

# FCC and ISED Canada Testing of the

Esprit Model Inc.  
JETIR900NGUS

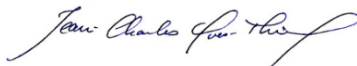
In accordance with FCC 47 CFR part 15.247 and  
ISED Canada's Radio Standards Specifications  
RSS-247

Prepared for: Esprit Model Inc.  
1240 Clearmont st. NW  
Palm Bay, FL 32905

FCC ID: ONTJETIR900NGUS  
IC: 10491A-JETR900NGUS

## COMMERCIAL-IN-CONFIDENCE

Document Number: TP72163756.100 | Version Number: 01

| RESPONSIBLE FOR      | NAME                 | DATE              | SIGNATURE                                                                             |
|----------------------|----------------------|-------------------|---------------------------------------------------------------------------------------|
| Authorized Signatory | Peter Walsh          | 2021 -February-18 |  |
| Testing              | Thierry Jean-Charles | 2021-February-08  |  |

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

|                                                                          |                                                                                                                        |
|--------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| FCC Accreditation<br>Designation Number US1063 Tampa, FL Test Laboratory | Innovation, Science, and Economic Development Canada<br>Accreditation<br>Site Number 2087A-2 Tampa, FL Test Laboratory |
|--------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|

### EXECUTIVE SUMMARY

Samples of this product were tested and found to be in compliance with 15.247 and ISED Canada's RSS-247

|                                                                                                               |                                                                                                                                                                                                                                                                                                                            |
|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <br>A2LA Cert. No. 2955.15 | <b>DISCLAIMER AND COPYRIGHT</b><br>This non-binding report has been prepared by TÜV SÜD America with all reasonable skill and care. The document is confidential to the potential Client and TÜV SÜD America. No part of this document may be reproduced without the prior written approval of TÜV SÜD America. © TÜV SÜD. |
|                                                                                                               | <b>DISCLAIMER AND COPYRIGHT</b><br>Our A2LA Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our A2LA Accreditation. Results of test not covered by our A2LA Accreditation Schedule are marked NUA (Not A2LA Accredited).                                              |

TÜV SÜD America  
5610 West Sligh Ave., Suite 100  
Tampa, FL 33634

Phone: 813-284-2715  
[www.tuv-sud-america.com](http://www.tuv-sud-america.com)



America

Add value.  
Inspire trust.

TÜV SÜD

TÜV®



## Contents

|          |                                                                  |           |
|----------|------------------------------------------------------------------|-----------|
| <b>1</b> | <b>Report Summary .....</b>                                      | <b>3</b>  |
| 1.1      | Report Modification Record.....                                  | 3         |
| 1.2      | Introduction.....                                                | 3         |
| 1.3      | Brief Summary of Results .....                                   | 5         |
| 1.4      | Product Information .....                                        | 6         |
| 1.5      | Deviations from the Standard.....                                | 8         |
| 1.6      | EUT Modification Record .....                                    | 9         |
| 1.7      | Test Location .....                                              | 9         |
| <b>2</b> | <b>Test Details .....</b>                                        | <b>10</b> |
| 2.1      | Antenna Requirements.....                                        | 10        |
| 2.2      | Carrier Frequency Separation.....                                | 11        |
| 2.3      | Number of Hopping Channels.....                                  | 15        |
| 2.4      | Channel Dwell Time .....                                         | 19        |
| 2.5      | 20 dB Bandwidth .....                                            | 27        |
| 2.6      | 99% Bandwidth .....                                              | 36        |
| 2.7      | Peak Output Power .....                                          | 45        |
| 2.8      | Band-Edge Compliance of RF Conducted Emissions .....             | 54        |
| 2.9      | RF Conducted Spurious Emissions .....                            | 64        |
| 2.10     | Radiated Spurious Emissions into Restricted Frequency Bands..... | 72        |
| 2.11     | Power Spectral Density .....                                     | 76        |
| 2.12     | Power Line Conducted Emissions .....                             | 85        |
| 2.13     | Duty Cycle of Test Mode of Operation .....                       | 86        |
| <b>3</b> | <b>Test Equipment Information .....</b>                          | <b>90</b> |
| 3.1      | General Test Equipment Used.....                                 | 90        |
| <b>4</b> | <b>Diagram of Test Set-ups.....</b>                              | <b>91</b> |
| <b>5</b> | <b>Measurement Uncertainty .....</b>                             | <b>94</b> |
| <b>6</b> | <b>Accreditation, Disclaimers and Copyright.....</b>             | <b>95</b> |



# 1 Report Summary

## 1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

| Issue | Description of Change | Date of Issue    |
|-------|-----------------------|------------------|
| 1     | First Issue           | 2021-February-18 |

## 1.2 Introduction

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC’s Code of Federal Regulations Section 15.247 and Innovation Science and Economic Development Canada’s Radio Standards Specification RSS-247 for the tests documented herein.



|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Applicant                     | Esprit Model Inc.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Manufacturer                  | Esprit Model Inc.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Applicant's Email Address     | <a href="mailto:zb@espritmodel.com">zb@espritmodel.com</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Model Number(s)               | JETIR900NGUS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Serial Number(s)              | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| FCC ID                        | ONTJETIR900NGUS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| ISED Certification Number     | 10491A-JETR900NGUS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Hardware Version(s)           | 9LRX3-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Software Version(s)           | 1.03                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Number of Samples Tested      | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Test Specification/Issue/Date | US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2020<br>Innovation, Science and Economic Development Canada<br>Radio Standards Specification: RSS-247 — Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 2, February 2017                                                                                                                                                                                                                                                                                                                          |
| Test Plan/Issue/Date          | 2020-October-12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Order Number                  | 72163756                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Date                          | 2020-October-19                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Date of Receipt of EUT        | 2020-October-26                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Start of Test                 | 2020-October-29                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Finish of Test                | 2020-November-16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Name of Engineer(s)           | Thierry Jean-Charles                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Related Document(s)           | ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices<br>FCC OET KDB Publication 558074 D01 15.247 Meas Guidance v05r02: 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, April 2, 2019.<br>US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2020.<br>Innovation, Science and Economic Development Canada<br>Radio Standards Specification: RSS-GEN - General Requirements for Compliance of Radio Apparatus, Issue 5, Amendment 1, March 2019. |



### 1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC Part 15.247 and ISED Canada's RSS-247 is shown below.

**Table 1.3-1: Test Result Summary**

| Test Parameter                                              | Test Plan (Yes/No) | Test Result | FCC 47 CFR Rule Part | ISED Canada's RSS | Test Report Page No |
|-------------------------------------------------------------|--------------------|-------------|----------------------|-------------------|---------------------|
| Antenna Requirement                                         | Yes                | Pass        | 15.203, 15.204       | -----             | 10                  |
| Carrier Frequency Separation                                | Yes                | Pass        | 15.247(a)(1)         | RSS-247 5.1(b)    |                     |
| Number of Hopping Channels                                  | Yes                | Pass        | 15.247(a)(1)(iii)    | RSS-247 5.1(d)    |                     |
| Channel Dwell Time                                          | Yes                | Pass        | 15.247(a)(1)(iii)    | RSS-247 5.1(d)    |                     |
| 20 dB Bandwidth                                             | Yes                | Pass        | 15.247(a)(1)(i)      | RSS-247 5.1(a)    | 11                  |
| 99% Bandwidth                                               | Yes                | Pass        | -----                | RSS-GEN 6.7       | 36                  |
| Peak Output Power                                           | Yes                | Pass        | 15.247(b)(3)         | RSS-247 5.4(d)    | 45                  |
| Band-Edge Compliance of RF Conducted Emissions              | Yes                | Pass        | 15.247(d)            | RSS-247 5.5       | 54                  |
| RF Conducted Spurious Emissions                             | Yes                | Pass        | 15.247(d)            | RSS-247 5.5       | 64                  |
| Radiated Spurious Emissions into Restricted Frequency Bands | Yes                | Pass        | 15.205, 15.209       | RSS-GEN 8.9, 8.10 | 72                  |
| Power Spectral Density                                      | Yes                | Pass        | 15.247(e)            | RSS-247 5.2(b)    | 76                  |
| Power Line Conducted Emissions                              | No                 | -----       | 15.207               | RSS-GEN 8.8       | 85                  |
| Duty Cycle                                                  | Yes                | -----       |                      |                   | 86                  |



## 1.4 Product Information

### 1.4.1 Technical Description

The equipment under test was a receiver/transmitter for radio control model toys. The EUT uses a 900 MHz LoRa transceiver.

#### Technical Details

Mode of Operation: LoRa  
 Frequency Range: 902.5 MHz - 927.3 MHz  
 Number of Channels: 32  
 Channel Separation: 800 kHz  
 Data Rate: SF = 6: 9.375 kbps  
 SF = 7: 5.468 kbps  
 Modulations: Chirp Spread Spectrum (CSS)  
 Antenna Type/Gain: Whip Antenna, 3 dBi  
 Input Power: 6 VDC

A full description and detailed product specification details are available from the manufacturer.

**Table 1.4.1-1 – Cable Descriptions**

| Cable/Port  | Description                                 |
|-------------|---------------------------------------------|
| Data Cable  | 30.48 cm, Not Shielded, EUT to Servo Motors |
| Power Leads | 2 m, Not Shielded, EUT to DC Power Supply   |
| Power Cord  | DC Power Supply to AC Mains                 |

**Table 1.4.1-2 – Support Equipment Descriptions**

| Make/Model               | Description                      |
|--------------------------|----------------------------------|
| HITEC RCD USA / HS-225BB | (3x) Servo Motors                |
| Hewlett Packard / 6291A  | DC Power Supply, S/N: 1928A05628 |



### Declaration of Build Status

| EQUIPMENT DESCRIPTION                                                                           |                                      |
|-------------------------------------------------------------------------------------------------|--------------------------------------|
| Model Name/Number                                                                               | Jeti Duplex R900NG                   |
| Part Number                                                                                     | R900NGUS                             |
| Hardware Version                                                                                | 9LRX3-1                              |
| Software Version                                                                                | 1.03                                 |
| FCC ID (if applicable)                                                                          | ONTJETIR900NGUS                      |
| ISED ID (if applicable)                                                                         | 10491A-JETR900NGUS                   |
| Technical Description (Please provide a brief description of the intended use of the equipment) | Receiver for radio controlled models |

| UN-INTENTIONAL RADIATOR                                                                                 |        |
|---------------------------------------------------------------------------------------------------------|--------|
| Highest frequency generated or used in the device or on which the device operates or tunes              | 928MHz |
| Lowest frequency generated or used in the device or on which the device operates or tunes               | 902MHz |
| Class A Digital Device (Use in commercial, industrial or business environment) <input type="checkbox"/> |        |
| Class B Digital Device (Use in residential environment only) <input checked="" type="checkbox"/>        |        |

| Power Source |                          |                          |                                     |
|--------------|--------------------------|--------------------------|-------------------------------------|
| AC           | Single Phase             | Three Phase              | Nominal Voltage                     |
|              | <input type="checkbox"/> | <input type="checkbox"/> |                                     |
| External DC  | Nominal Voltage          |                          | Maximum Current                     |
|              |                          |                          | 0.15A                               |
| Battery      | Nominal Voltage          |                          | Battery Operating End Point Voltage |
|              | 5v-9v                    |                          | 4.5                                 |

| EXTREME CONDITIONS  |     |    |                     |
|---------------------|-----|----|---------------------|
| Maximum temperature | +85 | °C | Minimum temperature |
|                     |     |    | -40 °C              |

| Ancillaries                                                     |
|-----------------------------------------------------------------|
| Please list all ancillaries which will be used with the device. |
|                                                                 |

I hereby declare that the information supplied is correct and complete.

Name: Danny Melnik

Position held: Engineer

Date: 1-7-2021



#### 1.4.2 Modes of Operation

The EUT was powered using a 6 VDC power supply. The EUT was evaluated for the 900 MHz LoRa transceiver for spreading factors 6 and 7. The test software power settings used was 14.

The device was configured at the maximum duty cycle allowed by the test firmware.

#### 1.4.3 Monitoring of Performance

Preliminary radiated emissions measurements were performed for the EUT in three orthogonal orientations. The worst case antenna port and spreading factor configurations were investigated as well. The EUT flat on the table top transmitting on antenna port 1 using spreading factor 6 was identified as the worst case and was used for the final measurements.

The RF conducted measurements were performed on a sample with RF connectors at the antenna ports to allow direct coupling to the spectrum analyzer.

The EUT is DC powered only without provisions for connection to the AC mains. The EUT is exempted from the power line conducted emissions requirements.

#### 1.4.4 Performance Criteria

The EUT was evaluated to the requirements listed below.

**Table 1.4.4 -1: Performance Criteria**

| Parameter                                                   | Requirement                                                  |
|-------------------------------------------------------------|--------------------------------------------------------------|
| Antenna Requirement                                         | FCC: Section 15.203. 15.204                                  |
| Carrier Frequency Separation                                | FCC: Section 15.247(a)(1); ISED Canada: RSS-247 5.1(b)       |
| Number of Hopping Channels                                  | FCC: Section 15.247(a)(1)(iii); ISED Canada: RSS-247 5.1(d)  |
| Dwell Time                                                  | FCC: Section 15.247(a)(1)(iii); ISED Canada: RSS-247 5.1(d)  |
| 20 dB Bandwidth                                             | FCC: Section 15.247(a)(1)(i); ISED Canada: RSS-247 5.1(a)    |
| 99% Bandwidth                                               | ISED Canada: RSS-GEN 6.7                                     |
| Peak Output Power                                           | FCC: Section 15.247(b)(1); ISED Canada: RSS-247 5.4(b)       |
| Band-Edge Compliance of RF Conducted Emissions              | FCC: Section 15.247(d); ISED Canada: RSS-247 5.5             |
| RF Conducted Spurious Emissions                             | FCC: Section 15.247(d); ISED Canada: RSS-247 5.5             |
| Radiated Spurious Emissions into Restricted Frequency Bands | FCC: Sections 15.205, 15.209; ISED Canada: RSS-GEN 8.9, 8.10 |
| Power Spectral Density                                      | FCC: Section 15.247(e); ISED Canada: RSS-247(b)              |

#### 1.5 Deviations from the Standard

The evaluation was performed without any deviation from the test standard.



## 1.6 EUT Modification Record

The table below details modifications made to the EUT during the test program. The modifications incorporated during each test are recorded on the appropriate test pages.

| Modification State | Description of Modification still fitted to EUT | Modification Fitted By | Date Modification Fitted |
|--------------------|-------------------------------------------------|------------------------|--------------------------|
|                    |                                                 |                        |                          |

The equipment was tested as provided without any modifications.

## 1.7 Test Location

TÜV SÜD Product Service conducted the following tests at our Tampa FL Test Laboratory.

| Test Name                                                   | Name of Engineer(s)  | Accreditation |
|-------------------------------------------------------------|----------------------|---------------|
| DC Powered Operating                                        |                      |               |
| Antenna Requirement                                         | Thierry Jean-Charles | A2LA          |
| Carrier Frequency Separation                                | Thierry Jean-Charles | A2LA          |
| Number of Hopping Channels                                  | Thierry Jean-Charles | A2LA          |
| Dwell Time                                                  | Thierry Jean-Charles | A2LA          |
| 20 dB Bandwidth                                             | Thierry Jean-Charles | A2LA          |
| 99% Bandwidth                                               | Thierry Jean-Charles | A2LA          |
| Peak Output Power                                           | Thierry Jean-Charles | A2LA          |
| Band-Edge Compliance of RF Conducted Emissions              | Thierry Jean-Charles | A2LA          |
| RF Conducted Spurious Emissions                             | Thierry Jean-Charles | A2LA          |
| Radiated Spurious Emissions into Restricted Frequency Bands | Thierry Jean-Charles | A2LA          |
| Power Spectral Density                                      | Thierry Jean-Charles | A2LA          |
| Duty Cycle                                                  | Thierry Jean-Charles | A2LA          |

Office Address:

TÜV SÜD America, Inc.  
5610 W. Sligh Ave, Suite 100  
Tampa, FL 33634  
USA



## 2 Test Details

### 2.1 Antenna Requirements

#### 2.1.1 Specification Reference

FCC: Section 15.203, 15.204

#### 2.1.2 Equipment Under Test and Modification State

S/N: N/A

#### 2.1.3 Date of Test

1/16/2021

#### 2.1.4 Test Method

N/A

#### 2.1.5 Environmental Conditions

Ambient Temperature N/A

Relative Humidity N/A

Atmospheric Pressure N/A

#### 2.1.6 Test Results

Limit Clause FCC Sections: 15.203, 15.204

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

The EUT uses whip coaxial antennas which are directly soldered to the PCB. The antennas are not removable and therefore meet the requirements of FCC Section 15.203.

#### 2.1.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

As this was a visual inspection, no test equipment was used.



## **2.2 Carrier Frequency Separation**

### **2.2.1 Specification Reference**

FCC: Section 15.247(a)(1)  
ISED Canada: RSS-247 5.1(c)

### **2.2.2 Equipment Under Test and Modification State**

S/N: N/A

### **2.2.3 Date of Test**

11/5/2020 to 11/14/2020

### **2.2.4 Test Method**

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set wide enough to capture two adjacent peaks and the RBW and VBW were set to approximately 30% of the channel spacing.

### **2.2.5 Environmental Conditions**

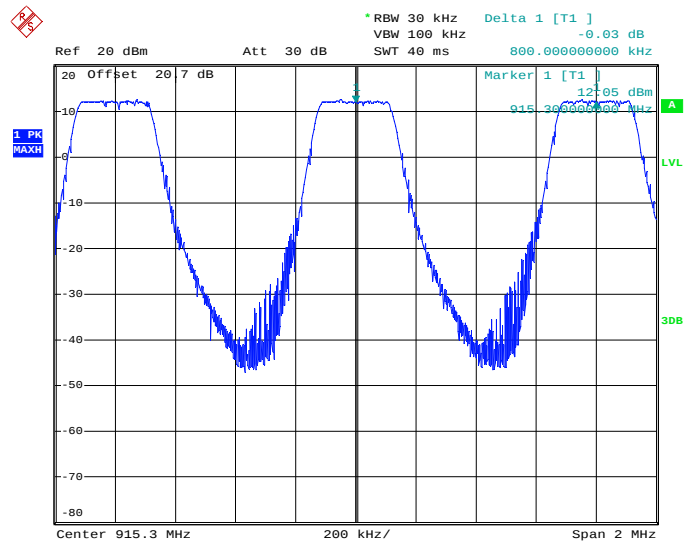
|                      |             |
|----------------------|-------------|
| Ambient Temperature  | 26.9°C      |
| Relative Humidity    | 39.9 %      |
| Atmospheric Pressure | 1019.3 mbar |

### **2.2.6 Test Results**

DC Powered Operating

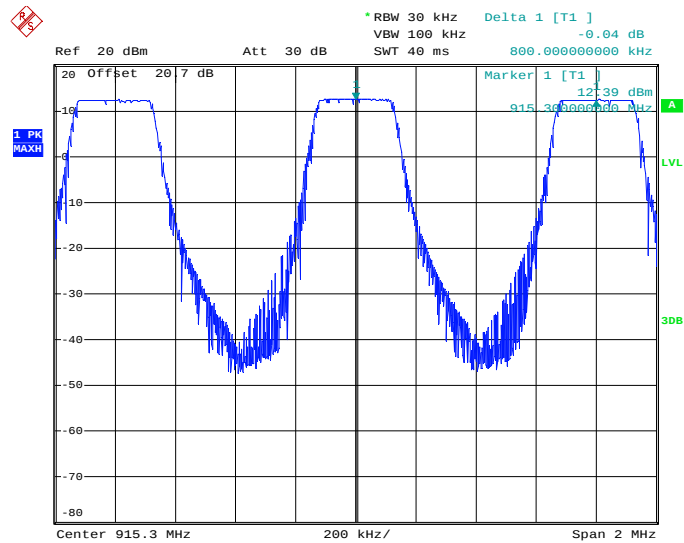
Limit Clause FCC Part 15.247(a)(1); ISED RSS-247 5.1 (c)

The Carrier Frequency Separation was measured to be 800 kHz.



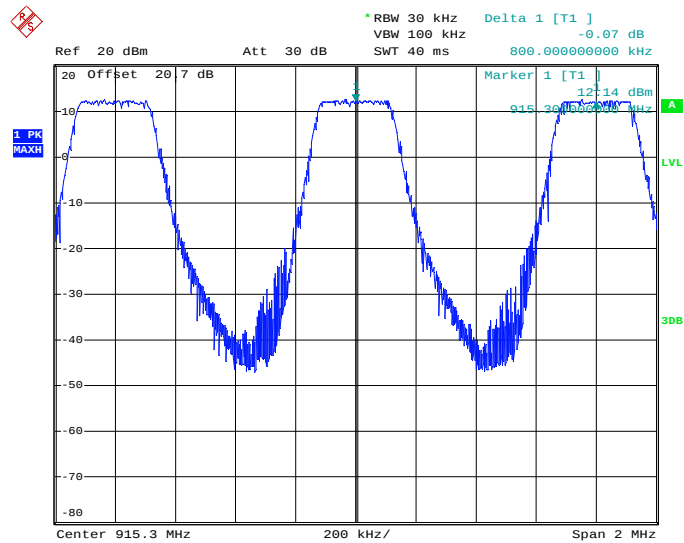
Date: 5.NOV.2020 23:15:59

Figure 2.2.6-1: Carrier Frequency Separation Test Results – Antenna 1 – SF6



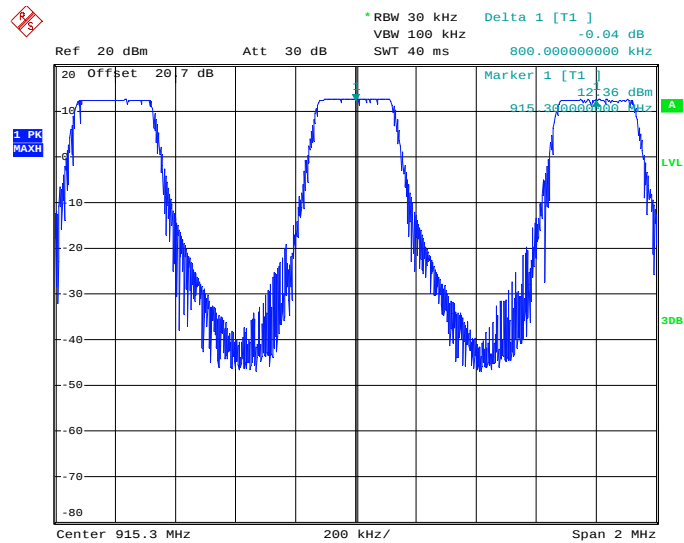
Date: 5.NOV.2020 23:24:35

Figure 2.2.6-2: Carrier Frequency Separation Test Results – Antenna 1 – SF7



Date: 5.NOV.2020 22:57:58

Figure 2.2.6-3: Carrier Frequency Separation Test Results – Antenna 2 – SF6



Date: 14.NOV.2020 15:45:51

Figure 2.2.6-4: Carrier Frequency Separation Test Results – Antenna 2 – SF7



### 2.2.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument                                | Manufacturer    | Type No   | TE No     | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|-------------------------------------------|-----------------|-----------|-----------|------------------------------|-----------------------------|-----------------|
| Spectrum Analyzer                         | Rohde & Schwarz | FSP40     | BEMC00283 | 4.50 SP5                     | 24                          | 04-Oct-2021     |
| Attenuator 20dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet  | 40AH2W-20 | BEMC02111 | N/A                          | 12                          | 25-Jul-2021     |

TU - Traceability Unscheduled

O/P MON - Traceability Unscheduled

N/A - Not Applicable



## **2.3 Number of Hopping Channels**

### **2.3.1 Specification Reference**

FCC: Section 15.247(a)(1)(i)  
ISED Canada: RSS-247 5.1(c)

### **2.3.2 Equipment Under Test and Modification State**

S/N: N/A

### **2.3.3 Date of Test**

11/5/2020

### **2.3.4 Test Method**

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set wide enough to capture the number of hopping channels. The peak detector max hold function was enabled for the measurements.

### **2.3.5 Environmental Conditions**

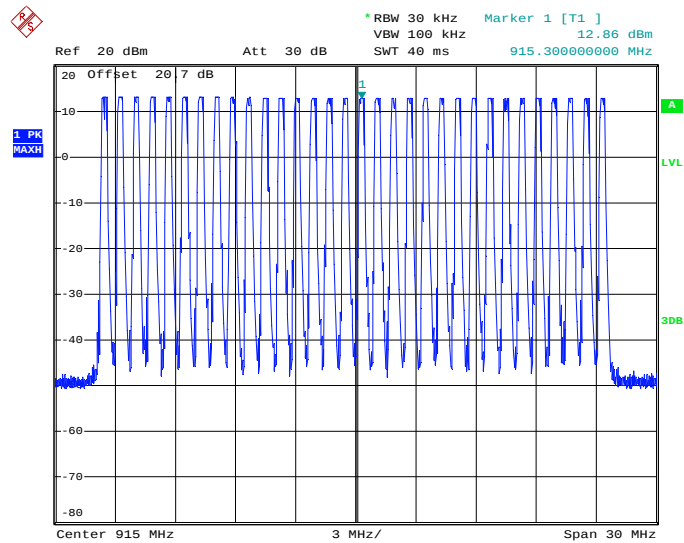
|                      |           |
|----------------------|-----------|
| Ambient Temperature  | 27°C      |
| Relative Humidity    | 40.5 %    |
| Atmospheric Pressure | 1019 mbar |

### **2.3.6 Test Results**

DC Powered Operating

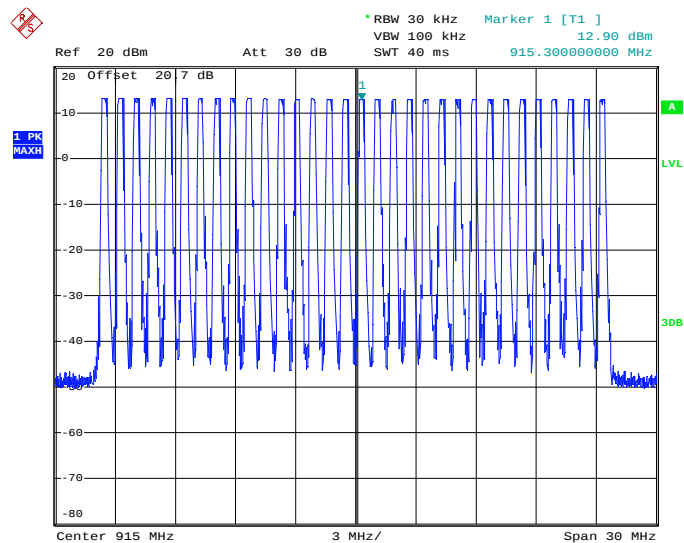
Limit Clause FCC Part 15.247(a)(1)(i); ISED RSS-247 5.1(c)

The number of hopping frequencies was measured to be 32.



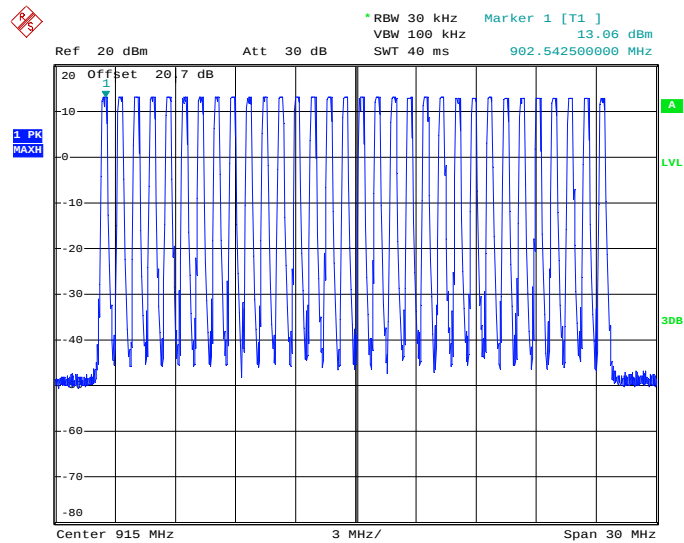
Date: 5.NOV.2020 23:39:03

Figure 2.3.6-1: Number of Hopping Channels test Results – Antenna 1 – SF6



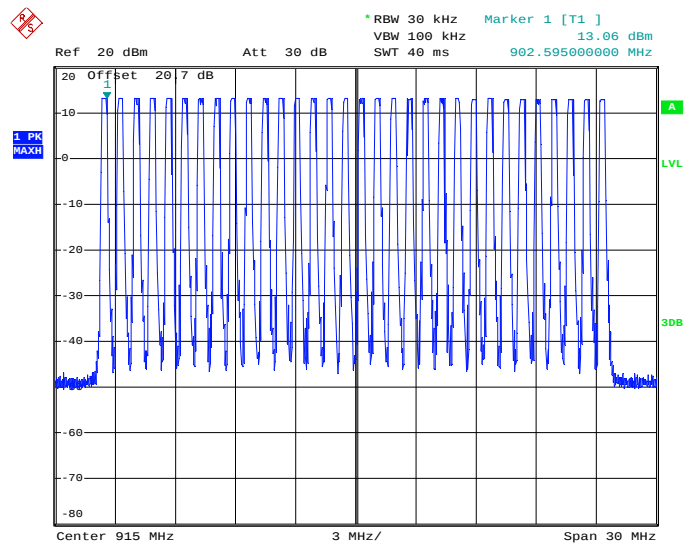
Date: 5.NOV.2020 23:34:02

Figure 2.3.6-2: Number of Hopping Channels test Results – Antenna 1 – SF7



Date: 5.NOV.2020 22:50:05

Figure 2.3.6-3: Number of Hopping Channels test Results – Antenna 2 – SF6



Date: 5.NOV.2020 22:43:14

Figure 2.3.6-4: Number of Hopping Channels test Results – Antenna 2 – SF7



### 2.3.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument                                | Manufacturer    | Type No   | TE No     | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|-------------------------------------------|-----------------|-----------|-----------|------------------------------|-----------------------------|-----------------|
| Spectrum Analyzer                         | Rohde & Schwarz | FSP40     | BEMC00283 | 4.50 SP5                     | 24                          | 04-Oct-2021     |
| Attenuator 20dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet  | 40AH2W-20 | BEMC02111 | N/A                          | 12                          | 25-Jul-2021     |

TU - Traceability Unscheduled

O/P MON - Traceability Unscheduled

N/A - Not Applicable



## 2.4 Channel Dwell Time

### 2.4.1 Specification Reference

FCC: Section 15.247(f)  
ISED Canada: RSS-247 5.3(a)

### 2.4.2 Equipment Under Test and Modification State

S/N: N/A

### 2.4.3 Date of Test

11/6/2020 to 11/14/2020

### 2.4.4 Test Method

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set 0 Hz centered on a hopping channel. The RBW was set to less than 30% of the channel spacing and the sweep time adjusted to capture the entire dwell time per channel with peak detector max hold function.

### 2.4.5 Environmental Conditions

Ambient Temperature 26.8°C  
Relative Humidity 42.5 %  
Atmospheric Pressure 1015.5 mbar

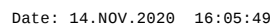
### 2.4.6 Test Results

DC Powered Operating

Limit Clause FCC Part 15.247(f); ISED RSS-247 5.3 (a)

**Table 2.4.6-1: Channel Dwell Time Test Results**

| Antenna | Spreading Factor | Number of hops on a 12.8 s Cycle (NHPC) | Measured Dwell Times (ms) | Dwell Times on a 12.8 s Cycle (ms) | Limit (ms) | Status |
|---------|------------------|-----------------------------------------|---------------------------|------------------------------------|------------|--------|
| 1       | SF = 6           | 9                                       | 17.880                    | 160.92                             | 400        | PASS   |
| 1       | SF = 7           | 9                                       | 17.115                    | 154.04                             | 400        | PASS   |
| 2       | SF = 6           | 9                                       | 17.835                    | 160.52                             | 400        | PASS   |
| 2       | SF = 7           | 9                                       | 17.131                    | 154.18                             | 400        | PASS   |



RBW 300 kHz Delta 1 [T1 ] 3.86 dB  
VBW 1 MHz 17.865000 ms  
SWT 2 s

Ref 20 dBm Att 30 dB

Offset 20 dBm

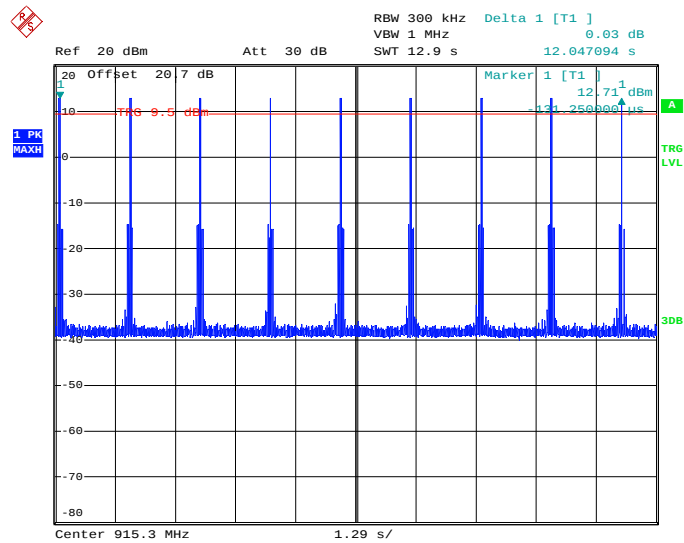
1 PK MAXH

TRG -9.5 dBm

Marker 1 [T1 ] 3.86 dB  
Delta 1 [T1 ] 3.04 dB  
Delta 2 [T1 ] 1.504131 s

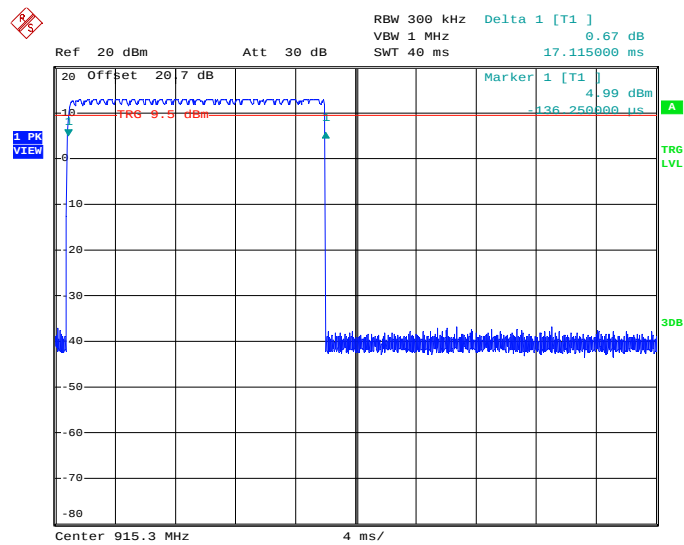
Center 915.3 MHz 200 ms/

Page 20 of 95



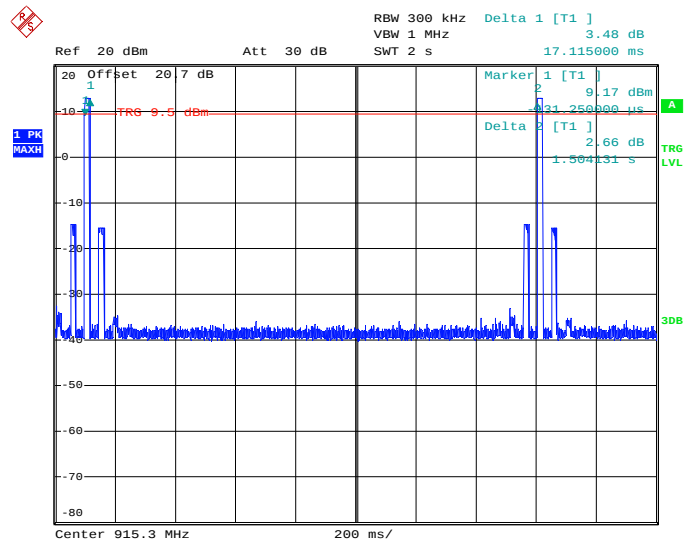
Date: 14.NOV.2020 16:23:26

Figure 2.4.6-3: Channel Dwell Time Test Results – Antenna 1 – SF6



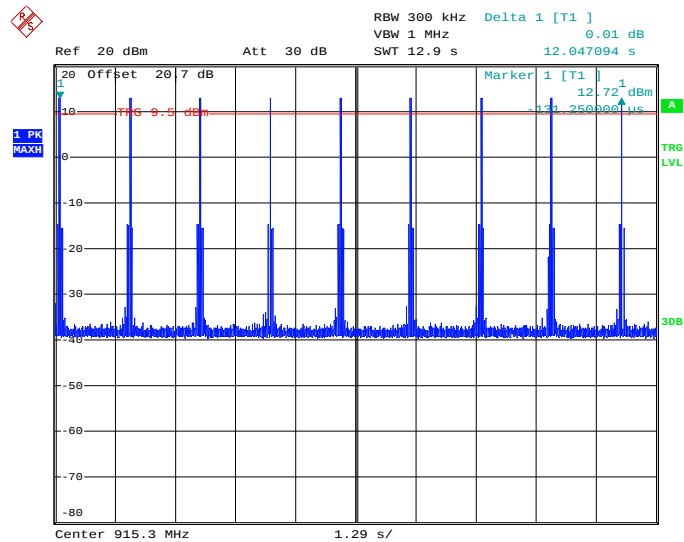
Date: 14.NOV.2020 16:04:37

Figure 2.4.6-4: Channel Dwell Time Test Results – Antenna 1 – SF7



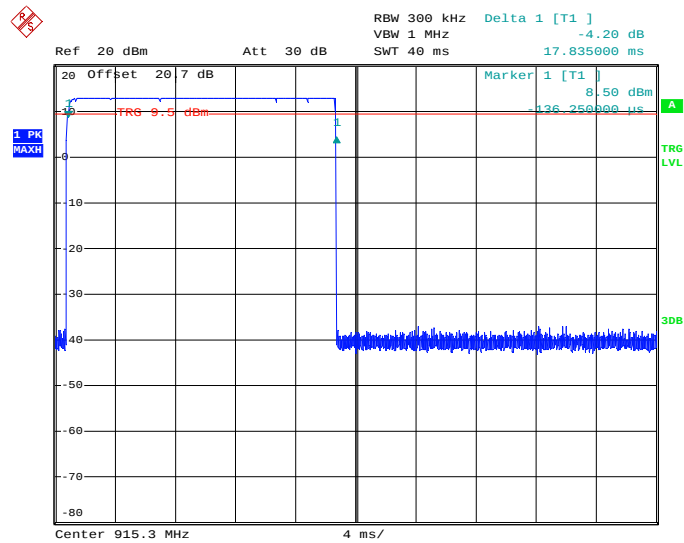
Date: 14.NOV.2020 16:19:02

Figure 2.4.6-5: Channel Dwell Time Test Results – Antenna 1 – SF7



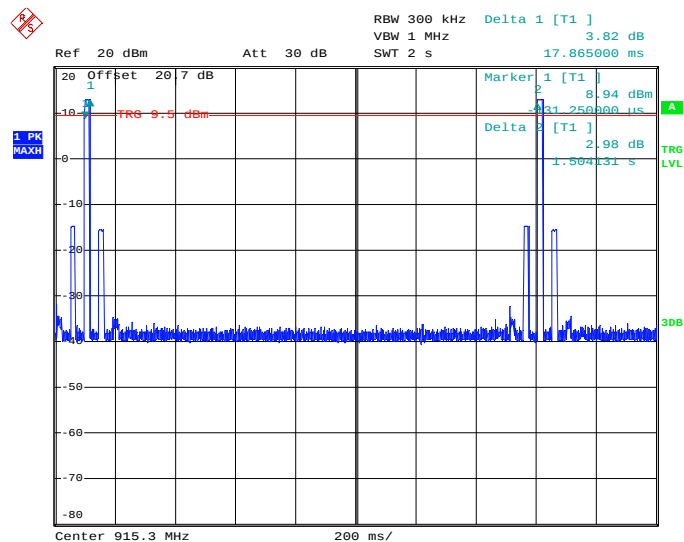
Date: 14.NOV.2020 16:21:17

Figure 2.4.6-6: Channel Dwell Time Test Results – Antenna 1 – SF7



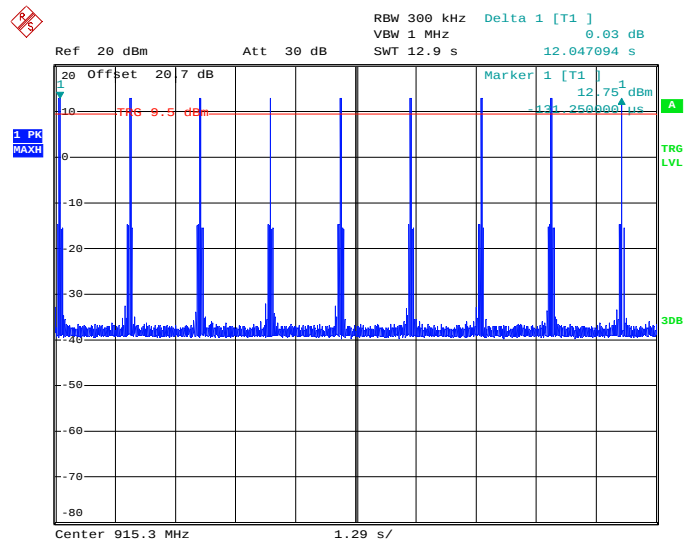
Date: 14.NOV.2020 16:08:05

Figure 2.4.6-7: Channel Dwell Time Test Results – Antenna 2 – SF6



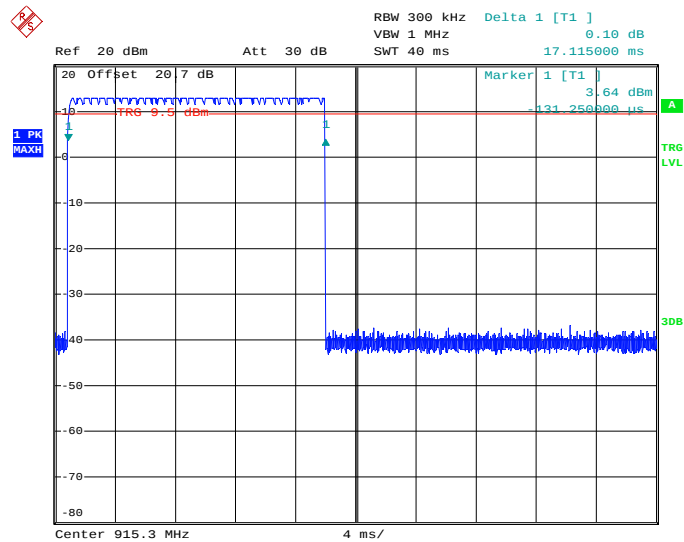
Date: 14.NOV.2020 16:13:53

Figure 2.4.6-8: Channel Dwell Time Test Results – Antenna 2 – SF6



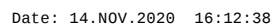
Date: 14.NOV.2020 16:26:40

Figure 2.4.6-9: Channel Dwell Time Test Results – Antenna 2 – SF6



Date: 14.NOV.2020 16:09:13

Figure 2.4.6-10: Channel Dwell Time Test Results – Antenna 2 – SF7



Date: 14.NOV.2020 16:28:55

Page 25 of 95



#### 2.4.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument                                | Manufacturer    | Type No   | TE No     | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|-------------------------------------------|-----------------|-----------|-----------|------------------------------|-----------------------------|-----------------|
| Spectrum Analyzer                         | Rohde & Schwarz | FSP40     | BEMC00283 | 4.50 SP5                     | 24                          | 04-Oct-2021     |
| Attenuator 20dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet  | 40AH2W-20 | BEMC02111 | N/A                          | 12                          | 25-Jul-2021     |

TU - Traceability Unscheduled

O/P MON - Traceability Unscheduled

N/A - Not Applicable



## 2.5 20 dB Bandwidth

### 2.5.1 Specification Reference

FCC: Section 15.247(a)(1)(i)  
ISED Canada: RSS-247 5.1(a)

### 2.5.2 Equipment Under Test and Modification State

S/N: N/A

### 2.5.3 Date of Test

11/16/2020

### 2.5.4 Test Method

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The spectrum analyzer span was set to 2 to 5 times the estimated bandwidth of the emission. The RBW was set to 1% to 5% of the estimated emission bandwidth. The trace was recorded using the max hold function with a peak detector.

### 2.5.5 Environmental Conditions

Ambient Temperature 26.9°C  
Relative Humidity 40.1 %  
Atmospheric Pressure 1020.8 mbar

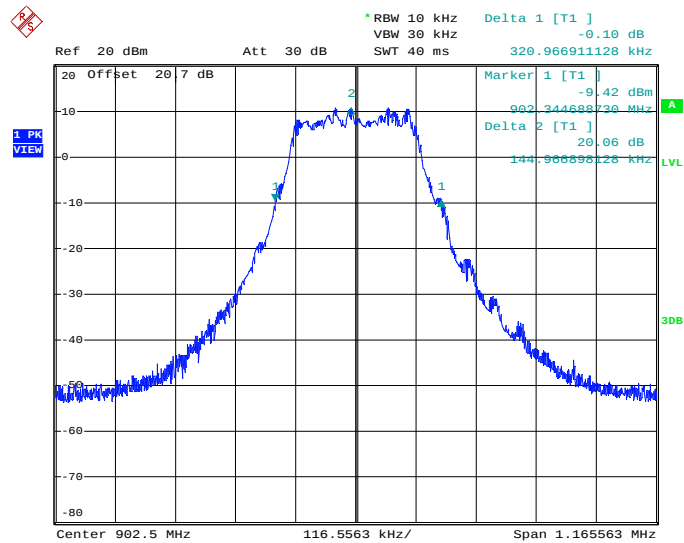
### 2.5.6 Test Results

DC Powered Operating

Limit Clause FCC Part 15.247(a)(1)(i), ISED RSS-247 5.1(a)

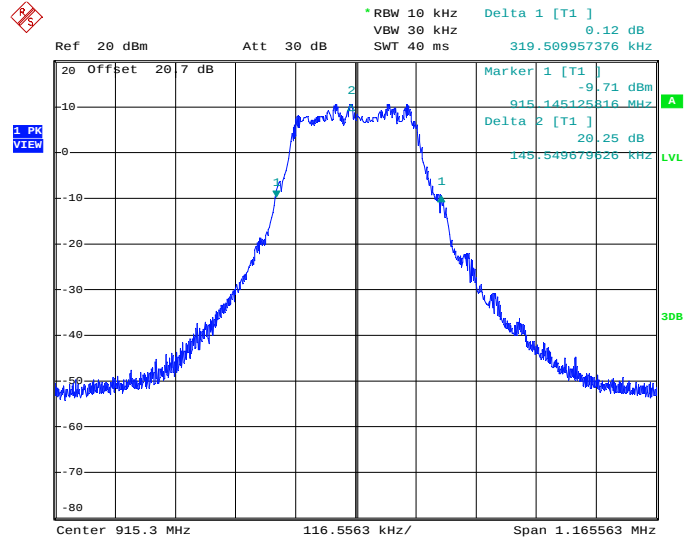
**Table 2.5.6-1: 20 dB Bandwidth Test Results – Antenna 1 – SF6**

| Frequency<br>(MHz) | 20 dB Bandwidth<br>(kHz) |
|--------------------|--------------------------|
| 902.5              | 320.9669                 |
| 915.3              | 319.5100                 |
| 927.3              | 317.6159                 |



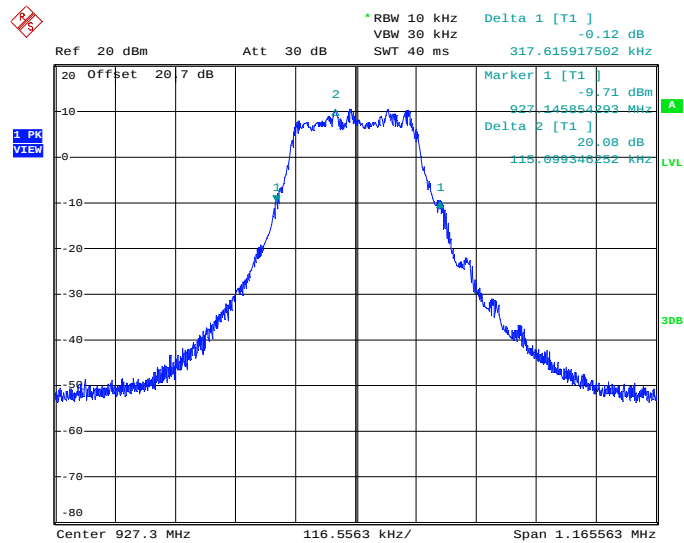
Date: 16.NOV.2020 22:50:17

Figure 2.5.6-1: 20 dB Bandwidth Test Results – Low Channel – Antenna 1 – SF6



Date: 16.NOV.2020 22:43:49

Figure 2.5.6-2: 20 dB Bandwidth Test Results – Middle Channel – Antenna 1 – SF6

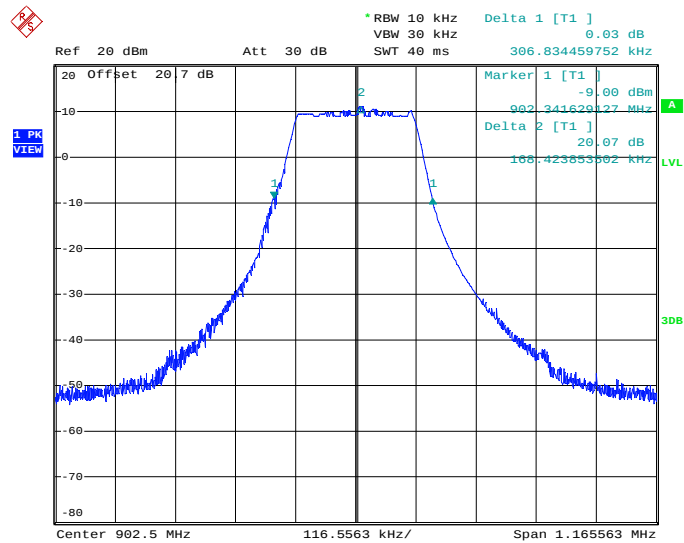


Date: 16.NOV.2020 22:26:39

Figure 2.5.6-3: 20 dB Bandwidth Test Results – High Channel – Antenna 1 – SF6

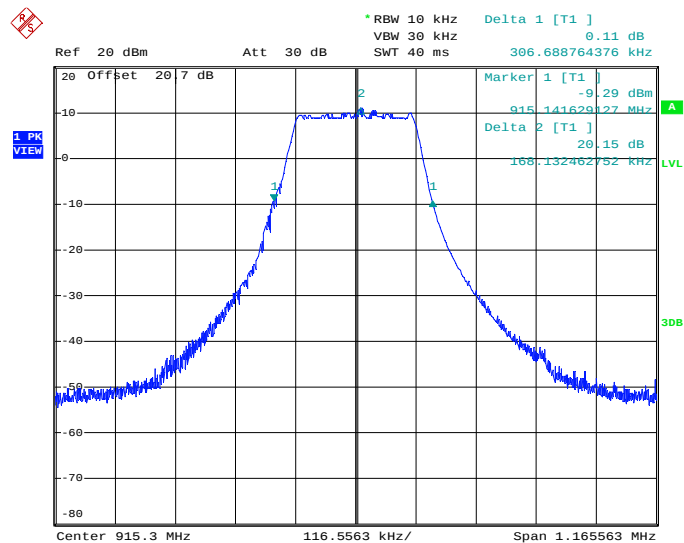
Table 2.5.6-2: 20 dB Bandwidth Test Results – Antenna 1 – SF7

| Frequency<br>(MHz) | 20 dB Bandwidth<br>(kHz) |
|--------------------|--------------------------|
| 902.5              | 306.8345                 |
| 915.3              | 306.6888                 |
| 927.3              | 305.5232                 |



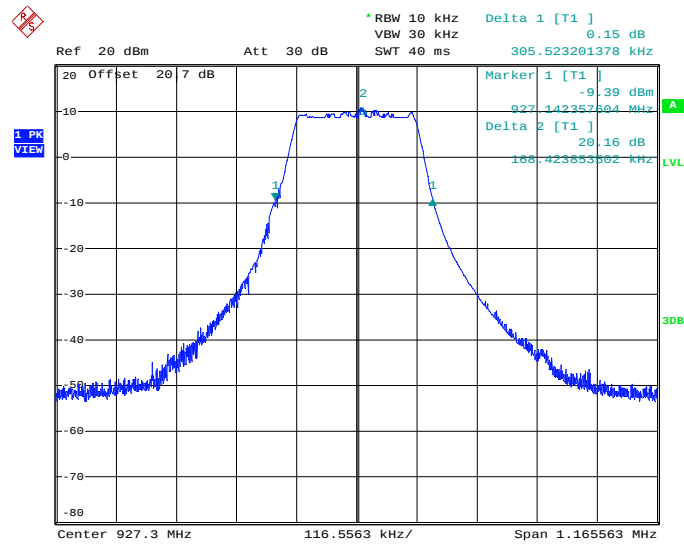
Date: 16.NOV.2020 22:54:46

Figure 2.5.6-4: 20 dB Bandwidth Test Results – Low Channel – Antenna 1 – SF7



Date: 16.NOV.2020 22:38:53

Figure 2.5.6-5: 20 dB Bandwidth Test Results – Middle Channel – Antenna 1 – SF7

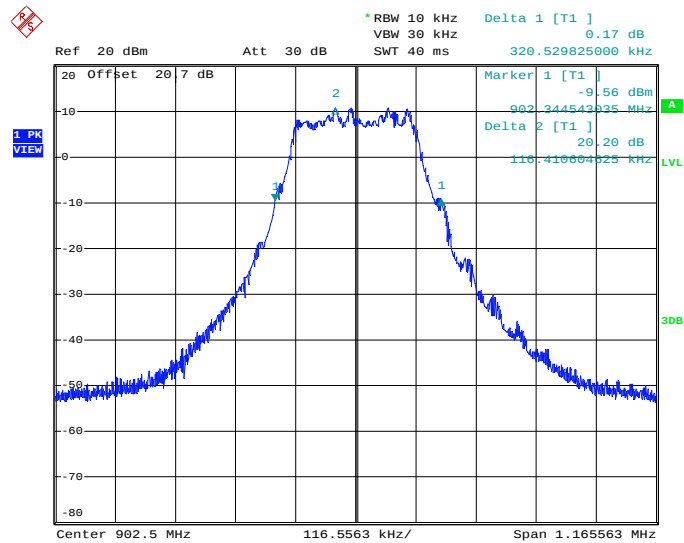


Date: 16.NOV.2020 22:31:28

**Figure 2.5.6-6: 20 dB Bandwidth Test Results – High Channel – Antenna 1 – SF7**

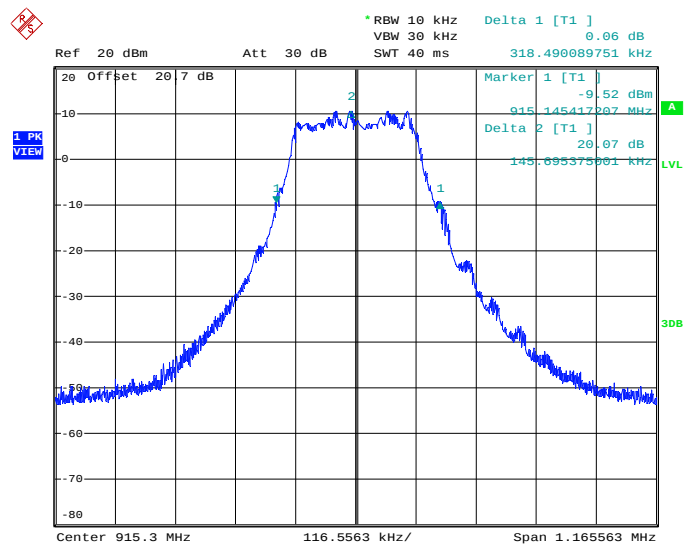
**Table 2.5.6-3: 20 dB Bandwidth Test Results – Antenna 2 – SF6**

| Frequency<br>(MHz) | 20 dB Bandwidth<br>(kHz) |
|--------------------|--------------------------|
| 902.5              | 320.5298                 |
| 915.3              | 318.4901                 |
| 927.3              | 317.6159                 |



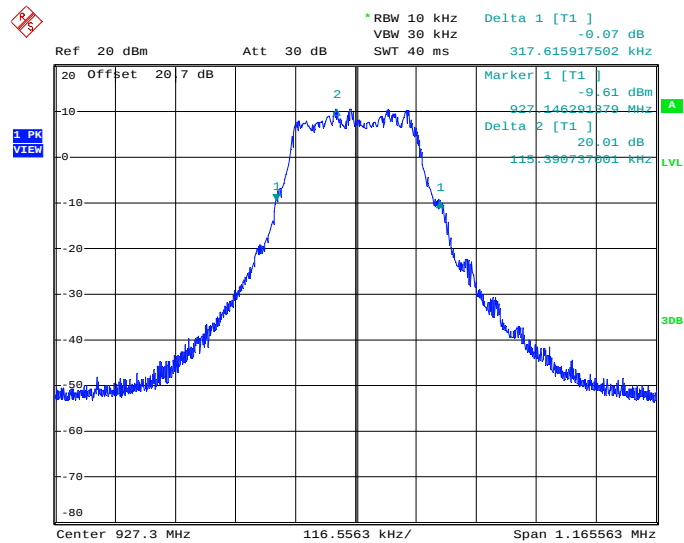
Date: 16.NOV.2020 21:59:18

Figure 2.5.6-7: 20 dB Bandwidth Test Results – Low Channel – Antenna 2 – SF6



Date: 16.NOV.2020 21:52:04

Figure 2.5.6-8: 20 dB Bandwidth Test Results – Middle Channel – Antenna 2 – SF6

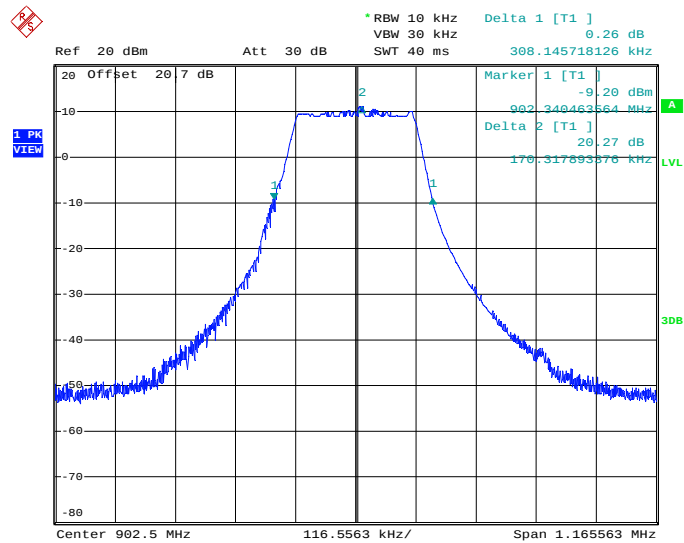


Date: 16.NOV.2020 22:19:12

Figure 2.5.6-9: 20 dB Bandwidth Test Results – High Channel – Antenna 2 – SF6

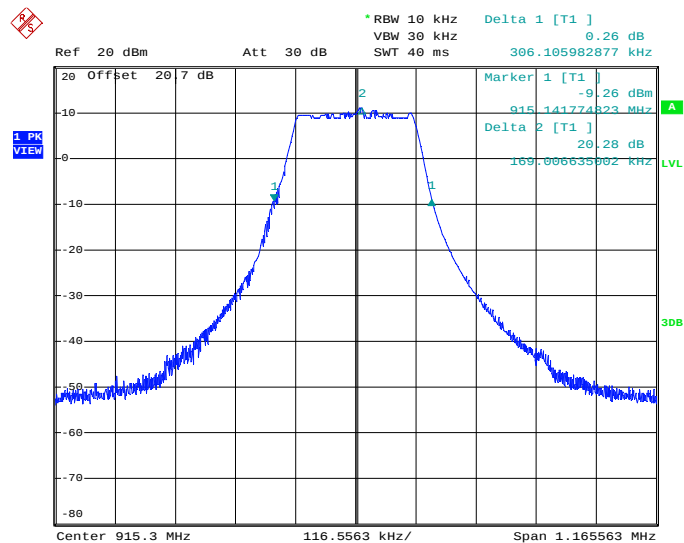
Table 2.5.6-4: 20 dB Bandwidth Test Results – Antenna 2 – SF7

| Frequency<br>(MHz) | 20 dB Bandwidth<br>(kHz) |
|--------------------|--------------------------|
| 902.5              | 308.1457                 |
| 915.3              | 306.1060                 |
| 927.3              | 306.3974                 |



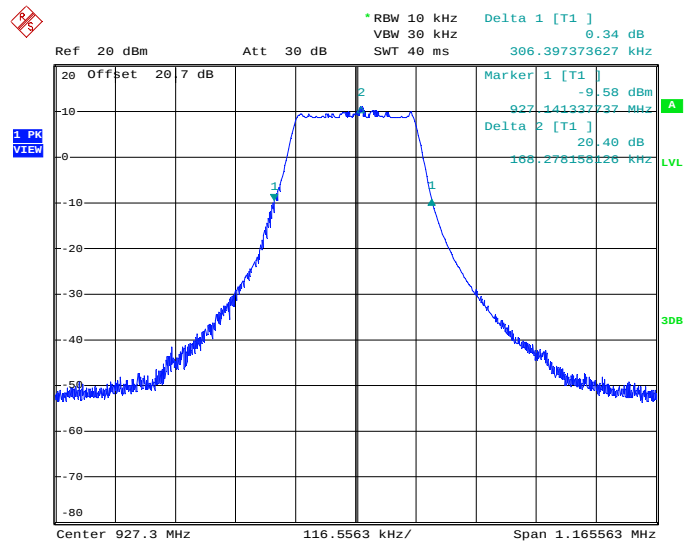
Date: 16.NOV.2020 22:04:02

Figure 2.5.6-10: 20 dB Bandwidth Test Results – Low Channel – Antenna 2 – SF7



Date: 16.NOV.2020 21:46:05

Figure 2.5.6-11: 20 dB Bandwidth Test Results – Middle Channel – Antenna 2 – SF7



Date: 16.NOV.2020 22:11:36

Figure 2.5.6-12: 20 dB Bandwidth Test Results – High Channel – Antenna 2 – SF7

2.5.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument                                | Manufacturer    | Type No   | TE No     | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|-------------------------------------------|-----------------|-----------|-----------|------------------------------|-----------------------------|-----------------|
| Spectrum Analyzer                         | Rohde & Schwarz | FSP40     | BEMC00283 | 4.50 SP5                     | 24                          | 04-Oct-2021     |
| Attenuator 20dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet  | 40AH2W-20 | BEMC02111 | N/A                          | 12                          | 25-Jul-2021     |

TU - Traceability Unscheduled  
O/P MON - Traceability Unscheduled  
N/A - Not Applicable



## 2.6 99% Bandwidth

### 2.6.1 Specification Reference

ISED Canada: RSS-GEN 6.7

### 2.6.2 Equipment Under Test and Modification State

S/N: N/A

### 2.6.3 Date of Test

11/4/2020

### 2.6.4 Test Method

The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission. The RBW was set to 1% to 5% of the approximated bandwidth. The occupied 99% bandwidth was measured by using the bandwidth measurement function of the spectrum analyzer with a peak detector.

### 2.6.5 Environmental Conditions

Ambient Temperature 26.9°C  
Relative Humidity 37.6 %  
Atmospheric Pressure 1023.5 mbar

### 2.6.6 Test Results

DC Powered Operating

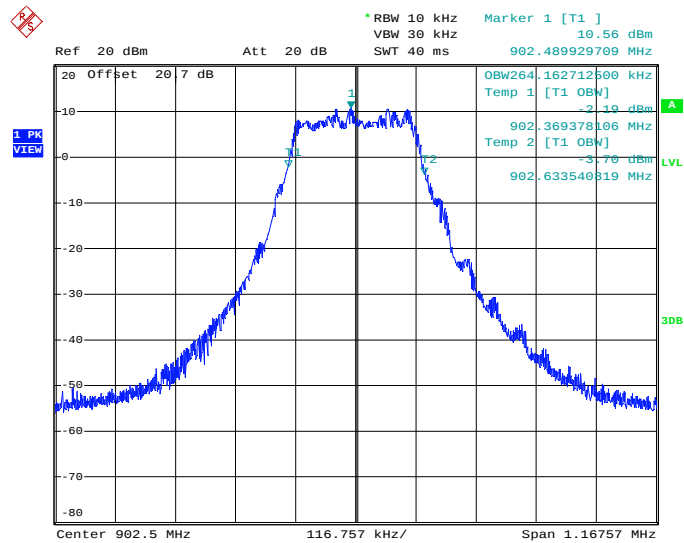
Rated Output Power: <info\_ropd> dBm

Limit Clause ISED RSS-GEN 6.7

SF6 – Antenna 1

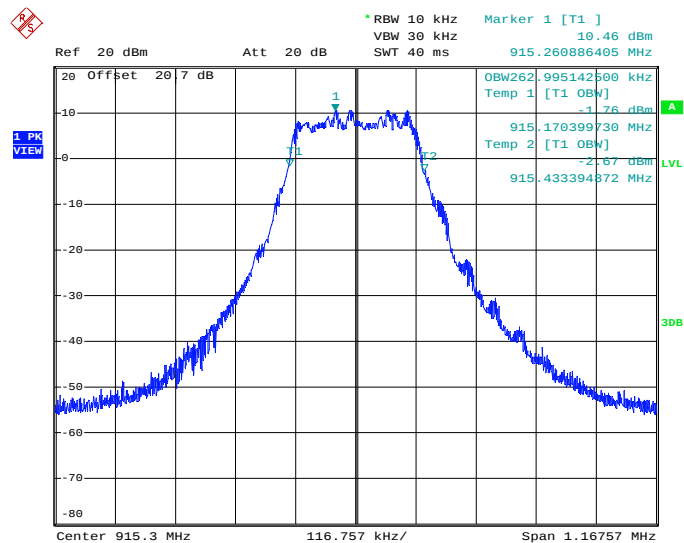
**Table 2.6.6-1: 99% Bandwidth Test Results – Antenna 1 – SF6**

| Frequency<br>(MHz) | 99% Bandwidth<br>(kHz) |
|--------------------|------------------------|
| 902.5              | 264.1627               |
| 915.3              | 262.9951               |
| 927.3              | 262.7033               |



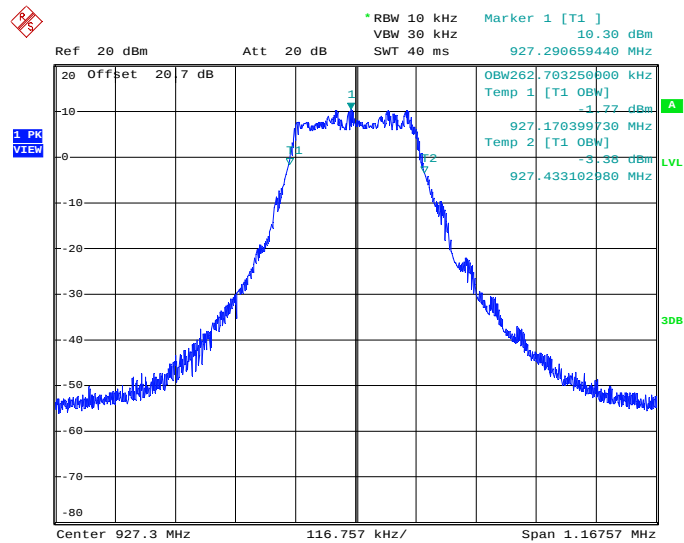
Date: 4.NOV.2020 21:40:54

Figure 2.6.6-1: 99% Bandwidth Test Results – Low Channel – Antenna 1 – SF6



Date: 4.NOV.2020 23:09:39

Figure 2.6.6-2: 99% Bandwidth Test Results – Middle Channel – Antenna 1 – SF6

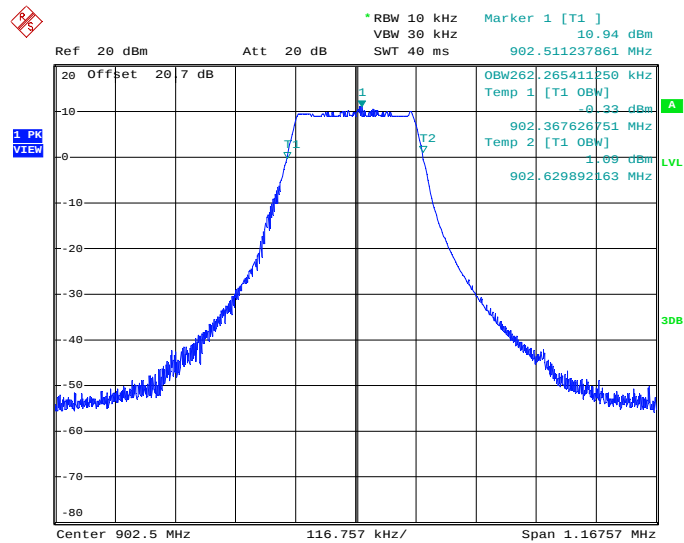


Date: 5.NOV.2020 18:44:18

Figure 2.6.6-3: 99% Bandwidth Test Results – High Channel – Antenna 1 – SF6

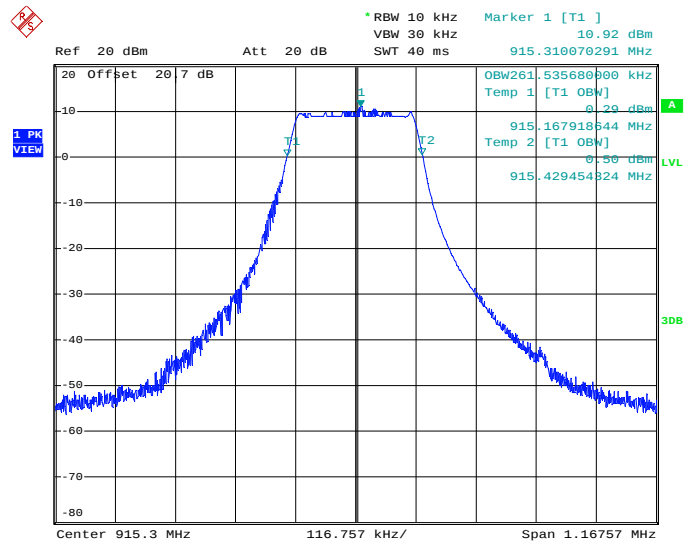
Table 2.6.6-2: 99% Bandwidth Test Results – Antenna 1 – SF7

| Frequency<br>(MHz) | 99% Bandwidth<br>(kHz) |
|--------------------|------------------------|
| 902.5              | 262.2654               |
| 915.3              | 261.5357               |
| 927.3              | 261.8276               |



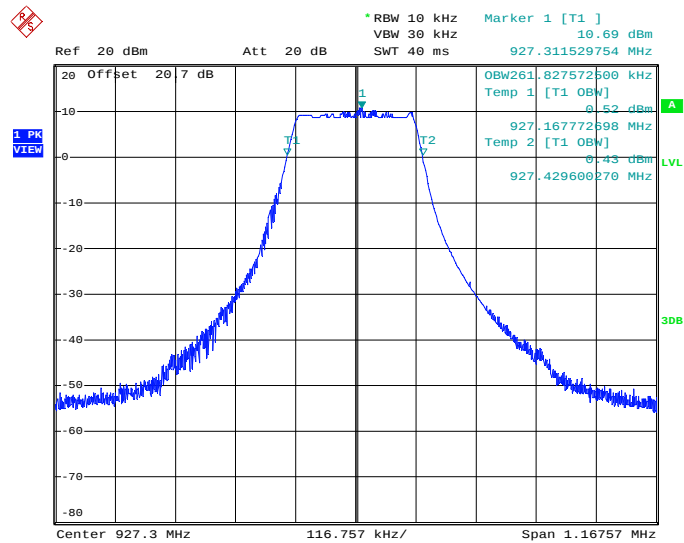
Date: 4.NOV.2020 22:20:04

Figure 2.6.6-4: 99% Bandwidth Test Results – Low Channel – Antenna 1 – SF7



Date: 4.NOV.2020 23:43:42

Figure 2.6.6-5: 99% Bandwidth Test Results – Middle Channel – Antenna 1 – SF7

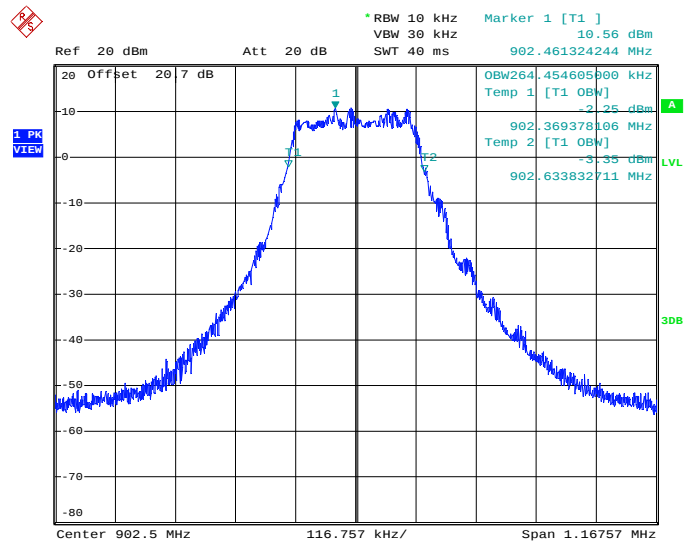


Date: 5.NOV.2020 00:04:59

Figure 2.6.6-6: 99% Bandwidth Test Results – High Channel – Antenna 1 – SF7

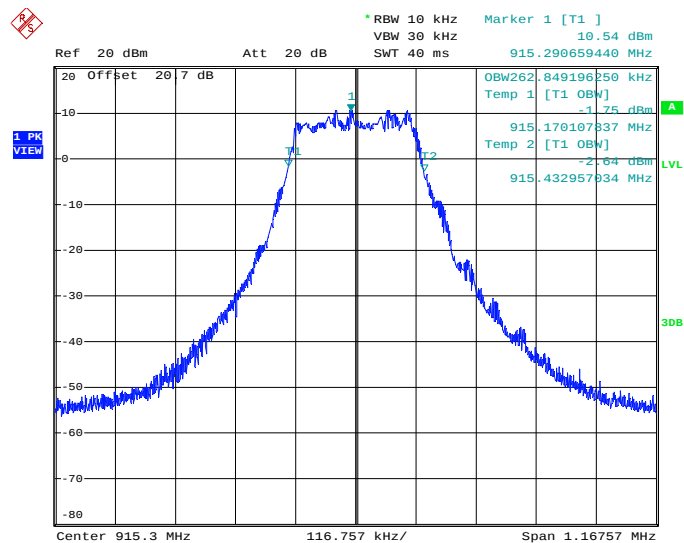
Table 2.6.6-3: 99% Bandwidth Test Results – Antenna 2 – SF6

| Frequency (MHz) | 99% Bandwidth (kHz) |
|-----------------|---------------------|
| 902.5           | 264.4546            |
| 915.3           | 262.8492            |
| 927.3           | 262.4113            |



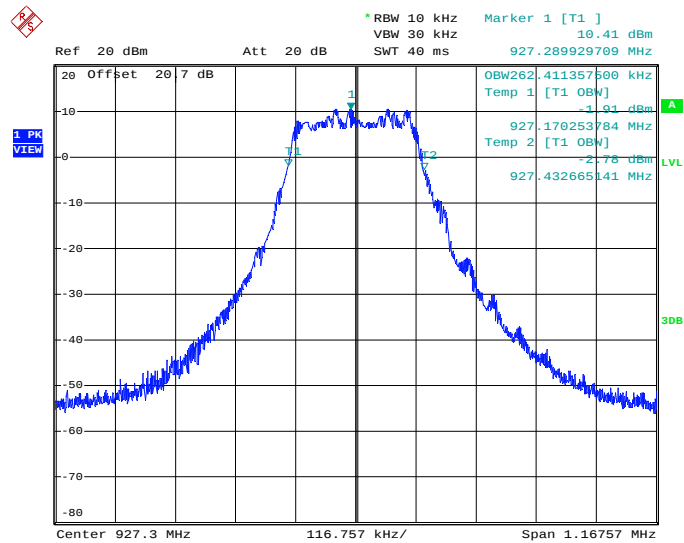
Date: 5.NOV.2020 19:18:05

Figure 2.6.6-7: 99% Bandwidth Test Results – Low Channel – Antenna 2 – SF6



Date: 5.NOV.2020 20:42:37

Figure 2.6.6-8: 99% Bandwidth Test Results – Middle Channel – Antenna 2 – SF6

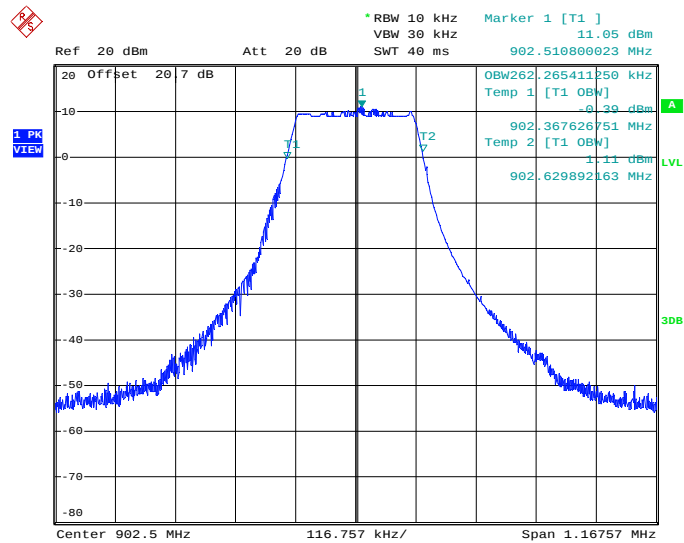


Date: 5.NOV.2020 21:09:39

Figure 2.6.6-9: 99% Bandwidth Test Results – High Channel – Antenna 2 – SF6

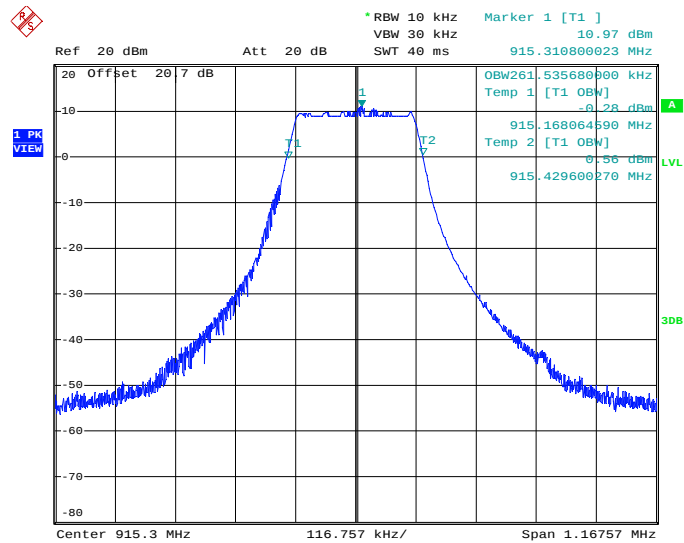
Table 2.6.6-4: 99% Bandwidth Test Results – Antenna 2 – SF7

| Frequency (MHz) | 99% Bandwidth (kHz) |
|-----------------|---------------------|
| 902.5           | 262.2654            |
| 915.3           | 261.5337            |
| 927.3           | 261.6816            |



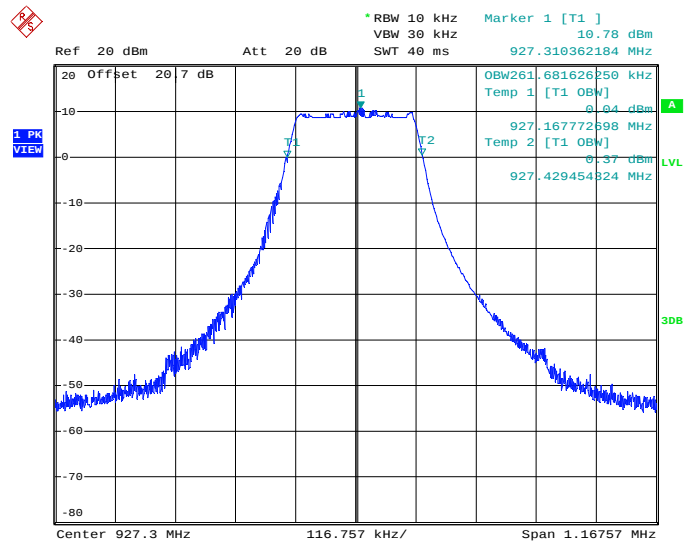
Date: 5.NOV.2020 19:52:31

Figure 2.6.6-10: 99% Bandwidth Test Results – Low Channel – Antenna 2 – SF7



Date: 5.NOV.2020 20:19:06

Figure 2.6.6-11: 99% Bandwidth Test Results – Middle Channel – Antenna 2 – SF7



Date: 5.NOV.2020 21:34:18

Figure 2.6.6-12: 99% Bandwidth Test Results – High Channel – Antenna 2 – SF7

2.6.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument                                | Manufacturer    | Type No   | TE No     | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|-------------------------------------------|-----------------|-----------|-----------|------------------------------|-----------------------------|-----------------|
| Spectrum Analyzer                         | Rohde & Schwarz | FSP40     | BEMC00283 | 4.50 SP5                     | 24                          | 04-Oct-2021     |
| Attenuator 20dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet  | 40AH2W-20 | BEMC02111 | N/A                          | 12                          | 25-Jul-2021     |

TU - Traceability Unscheduled  
O/P MON - Traceability Unscheduled  
N/A - Not Applicable



## 2.7 Peak Output Power

### 2.7.1 Specification Reference

FCC Section 15.247(b)(2)  
ISED Canada: RSS-247 5.4(a)

### 2.7.2 Equipment Under Test and Modification State

S/N: N/A

### 2.7.3 Date of Test

11/4/2020 to 11/5/2020

### 2.7.4 Test Method

The fundamental emission output power was measured in accordance with ANSI C63.10 Subclause 7.8.5. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer through suitable attenuation.

### 2.7.5 Environmental Conditions

|                      |             |
|----------------------|-------------|
| Ambient Temperature  | 26.8°C      |
| Relative Humidity    | 37.9 %      |
| Atmospheric Pressure | 1023.1 mbar |

### 2.7.6 Test Results

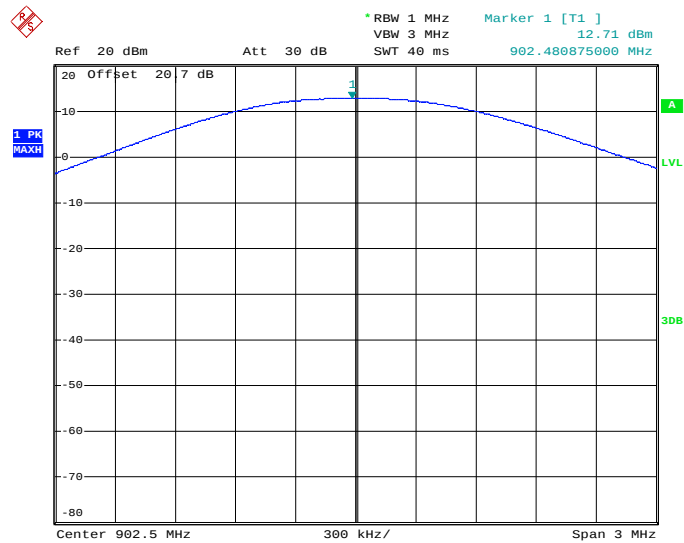
DC Powered Operating

Limit Clause FCC Part 15.247(b)(2), ISED RSS-247 5.4(a)

The Maximum Output Power allowed for frequency hopping systems employing at least 50 channels is 1 Watt (30 dBm). For frequency hopping systems employing less than 50 hopping channels but at least 25 hopping channels the power limit is 0.25 Watts (24 dBm).

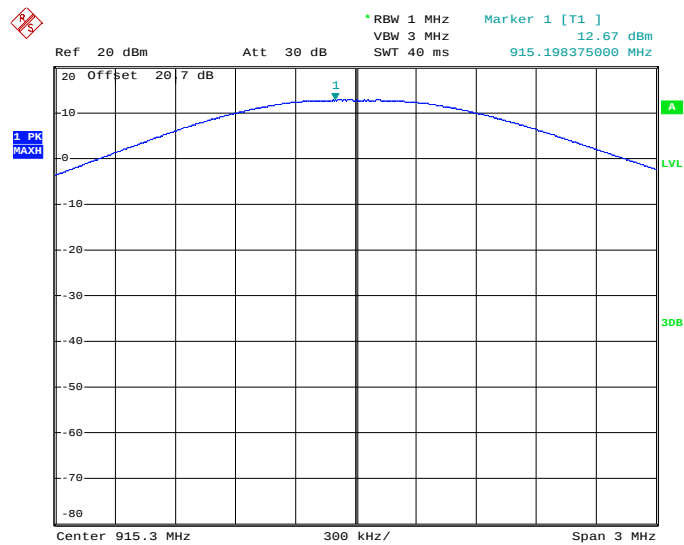
**Table 2.7.6-1: Maximum Output Power Test Results – Antenna 1 – SF6**

| Frequency<br>(MHz) | Measured Power<br>(dBm) |
|--------------------|-------------------------|
| 902.5              | 12.71                   |
| 915.3              | 12.67                   |
| 927.3              | 12.45                   |



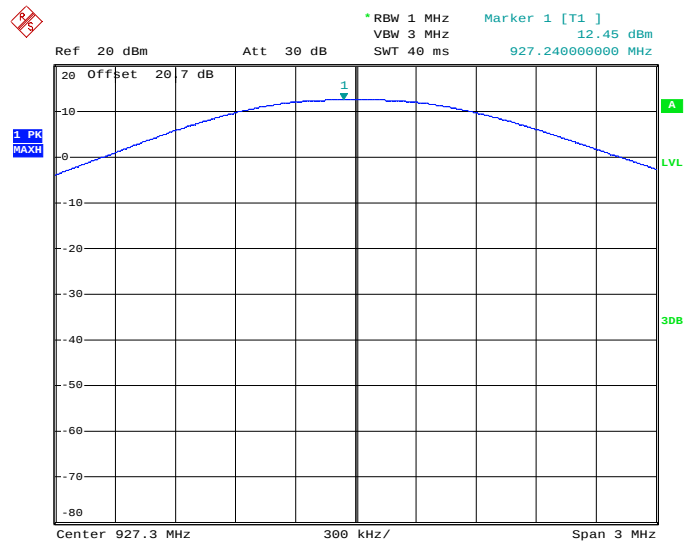
Date: 4.NOV.2020 21:59:15

Figure 2.7.6-1: Maximum Output Power Test Results – Low Channel – Antenna 1 – SF6



Date: 4.NOV.2020 23:21:42

Figure 2.7.6-2: Maximum Output Power Test Results – Middle Channel – Antenna 1 – SF6

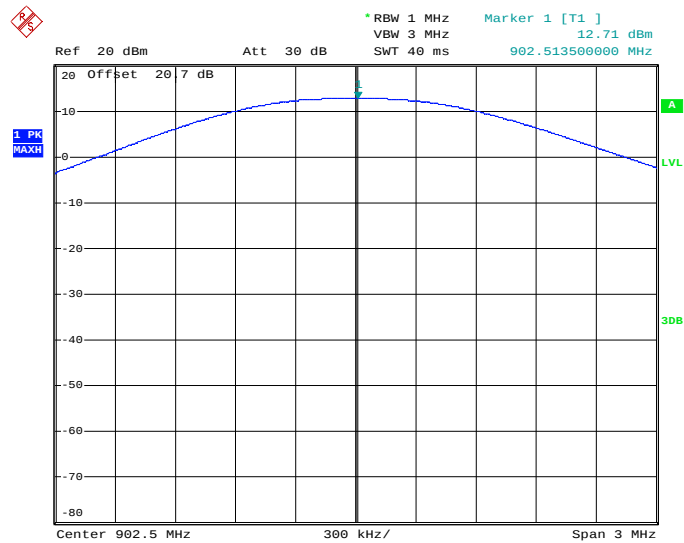


Date: 5.NOV.2020 18:46:01

Figure 2.7.6-3: Maximum Output Power Test Results – High Channel – Antenna 1 – SF6

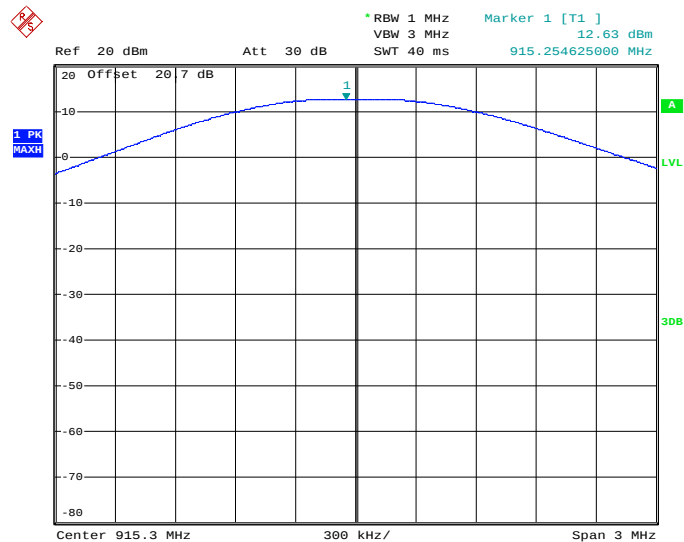
Table 2.7.6-2: Maximum Output Power Test Results – Antenna 1 – SF7

| Frequency (MHz) | Measured Power (dBm) |
|-----------------|----------------------|
| 902.5           | 12.71                |
| 915.3           | 12.63                |
| 927.3           | 12.51                |



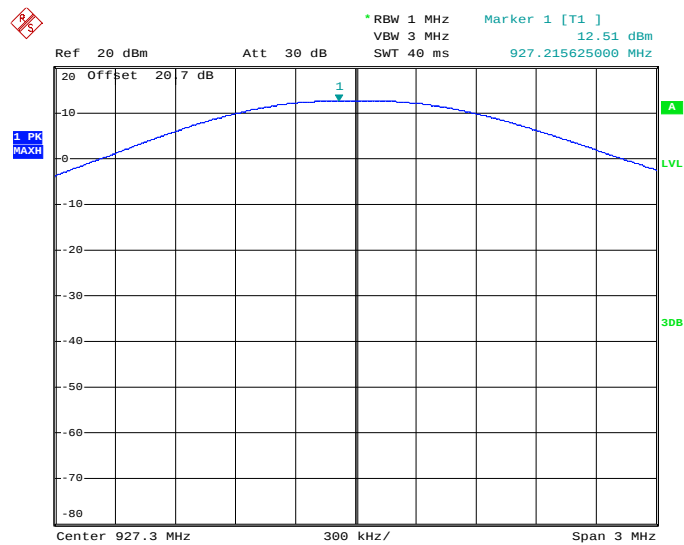
Date: 4.NOV.2020 22:23:14

Figure 2.7.6-4: Maximum Output Power Test Results – Low Channel – Antenna 1 – SF7



Date: 4.NOV.2020 23:45:22

Figure 2.7.6-5: Maximum Output Power Test Results – Middle Channel – Antenna 1 – SF7

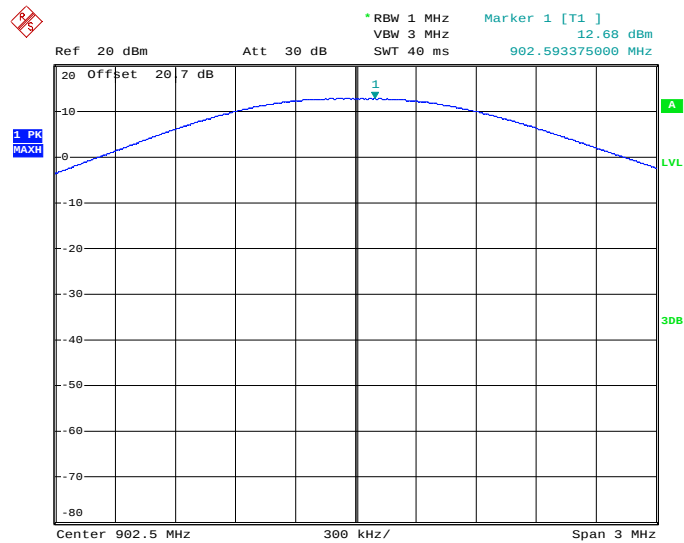


Date: 5.NOV.2020 00:06:39

Figure 2.7.6-6: Maximum Output Power Test Results – High Channel – Antenna 1 – SF7

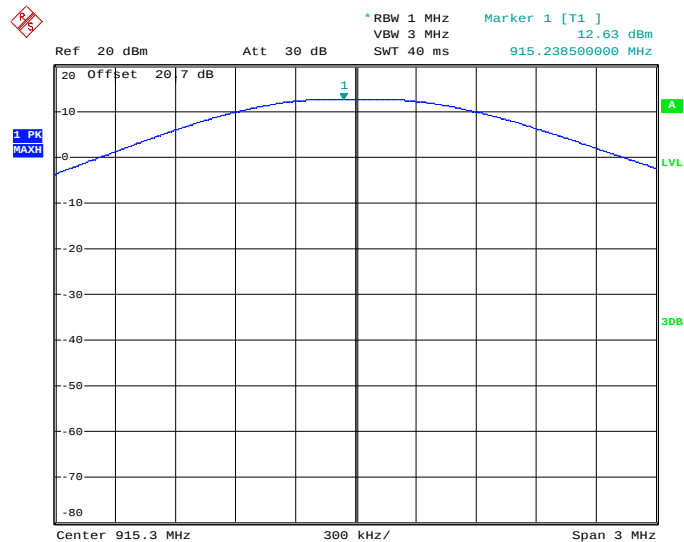
Table 2.7.6-3: Maximum Output Power Test Results – Antenna 2 – SF6

| Frequency (MHz) | Measured Power (dBm) |
|-----------------|----------------------|
| 902.5           | 12.68                |
| 915.3           | 12.63                |
| 927.3           | 12.48                |



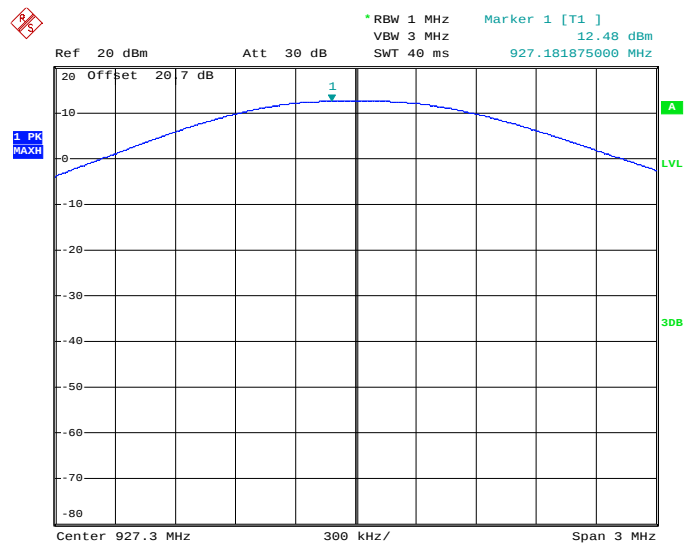
Date: 5.NOV.2020 19:19:42

Figure 2.7.6-7: Maximum Output Power Test Results – Low Channel – Antenna 2 – SF6



Date: 5.NOV.2020 20:44:14

Figure 2.7.6-8: Maximum Output Power Test Results – Middle Channel – Antenna 2 – SF6

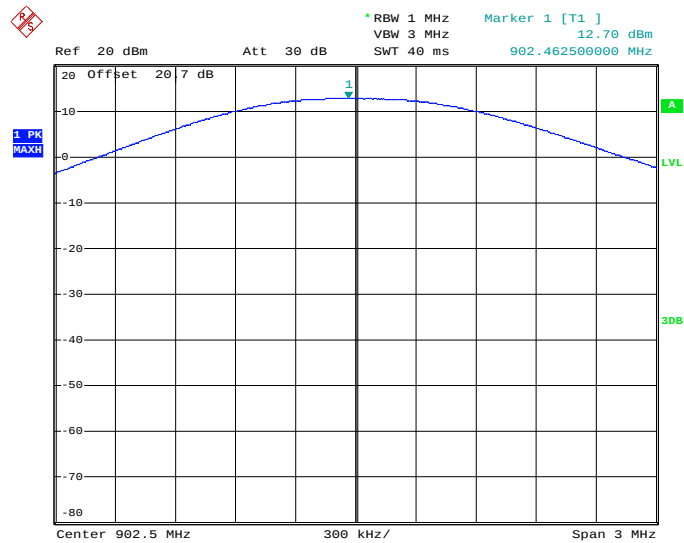


Date: 5.NOV.2020 21:11:16

Figure 2.7.6-9: Maximum Output Power Test Results – High Channel – Antenna 2 – SF6

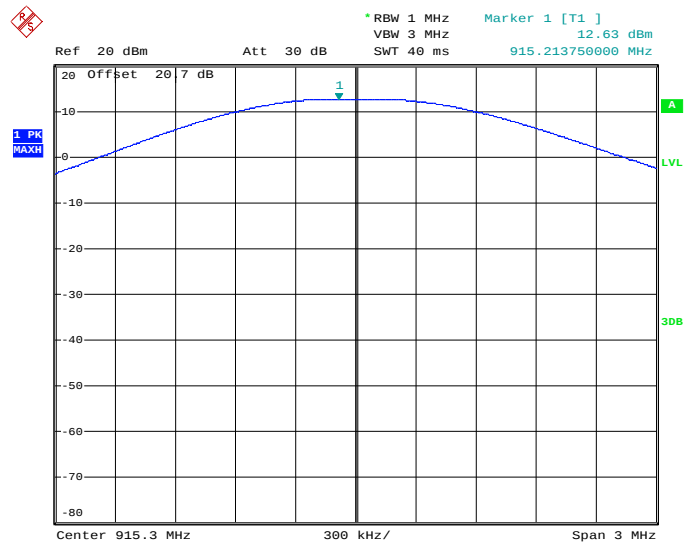
Table 2.7.6-4: Maximum Output Power Test Results – Antenna 2 – SF7

| Frequency (MHz) | Measured Power (dBm) |
|-----------------|----------------------|
| 902.5           | 12.70                |
| 915.3           | 12.63                |
| 927.3           | 12.49                |



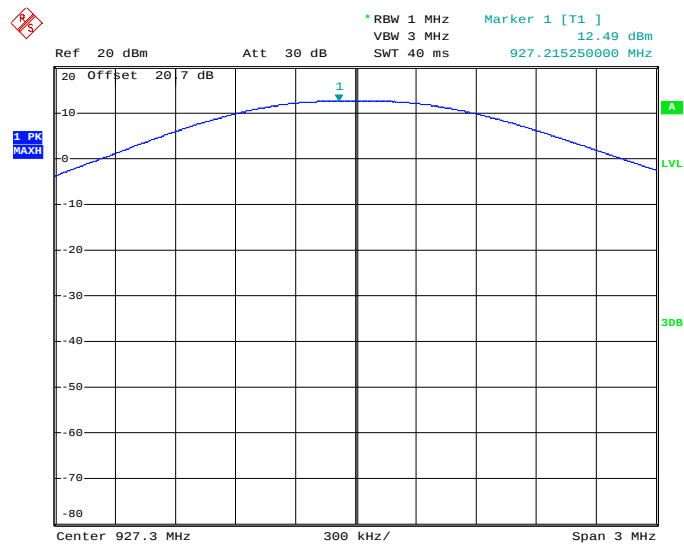
Date: 5.NOV.2020 19:54:08

Figure 2.7.6-10: Maximum Output Power Test Results – Low Channel – Antenna 2 – SF7



Date: 5.NOV.2020 20:20:43

Figure 2.7.6-11: Maximum Output Power Test Results – Middle Channel – Antenna 2 – SF7



Date: 5.NOV.2020 21:35:55

Figure 2.7.6-12: Maximum Output Power Test Results – High Channel – Antenna 2 – SF7

2.7.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument                                | Manufacturer    | Type No   | TE No     | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|-------------------------------------------|-----------------|-----------|-----------|------------------------------|-----------------------------|-----------------|
| Spectrum Analyzer                         | Rohde & Schwarz | FSP40     | BEMC00283 | 4.50 SP5                     | 24                          | 04-Oct-2021     |
| Attenuator 20dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet  | 40AH2W-20 | BEMC02111 | N/A                          | 12                          | 25-Jul-2021     |

TU - Traceability Unscheduled  
O/P MON - Traceability Unscheduled  
N/A - Not Applicable



## **2.8 Band-Edge Compliance of RF Conducted Emissions**

### **2.8.1 Specification Reference**

FCC: Section 15.247(d)  
ISED Canada: RSS-247 5.5

### **2.8.2 Equipment Under Test and Modification State**

S/N: N/A

### **2.8.3 Date of Test**

11/4/2020 to 11/6/2020

### **2.8.4 Test Method**

The RF Conducted Emissions at the Band-Edges were measured in accordance with Subclause 7.8.6 of ANSI C63.10. The RF output port of the EUT was connected to the input of the spectrum analyzer through suitable attenuation. The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement the spectrum analyzer's RBW was set to 100 kHz, and the VBW was set to  $\geq 300$  kHz.

### **2.8.5 Environmental Conditions**

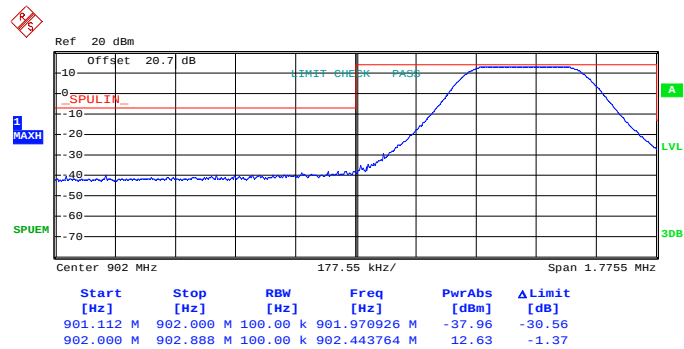
|                      |             |
|----------------------|-------------|
| Ambient Temperature  | 26.7 °C     |
| Relative Humidity    | 378 %       |
| Atmospheric Pressure | 1023.3 mbar |

### **2.8.6 Test Results**

DC Powered Operating

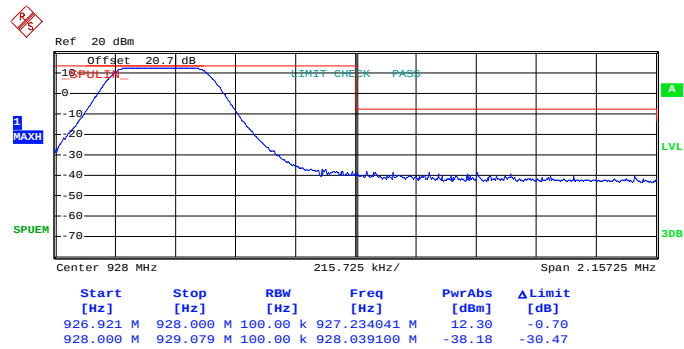
Limit Clause FCC Section 15.247(d), ISED Canada: RSS-247 5.5

In any 100 kHz bandwidth outside of the frequency band the radio frequency power shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB.



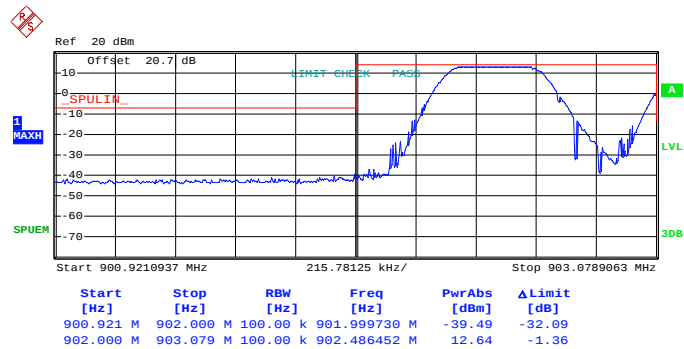
Date: 4.NOV.2020 22:52:48

Figure 2.8.6-1: RF Conducted Band-Edge – Low Channel – Hopping Off – Antenna 1 – SF6



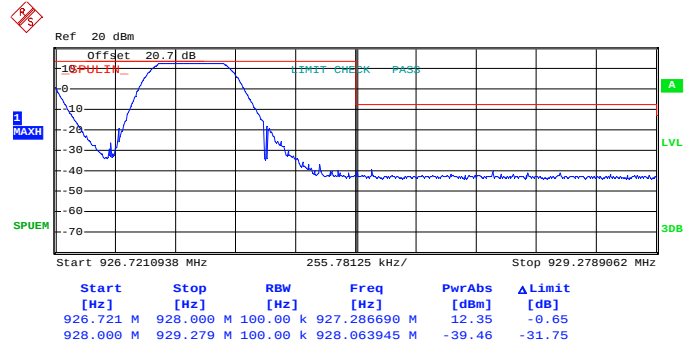
Date: 5.NOV.2020 18:51:44

Figure 2.8.6-2: RF Conducted Band-Edge – High Channel – Hopping Off – Antenna 1 – SF6



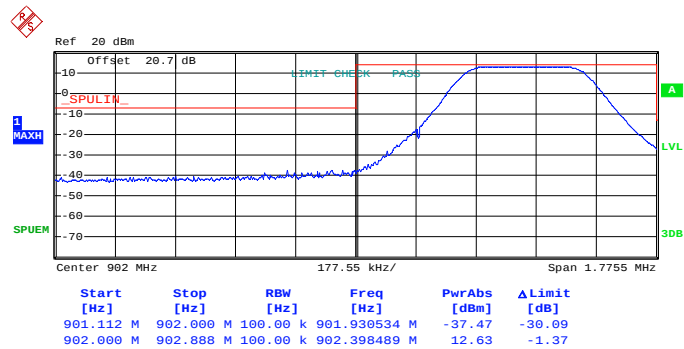
Date: 6.NOV.2020 18:18:16

Figure 2.8.6-3: RF Conducted Band-Edge – Hopping – Antenna 1 – SF6



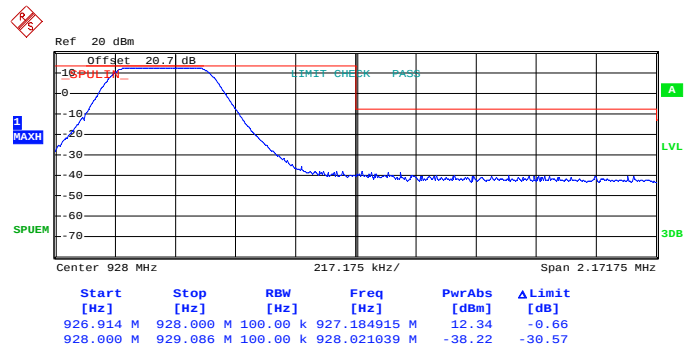
Date: 6.NOV.2020 18:23:02

Figure 2.8.6-4: RF Conducted Band-Edge – Hopping – Antenna 1 – SF6



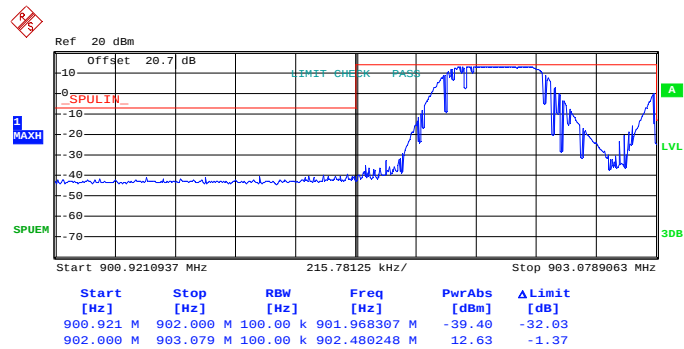
Date: 4.NOV.2020 22:40:57

Figure 2.8.6-5: RF Conducted Band-Edge – Low Channel – Hopping Off – Antenna 1 – SF7



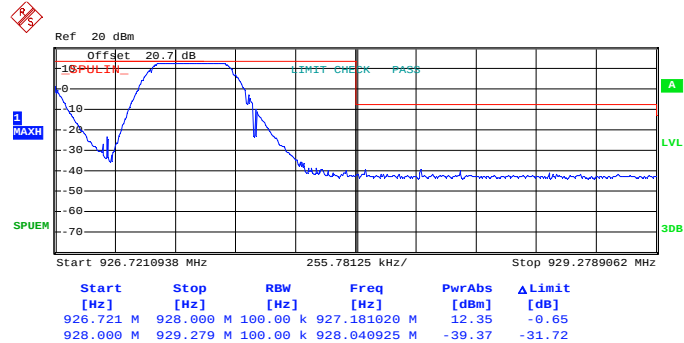
Date: 5.NOV.2020 00:11:39

Figure 2.8.6-6: RF Conducted Band-Edge – High Channel – Hopping Off – Antenna 1 – SF7



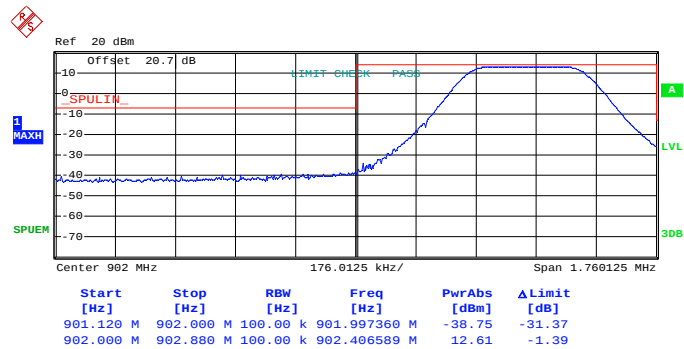
Date: 6.NOV.2020 18:32:30

Figure 2.8.6-7: RF Conducted Band-Edge – Hopping – Antenna 1 – SF7



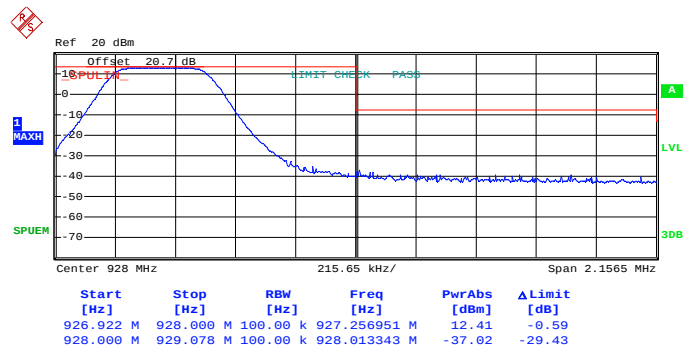
Date: 6.NOV.2020 18:42:24

Figure 2.8.6-8: RF Conducted Band-Edge – Hopping – Antenna 1 – SF7



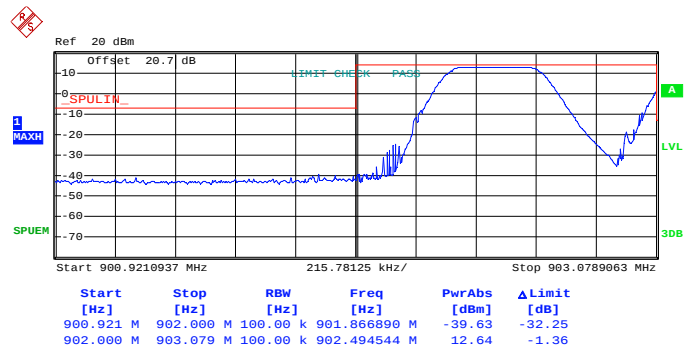
Date: 5.NOV.2020 19:24:34

Figure 2.8.6-9: RF Conducted Band-Edge – Low Channel – Hopping Off – Antenna 2 – SF6



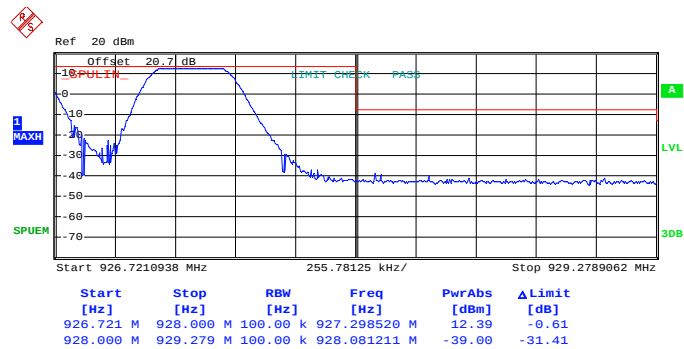
Date: 5.NOV.2020 21:16:08

Figure 2.8.6-10: RF Conducted Band-Edge – High Channel – Hopping Off – Antenna 2 – SF6



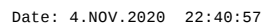
Date: 6.NOV.2020 18:58:05

Figure 2.8.6-11: RF Conducted Band-Edge – Hopping – Antenna 2 – SF6



Date: 6.NOV.2020 19:03:28

Figure 2.8.6-12: RF Conducted Band-Edge – Hopping – Antenna 2 – SF6



Ref 20 dBm

Offset 20.7 dB

10 PUL

LIMIT CHECK PASS

P

MAX

SPUR

Center 928 MHz

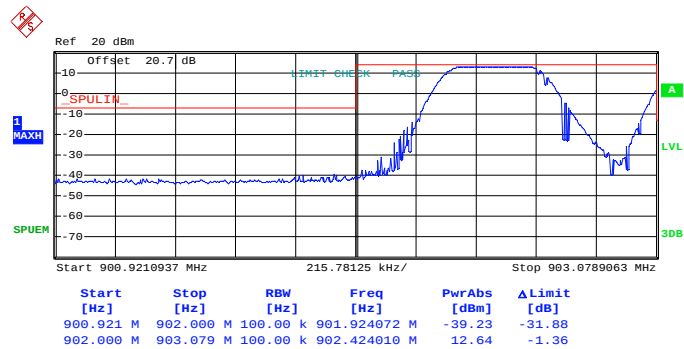
217.175 kHz/

Span 2.17175 MHz

| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz]    | PwrAbs [dBm] | ΔLimit [dB] |
|------------|-----------|----------|--------------|--------------|-------------|
| 926.914 M  | 928.000 M | 100.00 k | 927.184915 M | 12.34        | -0.66       |
| 928.000 M  | 929.086 M | 100.00 k | 928.021039 M | -38.22       | -30.57      |

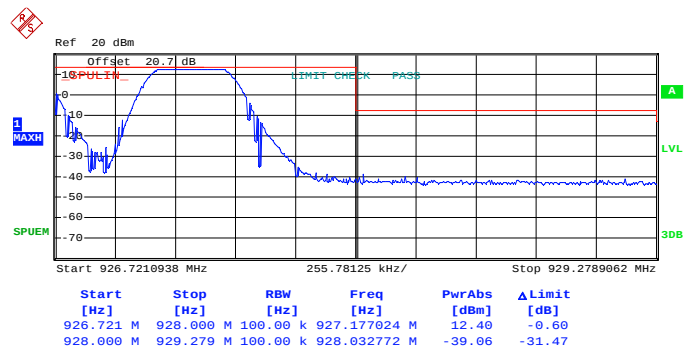
Date: 5.NOV.2020 00:11:39

**Figure 2.8.6-14: RF Conducted Band-Edge – High Channel – Hopping Off – Antenna 2 – SF7**



Date: 6.NOV.2020 19:19:34

Figure 2.8.6-15: RF Conducted Band-Edge – Hopping – Antenna 2 – SF7



Date: 6.NOV.2020 19:27:23

Figure 2.8.6-16: RF Conducted Band-Edge – Hopping – Antenna 2 – SF7



### 2.8.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument                                | Manufacturer    | Type No   | TE No     | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|-------------------------------------------|-----------------|-----------|-----------|------------------------------|-----------------------------|-----------------|
| Spectrum Analyzer                         | Rohde & Schwarz | FSP40     | BEMC00283 | 4.50 SP5                     | 24                          | 04-Oct-2021     |
| Attenuator 20dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet  | 40AH2W-20 | BEMC02111 | N/A                          | 12                          | 25-Jul-2021     |

TU - Traceability Unscheduled

O/P MON - Traceability Unscheduled

N/A - Not Applicable



## **2.9 RF Conducted Spurious Emissions**

### **2.9.1 Specification Reference**

FCC: Section 15.247(d)  
ISED Canada: RSS-247 5.5

### **2.9.2 Equipment Under Test and Modification State**

S/N: N/A

### **2.9.3 Date of Test**

11/4/2020 to 11/5/2020

### **2.9.4 Test Method**

The RF Conducted Spurious Emissions were measured in accordance with Subclause 7.8.8 of ANSI C63.10. The RF output port of the equipment under test was directly connected to the input of the spectrum analyzer. The EUT was investigated for conducted spurious emissions from 30 MHz to 10 GHz, 10 times the highest fundamental frequency. Measurements were made at the low, center and high channels of the EUT. For each measurement, the spectrum analyzer's RBW was set to 100 kHz and the VBW was set to 300 kHz. The peak Max Hold function of the analyzer was utilized.

### **2.9.5 Environmental Conditions**

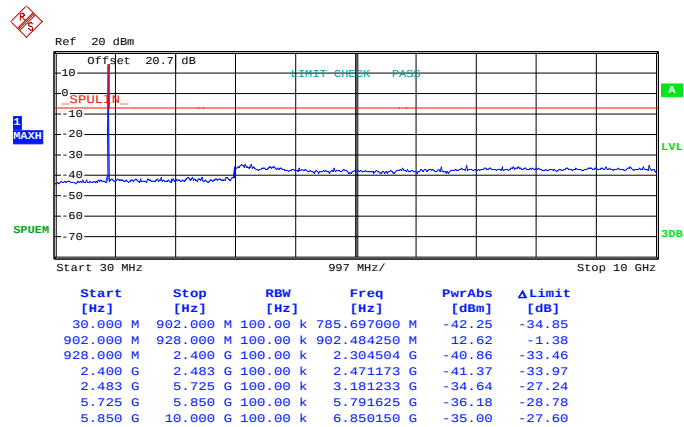
|                      |             |
|----------------------|-------------|
| Ambient Temperature  | 26.6 °C     |
| Relative Humidity    | 37.9 %      |
| Atmospheric Pressure | 1023.6 mbar |

### **2.9.6 Test Results**

DC Powered Operating

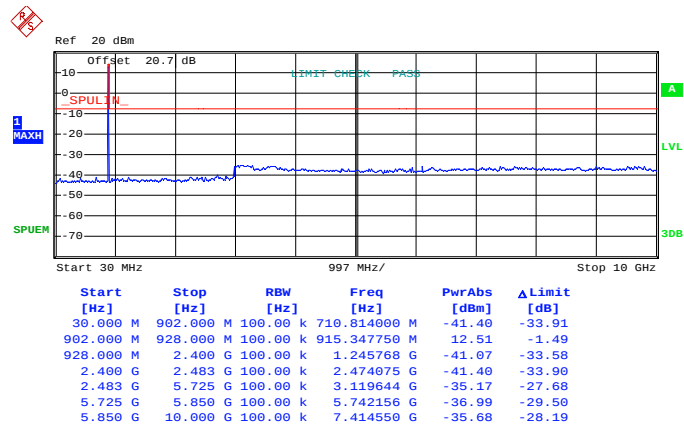
Limit Clause FCC Section 15.247(d), ISED Canada: RSS-247 5.5

In any 100 kHz bandwidth outside of the frequency band the radio frequency power shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB.



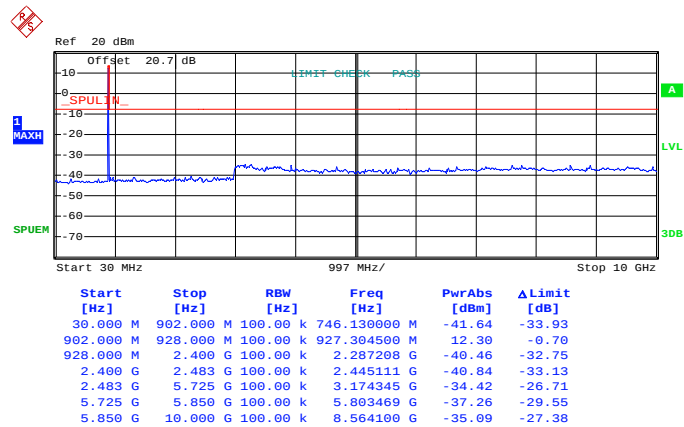
Date: 4.NOV.2020 22:55:14

Figure 2.9.6-1: Conducted Spurious Emissions Results – Low Channel – Antenna 1 – SF6



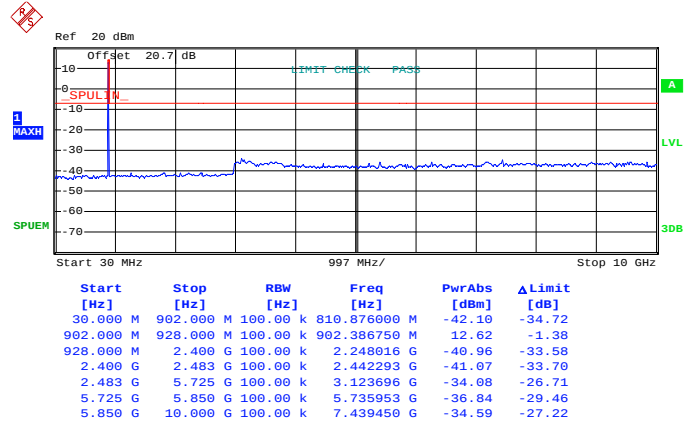
Date: 4.NOV.2020 23:29:05

Figure 2.9.6-2: Conducted Spurious Emissions Results – Middle Channel – Antenna 1 – SF6



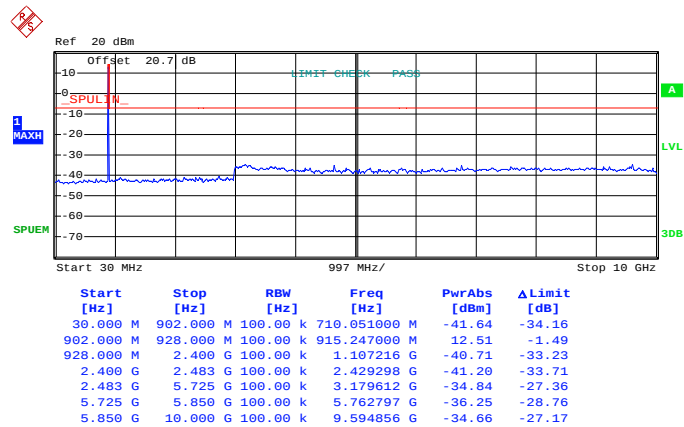
Date: 5.NOV.2020 18:54:06

Figure 2.9.6-3: Conducted Spurious Emissions Results – High Channel – Antenna 1 – SF6



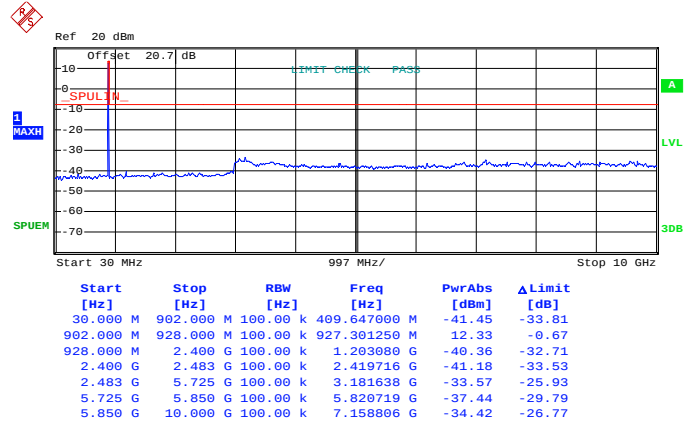
Date: 4.NOV.2020 22:43:21

Figure 2.9.6-4: Conducted Spurious Emissions Results – Low Channel – Antenna 1 – SF7



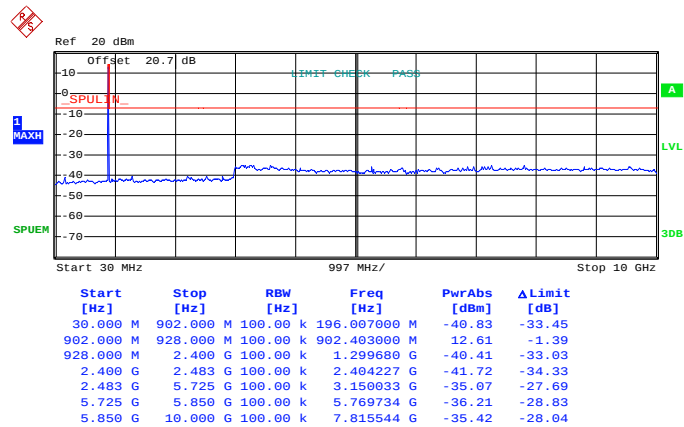
Date: 4.NOV.2020 23:57:31

Figure 2.9.6-5: Conducted Spurious Emissions Results – Middle Channel – Antenna 1 – SF7



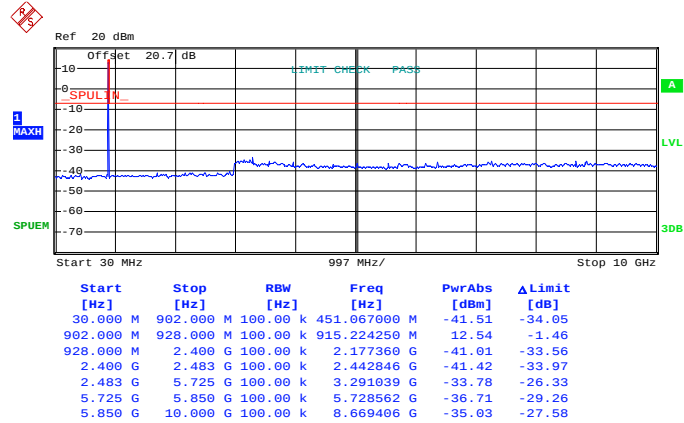
Date: 5.NOV.2020 00:13:57

Figure 2.9.6-6: Conducted Spurious Emissions Results – High Channel – Antenna 1 – SF7



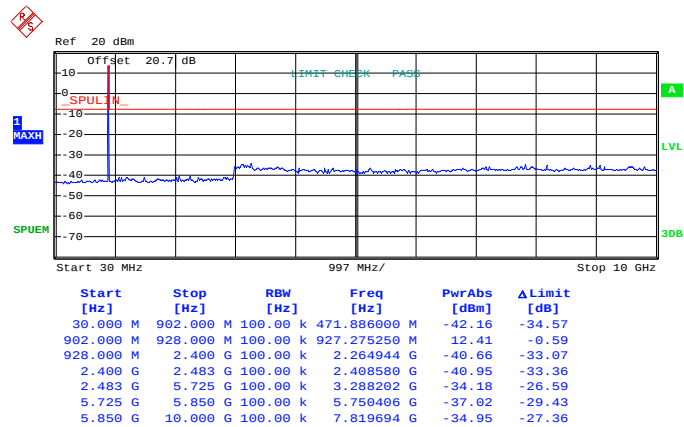
Date: 5.NOV.2020 19:26:48

Figure 2.9.6-7: Conducted Spurious Emissions Results – Low Channel – Antenna 2 – SF6



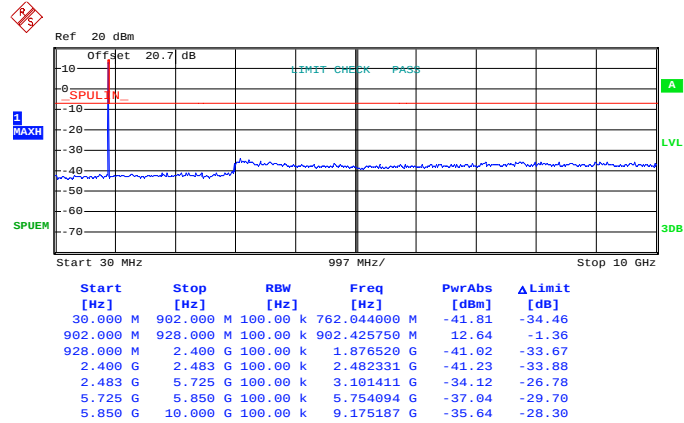
Date: 5.NOV.2020 20:51:22

Figure 2.9.6-8: Conducted Spurious Emissions Results – MiddleChannel – Antenna 2 – SF6



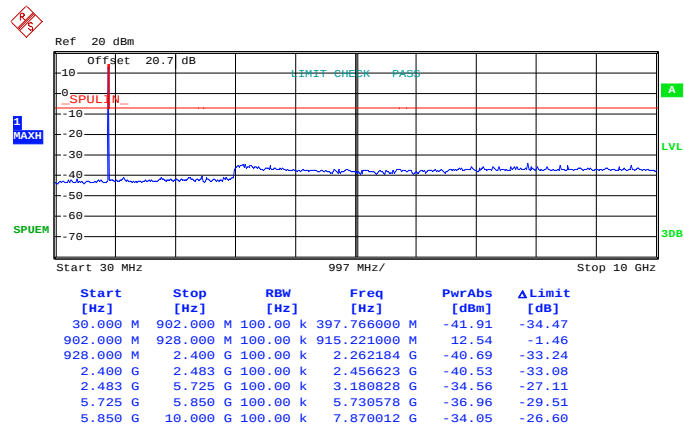
Date: 5.NOV.2020 21:18:23

Figure 2.9.6-9: Conducted Spurious Emissions Results – High Channel – Antenna 2 – SF6



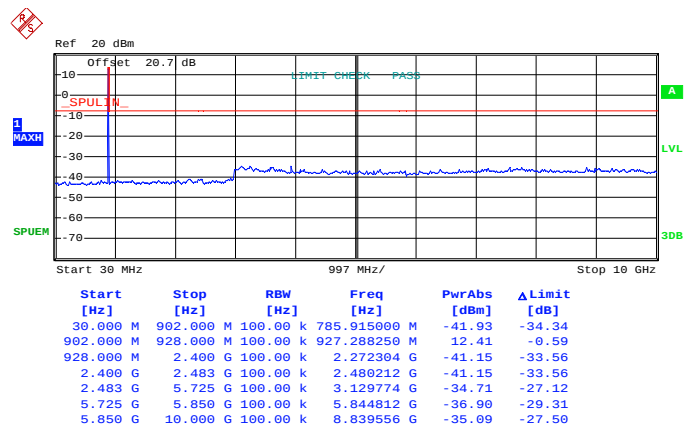
Date: 5.NOV.2020 20:01:14

Figure 2.9.6-10: Conducted Spurious Emissions Results – Low Channel – Antenna 2 – SF7



Date: 5.NOV.2020 20:27:49

Figure 2.9.6-11: Conducted Spurious Emissions Results – Middle Channel – Antenna 2 – SF7



Date: 5.NOV.2020 21:43:01

Figure 2.9.6-12: Conducted Spurious Emissions Results –High Channel – Antenna 2 – SF7



### 2.9.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument                                | Manufacturer    | Type No   | TE No     | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|-------------------------------------------|-----------------|-----------|-----------|------------------------------|-----------------------------|-----------------|
| Spectrum Analyzer                         | Rohde & Schwarz | FSP40     | BEMC00283 | 4.50 SP5                     | 24                          | 04-Oct-2021     |
| Attenuator 20dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet  | 40AH2W-20 | BEMC02111 | N/A                          | 12                          | 25-Jul-2021     |

TU - Traceability Unscheduled

O/P MON - Traceability Unscheduled

N/A - Not Applicable



## **2.10 Radiated Spurious Emissions into Restricted Frequency Bands**

### **2.10.1 Specification Reference**

FCC Sections: 15.205, 15.209;  
ISED Canada: RSS-GEN 8.9, 8.10

### **2.10.2 Equipment Under Test and Modification State**

S/N: N/A

### **2.10.3 Date of Test**

10/29/2020 to 11/4/2020

### **2.10.4 Test Method**

Radiated emissions tests were made over the frequency range of 9 kHz to 10 GHz, 10 times the highest fundamental frequency. Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in Section 15.209.

For measurements below 30 MHz, the receive antenna height was set to 1 m and the EUT was rotated through 360 degrees. The resolution bandwidth was set to 200 Hz below 150 kHz and to 9 kHz above 150 kHz.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000 MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak measurements are made with RBW of 1 MHz and VBW of 3 MHz. Average measurements are performed in the linear scale using VBW of 30 Hz.

### **2.10.5 Duty Cycle Correction**

The EUT was configured to transmit at the maximum duty cycle allowed by the test firmware during the evaluation. A Duty Cycle Correction was not applied to the average measurements for the corrected average results.

### **2.10.6 Environmental Conditions**

|                      |             |
|----------------------|-------------|
| Ambient Temperature  | 26.5 °C     |
| Relative Humidity    | 43.4 %      |
| Atmospheric Pressure | 1011.6 mbar |



## 2.10.7 Test Results

### DC Powered Operating

Limit Clause FCC Sections 15.205, 15.209, ISED Canada: RSS-GEN 8.9, 8.10

| Frequency (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|-----------------|-----------------------------------|-------------------------------|
| 0.009-0.490     | 2400/F(kHz)                       | 300                           |
| 0.4090-1.705    | 24000/F(kHz)                      | 30                            |
| 1.705-30.0      | 30                                | 30                            |
| 30-88           | 100**                             | 3                             |
| 88-216          | 150**                             | 3                             |
| 216-960         | 200**                             | 3                             |
| Above 960       | 500                               | 3                             |



Table 2.10.7-1: Radiated Spurious Emissions in the Restricted Bands Results

| Frequency<br>(MHz) | Level<br>(dBuV) |         | Antenna<br>Polarity<br>(H/V) | Correction<br>Factors<br>(dB) | Corrected Level<br>(dBuV/m) |         | Limit<br>(dBuV/m) |         | Margin<br>(dB) |         |
|--------------------|-----------------|---------|------------------------------|-------------------------------|-----------------------------|---------|-------------------|---------|----------------|---------|
|                    | pk              | Qpk/Avg |                              |                               | pk                          | Qpk/Avg | pk                | Qpk/Avg | pk             | Qpk/Avg |
| Low Channel        |                 |         |                              |                               |                             |         |                   |         |                |         |
| 2707.5             | 44.42           | 32.72   | H                            | -4.32                         | 40.10                       | 28.40   | 74.0              | 54.0    | 33.9           | 25.6    |
| 2707.5             | 44.99           | 33.28   | V                            | -4.32                         | 40.67                       | 28.96   | 74.0              | 54.0    | 33.3           | 25.0    |
| 3610               | 45.74           | 36.38   | H                            | -3.38                         | 42.36                       | 33.00   | 74.0              | 54.0    | 31.6           | 21.0    |
| 3610               | 45.87           | 36.68   | V                            | -3.38                         | 42.49                       | 33.30   | 74.0              | 54.0    | 31.5           | 20.7    |
| 4512.5             | 43.54           | 33.54   | H                            | -0.92                         | 42.62                       | 32.62   | 74.0              | 54.0    | 31.4           | 21.4    |
| 4512.5             | 45.63           | 35.14   | V                            | -0.92                         | 44.71                       | 34.22   | 74.0              | 54.0    | 29.3           | 19.8    |
| 5415               | 42.21           | 31.60   | H                            | 1.44                          | 43.65                       | 33.04   | 74.0              | 54.0    | 30.3           | 21.0    |
| 5415               | 43.55           | 34.30   | V                            | 1.44                          | 44.99                       | 35.74   | 74.0              | 54.0    | 29.0           | 18.3    |
| 8122.5             | 41.66           | 30.09   | H                            | 4.71                          | 46.37                       | 34.80   | 74.0              | 54.0    | 27.6           | 19.2    |
| 8122.5             | 43.87           | 33.13   | V                            | 4.71                          | 48.58                       | 37.84   | 74.0              | 54.0    | 25.4           | 16.2    |
| 9025               | 39.09           | 26.51   | H                            | 5.62                          | 44.71                       | 32.13   | 74.0              | 54.0    | 29.3           | 21.9    |
| 9025               | 38.79           | 26.91   | V                            | 5.62                          | 44.41                       | 32.53   | 74.0              | 54.0    | 29.6           | 21.5    |
| Middle Channel     |                 |         |                              |                               |                             |         |                   |         |                |         |
| 2745.9             | 46.17           | 35.82   | H                            | -4.25                         | 41.92                       | 31.57   | 74.0              | 54.0    | 32.1           | 22.4    |
| 2745.9             | 45.21           | 35.10   | V                            | -4.25                         | 40.96                       | 30.85   | 74.0              | 54.0    | 33.0           | 23.1    |
| 3661.2             | 45.49           | 36.57   | H                            | -3.26                         | 42.23                       | 33.31   | 74.0              | 54.0    | 31.8           | 20.7    |
| 3661.2             | 43.88           | 34.45   | V                            | -3.26                         | 40.62                       | 31.19   | 74.0              | 54.0    | 33.4           | 22.8    |
| 4576.5             | 46.01           | 35.02   | H                            | -0.78                         | 45.23                       | 34.24   | 74.0              | 54.0    | 28.8           | 19.8    |
| 4576.5             | 44.83           | 35.29   | V                            | -0.78                         | 44.05                       | 34.51   | 74.0              | 54.0    | 30.0           | 19.5    |
| 7322.4             | 43.05           | 31.34   | H                            | 3.61                          | 46.66                       | 34.95   | 74.0              | 54.0    | 27.3           | 19.0    |
| 7322.4             | 44.58           | 33.76   | V                            | 3.61                          | 48.19                       | 37.37   | 74.0              | 54.0    | 25.8           | 16.6    |
| 8237.7             | 40.65           | 27.77   | H                            | 4.87                          | 45.52                       | 32.64   | 74.0              | 54.0    | 28.5           | 21.4    |
| 8237.7             | 40.39           | 27.93   | V                            | 4.87                          | 45.26                       | 32.80   | 74.0              | 54.0    | 28.7           | 21.2    |
| 9153               | 39.02           | 26.75   | H                            | 5.44                          | 44.46                       | 32.19   | 74.0              | 54.0    | 29.5           | 21.8    |
| 9153               | 39.65           | 27.45   | V                            | 5.44                          | 45.09                       | 32.89   | 74.0              | 54.0    | 28.9           | 21.1    |
| High Channel       |                 |         |                              |                               |                             |         |                   |         |                |         |
| 2781.9             | 45.55           | 36.12   | H                            | -4.18                         | 41.37                       | 31.94   | 74.0              | 54.0    | 32.6           | 22.1    |
| 2781.9             | 45.61           | 36.71   | V                            | -4.18                         | 41.43                       | 32.53   | 74.0              | 54.0    | 32.6           | 21.5    |
| 3709.2             | 44.91           | 35.51   | H                            | -3.14                         | 41.77                       | 32.37   | 74.0              | 54.0    | 32.2           | 21.6    |
| 3709.2             | 43.99           | 34.07   | V                            | -3.14                         | 40.85                       | 30.93   | 74.0              | 54.0    | 33.2           | 23.1    |
| 4636.5             | 46.41           | 38.88   | H                            | -0.65                         | 45.76                       | 38.23   | 74.0              | 54.0    | 28.2           | 15.8    |
| 4636.5             | 46.38           | 38.40   | V                            | -0.65                         | 45.73                       | 37.75   | 74.0              | 54.0    | 28.3           | 16.3    |
| 7418.4             | 41.65           | 30.66   | H                            | 3.65                          | 45.30                       | 34.31   | 74.0              | 54.0    | 28.7           | 19.7    |
| 7418.4             | 43.15           | 32.80   | V                            | 3.65                          | 46.80                       | 36.45   | 74.0              | 54.0    | 27.2           | 17.6    |
| 8345.7             | 41.69           | 30.61   | H                            | 5.02                          | 46.71                       | 35.63   | 74.0              | 54.0    | 27.3           | 18.4    |
| 8345.7             | 43.44           | 32.61   | V                            | 5.02                          | 48.46                       | 37.63   | 74.0              | 54.0    | 25.5           | 16.4    |

Notes: All emissions above 9.2 GHz were attenuated below the limits and the noise floor of the measurement equipment.



## 2.10.8 Sample Calculations

$$R_c = R_u + CF_T$$

Where:

|        |   |                                                                   |
|--------|---|-------------------------------------------------------------------|
| $CF_T$ | = | Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only) |
| $R_u$  | = | Uncorrected Reading                                               |
| $R_c$  | = | Corrected Level                                                   |
| AF     | = | Antenna Factor                                                    |
| CA     | = | Cable Attenuation                                                 |
| AG     | = | Amplifier Gain                                                    |
| DC     | = | Duty Cycle Correction Factor                                      |

### Example Calculation: Peak

Corrected Level:  $44.42 + (-4.32) = 40.1 \text{ dB}\mu\text{V/m}$

Margin:  $74 \text{ dB}\mu\text{V/m} - 40.1 \text{ dB}\mu\text{V/m} = 33.9 \text{ dB}$

### Example Calculation: Average

Corrected Level:  $32.72 + (-4.32) - 0 = 28.40 \text{ dB}\mu\text{V/m}$

Margin:  $54 \text{ dB}\mu\text{V/m} - 28.40 \text{ dB}\mu\text{V/m} = 25.60 \text{ dB}$

## 2.10.9 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument                    | Manufacturer            | Type No                | TE No     | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|-------------------------------|-------------------------|------------------------|-----------|------------------------------|-----------------------------|-----------------|
| 9kHz-26.5GHz EMC analyzer/HYZ | Agilent                 | E7405A                 | BEMC00523 | A.14.06                      | 24                          | 27-Nov-2020     |
| Tile Automation Software      | ETS Lindgren            | TILE4! - Version 4.2.A | BEMC02095 | 4.2A                         | N/A                         | NCR             |
| BI LOG PERIODIC, ANTENNA      | Schaffner               | CBL6112B               | TEMC00005 | N/A                          | 24                          | 31-Oct-2021     |
| Loop Antenna                  | Com Power               | AL-130                 | TEMC00025 | N/A                          | 24                          | 26-Sep-2021     |
| EMC Chamber                   | Panashield              | N/A                    | TEMC00031 | N/A                          | 36                          | 28-Jan-2021     |
| Double Ridge Guide Horn       | ETS Lindgren            | 3117                   | TEMC00061 | N/A                          | 24                          | 07-Feb-2022     |
| PAM-118A                      | Com-Power Corporation   | PAM-118A               | TEMC00160 | N/A                          | 12                          | 16-Mar-2021     |
| 1.2 GHz High Pass Filter      | Micro-Tronics           | HPM50108-01            | TEMC00175 | N/A                          | 12                          | 12-Mar-2021     |
| A81-0303 18 GHz Cable Set     | Teledyne Storm Products | A81-0303-360/96        | TEMC00201 | N/A                          | 12                          | 22-Apr-2021     |

TU - Traceability Unscheduled

O/P MON - Traceability Unscheduled

N/A - Not Applicable

NCR – No Calibration Required



## 2.11 Power Spectral Density

### 2.11.1 Specification Reference

FCC: Section 15.247(f)  
ISED Canada: RSS-247 5.3(b)

### 2.11.2 Equipment Under Test and Modification State

S/N: N/A

### 2.11.3 Date of Test

11/4/2020 to 11/5/2020

### 2.11.4 Test Method

The power spectral density was measured in accordance with ANSI C63.10 Subclause 11.10.2 Method PKPSD (peak PSD). The RF output port of the EUT was directly connected to the input of the spectrum analyzer. Offset values were input for cable and external attenuation. The spectrum analyzer RBW was set to 3 kHz and VBW to 10 kHz. The Span was adjusted to 1.5 times the DTS bandwidth and the sweep time was set to auto. The measurements were performed using a Peak detector.

### 2.11.5 Environmental Conditions

Ambient Temperature 26.8 °C  
Relative Humidity 37.6 %  
Atmospheric Pressure 1023.6 mbar

### 2.11.6 Test Results

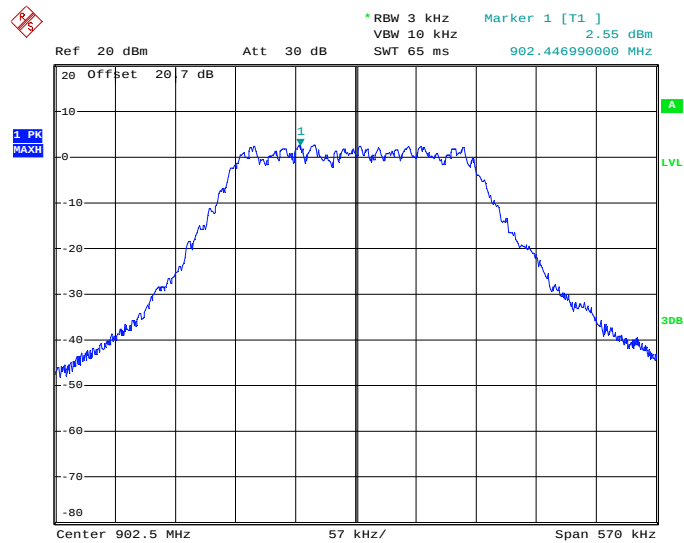
DC Powered Operating

Limit Clause FCC Section 15.247(f), ISED Canada: RSS-247 5.3(b)

The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time of continuous transmission.

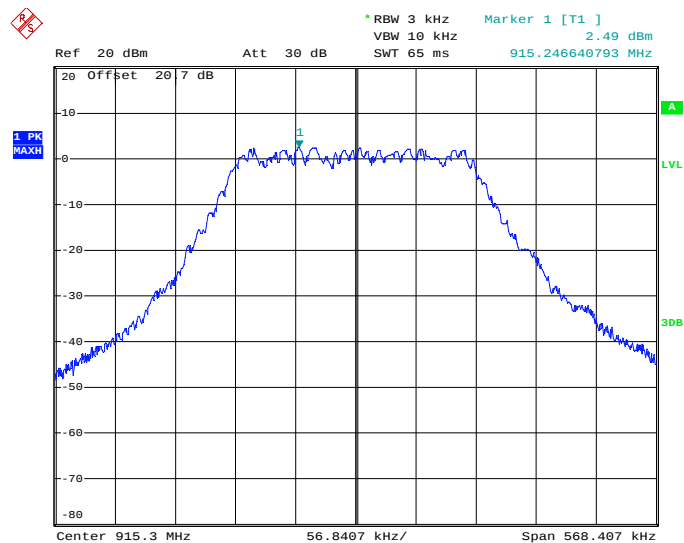
**Table 2.11.6-1: Power Spectral Density Test Results – Antenna 1 – SF6**

| Frequency<br>(MHz) | Measured Level<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|--------------------|-------------------------|----------------|----------------|
| 902.5              | 2.55                    | 8              | 5.45           |
| 915.3              | 2.49                    | 8              | 5.51           |
| 927.3              | 2.27                    | 8              | 5.73           |



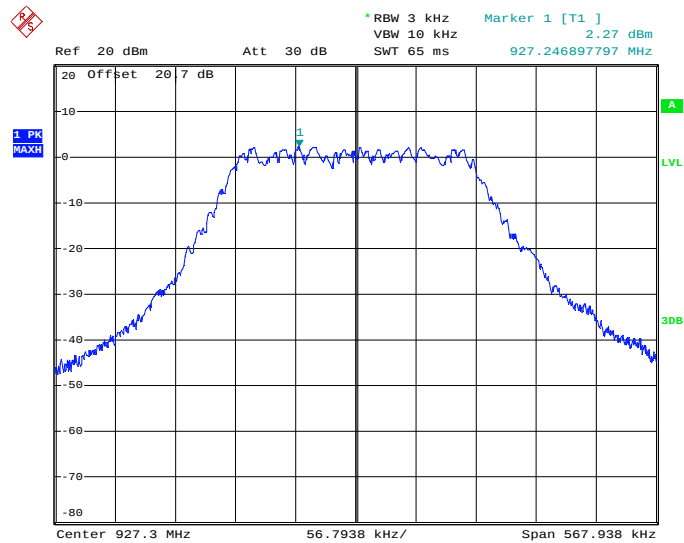
Date: 4.NOV.2020 22:02:44

Figure 2.11.6-1: Power Spectral Density Test Results – Low Channel – Antenna 1 – SF6



Date: 4.NOV.2020 23:25:01

Figure 2.11.6-2: Power Spectral Density Test Results – Middle Channel – Antenna 1 – SF6

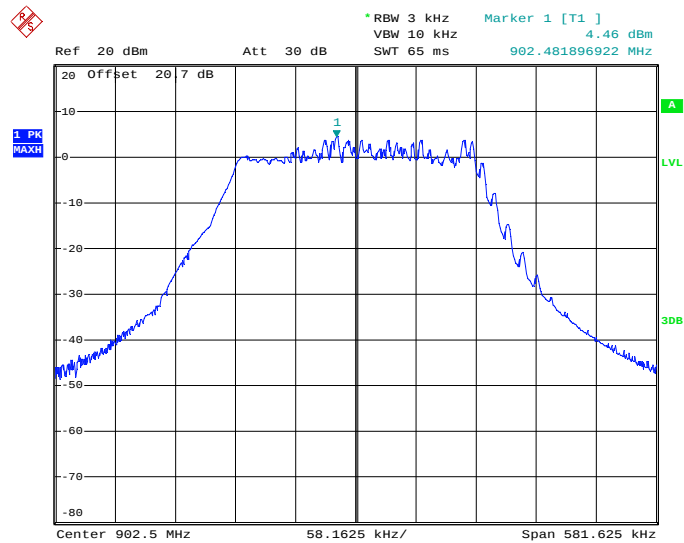


Date: 5.NOV.2020 18:49:43

Figure 2.11.6-3: Power Spectral Density Test Results – High Channel – Antenna 1 – SF6

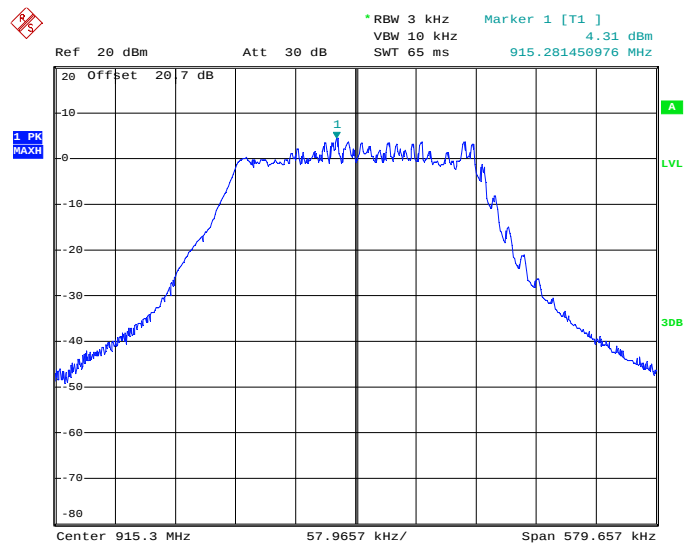
Table 2.11.6-2: Power Spectral Density Test Results – Antenna 1 – SF7

| Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Margin (dB) |
|-----------------|----------------------|-------------|-------------|
| 902.5           | 4.46                 | 8           | 3.54        |
| 915.3           | 4.31                 | 8           | 3.69        |
| 927.3           | 4.16                 | 8           | 3.84        |



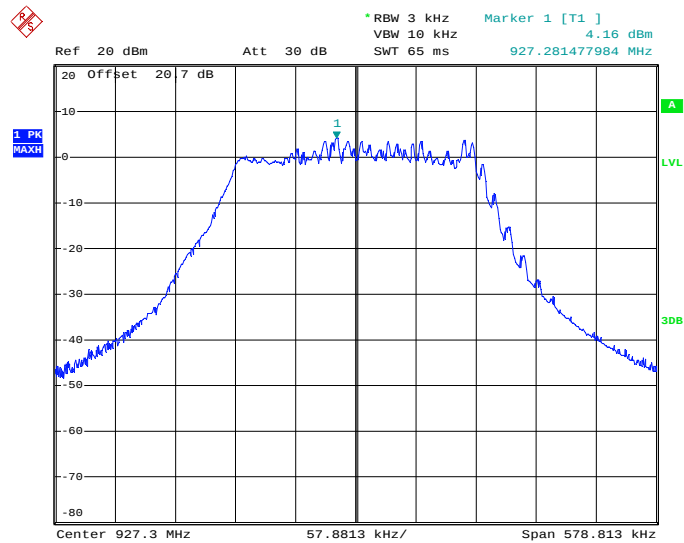
Date: 4.NOV.2020 22:26:43

Figure 2.11.6-4: Power Spectral Density Test Results – Low Channel – Antenna 1 – SF7



Date: 4.NOV.2020 23:48:41

Figure 2.11.6-5: Power Spectral Density Test Results – Middle Channel – Antenna 1 – SF7

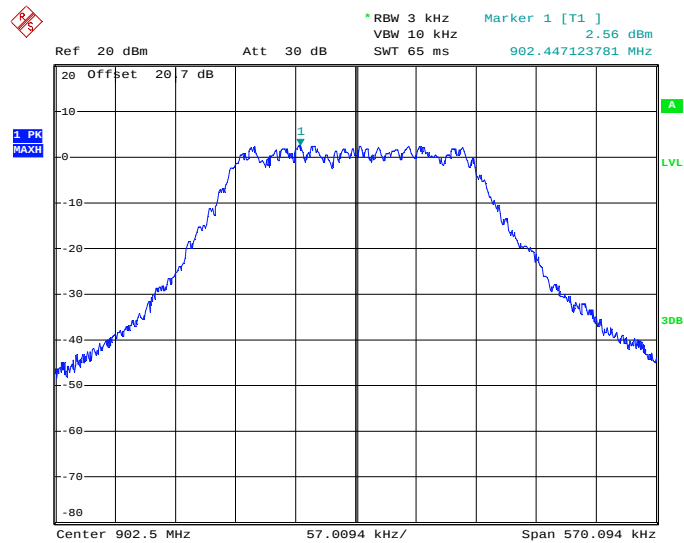


Date: 5.NOV.2020 00:09:58

Figure 2.11.6-6: Power Spectral Density Test Results – High Channel – Antenna 1 – SF7

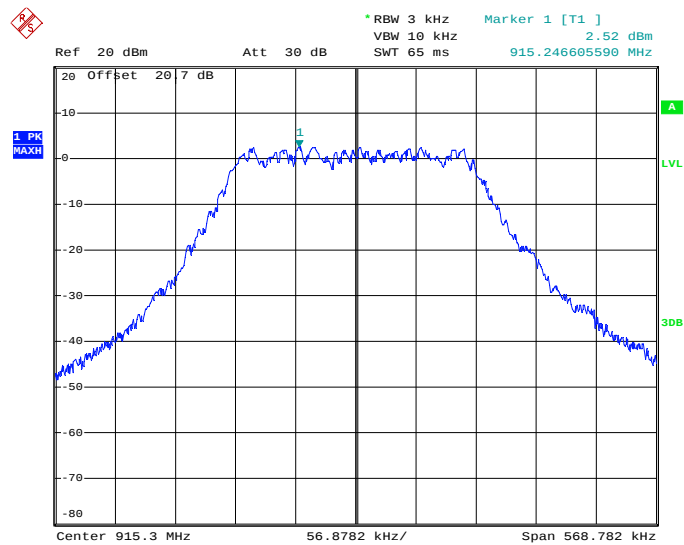
Table 2.11.6-3: Power Spectral Density Test Results – Antenna 2 – SF6

| Frequency<br>(MHz) | Measured Level<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|--------------------|-------------------------|----------------|----------------|
| 902.5              | 2.56                    | 8              | 5.44           |
| 915.3              | 2.52                    | 8              | 5.48           |
| 927.3              | 2.41                    | 8              | 5.59           |



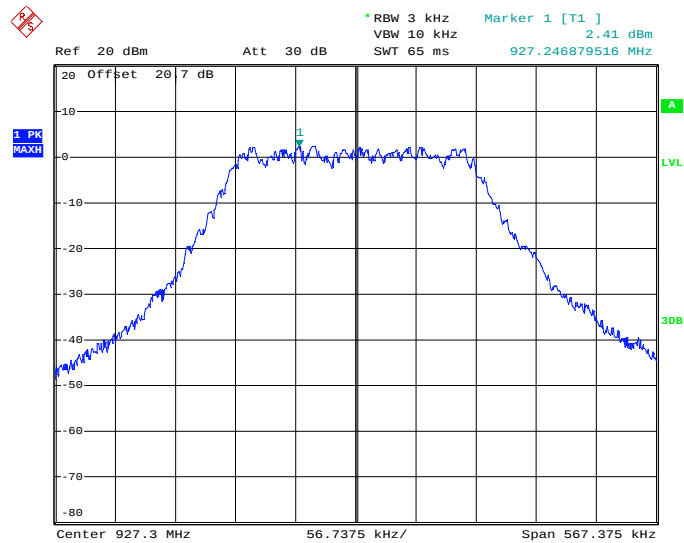
Date: 5.NOV.2020 19:22:56

Figure 2.11.6-7: Power Spectral Density Test Results – Low Channel – Antenna 2 – SF6



Date: 5.NOV.2020 20:47:29

Figure 2.11.6-8: Power Spectral Density Test Results – Middle Channel – Antenna 2 – SF6

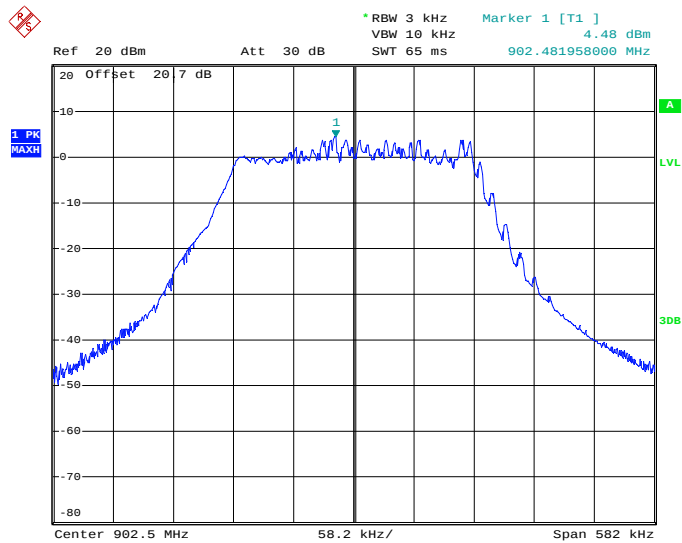


Date: 5.NOV.2020 21:14:30

Figure 2.11.6-9: Power Spectral Density Test Results – High Channel – Antenna 2 – SF6

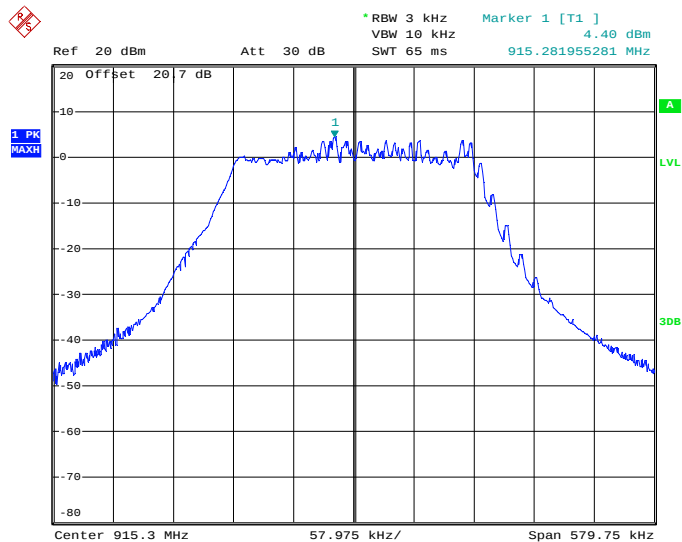
Table 2.11.6-4: Power Spectral Density Test Results – Antenna 2 – SF7

| Frequency<br>(MHz) | Measured Level<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|--------------------|-------------------------|----------------|----------------|
| 902.5              | 4.48                    | 8              | 3.52           |
| 915.3              | 4.40                    | 8              | 3.60           |
| 927.3              | 4.25                    | 8              | 3.75           |



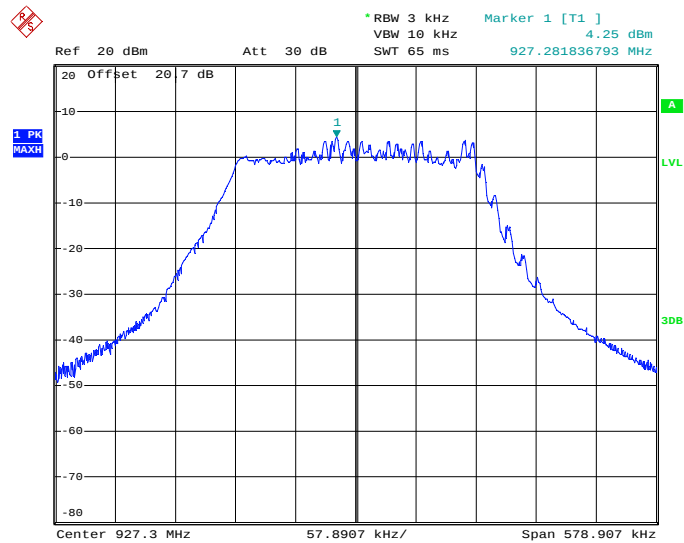
Date: 5.NOV.2020 19:57:22

Figure 2.11.6-10: Power Spectral Density Test Results – Low Channel – Antenna 2 – SF7



Date: 5.NOV.2020 20:23:57

Figure 2.11.6-11: Power Spectral Density Test Results – Middle Channel – Antenna 2 – SF7



Date: 5.NOV.2020 21:39:08

Figure 2.11.6-12: Power Spectral Density Test Results – High Channel – Antenna 2 – SF7

2.11.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument                                | Manufacturer    | Type No   | TE No     | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|-------------------------------------------|-----------------|-----------|-----------|------------------------------|-----------------------------|-----------------|
| Spectrum Analyzer                         | Rohde & Schwarz | FSP40     | BEMC00283 | 4.50 SP5                     | 24                          | 04-Oct-2021     |
| Attenuator 20dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet  | 40AH2W-20 | BEMC02111 | N/A                          | 12                          | 25-Jul-2021     |

TU - Traceability Unscheduled  
O/P MON - Traceability Unscheduled  
N/A - Not Applicable



## **2.12 Power Line Conducted Emissions**

### **2.12.1 Specification Reference**

FCC: Section 15.207  
ISED Canada; RSS-GEN 8.8

### **2.12.2 Test Results**

The EUT is DC powered only without provisions for connection to the AC Mains. The EUT is exempted from the power line conducted emissions requirements.



## 2.13 Duty Cycle of Test Mode of Operation

### 2.13.1 Specification Reference

FCC: N/A  
ISED Canada: N/A

### 2.13.2 Equipment Under Test and Modification State

S/N: N/A

### 2.13.3 Date of Test

11/14/2020

### 2.13.4 Test Method

The transmitter duty cycle was measured in accordance with FCC KDB 558074 D01 15.247 Meas Guidance v05r02. The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The reference level of the measuring equipment was offset to account for the insertion loss of the measurement cable and external attenuation. The spectrum analyzer RBW was set to the largest value. The measurements were performed using a Peak detector.

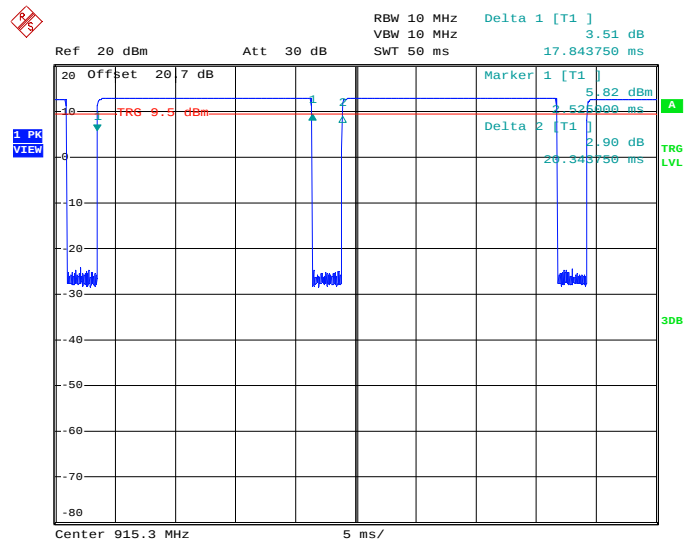
### 2.13.5 Environmental Conditions

Ambient Temperature 26.8 °C  
Relative Humidity 42.5 %  
Atmospheric Pressure 1015.5 mbar

### 2.13.6 Test Results

**Table 2.13.6-1: Duty Cycle Measurement Results**

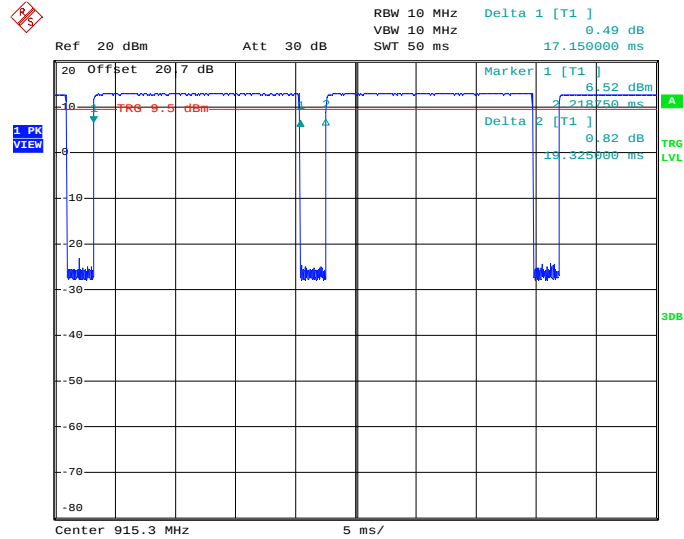
| Antenna Port | Spreading Factor | Tx On (ms) | Period (ms) | Duty Cycle (%) |
|--------------|------------------|------------|-------------|----------------|
| 1            | SF = 6           | 17.84375   | 20.34375    | 87.71          |
| 1            | SF = 7           | 17.15000   | 19.32500    | 88.75          |
| 2            | SF = 6           | 17.84375   | 20.34375    | 87.71          |
| 2            | SF = 7           | 17.11875   | 19.32500    | 88.58          |



Date: 14.NOV.2020 15:57:36

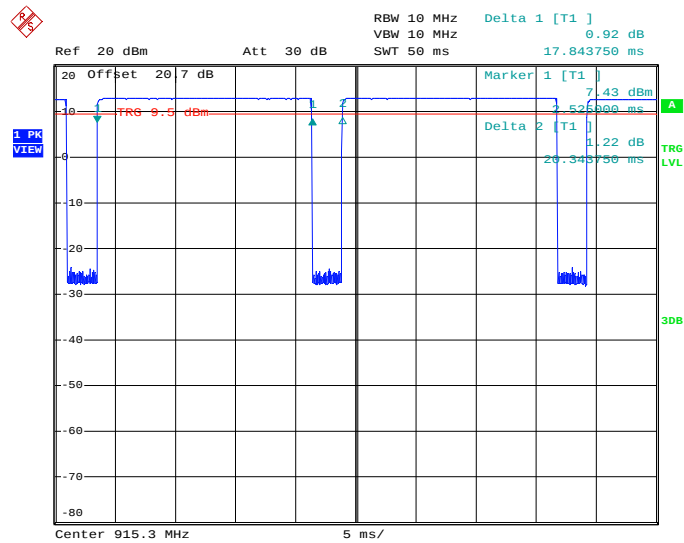
Figure 2.13.6-1: Duty Cycle Measurement Results – Antenna 1 – SF6

SF7 – Antenna 1



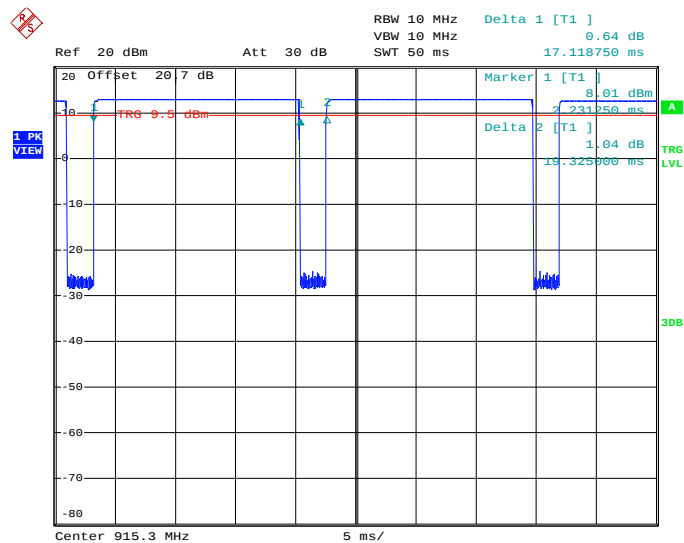
Date: 14.NOV.2020 15:59:03

Figure 2.13.6-2: Duty Cycle Measurement Results – Antenna 1 – SF7



Date: 14.NOV.2020 15:54:17

Figure 2.13.6-3: Duty Cycle Measurement Results – Antenna 2 – SF6



Date: 14.NOV.2020 15:52:40

Figure 2.13.6-4: Duty Cycle Measurement Results – Antenna 2 – SF7



### 2.13.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument                                | Manufacturer    | Type No   | TE No     | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|-------------------------------------------|-----------------|-----------|-----------|------------------------------|-----------------------------|-----------------|
| Spectrum Analyzer                         | Rohde & Schwarz | FSP40     | BEMC00283 | 4.50 SP5                     | 24                          | 04-Oct-2021     |
| Attenuator 20dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet  | 40AH2W-20 | BEMC02111 | N/A                          | 12                          | 25-Jul-2021     |

TU - Traceability Unscheduled

O/P MON - Traceability Unscheduled

N/A - Not Applicable



### 3 Test Equipment Information

#### 3.1 General Test Equipment Used

| Instrument                                | Manufacturer            | Type No                | TE No     | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|-------------------------------------------|-------------------------|------------------------|-----------|------------------------------|-----------------------------|-----------------|
| Spectrum Analyzer                         | Rohde & Schwarz         | FSP40                  | BEMC00283 | 4.50 SP5                     | 24                          | 04-Oct-2021     |
| 9kHz-26.5GHz EMC analyzer/HYZ             | Agilent                 | E7405A                 | BEMC00523 | A.14.06                      | 24                          | 27-Nov-2020     |
| Tile Automation Software                  | ETS Lindgren            | TILE4! - Version 4.2.A | BEMC02095 | 4.2A                         | N/A                         | NCR             |
| Attenuator 20dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet          | 40AH2W-20              | BEMC02111 | N/A                          | 12                          | 25-Jul-2021     |
| BI LOG PERIODIC, ANTENNA                  | Schaffner               | CBL6112B               | TEMC00005 | N/A                          | 24                          | 31-Oct-2021     |
| Loop Antenna                              | Com Power               | AL-130                 | TEMC00025 | N/A                          | 24                          | 26-Sep-2021     |
| EMC Chamber                               | Panashield              | N/A                    | TEMC00031 | N/A                          | 36                          | 28-Jan-2021     |
| Double Ridge Guide Horn                   | ETS Lindgren            | 3117                   | TEMC00061 | N/A                          | 24                          | 07-Feb-2022     |
| PAM-118A                                  | Com-Power Corporation   | PAM-118A               | TEMC00160 | N/A                          | 12                          | 16-Mar-2021     |
| 1.2 GHz High Pass Filter                  | Micro-Tronics           | HPM50108-01            | TEMC00175 | N/A                          | 12                          | 12-Mar-2021     |
| A81-0303 18 GHz Cable Set                 | Teledyne Storm Products | A81-0303-360/96        | TEMC00201 | N/A                          | 12                          | 22-Apr-2021     |

TU - Traceability Unscheduled

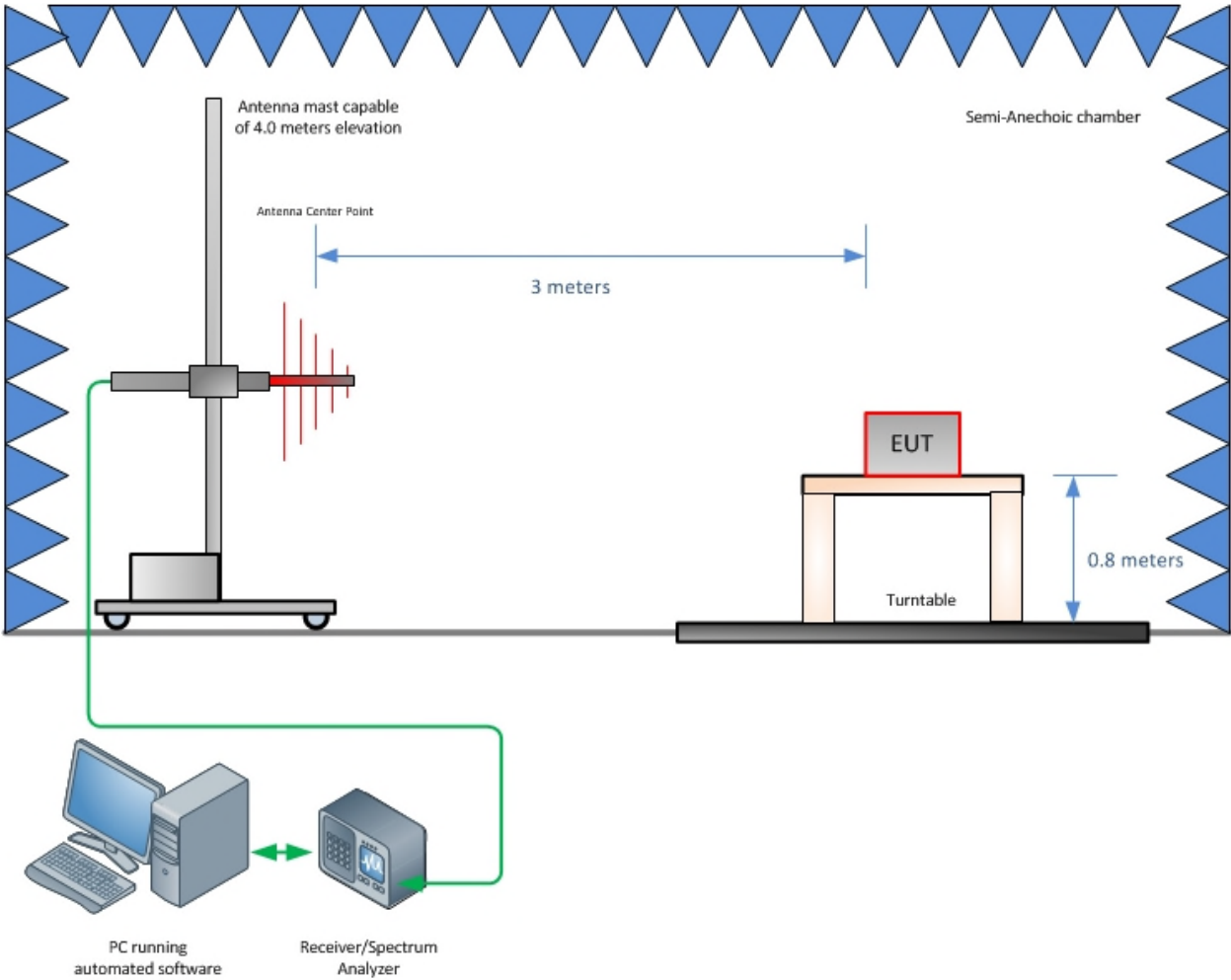
O/P MON - Traceability Unscheduled

N/A - Not Applicable

NCR – No Calibration Required



4      **Diagram of Test Set-ups**



**Figure 4-1 - Radiated Emissions Test Setup up to 1 GHz**

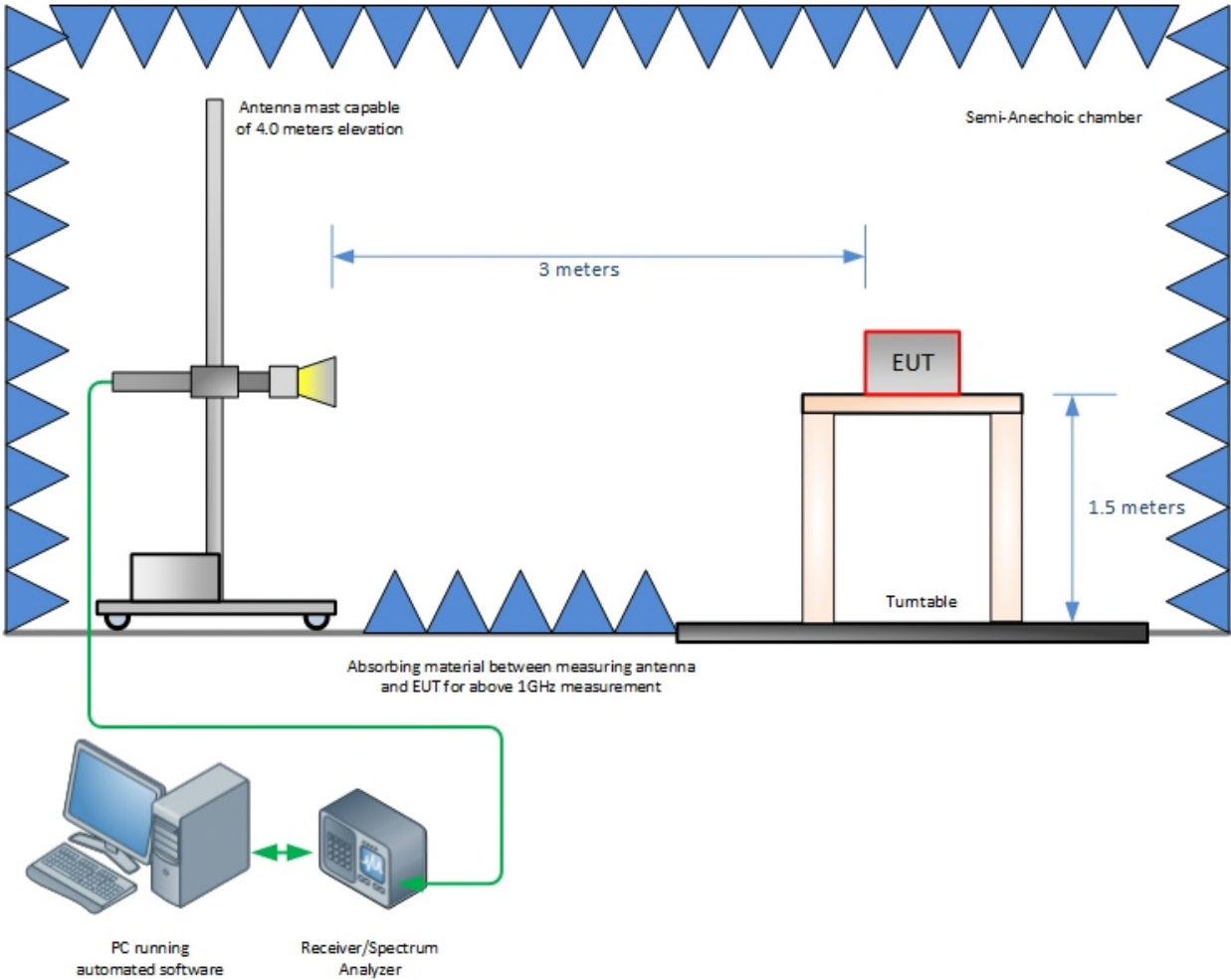


Figure 4-2 - Radiated Emissions Test Setup above 1 GHz

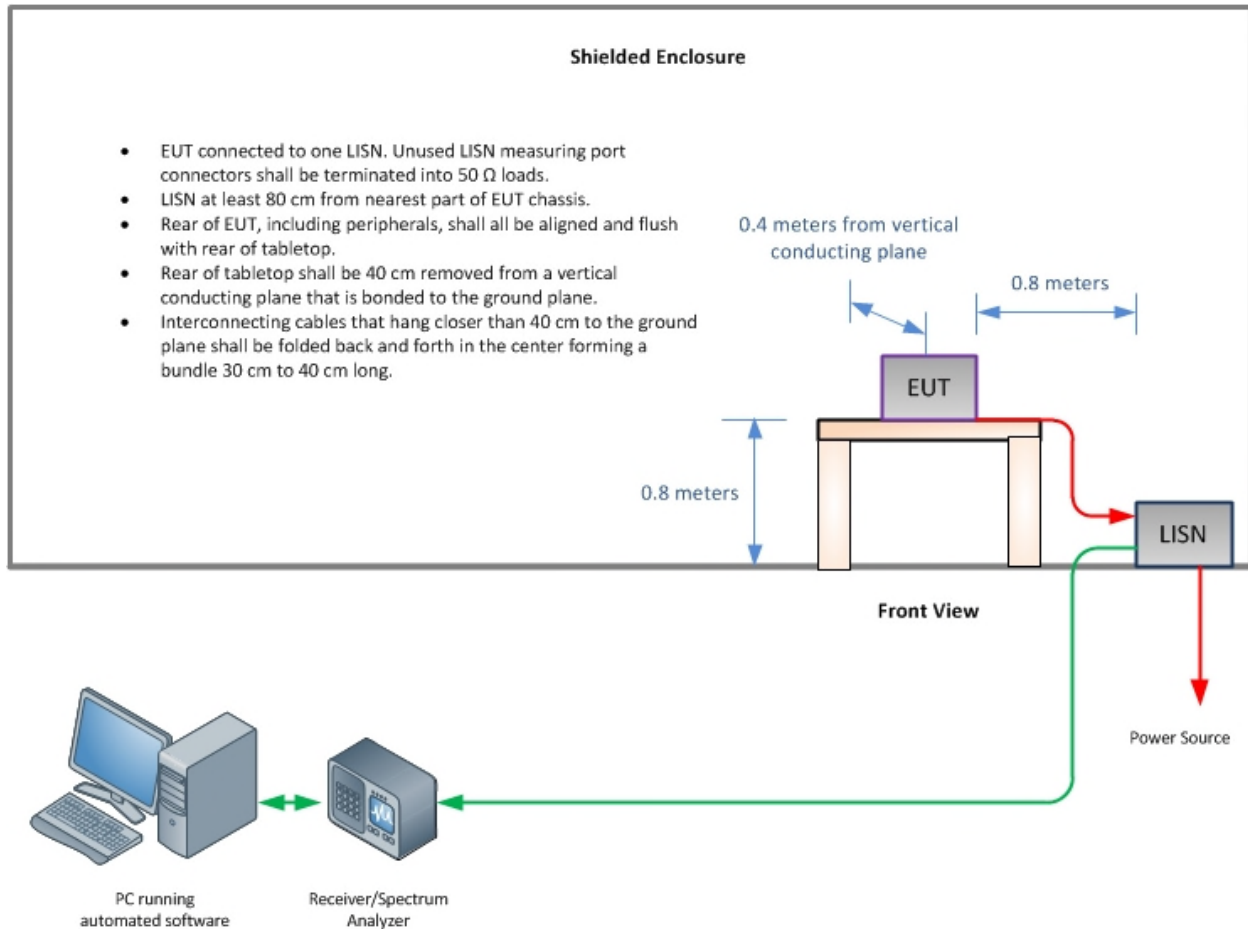


Figure 4-3 – Conducted Emissions Test Setup



## 5 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

**Table 5-1 - Values of  $U_{\text{CISPR}}$  and  $U_{\text{Lab}}$**

| Measurement                                                                                                                                            | $U_{\text{CISPR}}$         | $U_{\text{Lab}}$              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-------------------------------|
| Conducted disturbance (mains port)<br>(9 kHz – 150 kHz)<br>(150 kHz – 30 MHz)                                                                          | 3.8 dB<br>3.4 dB           | 3.71 dB<br>3.31 dB            |
| Conducted disturbance (telecom port)<br>(150 kHz – 30 MHz 55 dB LCL)<br>(150 kHz – 30 MHz 65 dB LCL)<br>(150 kHz – 30 MHz 75 dB LCL)                   | 5.0 dB<br>5.0 dB<br>5.0 dB | 4.11 dB<br>4.50 dB<br>4.94 dB |
| Radiated disturbance (electric field strength on an open area test site or alternative test site)<br>(30 MHz – 1 000 MHz)<br>(1 – 6 GHz)<br>(6-18 GHz) | 6.3 dB<br>5.2 dB<br>5.5 dB | 5.85 dB<br>4.48 dB<br>4.48 dB |

### Notes:

$U_{\text{CISPR}}$  resembles a value of measurement uncertainty for a specific test, which was determined by considering uncertainties associated with the quantities listed in CISPR 16-4-2:2011.



## **6 Accreditation, Disclaimers and Copyright**

TÜV SÜD America Inc.'s reports apply only to the specific sample tested under stated test conditions. It is the manufacturer's responsibility to assure the continued compliance of production units of this model. TÜV SÜD America, Inc. shall have no liability for any deductions, inferences or generalizations drawn by the client or others from TÜV SÜD America, Inc.'s issued reports.

This report is the confidential property of the client. As a mutual protection to our clients, the public and TÜV SÜD America, Inc., extracts from the test report shall not be reproduced, except in full without TÜV SÜD America, Inc.'s written approval.

This report must not be used to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the federal government.