Report on the FCC and IC Testing of:

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

In accordance with FCC 47 CFR Part 15C, Industry Canada RSS-210 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

Product Service

Choose certainty.
Add value.

FCC ID: 2ARNH-15351660 and 2ARNH-1535166A
IC: 24476-15351660 and 24476-1535166A

COMMERCIAL-IN-CONFIDENCE

Document Number: 75943624-05 | Issue: 02

SIGNATURE			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Simon Bennett	Chief Engineer	Authorised Signatory	04 February 2019

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service 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-210 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	04 February 2019
Daniel Bishop	Test Engineer	Testing	04 February 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-210: Issue 09 (08-2016) and Industry Canada RSS-GEN: Issue 05 (04-2018).

TÜV SÜD Product Service
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Product Service

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Product Service

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	21 November 2018
2	To amend the FCC and IC ID's	04 February 2019

Table 1

1.2 Introduction

Applicant	DETNET SOUTH AFRICA (PTY) LTD
Manufacturer	DETNET SOUTH AFRICA (PTY) LTD
Model Number(s)	CE4 Commander
Serial Number(s)	1) CE4 Commander: 15300000F 2) CE4 Commander: 153000004
Hardware Version(s)	1) CE4 Commander: V5 2) CE4 Commander: V5A
Software Version(s)	CE4 Commander: 36230C
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2017 Industry Canada RSS-210: Issue 09 (08-2016) Industry Canada RSS-GEN: Issue 05 (04-2018)
Order Number Date	4500348610 23-August-2018
Date of Receipt of EUT	07-September-2018
Start of Test	17-September-2018
Finish of Test	01-November-2018
Name of Engineer(s)	Graeme Lawler and Daniel Bishop
Related Document(s)	ANSI C63.10 (2013)

Product Service

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-210 and Industry Canada RSS-GEN is shown below.

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	Part 15C	RSS-210	RSS-GEN			
Configuration and Mode: CE4 Commander - 13.56 MHz TX						
2.1	15.215 (c)	-	6.6	20 dB Bandwidth	Pass	ANSI C63.10 (2013)
2.2	15.225 (a)(b)(c)(d)	B6	6.13	Field Strength of any Emission	Pass	ANSI C63.10 (2013)
2.3	15.225 (e)	B.6	6.11	Frequency Tolerance Under Temperature Variations	Pass	ANSI C63.10 (2013)

Table 2

Product Service

1.4 Application Form

CE4 Commander

EQUIPMENT DESCRIPTION	
Model Name/Number	CE4 Commander
Part Number	
Hardware Version	V5
Software Version	36230C
FCC ID (if applicable)	2ARNH-15351660
Industry Canada ID (if applicable)	24476-15351660
Technical Description (Please provide a brief description of the intended use of the equipment)	Free standing blast controller for testing and blasting of electronic detonators.

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
WiFi	2400	18	2	*2412 – 2457*			2412	2434	2457
NFC	13.56	6		*13.56*				13.56	
RF	900	30	2	902 – 928			902	915	928

UN-INTENTIONAL RADIATOR	
Highest frequency generated or used in the device or on which the device operates or tunes	3177.2MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	32.768KHz
Class A Digital Device (Use in commercial, industrial or business environment) ☒ Class B Digital Device (Use in residential environment only) ☐	

Power Source				
AC	Single Phase	Three Phase	Nominal Voltage	
External DC	Nominal Voltage		Maximum Current	
Battery	Nominal Voltage		Battery Operating End Point Voltage	
	3.7		3.3	
Can EUT transmit whilst being charged?			Yes ☐ No ☒	

Product Service

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

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

ANTENNA CHARACTERISTICS						
☒	Antenna connector			State impedance	50	Ohm
☐	Temporary antenna connector			State impedance		Ohm
☒	Integral antenna	Type	PCB Trace Antenna			
☐	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: 2018-09-12

Product Service

EQUIPMENT DESCRIPTION	
Model Name/Number	CE4 Commander
Part Number	
Hardware Version	V5A
Software Version	36230C
FCC ID (if applicable)	2ARNH-1535166A
Industry Canada ID (if applicable)	24476-1535166A
Technical Description (Please provide a brief description of the intended use of the equipment)	Free standing blast controller for testing and blasting of electronic detonators.

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
WiFi	2400	18		*2.412 – 2.457GHz*					
NFC	13.56	6		13.56				13.56	
RF	*900*	27	2.1	907.125 – 913.325 MHz			907.12 5 MHz	910.12 5 MHz	913.32 5 MHz

UN-INTENTIONAL RADIATOR	
Highest frequency generated or used in the device or on which the device operates or tunes	**3177.2 MHz**
Lowest frequency generated or used in the device or on which the device operates or tunes	32.768 KHz
Class A Digital Device (Use in commercial, industrial or business environment) ☒ Class B Digital Device (Use in residential environment only) ☐	

Power Source			
AC	Single Phase	Three Phase	Nominal Voltage
External DC	Nominal Voltage	Maximum Current	
Battery	Nominal Voltage	Battery Operating End Point Voltage	
Can EUT transmit whilst being charged?		Yes ☐ No ☒	

Product Service

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

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

ANTENNA CHARACTERISTICS						
☒	Antenna connector			State impedance	50	Ohm
☐	Temporary antenna connector			State impedance		Ohm
☒	Integral antenna	Type	PCB Trace Antenna			
☐	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: 2018-09-12

Product Service

1.5 Product Information

1.5.1 Technical Description

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

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
CE4 Commander 2, Serial Number: 153000004			
0	As supplied by the customer	Not Applicable	Not Applicable
CE4 Commander 3, Serial Number: 1530000CF			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3

1.8 Test Location

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

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: CE4 Commander - 13.56 MHz TX		
20 dB Bandwidth	Daniel Bishop	UKAS
Field Strength of any Emission	Graeme Lawler	UKAS
Frequency Tolerance Under Temperature Variations	Daniel Bishop	UKAS

Table 4

Office Address:

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

Product Service

2 Test Details

2.1 20 dB Bandwidth

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.215 (c)
Industry Canada RSS-GEN, Clause 6.7

2.1.2 Equipment Under Test and Modification State

CE4 Commander, S/N: 153000004 - Modification State 0

2.1.3 Date of Test

01-November-2018

2.1.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.9.1 and RSS-GEN clause 6.7.

2.1.5 Environmental Conditions

Ambient Temperature	22.3 °C
Relative Humidity	43.5 %

2.1.6 Test Results

CE4 Commander - 13.56 MHz TX

Frequency (MHz)	20 dB Bandwidth (Hz)	99% Occupied Bandwidth (Hz)	F_{LOWER} (MHz)	F_{UPPER} (MHz)
13.56	27.244	22.436	13.55997756	13.56002244

Table 5

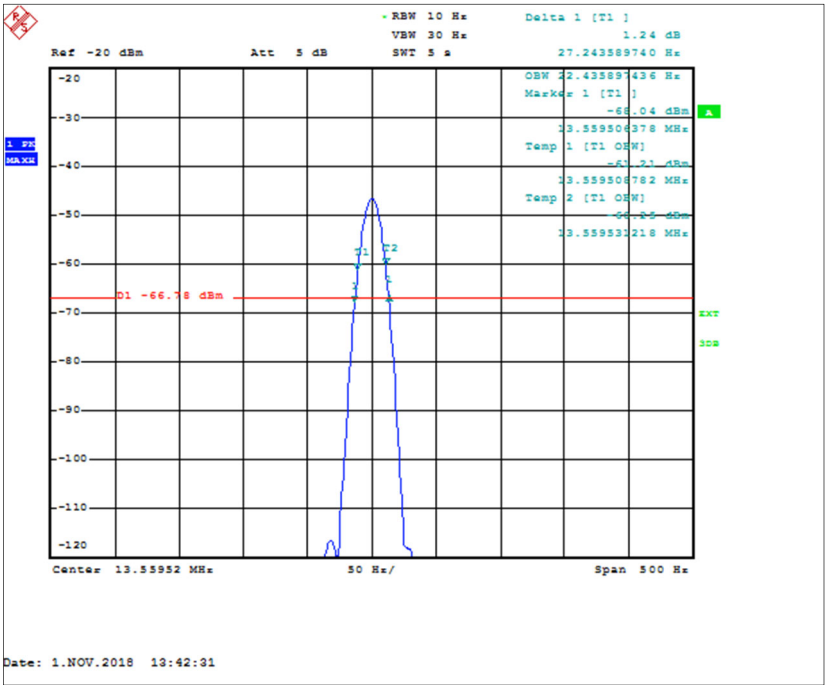

Figure 1 - 20 dB Bandwidth

FCC 47 CFR Part 15, Limit Clause 15.215 (c)

The 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

Industry Canada RSS 210 and Industry Canada RSS GEN, Limit Clause

None specified.

Product Service

2.1.7 Test Location and Test Equipment Used

This test was carried out in RF Lab 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
RF Coupler	TUV SUD Product Service	RFC1	414	-	TU
RF Coupler	TUV SUD Product Service	TÜV	415	-	TU
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2019
Hygrometer	Rotronic	A1	1388	12	20-Jun-2019
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	14-Mar-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2019

Table 6

TU - Traceability Unscheduled

Product Service

2.2 Field Strength of any Emission

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.225 (a)(b)(c)(d)
Industry Canada RSS-210, Clause B.6
Industry Canada RSS-GEN, Clause 6.13

2.2.2 Equipment Under Test and Modification State

CE4 Commander, S/N: 153000004 - Modification State 0

2.2.3 Date of Test

23-September-2018 to 24-September-2018

2.2.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.3, 6.4 and 6.5.

Pre-scan measurements were made at a distance of 3 m as shown by the plots below using a peak detector. Final emission measurements were then made using a Quasi-Peak detector and recorded in the tables below. The limit lines shown on the plot were extrapolated from either 300 m or 30 m to the measurement distance of 3 m in accordance with ANSI C63.10 Clause 6.4.4.2.

2.2.5 Environmental Conditions

Ambient Temperature	20.0 °C
Relative Humidity	44.0 %

2.2.6 Test Results

CE4 Commander - 13.56 MHz TX, Carrier Results

Frequency (MHz)	Quasi-Peak Level (dBµV/m) at 3m	Quasi-Peak Level (dBµV/m) at 30m	Quasi-Peak Level (µV/m) at 3m	Quasi-Peak Level (µV/m) at 30m
13.56 MHz	54.55	33.16	533.94	45.50

Table 7

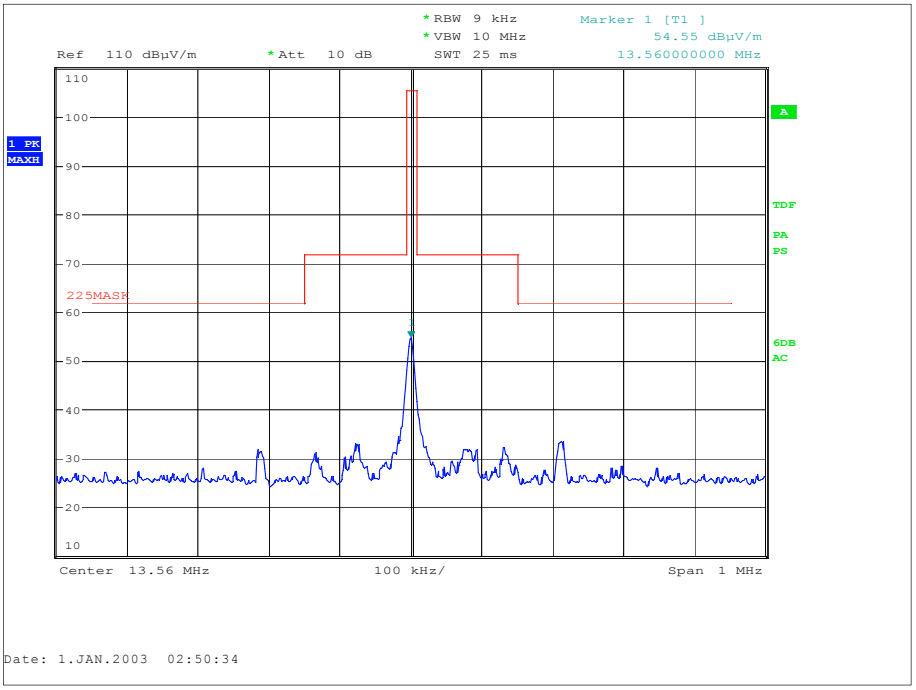

Figure 2 - Plot of the Fundamental - 13.56 MHz

Frequency MHz	Quasi-Peak Level (dBµV/m) at 3 m	Quasi-Peak Level (dBµV/m) at 30 m	Quasi-Peak Level (µV/m) at 3 m	Quasi-Peak Level (µV/m) at 30 m
*				

Table 8 - Emissions Results - 9 kHz to 30 MHz

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

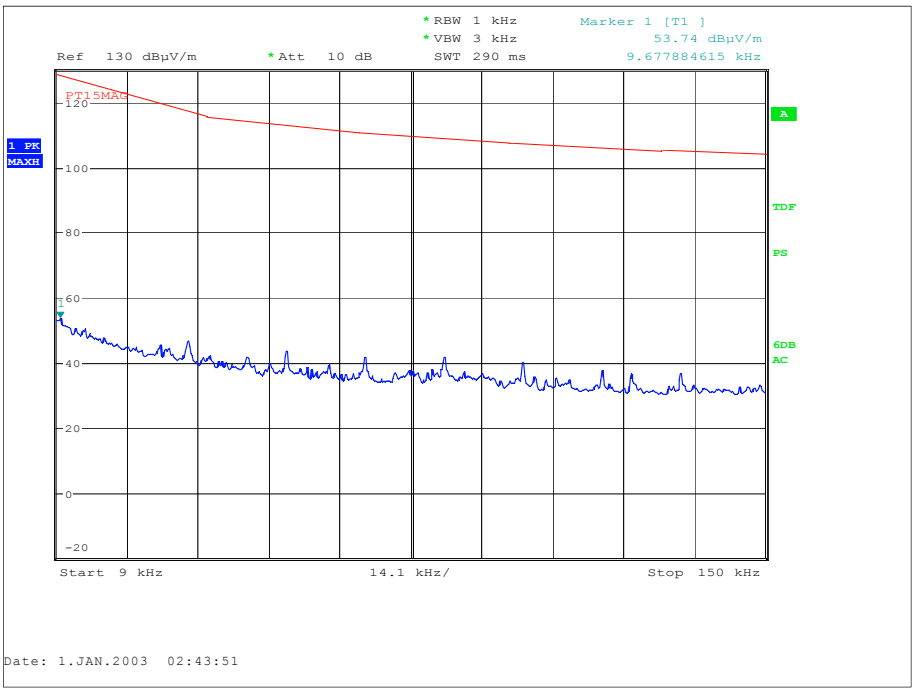

Figure 3 - 9 kHz to 150 kHz

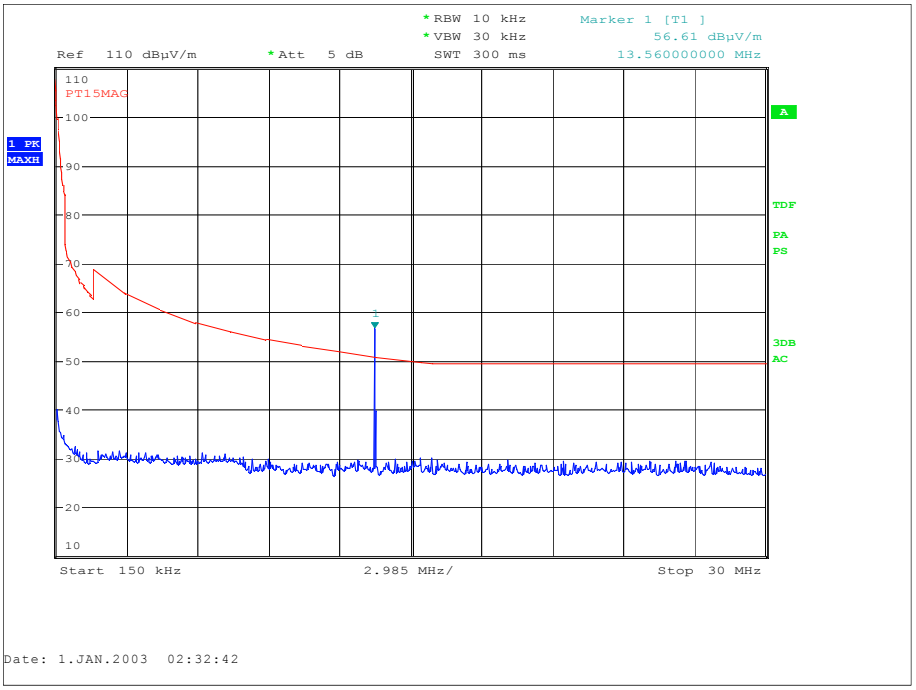

Figure 4 - 150 kHz to 30 MHz

Frequency (MHz)	QP Level (dBuV/m)	QP Limit (dBuV/m)	QP Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
81.778	28.5	40.0	-11.5	285	1.00	Vertical
84.185	30.7	40.0	-9.3	229	1.00	Vertical
86.570	29.9	40.0	-10.1	243	1.00	Vertical
88.973	29.6	43.5	-13.9	236	1.09	Vertical
216.008	37.1	46.0	-8.9	129	2.75	Vertical
262.093	34.5	46.0	-11.5	282	1.00	Horizontal

Table 9 - Emissions Results – 30 MHz to 1 GHz

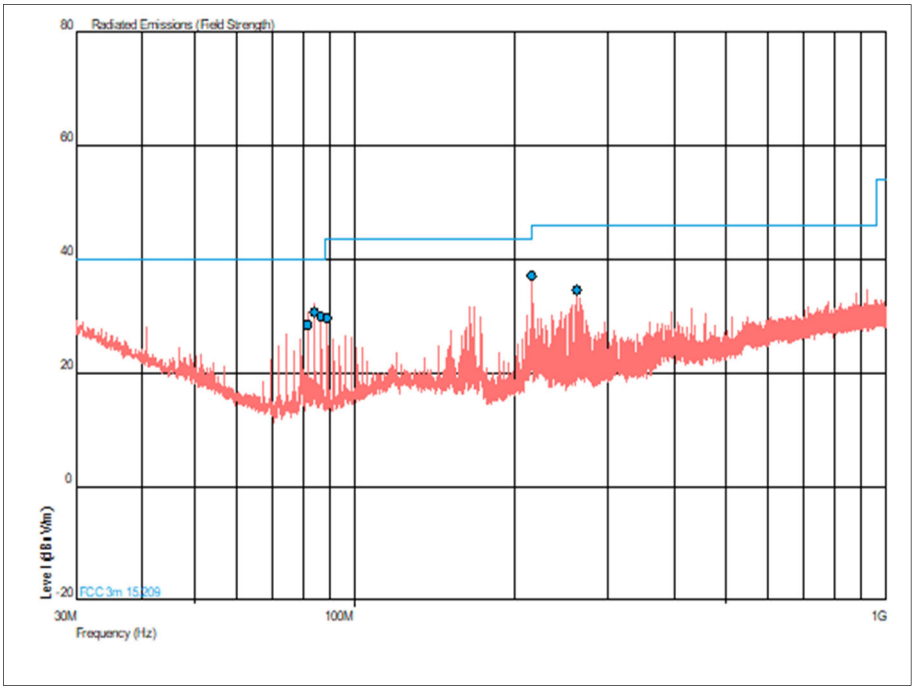

Figure 5 - 30 MHz to 1 GHz

FCC 47 CFR Part 15, Limit Clause 15.225 (a)(b)(c)(d)

(a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 m.

(b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 m.

(c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 m.

(d) The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

FCC 47 CFR Part 15, Limit Clause 15.209

Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (m)
0.009 to 0.490	2400/F (kHz)	300
0.490 to 1.705	24000/F (kHz)	30
1705 to 30	30	30
30 to 88	100**	3
88 to 216	150**	3
216 to 960	200**	3
Above 960	500	5

Table 10 - FCC Radiated Emission Limit

Industry Canada RSS-210, Limit Clause B.6

The field strength of any emission shall not exceed the following limits:

(a) 15.848 mW/m (84 dBµV/m) at 30 m, within the band 13.553 – 13.567 MHz.

(b) 334 µV/m (50.5 dBµV/m) at 30 m, withing the bands 13.410 – 13.553 MHz and 13.567 – 13.710 MHz.

(c) 106 µV/m (40.5 dBµV/m) at 30 m, within the bands 13.110 – 13.410 MHz and 13.710 – 14.010 MHz.

(d) RSS-GEN general field strength limits for frequencies outside the band 13.110 – 14.010 MHz.

Industry Canada RSS-GEN, Limit Clause

Frequency	Magnetic Field Strength (H-Field) (µA/m)	Measurement Distance (m)
9 - 490 kHz	6.37/F (F in kHz)	300
490 - 1,705 kHz	63.7/F (F in kHz)	30
1,705 kHz - 30 MHz	0.08	30

Table 11 - Industry Canada Radiated Emission Limit - Less than 30 MHz

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

Table 12 - Industry Canada Radiated Emission Limit - 30 MHz to 1 GHz

Product Service

2.2.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 7.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Turntable Controller	Heinrich Diesel	HD 050	280	-	TU
Antenna with permanent attenuator (Bilog)	Schaffner	CBL6143	287	24	15-May-2020
Antenna (Active Loop, 9kHz-30MHz)	Rohde & Schwarz	HFH2-Z2	333	24	09-Dec-2018
Antenna (Dish/Tripod/Adaptor, 1GHz-18GHz)	Rohde & Schwarz	AC-008	334	-	TU
Screened Room (7)	Siemens	S M	1547	36	21-Jan-2021
Hygromer	Rotronic	A1	2138	12	21-Feb-2019
Comb Generator	Schaffner	RSG1000	3034	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Nov-2018
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	3916	-	TU
Mast Controller	Maturo Gmbh	NCD	3917	-	TU
N to N cable, 4m	Rhophase	2303-002-TUVS	4849	12	18-Dec-2018
N to N cable, 4m	Rhophase	2303-002-TUVS	4850	12	18-Dec-2018
Cable (26.5GHz)	Rosenberger	LU7-133-5000	5019	-	O/P Mon

Table 13

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

Product Service

2.3 Frequency Tolerance Under Temperature Variations

2.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.225 (e)
Industry Canada RSS-210, Clause B.6
Industry Canada RSS-GEN, Clause 6.11

2.3.2 Equipment Under Test and Modification State

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

2.3.3 Date of Test

17-September-2018 to 18-September-2018

2.3.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.8 and RSS-GEN, clause 6.11.

2.3.5 Environmental Conditions

Ambient Temperature	22.4 °C
Relative Humidity	66.5 %

2.3.6 Test Results

Commander 1 - 13.56 MHz TX

Temperature	Voltage	Measured Frequency (MHz)	Frequency Deviation (%)	Frequency Error (ppm)
-20.0 °C	3.7 V DC	13.559490	0.003761203	37.61061947
-10.0 °C	3.7 V DC	13.559510	0.003613700	36.13569322
0.0 °C	3.7 V DC	13.559535	0.003429321	34.29203540
+10.0 °C	3.7 V DC	13.559535	0.003429321	34.29203540
+20.0 °C	3.7 V DC	13.559525	0.003503073	35.02949853
+30.0 °C	3.7 V DC	13.559520	0.003539948	35.39823009
+40.0 °C	3.7 V DC	13.559505	0.003650576	36.50442478
+50.0 °C	3.7 V DC	13.559490	0.003761203	37.61061947

Table 14 - Frequency Tolerance Under Temperature Variation

Temperature	Voltage	Measured Frequency (MHz)	Frequency Deviation (%)	Frequency Error (ppm)
+20.0 °C	3.14 V DC	13.559520	0.003539948	35.39823009
+20.0 °C	3.70 V DC	13.559520	0.003539948	35.39823009
+20.0 °C	4.26 V DC	13.559520	0.003539948	35.39823009

Table 15 - Frequency Tolerance Under Voltage Variation

Product Service

FCC 47 CFR Part 15, Limit Clause 15.225 (e)

The frequency tolerance of the carrier signal shall be maintained within ± 0.01 % of the operating frequency.

Industry Canada RSS-210, Limit Clause B.6

Carrier frequency stability shall be maintained to ±0.01% (±100 ppm)

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
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	20-Oct-2018
Hygrometer	Rotronic	A1	1388	12	20-Jun-2019
Multimeter	Fluke	79 Series II	3057	12	20-Jul-2019
Thermocouple Thermometer	Fluke	51	3172	12	29-Nov-2018
Loop Antenna	ETS-Lindgren	7604	4134	24	27-Oct-2018
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	20-Oct-2018
Climatic Chamber	Aralab	FitoTerm 300E45	4823	-	O/P Mon
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon
EXA	Keysight Technologies	N9010B	4969	12	21-Dec-2018

Table 16

O/P Mon – Output Monitored using calibrated equipment

3 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
20 dB Bandwidth	± 6.66 Hz.
Field Strength of any Emission	9 kHz to 30 MHz: ± 3.4 dB 30 MHz to 1 GHz: ± 5.2 dB
Frequency Tolerance Under Temperature Variations	± 48.35 Hz

Table 17