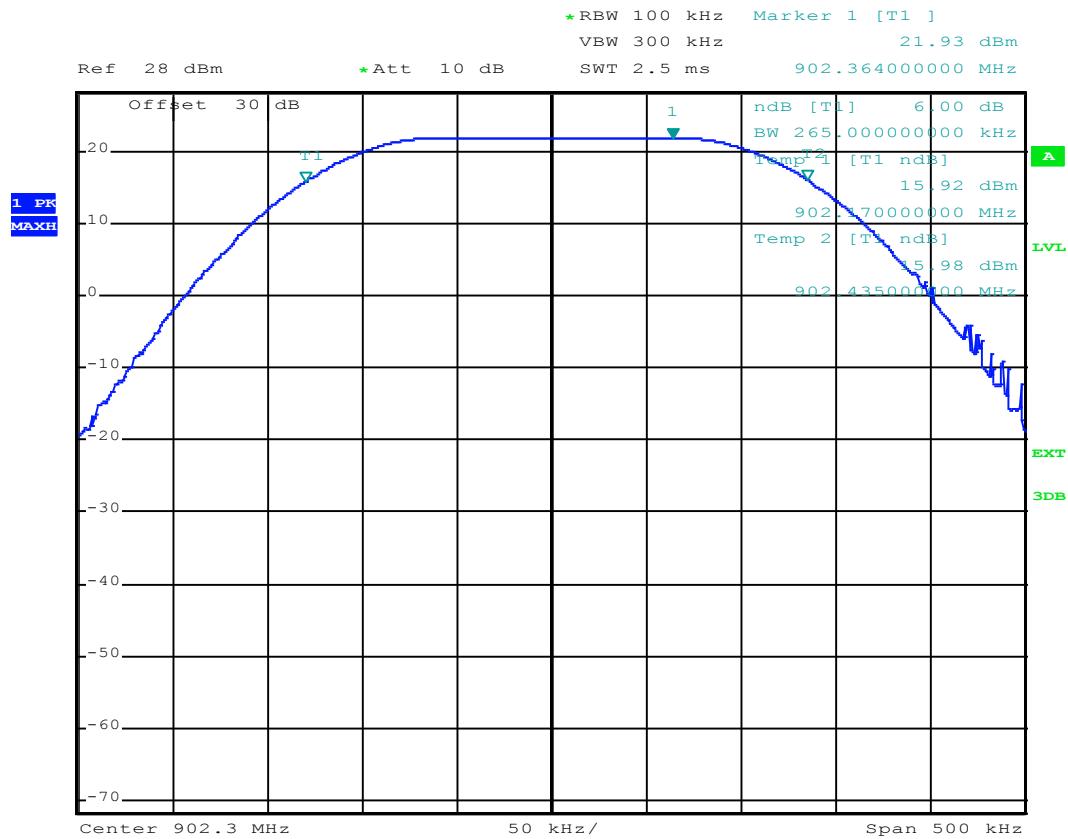
TYPE	MANUFACTURER	EMITECH NUMBER
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Spectrum Analyzer FSP40	Rohde & Schwarz	4088
Attenuator 30dB 25W	Aeroflex	8552
Multimeter 177	Fluke	14903
Meteo station WS-9232	La Crosse Technology	8750
Software	GPIBSHOT V2.4	-

APPENDIX 2: 6 dB bandwidth

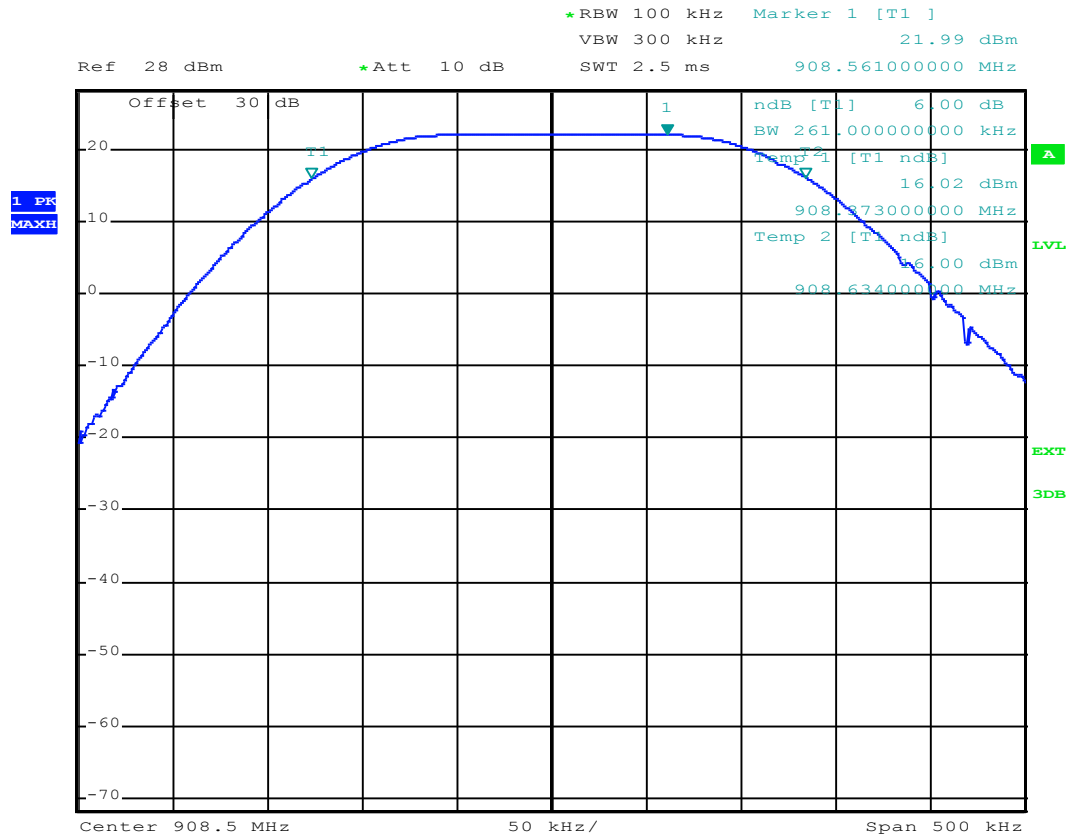
Low Channel – SF7



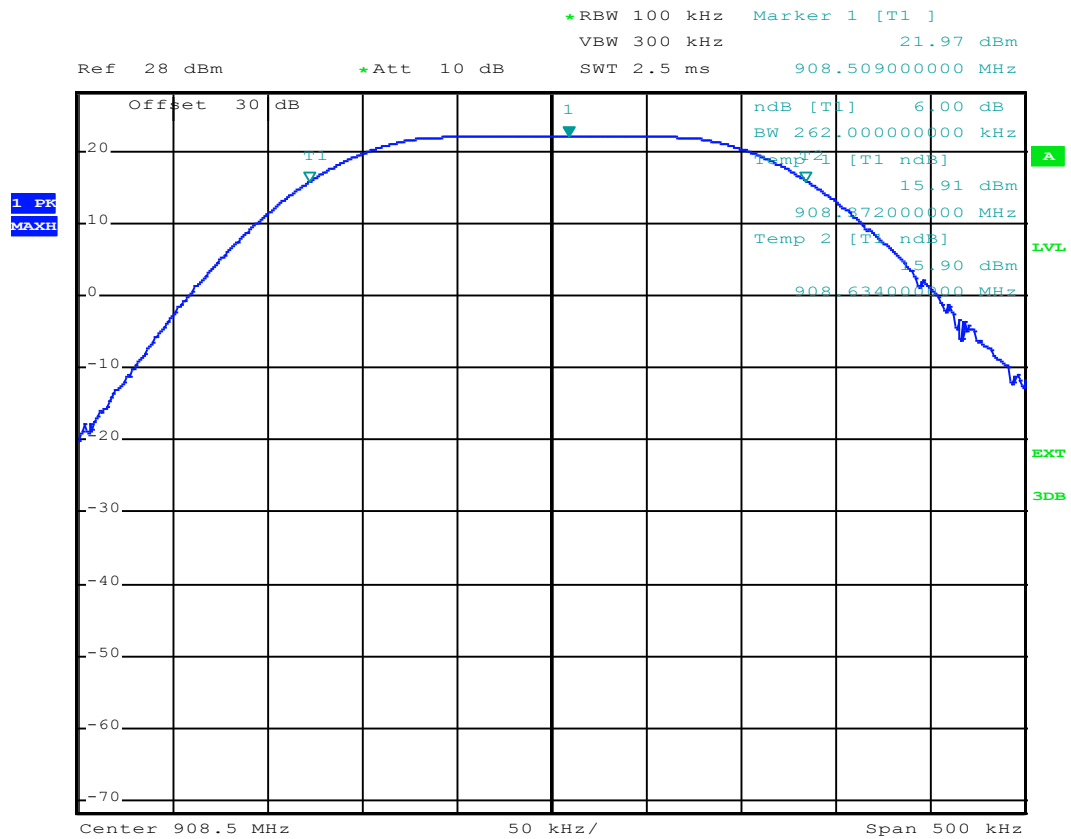
Low Channel SF10



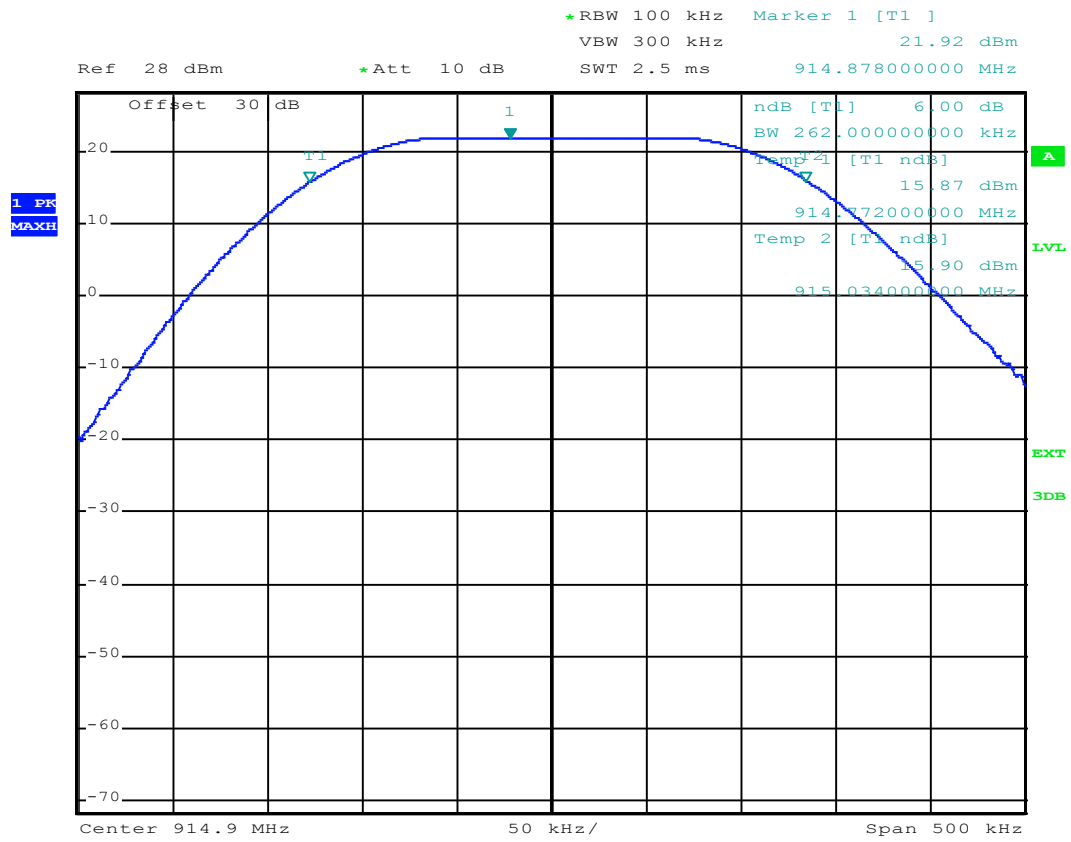
Central Channel – SF7



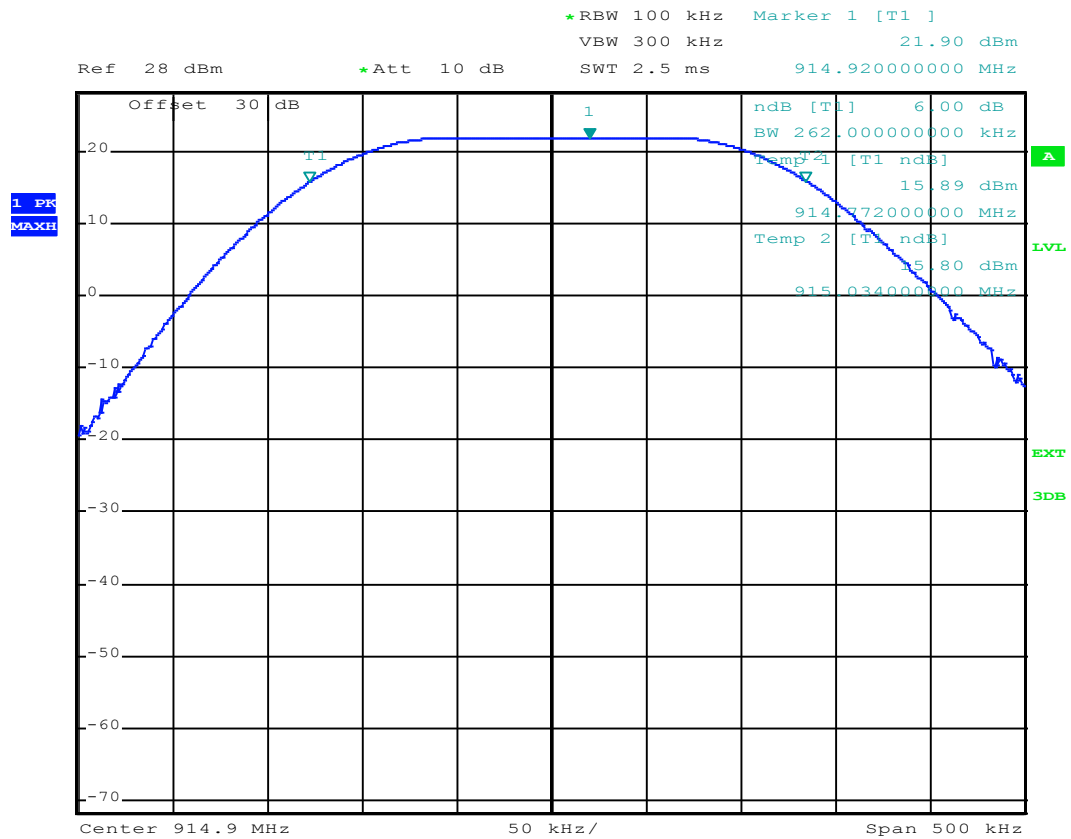
Central Channel – SF10



High Channel – SF7

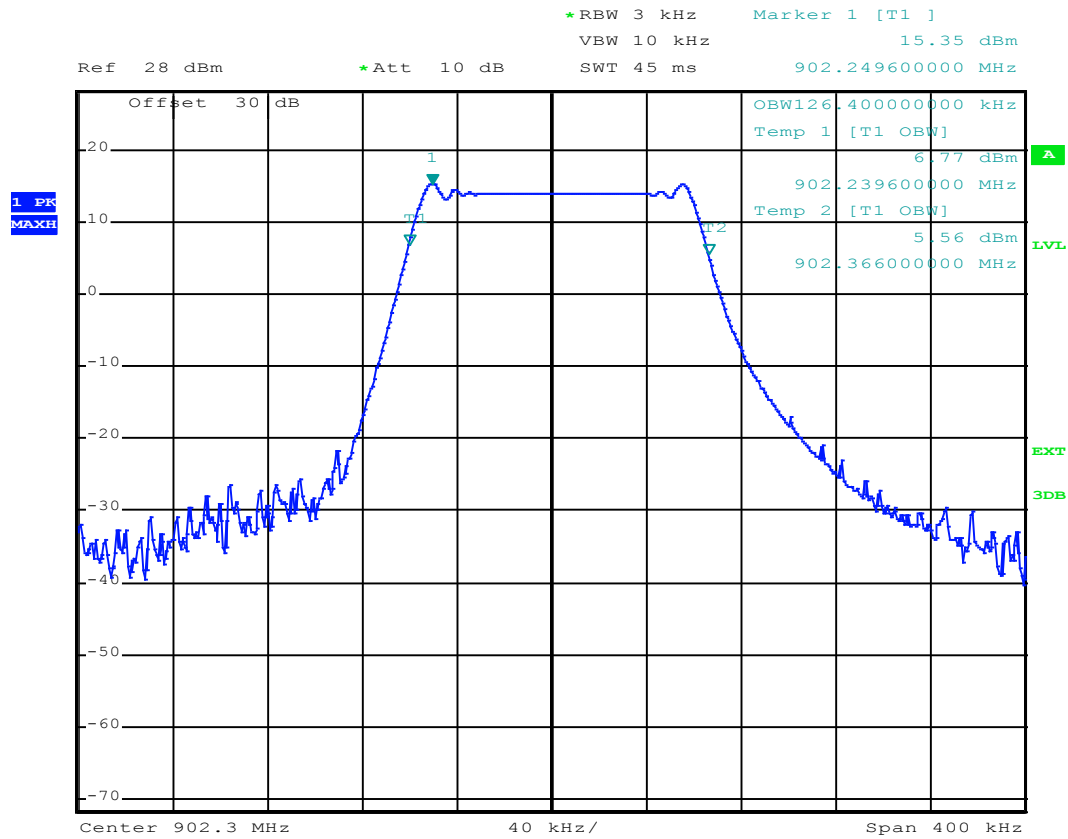


High Channel – SF10

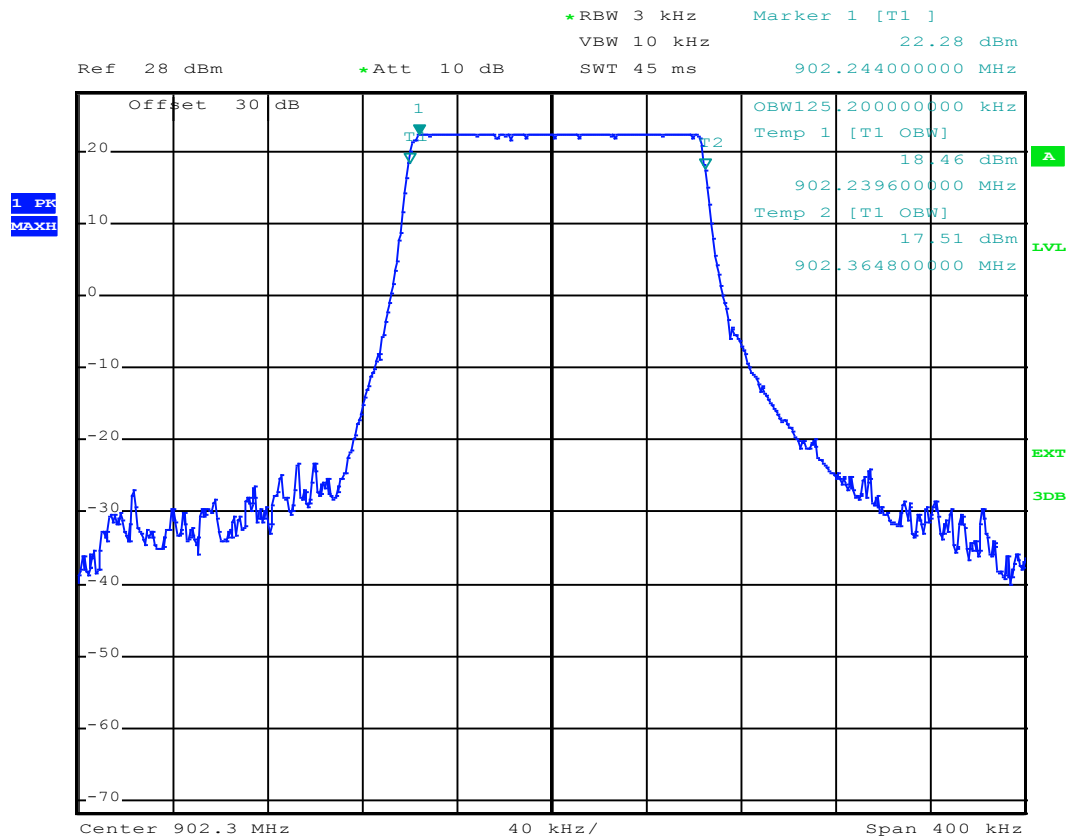


APPENDIX 3: 99% bandwidth

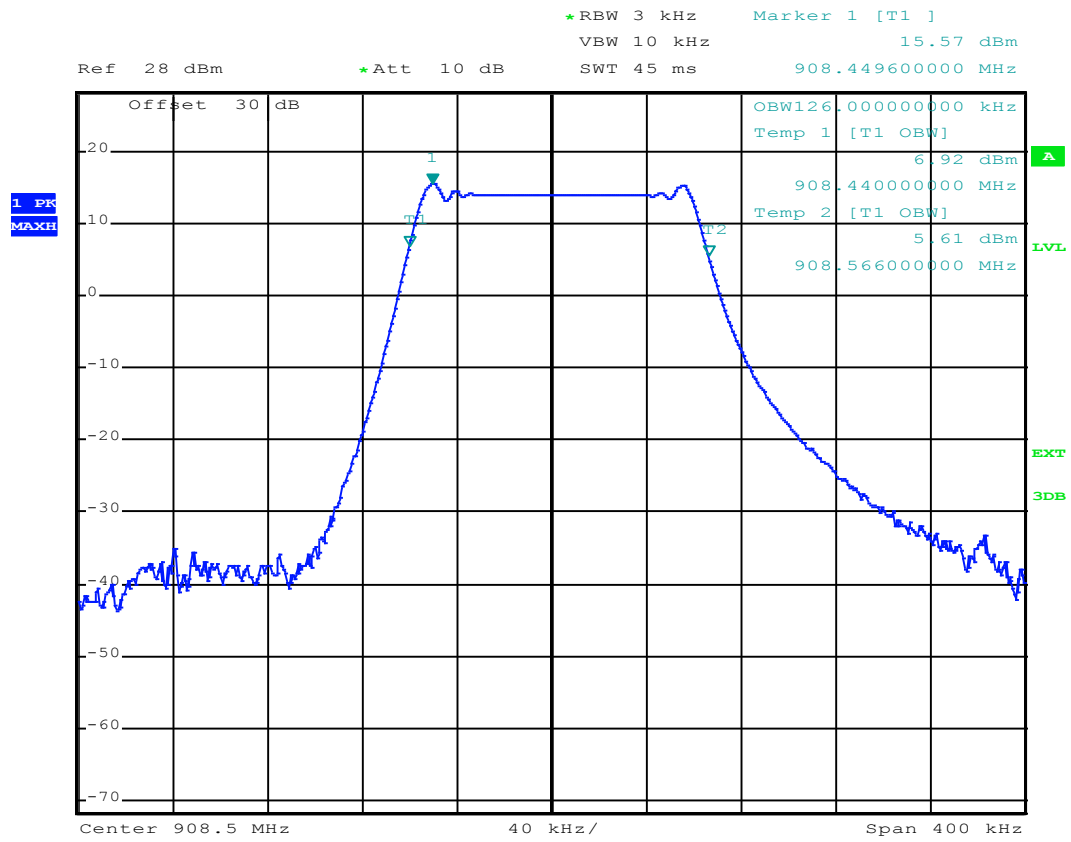
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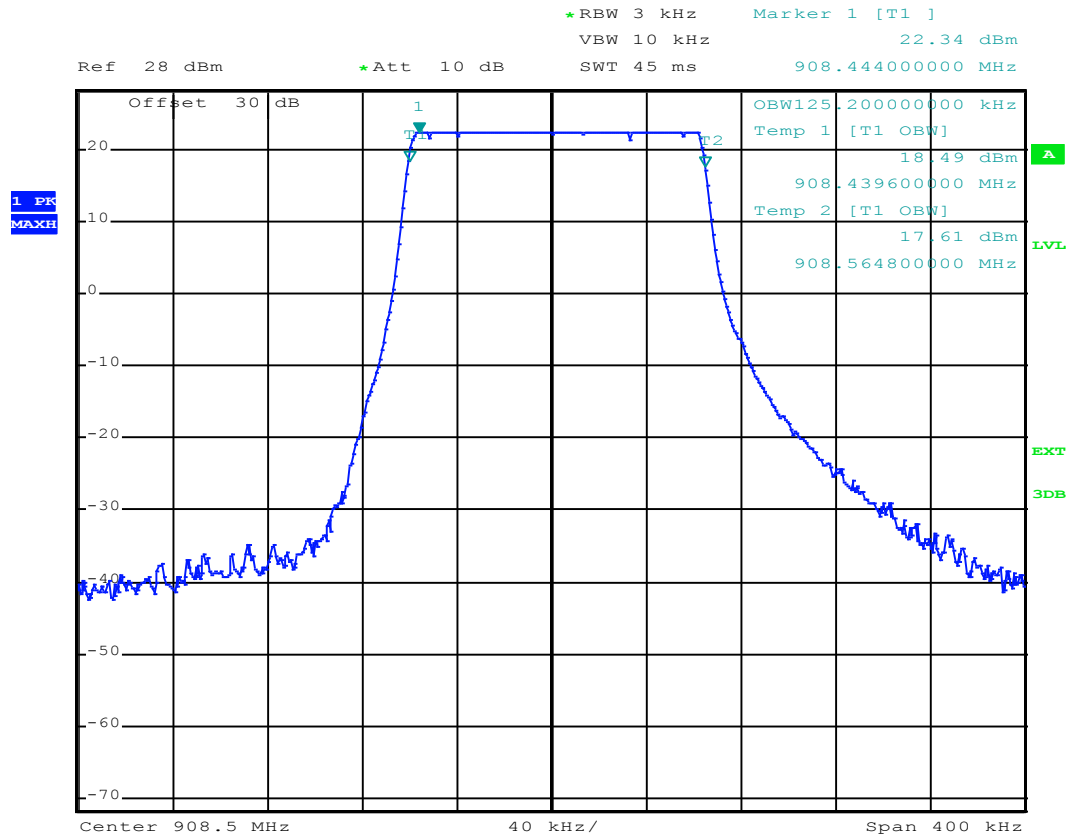
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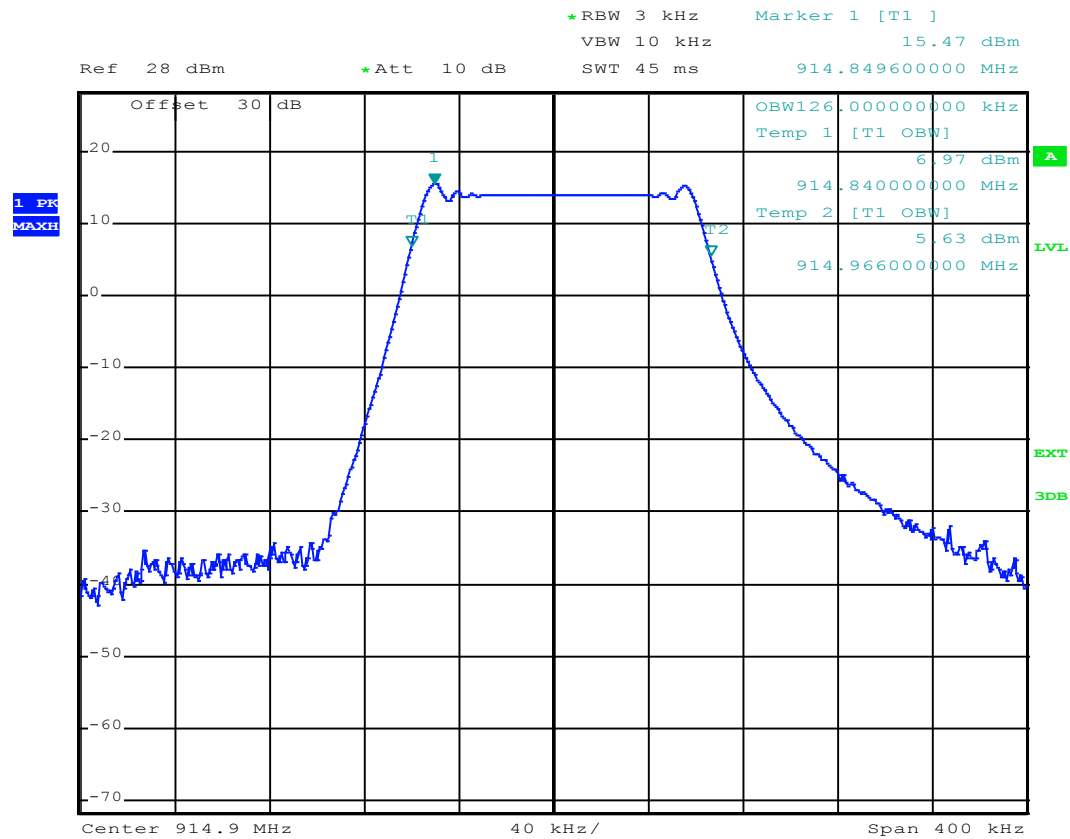
Central Channel – SF7



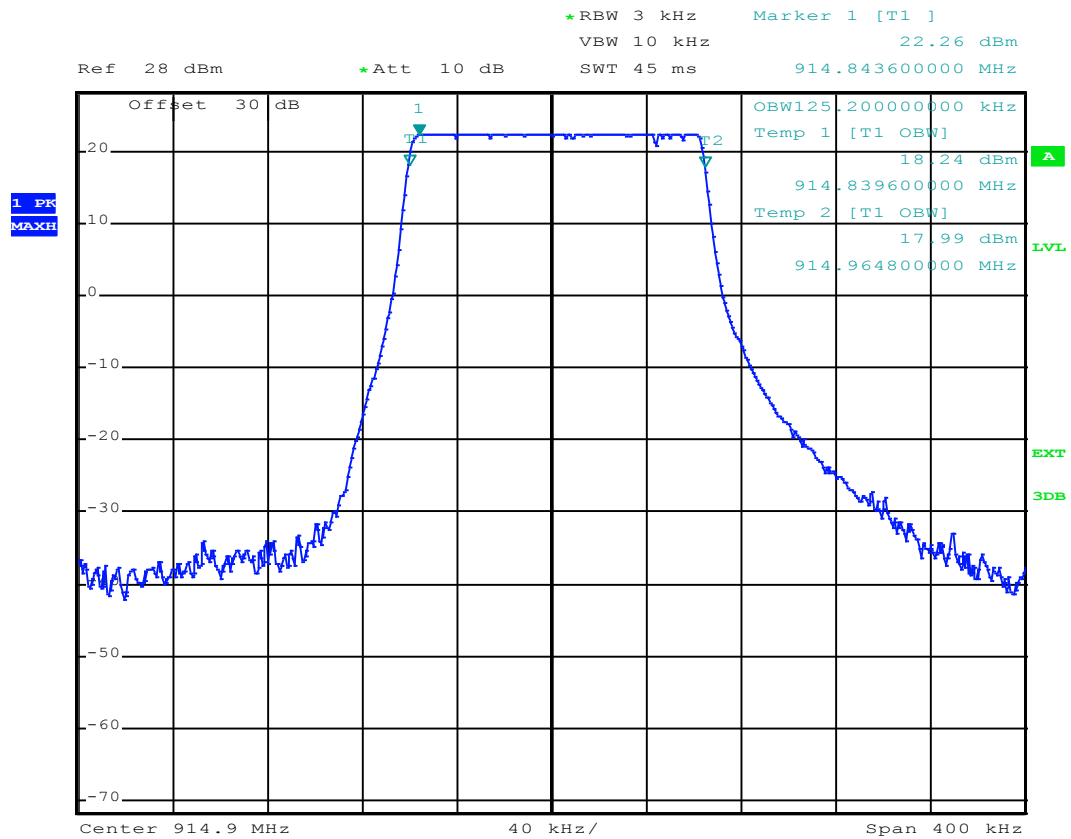
Central Channel – SF10



High Channel – SF7

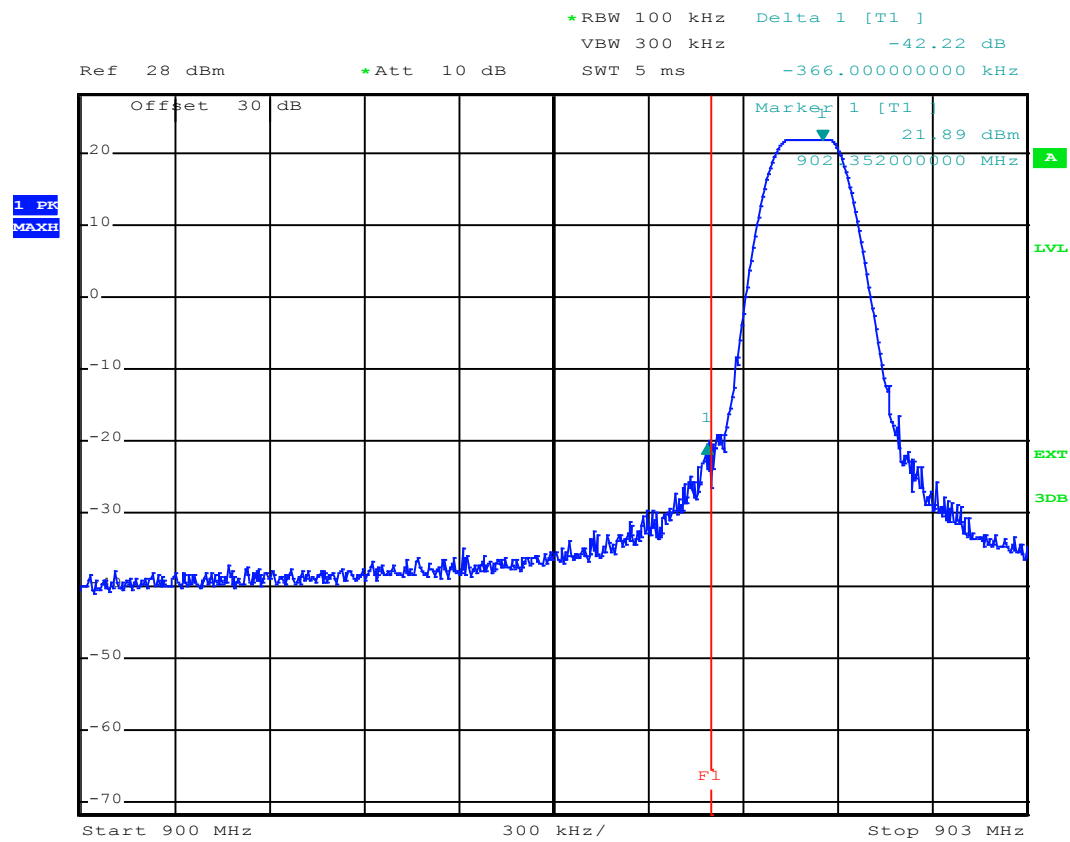


High Channel – SF10

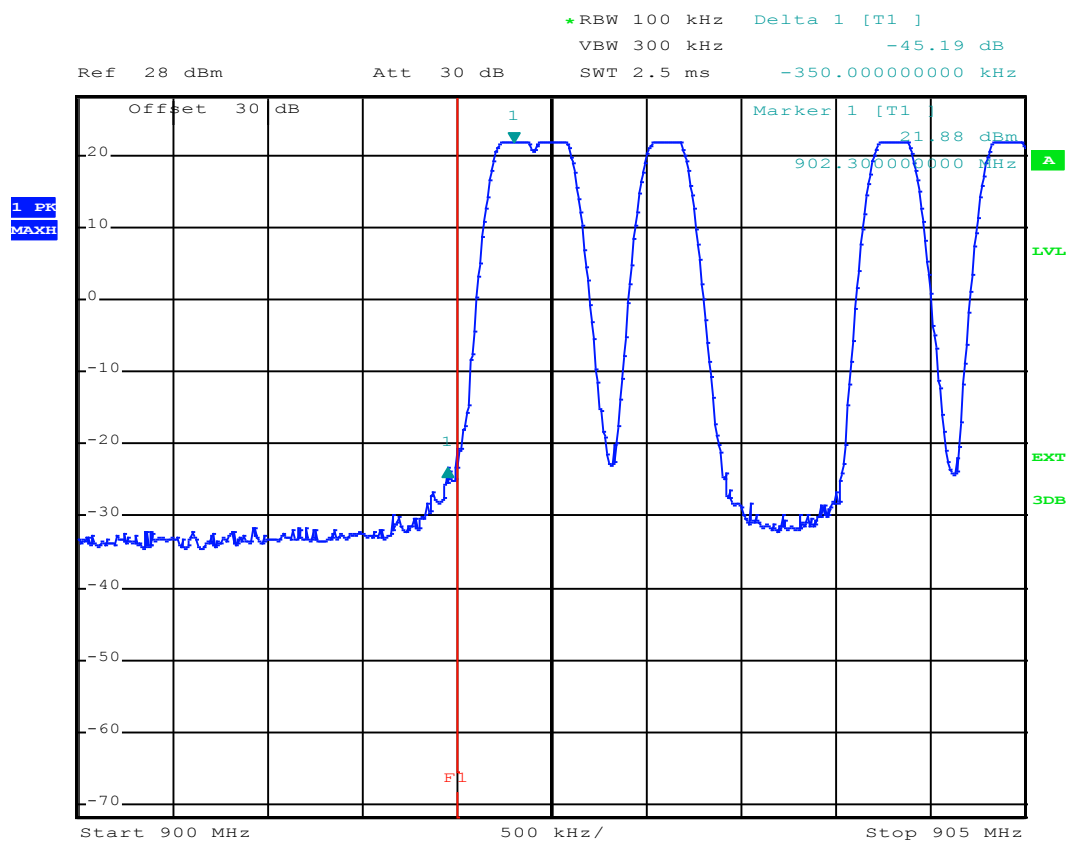


APPENDIX 4: Band edge

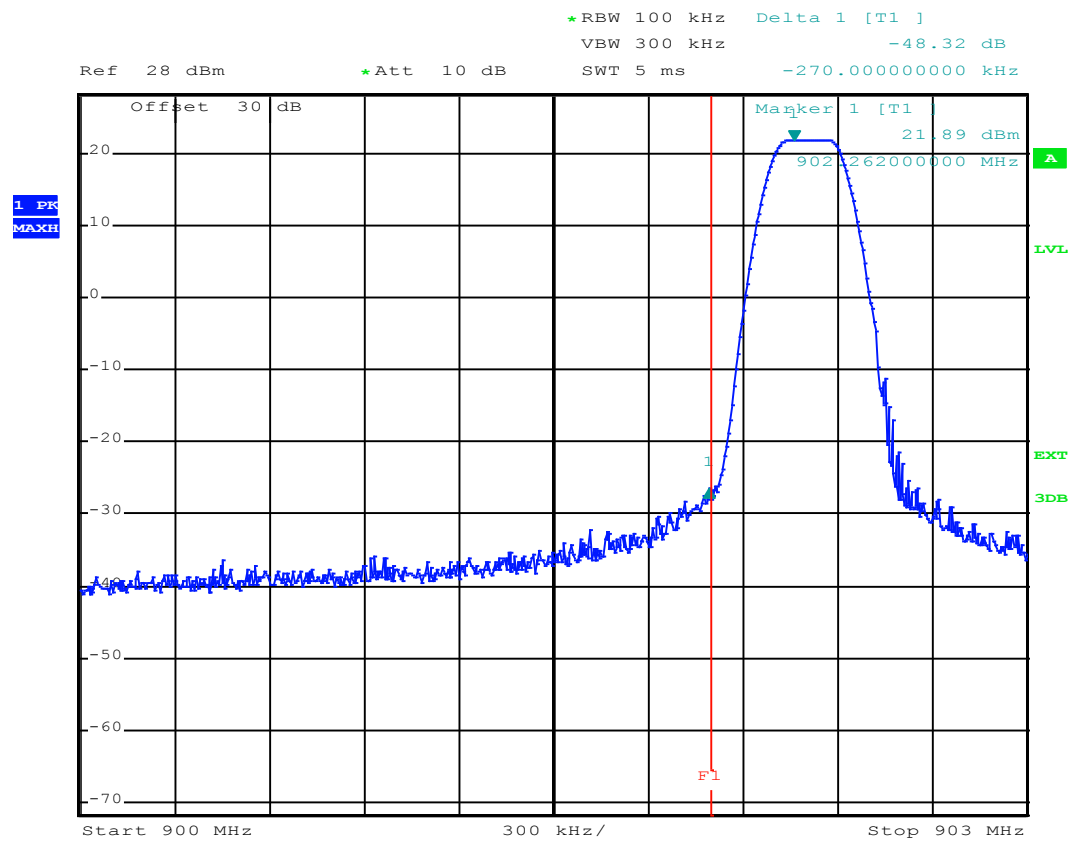
Low Channel with hopping mode off – SF7



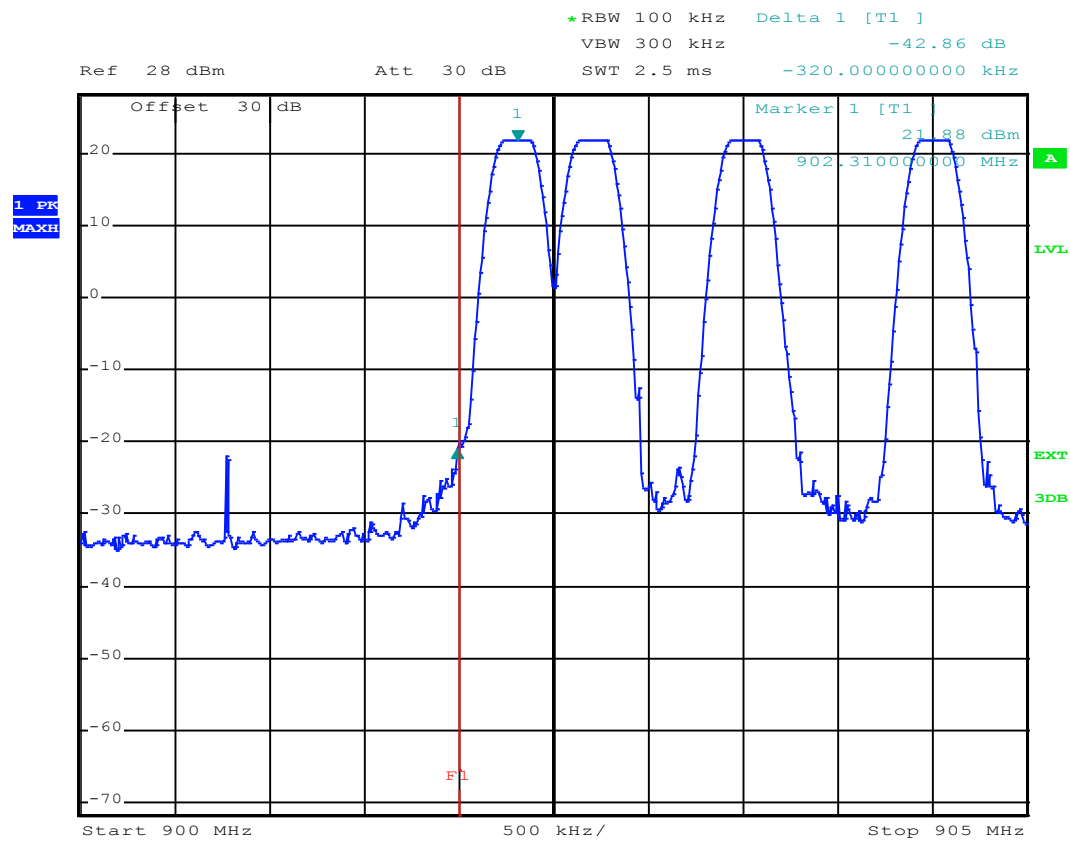
Low Channel with hopping mode on – SF7



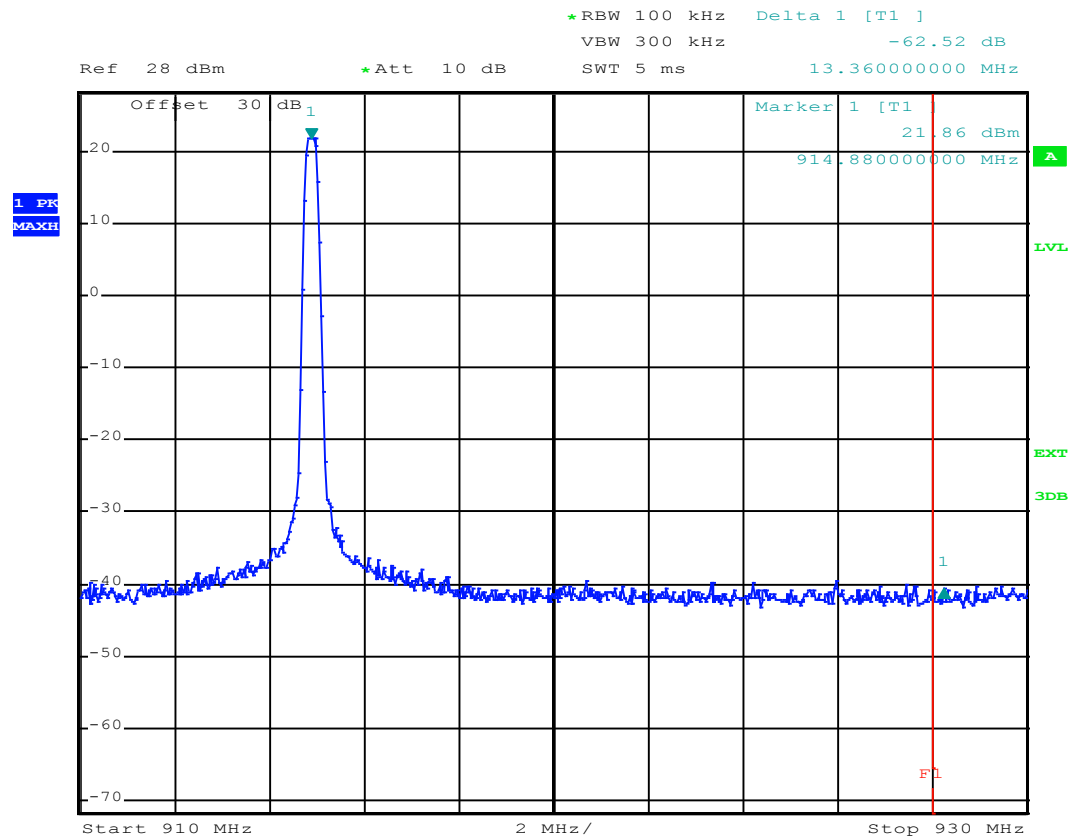
Low Channel with hopping mode off – SF10



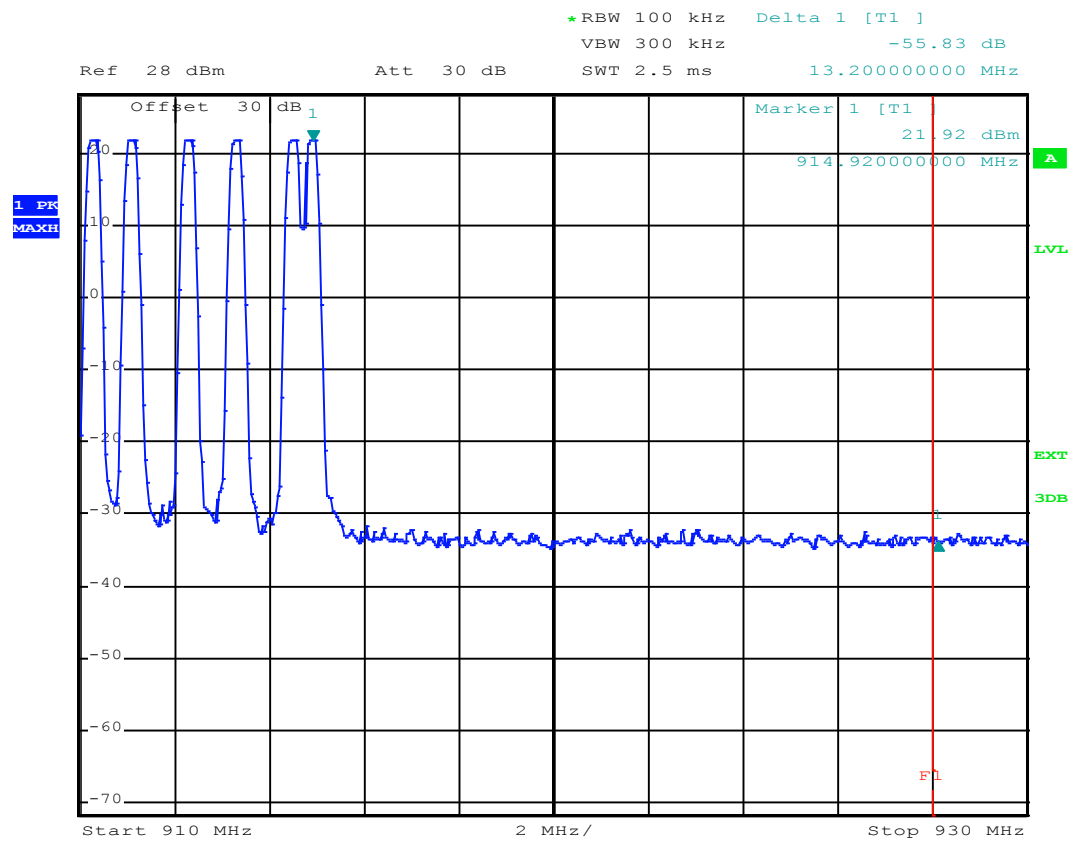
Low Channel with hopping mode on – SF10



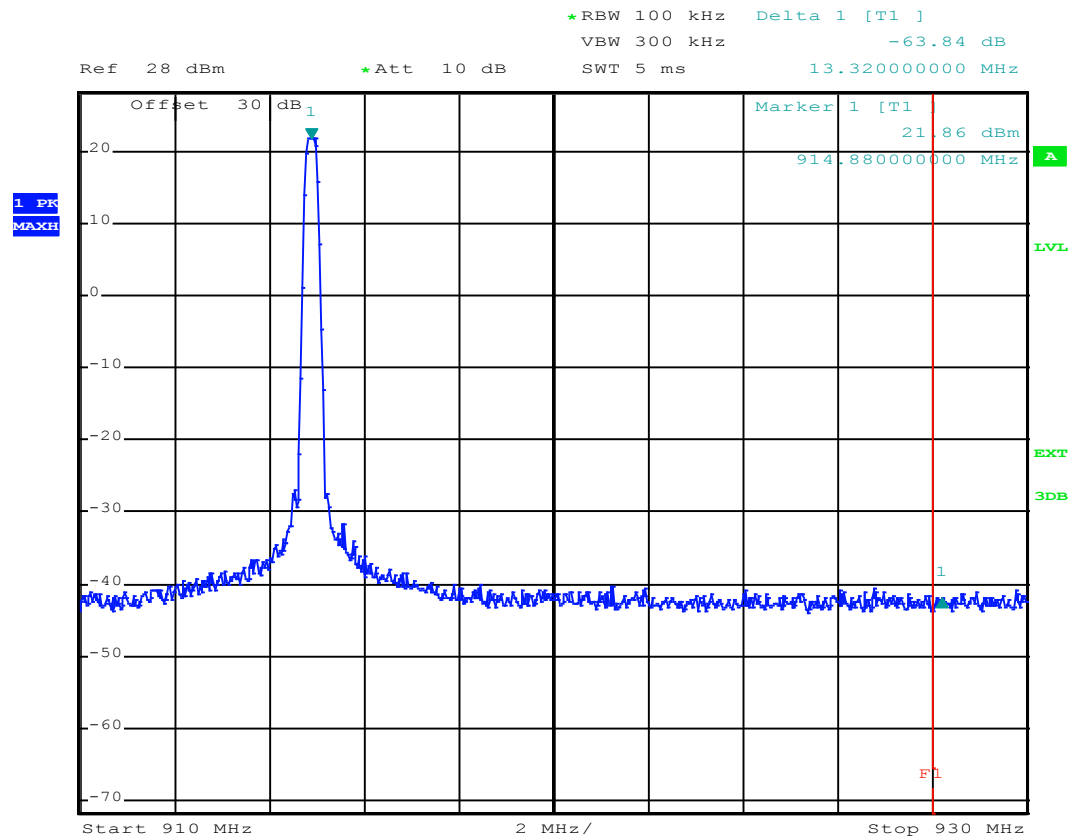
High Channel with hopping mode off – SF7



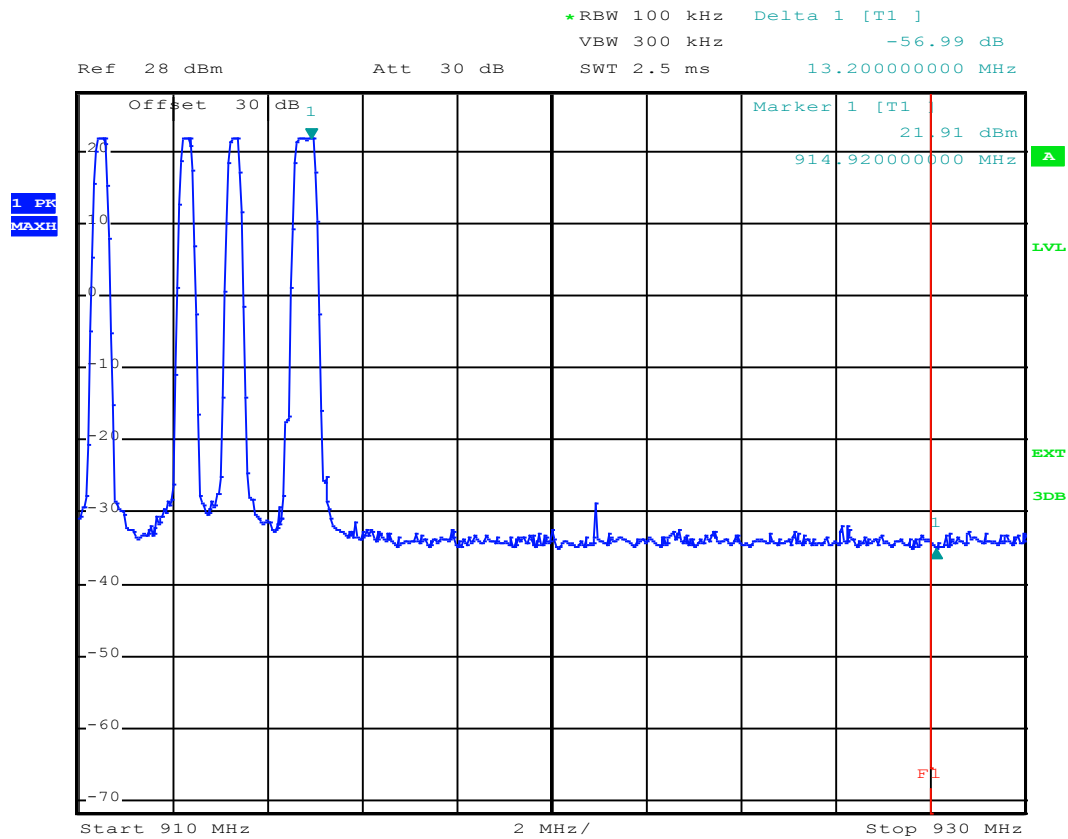
High Channel with hopping mode on – SF7



High Channel with hopping mode off – SF10

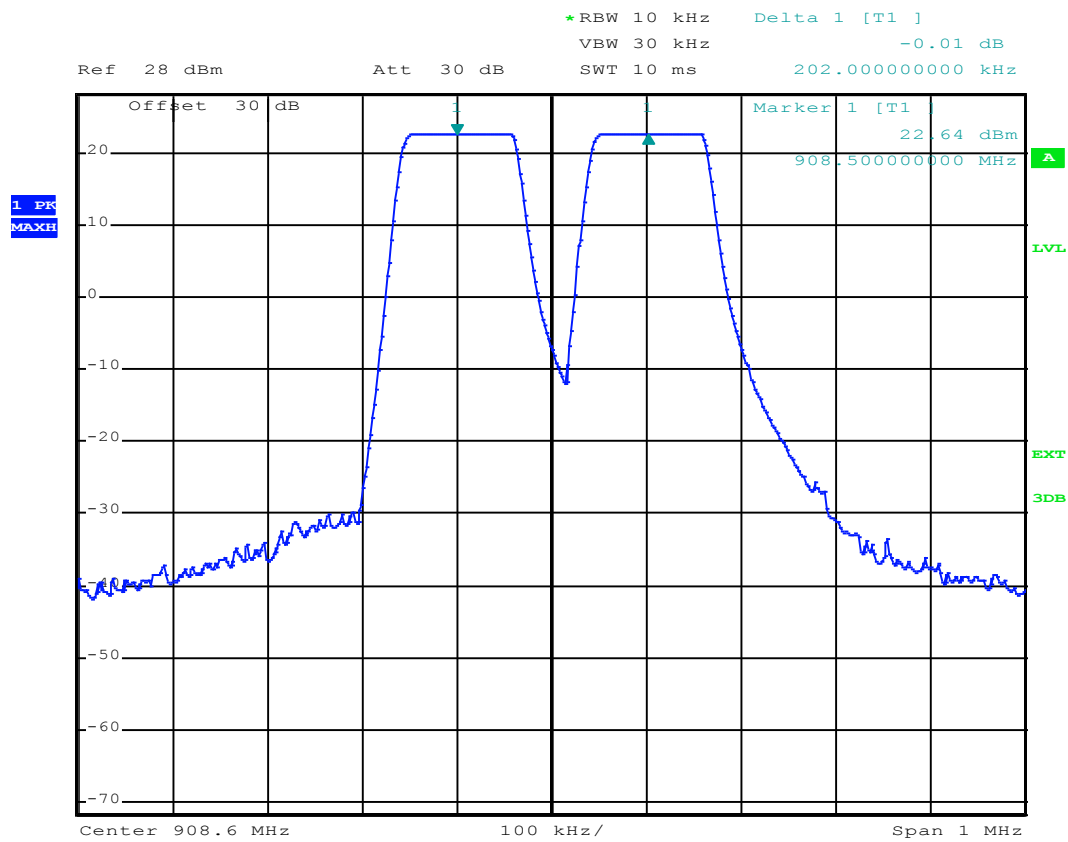


High Channel with hopping mode on – SF10

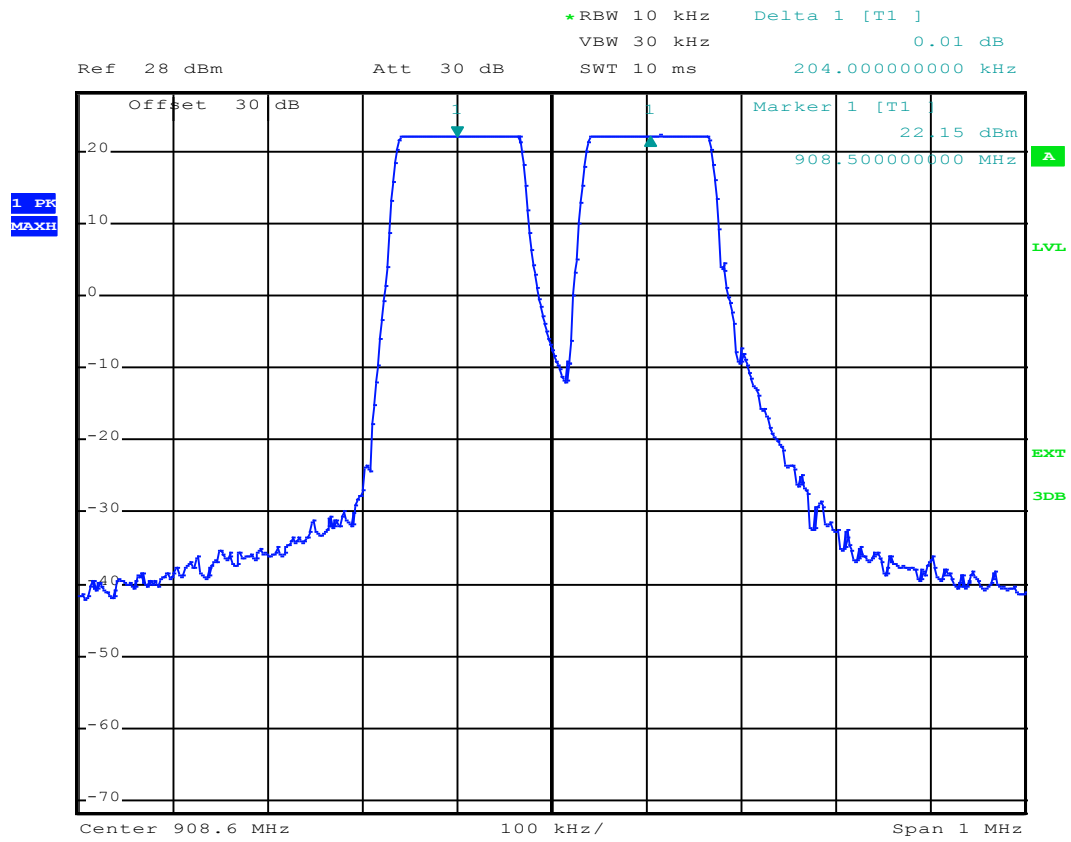


APPENDIX 5: Channel spacing

SF7

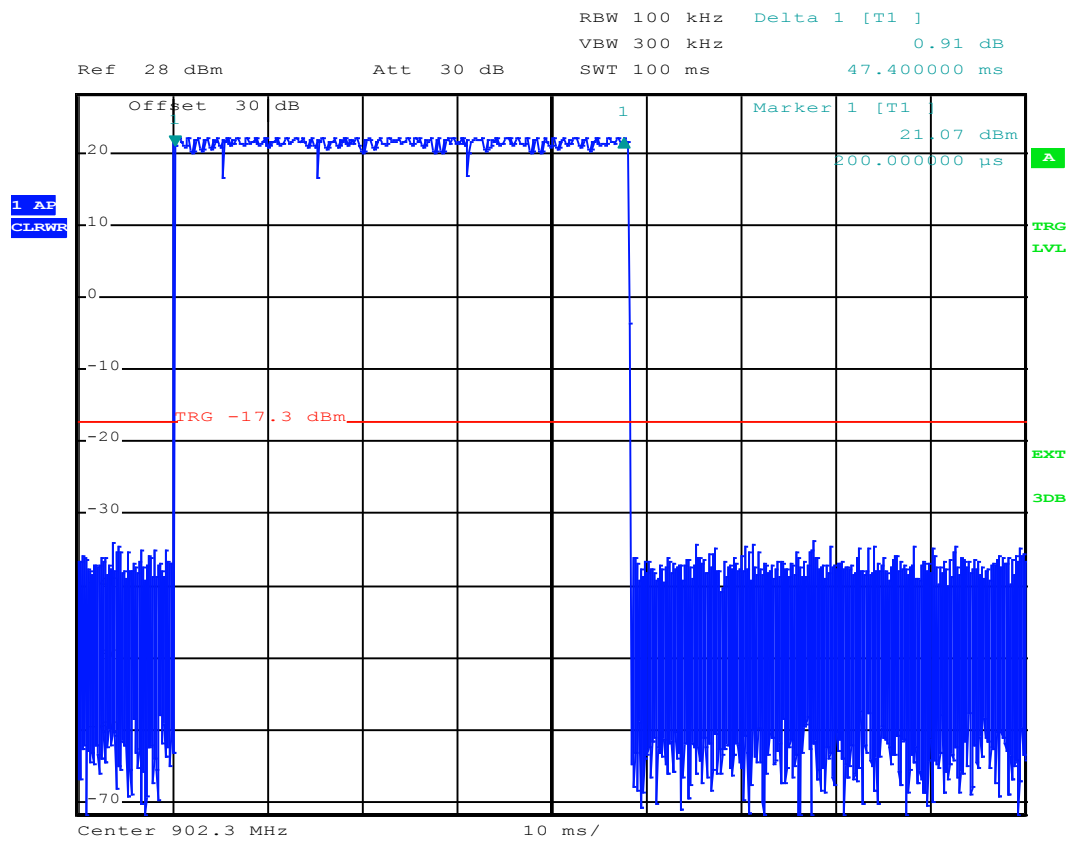


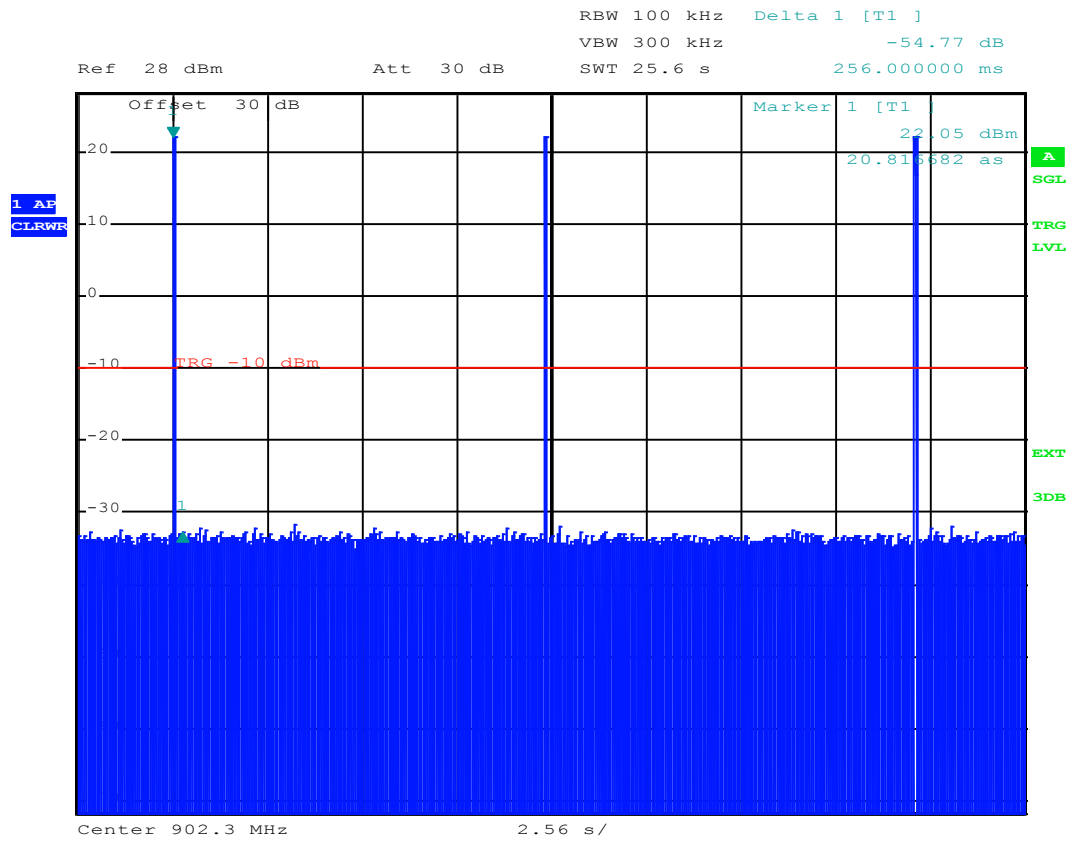
SF10



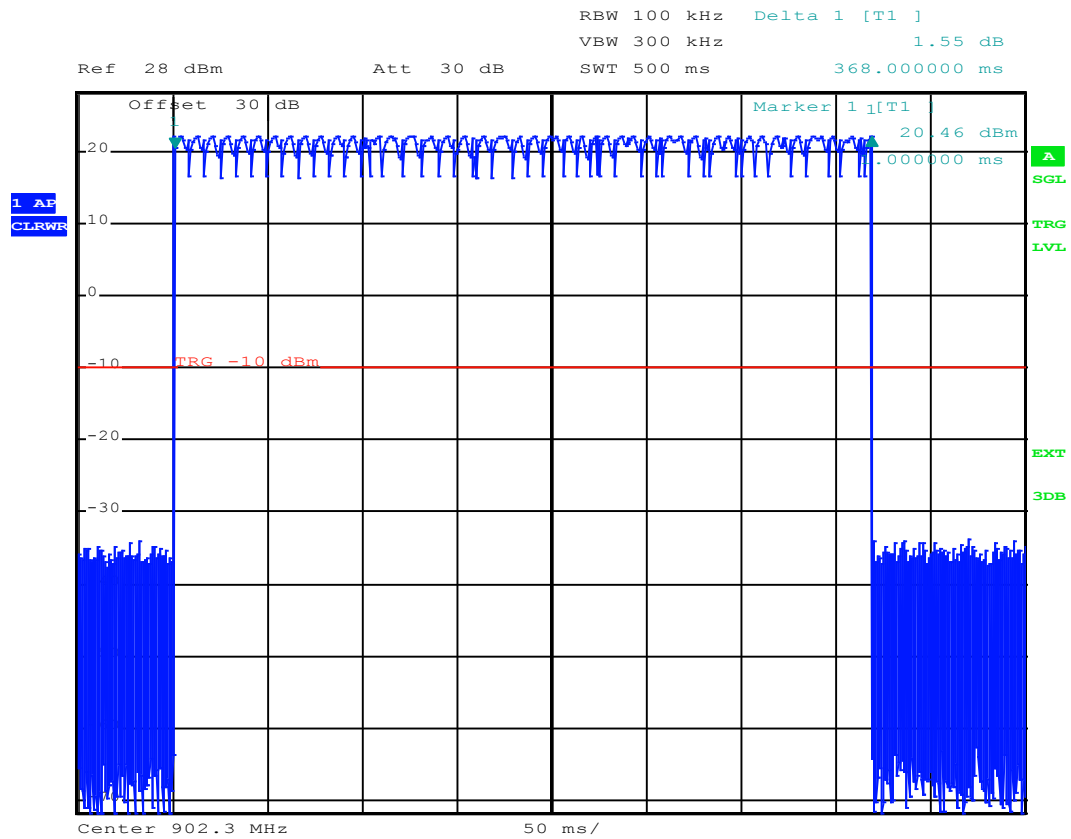
APPENDIX 6: Time of occupancy on any frequency

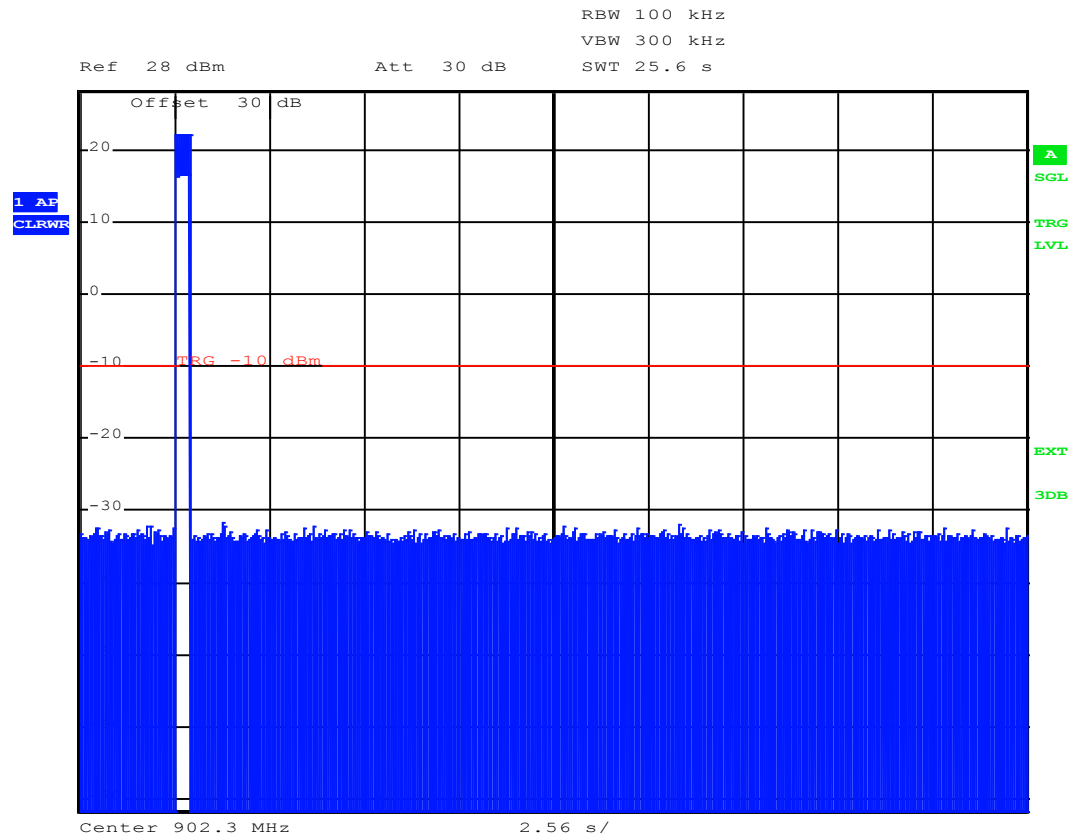
Low Channel - SF7



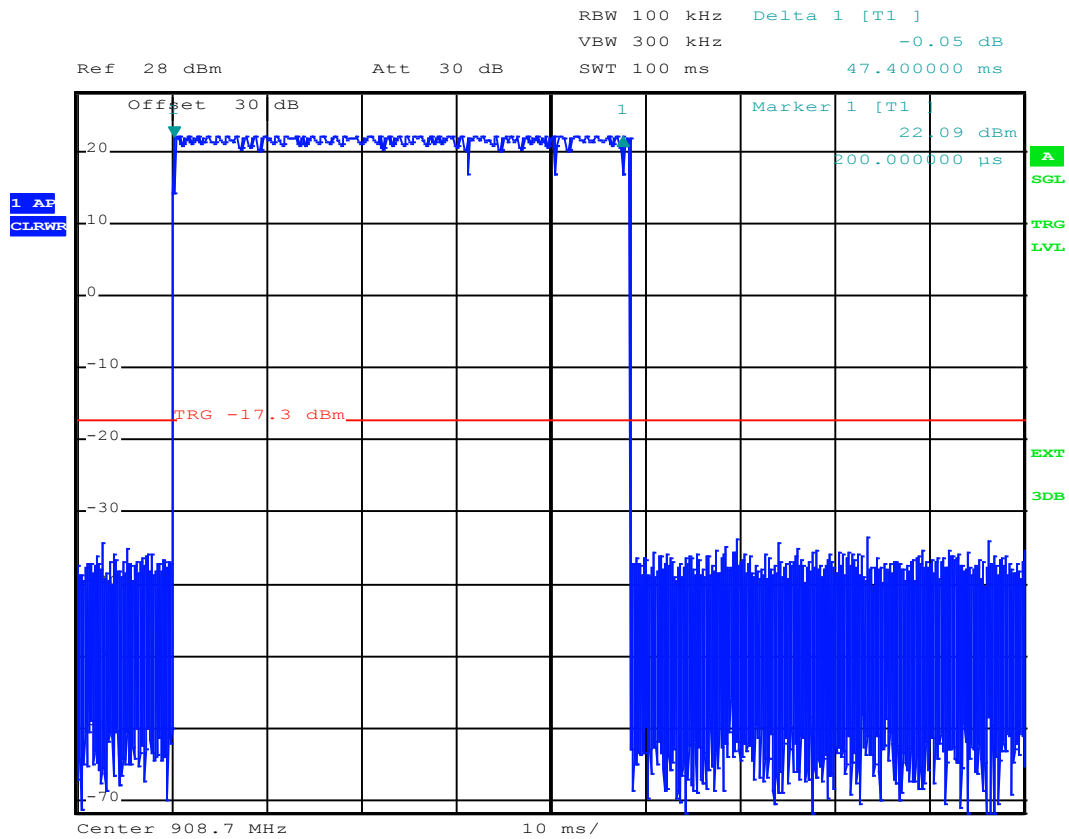


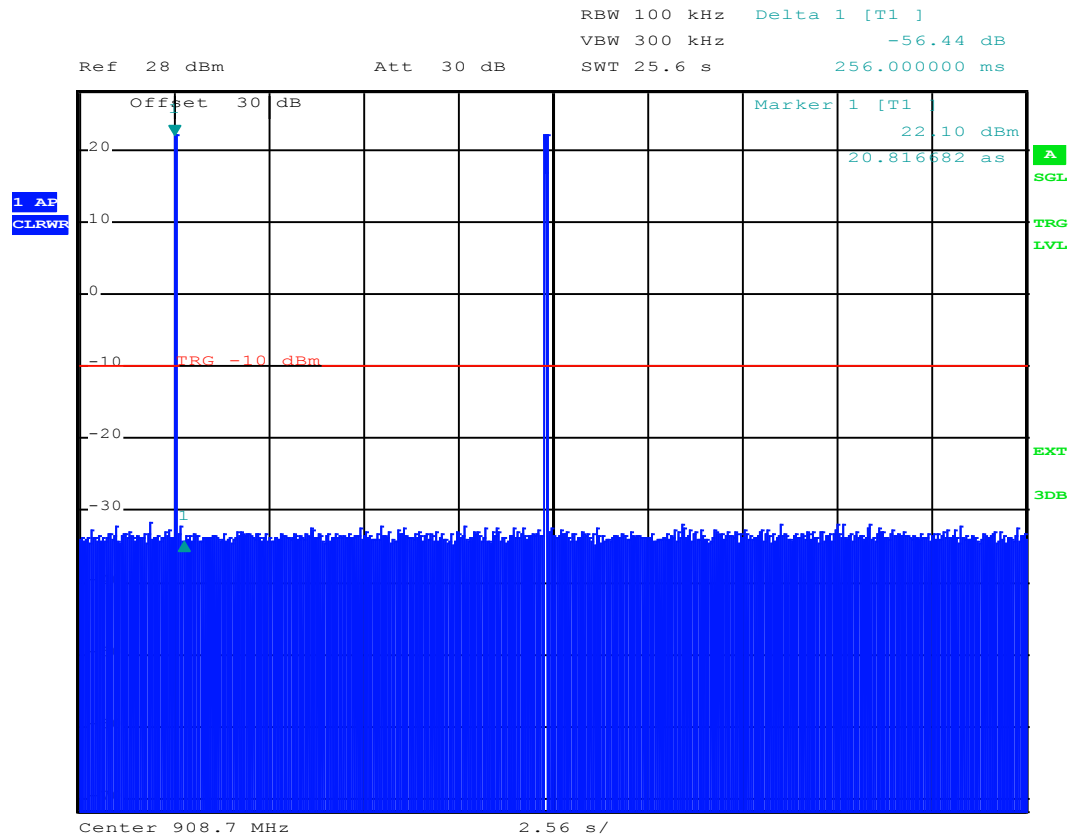
Low Channel – SF10



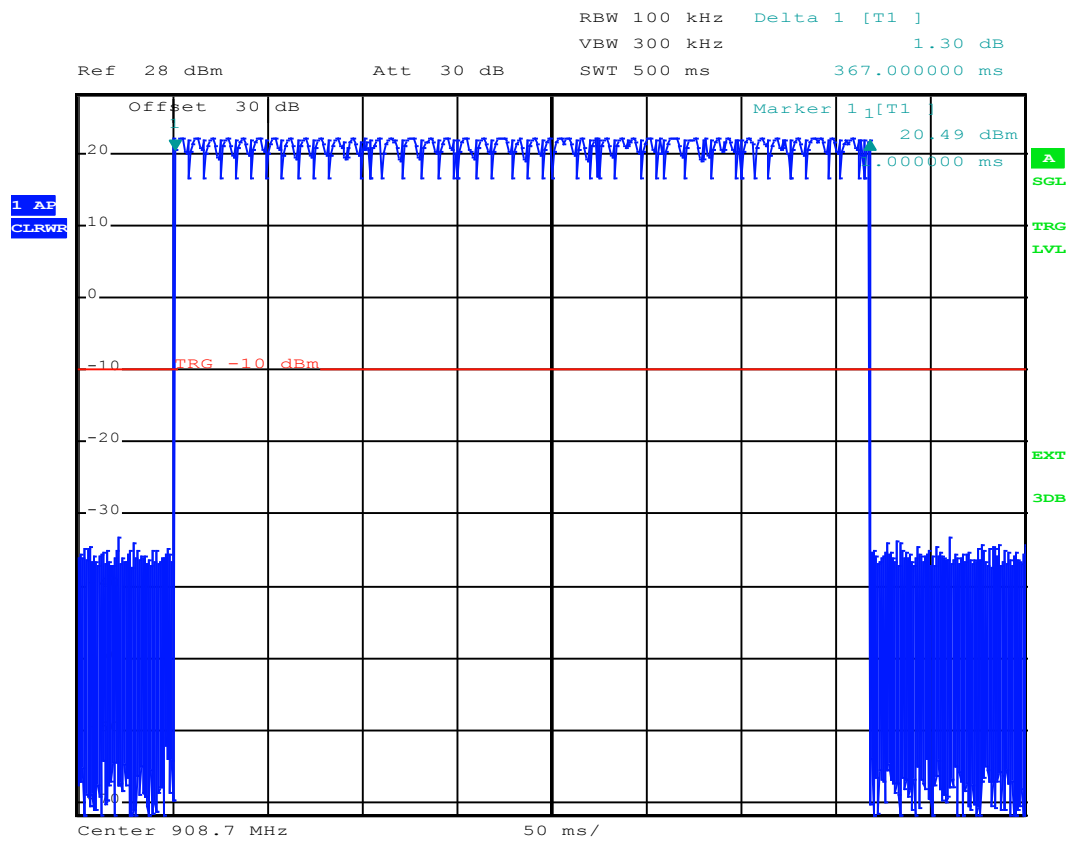


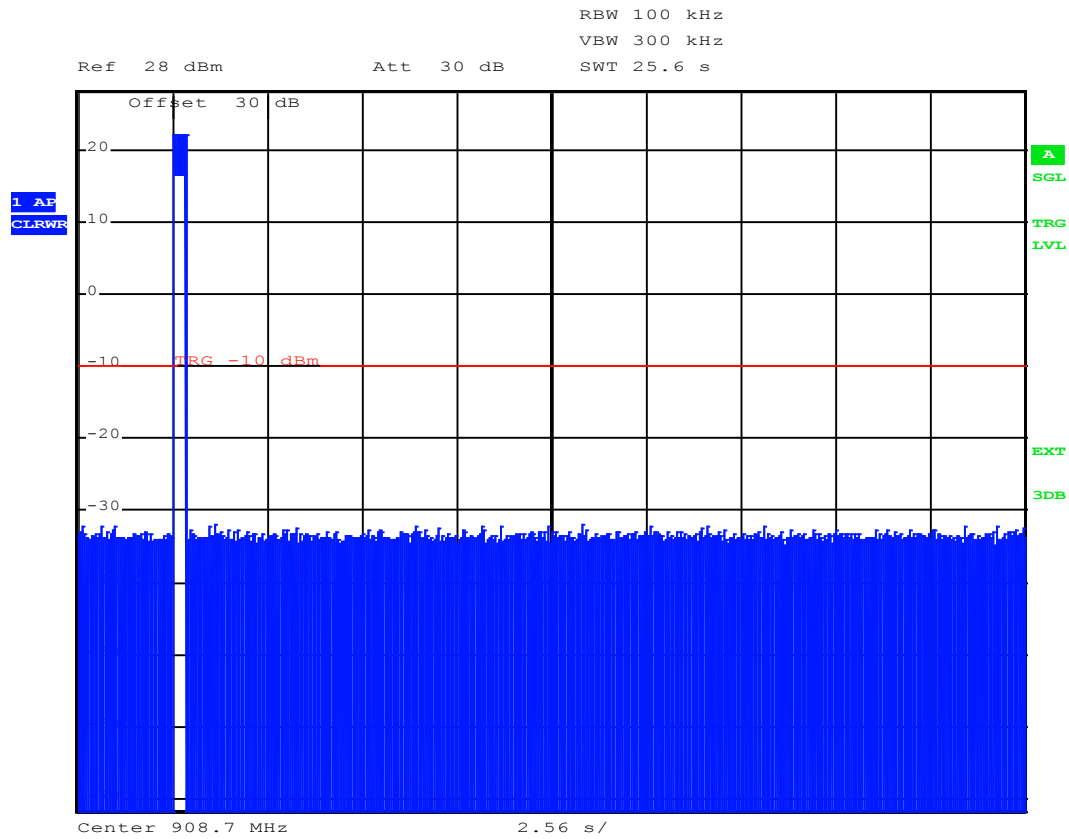
Central Channel – SF7



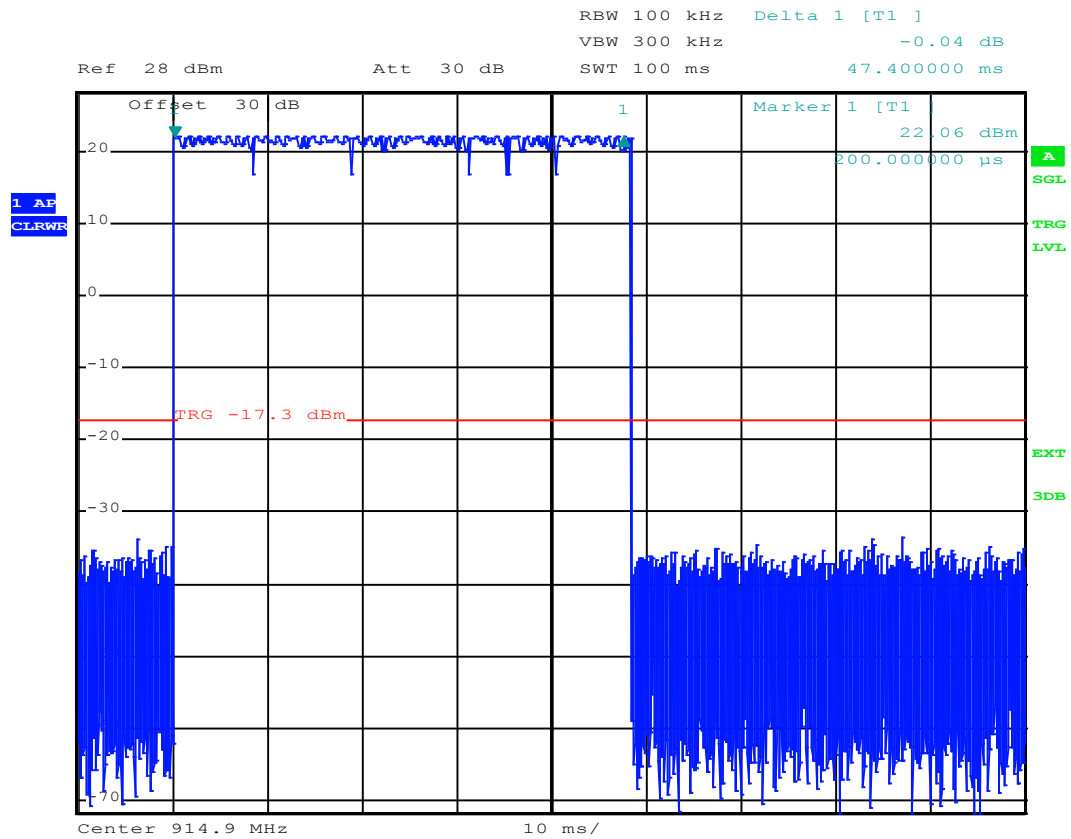


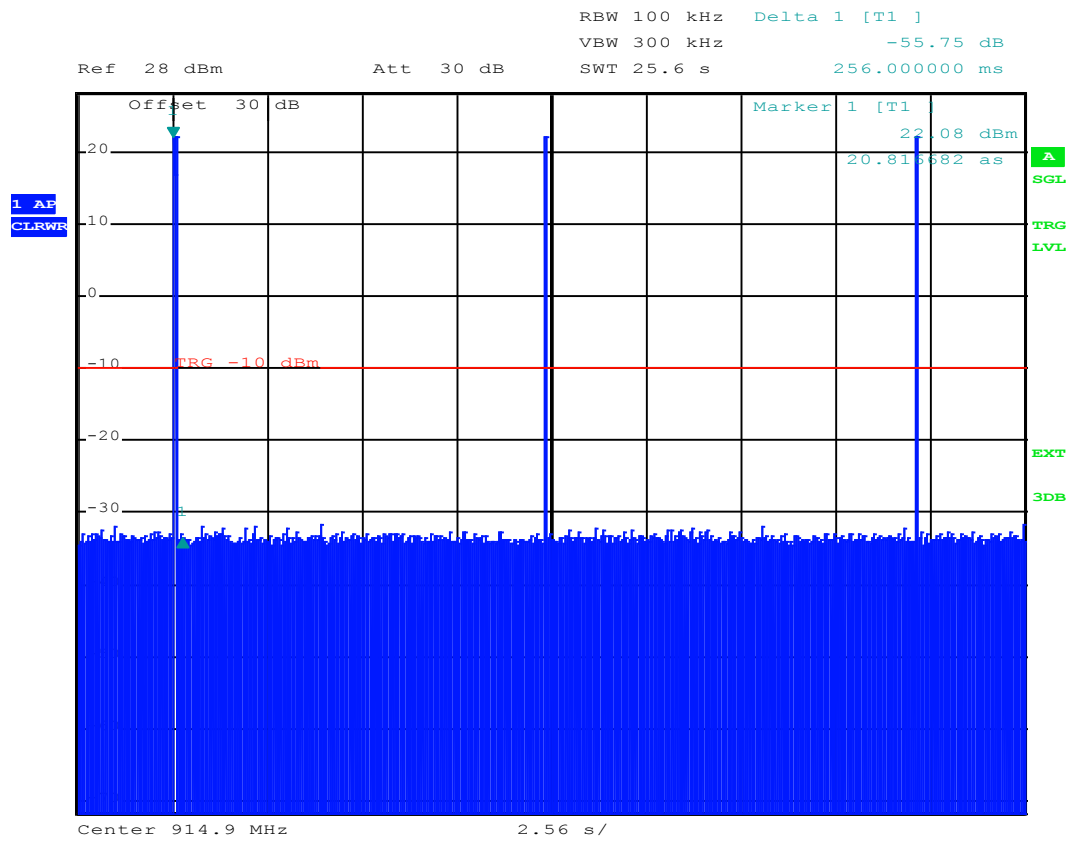
Central Channel – SF10



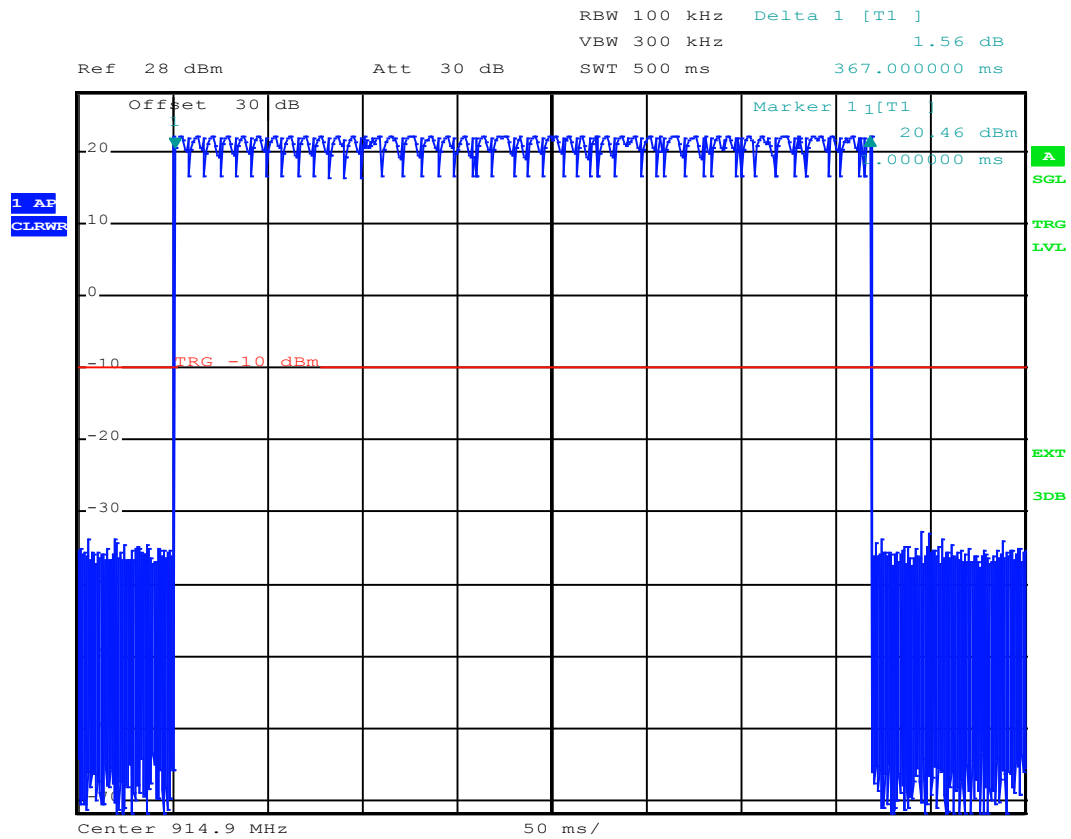


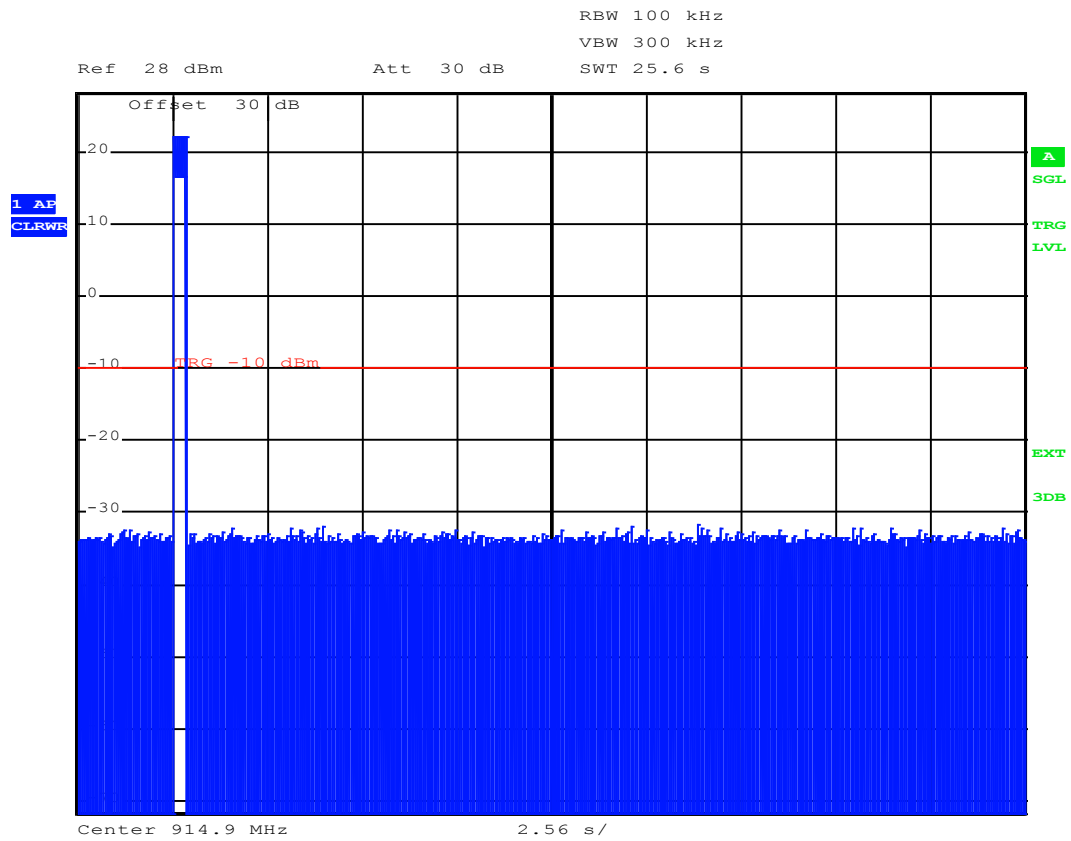
High Channel – SF7





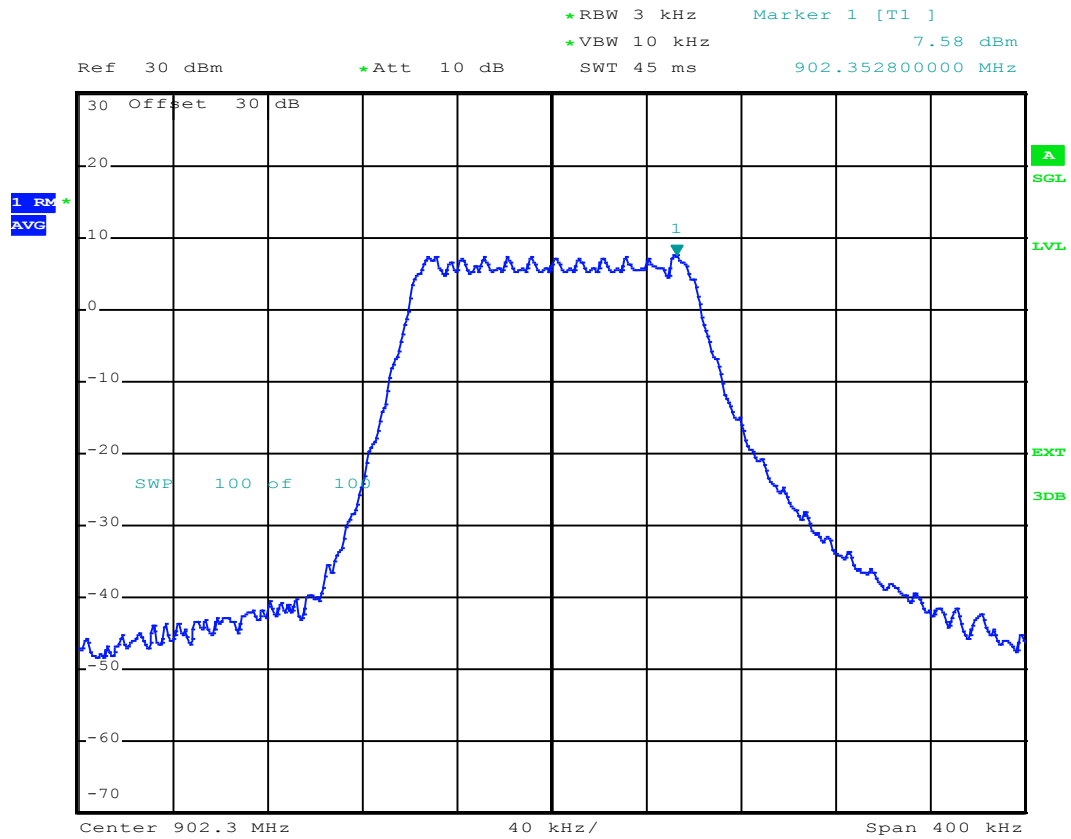
High Channel – SF10



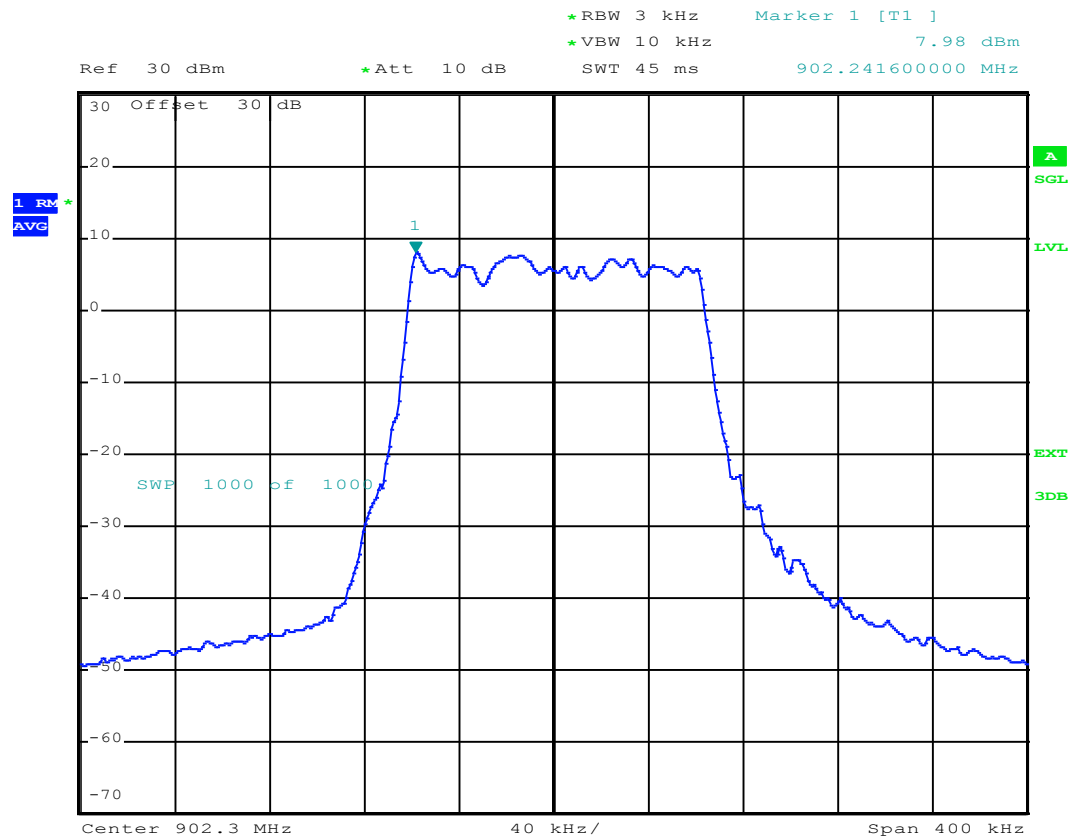


APPENDIX 7: Power Spectral Density

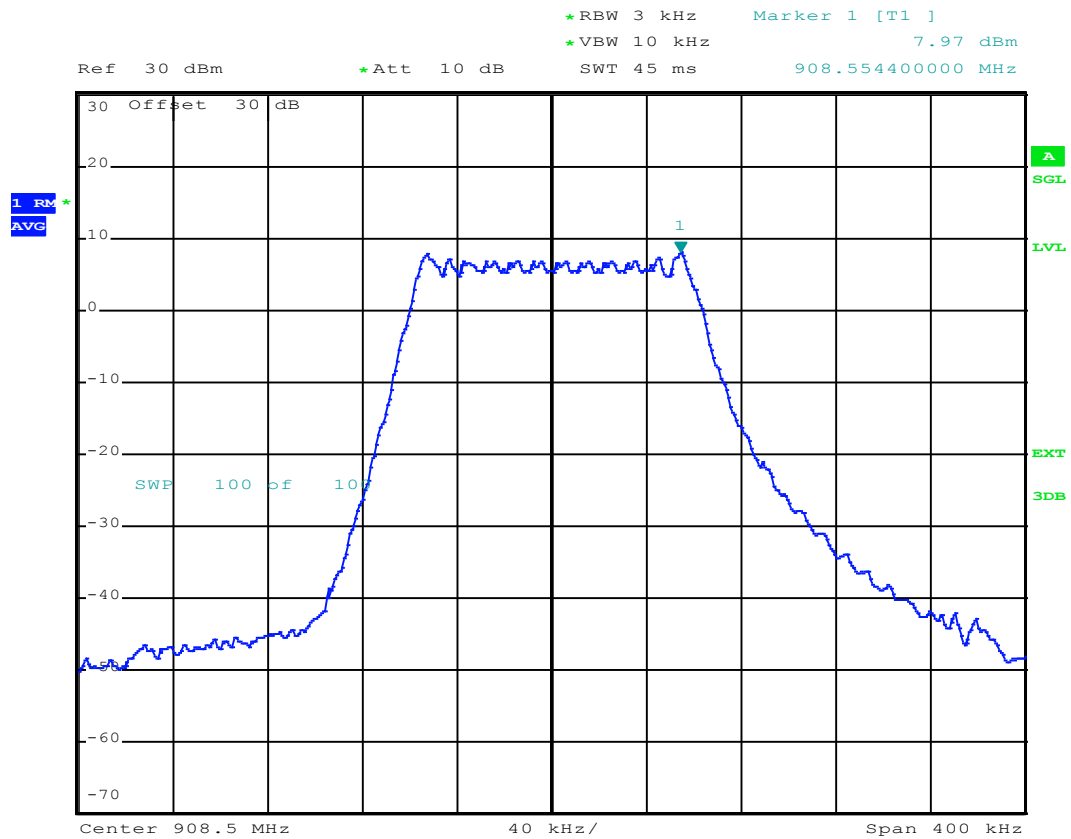
Low Channel – SF7



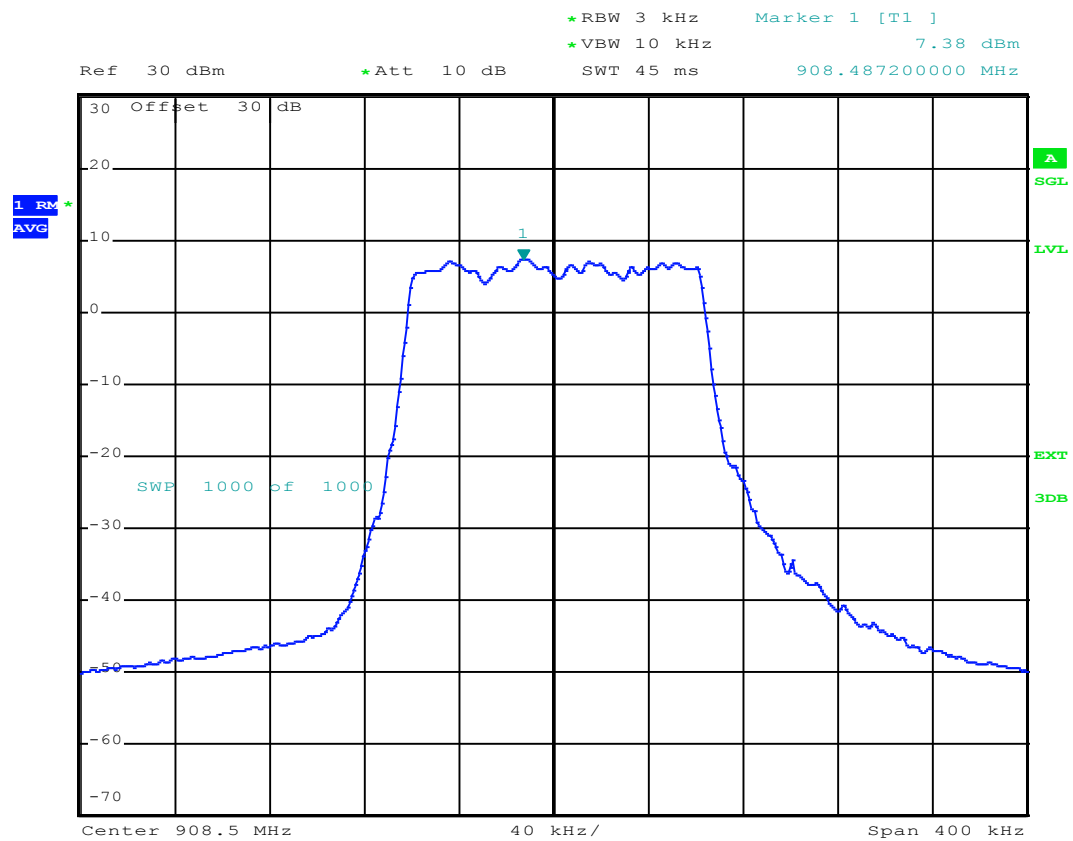
Low Channel – SF10



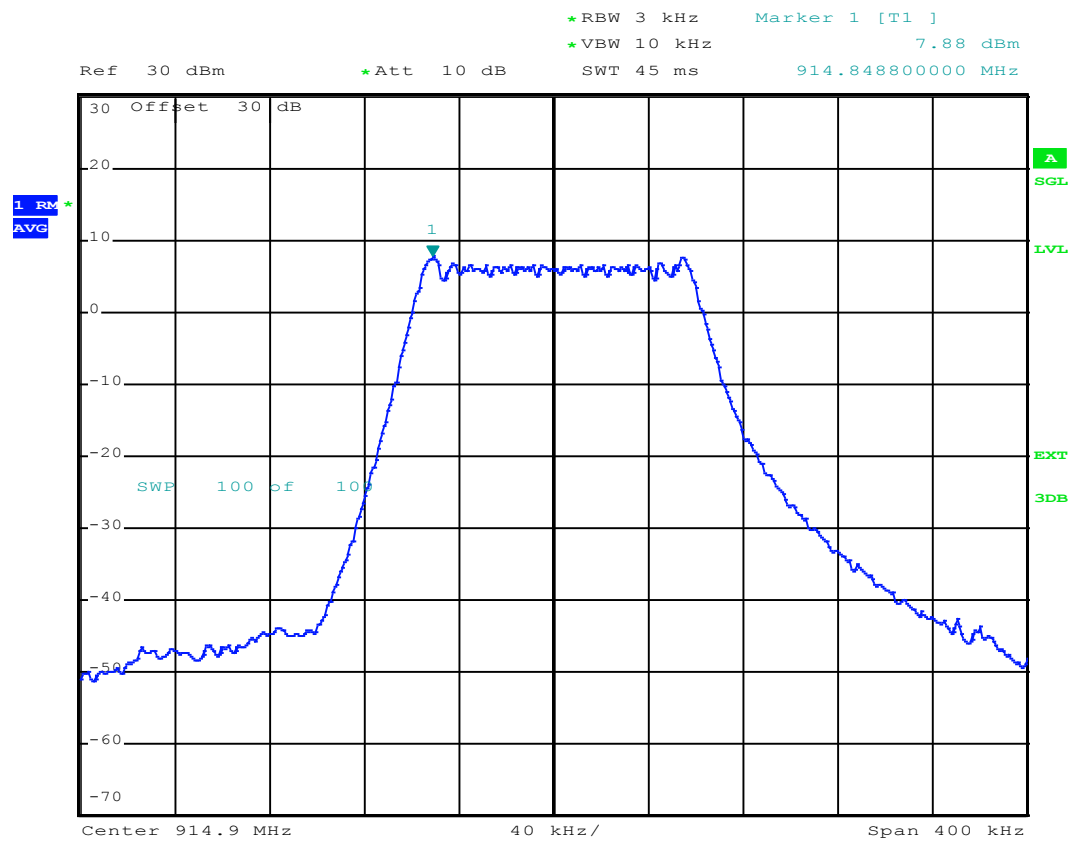
Central Channel – SF7



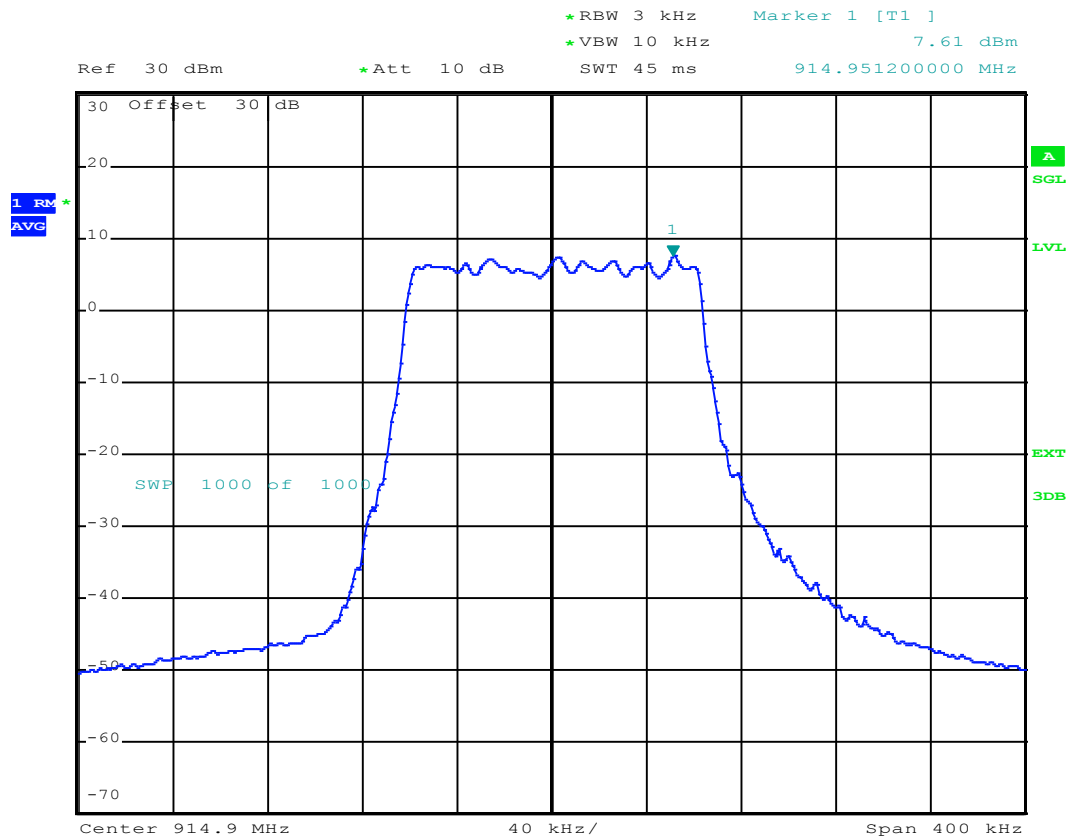
Central Channel – SF10



High Channel – SF7

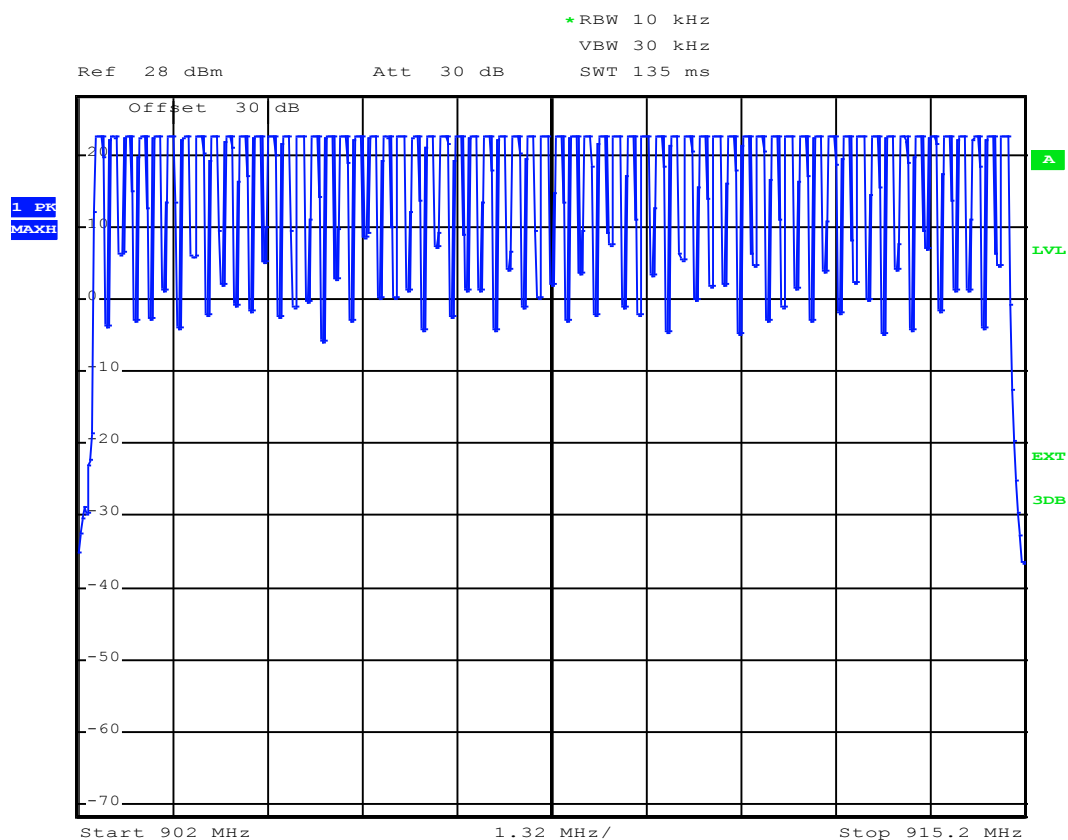


High Channel – SF10



APPENDIX 8: Number of hopping channels

64 Channels – SF7



64 Channels – SF10

