

# Report on the FCC and IC Testing of:

DETNET SOUTH AFRICA (PTY) LTD

Free standing blast controller, Model: DigiShot Plus

Omni directional aerial, Model: DIPL-A0049

Universal Mains Charger, Model: GS25B18-P1J

In accordance with FCC 47 CFR Part 15C,  
Industry Canada RSS-247 and  
Industry Canada RSS-GEN

Prepared for: DETNET SOUTH AFRICA (PTY) LTD  
Block 1B, Founders Hill Office Park  
Centenary Road, Modderfontein  
P O Box 10, 1645, SOUTH AFRICA



Add value.  
Inspire trust.

FCC ID: 2ARNH-09230850 IC: 24476-09230850

## COMMERCIAL-IN-CONFIDENCE

Document Number: 75943833-03 | Issue: 02

### SIGNATURE

| NAME          | JOB TITLE      | RESPONSIBLE FOR      | ISSUE DATE    |
|---------------|----------------|----------------------|---------------|
| Simon Bennett | Chief Engineer | Authorised Signatory | 09 April 2019 |

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

### ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 15C, Industry Canada RSS-247 and Industry Canada RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

### SIGNATURE

| NAME          | JOB TITLE     | RESPONSIBLE FOR | ISSUE DATE    |
|---------------|---------------|-----------------|---------------|
| Daniel Bishop | Test Engineer | Testing         | 09 April 2019 |
| Graeme Lawler | Test Engineer | Testing         | 09 April 2019 |

FCC Accreditation

90987 Octagon House, Fareham Test Laboratory

Industry Canada Accreditation

IC2932B-1 Octagon House, Fareham Test Laboratory

### EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15C: 2017, Industry Canada RSS-247: Issue 2 (2017-02) and Industry Canada RSS-GEN: Issue 5 (2018-04).



### DISCLAIMER AND COPYRIGHT

This non-binding report has been prepared by TÜV SÜD with all reasonable skill and care. The document is confidential to the potential Client and TÜV SÜD. No part of this document may be reproduced without the prior written approval of TÜV SÜD. © 2019 TÜV SÜD.

### ACCREDITATION

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation. Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).

TÜV SÜD  
is a trading name of TÜV SÜD Ltd  
Registered in Scotland at East Kilbride,  
Glasgow G75 0QF, United Kingdom  
Registered number: SC215164

TÜV SÜD Ltd is a  
TÜV SÜD Group Company

Phone: +44 (0) 1489 558100  
Fax: +44 (0) 1489 558101  
[www.tuv-sud.co.uk](http://www.tuv-sud.co.uk)

TÜV SÜD  
Octagon House  
Concorde Way  
Fareham  
Hampshire PO15 5RL  
United Kingdom



## Contents

|          |                                                              |           |
|----------|--------------------------------------------------------------|-----------|
| <b>1</b> | <b>Report Summary .....</b>                                  | <b>2</b>  |
| 1.1      | Report Modification Record.....                              | 2         |
| 1.2      | Introduction.....                                            | 2         |
| 1.3      | Brief Summary of Results .....                               | 3         |
| 1.4      | Application Form .....                                       | 4         |
| 1.5      | Product Information .....                                    | 6         |
| 1.6      | Deviations from the Standard.....                            | 7         |
| 1.7      | EUT Modification Record .....                                | 7         |
| 1.8      | Test Location .....                                          | 8         |
| <b>2</b> | <b>Test Details .....</b>                                    | <b>9</b>  |
| 2.1      | Maximum Conducted Output Power .....                         | 9         |
| 2.2      | Frequency Hopping Systems - Average Time of Occupancy .....  | 13        |
| 2.3      | Frequency Hopping Systems - Channel Separation.....          | 16        |
| 2.4      | Frequency Hopping Systems - Number of Hopping Channels ..... | 19        |
| 2.5      | Authorised Band Edges .....                                  | 21        |
| 2.6      | Spurious Radiated Emissions .....                            | 24        |
| 2.7      | Frequency Hopping Systems - 20 dB Bandwidth .....            | 30        |
| 2.8      | Restricted Band Edges.....                                   | 33        |
| <b>3</b> | <b>Photographs .....</b>                                     | <b>37</b> |
| 3.1      | Test Setup Photographs .....                                 | 37        |
| <b>4</b> | <b>Measurement Uncertainty .....</b>                         | <b>39</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                                | 18 December 2018 |
| 2     | To amend the FCC and IC IDs and model name | 09 April 2019    |

**Table 1**

## 1.2 Introduction

|                               |                                                                                                                                                                        |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Applicant                     | DETNET SOUTH AFRICA (PTY) LTD                                                                                                                                          |
| Manufacturer                  | DETNET SOUTH AFRICA (PTY) LTD                                                                                                                                          |
| Model Number(s)               | Free standing blast controller, DigiShot Plus<br>Omni directional aerial, DIPL-A0049<br>Universal Mains Charger, GS25B18-P1J                                           |
| Serial Number(s)              | Free standing blast controller, 1030002244<br>Omni directional aerial, Not Serialised (75943833-TSR0014)<br>Universal Mains Charger, Not Serialised (75943833-TSR0013) |
| Hardware Version(s)           | Hardware rev.11 PCB rev.3                                                                                                                                              |
| Software Version(s)           | SVN 34340                                                                                                                                                              |
| Number of Samples Tested      | 1 plus ancillaries                                                                                                                                                     |
| Test Specification/Issue/Date | FCC 47 CFR Part 15C: 2017<br>Industry Canada RSS-247: Issue 2 (2017-02)<br>Industry Canada RSS-GEN: Issue 5 (2018-04)                                                  |
| Order Number                  | 4500351687                                                                                                                                                             |
| Date                          | 18-September-2018                                                                                                                                                      |
| Date of Receipt of EUT        | 11-October-2018 and 28-November-2018                                                                                                                                   |
| Start of Test                 | 10-October-2018                                                                                                                                                        |
| Finish of Test                | 11-December-2018                                                                                                                                                       |
| Name of Engineer(s)           | Daniel Bishop and Graeme Lawler                                                                                                                                        |
| Related Document(s)           | ANSI C63.10 (2013)<br>KDB 662911 D01 v02r02                                                                                                                            |



### 1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C, Industry Canada RSS-247 and Industry Canada RSS-GEN is shown below.

| Section                                                 | Specification Clause  |         |         | Test Description                                       | Result | Comments/Base Standard                      |
|---------------------------------------------------------|-----------------------|---------|---------|--------------------------------------------------------|--------|---------------------------------------------|
|                                                         | Part 15C              | RSS-247 | RSS-GEN |                                                        |        |                                             |
| Configuration and Mode: 902 to 928 MHz FHSS Transmitter |                       |         |         |                                                        |        |                                             |
| 2.1                                                     | 15.247 (b)            | 5.4     | 6.12    | Maximum Conducted Output Power                         | Pass   | ANSI C63.10 (2013)<br>KDB 662911 D01 v02r02 |
| 2.2                                                     | 15.247 (a)(1)         | 5.1     | -       | Frequency Hopping Systems - Average Time of Occupancy  | Pass   | ANSI C63.10 (2013)                          |
| 2.3                                                     | 15.247 (a)(1)         | 5.1     | -       | Frequency Hopping Systems - Channel Separation         | Pass   | ANSI C63.10 (2013)                          |
| 2.4                                                     | 15.247 (a)(1)         | 5.1     | -       | Frequency Hopping Systems - Number of Hopping Channels | Pass   | ANSI C63.10 (2013)                          |
| 2.5                                                     | 15.247 (d)            | 5.5     | -       | Authorised Band Edges                                  | Pass   | ANSI C63.10 (2013)                          |
| 2.6                                                     | 15.247 (d) and 15.205 | 5.5     | 6.13    | Spurious Radiated Emissions                            | Pass   | ANSI C63.10 (2013)                          |
| 2.7                                                     | 15.247 (a)(1)         | 5.1     |         | Frequency Hopping Systems - 20 dB Bandwidth            | Pass   | ANSI C63.10 (2013)                          |
| 2.8                                                     | 15.205                | -       | 8.10    | Restricted Band Edges                                  | Pass   | ANSI C63.10 (2013)                          |

**Table 2**



## 1.4 Application Form

| EQUIPMENT DESCRIPTION                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Model Name/Number                                                                               | DigiShot Plus                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Part Number                                                                                     | 1480002C5                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Hardware Version                                                                                | Hardware rev.11 PCB rev.3                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Software Version                                                                                | SVN 34340                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| FCC ID (if applicable)                                                                          | 2ARNH-09230850                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Industry Canada ID (if applicable)                                                              | 24476-09230850                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Technical Description (Please provide a brief description of the intended use of the equipment) | <p>Free standing electronic detonator blast controller.</p> <p>This unit integrates a EDP-209 (AC4490 transceiver) operating in the 902 MHz to 928 MHz frequency band. It uses frequency hopping technology over 32 channels with an output power of approximately 30 dBm and a Tx duty cycle of approximately 2.9%.</p> <p>The units also include an AC PSU for charging and/or operation, a serial port to download / printing of the blast plan and an omni directional antenna.</p> |

| INTENTIONAL RADIATORS |                      |                                       |                    |                               |                      |                         |                     |        |     |
|-----------------------|----------------------|---------------------------------------|--------------------|-------------------------------|----------------------|-------------------------|---------------------|--------|-----|
| Technology            | Frequency Band (MHz) | Conducted Declared Output Power (dBm) | Antenna Gain (dBi) | Supported Bandwidth (s) (MHz) | Modulation Scheme(s) | ITU Emission Designator | Test Channels (MHz) |        |     |
|                       |                      |                                       |                    |                               |                      |                         | Bottom              | Middle | Top |
| RF                    | 900                  | 30.0                                  | 2.1                | 902 -928 MHz                  |                      |                         | 902                 | 915    | 928 |

| UN-INTENTIONAL RADIATOR                                                                                            |         |
|--------------------------------------------------------------------------------------------------------------------|---------|
| Highest frequency generated or used in the device or on which the device operates or tunes                         | 928 MHz |
| Lowest frequency generated or used in the device or on which the device operates or tunes                          | 1200 Hz |
| Class A Digital Device (Use in commercial, industrial or business environment) <input checked="" type="checkbox"/> |         |
| Class B Digital Device (Use in residential environment only) <input type="checkbox"/>                              |         |

| Power Source                           |                 |                                     |                                                                     |
|----------------------------------------|-----------------|-------------------------------------|---------------------------------------------------------------------|
| AC                                     | Single Phase    | Three Phase                         | Nominal Voltage                                                     |
|                                        |                 |                                     |                                                                     |
| External DC                            | Nominal Voltage | Maximum Current                     |                                                                     |
|                                        |                 |                                     |                                                                     |
| Battery                                | Nominal Voltage | Battery Operating End Point Voltage |                                                                     |
|                                        | 12V             | 11.2V                               |                                                                     |
| Can EUT transmit whilst being charged? |                 |                                     | Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> |

| EXTREME CONDITIONS  |    |    |                            |
|---------------------|----|----|----------------------------|
| Maximum temperature | 60 | °C | Minimum temperature -30 °C |

| Ancillaries |
|-------------|
|             |



|                                                                 |
|-----------------------------------------------------------------|
| Please list all ancillaries which will be used with the device. |
| Moulded Dipole Antenna with magnetic base                       |

| ANTENNA CHARACTERISTICS             |                             |                 |    |     |
|-------------------------------------|-----------------------------|-----------------|----|-----|
| <input checked="" type="checkbox"/> | Antenna connector           | State impedance | 50 | Ohm |
| <input type="checkbox"/>            | Temporary antenna connector | State impedance |    | Ohm |
| <input type="checkbox"/>            | Integral antenna            | Type            |    |     |
| <input type="checkbox"/>            | External antenna            | Type            |    |     |

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

Name: H van der Walt

Position held: Quality and Compliance Manager

Date: 2018-10-01





### 1.5.3 EUT Configuration and Rationale for Radiated Spurious Emissions

The EUT was placed on the non-conducting platform in a manner typical of a normal installation.

The EUT was orientated as shown in the setup photographs.

Ports on the EUT were terminated with loads as described in ANSI C63.4 clause 6.2.4. Where multiple connectors of the same type, additional interconnecting cables were connected, and pre-scans performed to determine whether the level of the emissions were increased by >2 dB.

### 1.6 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

### 1.7 EUT Modification Record

The table below details modifications made to the EUT during the test programme.  
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 |
|----------------------------------------------------------------------------|-------------------------------------------------|------------------------|--------------------------|
| Free standing blast controller, Serial Number: 1030002244                  |                                                 |                        |                          |
| 0                                                                          | As supplied by the customer                     | Not Applicable         | Not Applicable           |
| Omni directional aerial, Serial Number: Not Serialised (75943833- TSR0014) |                                                 |                        |                          |
| 0                                                                          | As supplied by the customer                     | Not Applicable         | Not Applicable           |
| Universal Mains Charger Serial Number: Not Serialised (75943833-TSR0013)   |                                                 |                        |                          |
| 0                                                                          | As supplied by the customer                     | Not Applicable         | Not Applicable           |

**Table 3**



## 1.8 Test Location

TÜV SÜD conducted the following tests at our Fareham Test Laboratory.

| Test Name                                               | Name of Engineer(s) | Accreditation |
|---------------------------------------------------------|---------------------|---------------|
| Configuration and Mode: 902 to 928 MHz FHSS Transmitter |                     |               |
| Maximum Conducted Output Power                          | Daniel Bishop       | UKAS          |
| Frequency Hopping Systems - Average Time of Occupancy   | Daniel Bishop       | UKAS          |
| Frequency Hopping Systems - Channel Separation          | Daniel Bishop       | UKAS          |
| Frequency Hopping Systems - Number of Hopping Channels  | Daniel Bishop       | UKAS          |
| Authorised Band Edges                                   | Graeme Lawler       | UKAS          |
| Spurious Radiated Emissions                             | Graeme Lawler       | UKAS          |
| Frequency Hopping Systems - 20 dB Bandwidth             | Daniel Bishop       | UKAS          |
| Restricted Band Edges                                   | Graeme Lawler       | UKAS          |

**Table 4**

Office Address:

Octagon House  
Concorde Way  
Segensworth North  
Fareham  
Hampshire  
PO15 5RL  
United Kingdom



## 2 Test Details

### 2.1 Maximum Conducted Output Power

#### 2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (b)  
Industry Canada RSS-247, Clause 5.4  
Industry Canada RSS-GEN, Clause 6.12

#### 2.1.2 Equipment Under Test and Modification State

Free standing blast controller, S/N: 1030002244 - Modification State 0

#### 2.1.3 Date of Test

11-October-2018

#### 2.1.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.5.

#### 2.1.5 Environmental Conditions

Ambient Temperature 21.4 °C  
Relative Humidity 44.5 %

#### 2.1.6 Test Results

902 to 928 MHz FHSS Transmitter

| Frequency (MHz) | Maximum Output Power |         |
|-----------------|----------------------|---------|
|                 | dBm                  | mW      |
| 902             | 28.71                | 743.019 |
| 915             | 28.08                | 642.688 |
| 928             | 28.84                | 765.597 |

**Table 5 - Maximum Conducted Output Power Results**

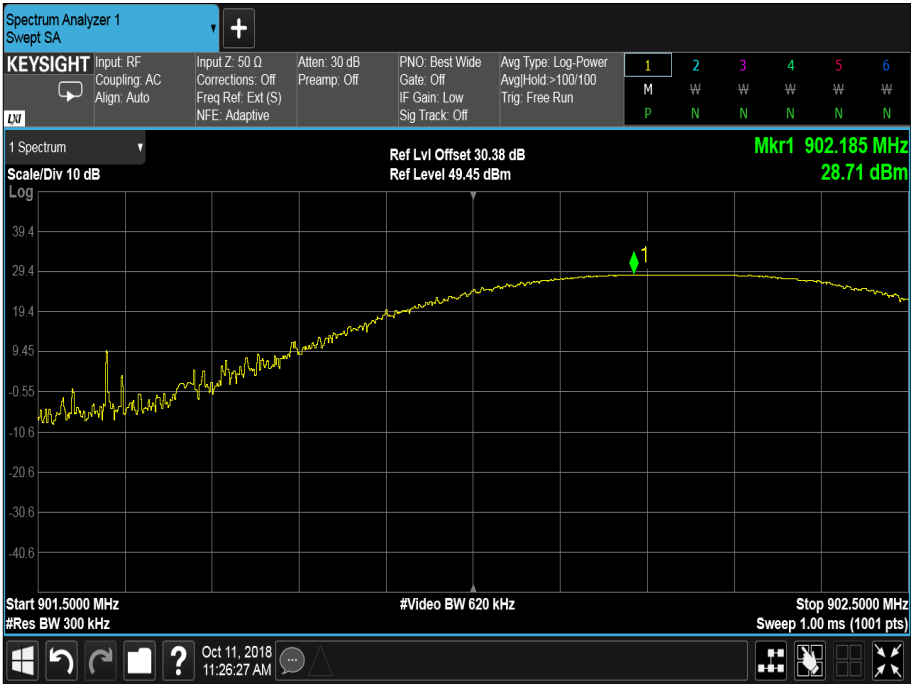


Figure 3 - 902 MHz - Maximum Output Power

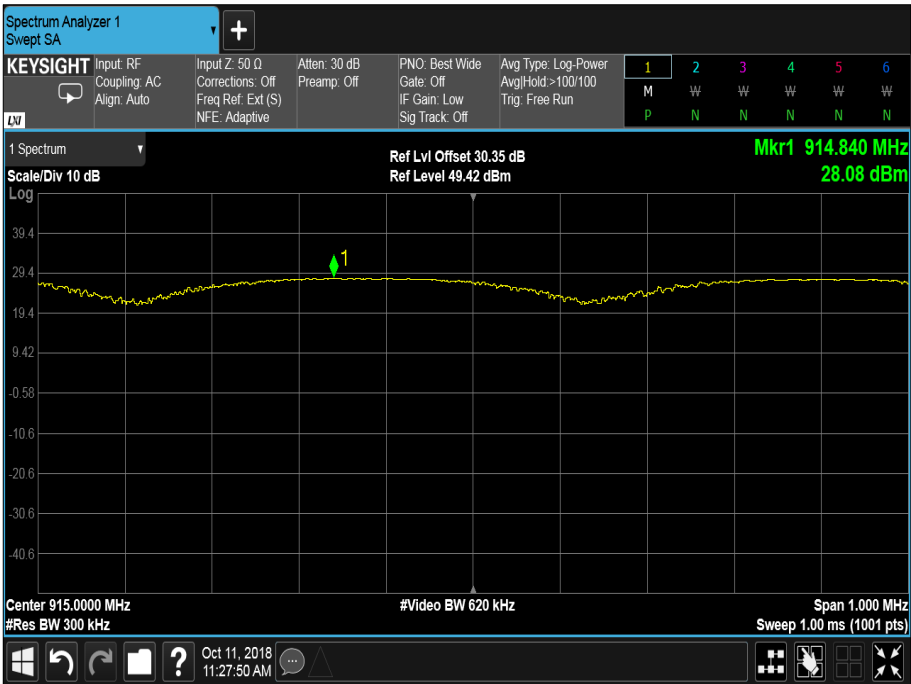


Figure 4 - 915 MHz - Maximum Output Power

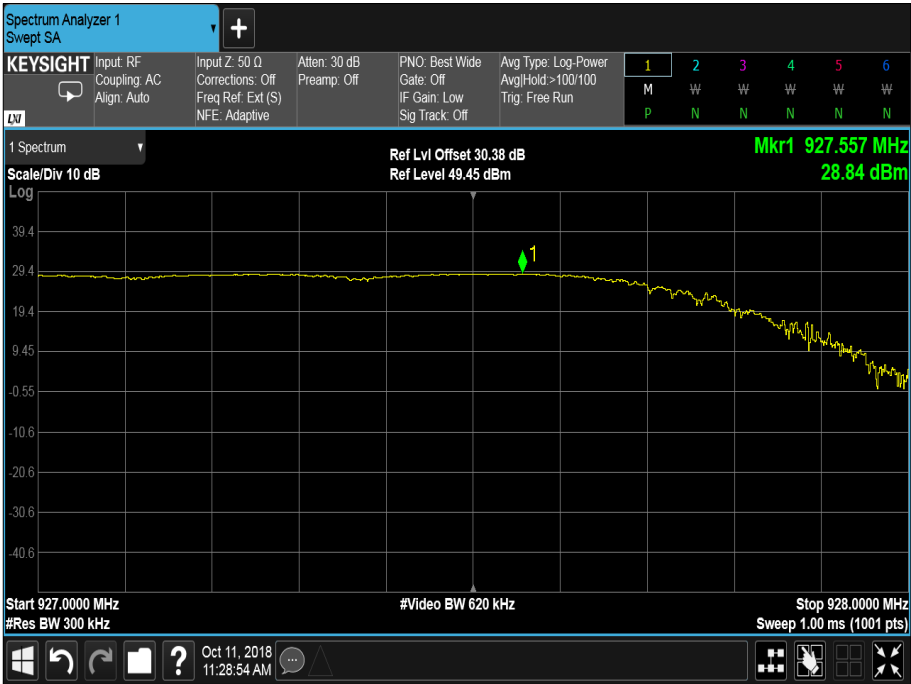


Figure 5 - 928 MHz - Maximum Output Power

FCC 47 CFR Part 15, Limit Clause 15.247 (b)(2)

For frequency hopping systems operating in the 902–928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels.

Industry Canada RSS-247, Limit Clause 5.4 (a)

For FHSs operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.



### 2.1.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

| Instrument              | Manufacturer          | Type No                      | TE No | Calibration Period (months) | Calibration Due |
|-------------------------|-----------------------|------------------------------|-------|-----------------------------|-----------------|
| Standard                | Rohde & Schwarz       | XSRM                         | 1316  | 6                           | 16-Apr-2019     |
| Hygrometer              | Rotronic              | A1                           | 1388  | 12                          | 20-Jun-2019     |
| Network Analyser        | Rohde & Schwarz       | ZVA 40                       | 3548  | 12                          | 17-Oct-2018     |
| Frequency Standard      | Spectracom            | SecureSync<br>1200-0408-0601 | 4393  | 6                           | 16-Apr-2019     |
| Calibration Unit        | Rohde & Schwarz       | ZV-Z54                       | 4368  | 12                          | 22-Oct-2018     |
| Attenuator (30dB, 100W) | Weinschel             | 48-30-43                     | 4871  | 12                          | 17-Jul-2019     |
| EXA                     | Keysight Technologies | N9010B                       | 4969  | 12                          | 21-Dec-2018     |

**Table 6**



## 2.2 Frequency Hopping Systems - Average Time of Occupancy

### 2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)  
Industry Canada RSS-247, Clause 5.1

### 2.2.2 Equipment Under Test and Modification State

Free standing blast controller, S/N: 1030002244 - Modification State 0

### 2.2.3 Date of Test

10-October-2018 to 11-October-2018

### 2.2.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.4.

### 2.2.5 Environmental Conditions

Ambient Temperature 21.4 °C  
Relative Humidity 44.5 %

### 2.2.6 Test Results

902 to 928 MHz FHSS Transmitter

| Dwell Time (ms) | Number of Transmissions | Average Occupancy Time (ms) |
|-----------------|-------------------------|-----------------------------|
| 2.960           | 21                      | 62.16                       |

Table 7

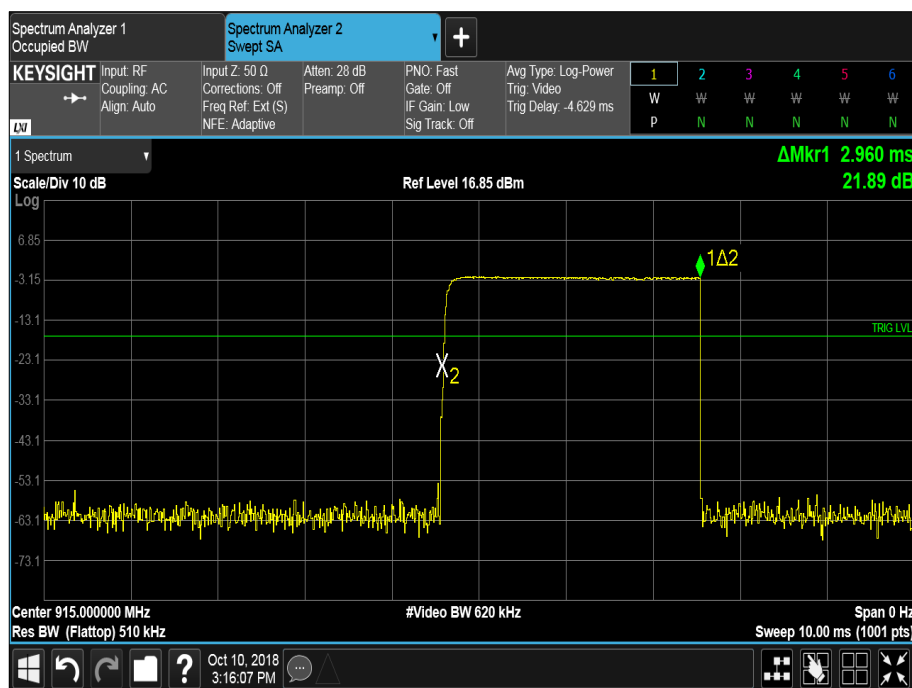


Figure 6 - Dwell Time

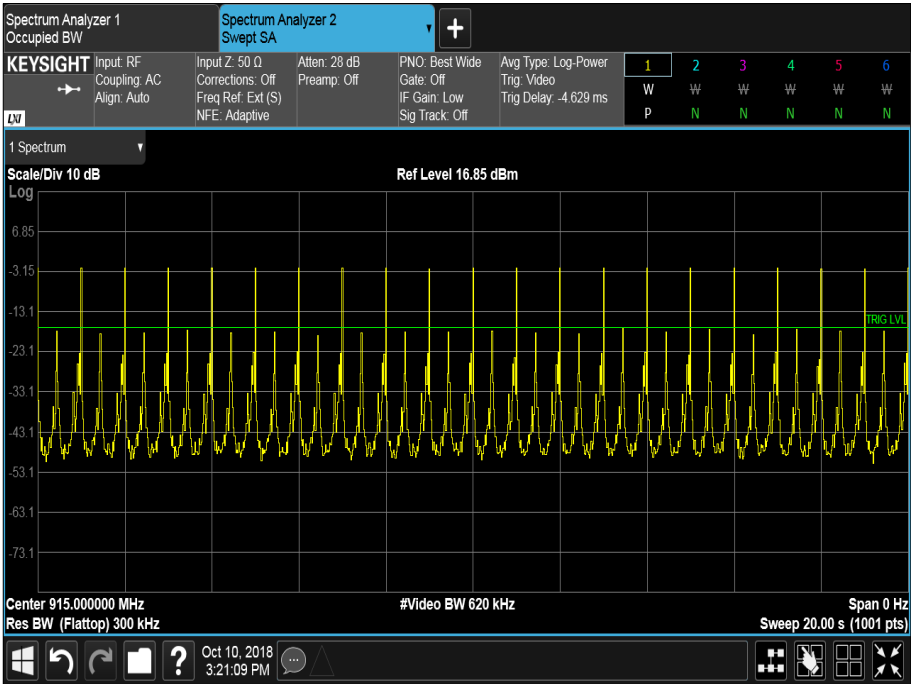


Figure 7 - Total Average Time of Occupancy

FCC 47 CFR Part 15, Limit Clause (a)(1)(i)

For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Industry Canada RSS-247, Limit Clause 5.1 (c)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period.



### 2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

| Instrument              | Manufacturer          | Type No                      | TE No | Calibration Period (months) | Calibration Due |
|-------------------------|-----------------------|------------------------------|-------|-----------------------------|-----------------|
| Standard                | Rohde & Schwarz       | XSRM                         | 1316  | 6                           | 16-Apr-2019     |
| Hygrometer              | Rotronic              | A1                           | 1388  | 12                          | 20-Jun-2019     |
| Network Analyser        | Rohde & Schwarz       | ZVA 40                       | 3548  | 12                          | 17-Oct-2018     |
| Frequency Standard      | Spectracom            | SecureSync<br>1200-0408-0601 | 4393  | 6                           | 16-Apr-2019     |
| Calibration Unit        | Rohde & Schwarz       | ZV-Z54                       | 4368  | 12                          | 22-Oct-2018     |
| Attenuator (30dB, 100W) | Weinschel             | 48-30-43                     | 4871  | 12                          | 17-Jul-2019     |
| EXA                     | Keysight Technologies | N9010B                       | 4969  | 12                          | 21-Dec-2018     |

**Table 8**



## 2.3 Frequency Hopping Systems - Channel Separation

### 2.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)  
 Industry Canada RSS-247, Clause 5.1

### 2.3.2 Equipment Under Test and Modification State

Free standing blast controller, S/N: 1030002244 - Modification State 0

### 2.3.3 Date of Test

11-October-2018

### 2.3.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.2.

### 2.3.5 Environmental Conditions

Ambient Temperature 21.4 °C  
 Relative Humidity 44.5 %

### 2.3.6 Test Results

902 to 928 MHz FHSS Transmitter

| Channel Separation (MHz) |
|--------------------------|
| 0.530                    |
| 0.250                    |

Table 9

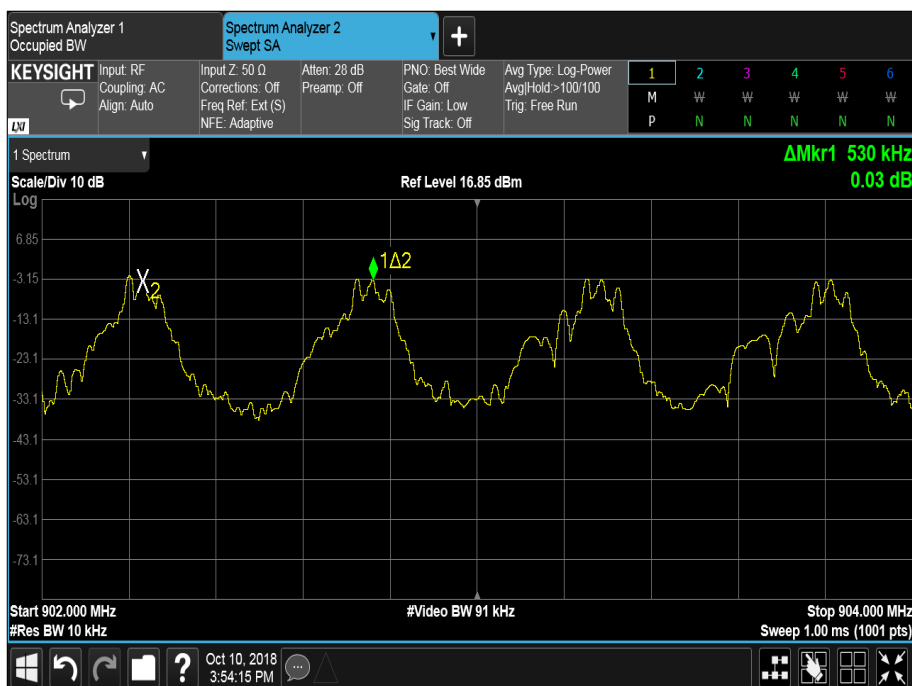


Figure 8

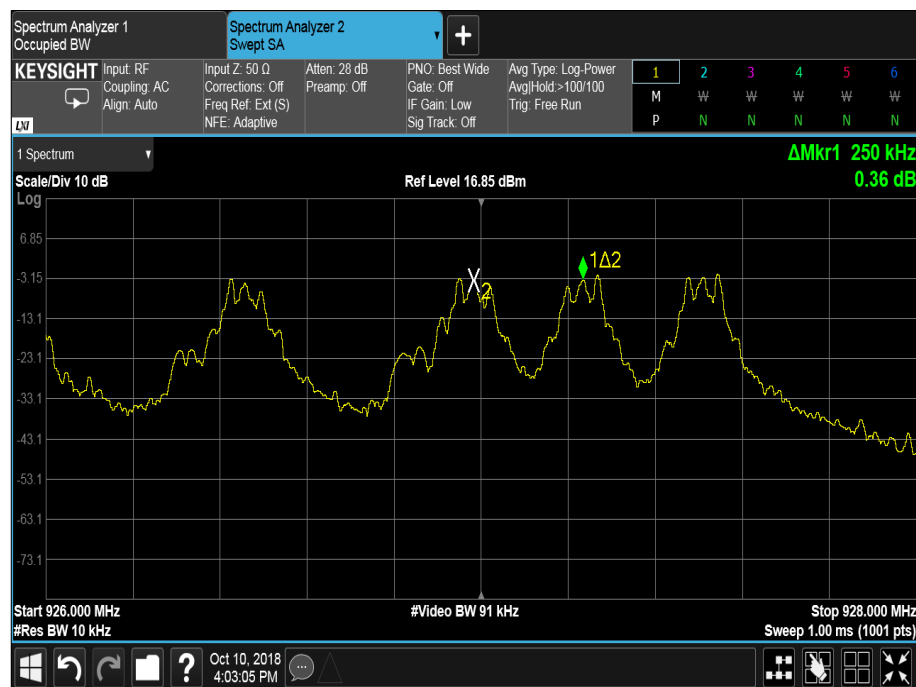


Figure 9

Two different channel separation figures were observed. At the top channel, three channels are spaced closer together than in the rest of the signal, causing the channel separation to be halved for these three channels when compared to the rest of the signal.

#### FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(i)

If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

#### Industry Canada RSS-247, Limit Clause 5.1 (c)

For FHSs in the band 902-928 MHz: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.



### 2.3.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

| Instrument              | Manufacturer          | Type No                      | TE No | Calibration Period (months) | Calibration Due |
|-------------------------|-----------------------|------------------------------|-------|-----------------------------|-----------------|
| Standard                | Rohde & Schwarz       | XSRM                         | 1316  | 6                           | 16-Apr-2019     |
| Hygrometer              | Rotronic              | A1                           | 1388  | 12                          | 20-Jun-2019     |
| Network Analyser        | Rohde & Schwarz       | ZVA 40                       | 3548  | 12                          | 17-Oct-2018     |
| Frequency Standard      | Spectracom            | SecureSync<br>1200-0408-0601 | 4393  | 6                           | 16-Apr-2019     |
| Calibration Unit        | Rohde & Schwarz       | ZV-Z54                       | 4368  | 12                          | 22-Oct-2018     |
| Attenuator (30dB, 100W) | Weinschel             | 48-30-43                     | 4871  | 12                          | 17-Jul-2019     |
| EXA                     | Keysight Technologies | N9010B                       | 4969  | 12                          | 21-Dec-2018     |

**Table 10**



## 2.4 Frequency Hopping Systems - Number of Hopping Channels

### 2.4.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)  
Industry Canada RSS-247, Clause 5.1

### 2.4.2 Equipment Under Test and Modification State

Free standing blast controller, S/N: 1030002244 – Modification State 0

### 2.4.3 Date of Test

11-October-2018

### 2.4.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.3.

### 2.4.5 Environmental Conditions

Ambient Temperature 21.4 °C  
Relative Humidity 44.5 %

### 2.4.6 Test Results

902 to 928 MHz FHSS Transmitter

Number of Hopping Channels: 50

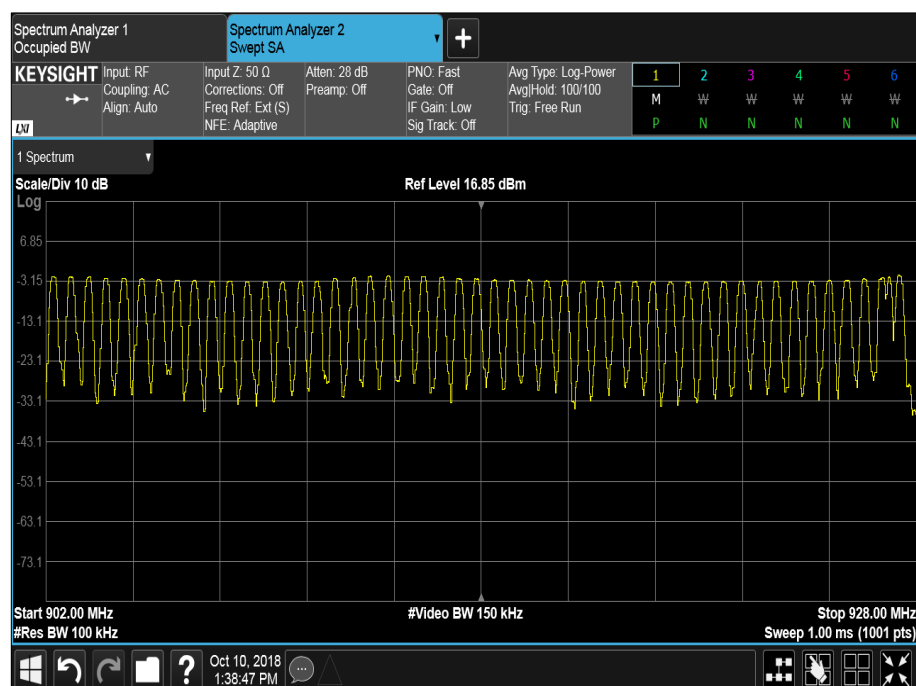


Figure 10 – Measurement Frequency Range: 902 MHz to 928 MHz



FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(i) and Industry Canada RSS-247, Limit Clause 5.1 (3)

If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies.

If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies.

#### **2.4.7 Test Location and Test Equipment Used**

This test was carried out in RF Laboratory 1.

| Instrument              | Manufacturer          | Type No                      | TE No | Calibration Period (months) | Calibration Due |
|-------------------------|-----------------------|------------------------------|-------|-----------------------------|-----------------|
| Standard                | Rohde & Schwarz       | XSRM                         | 1316  | 6                           | 16-Apr-2019     |
| Hygrometer              | Rotronic              | A1                           | 1388  | 12                          | 20-Jun-2019     |
| Network Analyser        | Rohde & Schwarz       | ZVA 40                       | 3548  | 12                          | 17-Oct-2018     |
| Frequency Standard      | Spectracom            | SecureSync<br>1200-0408-0601 | 4393  | 6                           | 16-Apr-2019     |
| Calibration Unit        | Rohde & Schwarz       | ZV-Z54                       | 4368  | 12                          | 22-Oct-2018     |
| Attenuator (30dB, 100W) | Weinschel             | 48-30-43                     | 4871  | 12                          | 17-Jul-2019     |
| EXA                     | Keysight Technologies | N9010B                       | 4969  | 12                          | 21-Dec-2018     |

**Table 11**



## **2.5 Authorised Band Edges**

### **2.5.1 Specification Reference**

FCC 47 CFR Part 15C, Clause 15.247 (d)  
Industry Canada RSS-247, Clause 5.5

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

Free standing blast controller, S/N: 1030002244 - Modification State 0  
GS25B18-P1J, S/N: N/A - Modification State 0  
DIPL-A0049, S/N: Not Serialised (75943833- TSR0014) - Modification State 0

### **2.5.3 Date of Test**

27-November-2018

### **2.5.4 Test Method**

The test was performed in accordance with ANSI C63.10, clause 6.10.4.

The EUT could not be operated without hopping (i.e. on static channels), therefore this test was only performed with hopping enabled.

### **2.5.5 Environmental Conditions**

Ambient Temperature 18.1 °C  
Relative Humidity 47.0 %

### **2.5.6 Test Results**

902 to 928 MHz FHSS Transmitter

| Mode    | Frequency (MHz) | Measured Frequency (MHz) | Level (dBc) |
|---------|-----------------|--------------------------|-------------|
| Hopping | 902             | 902                      | -27.20      |
| Hopping | 928             | 928                      | -40.81      |

**Table 12**

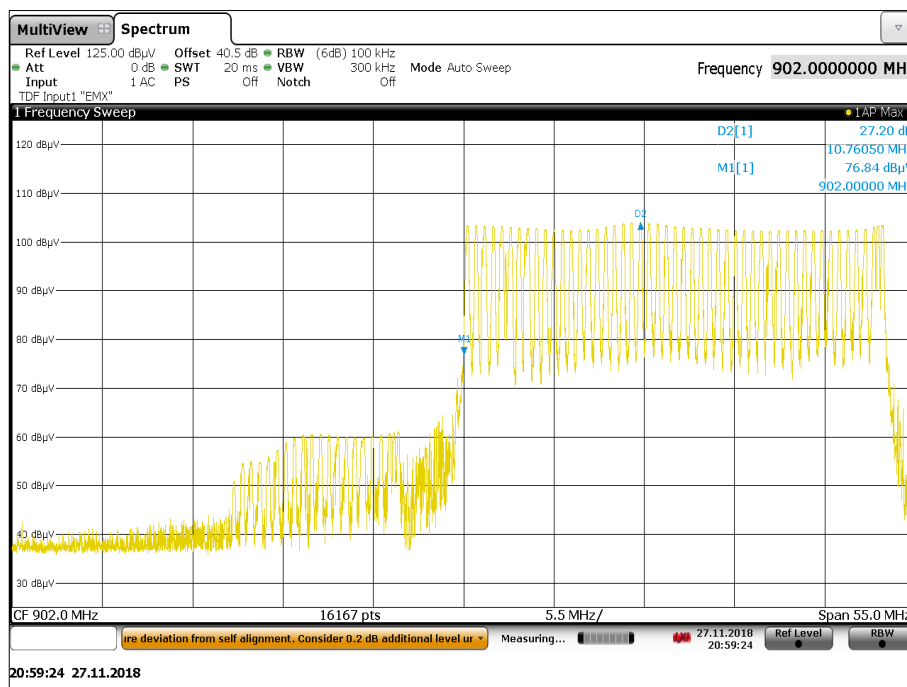


Figure 11 - Hopping 902 MHz - Measured Frequency 902 MHz

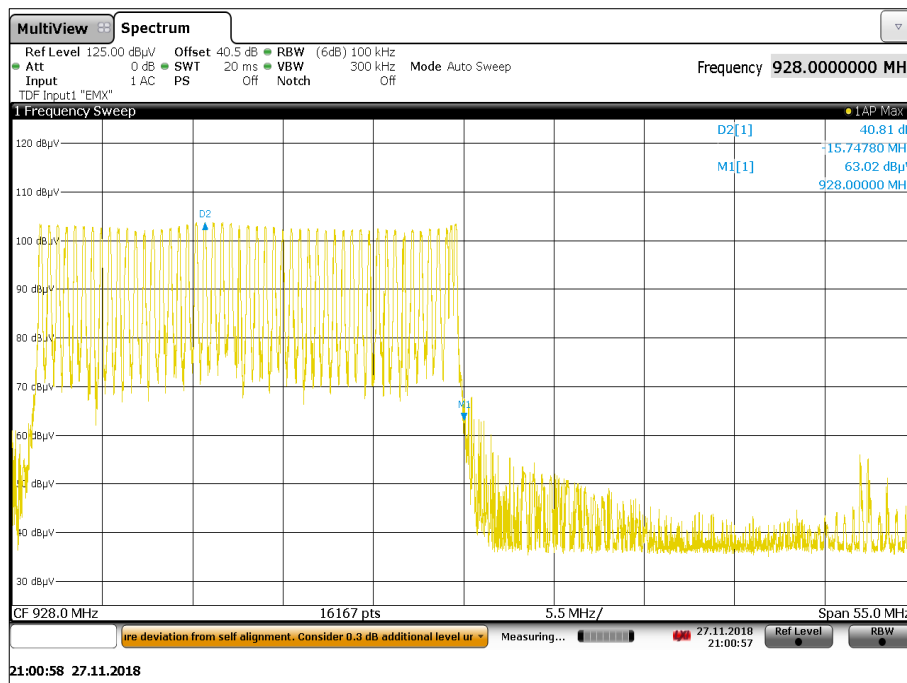


Figure 12 - Hopping 928 MHz - Measured Frequency 928 MHz



FCC 47 CFR Part 15, Limit Clause 15.247 (d)

20 dB below the fundamental measured in a 100 kHz bandwidth using a peak detector. 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 below the fundamental instead of 20 dB.

Industry Canada RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

## 2.5.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

| Instrument                           | Manufacturer          | Type No             | TE No | Calibration Period (months) | Calibration Due |
|--------------------------------------|-----------------------|---------------------|-------|-----------------------------|-----------------|
| Screened Room (5)                    | Rainford              | Rainford            | 1545  | 36                          | 23-Jan-2021     |
| Turntable Controller                 | Inn-Co GmbH           | CO 1000             | 1606  | -                           | TU              |
| Cable (Rx, Km-Km 2m)                 | Scott Cables          | KPS-1501-2000-KPS   | 4526  | 6                           | 26-Apr-2019     |
| PXA Signal Analyser                  | Keysight Technologies | N9030A              | 4653  | 12                          | 05-Feb-2019     |
| Double Ridged Waveguide Horn Antenna | ETS-Lindgren          | 3117                | 4722  | 12                          | 01-Mar-2019     |
| Mast Controller                      | Maturo GmbH           | NCD                 | 4810  | -                           | TU              |
| Tilt Antenna Mast                    | Maturo GmbH           | TAM 4.0-P           | 4811  | -                           | TU              |
| 9m N type RF cable                   | Rosenberger           | 2303-0 9.0m PNm PNm | 4827  | 6                           | 04-Jan-2019     |
| Hygrometer                           | Rotronic              | HP21                | 4989  | 12                          | 26-Apr-2019     |
| EMI Test Receiver                    | Rohde & Schwarz       | ESW44               | 5084  | 12                          | 12-Sep-2019     |

**Table 13**

TU - Traceability Unscheduled



## **2.6 Spurious Radiated Emissions**

### **2.6.1 Specification Reference**

FCC 47 CFR Part 15C, Clause 15.247 (d) and 15.205  
Industry Canada RSS-247, Clause 5.5  
Industry Canada RSS-GEN, Clause 6.13

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

Free standing blast controller, S/N: 1030002244 - Modification State 0  
GS25B18-P1J, S/N: N/A - Modification State 0  
DIPL-A0049, S/N: Not Serialised (75943833- TSR0014) - Modification State 0

### **2.6.3 Date of Test**

27-November-2018

### **2.6.4 Test Method**

This test was performed in accordance with ANSI C63.10-2013 clause 6.3, 6.5 and 6.6.  
For frequencies > 1 GHz, plots for average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.3 to characterize the EUT. Where emissions were detected, final average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.2.

Where emissions were found to be pulsed in nature they were measured in accordance with ANSI C63.10 clause 7.5. A peak measurement was performed and then a duty cycle correction factor was added to the peak measurement.

Duty cycle correction factor (dB)  
 $= 20\log(\text{On Time}/(\text{On Time}+\text{Off Time})) = 20\log(2.91\text{mS}/(2.91\text{mS}+1000.00\text{mS})) = -50.74\text{dB}$   
The plots shown are the characterization of the EUT. The limits on the plots represent the most stringent case for restricted bands, (74/54 dBuV/m) when compared to 20 dBc outside restricted bands. The limits shown have been used as a threshold to determine where further measurements are necessary. Where results are within 10 dB of the limits shown on the plots, further investigation was carried out and reported in results tables.

Over the range 614 MHz to 960 MHz the -20dBc limit of 83.78dBuV/m has been shown.

The following conversion can be applied to convert from dBuV/m to uV/m:  
 $10^{(\text{Field Strength in dBuV/m}/20)}$ .

### **2.6.5 Environmental Conditions**

|                     |         |
|---------------------|---------|
| Ambient Temperature | 18.1 °C |
| Relative Humidity   | 47.0 %  |

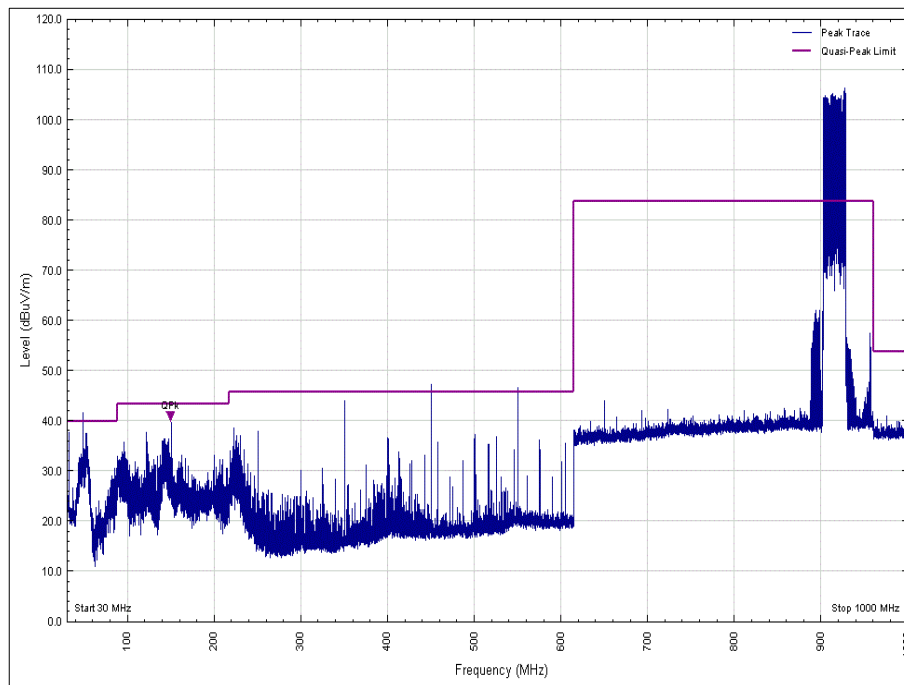
## 2.6.6 Test Results

### 902 to 928 MHz FHSS Transmitter

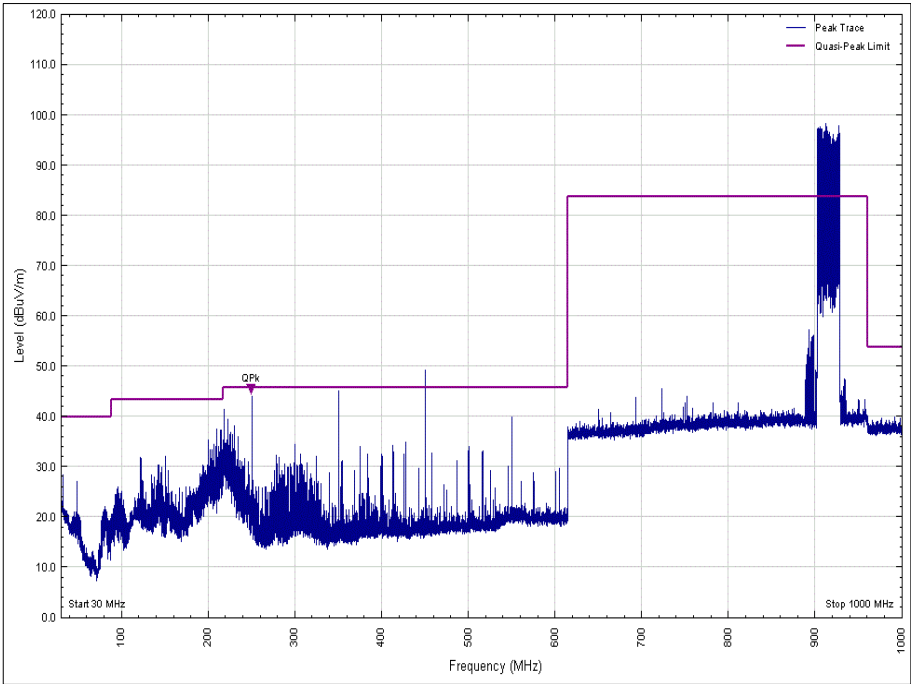
| Frequency (MHz) | Level | Limit | Margin | Detector | Unit   | Angle (°) | Height (cm) | Polarisation |
|-----------------|-------|-------|--------|----------|--------|-----------|-------------|--------------|
| 121.790         | 36.2  | 43.5  | -7.3   | Q-Peak   | dBuV/m | 163       | 100         | Vertical     |
| 149.995         | 39.3  | 43.5  | -4.2   | Q-Peak   | dBuV/m | 255       | 100         | Vertical     |
| 400.015         | 36.9  | 46.0  | -9.1   | Q-Peak   | dBuV/m | 347       | 127         | Vertical     |
| 250.002         | 44.1  | 46.0  | -2.0   | Q-Peak   | dBuV/m | 173       | 107         | Horizontal   |

**Table 14 – Frequency Hopping - 30 MHz to 1 GHz - EUT Orientation: X**

No other emissions were detected within 10 dB of the limit.



**Figure 13 - Frequency Hopping - 30 MHz to 1 GHz  
 Polarity: Vertical, EUT Orientation: X**



**Figure 14 - Frequency Hopping - 30 MHz to 1 GHz**  
**Polarity: Horizontal, EUT Orientation: X**



| Frequency (MHz) | Level | Limit | Margin | Detector | Unit | Angle (°) | Height (cm) | Polarisation |
|-----------------|-------|-------|--------|----------|------|-----------|-------------|--------------|
| *               |       |       |        |          |      |           |             |              |

Table 15 - Frequency Hopping – 1 GHz to 10 GHz - EUT Orientation: X

\*No emissions were detected within 10 dB of the limit.

Remarks

Average levels were determined by subtracting the duty cycle correction factor (as calculated in section 2.6.4) from the peak level. The average level of all emissions had a margin of more than 10 dB from the applicable limit.

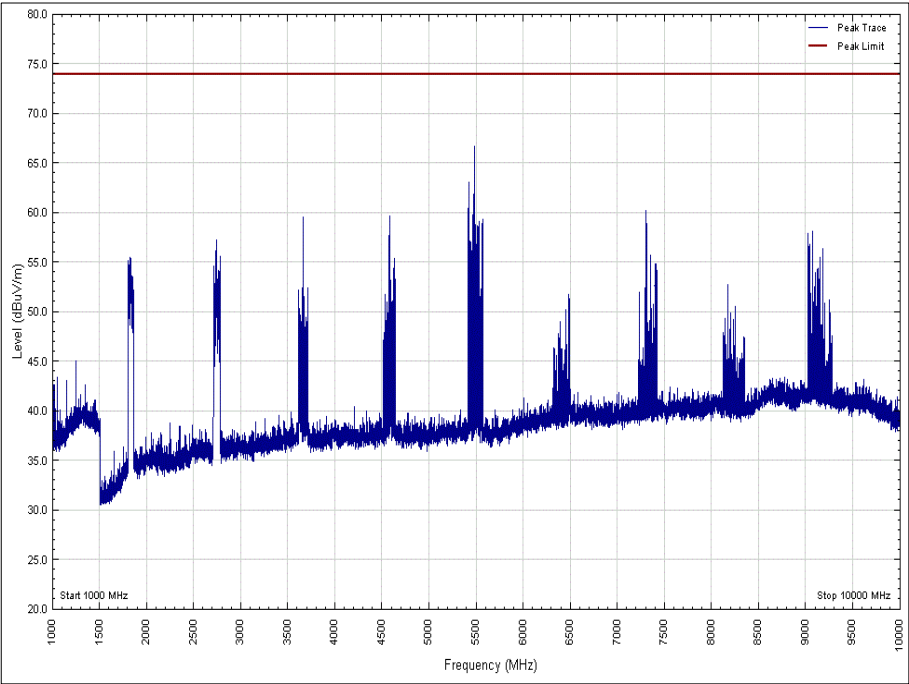
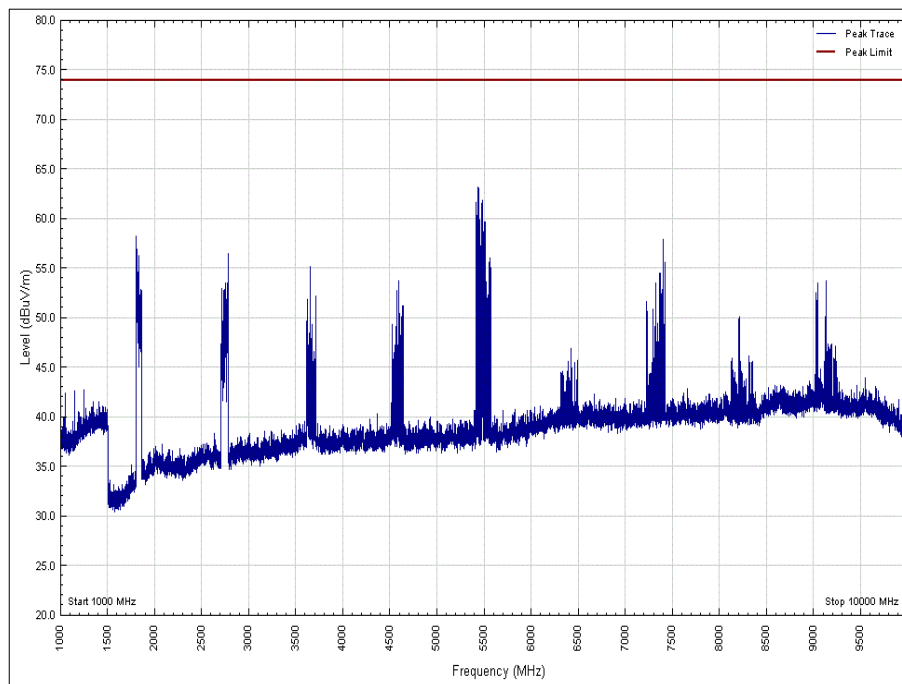


Figure 15 - Frequency Hopping - 1 GHz to 10 GHz Peak  
Polarity: Vertical, EUT Orientation: X



**Figure 16 - Frequency Hopping - 1 GHz to 10 GHz Peak**  
**Polarity: Horizontal, EUT Orientation: X**

FCC 47 CFR Part 15, Limit Clause 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in 15.209(a)

Industry Canada RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.



## 2.6.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

| Instrument                                | Manufacturer        | Type No                | TE No | Calibration Period (months) | Calibration Due |
|-------------------------------------------|---------------------|------------------------|-------|-----------------------------|-----------------|
| Pre-Amplifier                             | Phase One           | PS04-0086              | 1533  | 12                          | 12-Jan-2019     |
| 18GHz - 40GHz Pre-Amplifier               | Phase One           | PSO4-0087              | 1534  | 12                          | 02-Feb-2019     |
| Screened Room (5)                         | Rainford            | Rainford               | 1545  | 36                          | 23-Jan-2021     |
| Turntable Controller                      | Inn-Co GmbH         | CO 1000                | 1606  | -                           | TU              |
| Digital Multimeter                        | Iso-tech            | IDM-101                | 2895  | 12                          | 04-Oct-2019     |
| Antenna with permanent attenuator (Bilog) | Chase               | CBL6143                | 2904  | 24                          | 08-Aug-2019     |
| 1501A 4.0M Km Km Cable                    | Rhophase            | KPS-1501A-4000-KPS     | 4301  | 12                          | 19-Feb-2019     |
| 1GHz to 8GHz Low Noise Amplifier          | Wright Technologies | APS04-0085             | 4365  | 12                          | 25-Oct-2019     |
| 1 metre K-Type Cable                      | Florida Labs        | KMS-180SP-39.4-KMS     | 4520  | 12                          | 13-Feb-2019     |
| Cable (Rx, Km-Km 2m)                      | Scott Cables        | KPS-1501-2000-KPS      | 4526  | 6                           | 26-Apr-2019     |
| High Pass Filter (4GHz)                   | K&L Microwave       | 11SH10-4000/X18000-0/0 | 4599  | 12                          | 04-Sep-2019     |
| Double Ridged Waveguide Horn Antenna      | ETS-Lindgren        | 3117                   | 4722  | 12                          | 01-Mar-2019     |
| Mast Controller                           | Maturo GmbH         | NCD                    | 4810  | -                           | TU              |
| Tilt Antenna Mast                         | Maturo GmbH         | TAM 4.0-P              | 4811  | -                           | TU              |
| 9m N type RF cable                        | Rosenberger         | 2303-0 9.0m PNm PNm    | 4827  | 6                           | 04-Jan-2019     |
| 4dB Attenuator                            | Pasternack          | PE7047-4               | 4935  | 12                          | 28-Nov-2018     |
| Hygrometer                                | Rotronic            | HP21                   | 4989  | 12                          | 26-Apr-2019     |
| EMI Test Receiver                         | Rohde & Schwarz     | ESW44                  | 5084  | 12                          | 12-Sep-2019     |
| EmX Software                              | TUV SUD             | EmX                    | 5125  | -                           | Software        |

**Table 16**

TU - Traceability Unscheduled



## 2.7 Frequency Hopping Systems - 20 dB Bandwidth

### 2.7.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)  
Industry Canada RSS-247, Clause 5.1

### 2.7.2 Equipment Under Test and Modification State

Free standing blast controller, S/N: 1030002244 - Modification State 0

### 2.7.3 Date of Test

11-December-2018

### 2.7.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.9.1.

### 2.7.5 Environmental Conditions

Ambient Temperature 22.4 °C  
Relative Humidity 35.1 %

### 2.7.6 Test Results

902 to 928 MHz FHSS Transmitter

| 20 dB Bandwidth (kHz) |         |         |
|-----------------------|---------|---------|
| 902 MHz               | 915 MHz | 928 MHz |
| 164.5                 | 179.5   | 16.54   |

Table 17



Figure 17 - 902 MHz



Figure 18 - 915 MHz



Figure 19 - 928 MHz

FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(i) and Industry Canada RSS-247, Limit Clause 5.1 (3)

The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.



### 2.7.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

| Instrument              | Manufacturer          | Type No                      | TE No | Calibration Period (months) | Calibration Due |
|-------------------------|-----------------------|------------------------------|-------|-----------------------------|-----------------|
| Standard                | Rohde & Schwarz       | XSRM                         | 1316  | 6                           | 16-Apr-2019     |
| Hygrometer              | Rotronic              | A1                           | 1388  | 12                          | 20-Jun-2019     |
| Frequency Standard      | Spectracom            | SecureSync<br>1200-0408-0601 | 4393  | 6                           | 16-Apr-2019     |
| Attenuator (30dB, 100W) | Weinschel             | 48-30-43                     | 4871  | 12                          | 17-Jul-2019     |
| EXA                     | Keysight Technologies | N9010B                       | 4969  | 12                          | 21-Dec-2018     |

**Table 18**



## **2.8 Restricted Band Edges**

### **2.8.1 Specification Reference**

FCC 47 CFR Part 15C, Clause 15.205  
Industry Canada RSS-GEN, Clause 8.10

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

Free standing blast controller, S/N: 1030002244 - Modification State 0  
GS25B18-P1J, S/N: N/A - Modification State 0  
DIPL-A0049, S/N: Not Serialised (75943833- TSR0014) - Modification State 0

### **2.8.3 Date of Test**

27-November-2018

### **2.8.4 Test Method**

This test was performed in accordance with ANSI C63.10, clause 6.10.5.

The following conversion can be applied to convert from dB $\mu$ V/m to  $\mu$ V/m:  
 $10^{(\text{Field Strength in dB}\mu\text{V/m}/20)}$ .

### **2.8.5 Environmental Conditions**

Ambient Temperature 18.1 °C  
Relative Humidity 47.0 %

### **2.8.6 Test Results**

902 to 928 MHz FHSS Transmitter

| Mode    | Frequency (MHz) | Measured Frequency (MHz) | Peak Level (dB $\mu$ V/m) |
|---------|-----------------|--------------------------|---------------------------|
| Hopping | 614             | 614                      | 36.44                     |
| Hopping | 960             | 960                      | 41.06                     |

**Table 19**

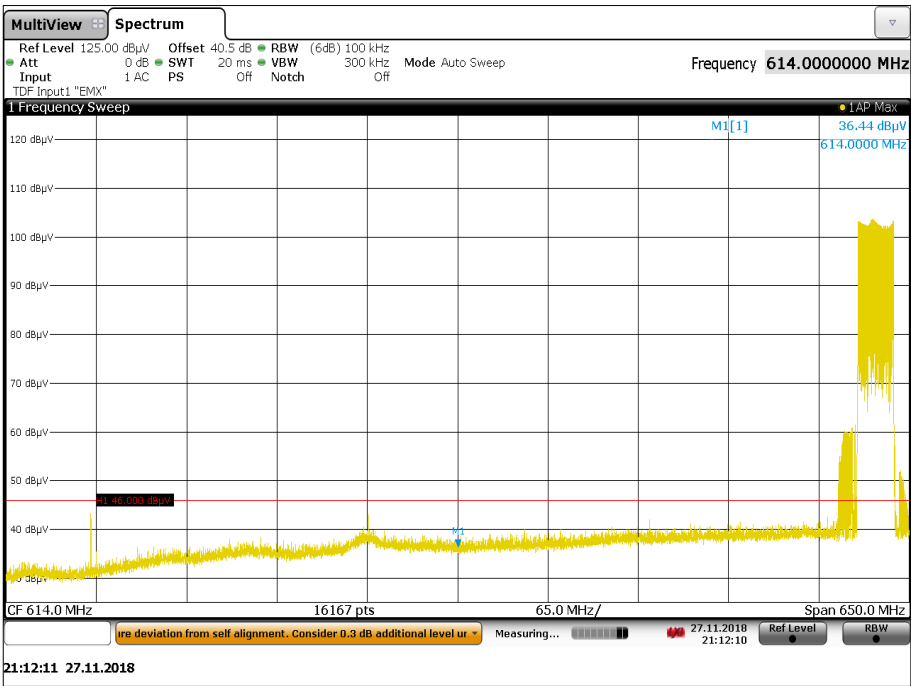


Figure 20 - Hopping 614 MHz - Measured Frequency 614 MHz - Peak

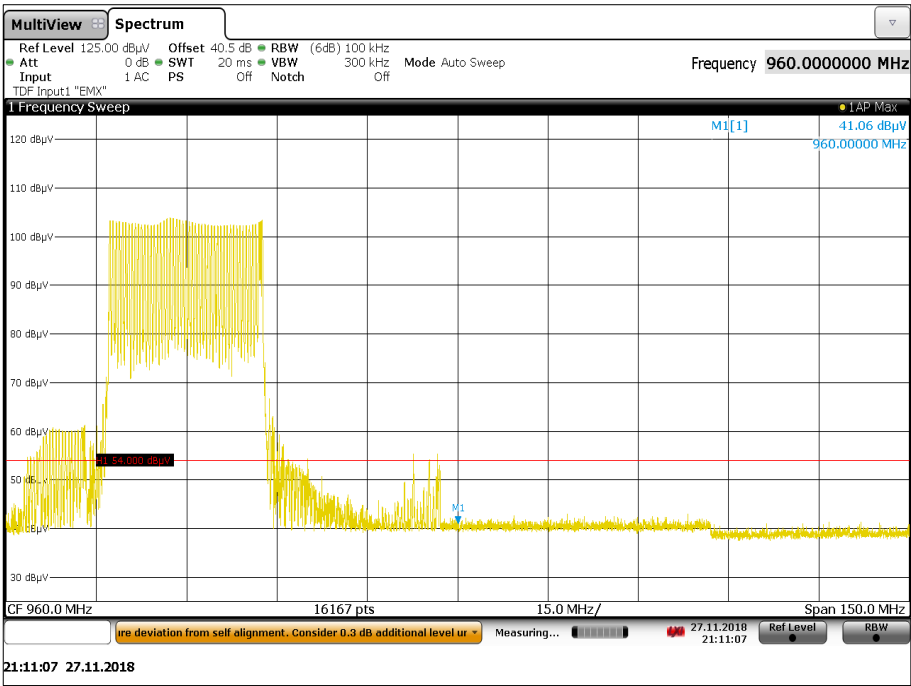


Figure 21 - Hopping 960 MHz - Measured Frequency 960 MHz - Peak



FCC 47 CFR Part 15, Limit Clause 15.209

| Frequency (MHz) | Field Strength ( $\mu\text{V}/\text{m}$ at 3 m) |
|-----------------|-------------------------------------------------|
| 30 to 88        | 100                                             |
| 88 to 216       | 150                                             |
| 216 to 960      | 200                                             |
| Above 960       | 500                                             |

**Table 20**

Industry Canada RSS-GEN, Limit Clause 8.9

| Frequency (MHz) | Field Strength ( $\mu\text{V}/\text{m}$ at 3 metres) |
|-----------------|------------------------------------------------------|
| 30-88           | 100                                                  |
| 88-216          | 150                                                  |
| 216-960         | 200                                                  |
| Above 960*      | 500                                                  |

**Table 21**

\*Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.



## 2.8.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

| Instrument                           | Manufacturer    | Type No             | TE No | Calibration Period (months) | Calibration Due |
|--------------------------------------|-----------------|---------------------|-------|-----------------------------|-----------------|
| Screened Room (5)                    | Rainford        | Rainford            | 1545  | 36                          | 23-Jan-2021     |
| Turntable Controller                 | Inn-Co GmbH     | CO 1000             | 1606  | -                           | TU              |
| Cable (Rx, Km-Km 2m)                 | Scott Cables    | KPS-1501-2000-KPS   | 4526  | 6                           | 26-Apr-2019     |
| Double Ridged Waveguide Horn Antenna | ETS-Lindgren    | 3117                | 4722  | 12                          | 01-Mar-2019     |
| Mast Controller                      | Maturo GmbH     | NCD                 | 4810  | -                           | TU              |
| Tilt Antenna Mast                    | Maturo GmbH     | TAM 4.0-P           | 4811  | -                           | TU              |
| 9m N type RF cable                   | Rosenberger     | 2303-0 9.0m PNm PNm | 4827  | 6                           | 04-Jan-2019     |
| Hygrometer                           | Rotronic        | HP21                | 4989  | 12                          | 26-Apr-2019     |
| EMI Test Receiver                    | Rohde & Schwarz | ESW44               | 5084  | 12                          | 12-Sep-2019     |

**Table 22**

TU - Traceability Unscheduled

## 3 Photographs

### 3.1 Test Setup Photographs

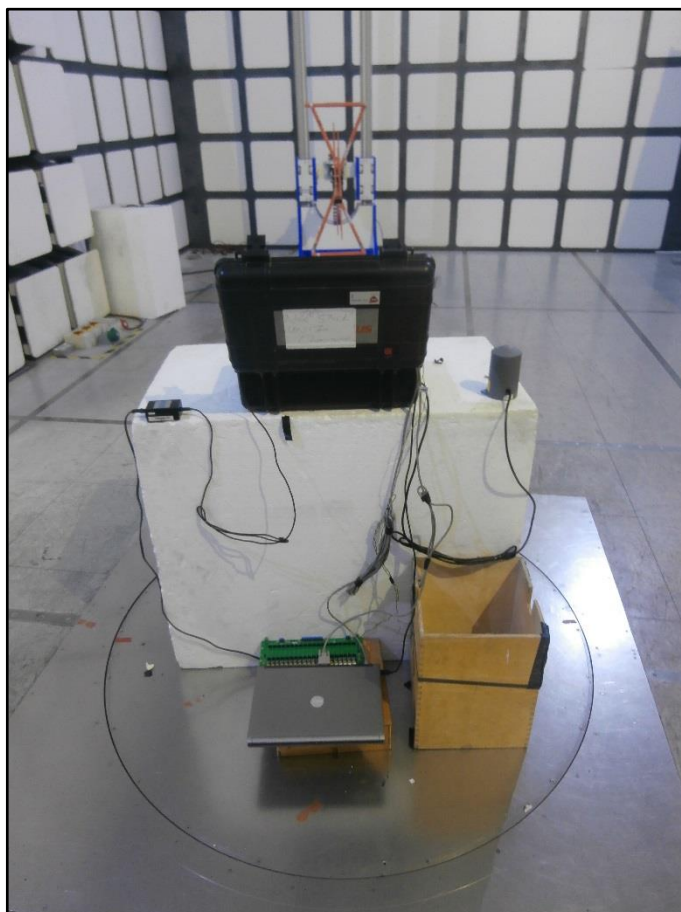


Figure 22 – Spurious Emissions 30 MHz to 1 GHz



**Figure 23 – Spurious Emissions 1 GHz to 10 GHz**



## 4 Measurement Uncertainty

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

| Test Name                                              | Measurement Uncertainty                                        |
|--------------------------------------------------------|----------------------------------------------------------------|
| Restricted Band Edges                                  | 30 MHz to 1 GHz: $\pm 5.2$ dB<br>1 GHz to 40 GHz: $\pm 6.3$ dB |
| Frequency Hopping Systems - 20 dB Bandwidth            | $\pm 17.944$ kHz                                               |
| Spurious Radiated Emissions                            | 30 MHz to 1 GHz: $\pm 5.2$ dB<br>1 GHz to 40 GHz: $\pm 6.3$ dB |
| Authorised Band Edges                                  | 30 MHz to 1 GHz: $\pm 5.2$ dB<br>1 GHz to 40 GHz: $\pm 6.3$ dB |
| Frequency Hopping Systems - Number of Hopping Channels | -                                                              |
| Frequency Hopping Systems - Channel Separation         | $\pm 17.944$ kHz                                               |
| Frequency Hopping Systems - Average Time of Occupancy  | -                                                              |
| Maximum Conducted Output Power                         | $\pm 3.2$ dB                                                   |

**Table 23**