

## Certification Radio test report

According to the standard:  
CFR 47 FCC PART 15

Equipment under test:  
INDUSTRIAL TRACKER

FCC ID: 2AOSP-U200

Company:  
ABEEWAY

Distribution: Mr DANCHESI

(Company: ABEEWAY)

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|-----|----------|---------------------|------------------------------------------------|------|
|     |          |                     | Name and Function                              | Visa |
| 0   | 6-Sep-18 | Creation            | M. DUMESNIL, Radio Technical Manager           |      |

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**DESIGNATION OF PRODUCT:** INDUSTRIAL TRACKER

**Serial number (S/N):** 20635F0OC80001FB

**Reference / model (P/N):** U200

**Software version:** actt-macro-mtos-rev1.2-4  
Asset Tracker v1.x (for production)

**MANUFACTURER:** ABEEWAY

**COMPANY SUBMITTING THE PRODUCT:**

**Company:** ABEEWAY

**Address:** 635 ROUTE DES LUCIOLES  
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FRANCE

**Responsible:** Mr DANCHESI

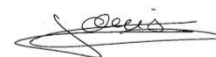
**Person present during the tests:** Mr DANCHESI (30 and 31 Aug-18)

**DATES OF TEST:** From 30-Aug-18 to 5-Sep-18

**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 document presents the result of RADIO test carried out on the following equipment:: **Industrial Tracker** in accordance with normative reference.

The device under test integrates a multifrequencies wireless transceiver LoRa.

The products integrate also a Wi-Fi module already certified (FCCID: 2AC7Z-ESPWROOM02) and a GPS receiver.

This radio test report concerns only the results for certification procedure on the LoRa part, for test under subpart B see radio test report RR051-17-104472-3-A Ed. 0.

The two transceivers (LoRa and Wi-Fi) can't emit simultaneously as declared by the manufacturer.

## 2. PRODUCT DESCRIPTION

Class: B

Utilization: Residential

Antenna type and gain: Integrated antenna, gain declared by the applicant (considered 1 dBi)

Power adjusted by software: The power level is tuned to reach max power

Operating frequency range: From 902.3 MHz to 914.9 MHz

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

Spread factor: 7 and 10

Power source: No rechargeable 3.6Vdc 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 (2018)      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.

558074 D01 DTS v05              Guidance for compliance measurements on digital transmission system,  
frequency hopping spread spectrum system, and hybrid system devices  
operating under section 15.247 of the FCC rules.

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 B –Unintentional Radiators

Paragraph 109: Radiated emission limits

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 transmitter

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 V3.16.0.64           | Software                                  | /                | /                            | /                    |
| 1406           | EMCO 6502                    | Loop antenna                              | 13/04/2017       | 2                            | 13/04/2019           |
| 2648           | ALC ALN02-0032               | Low-noise amplifier                       | 30/03/2018       | 1                            | 30/03/2019           |
| 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                            | 29/03/2020           |
| 6884           | Suhner 1.5m                  | Cable                                     | 29/03/2018       | 2                            | 29/03/2020           |
| 7190           | R&S HL223                    | Antenna                                   | 15/03/2016       | 3                            | 15/03/2019           |
| 7240           | Emco 3110                    | Biconical antenna                         | 15/03/2016       | 3                            | 15/03/2019           |
| 7310           | Filtek HP12/1200-5AA         | High-pass filter                          | 29/03/2018       | 2                            | 29/03/2020           |
| 8511           | HP 8447D                     | Low-noise amplifier                       | 01/02/2018       | 1                            | 01/02/2019           |
| 8534           | EMCO 3115                    | Antenna                                   | 16/03/2016       | 3                            | 16/03/2019           |
| 8535           | EMCO 3115                    | Antenna                                   | 10/02/2016       | 4                            | 10/02/2020           |
| 8578           | 2GHz                         | Cable                                     | 29/03/2018       | 2                            | 29/03/2020           |
| 8593           | SIDT Cage 2                  | Anechoic chamber                          | /                | /                            | /                    |
| 8707           | R&S ESI7                     | Test receiver                             | 13/02/2018       | 1                            | 13/02/2019           |
| 8732           | Emitech                      | OATS                                      | 11/10/2016       | 3                            | 11/10/2019           |
| 8749           | La Crosse Technology WS-9232 | Meteo station                             | 23/09/2016       | 2                            | 23/09/2018           |
| 8750           | La Crosse Technology WS-9232 | Meteo station                             | 23/09/2016       | 2                            | 23/09/2018           |
| 8783           | EMCO 3147                    | Log periodic antenna                      | 15/03/2016       | 3                            | 15/03/2019           |
| 8864           | Champ libre Juigné. V3.4     | Software                                  | /                | /                            | /                    |
| 8896           | ACQUISYS GPS8                | Satellite synchronized frequency standard | /                | /                            | /                    |
| 8972           | K&L Microwave 500-1000MHz    | Notch filter                              | /                | /                            | /                    |
| 10730          | Mini-circuit ZFL-1000LN      | Low-noise amplifier                       | 12/02/2018       | 1                            | 12/02/2019           |
| 10739          | LUCIX Corp S005180M3201      | Low-noise amplifier                       | 29/03/2018       | 1                            | 29/03/2019           |
| 12911          | Huber + Suhner N-2m          | cable                                     | 29/03/2018       | 2                            | 29/03/2020           |
| 12912          | Huber + Suhner N-5m          | cable                                     | 29/03/2018       | 2                            | 29/03/2020           |
| 14476          | Fluke 177                    | Multimeter                                | 20/07/2018       | 2                            | 20/07/2020           |
| -              | GPIB SHOT V2.4               | Software                                  | /                | /                            | /                    |

## 6. TESTS AND CONCLUSIONS

### 6.1 unintentional radiator (subpart B)

| Test procedure  | Description of test      | Respected criteria? |    |     |     | Comment |
|-----------------|--------------------------|---------------------|----|-----|-----|---------|
|                 |                          | Yes                 | No | NAP | NAs |         |
| FCC Part 15.109 | RADIATED EMISSION LIMITS | X                   |    |     |     |         |

NAP: Not Applicable

NAs: Not Asked

### 6.2 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   |     |                  |
| 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<br>Note 6 |
|                 | (g) Frequency hopping requirements                                        |                     |    | X   |     |                  |
|                 | (h) Frequency hopping intelligence                                        |                     |    | X   |     |                  |
|                 | (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 is not possible (integral antenna), so we used the radiated method in open field.

Note 5: The transceiver used is SX1272 of Semtech also LoRa protocol is used.

The frequency hopping system uses 64 channels

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

#### **With Spread Factor 7:**

The timing by channel is 36ms (see appendix 5).

During  $64 \text{ channels} \times 0.4 \text{ s} = 25.6 \text{ s}$ , any channel is used 1 time, then  $1 \times 36\text{ms} = 36\text{ms}$ , 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<br>( $0.4\text{s} \times \text{Nbr of channel}$ )<br>(s) | Maximal Duration of each burst<br>(ms) | Number of burst repetition during observation period | average time of occupancy on any channel<br>(s) | Limits<br>(s) |
|--------------------|-----------------------------------------------------------------------------|----------------------------------------|------------------------------------------------------|-------------------------------------------------|---------------|
| 64                 | 25.6                                                                        | 36                                     | 1                                                    | 0.036                                           | 0.4           |

#### **With Spread Factor 10:**

The timing by channel is 248.4ms (see appendix 5).

During  $64 \text{ channels} \times 0.4 \text{ s} = 25.6 \text{ s}$ , any channel is used 1 time, then  $1 \times 248.4\text{ms} = 248.4\text{ms}$ , 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<br>( $0.4\text{s} \times \text{Nbr of channel}$ )<br>(s) | Maximal Duration of each burst<br>(ms) | Number of burst repetition during observation period | average time of occupancy on any channel<br>(s) | Limits<br>(s) |
|--------------------|-----------------------------------------------------------------------------|----------------------------------------|------------------------------------------------------|-------------------------------------------------|---------------|
| 64                 | 25.6                                                                        | 248.4                                  | 1                                                    | 0.248                                           | 0.4           |

Note 6:

The minimum 6 dB bandwidth of the equipment is 260 kHz on high channel (see appendix 2).

The maximum 99% bandwidth of the equipment is 126 kHz (see appendix 3).

**7. RF EXPOSURE****LoRa part:**

Maximum measured power = 108.7 dB $\mu$ V/m = 0.179 W at 914.9 MHz

with  $P = (E \times d)^2 / (30 \times G_p)$  with  $d = 10$  m and  $G_p = 1.26$

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

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

$$\Rightarrow 0.179 / (4 \times \pi \times (20 \text{ cm})^2) = 0.036 \times 10^{-3} \text{ mW/cm}^2 \text{ (limit = } f / 1500 = 914.9 / 1500 = 0.6 \text{ mW/cm}^2 \text{)}.$$

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

**WiFi Part:**

According grant maximum measured power = 108.7 dB $\mu$ V/m = 0.167 W for 2412 - 2462 MHz frequency band.

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

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

$$\Rightarrow 0.167 / (4 \times \pi \times (20 \text{ cm})^2) = 0.033 \times 10^{-3} \text{ mW/cm}^2 \text{ (limit = } 1 \text{ mW/cm}^2 \text{)}.$$

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

**8. 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<br>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                           | $\pm 5\text{ \%}$               |

**9. RADIATED EMISSION LIMITS****Temperature (°C) :** 23.2**Humidity (%HR):** 50**Date :** August 29, 2018**Technician :** S. LOUIS**Standard:** FCC Part 15**Test procedure:** paragraph 109**Limit class:** Class B**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 5 GHz / 5<sup>th</sup> harmonic of the highest frequency used (928MHz).

**Detection mode:** Quasi-peak (F < 1 GHz)

Average (F > 1 GHz)

**Bandwidth:** 120 kHz (F < 1 GHz)

1 MHz (F > 1 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 is blocked in reception mode using SF10 Spread Factor.

**Results:**

Power source:

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

Voltage at the beginning of test (V): 3.88

Voltage at the end of test (V): 3.73

Percentage of voltage drop during the test (%): 3.87

Sample N° 1 Channel Low, Central and High

Not any spurious has been detected.

|                                                                      |                               |
|----------------------------------------------------------------------|-------------------------------|
| Applicable limits: for $30 \text{ MHz} \leq F \leq 88 \text{ MHz}$ : | 40 dB $\mu$ V/m at 3 meters   |
| for $88 \text{ MHz} < F \leq 216 \text{ MHz}$ :                      | 43.5 dB $\mu$ V/m at 3 meters |
| for $216 \text{ MHz} < F \leq 960 \text{ MHz}$ :                     | 46 dB $\mu$ V/m at 3 meters   |
| Above 960 MHz :                                                      | 54 dB $\mu$ V/m at 3 meters   |

**Test conclusion:**

RESPECTED STANDARD

**10. ADDITIONAL PROVISIONS TO THE GENERAL RADIATED EMISSION LIMITATIONS****Temperature (°C) :** 22.2**Humidity (%HR):** 38**Date :** September 5, 2018**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.

The power level is tuned to reach max power.

## Results:

Power source:

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

Voltage at the beginning of test (V): 3.69

Voltage at the end of test (V): 3.64

Percentage of voltage drop during the test (%): 1.35

Lower Band Edge: from 900MHz to 902MHz

Upper Band Edge: from 928MHz to 930MHz

Sample N° 1 with Spread Factor 7 – Hopping mode off:

| 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) | Limit (dBc) | Margin (dB) |
|-----------------------------|----------------------------------------------|----------------------------|------------------------------------------------|----------------------|-------------|-------------|
| 902.3                       | 103.40                                       | P                          | 901.98                                         | 45.39                | -30 dBc (2) | 15.39       |
| 914.9                       | 106.80                                       | P                          | 928.04                                         | 60.90                | -30 dBc (2) | 30.90       |

(1) Marker-Delta method

(2) According to KDB 558074 §11.1, as the output power was measured with an average detection the limit is -30 dBc 99% bandwidth curves are given in appendix 3; band-edge curves are given in appendix 4.

Sample N° 1 with Spread Factor 7 – Hopping mode on:

| 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) | Limit (dBc) | Margin (dB) |
|-----------------------------|----------------------------------------------|----------------------------|------------------------------------------------|----------------------|-------------|-------------|
| 902.3                       | 103.40                                       | P                          | 901.98                                         | 46.36                | -30 dBc (2) | 16.36       |
| 914.9                       | 106.80                                       | P                          | 928.21                                         | 60.96                | -30 dBc (2) | 30.96       |

(1) Marker-Delta method

(2) According to KDB 558074 §11.1, as the output power was measured with an average detection the limit is -30 dBc 99% bandwidth curves are given in appendix 3; band-edge curves are given in appendix 4.

Sample N° 1 with Spread Factor 10 – Hopping mode off:

| 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) | Limit (dBc) | Margin (dB) |
|-----------------------------|----------------------------------------------|----------------------------|------------------------------------------------|----------------------|-------------|-------------|
| 902.3                       | 104.10                                       | P                          | 901.99                                         | 46.31                | -30 dBc (2) | 16.31       |
| 914.9                       | 108.30                                       | P                          | 928.07                                         | 61.01                | -30 dBc (2) | 31.01       |

<sup>(1)</sup> Marker-Delta method

<sup>(2)</sup> According to KDB 558074 §11.1, as the output power was measured with an average detection the limit is -30 dBc 99% bandwidth curves are given in appendix 3; band-edge curves are given in appendix 4.

Sample N° 1 with Spread Factor 10 – Hopping mode on:

| 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) | Limit (dBc) | Margin (dB) |
|-----------------------------|----------------------------------------------|----------------------------|------------------------------------------------|----------------------|-------------|-------------|
| 902.3                       | 104.10                                       | P                          | 901.97                                         | 51.37                | -30 dBc (2) | 21.37       |
| 914.9                       | 108.30                                       | P                          | 928.08                                         | 61.40                | -30 dBc (2) | 31.40       |

<sup>(1)</sup> Marker-Delta method

<sup>(2)</sup> According to KDB 558074 §11.1, as the output power was measured with an average detection the limit is -30 dBc 99% bandwidth curves are given in appendix 3; band-edge curves are given in appendix 4.

**Test conclusion:**

RESPECTED STANDARD

**11. MAXIMUM PEAK CONDUCTED (AVERAGE) OUTPUT POWER****Temperature (°C) :** 24.3**Humidity (%HR):** 39**Date :** September 4, 2018**Technician :** S. LOUIS**Standard:** FCC Part 15**Test procedure:** paragraph 15.247 (b)

AVGSA-1 of paragraph 11.9.2.2.2 of ANSI C63.10

**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

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.

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

See photos in appendix 2.

**Distance of antenna:** 10 meters (in open area test site)**Antenna height:** 1 to 4 meters (in open area test site)**Antenna polarization:** vertical and horizontal (only the highest level is recorded)

The measure of average output power is measured with a spectrum analyzer:

Resolution bandwidth: 1% to 5% of the OBW, not to exceed 1 MHz.

Video bandwidth: 3 x RBW

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 channel power function is used to compute power on OBW band.

Finally the radiated electro-magnetic field is converted in dBm with the following formula:

$$\text{EIRP(dBm)} = E \text{ (dB}\mu\text{V/m)} + 20\log(D) - 104.8;$$
 where D is the measurement distance in meters and antenna Gain = 1 dBi.

**Equipment under test operating condition:**

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.

The power level is tuned to reach max power.

## Results:

Power source:

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

Voltage at the beginning of test (V): 3.76

Voltage at the end of test (V): 3.71

Percentage of voltage drop during the test (%): 1.33

Sample N° 1 Low Channel 902.3MHz – SF7

|                                         | Electro-magnetic field<br>(dBμV/m): | Conducted<br>power (1)<br>(W) | Limit<br>(W) |
|-----------------------------------------|-------------------------------------|-------------------------------|--------------|
| <b>Nominal supply<br/>voltage: 3.6V</b> | 103.4                               | 0.058                         | 1            |

Polarization of test antenna: Horizontal (height: 118 cm)

Position of equipment: Position 3 (azimuth: 0 degrees)

Sample N° 1 Central Channel 908.7MHz – SF7

|                                         | Electro-magnetic field<br>(dBμV/m): | Conducted<br>power (1)<br>(W) | Limit<br>(W) |
|-----------------------------------------|-------------------------------------|-------------------------------|--------------|
| <b>Nominal supply<br/>voltage: 3.6V</b> | 105.1                               | 0.086                         | 1            |

Polarization of test antenna: Horizontal (height: 116 cm)

Position of equipment: Position 1 (azimuth: 172 degrees)

Sample N° 1 High Channel 914.9MHz –SF7

|                                         | Electro-magnetic field<br>(dBμV/m): | Conducted<br>power (1)<br>(W) | Limit<br>(W) |
|-----------------------------------------|-------------------------------------|-------------------------------|--------------|
| <b>Nominal supply<br/>voltage: 3.6V</b> | 106.8                               | 0.127                         | 1            |

Polarization of test antenna: Horizontal (height: 116 cm)

Position of equipment: Position 1 (azimuth: 167 degrees)

(1)  $P = (E \times d)^2 / (30 \times G_p)$  with  $d = 10\text{ m}$  and  $G_p = 1.26$

Antenna gain: 1 dBi

Sample N° 1 Low Channel 902.3MHz – SF10

|                                         | Electro-magnetic field<br>(dBμV/m): | Conducted<br>power (1)<br>(W) | Limit<br>(W) |
|-----------------------------------------|-------------------------------------|-------------------------------|--------------|
| <b>Nominal supply<br/>voltage: 3.6V</b> | 104.1                               | 0.068                         | 1            |

Polarization of test antenna: Horizontal (height: 116 cm)

Position of equipment: Position 1 (azimuth: 0 degrees)

Sample N° 1 Central Channel 908.7MHz – SF10

|                                         | Electro-magnetic field<br>(dBμV/m): | Conducted<br>power (1)<br>(W) | Limit<br>(W) |
|-----------------------------------------|-------------------------------------|-------------------------------|--------------|
| <b>Nominal supply<br/>voltage: 3.6V</b> | 106.2                               | 0.110                         | 1            |

Polarization of test antenna: Horizontal (height: 121cm)

Position of equipment: Position 1 (azimuth: 178 degrees)

Sample N° 1 High Channel 914.9MHz –SF10

|                                         | Electro-magnetic field<br>(dBμV/m): | Conducted<br>power (1)<br>(W) | Limit<br>(W) |
|-----------------------------------------|-------------------------------------|-------------------------------|--------------|
| <b>Nominal supply<br/>voltage: 3.6V</b> | 108.3                               | 0.179                         | 1            |

Polarization of test antenna: Horizontal (height: 225 cm)

Position of equipment: Position 1 (azimuth: 169 degrees)

(1)  $P = (E \times d)^2 / (30 \times G_p)$  with  $d = 10\text{ m}$  and  $G_p = 1.26$

Antenna gain: 1 dBi

**Test conclusion:**

RESPECTED STANDARD

**12. INTENTIONAL RADIATOR****Temperature (°C) :** 23.2**Humidity (%HR):** 52**Date :** August 30, 2018**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 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.

Emissions in non-restricted frequency bands method of paragraph 11 of KDB 558074 and Emissions in restricted frequency bands method of paragraph 12 of KDB 558074 are apply.

**Frequency range:** From 9 kHz to 9.28GHz / 10<sup>th</sup> harmonic of the highest fundamental frequency (928MHz)**Detection mode:** Quasi-peak (F < 1 GHz)

Peak / Average (F &gt; 1 GHz)

**Bandwidth:** 200Hz (9 kHz < F < 150kHz)  
9 kHz (150 kHz < F < 30MHz)  
120 kHz (30 MHz < F < 1 GHz)  
100 kHz / 1 MHz (F > 1 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, at the highest output power level at which the transmitter is intended to operate.

The power level is tuned to reach max power.

## Results:

Power source:

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

Voltage at the beginning of test (V): 3.76

Voltage at the end of test (V): 3.62

Percentage of voltage drop during the test (%): 3.72

Sample N° 1 Low Channel – SF7

| Frequencies (MHz) | Detector<br>P<br>QP<br>Av | Antenna height (cm) | RBW (kHz) | Position | Polarization<br>H: Horizontal<br>V: Vertical | Field strength (dBμV/m) | Limits (dBμV/m) | Margin (dB) |
|-------------------|---------------------------|---------------------|-----------|----------|----------------------------------------------|-------------------------|-----------------|-------------|
| 1804.6            | P                         | 150                 | 100       | 3        | H                                            | 46.3                    | 88.7            | 42.4        |
| 2706.9 (1)        | P                         | 150                 | 1000      | 3        | H                                            | 50.2 (2)                | 74              | 23.8        |
| 3609.2 (1)        | P                         | 150                 | 1000      | 3        | H                                            | 50.6 (2)                | 74              | 23.4        |
| 4511.5 (1)        | P                         | 150                 | 1000      | 3        | H                                            | 50.8 (2)                | 74              | 23.2        |
| 5413.8 (1)        | P                         | 150                 | 1000      | 1        | V                                            | 47.8 (2)                | 74              | 26.2        |
| 6316.1            | P                         | 150                 | 100       | 3        | H                                            | 48.2                    | 88.7            | 40.5        |
| 7218.4            | P                         | 150                 | 100       | 1        | H                                            | 53.7                    | 88.7            | 35.0        |
| 8120.7 (1)        | P                         | 150                 | 1000      | 1        | H                                            | 53.9 (2)                | 74              | 20.1        |
| 8120.7 (1)        | P                         | 150                 | 1000      | 1        | H                                            | 50.3                    | 54              | 3.7         |
| 9023 (1)          | P                         | 150                 | 1000      | 3        | H                                            | 59.1                    | 74              | 14.9        |
| 9023 (1)          | Av                        | 150                 | 1000      | 3        | H                                            | 53.9                    | 54              | 0.1         |

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<br>P<br>QP<br>Av | Antenna height (cm) | RBW (kHz) | Position | Polarization<br>H: Horizontal<br>V: Vertical | Field strength (dBμV/m) | Limits (dBμV/m) | Margin (dB) |
|-------------------|---------------------------|---------------------|-----------|----------|----------------------------------------------|-------------------------|-----------------|-------------|
| 1804.6            | P                         | 150                 | 100       | 3        | H                                            | 46.8                    | 88.7            | 41.9        |
| 2706.9 (1)        | P                         | 150                 | 1000      | 3        | H                                            | 51 (2)                  | 74              | 23.0        |
| 3609.2 (1)        | P                         | 150                 | 1000      | 3        | H                                            | 50.4 (2)                | 74              | 23.6        |
| 4511.5 (1)        | P                         | 150                 | 1000      | 3        | H                                            | 50.4 (2)                | 74              | 23.6        |
| 5413.8 (1)        | P                         | 150                 | 1000      | 3        | H                                            | 48.6 (2)                | 74              | 25.4        |
| 6316.1            | P                         | 150                 | 100       | 1        | V                                            | 48.2                    | 88.7            | 40.5        |
| 7218.4            | P                         | 150                 | 100       | 1        | H                                            | 52.3                    | 88.7            | 36.4        |
| 8120.7 (1)        | P                         | 150                 | 1000      | 1        | H                                            | 54.1                    | 74              | 20.1        |
| 8120.7 (1)        | Av                        | 150                 | 1000      | 1        | H                                            | 50.3                    | 54              | 3.7         |
| 9023 (1)          | P                         | 150                 | 1000      | 3        | H                                            | 58.4                    | 74              | 15.6        |
| 9023 (1)          | Av                        | 150                 | 1000      | 3        | H                                            | 53.9                    | 54              | 0.1         |

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<br>P<br>QP<br>Av | Antenna height (cm) | RBW (kHz) | Position | Polarization<br>H: Horizontal<br>V: Vertical | Field strength (dBμV/m) | Limits (dBμV/m) | Margin (dB) |
|-------------------|---------------------------|---------------------|-----------|----------|----------------------------------------------|-------------------------|-----------------|-------------|
| 1817.4            | P                         | 150                 | 100       | 3        | H                                            | 44.2                    | 88.7            | 44.5        |
| 2726.1 (1)        | P                         | 150                 | 1000      | 3        | H                                            | 49.8 (2)                | 74              | 24.2        |
| 3634.8 (1)        | P                         | 150                 | 1000      | 3        | H                                            | 48.4 (2)                | 74              | 25.6        |
| 4543.5 (1)        | P                         | 150                 | 1000      | 3        | H                                            | 50.0 (2)                | 74              | 24.0        |
| 5452.2 (1)        | P                         | 150                 | 1000      | 1        | V                                            | 47.2 (2)                | 74              | 26.8        |
| 6360.9            | P                         | 150                 | 100       | 2        | V                                            | 47.8                    | 88.7            | 40.9        |
| 7269.6 (1)        | P                         | 150                 | 1000      | 1        | H                                            | 53.2 (2)                | 74              | 20.8        |
| 8178.3 (1)        | P                         | 150                 | 1000      | 1        | H                                            | 53.9 (2)                | 74              | 20.1        |
| 8178.3 (1)        | Av                        | 150                 | 1000      | 1        | H                                            | 50.1                    | 54              | 0.9         |
| 9087 (1)          | P                         | 150                 | 1000      | 3        | H                                            | 59.1                    | 74              | 14.9        |
| 9087 (1)          | Av                        | 150                 | 1000      | 3        | H                                            | 53.9                    | 54              | 0.1         |

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<br>P<br>QP<br>Av | Antenna height (cm) | RBW (kHz) | Position | Polarization<br>H: Horizontal<br>V: Vertical | Field strength (dBμV/m) | Limits (dBμV/m) | Margin (dB) |
|-------------------|---------------------------|---------------------|-----------|----------|----------------------------------------------|-------------------------|-----------------|-------------|
| 1817.4            | P                         | 150                 | 100       | 3        | H                                            | 43.5                    | 88.7            | 45.2        |
| 2726.1 (1)        | P                         | 150                 | 1000      | 3        | H                                            | 50.2 (2)                | 74              | 23.8        |
| 3634.8 (1)        | P                         | 150                 | 1000      | 3        | H                                            | 48.1 (2)                | 74              | 25.9        |
| 4543.5 (1)        | P                         | 150                 | 1000      | 3        | H                                            | 50.0 (2)                | 74              | 24.0        |
| 5452.2 (1)        | P                         | 150                 | 1000      | 1        | V                                            | 46.8 (2)                | 74              | 27.2        |
| 6360.9            | P                         | 150                 | 100       | 2        | V                                            | 47.2                    | 88.7            | 41.5        |
| 7269.6 (1)        | P                         | 150                 | 1000      | 1        | H                                            | 53.4 (2)                | 74              | 20.6        |
| 8178.3 (1)        | P                         | 150                 | 1000      | 1        | H                                            | 53.9 (2)                | 74              | 20.1        |
| 8178.3 (1)        | P                         | 150                 | 1000      | 1        | H                                            | 51.2                    | 54              | 2.8         |
| 9087 (1)          | P                         | 150                 | 1000      | 3        | H                                            | 58.8                    | 74              | 15.2        |
| 9087 (1)          | Av                        | 150                 | 1000      | 3        | H                                            | 53.9                    | 54              | 0.1         |

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<br>P<br>QP<br>Av | Antenna height (cm) | RBW (kHz) | Position | Polarization<br>H: Horizontal<br>V: Vertical | Field strength (dBμV/m) | Limits (dBμV/m) | Margin (dB) |
|-------------------|---------------------------|---------------------|-----------|----------|----------------------------------------------|-------------------------|-----------------|-------------|
| 1829.8            | P                         | 150                 | 100       | 3        | H                                            | 41.2                    | 88.7            | 47.5        |
| 2744.7 (1)        | P                         | 150                 | 1000      | 3        | H                                            | 47.8 (2)                | 74              | 26.2        |
| 3659.6 (1)        | P                         | 150                 | 1000      | 3        | H                                            | 48.0 (2)                | 74              | 26.0        |
| 4574.5 (1)        | P                         | 150                 | 1000      | 3        | H                                            | 49.5 (2)                | 74              | 24.5        |
| 5489.4 (1)        | P                         | 150                 | 1000      | 1        | V                                            | 45.6 (2)                | 74              | 28.4        |
| 6404.3            | P                         | 150                 | 100       | 2        | V                                            | 47.1                    | 88.7            | 41.6        |
| 7319.2 (1)        | P                         | 150                 | 1000      | 1        | H                                            | 52.2 (2)                | 74              | 21.8        |
| 8234.1 (1)        | P                         | 150                 | 1000      | 1        | H                                            | 57.0                    | 74              | 17.0        |
| 8234.1 (1)        | Av                        | 150                 | 1000      | 1        | H                                            | 52.9                    | 54              | 1.1         |
| 9149 (1)          | P                         | 150                 | 1000      | 3        | H                                            | 58.6                    | 74              | 14.9        |
| 9149 (1)          | Av                        | 150                 | 1000      | 3        | H                                            | 53.8                    | 54              | 0.2         |

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 High Channel – SF10

| Frequencies (MHz) | Detector<br>P<br>QP<br>Av | Antenna height (cm) | RBW (kHz) | Position | Polarization<br>H: Horizontal<br>V: Vertical | Field strength (dBμV/m) | Limits (dBμV/m) | Margin (dB) |
|-------------------|---------------------------|---------------------|-----------|----------|----------------------------------------------|-------------------------|-----------------|-------------|
| 1829.8            | P                         | 150                 | 100       | 3        | H                                            | 41.3                    | 88.7            | 47.4        |
| 2744.7 (1)        | P                         | 150                 | 1000      | 3        | H                                            | 48.1 (2)                | 74              | 25.9        |
| 3659.6 (1)        | P                         | 150                 | 1000      | 3        | H                                            | 48.1 (2)                | 74              | 25.9        |
| 4574.5 (1)        | P                         | 150                 | 1000      | 3        | H                                            | 48.8 (2)                | 74              | 25.2        |
| 5489.4 (1)        | P                         | 150                 | 1000      | 1        | V                                            | 45.8 (2)                | 74              | 28.2        |
| 6404.3            | P                         | 150                 | 100       | 2        | V                                            | 46.6                    | 88.7            | 42.1        |
| 7319.2 (1)        | P                         | 150                 | 1000      | 1        | H                                            | 52.1 (2)                | 74              | 25.9        |
| 8234.1 (1)        | P                         | 150                 | 1000      | 1        | H                                            | 57.2                    | 74              | 16.8        |
| 8234.1 (1)        | P                         | 150                 | 1000      | 1        | H                                            | 53.1                    | 54              | 0.9         |
| 9149 (1)          | P                         | 150                 | 1000      | 3        | H                                            | 58.8                    | 74              | 15.2        |
| 9149 (1)          | Av                        | 150                 | 1000      | 3        | H                                            | 53.9                    | 54              | 0.1         |

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 118.7 dB $\mu$ V/m at 3m on high channel.

So the applicable limit is 88.7 dB $\mu$ 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

**13. MAXIMUM CONDUCTED POWER DENSITY****Temperature (°C) :** 21**Humidity (%HR):** 43**Date :** September 5, 2018**Technician :** S. LOUIS**Standard:** FCC Part 15**Test procedure:** paragraph 15.247 (e)

AVGPSD-1 of paragraph 11.10.3 of ANSI C63.10

**Test set up:**

The system is tested in anechoic chamber. The EUT is placed on a rotating table, 1.5m from a ground plane. Zero degree azimuth corresponds to the front of the device under test.

The measure is realized in radiated mode taking into account a correlation between the maximal Peak Output Power found in Open test area and near field found in the anechoic room.

The PSD is measured with a spectrum analyzer.

|                       |                      |
|-----------------------|----------------------|
| Resolution bandwidth: | 3 kHz                |
| Video bandwidth:      | 10 kHz               |
| Span:                 | At least 1.5 x OBW   |
| Detector:             | RMS                  |
| Sweep points:         | At least 2 x SPAN    |
| 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, at the highest output power level at which the transmitter is intended to operate.

The power level is tuned to reach max power

## Results:

Power source:

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

Voltage at the beginning of test (V): 3.76

Voltage at the end of test (V): 3.71

Percentage of voltage drop during the test (%): 1.33

Sample N° 1 Low Channel – SF7

|                               |                                                       |
|-------------------------------|-------------------------------------------------------|
|                               | <b>Peak power density at frequency:<br/>902.3 MHz</b> |
| <b>Normal test conditions</b> | +3.9dBm                                               |
| <b>Limits</b>                 | +8 dBm                                                |

Sample N° 1 Central Channel – SF7

|                               |                                                       |
|-------------------------------|-------------------------------------------------------|
|                               | <b>Peak power density at frequency:<br/>908.7 MHz</b> |
| <b>Normal test conditions</b> | +6.1dBm                                               |
| <b>Limits</b>                 | +8 dBm                                                |

Sample N° 1 High Channel – SF7

|                               |                                                       |
|-------------------------------|-------------------------------------------------------|
|                               | <b>Peak power density at frequency:<br/>914.9 MHz</b> |
| <b>Normal test conditions</b> | +7.1dBm                                               |
| <b>Limits</b>                 | +8 dBm                                                |

Sample N° 1      Low Channel – SF10

|                               |                                                       |
|-------------------------------|-------------------------------------------------------|
|                               | <b>Peak power density at frequency:<br/>902.3 MHz</b> |
| <b>Normal test conditions</b> | +4.5dBm                                               |
| <b>Limits</b>                 | +8 dBm                                                |

Sample N° 1      Central Channel – SF10

|                               |                                                       |
|-------------------------------|-------------------------------------------------------|
|                               | <b>Peak power density at frequency:<br/>908.7 MHz</b> |
| <b>Normal test conditions</b> | +7.3dBm                                               |
| <b>Limits</b>                 | +8 dBm                                                |

Sample N° 1      High Channel – SF10

|                               |                                                       |
|-------------------------------|-------------------------------------------------------|
|                               | <b>Peak power density at frequency:<br/>914.9 MHz</b> |
| <b>Normal test conditions</b> | +7.9dBm                                               |
| <b>Limits</b>                 | +8 dBm                                                |

**Test conclusion:**

RESPECTED STANDARD

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

## APPENDIX 1: Test equipment list

### Radiated emission limits

| TYPE                                           | MANUFACTURER         | EMITECH NUMBER |
|------------------------------------------------|----------------------|----------------|
| Anechoic Chamber                               | EMITECH              | 8593           |
| Satellite synchronized frequency standard GPS8 | ACQUISYS             | 8896           |
| Spectrum Analyzer FSP40                        | Rohde & Schwarz      | 4088           |
| Biconical antenna 3110                         | EMCO                 | 7240           |
| Log periodic antenna HL223                     | Rohde & Schwarz      | 7190           |
| Antenna 3115                                   | EMCO                 | 8535           |
| Low-noise amplifier 8447D                      | Hewlett Packard      | 8511           |
| Low-noise amplifier S005180M3201               | LUCIX Corp.          | 10739          |
| Cable N-2m                                     | Huber + Suhner       | 12911          |
| Cable N-5m                                     | Huber + Suhner       | 12912          |
| Cable N-1.5m                                   | Suhner               | 6884           |
| Multimeter 177                                 | FLUKE                | 14476          |
| Meteo station WS-9232                          | La Crosse Technology | 8750           |
| Software                                       | BAT-EMC V3.6.0.32    | 0000           |

### 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 HL223                     | Rohde & Schwarz      | 7190           |
| Cable N-2m                                     | Huber + Suhner       | 12911          |
| Cable N-5m                                     | Huber + Suhner       | 12912          |
| Cable N-1.5m                                   | Suhner               | 6884           |
| Multimeter 177                                 | FLUKE                | 14476          |
| Meteo station WS-9232                          | La Crosse Technology | 8750           |
| Software                                       | GPIBSHOT V2.4        | -              |

### Maximum Peak Conducted (Average) Output Power

| TYPE                                           | MANUFACTURER             | EMITECH NUMBER |
|------------------------------------------------|--------------------------|----------------|
| Open test site                                 | EMITECH                  | 8732           |
| Satellite synchronized frequency standard GPS8 | ACQUISYS                 | 8896           |
| Test receiver ESI7                             | Rohde & Schwarz          | 8707           |
| Log periodic antenna 3147                      | EMCO                     | 8783           |
| Cable N-2GHz                                   | /                        | 8578           |
| Multimeter 177                                 | FLUKE                    | 14476          |
| Meteo station WS-9232                          | La Crosse Technology     | 8749           |
| Software                                       | Champ libre Juigné. V3.5 | 8864           |

### Intentional Radiator

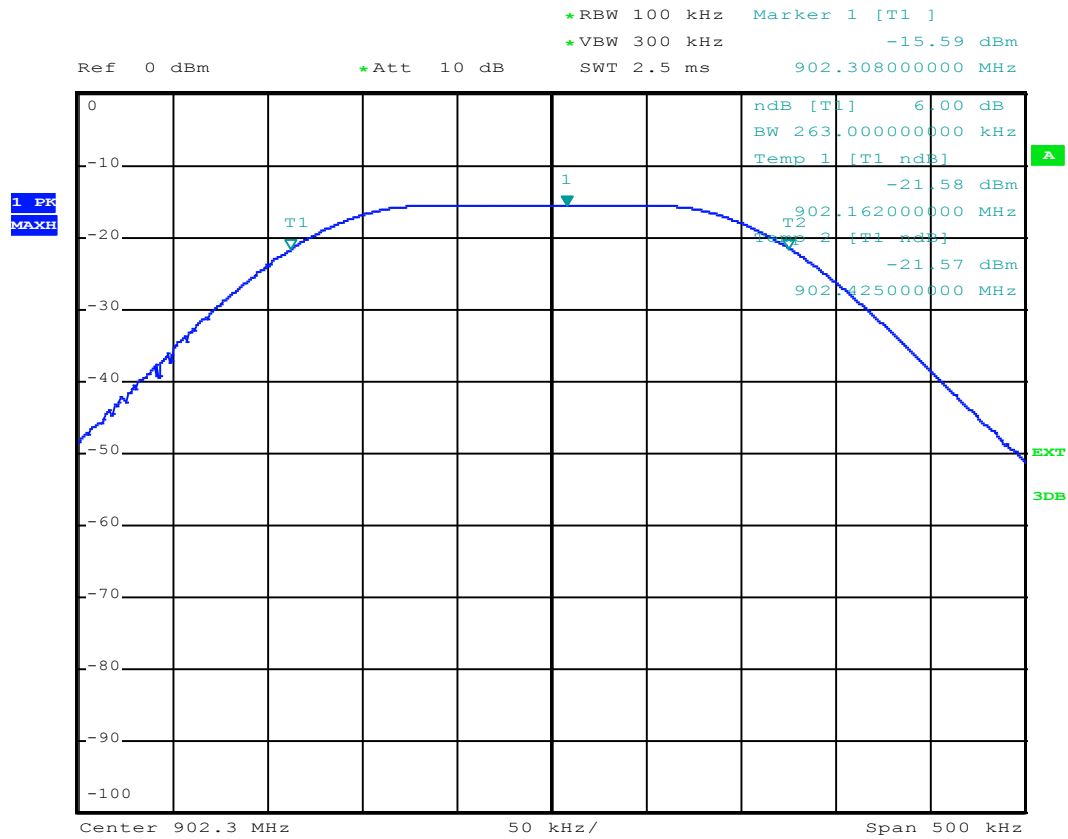
| TYPE                                           | MANUFACTURER         | EMITECH NUMBER |
|------------------------------------------------|----------------------|----------------|
| Anechoic Chamber                               | EMITECH              | 8593           |
| Satellite synchronized frequency standard GPS8 | ACQUISYS             | 8896           |
| Test receiver ESI7                             | Rohde & Schwarz      | 8707           |
| Spectrum Analyzer FSP40                        | Rohde & Schwarz      | 4088           |
| Loop antenna 6502                              | EMCO                 | 1406           |
| Biconical antenna 3110                         | EMCO                 | 7240           |
| Log periodic antenna HL223                     | Rohde & Schwarz      | 7190           |
| Antenna 3115                                   | EMCO                 | 8534           |
| Low-noise amplifier 8447D                      | Hewlett Packard      | 8511           |
| Low-noise amplifier ZFL-1000L                  | Mini Circuit         | 10730          |
| Low-noise amplifier ALN02-0032                 | ALC Microwave        | 2648           |
| Low pass filter WLJS800-C11/60EE               | Wainwright           | 4393           |
| Notch filter 500-1000MHz                       | K&L Microwave        | 8972           |
| High pass filter HP12/1200-5AA                 | Filtek               | 7310           |
| Cable N-2m                                     | Huber + Suhner       | 12911          |
| Cable N-5m                                     | Huber + Suhner       | 12912          |
| Cable N-1.5m                                   | Suhner               | 6884           |
| Multimeter 177                                 | FLUKE                | 14476          |
| Meteo station WS-9232                          | La Crosse Technology | 8750           |
| Software                                       | BAT-EMC V3.6.0.32    | 0000           |

**Maximum Conducted Power Density**

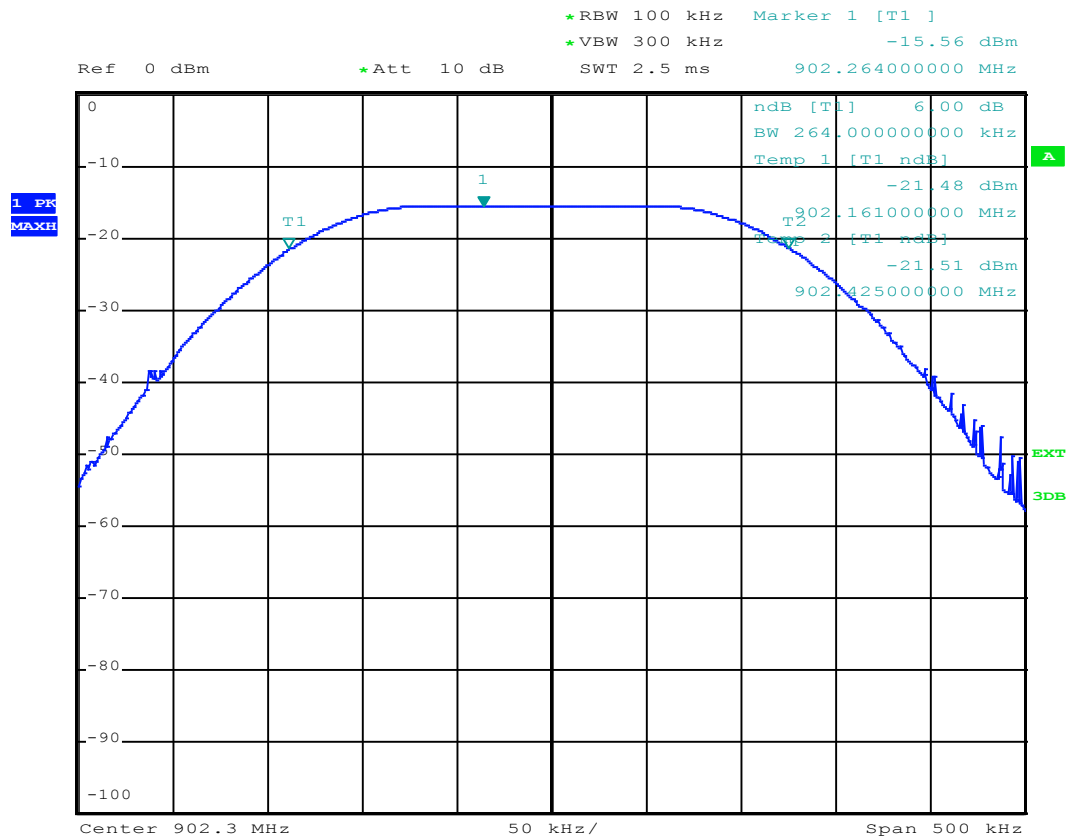
| TYPE                                           | MANUFACTURER         | EMITECH NUMBER |
|------------------------------------------------|----------------------|----------------|
| Anechoic Chamber                               | EMITECH              | 8593           |
| Satellite synchronized frequency standard GPS8 | ACQUISYS             | 8896           |
| Spectrum Analyzer FSP40                        | Rohde & Schwarz      | 4088           |
| Log periodic antenna HL223                     | Rohde & Schwarz      | 7190           |
| Cable N-2m                                     | Huber + Suhner       | 12911          |
| Cable N-5m                                     | Huber + Suhner       | 12912          |
| Cable N-1.5m                                   | Suhner               | 6884           |
| Multimeter 177                                 | FLUKE                | 14476          |
| Meteo station WS-9232                          | La Crosse Technology | 8750           |
| Software                                       | GPBShot V2.4         | -              |

## APPENDIX 2: 6 dB bandwidth

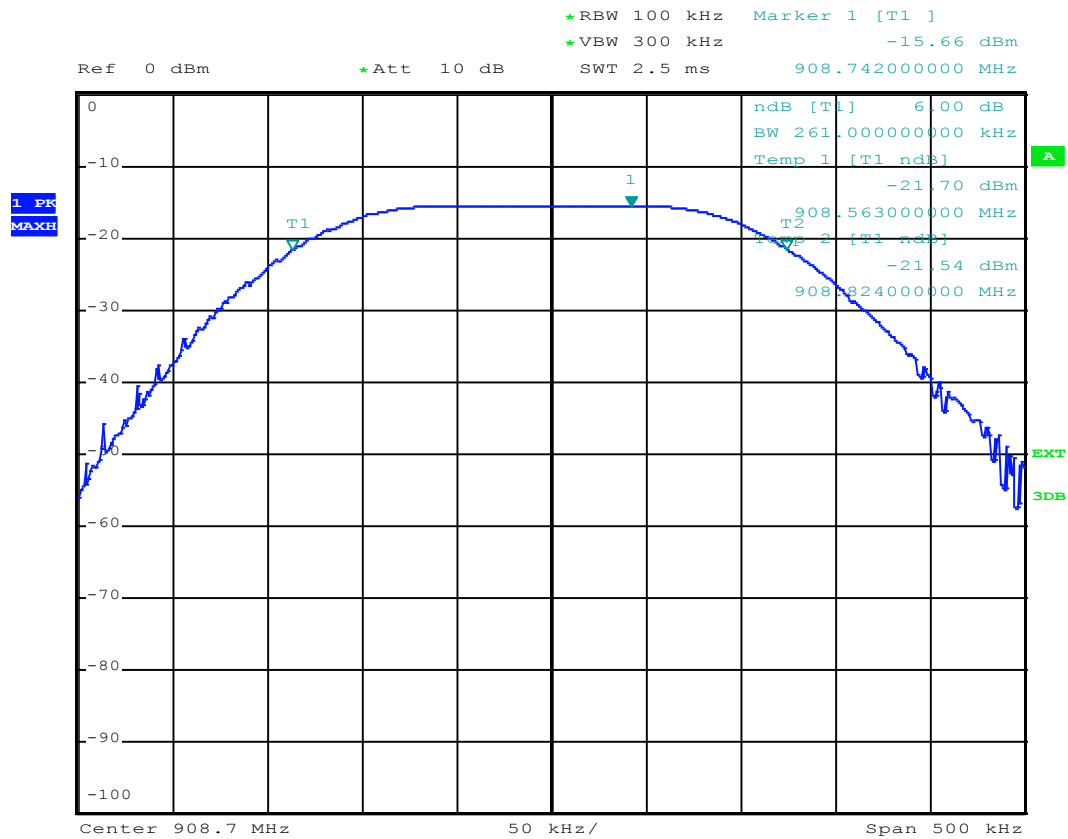
### Low Channel – SF7



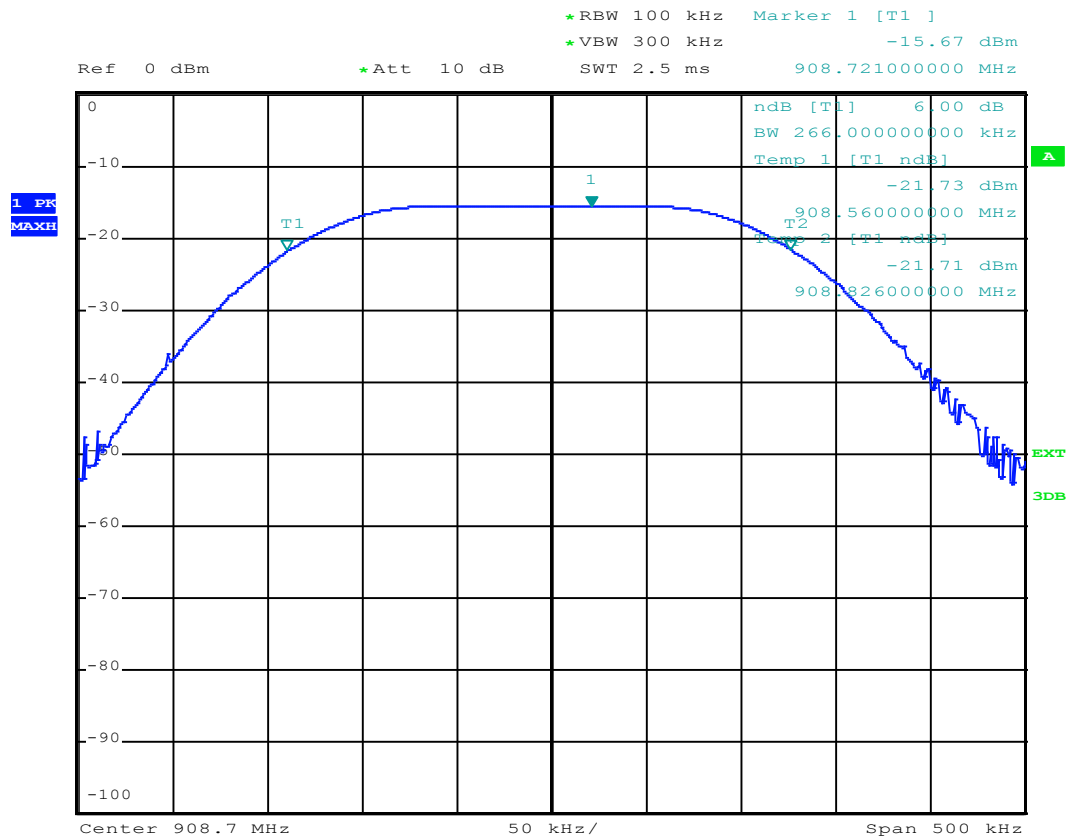
## Low Channel – SF10



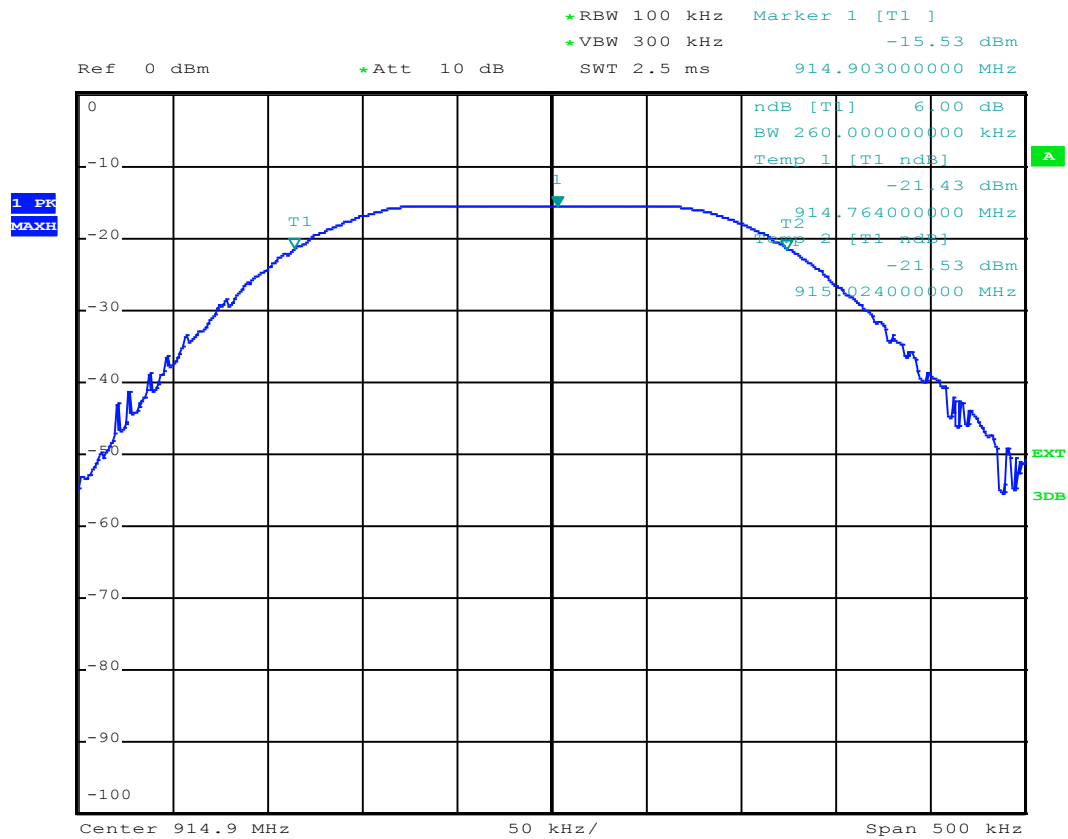
# Central Channel – SF7



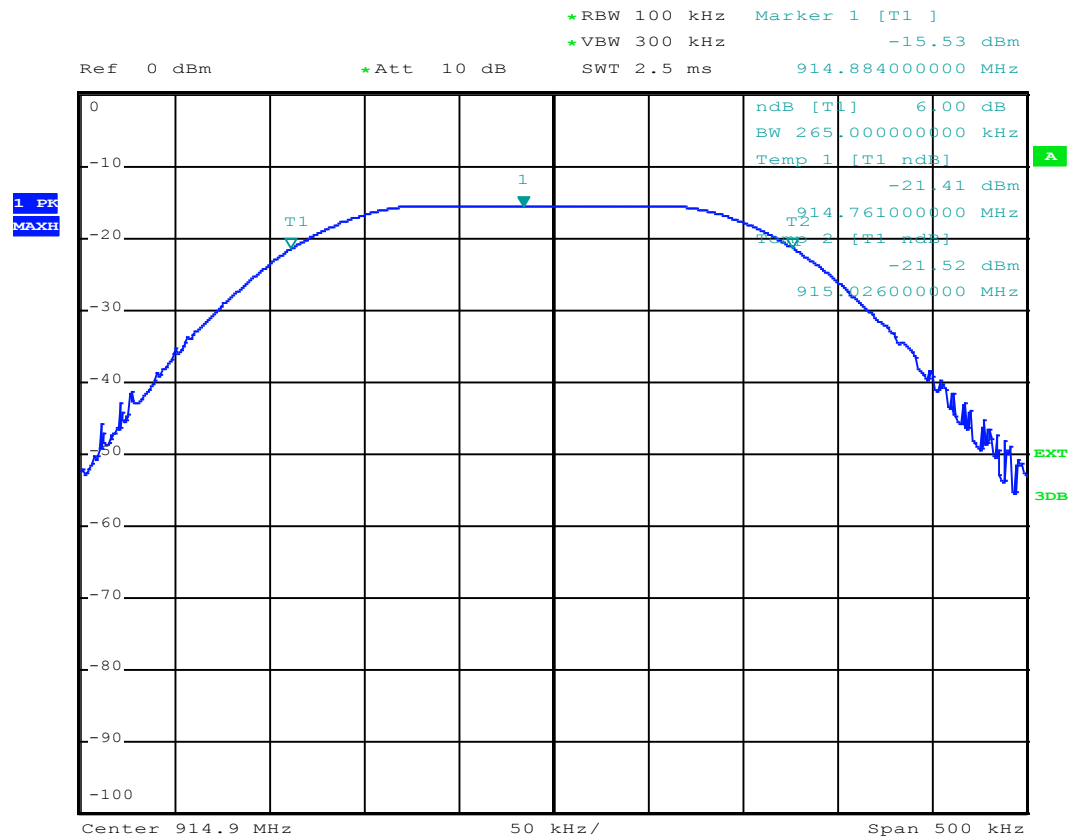
## Central Channel – SF10



# High Channel -SF7

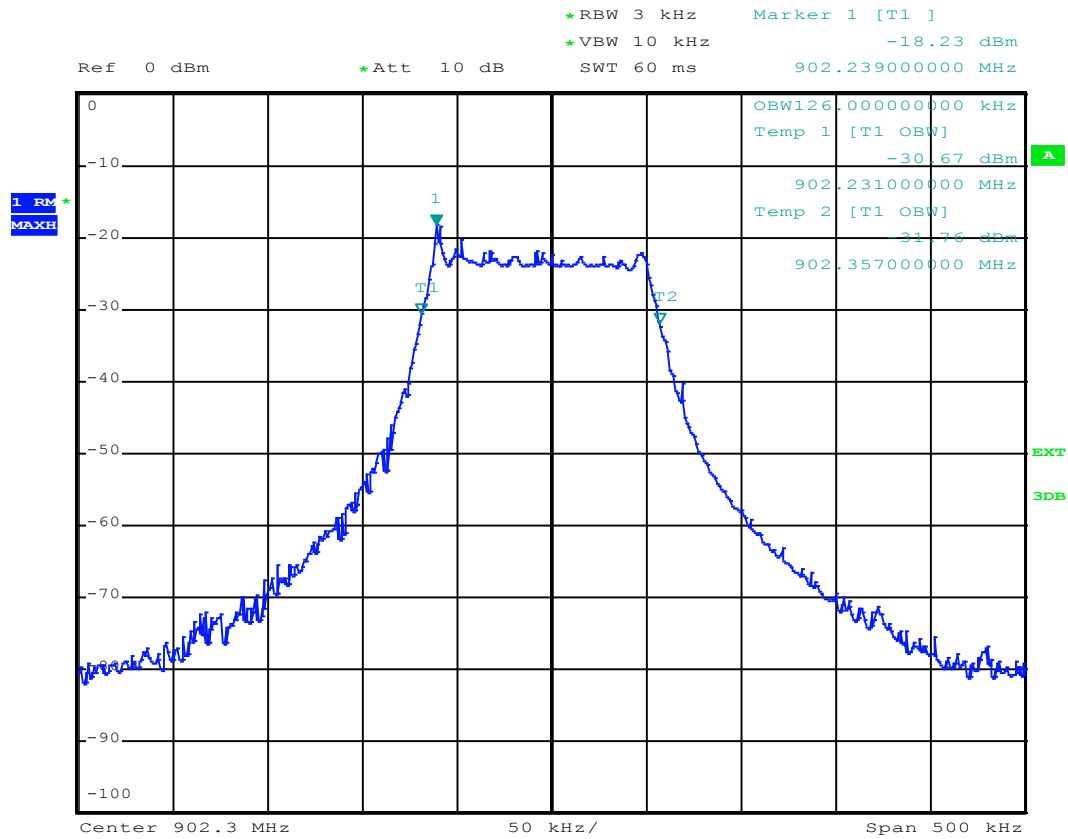


# High Channel –SF10

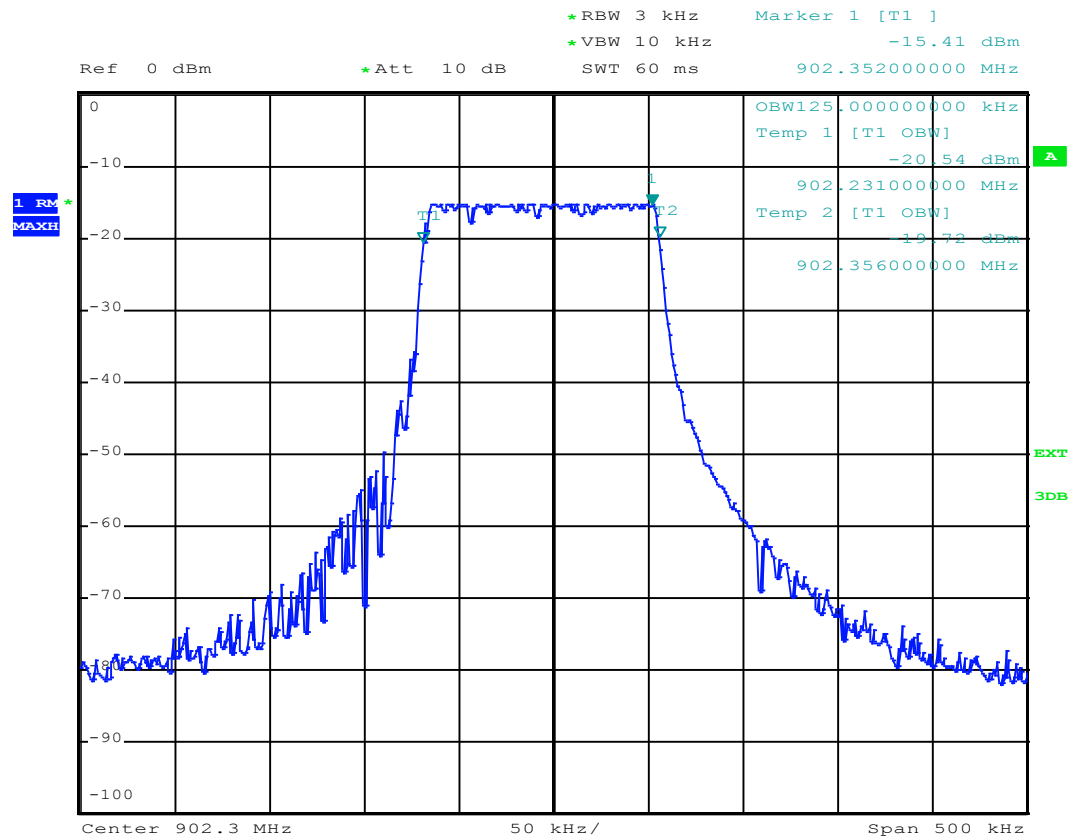


### APPENDIX 3: 99% bandwidth

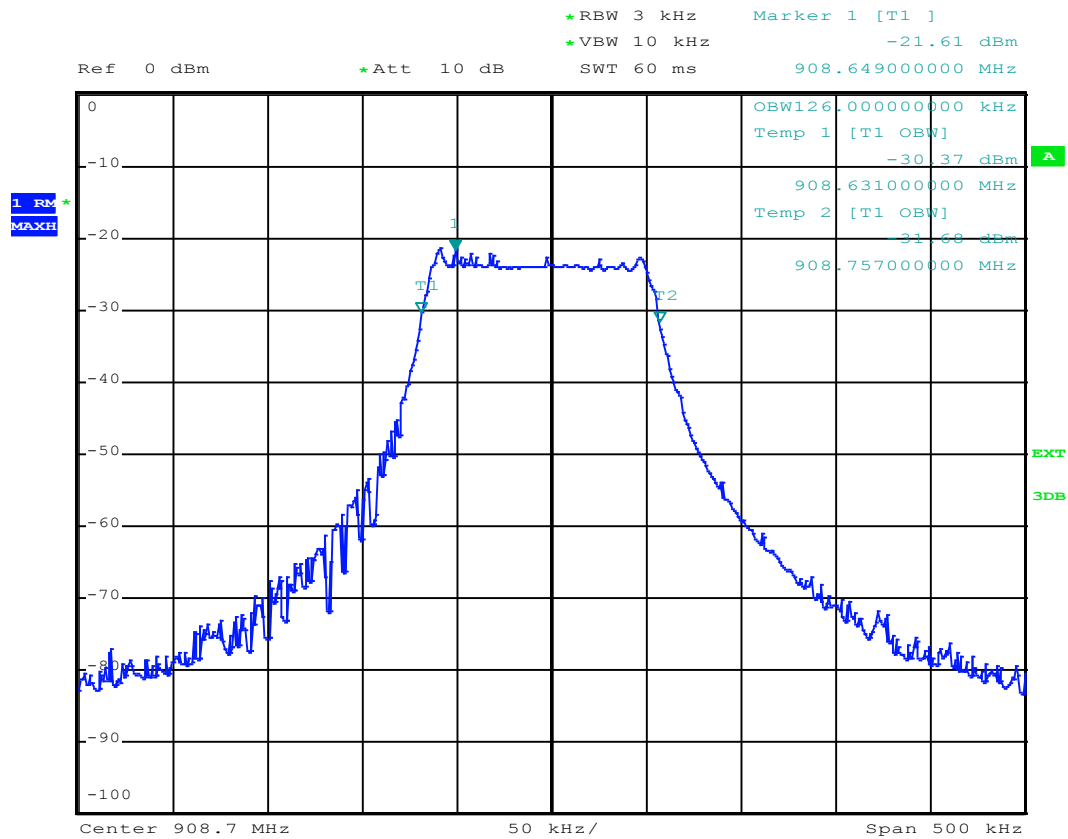
#### Low Channel – SF7



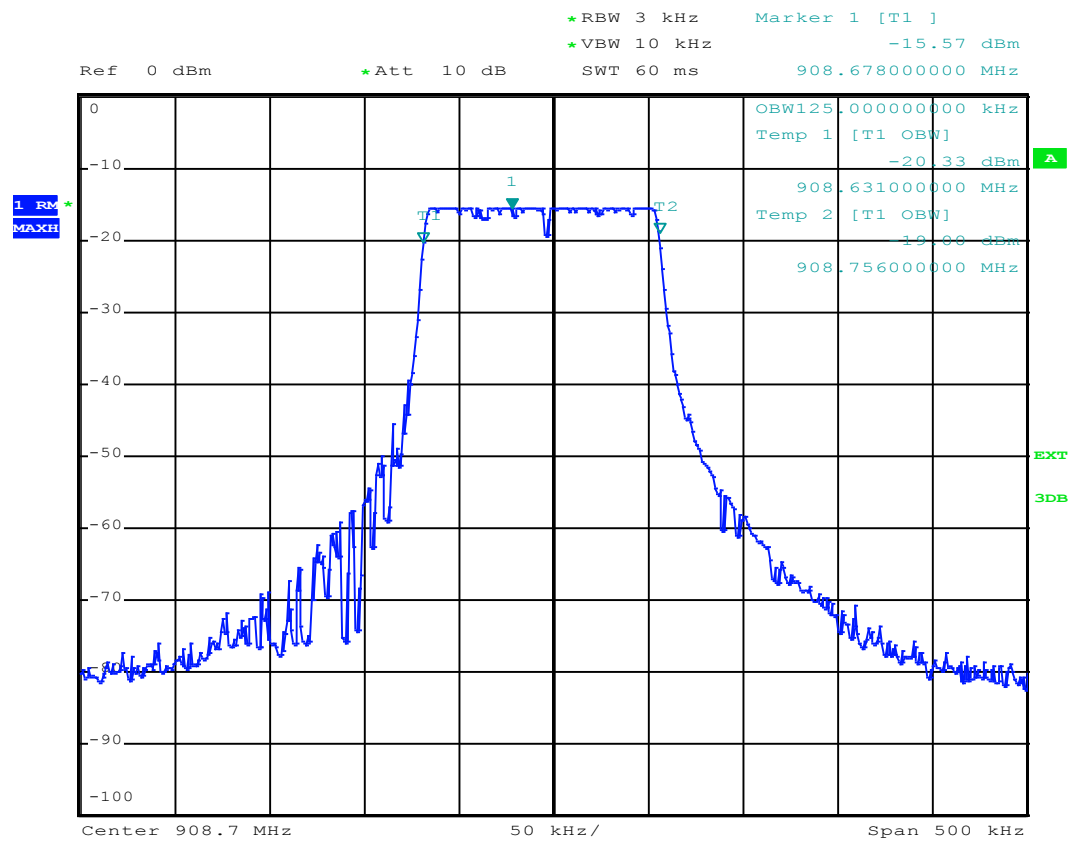
## Low Channel – SF10



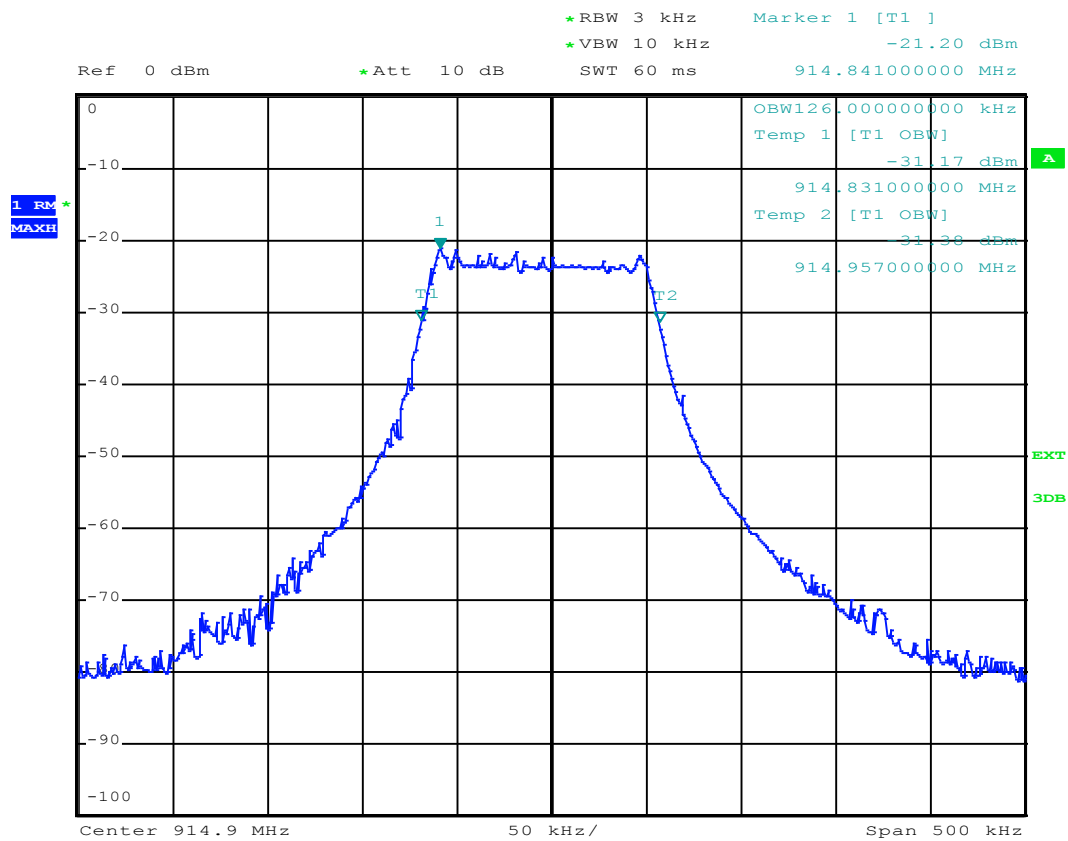
## Central Channel – SF7



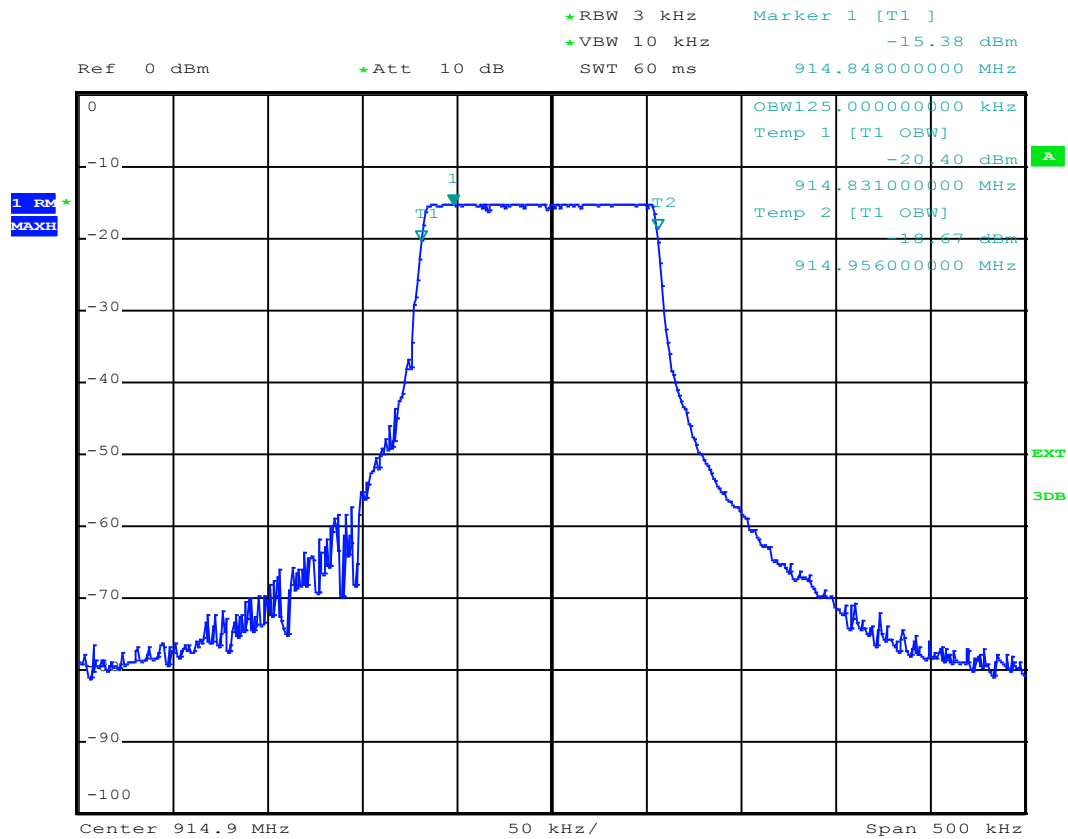
## Central Channel – SF10



## High Channel – SF7

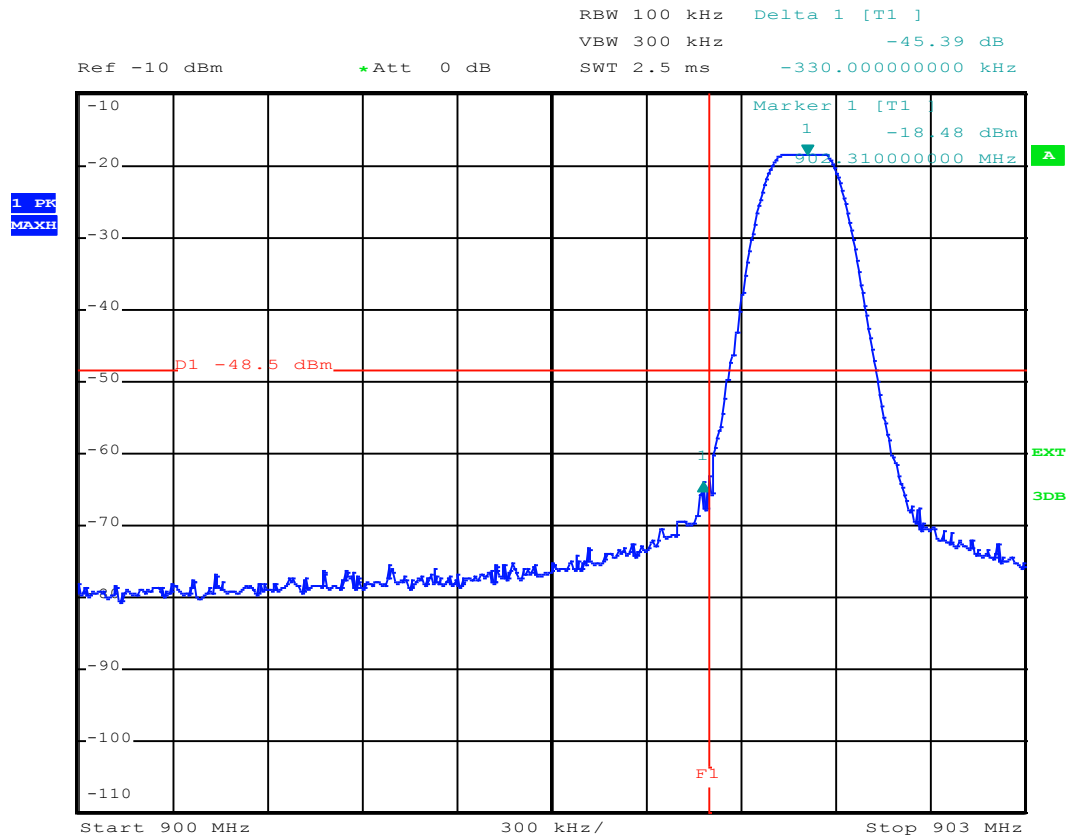


## High Channel – SF10

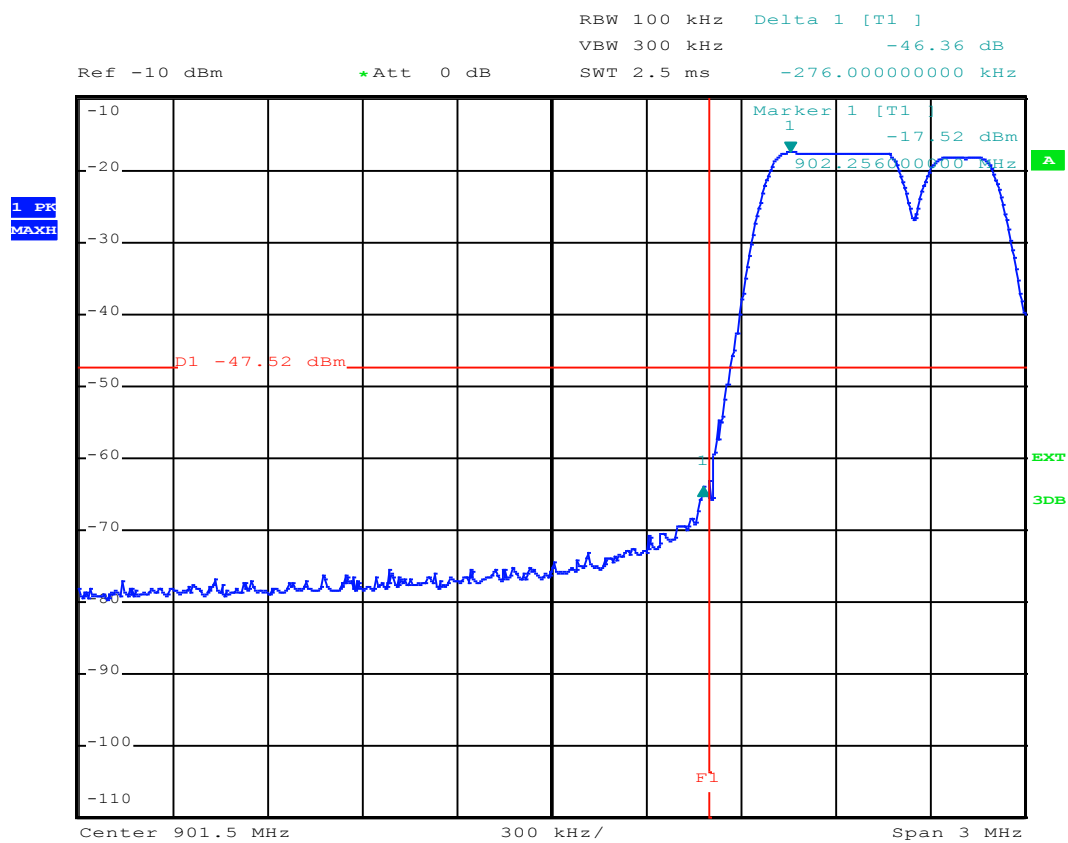


## APPENDIX 4: Band edge

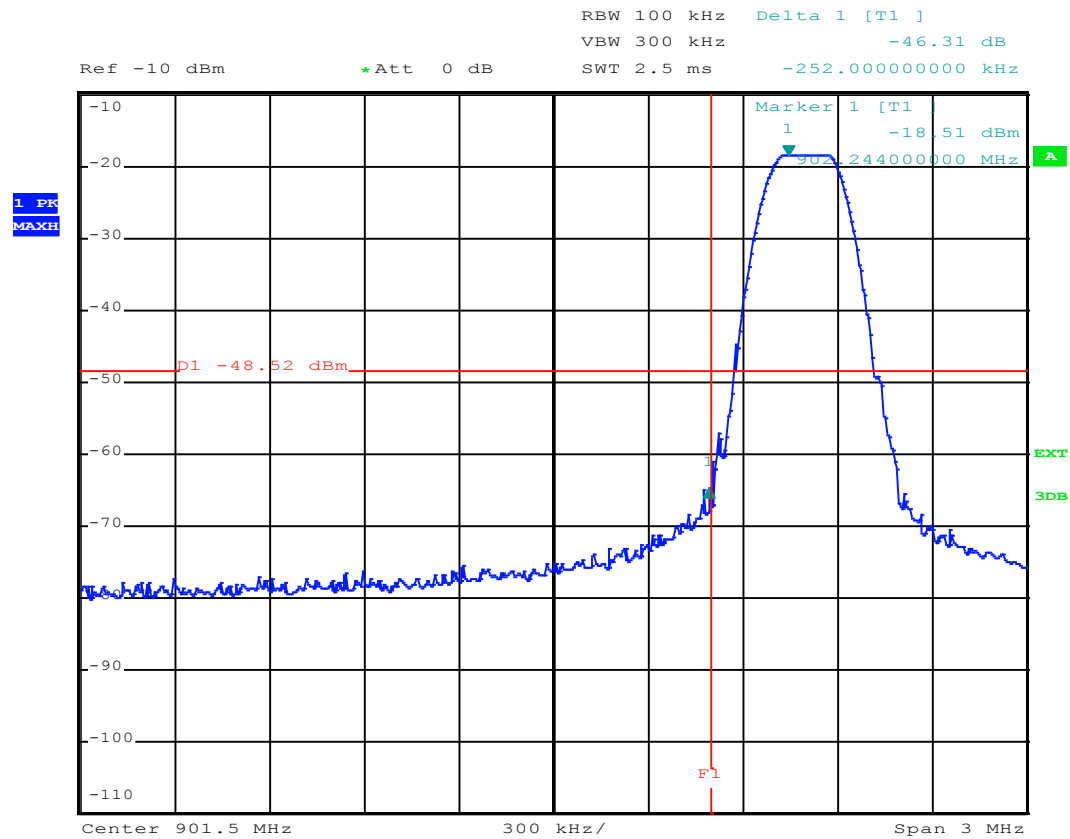
Low Channel with hopping mode off – SF7



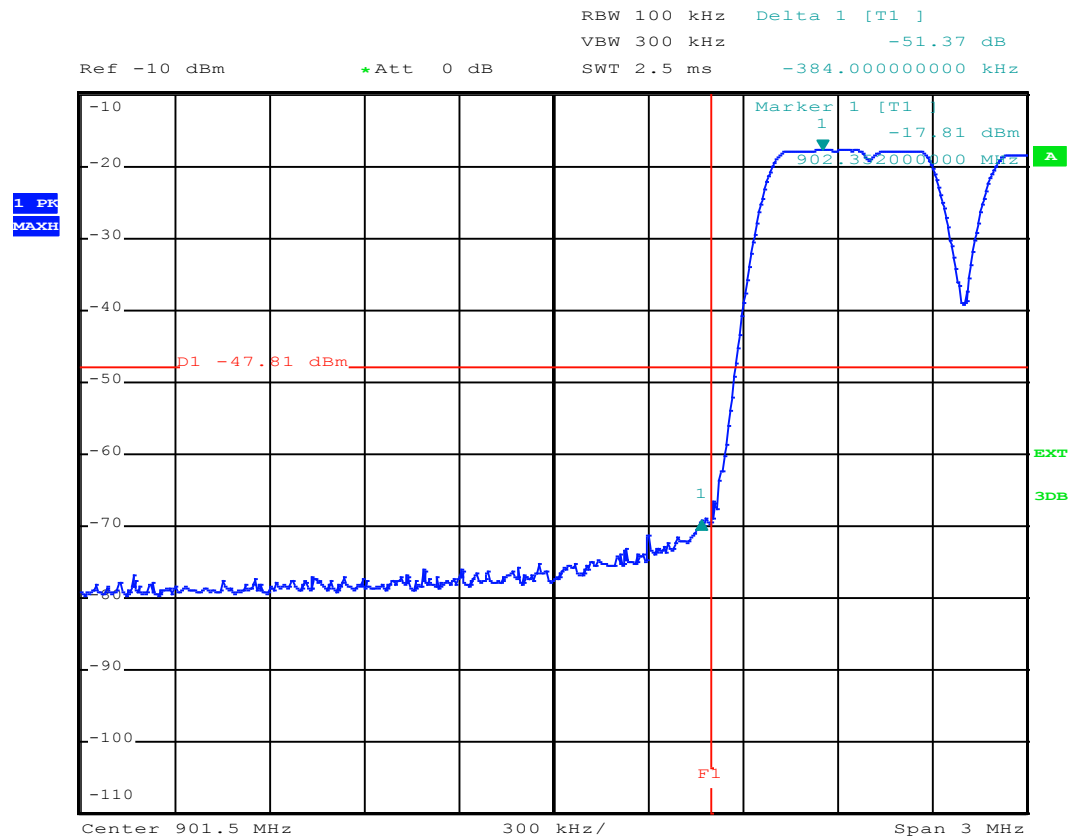
# Low Channel with hopping mode on – SF7



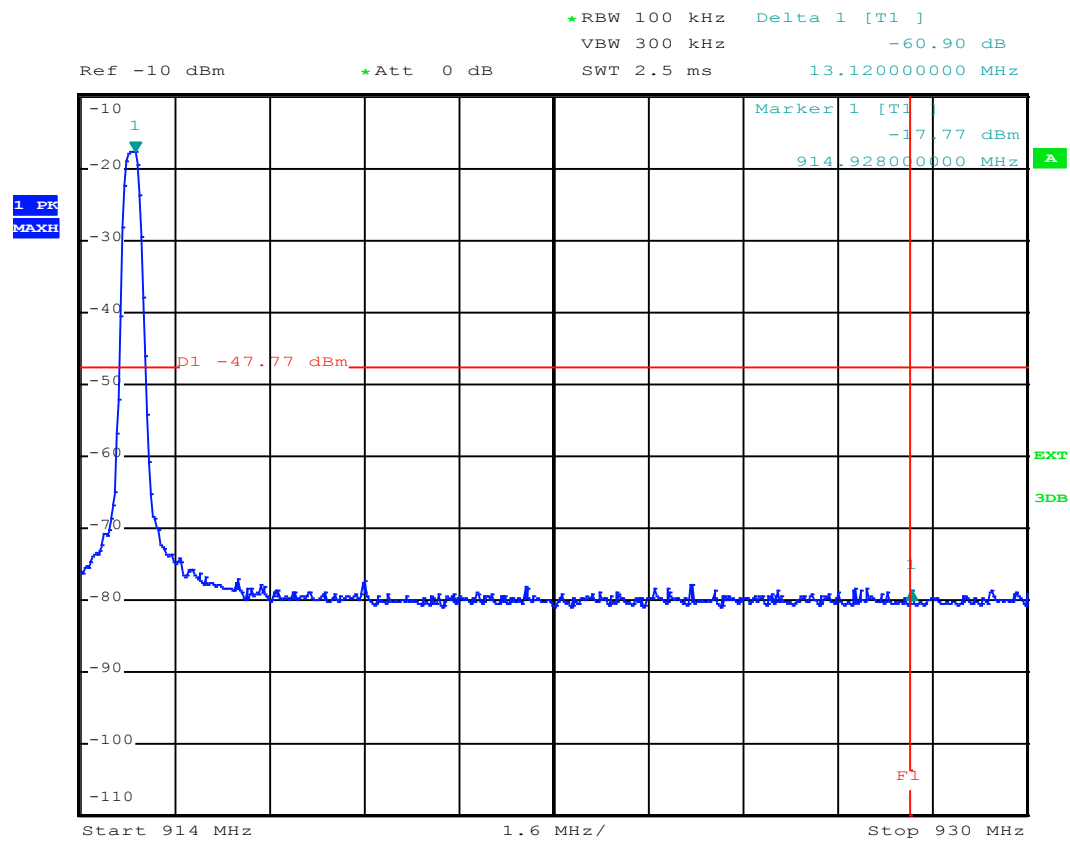
# Low Channel with hopping mode off – SF10



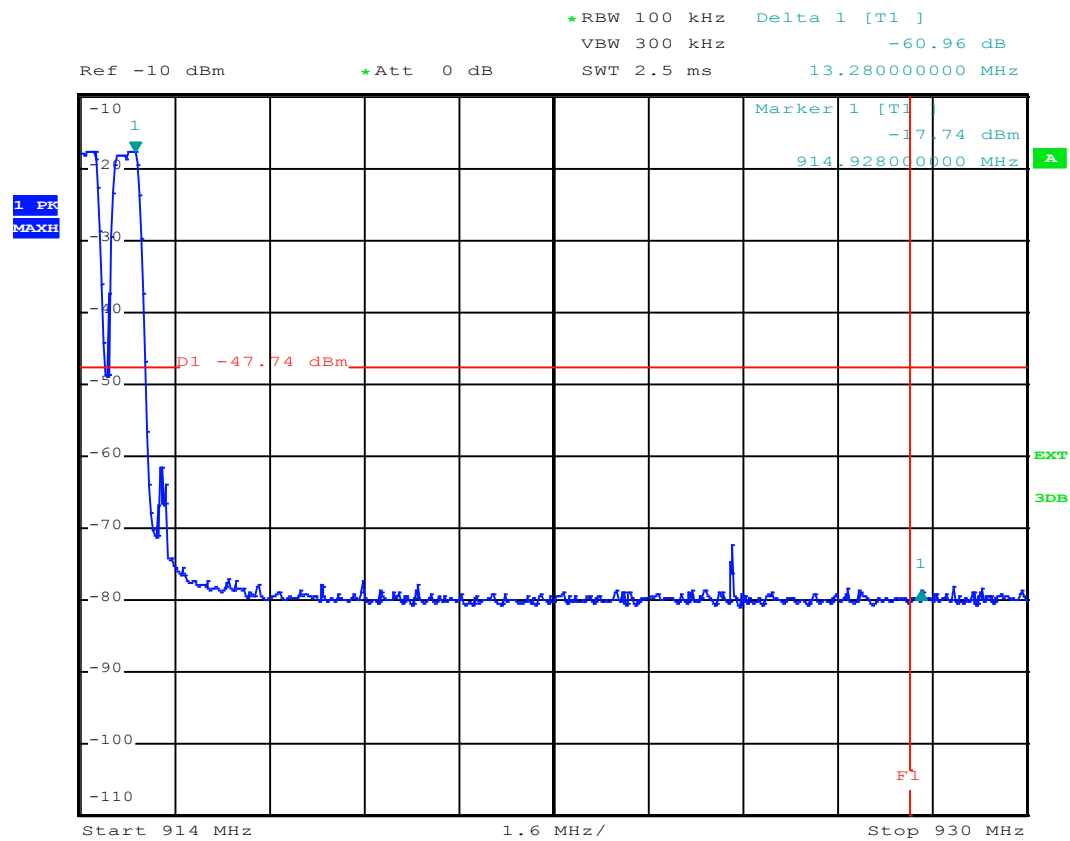
# Low Channel with hopping mode on – SF10



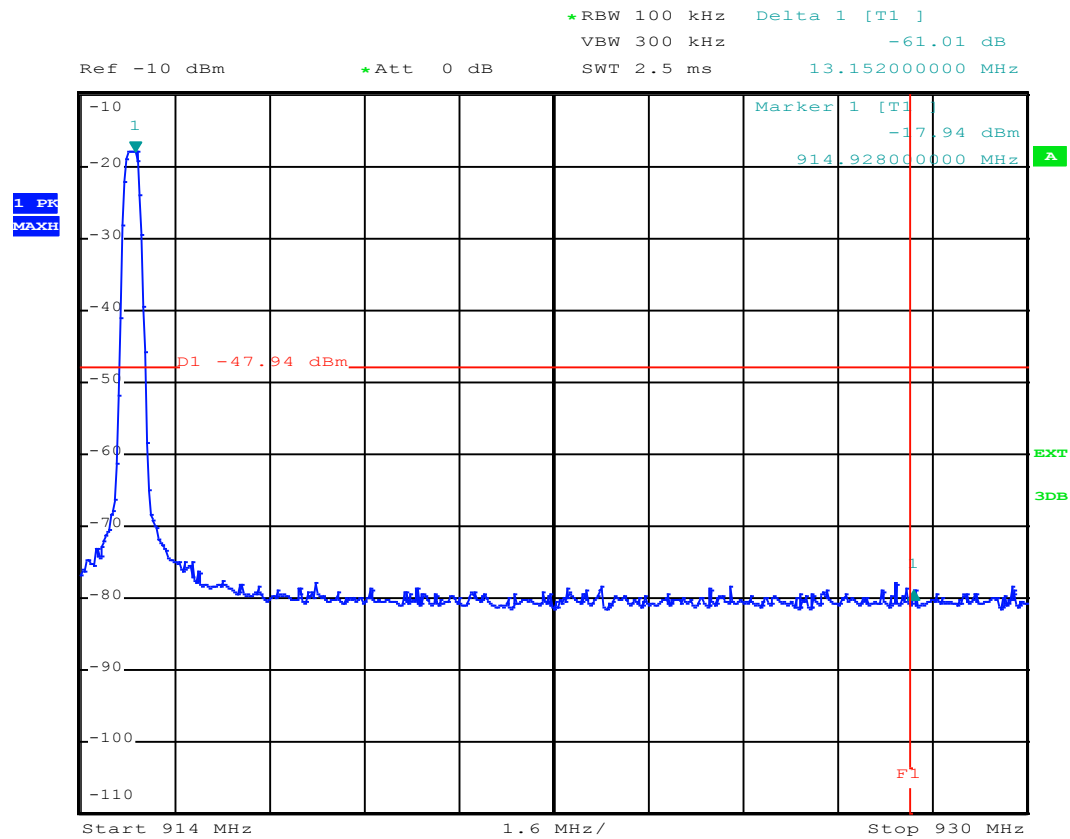
# High Channel with hopping mode off – SF7



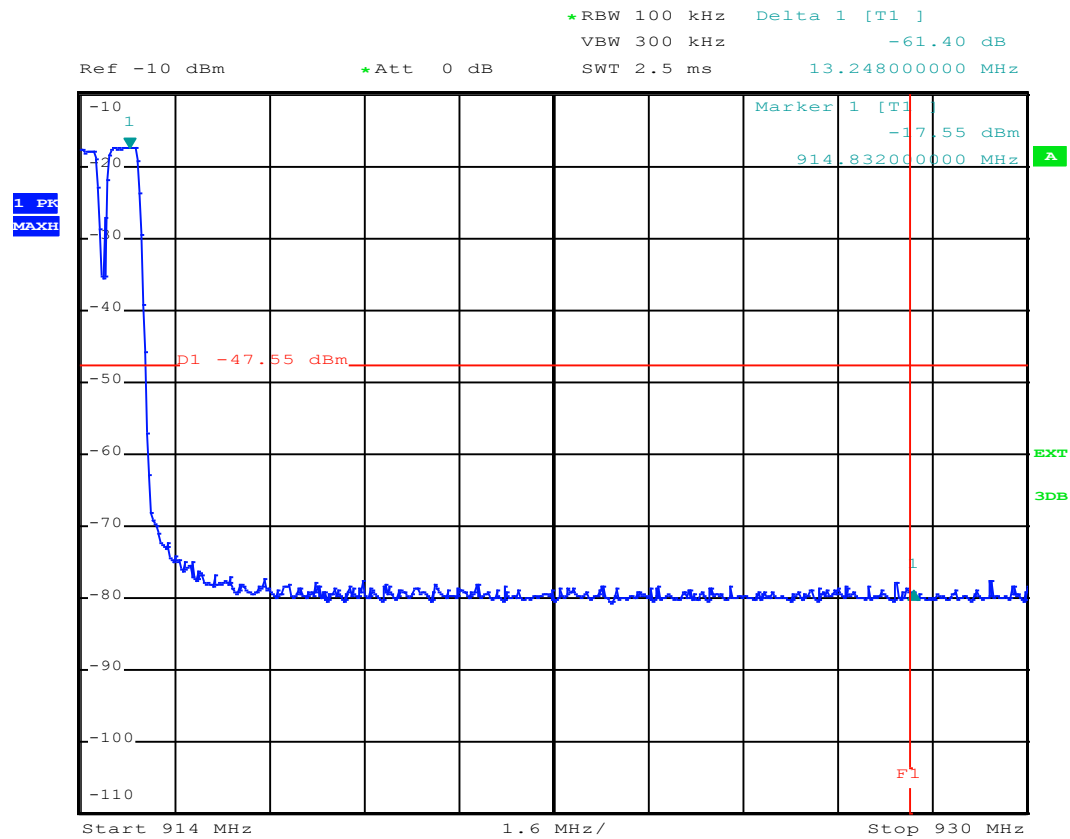
# High Channel with hopping mode on – SF7



# High Channel with hopping mode off – SF10

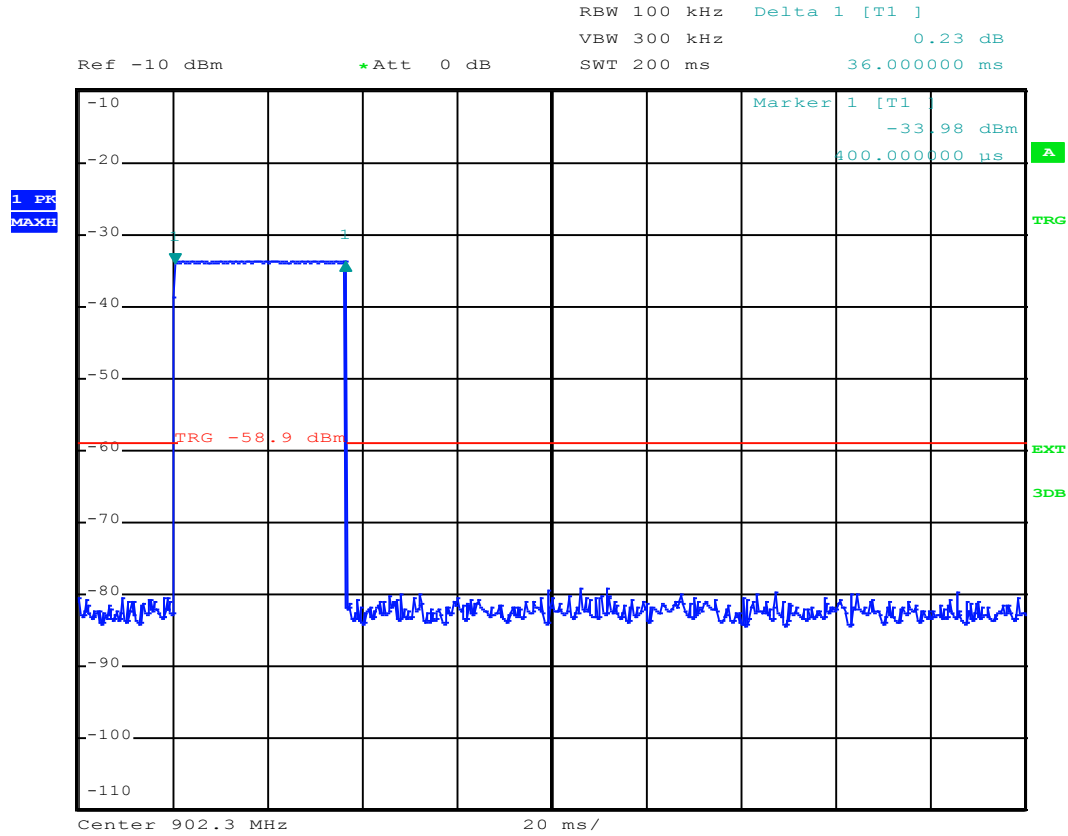


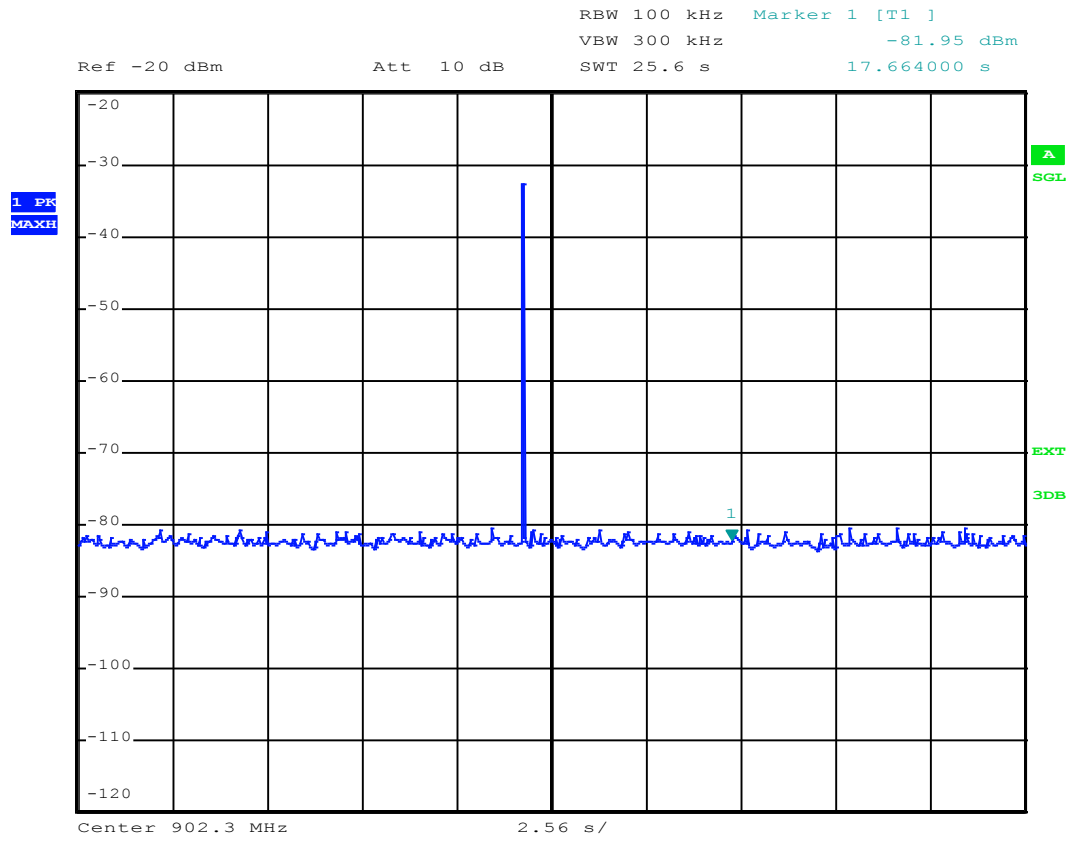
# High Channel with hopping mode on – SF10



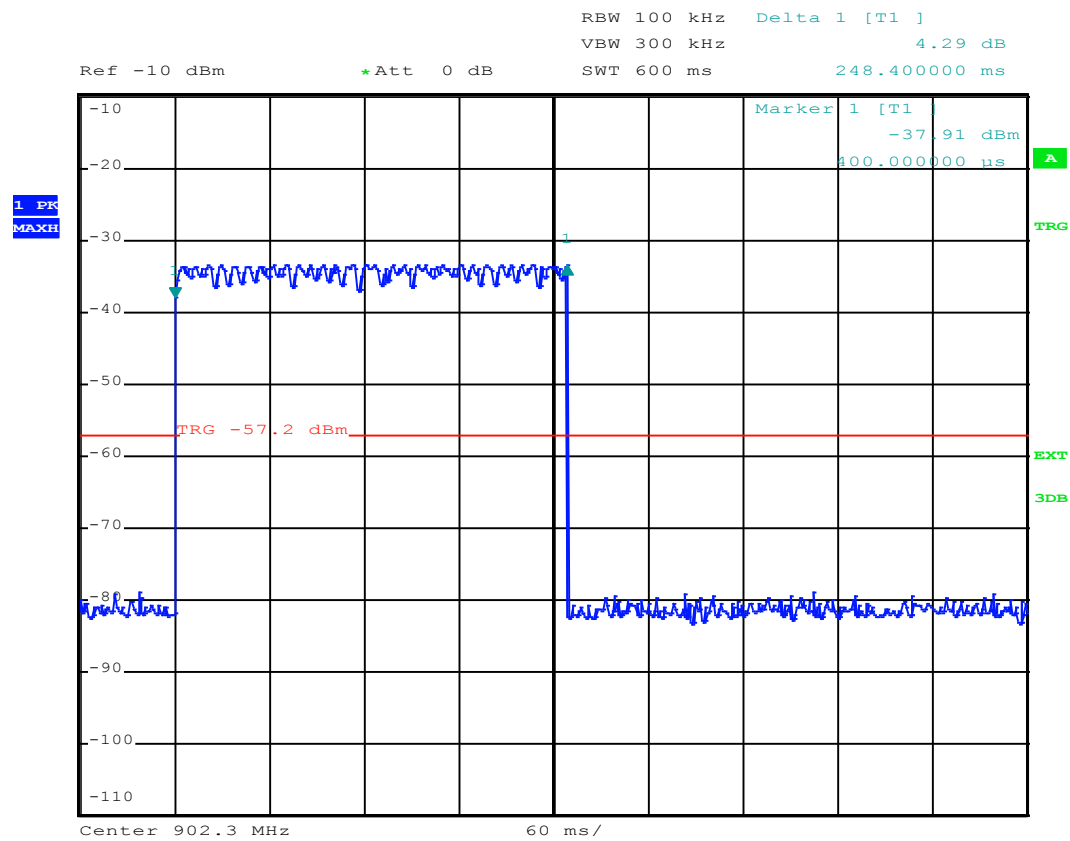
## APPENDIX 5: Time of occupancy on any frequency

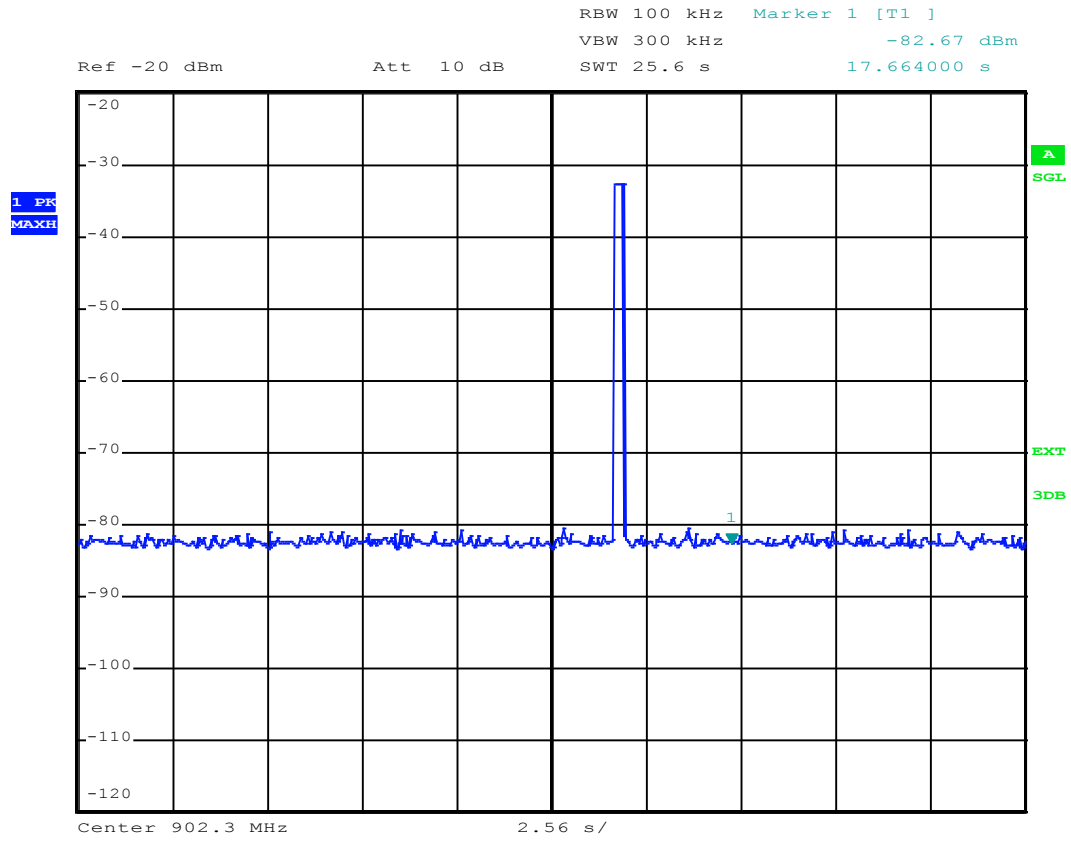
### Low Channel - SF7



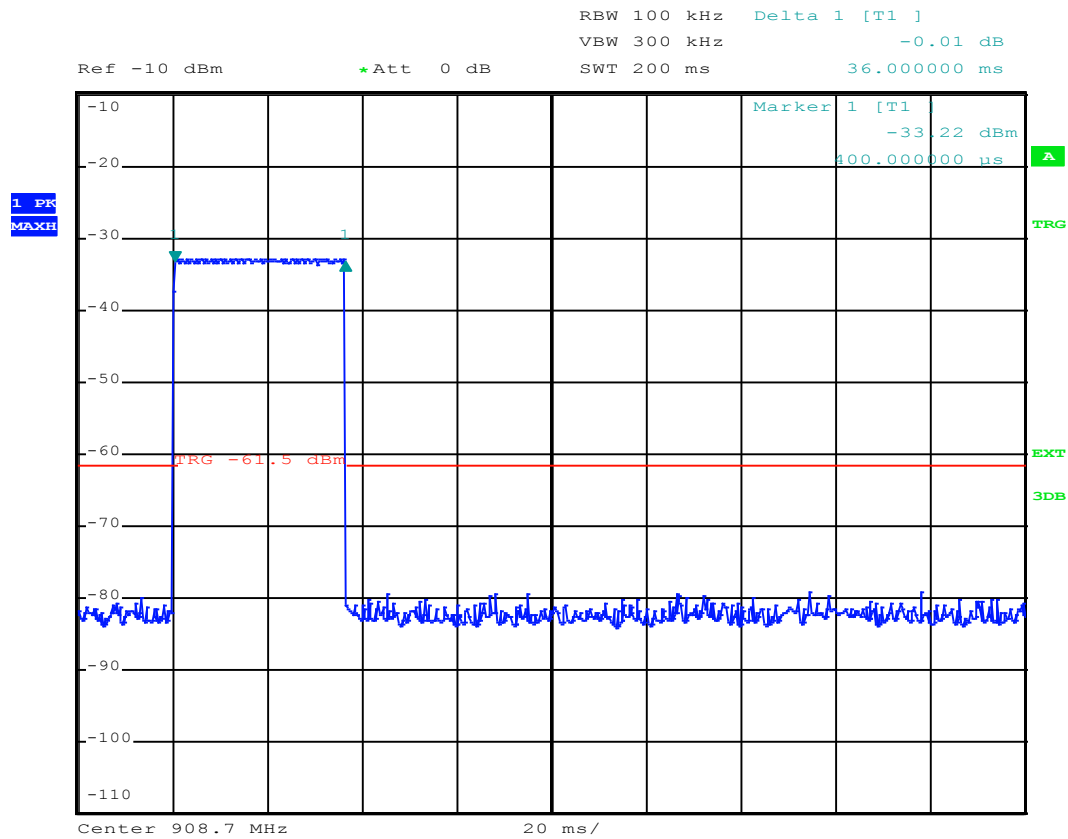


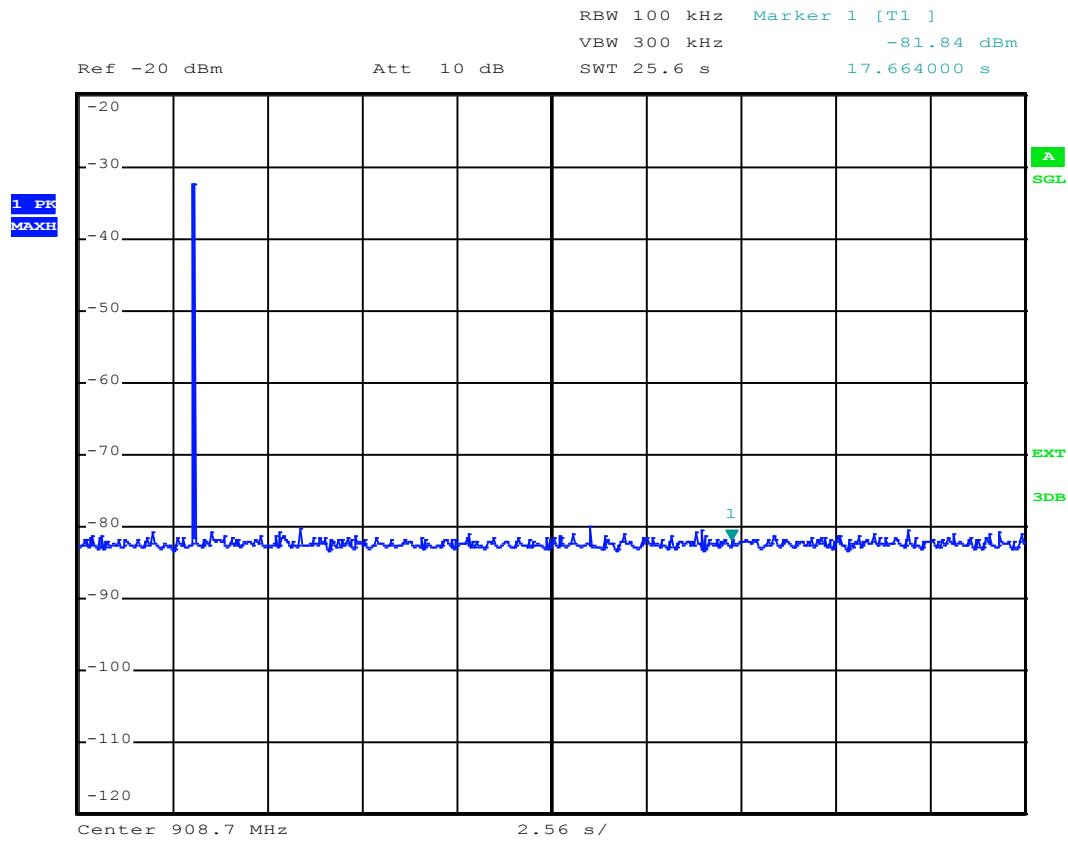
## Low Channel – SF10



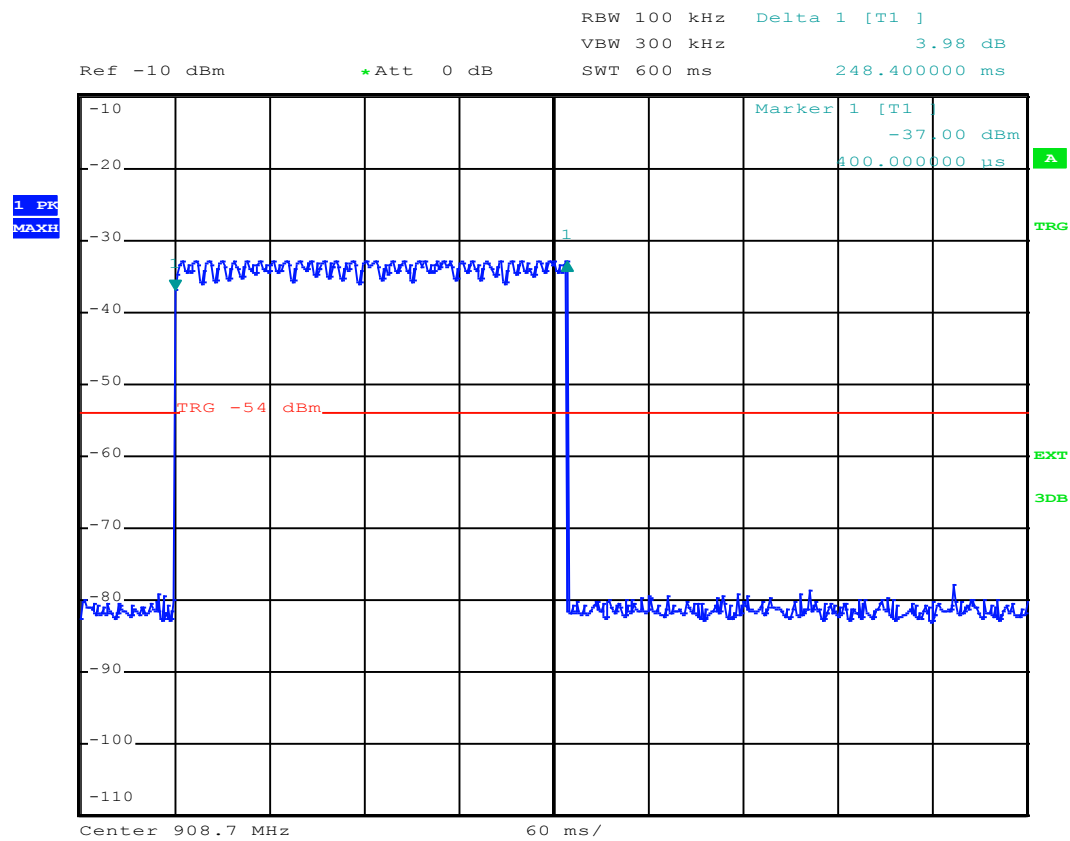


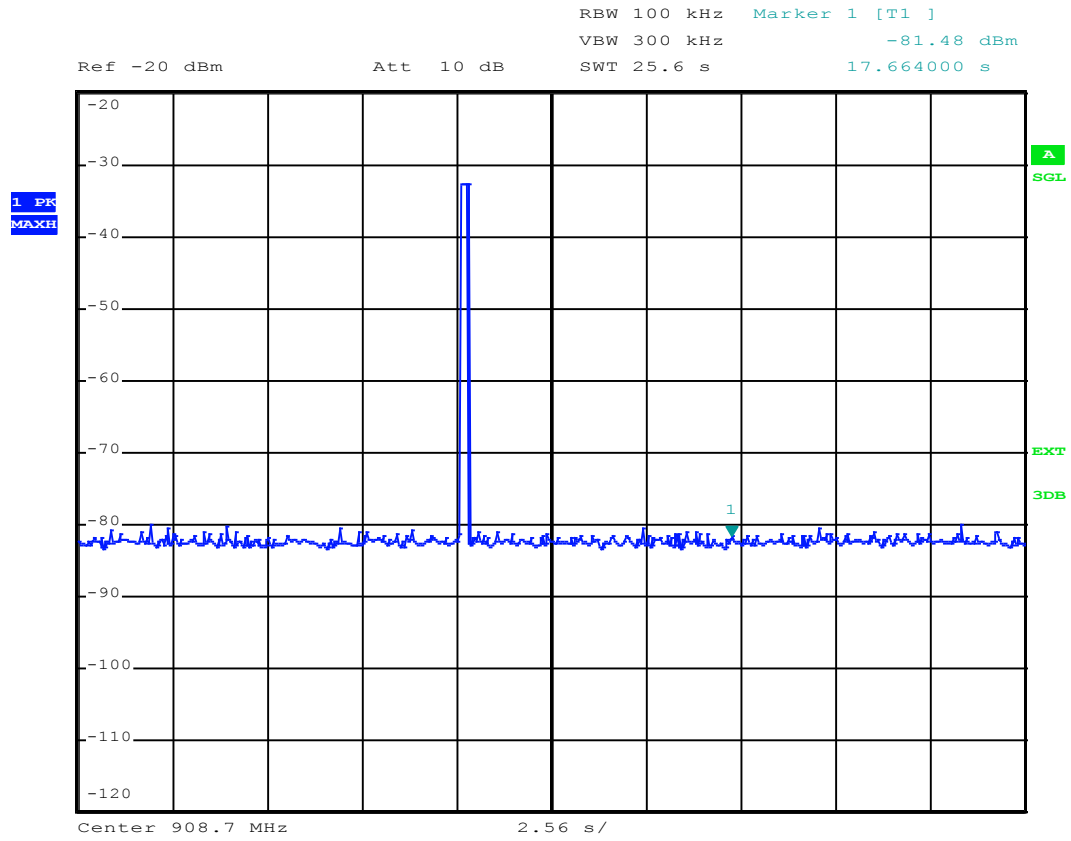
## Central Channel – SF7



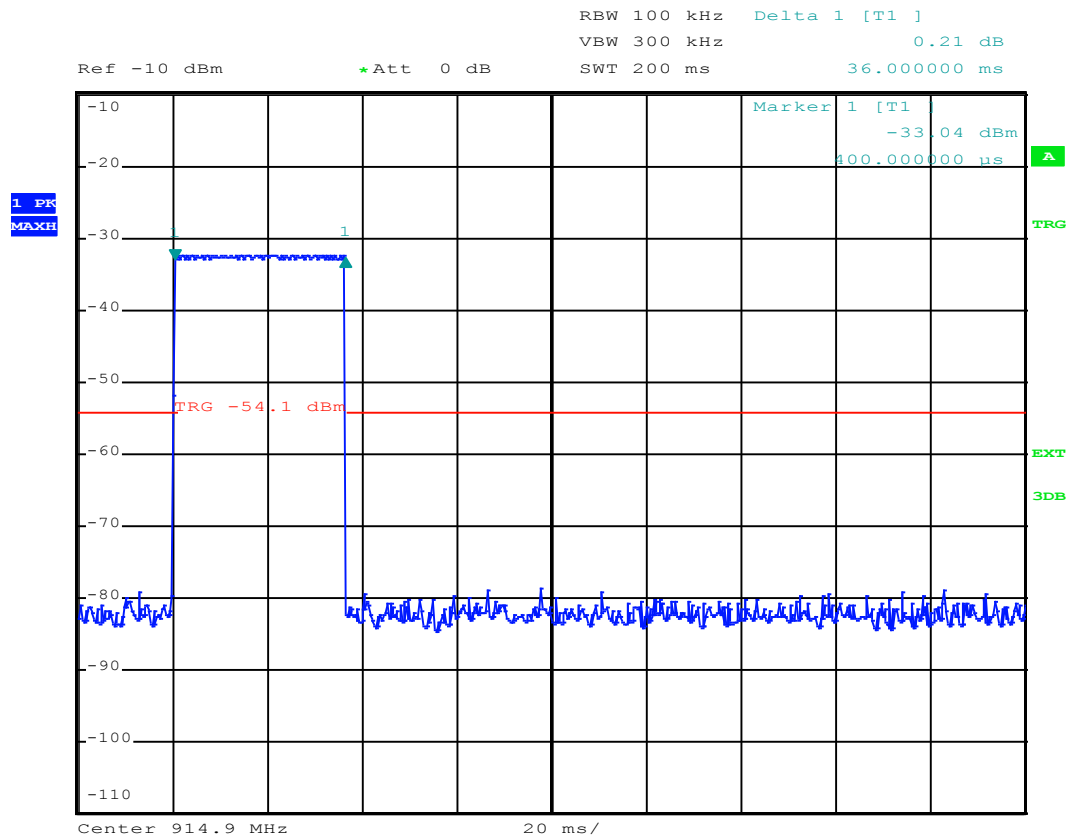


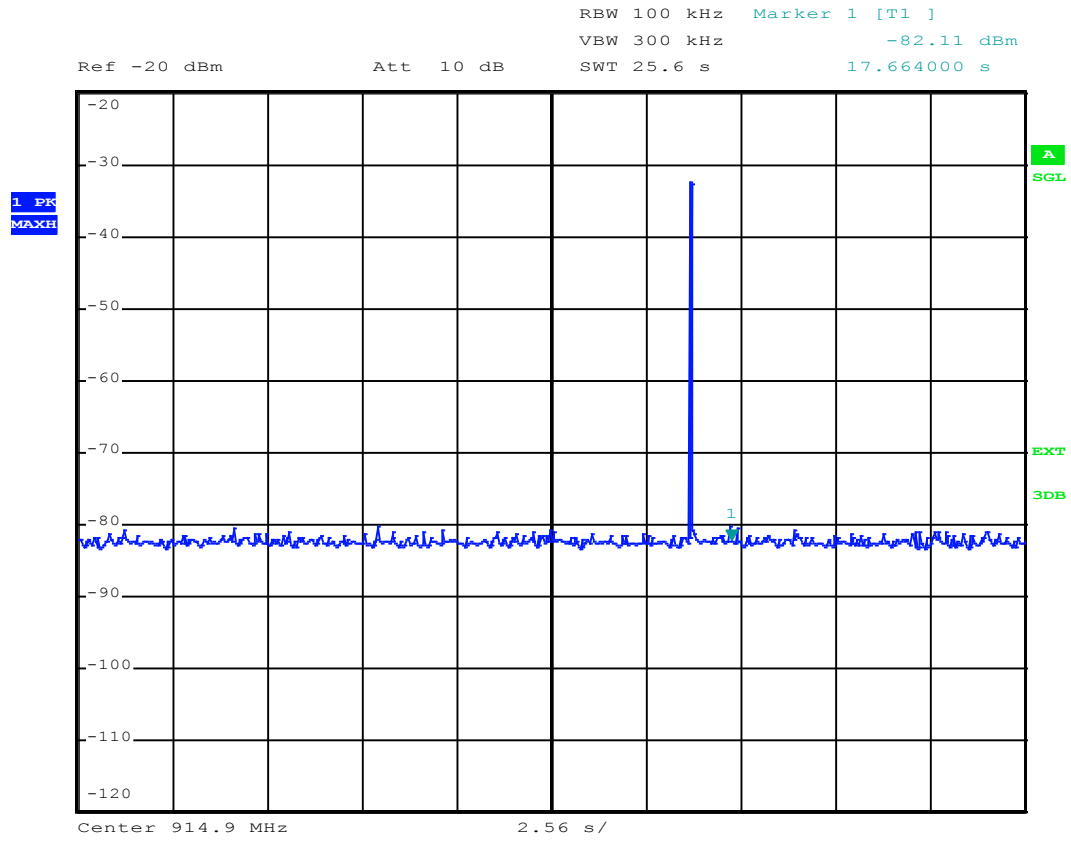
# Central Channel – SF10



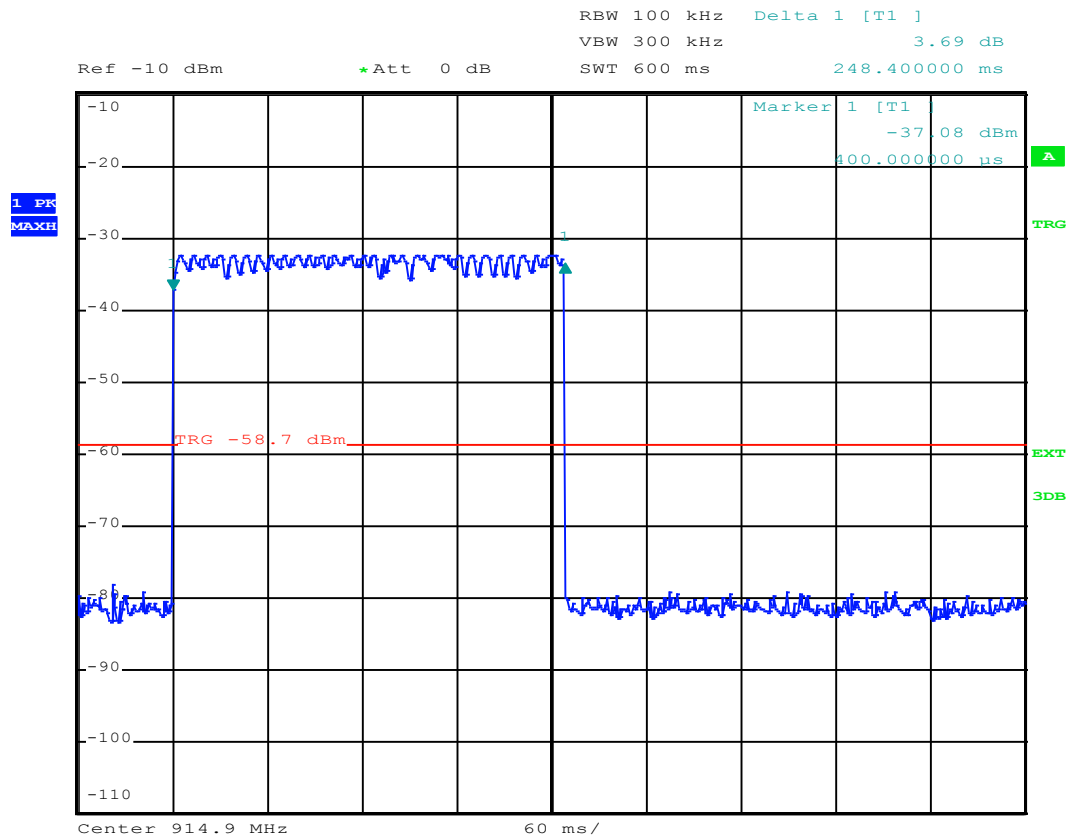


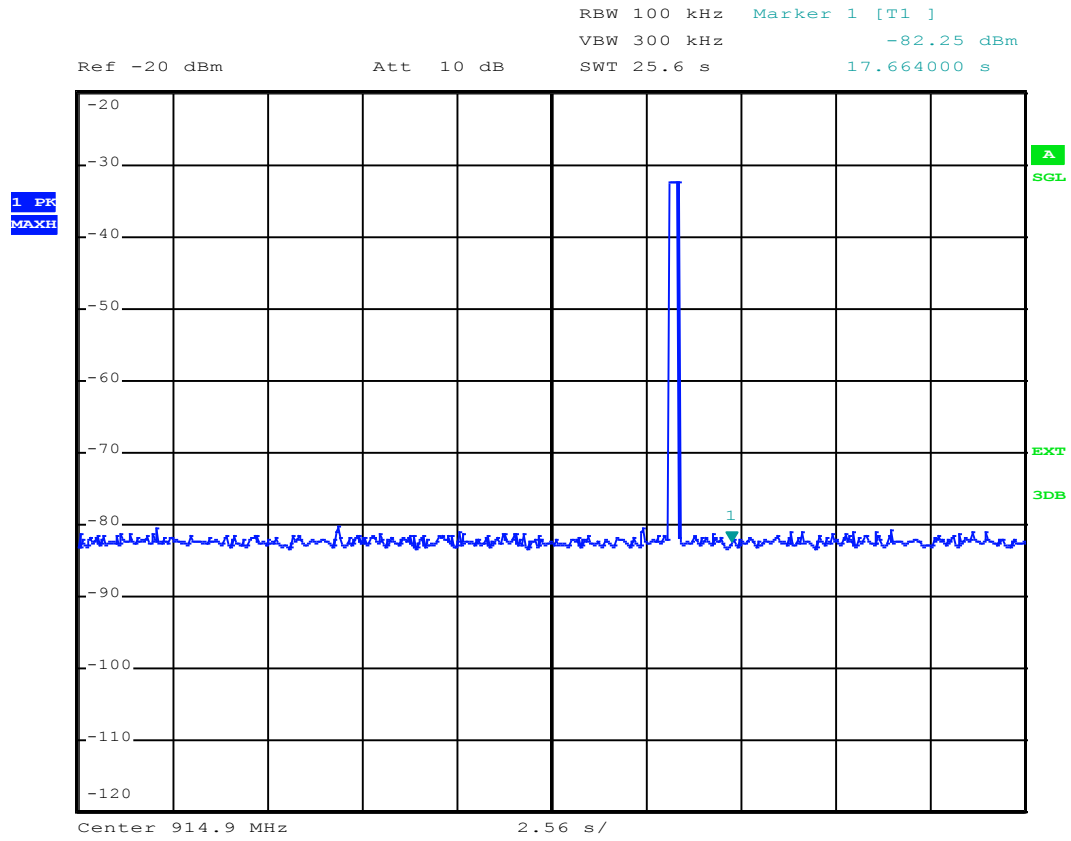
# High Channel – SF7





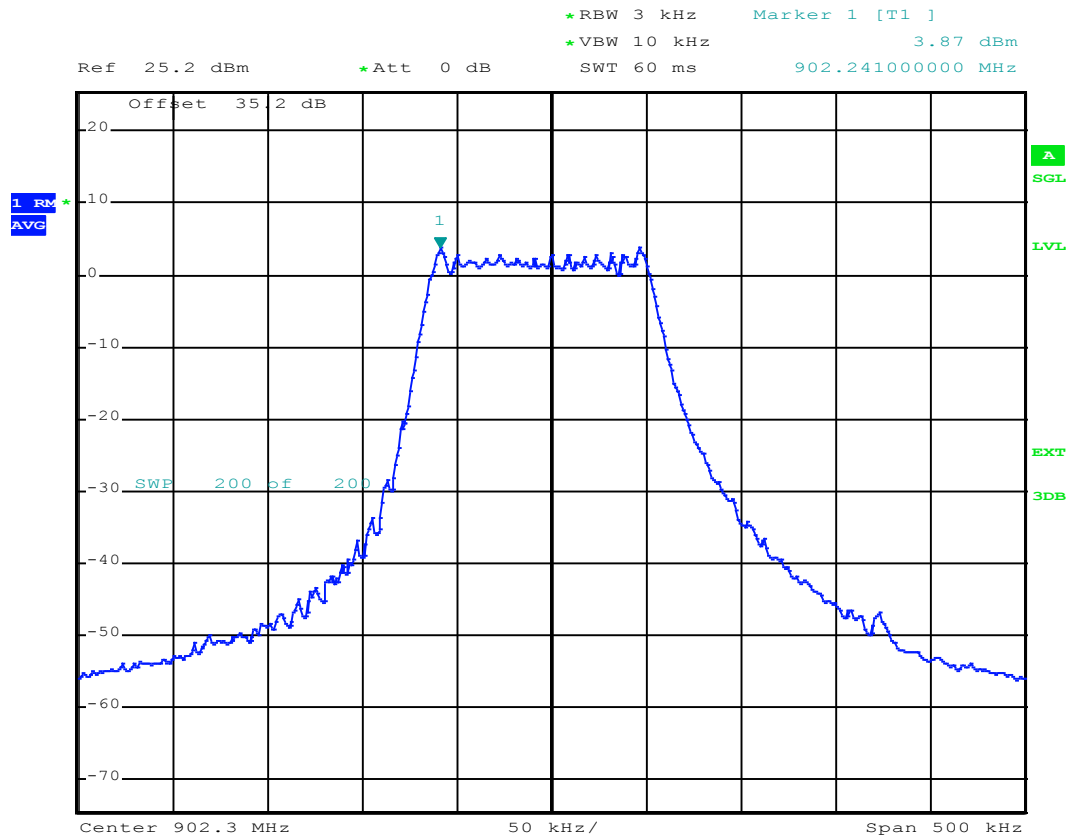
# High Channel – SF10



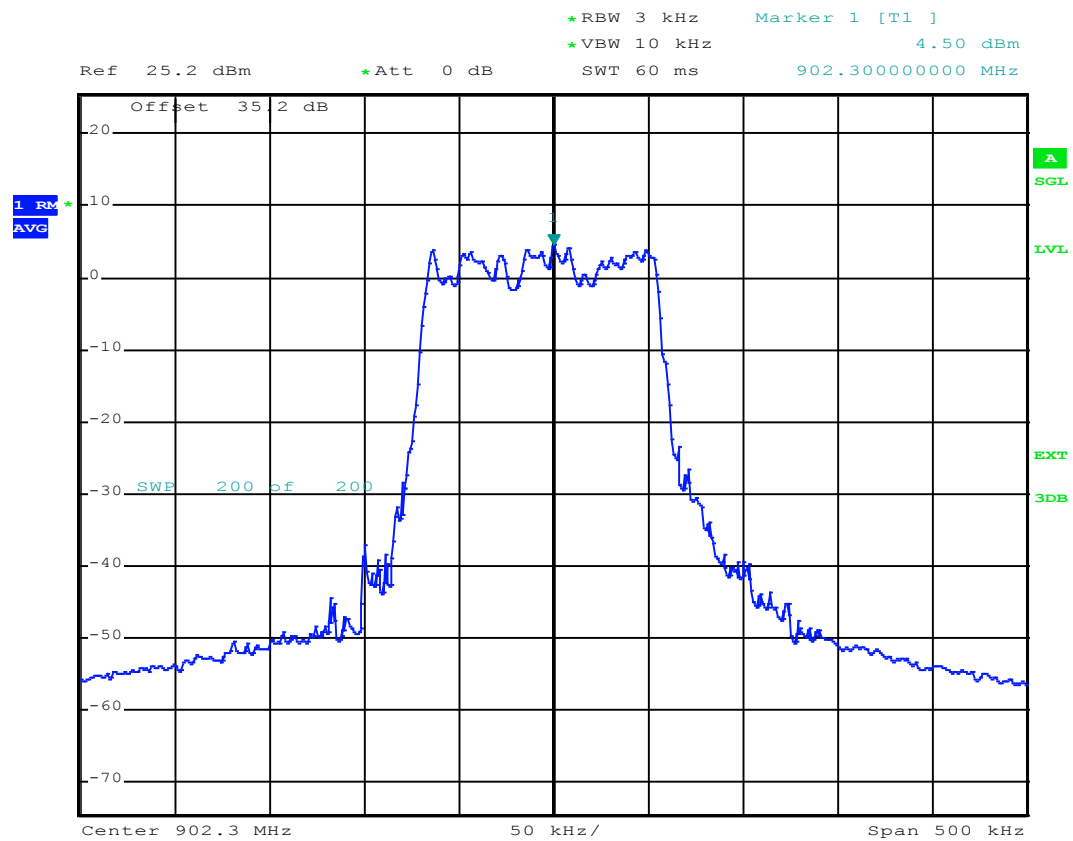


## APPENDIX 6: Peak Power Density

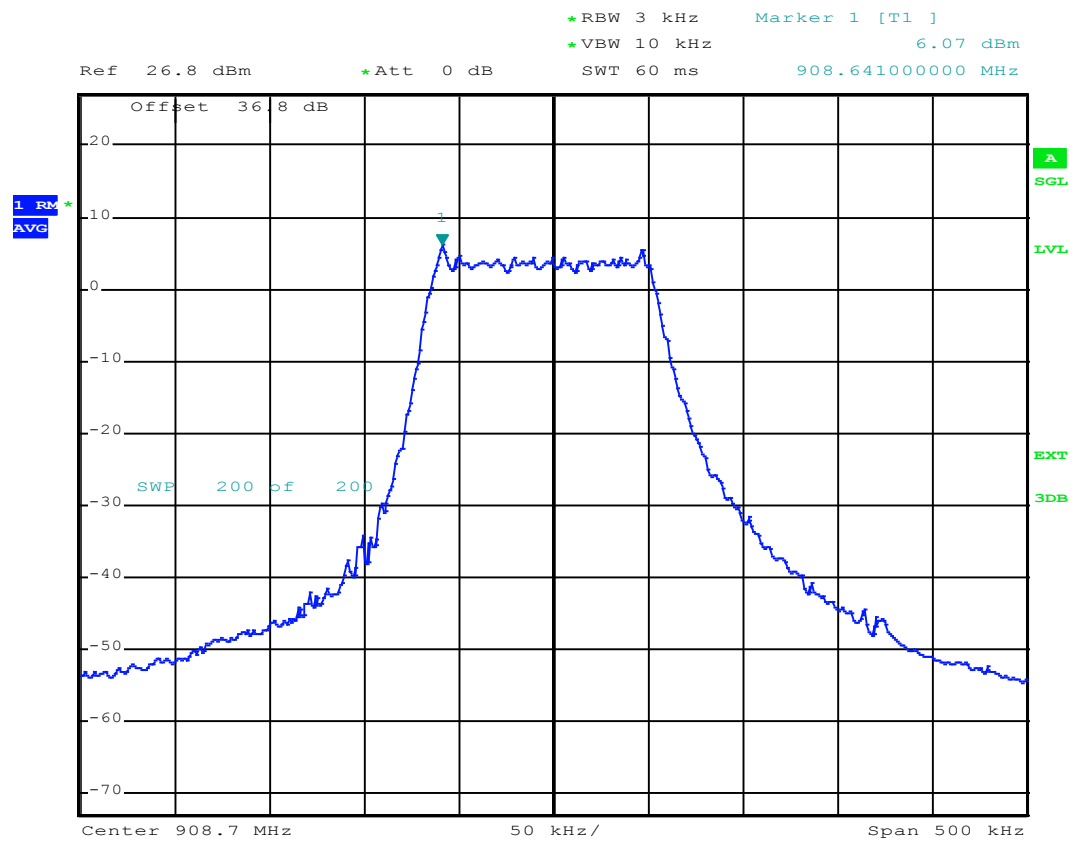
### Low Channel – SF7



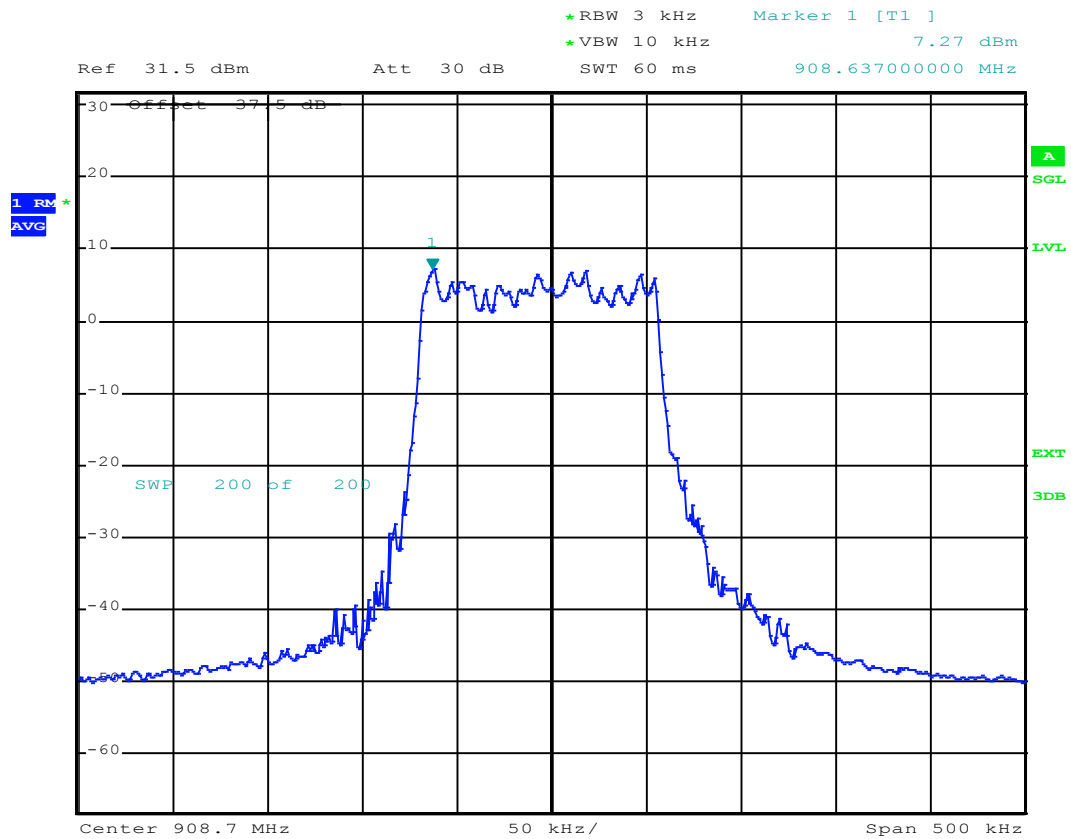
## Low Channel – SF10



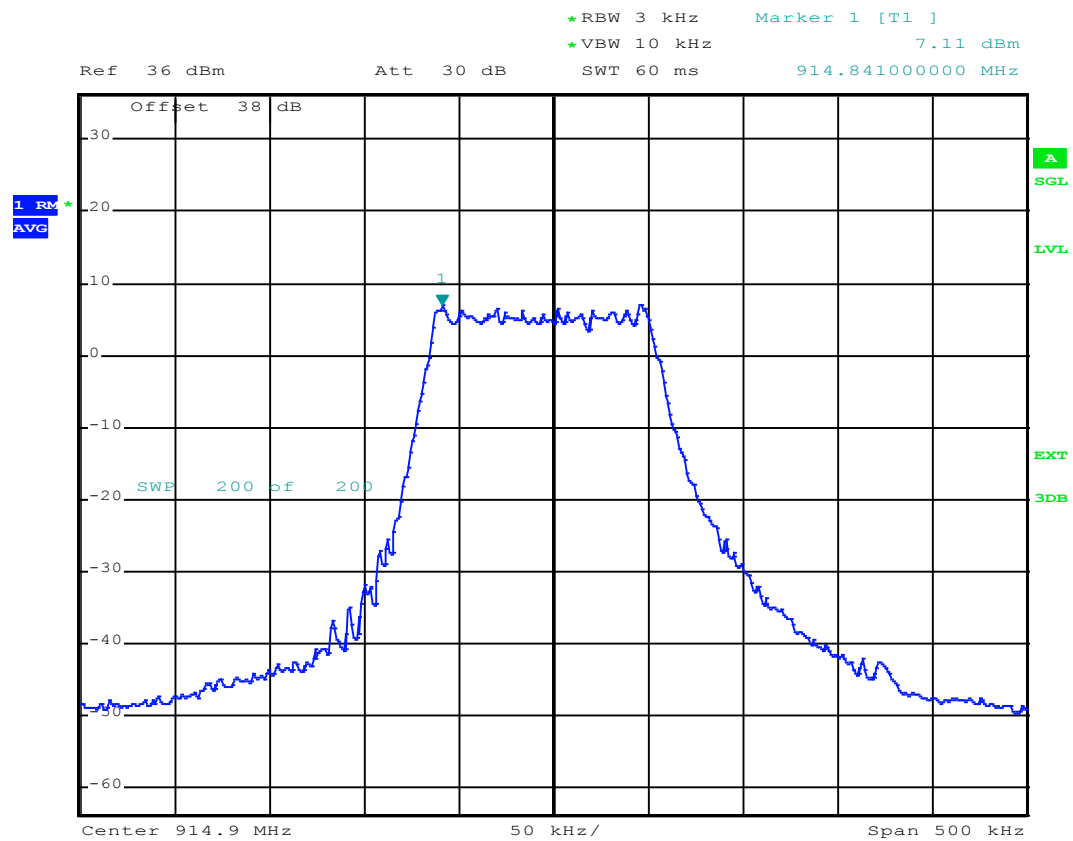
# Central Channel – SF7



# Central Channel – SF10



# High Channel – SF7



# High Channel – SF10

