

# 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



Product Service

Choose certainty.  
Add value.

Prepared for: DETNET SOUTH AFRICA (PTY) LTD  
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1645  
SOUTH AFRICA

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).



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#### ACCREDITATION

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## 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<br>2) CE4 Commander: 153000004                                                              |
| Hardware Version(s)           | 1) CE4 Commander: V5<br>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<br>Industry Canada RSS-210: Issue 09 (08-2016)<br>Industry Canada RSS-GEN: Issue 05 (04-2018) |
| Order Number                  | 4500348610                                                                                                              |
| Date                          | 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**



## 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) <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                                 |
|                                        | 3.7             |             | 3.3                                                                 |
| 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. |
|                                                                 |

| ANTENNA CHARACTERISTICS             |                             |      |                   |    |     |
|-------------------------------------|-----------------------------|------|-------------------|----|-----|
| <input checked="" type="checkbox"/> | Antenna connector           |      | State impedance   | 50 | Ohm |
| <input type="checkbox"/>            | Temporary antenna connector |      | State impedance   |    | Ohm |
| <input checked="" type="checkbox"/> | Integral antenna            | Type | PCB Trace Antenna |    |     |
| <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: 2018-09-12



| 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) <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                                 |
|                                        |                 |             |                                                                     |
| 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. |
|                                                                 |

| ANTENNA CHARACTERISTICS             |                             |      |                   |    |     |
|-------------------------------------|-----------------------------|------|-------------------|----|-----|
| <input checked="" type="checkbox"/> | Antenna connector           |      | State impedance   | 50 | Ohm |
| <input type="checkbox"/>            | Temporary antenna connector |      | State impedance   |    | Ohm |
| <input checked="" type="checkbox"/> | Integral antenna            | Type | PCB Trace Antenna |    |     |
| <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: 2018-09-12



## 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



## 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 <sub>LOWER</sub> (MHz) | F <sub>UPPER</sub> (MHz) |
|-----------------|----------------------|-----------------------------|--------------------------|--------------------------|
| 13.56           | 27.244               | 22.436                      | 13.55997756              | 13.56002244              |

**Table 5**



Product Service

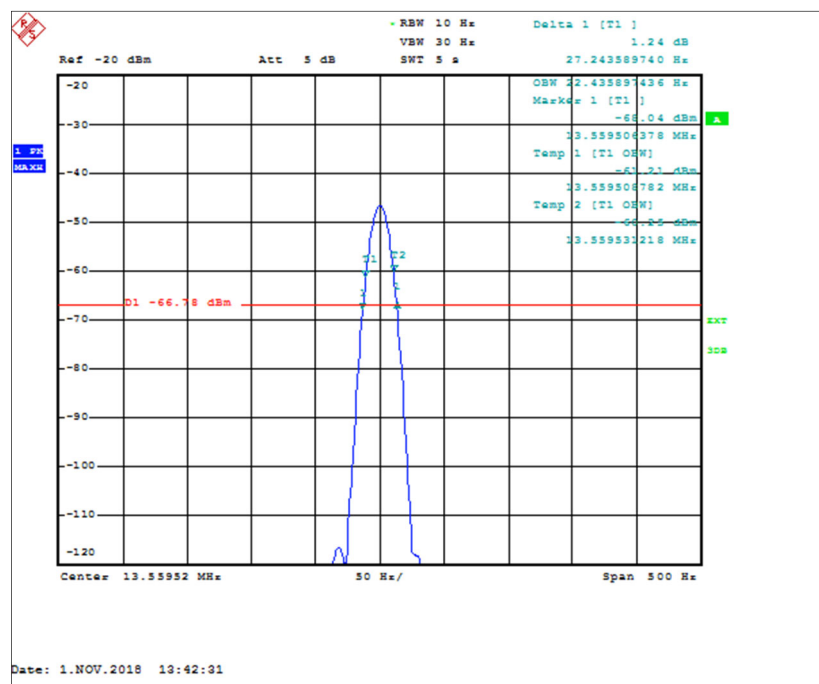


**Figure 1 - 20 dB Bandwidth**

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.



### 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<br>1200-0408-0601 | 4393  | 6                           | 16-Apr-2019     |

**Table 6**

TU - Traceability Unscheduled



## **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**



Product Service

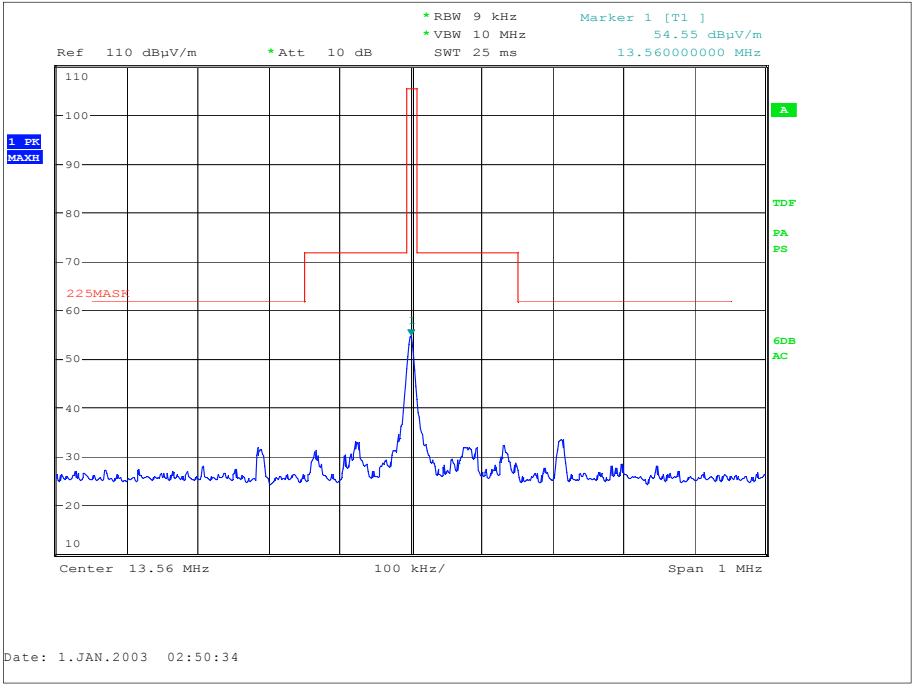


Figure 2 - Plot of the Fundamental - 13.56 MHz



| 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.

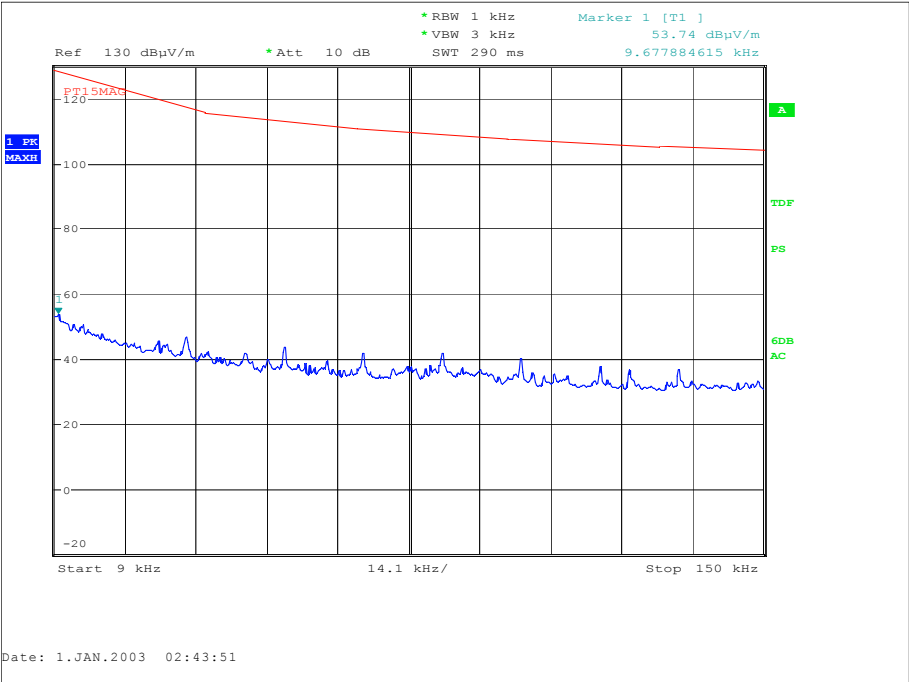


Figure 3 - 9 kHz to 150 kHz

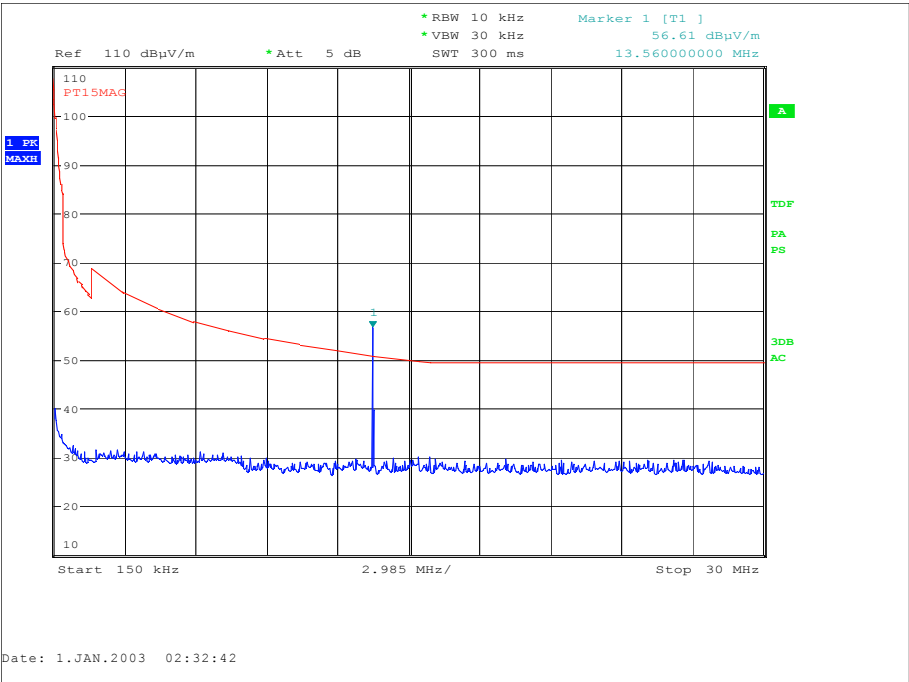


Figure 4 - 150 kHz to 30 MHz



| 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

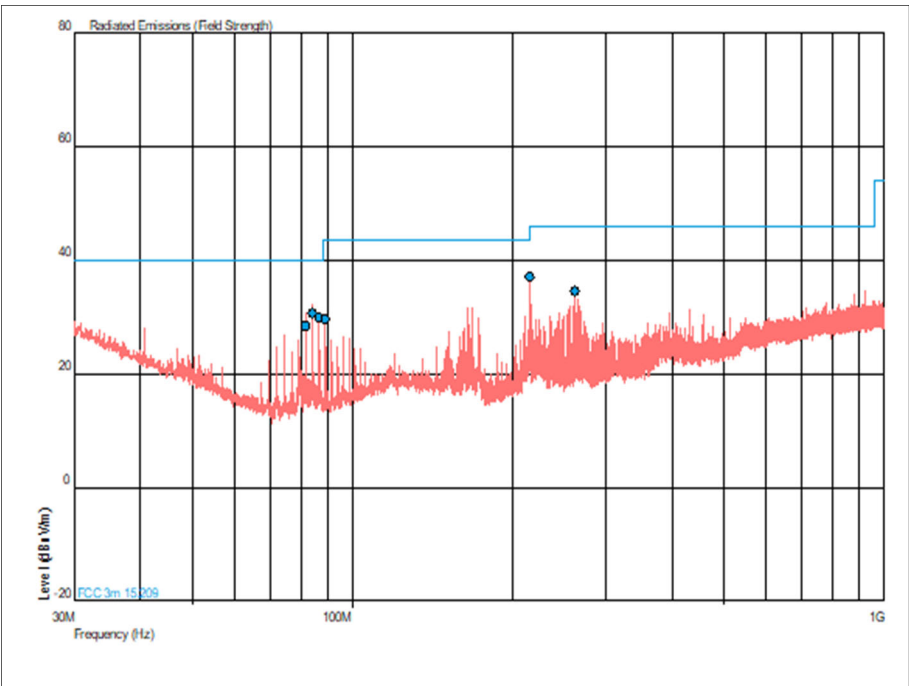


Figure 5 - 30 MHz to 1 GHz



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 dB $\mu$ V/m) at 30 m, within the band 13.553 – 13.567 MHz.
- (b) 334  $\mu$ V/m (50.5 dB $\mu$ V/m) at 30 m, withing the bands 13.410 – 13.553 MHz and 13.567 – 13.710 MHz.
- (c) 106  $\mu$ V/m (40.5 dB $\mu$ V/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) ( $\mu$ A/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 ( $\mu$ V/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**



## 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     |
| Hygrometer                                | 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



## 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**



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

The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01$  % of the operating frequency.

Industry Canada RSS-210, Limit Clause B.6

Carrier frequency stability shall be maintained to  $\pm 0.01\%$  ( $\pm 100$  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                                  | $\pm 6.66 \text{ Hz}$ .                                                        |
| Field Strength of any Emission                   | 9 kHz to 30 MHz: $\pm 3.4 \text{ dB}$<br>30 MHz to 1 GHz: $\pm 5.2 \text{ dB}$ |
| Frequency Tolerance Under Temperature Variations | $\pm 48.35 \text{ Hz}$                                                         |

Table 17