Report on the Industry Canada Testing of:

DETNET SOUTH AFRICA (PTY) LTD
Blasting control of electronic detonators, Model: CE4 Commander

In accordance with 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

IC: 24476-15351660

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Document Number: 75943624-17 | Issue: 02

SIGNATURE			
Ryan Henley			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Ryan Henley	Sales Manager	Authorised Signatory	02 February 2022

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 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**
Graeme Lawler	Test Engineer	Testing	02 February 2022
Nandhini Mathivanan	Test Engineer	Testing	02 February 2022

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 Industry Canada RSS-247 Issue 2 (2017-02) and Industry Canada RSS-GEN: Issue 5 (2018-04).

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).

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Contents

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	03 April 2019
2	Add Declared Variant	02 February 2022

Table 1

1.2 Introduction

Applicant	DETNET SOUTH AFRICA (PTY) LTD
Manufacturer	DETNET SOUTH AFRICA (PTY) LTD
Model Number(s)	CE4 Commander
Manufacturer's Declared Variant(s)	CE4 Commander DS600
Serial Number(s)	1530000B8
Hardware Version(s)	V5
Software Version(s)	36230C
Number of Samples Tested	1
Test Specification/Issue/Date	Industry Canada RSS-247: Issue 2 (2017-02) Industry Canada RSS-GEN: Issue 5 (2018-04)
Order Number Date	4500366034 06-February-2019
Date of Receipt of EUT	07-September-2018
Start of Test	12-February-2019
Finish of Test	25-February-2019
Name of Engineer(s)	Nandhini Mathivanan and Graeme Lawler
Related Document(s)	ANSI C63.10 (2013)

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with Industry Canada RSS-247 and Industry Canada RSS-GEN is shown below.

Section	Specification Clause		Test Description	Result	Comments/Base Standard
	RSS-247	RSS-GEN			
Configuration and Mode: Commander 1 - 900 MHz					
2.1	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013)
2.2	5.1	-	Frequency Hopping Systems - Average Time of Occupancy	Pass	ANSI C63.10 (2013)
2.3	5.1	-	Frequency Hopping Systems - Channel Separation	Pass	ANSI C63.10 (2013)
2.4	5.1	-	Frequency Hopping Systems - Number of Hopping Channels	Pass	ANSI C63.10 (2013)
2.5	5.1		Frequency Hopping Systems - 20 dB Bandwidth	Pass	ANSI C63.10 (2013)
2.6	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.7	-	8.10	Restricted Band Edges	Pass	ANSI C63.10 (2013)
2.8	5.5	6.13	Spurious Radiated Emissions	Pass	ANSI C63.10 (2013)

Table 2

1.4 Manufacturer's Declared Variant(s)

Classification:	System/Product:	Document Ref:	Revision:
Restricted	DigiShot 600	TGN-00106	1
	Document Type: TGN-Tech General	Current Author: Morgan Lombard	
detnet the future of electronic initiation	Title: Changes between DigiShot 600 Commander and CE4 Commander.	Original Author: Morgan Lombard	
		Page: Page 1 of 3	

1 INTRODUCTION

1.1 Objective

This document describes the differences between the standard CE4 Commander and the DigiShot Commander. Note that from a branding perspective, the system will be branded as 'DigiShot' not 'DigiShot 600' – the latter name being used internally in DetNet to distinguish between the new and old systems.

1.2 Reference Documents

- URS-00111 : DigiShot 600

2 CHANGES

2.1 Hardware Changes

The number of Channels have been reduced to from 4 IOM to 2 IOM.

Table 1 - Hardware differences

	CE4 Commander	DigiShot Commander
Channels	4	2 *

* Channel 3 and 4 will be used on DigiShot.

2.2 Mechanical changes

- Main enclosure colour changed from Pantone Yellow 1235C to Pantone Orange 21C. Base material remains PA 66. Other elements remain the same.
- Top two IOM, bezels, spring-loaded wire terminals, associated gaskets and fastening hardware removed.
- The DigiShot UI Faceplate lacks the holes for the above bezels and spring-loaded wire terminals. A Matt Polycarbonate product label is placed over this area.
- Same packaging will be used as the CE4 Commander, at roughly the same weight (14Kg). Packaging tests are conducted to the nearest Kg so the difference in weight from the lack of two IOM is negligible.
- Fitted with an improved UI front plate and sealing.

APPROVER	APPROVER SIGNATURE	SIGNATURE DATE	ISSUE DATE
Abrie Liebenberg	X  Signed by: AJLieb 20200403	2020/10/20	2020/10/20

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APPROVED

Classification:	System/Product:	Document Ref:	Revision:
Restricted	DigiShot 600	TGN-00106	1
	Document Type:	Current Author:	
This page is valid only if it forms part of the complete document which is approved and dated on the first page and carries the same document reference and revision number on all pages.	TGN-Tech General	Morgan Lombard	
	Title:	Original Author:	
	Changes between DigiShot 600 Commander and CE4 Commander.	Morgan Lombard	
		Page: Page 2 of 3	

Figure 1: CE4 Commander UI vs. DigiShot Commander UI


Figure 2: DigiShot System packaging uses existing CE4 Commander Packaging.

Classification:	System/Product:	Document Ref:	Revision:
Restricted	DigiShot 600	TGN-00106	1
	Document Type:	Current Author:	
	TGN-Tech General	Morgan Lombard	
This page is valid only if it forms part of the complete document which is approved and dated on the first page and carries the same document reference and revision number on all pages.	Title: Changes between DigiShot 600 Commander and CE4 Commander.	Original Author: Morgan Lombard	
		Page: Page 3 of 3	

2.3 Firmware Changes

The Base is only allowed to connect to one Bench by default. A ticket option can be used to change the number of benches to two. The Bench only allows 300 detonators per channel. The Bench is limited to two channels. The Bench only works with DigiShot detonators.

Table 2 - Firmware differences

	CE4 Commander	DigiShot Commander
Benches	10	1 (2)
Channels	4	2
Detonators per Channel	400	300
Detonator Product	DigiShot+, IntelliShot	DigiShot

3 REVISION HISTORY

Revision 1: New document

1.5 Declaration of Build Status

MAIN EUT			
MANUFACTURING DESCRIPTION	Blasting control of electronic detonators		
MANUFACTURER	DetNet South Africa		
MODEL NAME/NUMBER	CE4 Commander		
PART NUMBER			
SERIAL NUMBER			
HARDWARE VERSION	V5		
SOFTWARE VERSION	36230C		
PSU VOLTAGE/FREQUENCY/CURRENT			
HIGHEST INTERNALLY GENERATED / USED FREQUENCY	3177.2 MHz		
FCC ID (if applicable)	2ARNH-15351660		
INDUSTRY CANADA ID (if applicable)	24476-15351660		
TECHNICAL DESCRIPTION (a brief description of the intended use and operation)	Free standing blast controller for testing and blasting of electronic detonators.		
COUNTRY OF ORIGIN	South Africa		
RF CHARACTERISTICS (if applicable)			
TRANSMITTER FREQUENCY OPERATING RANGE (MHz)	902 – 928		
RECEIVER FREQUENCY OPERATING RANGE (MHz)	902 – 928		
INTERMEDIATE FREQUENCIES	3 177.2 MHz		
EMISSION DESIGNATOR(S): (i.e. G1D, GXW)			
MODULATION TYPES: (i.e. GMSK, QPSK)	ASK, CCK, BPSK, QPSK, 16QAM, 64QAM		
OUTPUT POWER (W or dBm)	30dBm		
SEPARATE BATTERY/POWER SUPPLY (if applicable)			
MANUFACTURING DESCRIPTION			
MANUFACTURER			
TYPE			
PART NUMBER			
PSU VOLTAGE/FREQUENCY/CURRENT			
COUNTRY OF ORIGIN			
MODULES (if applicable)			
MANUFACTURING DESCRIPTION	Long range RF	WiFi Module	NFC
MANUFACTURER	900 MHz Laird Transceiver (was aerocomm)	Gain Span	ST
TYPE	AC4490LR-100	GS1011MEP	ST95HF
POWER	30dBm	18dBm	6dBm
FCC ID	KQLAC4490	YOPGS1011MEP	YCPEVALST95HF
INDUSTRY CANADA ID			
EMISSION DESIGNATOR			
DHSS/FHSS/COMBINED OR OTHER			
COUNTRY OF ORIGIN			
ANCILLARIES (if applicable)			
MANUFACTURING DESCRIPTION			
MANUFACTURER			
TYPE			
PART NUMBER			
SERIAL NUMBER			
COUNTRY OF ORIGIN			

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

Name: H van der Walt Position held: Quality and Compliance Manager
Date: 2018-09-12

1.6 Product Information

1.6.1 Technical Description

CE4 Commander - Free standing blast controller for testing and blasting of electronic detonators.

1.6.2 Test Setup Diagram(s)

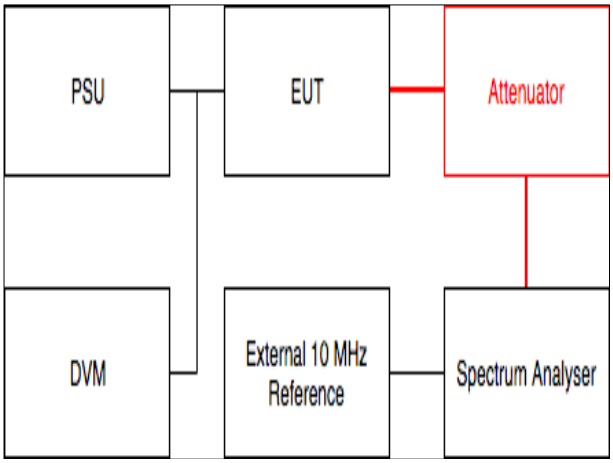

Figure 1 - Conducted Test Setup

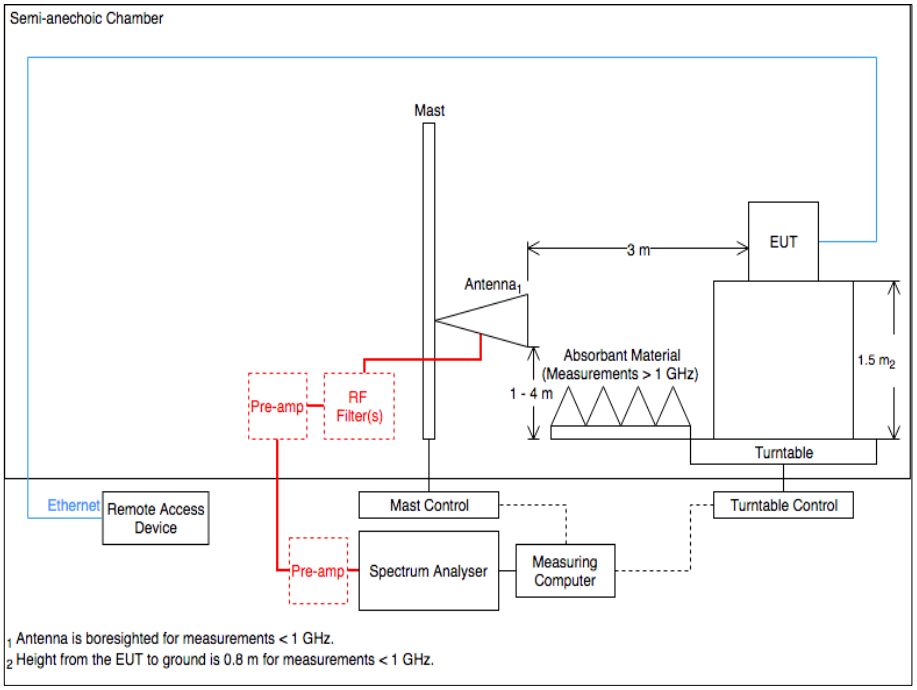

Figure 2 - Radiated Emissions Test Setup

1.6.3 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. Pre-scans were performed with the EUT orientated in an upright position with reference to the ground plane as intended for normal operation.

Ports on the EUT were terminated with loads as described in ANSI C63.4, clause 6.2.4.

1.7 Deviations from the Standard

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

1.8 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
Serial Number: 1530000B8			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3

1.9 Test Location

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

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: Commander 1 - 900 MHz		
Maximum Conducted Output Power	Nandhini Mathivanan	UKAS
Frequency Hopping Systems - Average Time of Occupancy	Nandhini Mathivanan	UKAS
Frequency Hopping Systems - Channel Separation	Nandhini Mathivanan	UKAS
Frequency Hopping Systems - Number of Hopping Channels	Nandhini Mathivanan	UKAS
Frequency Hopping Systems - 20 dB Bandwidth	Nandhini Mathivanan	UKAS
Authorised Band Edges	Graeme Lawler	UKAS
Restricted Band Edges	Graeme Lawler	UKAS
Spurious Radiated Emissions	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

Industry Canada RSS-247, Clause 5.4
Industry Canada RSS-GEN, Clause 6.12

2.1.2 Equipment Under Test and Modification State

CE4 Commander, S/N: 1530000B8 - Modification State 0

2.1.3 Date of Test

14-February-2019

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	21.8 °C
Relative Humidity	35.1 %

2.1.6 Test Results

Commander 1 - 900 MHz

Frequency (MHz)	Maximum Output Power	
	dBm	mW
902.750	29.47	885.116
914.900	29.64	920.500
927.575	29.56	903.650

Table 5 - Maximum Conducted Output Power Results

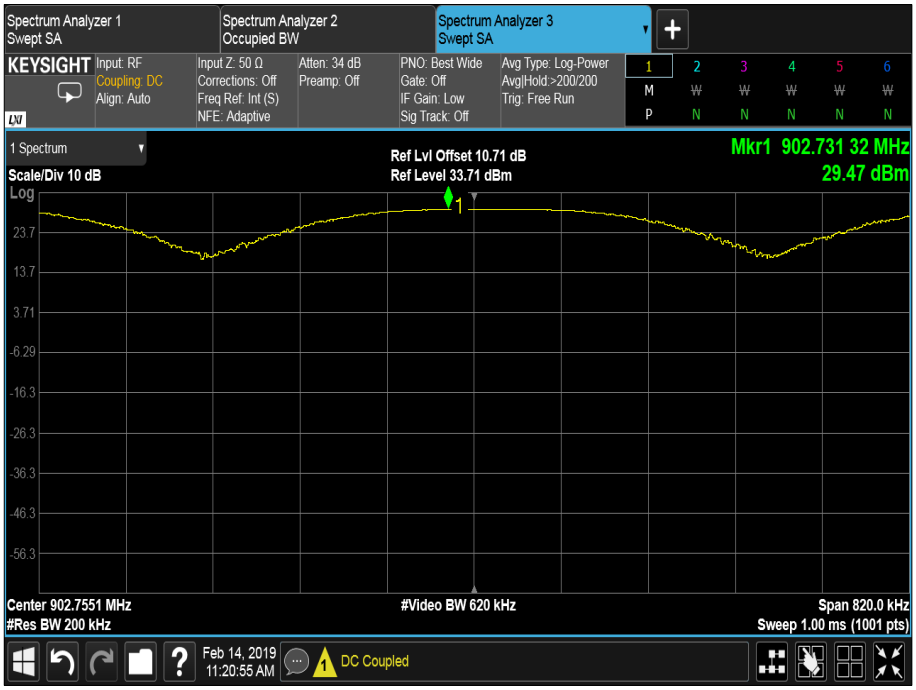

Figure 3 - 902.750 MHz - Maximum Output Power

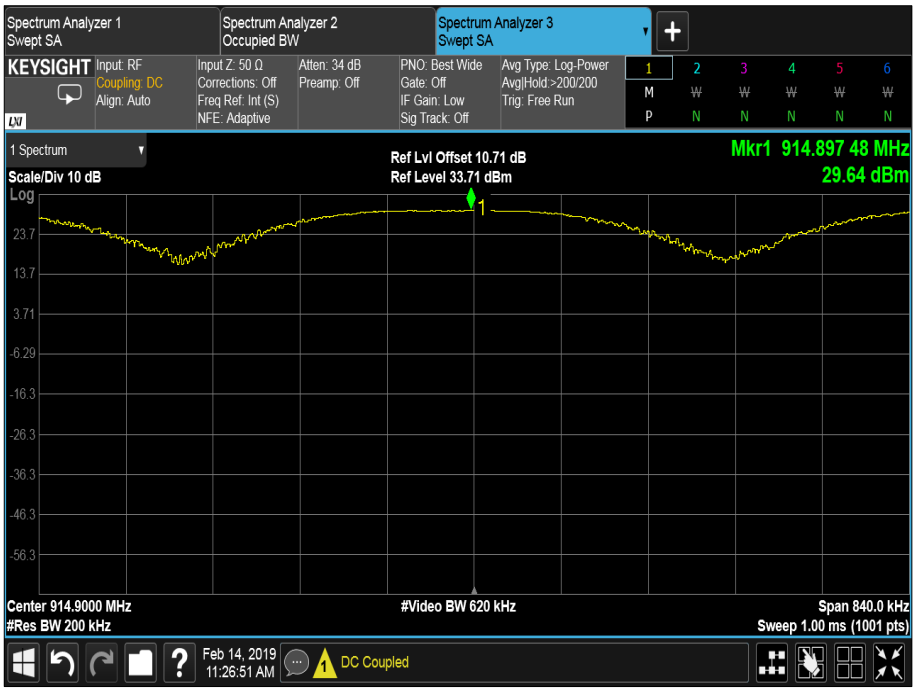

Figure 4 - 914.900 MHz - Maximum Output Power

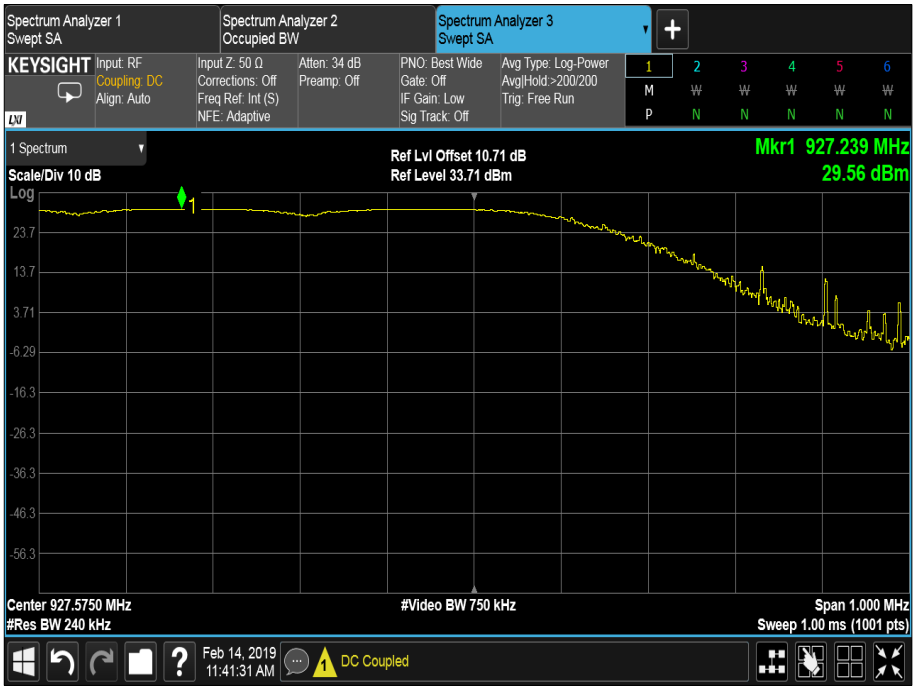

Figure 5 - 927.575 MHz - Maximum Output Power

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 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator (10dB)	Weinschel	47-10-34	481	12	18-Jul-2019
Hygrometer	Rotronic	I-1000	2891	12	18-Sep-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
EXA	Keysight Technologies	N9010B	4969	24	21-Dec-2019
Cable (18GHz	Rosenberger	LU7-071-1000	5096	12	04-Oct-2019

Table 6

2.2 Frequency Hopping Systems - Average Time of Occupancy

2.2.1 Specification Reference

Industry Canada RSS-247, Clause 5.1

2.2.2 Equipment Under Test and Modification State

CE4 Commander, S/N: 1530000B8 - Modification State 0

2.2.3 Date of Test

12-February-2019 to 13-February-2019

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	22.2 °C
Relative Humidity	35.3 %

2.2.6 Test Results

Commander 1 - 900 MHz

Dwell Time (ms)	Number of Transmissions	Average Occupancy Time (ms)
2.950	21	0.062

Table 7

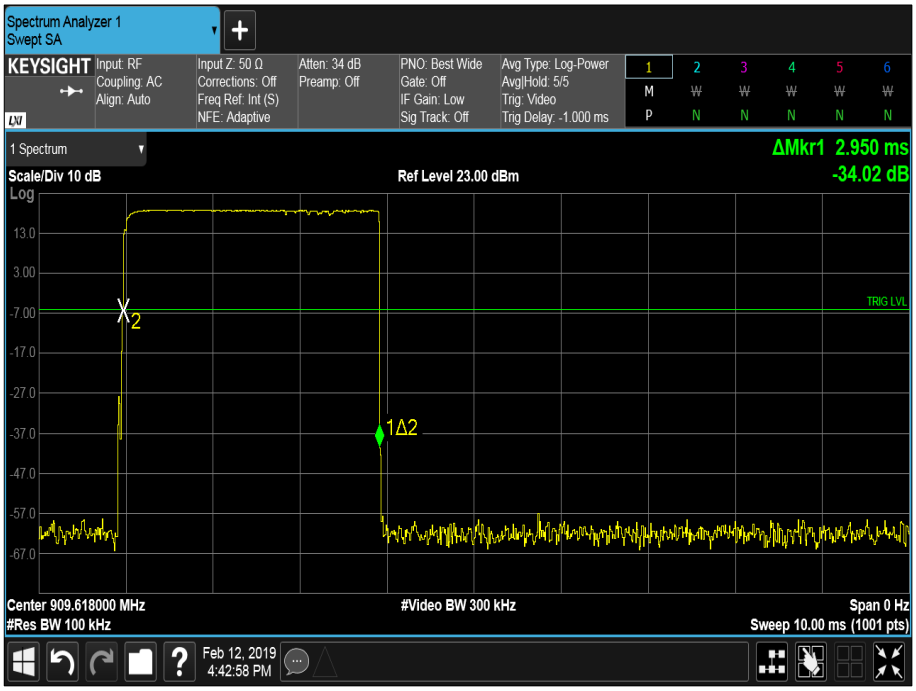

Figure 6 - Dwell Time

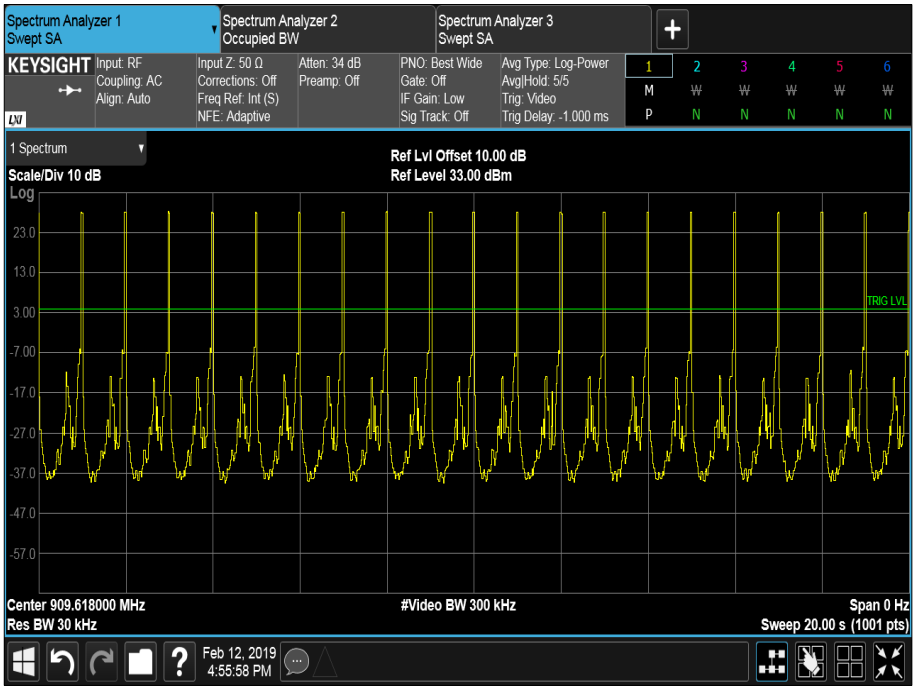

Figure 7 - Total Average Time of Occupancy

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 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator (10dB)	Weinschel	47-10-34	481	12	18-Jul-2019
Hygrometer	Rotronic	I-1000	2891	12	18-Sep-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
EXA	Keysight Technologies	N9010B	4969	24	21-Dec-2019
Cable (18GHz	Rosenberger	LU7-071-1000	5096	12	04-Oct-2019

Table 8

2.3 Frequency Hopping Systems - Channel Separation

2.3.1 Specification Reference

Industry Canada RSS-247, Clause 5.1

2.3.2 Equipment Under Test and Modification State

CE4 Commander, S/N: 1530000B8 - Modification State 0

2.3.3 Date of Test

13-February-2019

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	22.3 °C
Relative Humidity	353.0 %

2.3.6 Test Results

Commander 1 - 900 MHz

Channel Separation (MHz)
0.528

Table 9

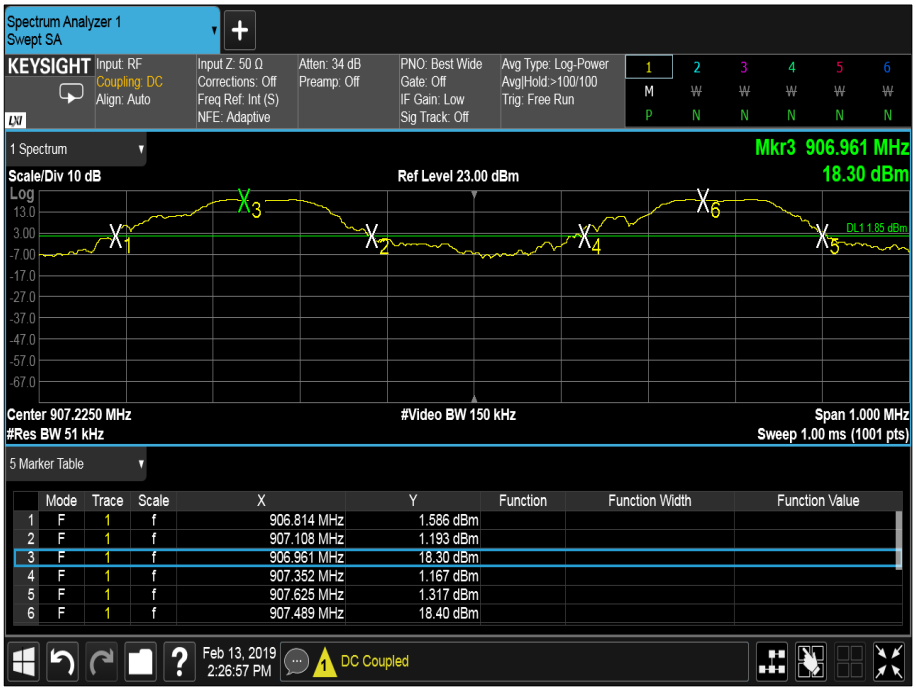

Figure 8, Channel Separation

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 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator (10dB)	Weinschel	47-10-34	481	12	18-Jul-2019
Hygrometer	Rotronic	I-1000	2891	12	18-Sep-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
EXA	Keysight Technologies	N9010B	4969	24	21-Dec-2019
Cable (18GHz	Rosenberger	LU7-071-1000	5096	12	04-Oct-2019

Table 10

2.4 Frequency Hopping Systems - Number of Hopping Channels

2.4.1 Specification Reference

Industry Canada RSS-247, Clause 5.1

2.4.2 Equipment Under Test and Modification State

CE4 Commander, S/N: 1530000B8 - Modification State 0

2.4.3 Date of Test

13-February-2019

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	22.3 °C
Relative Humidity	35.3 %

2.4.6 Test Results

Commander 1 - 900 MHz

Number of Hopping Channels: 50

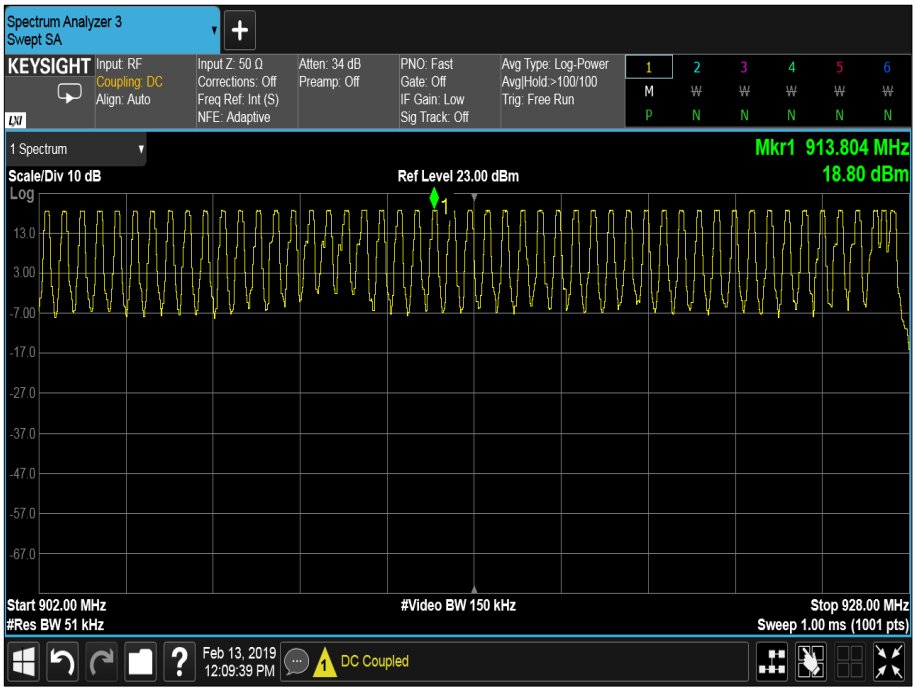

Figure 9 - Measurement Frequency Range: 902 MHz to 928 MHz

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

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 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator (10dB)	Weinschel	47-10-34	481	12	18-Jul-2019
Hygrometer	Rotronic	I-1000	2891	12	18-Sep-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
EXA	Keysight Technologies	N9010B	4969	24	21-Dec-2019
Cable (18GHz	Rosenberger	LU7-071-1000	5096	12	04-Oct-2019

Table 11

2.5 Frequency Hopping Systems - 20 dB Bandwidth

2.5.1 Specification Reference

Industry Canada RSS-247, Clause 5.1

2.5.2 Equipment Under Test and Modification State

CE4 Commander, S/N: 1530000B8 - Modification State 0

2.5.3 Date of Test

13-February-2019

2.5.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.9.2

2.5.5 Environmental Conditions

Ambient Temperature	22.3 °C
Relative Humidity	35.3 %

2.5.6 Test Results

Commander 1 - 900 MHz

20 dB Bandwidth (kHz)		
902.750 MHz	914.900 MHz	927.575 MHz
163.4	167.1	186.2

Table 12

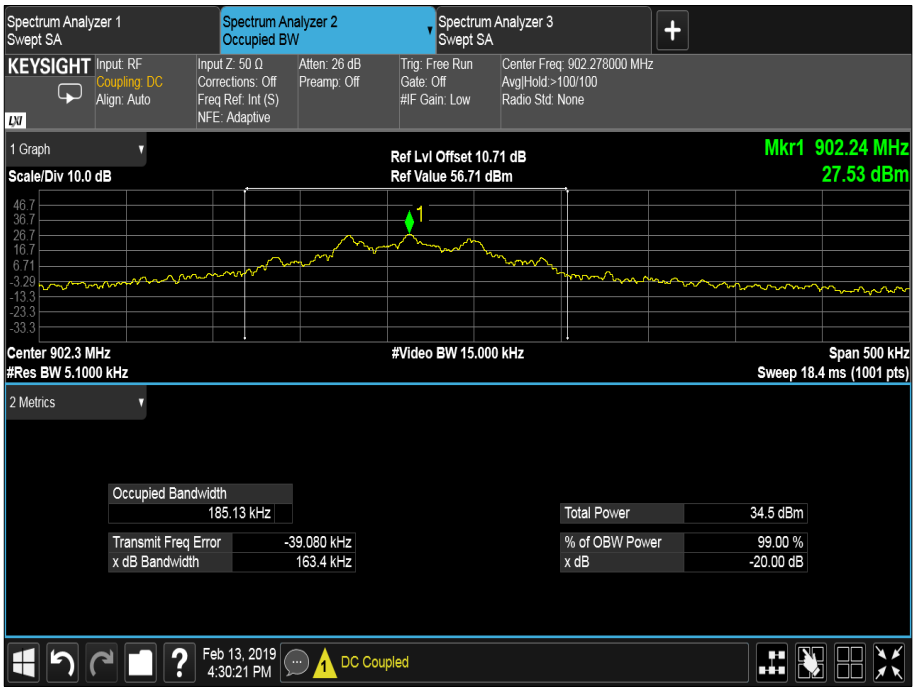

Figure 10 - 902.75 MHz

Figure 11 - 914.90 MHz

Figure 12 - 927.575 MHz

Industry Canada RSS-247, Limit Clause 5.1 (3)

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

2.5.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator (10dB)	Weinschel	47-10-34	481	12	18-Jul-2019
Hygrometer	Rotronic	I-1000	2891	12	18-Sep-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
EXA	Keysight Technologies	N9010B	4969	24	21-Dec-2019
Cable (18GHz	Rosenberger	LU7-071-1000	5096	12	04-Oct-2019

Table 13

2.6 Authorised Band Edges

2.6.1 Specification Reference

Industry Canada RSS-247, Clause 5.5

2.6.2 Equipment Under Test and Modification State

CE4 Commander, S/N: 1530000B8 - Modification State 0

2.6.3 Date of Test

25-February-2019

2.6.4 Test Method

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

2.6.5 Environmental Conditions

Ambient Temperature	20.1 °C
Relative Humidity	32.0 %

2.6.6 Test Results

Commander 1 - 900 MHz

Mode	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
Hopping	902.000	902.00	-24.21
Hopping	928.000	928.00	-37.88

Table 14

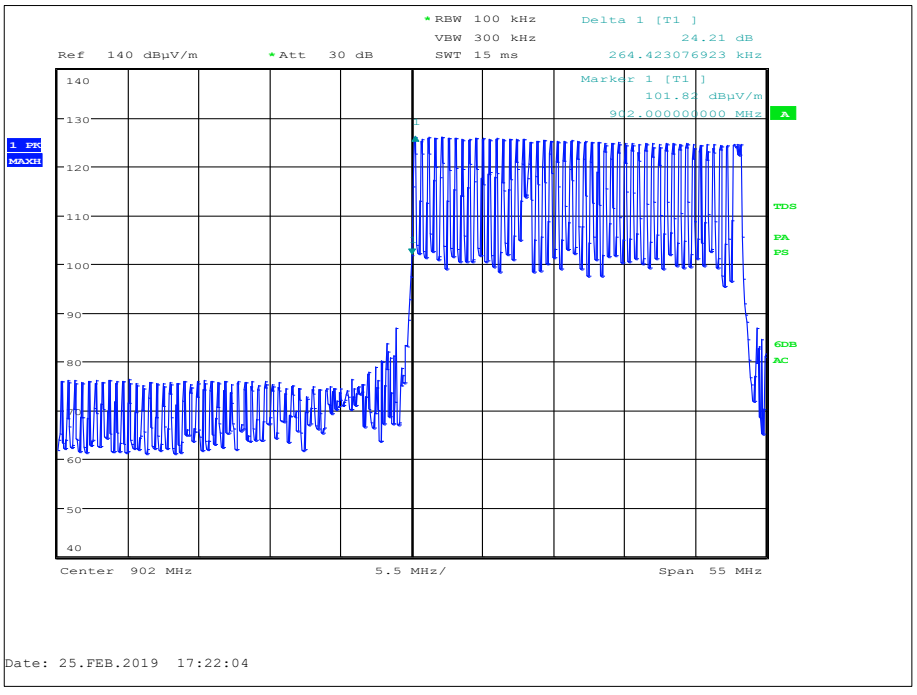

Figure 13 - Hopping - Measured Frequency 902.00 MHz

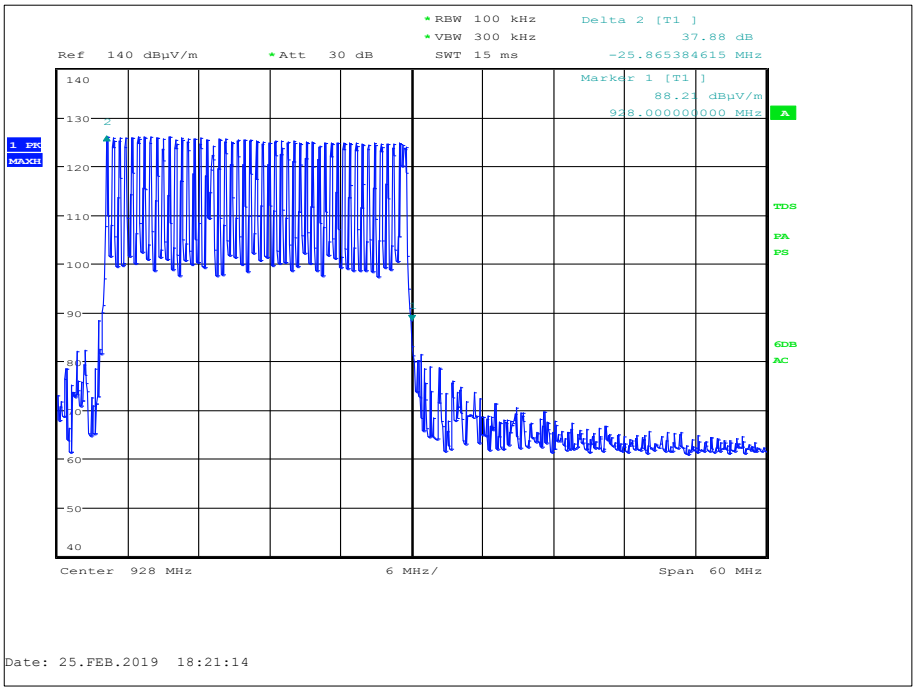

Figure 14 - Hopping - Measured Frequency 928.00 MHz

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
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Antenna with permanent attenuator (Bilog)	Chase	CBL6143	2904	24	08-Aug-2019
Comb Generator	Schaffner	RSG1000	3034	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	17-Dec-2019
Cable (Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4526	6	26-Apr-2019
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	11-Mar-2019
4dB Attenuator	Pasternack	PE7047-4	4935	24	28-Nov-2019
Hygrometer	Rotronic	HP21	4989	12	26-Apr-2019
8m N-Type RF Cable	Teledyne	PR90-088-8MTR	5093	12	04-Oct-2019
EmX Software	TUV SUD	EmX	5125	-	Software

Table 15

TU - Traceability Unscheduled

2.7 Restricted Band Edges

2.7.1 Specification Reference

Industry Canada RSS-GEN, Clause 8.10

2.7.2 Equipment Under Test and Modification State

CE4 Commander, S/N: 1530000B8 - Modification State 0

2.7.3 Date of Test

25-February-2019

2.7.4 Test Method

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

Plots for average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.3. These are shown for information purposes and were used to determine the worst-case measurement point. Final average measurements were then taken in accordance with ANSI C63.10 clause 4.1.4.2.1 to obtain the measurement result recorded in the test results tables.

The following conversion can be applied to convert from dBµV/m to µV/m:
10^(Field Strength in dBµV/m/20).

2.7.5 Environmental Conditions

Ambient Temperature	20.1 °C
Relative Humidity	32.0 %

2.7.6 Test Results

Commander 1 - 900 MHz

Mode	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dBµV/m)
Hopping	902.000	614.000	39.76
Hopping	928.000	960.000	47.44

Table 16

Figure 15 - Hopping - Measured Frequency 614.000 MHz - Peak

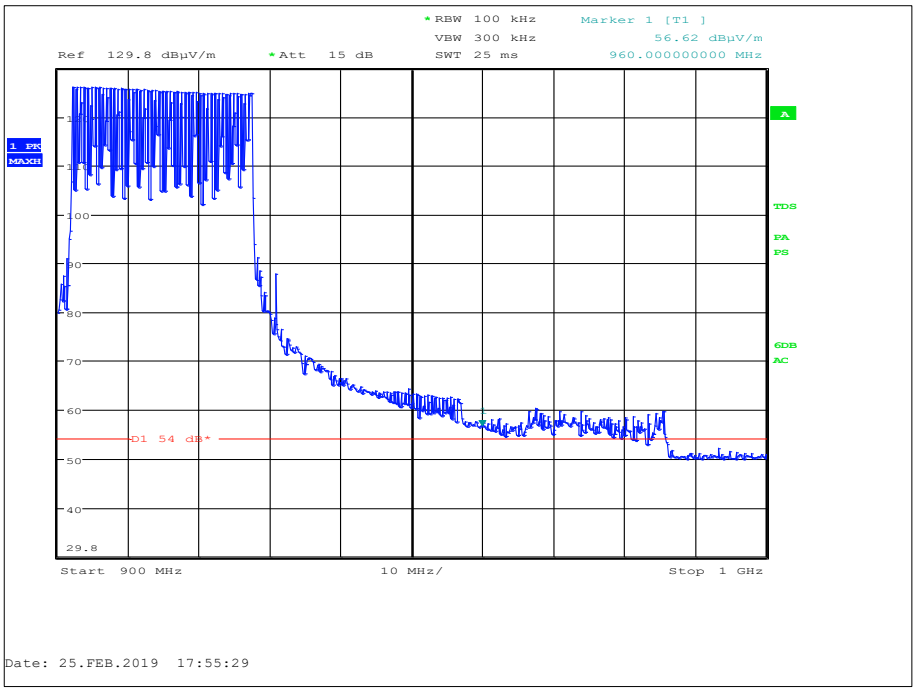

Figure 16 - Hopping - Measured Frequency 960.000 MHz - Peak

Industry Canada RSS-GEN, Limit Clause 8.9

Frequency (MHz)	Field Strength (µV/m at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960*	500

Table 17

*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.

2.7.7 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
Antenna with permanent attenuator (Bilog)	Chase	CBL6143	2904	24	08-Aug-2019
Comb Generator	Schaffner	RSG1000	3034	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	17-Dec-2019
Cable (Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4526	6	26-Apr-2019
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	11-Mar-2019
4dB Attenuator	Pasternack	PE7047-4	4935	24	28-Nov-2019
Hygrometer	Rotronic	HP21	4989	12	26-Apr-2019
8m N-Type RF Cable	Teledyne	PR90-088-8MTR	5093	12	04-Oct-2019
EmX Software	TUV SUD	EmX	5125	-	Software

Table 18

TU - Traceability Unscheduled

2.8 Spurious Radiated Emissions

2.8.1 Specification Reference

Industry Canada RSS-247, Clause 5.5
Industry Canada RSS-GEN, Clause 6.13

2.8.2 Equipment Under Test and Modification State

CE4 Commander, S/N: 1530000B8 - Modification State 0

2.8.3 Date of Test

25-February-2019

2.8.4 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.

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.

The following conversion can be applied to convert from dBµV/m to µV/m:
10^(Field Strength in dBµV/m/20).

For frequencies > 18 GHz, the measurement distance was reduced to 1 meter and the limit line was increased by 20*LOG(3/1) = 9.54 dB.

2.8.5 Environmental Conditions

Ambient Temperature	20.1 °C
Relative Humidity	32.0 %

2.8.6 Test Results

Commander 1 - 900 MHz

Frequency (MHz)	Level	Limit	Margin	Detector	Unit	Angle (°)	Height (cm)	Polarisation
168.010	35.16	43.5	8.3	QPeak	dBuV/m	178	100	Vertical
262.923	39.35	46.0	6.7	QPeak	dBuV/m	201	215	Vertical
263.974	36.55	46.0	9.4	QPeak	dBuV/m	274	100	Horizontal
285.000	39.64	46.0	6.4	QPeak	dBuV/m	213	215	Vertical
324.394	39.24	46.0	6.8	QPeak	dBuV/m	169	151	Vertical
608.000	39.54	46.0	6.5	QPeak	dBuV/m	360	135	Vertical
610.000	39.65	46.0	6.4	QPeak	dBuV/m	360	135	Vertical
612.000	39.68	46.0	6.3	QPeak	dBuV/m	360	135	Vertical
614.000	39.76	46.0	6.2	QPeak	dBuV/m	360	135	Vertical
960.000	47.44	54.0	6.6	QPeak	dBuV/m	360	135	Vertical
966.859	50.34	54.0	3.7	QPeak	dBuV/m	360	135	Vertical
970.640	49.46	54.0	4.5	QPeak	dBuV/m	360	135	Vertical
793.526	50.00	54.0	4.0	QPeak	dBuV/m	360	135	Vertical
975.962	50.16	54.0	3.8	QPeak	dBuV/m	360	135	Vertical
983.333	50.41	54.0	3.6	QPeak	dBuV/m	360	135	Vertical
985.449	52.22	54.0	1.8	QPeak	dBuV/m	360	135	Vertical

Table 19 - 902.75 MHz - 30 MHz to 1 GHz Emissions Results, EUT Orientation: Y

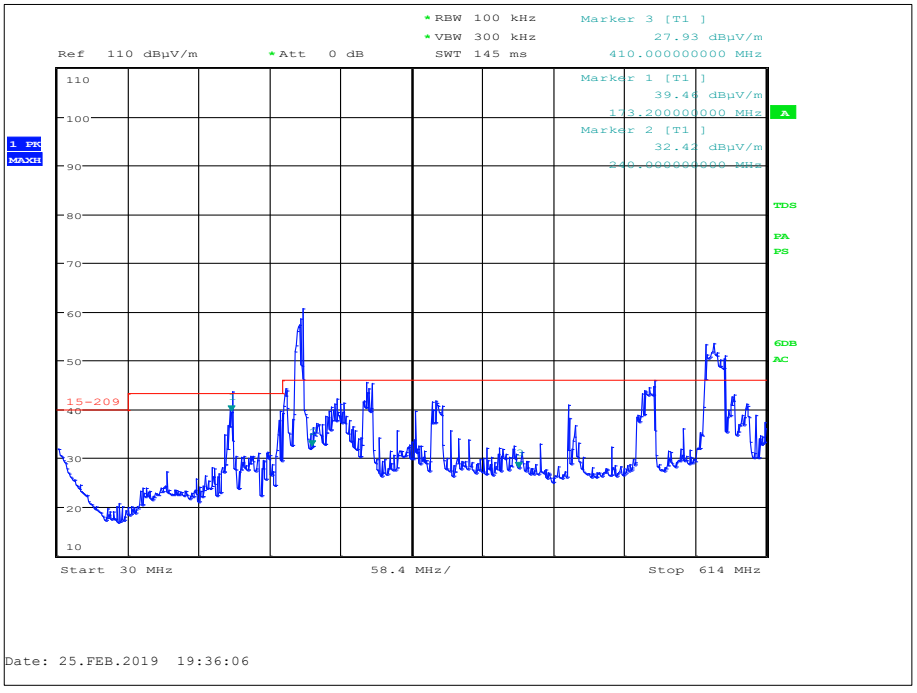

Figure 17 - 902.75 MHz - 30 MHz to 614 MHz, Polarity: Horizontal and Vertical, EUT Orientation: Y

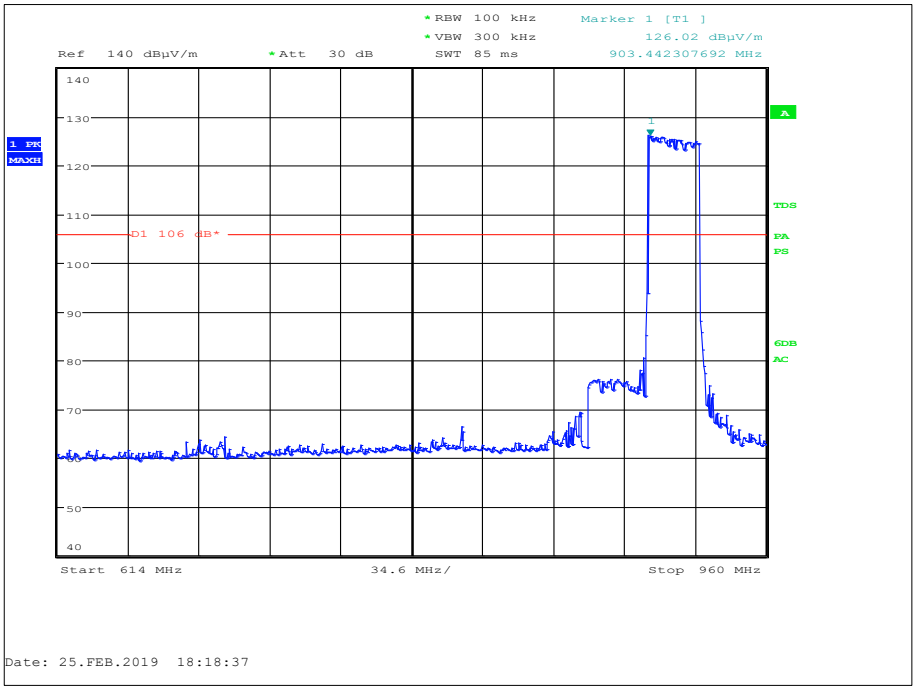

Figure 18 - 902.75 MHz - 614 MHz to 960 MHz, Polarity: Horizontal and Vertical, EUT Orientation: Y

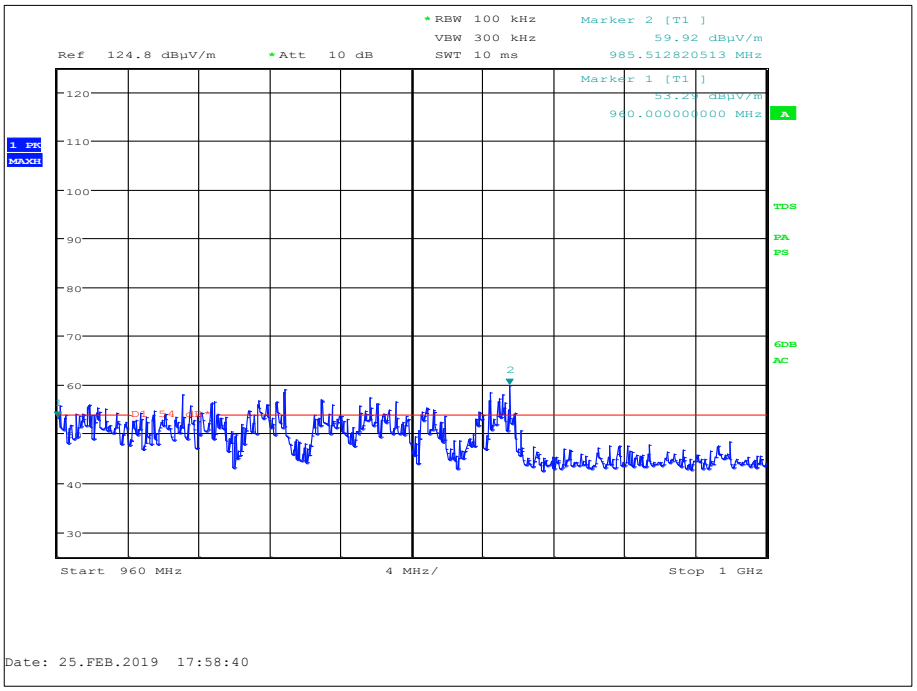

Figure 19 - 902.75 MHz - 960 MHz to 1 GHz, Polarity: Horizontal and Vertical, EUT Orientation: Y

Frequency (GHz)	Result (dBµV/m)		Limit (dBµV/m)		Margin (dBµV/m)	
	Peak	Average	Peak	Average	Peak	Average
1.025580	60.65	46.73	73.98	53.98	13.33	7.25
1.159634	62.19	45.19	73.98	53.98	11.79	8.79
3.621720	65.18	14.78	73.98	53.98	8.80	39.20
5.435460	66.23	15.83	73.98	53.98	7.75	38.15
7.268938	66.23	15.83	73.98	53.98	7.75	38.15
8.120150	71.98	21.48	73.98	53.98	2.00	32.50

Table 20 - 902.75 MHz - 1 GHz to 10 GHz Emissions Results

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

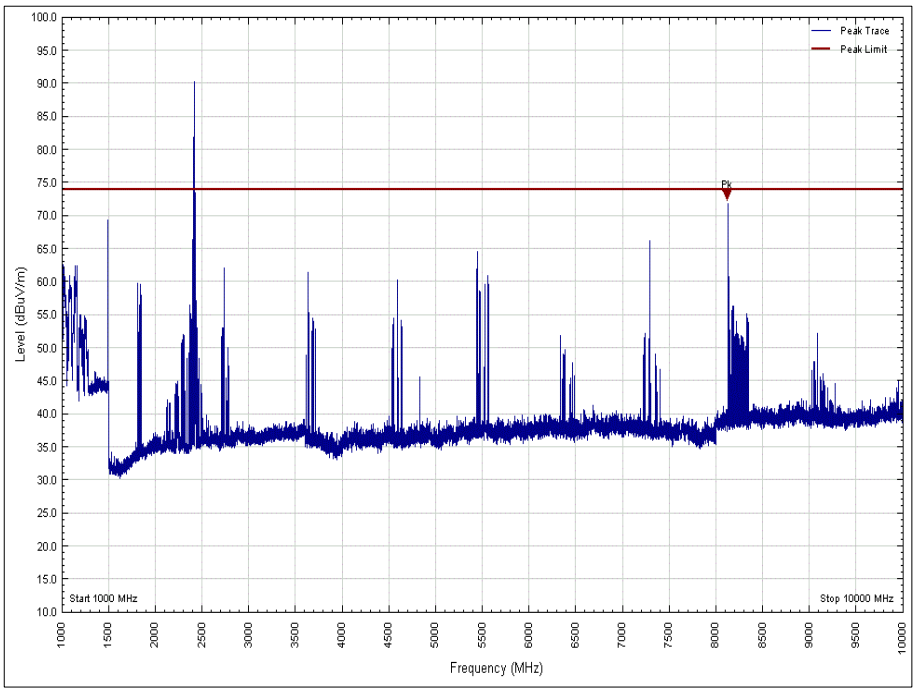

Figure 20 - 902.75 MHz - 1 GHz to 10 GHz - Peak
Polarity: Vertical, EUT Orientation:Y

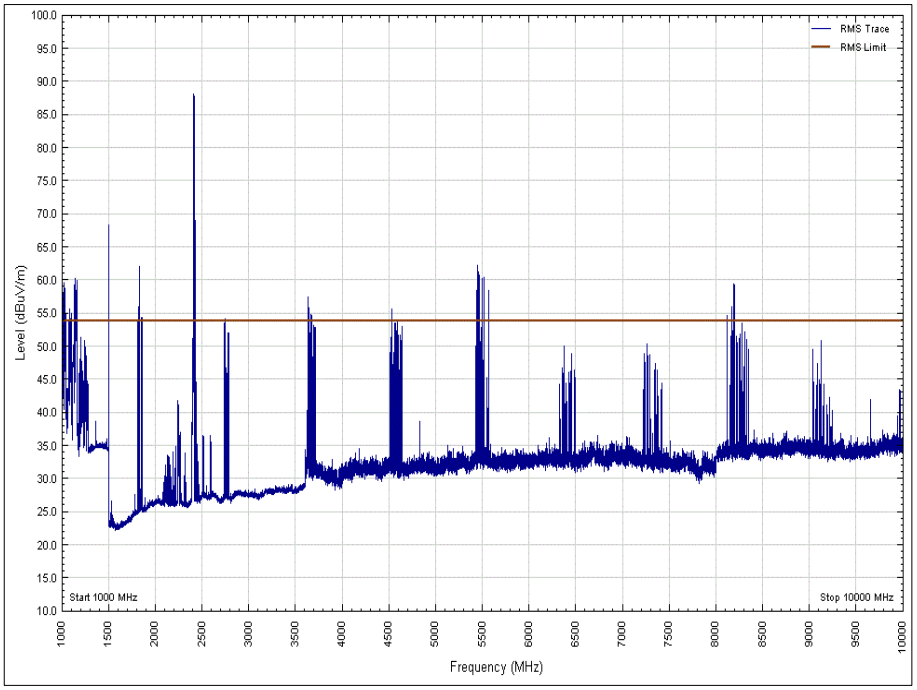

Figure 21 - 902.75 MHz - 1 GHz to 10 GHz - Average
Polarity: Vertical, EUT Orientation: Y

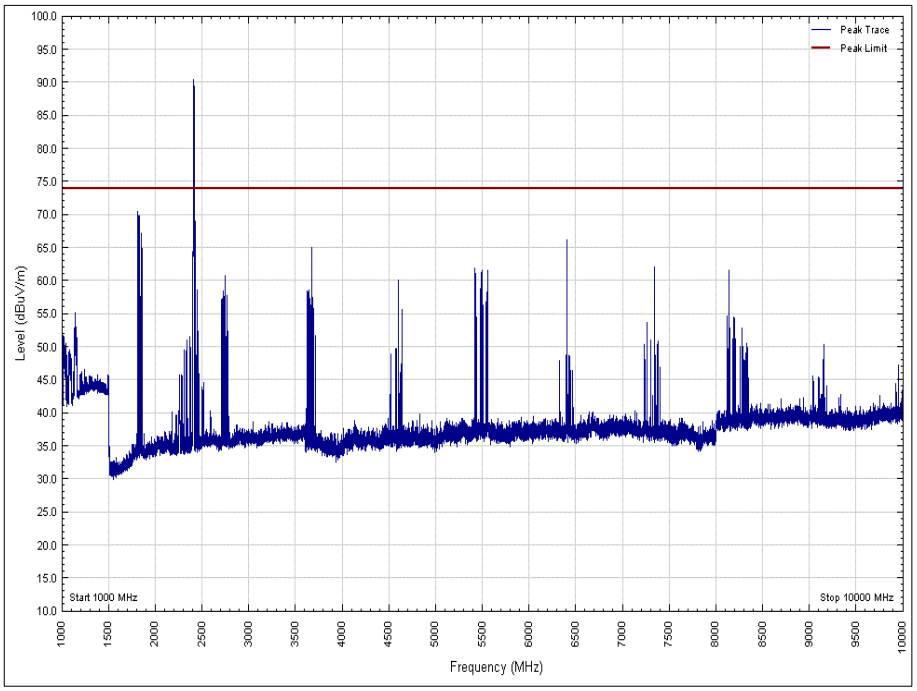

Figure 22 - 902.75 MHz - 1 GHz to 10 GHz - Peak
Polarity: Horizontal, EUT Orientation Y

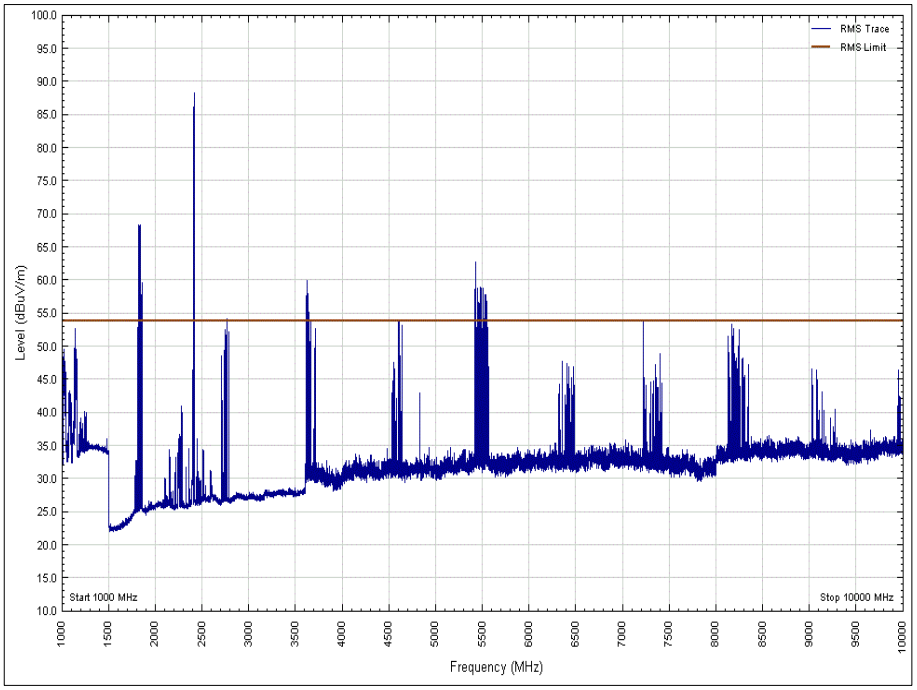

Figure 23 - 902.75 MHz - 1 GHz to 10 GHz - Average
Polarity: Horizontal, EUT Orientation: Y

Remarks

The 2.4 GHz WiFi could not be disabled for the test and therefore it's intentional transmitter can be seen on the plots above but as it is an intentional transmitter it is not subject to the requirements of this test.

The emissions at 1.5 GHz do not fall within a restricted band and therefore the limit is -20 dBc from the peak level of the intentional transmitter at 900 MHz when measured in a 100 kHz RBW.

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.

2.8.7 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
Antenna 18-40GHz (Double Ridge Guide)	Link Microtek Ltd	AM180HA-K-TU2	230	24	02-May-2020
Pre-Amplifier	Phase One	PS04-0086	1533	12	08-Feb-2020
18GHz - 40GHz Pre-Amplifier	Phase One	PSO4-0087	1534	12	05-Feb-2020
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Antenna with permanent attenuator (Bilog)	Chase	CBL6143	2904	24	08-Aug-2019
Comb Generator	Schaffner	RSG1000	3034	-	TU
Signal Generator	Rohde & Schwarz	SMR40	3171	12	27-Nov-2019
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	17-Dec-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
Cable 1503 2M 2.92(P)m 2.92(P)m	Rhophase	KPS-1503A-2000-KPS	4293	12	26-Oct-2019
1501A 4.0M Km Km Cable	Rhophase	KPS-1501A-4000-KPS	4301	-	O/P Mon
1GHz to 8GHz Low Noise Amplifier	Wright Technologies	APS04-0085	4365	12	25-Oct-2019
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Cable (Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4526	6	26-Apr-2019
Cable (Rx, SMAm-SMAm 0.5m)	Scott Cables	SLSLL18-SMSM-00.50M	4528	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
4dB Attenuator	Pasternack	PE7047-4	4935	24	28-Nov-2019
High Pass filter	Wainwright	WHKX12-1290-1500-18000-80SS	4962	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	26-Apr-2019
8m N-Type RF Cable	Teledyne	PR90-088-8MTR	5093	12	04-Oct-2019
EmX Software	TUV SUD	EmX	5125	-	Software

Table 21

TU - Traceability Unscheduled
O/P Mon – Output Monitored

3 Photographs

3.1 Test Setup Photographs

Figure 24 - Radiated Spurious Emissions, 30 MHz to 1 GHz

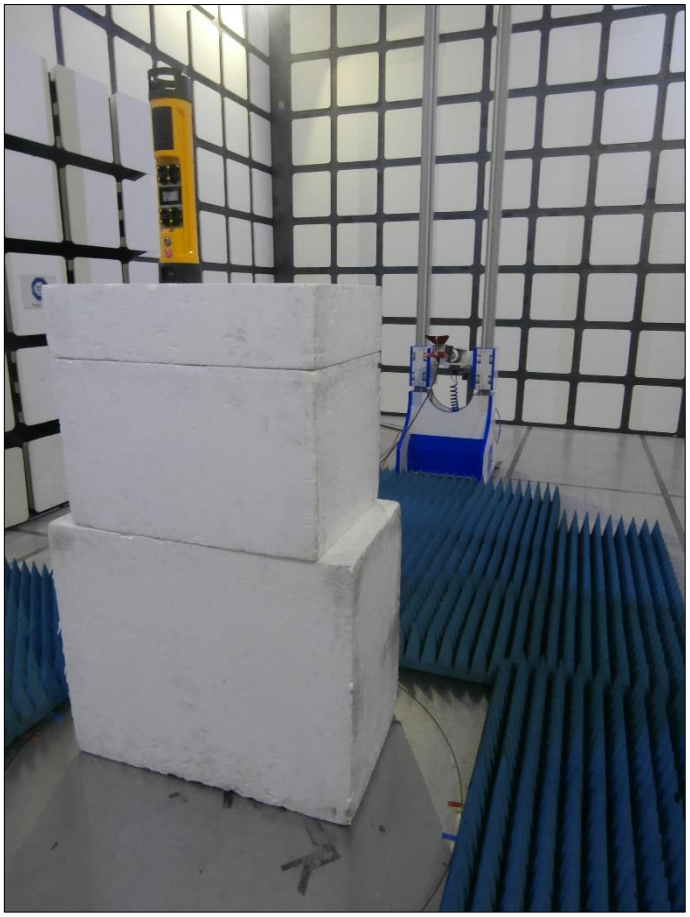

Figure 25 - Radiated Spurious Emissions, 1 GHz to 10 GHz

4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Maximum Conducted Output Power	± 3.2 dB
Frequency Hopping Systems - Average Time of Occupancy	-
Frequency Hopping Systems - Channel Separation	± 5.072 kHz
Frequency Hopping Systems - Number of Hopping Channels	-
Frequency Hopping Systems - 20 dB Bandwidth	± 5.072 kHz
Authorised Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Restricted Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Spurious Radiated Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB

Table 22