Report on the Radio Testing

For

Buddi Limited

on

SmartTag Location Quad

Report no. TRA-021068-13-47-00A

27th January 2017



Element Materials Technology Warwick Ltd.
Registered in England and Wales. Registered Office: 5 Fleet Place, London, EC4M 7RD
Company Reg No. 02536659

Report Number: TRA-021068-13-47-00A
Issue: A

REPORT ON THE RADIO TESTING OF A
Buddi Limited
SmartTag Location Quad
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.249 & IC RSS-210 Annex 2.9

TEST DATE: 17th - 18th January 2017

Written by: D Winstanley — D Winstanley, Radio Senior Test Engineer

Approved by: 
Digitally signed by John Charters
DN: cn=John Charters, o=Element Materials Technology, ou, email=john.charters@element.com, c=GB
Date: 2017.01.30 10:05:53 Z
— J Charters, Department Manger - Radio

Date: 27th January 2017





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# 1 Revision Record

| *Issue Number* | *Issue Date* | *Revision History* |
|---|---|---|
| A | 27th January 2017 | Original |
| | | |

## 2 Summary

| | |
|---|---|
| TEST REPORT NUMBER: | TRA-021068-13-47-00A |
| WORKS ORDER NUMBER | TRA-021068-11 |
| PURPOSE OF TEST: | USA: Testing of radio frequency equipment per the relevant authorization procedure of chapter 47 of CFR (code of federal regulations) Part 2, subpart J.<br><br>Canada: Testing of radio apparatus for TAC (technical acceptance certificate) per subsections 4(2) of the Radio communication Act and 21(1) of the Radio communication Regulations. |
| TEST SPECIFICATION(S): | 47CFR15.249 & RSS-210 Annex 2.9 |
| EQUIPMENT UNDER TEST (EUT): | SmartTag Location Quad |
| FCC IDENTIFIER: | ZDLST3 |
| IC NUMBER: | 20371-ST3 |
| EUT SERIAL NUMBER: | Not Available |
| MANUFACTURER/AGENT: | Buddi Limited |
| ADDRESS: | Talbot House<br>17 Church Street<br>Rickmansworth<br>Hertfordshire<br>WD3 1DE |
| CLIENT CONTACT: | Charles Lewinton<br>☎<br>✉ charles@buddi.co.uk |
| TEST DATE: | 17th - 18th January 2017 |
| TESTED BY: | D Winstanley<br>Element |

## *2.1 Test Summary*

| *Test Method and Description* | *Requirement Clause* | | *Applicable to this equipment* | *Result / Note* |
|---|---|---|---|---|
| | *RSS* | *47CFR15* | | |
| Radiated spurious emissions | 210, A2.9(b) | 15.249(d) | ☒ | *Pass* |
| AC power line conducted emissions | Gen, 8.8 | 15.207 | ☒ | *Note 1* |
| Occupied bandwidth | Gen, 6.6 | 15.215(c) | ☒ | *Note 1* |
| Field strength of fundamental | 210, A2.9(a) | 15.249(a) | ☒ | *Pass* |
| Calculation of duty correction[1] | - | 15.35(c) | ☒ | *N/A* |

**Notes:**

Note 1
Limited radio testing of Colorado Smart Tag, 915 MHz Radio; to determine whether there have been any changes to the radio parameters previously reported on.

Scope of Work:
Radiated Spurious Emissions only;

The results contained in this report relate only to the items tested, in the condition at time of test, and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only. Any modifications made are identified in Section 8 of this report.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 5.2 of this test report (Deviations from Test Standards).

# 3 Contents

# 4 Introduction

This report TRA-021068-13-47-00A presents the results of the Radio testing on a Buddi Limited, SmartTag Location Quad to specification 47CFR15 Radio Frequency Devices and RSS-210 Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.

The testing was carried out for Buddi Limited by Element, at the address(es) detailed below.

☐ Element Hull
Unit E
South Orbital Trading Park
Hedon Road
Hull
HU9 1NJ
UK

☒ Element Skelmersdale
Unit 1
Pendle Place
Skemersdale
West Lancashire
WN8 9PN
UK

This report details the configuration of the equipment, the test methods used and any relevant modifications where appropriate.

All test and measurement equipment under the control of the laboratory and requiring calibration is subject to an established programme and procedures to control and maintain measurement standards. The quality management system meets the principles of ISO 9001, and has quality control procedures for monitoring the validity of tests undertaken. Records and sufficient detail are retained to establish an audit trail of calibration records relating to its test results for a defined period. Under control of the established calibration programme, key quantities or values of the test & measurement instrumentation are within specification and comply with the relevant traceable internationally recognised and appropriate standard specifications, which are UKAS calibrated as such where these properties have a significant effect on results. Participation in inter-laboratory comparisons and proficiency testing ensures satisfactory correlation of results conform to Elements own procedures, as well as statistical techniques for analysis of test data providing the appropriate confidence in measurements.

Throughout this report EUT denotes equipment under test.

FCC Site Listing:
Element is accredited for the above sites under the US-EU MRA, Designation number UK0009.

IC Registration Number(s):
Element North West 3930B

The test site requirements of ANSI C63.4-2014 are met up to 1 GHz.

The test site SVSWR requirements of CISPR 16-1-4:2010 are met over the frequency range 1 GHz to 18 GHz.

# 5 Test Specifications

## *5.1 Normative References*

- FCC 47 CFR Ch. I – Part 15 – Radio Frequency Devices.
- ANSI C63.10-2013 – American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- ANSI C63.4-2014 – American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
- Industry Canada RSS-210, Issue 8, December 2010 – Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.
- Industry Canada RSS-Gen, Issue 4, November 2014 – General Requirements for Compliance of Radio Apparatus.

## *5.2 Deviations from Test Standards*

There were no deviations from the test standard.

# 6 Glossary of Terms

| | |
|---|---|
| **§** | denotes a section reference from the standard, not this document |
| **AC** | Alternating Current |
| **ANSI** | American National Standards Institute |
| **BW** | bandwidth |
| **C** | Celsius |
| **CFR** | Code of Federal Regulations |
| **CW** | Continuous Wave |
| **dB** | decibel |
| **dBm** | dB relative to 1 milliwatt |
| **DC** | Direct Current |
| **DSSS** | Direct Sequence Spread Spectrum |
| **EIRP** | Equivalent Isotropically Radiated Power |
| **ERP** | Effective Radiated Power |
| **EUT** | Equipment Under Test |
| **FCC** | Federal Communications Commission |
| **FHSS** | Frequency Hopping Spread Spectrum |
| **Hz** | hertz |
| **IC** | Industry Canada |
| **ITU** | International Telecommunication Union |
| **LBT** | Listen Before Talk |
| **m** | metre |
| **max** | maximum |
| **MIMO** | Multiple Input and Multiple Output |
| **min** | minimum |
| **MRA** | Mutual Recognition Agreement |
| **N/A** | Not Applicable |
| **PCB** | Printed Circuit Board |
| **PDF** | Portable Document Format |
| **Pt-mpt** | Point-to-multipoint |
| **Pt-pt** | Point-to-point |
| **RF** | Radio Frequency |
| **RH** | Relative Humidity |
| **RMS** | Root Mean Square |
| **Rx** | receiver |
| **s** | second |
| **SVSWR** | Site Voltage Standing Wave Ratio |
| **Tx** | transmitter |
| **UKAS** | United Kingdom Accreditation Service |
| **V** | volt |
| **W** | watt |
| **Ω** | ohm |

# 7 Equipment Under Test

## *7.1 EUT Identification*

- Name: SmartTag Location Quad
- Serial Number: Not Available
- Model Number: S1-BUD-B-TE2RA-WIQD
- Firmware Revision: 1.11.0
- Build Level / Revision Number: Not Stated

## *7.2 System Equipment*

Equipment listed below forms part of the overall test setup and is required for equipment functionality and/or monitoring during testing. The compliance levels achieved in this report relate only to the EUT and not items given in the following list.

Type Of Equipment: on body charger
Part Number: T5-SMS-OBCHBK-D

Type Of Equipment: Power Supply for on body charger

## *7.3 EUT Mode of Operation*

### *7.3.1 Transmission*

The mode of operation for Tx tests was as follows…

Transmitting a modulated carrier on top and bottom operating frequencies at 100 % duty cycle. Transmitting in normal operation for duty cycle measurements.

### *7.3.2 Reception*

Not Applicable. Standby mode only.

## *7.4 EUT Radio Parameters*

### *7.4.1 General*

| | |
|---|---|
| ***Frequencies of operation:*** | 914.5 MHZ and 921.0 MHz |
| ***Modulation type(s):*** | FSK |
| ***Occupied channel bandwidth(s):*** | 70kHz |
| ***Channel spacing:*** | Not Applicable, Wideband |
| ***ITU emission designator(s):*** | 70k0F1D |
| ***Nominal Supply Voltage:*** | 3.7Vdc |
| ***Duty cycle:*** | 5.75% |

### *7.4.2 Antennas*

| | |
|---|---|
| ***Type:*** | Integral PCB |
| ***Frequency range:*** | 914.5 MHz – 921.0 MHz |
| ***Impedance:*** | 50Ohms |
| ***Polarisation:*** | Omni directional |
| ***Connector type:*** | Integral – Not Applicable |

## *7.5 EUT Description*

The EUT is Offender monitoring tag.

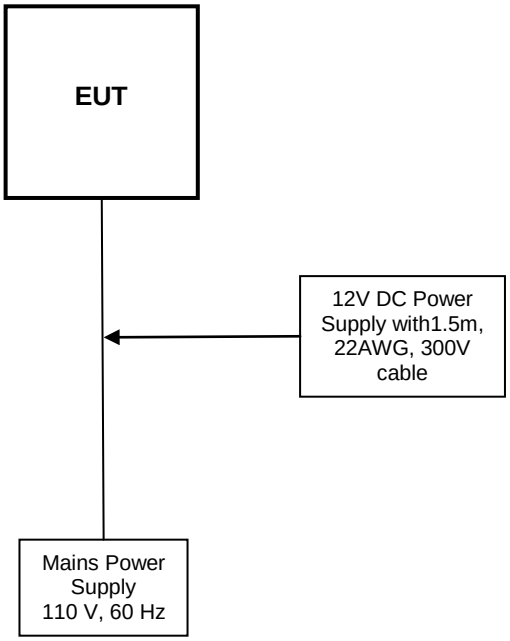
# 8 Modifications

No modifications were performed during this assessment.

# 9 EUT Test Setup

## *9.1 Block Diagram*

The following diagram shows basic EUT interconnections with cable type and cable lengths identified:



### *9.2 General Set-up Photograph*

The following photograph shows basic EUT set-up:

# 10 General Technical Parameters

## *10.1 Normal Conditions*

The E U T was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was batteries and power supply with charger to connect to 110 V ac, 60 Hz, from the mains.

## *10.2 Varying Test Conditions*

There are no specific frequency stability requirements for the type of device. The results contained in this report demonstrate that the occupied bandwidth is contained within the authorised band and the manufacturer has declared sufficient frequency stability (refer to section 7.4).

Variation of supply voltage is required to ensure stability of the declared output power. During carrier power testing the following variations were made:

| | ***Category*** | ***Nominal*** | ***Variation*** |
|---|---|---|---|
| ☐ | Mains | 110 V ac +/-2 % | 85 % and 115 % |
| ☒ | Battery | Fully Charged | N/A |

# 11 Radiated emissions

## *11.1 Definitions*

*Out-of-band emissions*
Emissions on a frequency or frequencies immediately outside the necessary bandwidth which result from the modulation process, but exclude spurious emissions.

*Spurious emissions*
Emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

*Restricted bands*
A frequency band in which intentional radiators are permitted to radiate only spurious emissions but not fundamental signals.

## *11.2 Test Parameters*

| | |
|---|---|
| Test Location: | Element Skelmersdale |
| Test Chamber: | Radio Chamber (REF940) |
| Test Standard and Clause: | ANSI C63.10-2013, Clause 6.5 and 6.6 |
| EUT Channels / Frequencies Measured: | 914.5 MHz and 921 |
| Deviations From Standard: | None |
| Measurement BW: | 30 MHz to 1 GHz: 120 kHz<br>Above 1 GHz: 1 MHz |
| Measurement Detector: | Up to 1 GHz: quasi-peak<br>Above 1 GHz: RMS average and Peak |

**Environmental Conditions (Normal Environment)**

| | |
|---|---|
| Temperature: 23 °C | +15 ºC to +35 ºC (as declared) |
| Humidity: 32 % RH | 20 % RH to 75 % RH (as declared) |

## *11.3 Test Limit*

Except for harmonics, out-of-band emissions shall be attenuated by at least 50 dB below the level of the fundamental or to the general field strength limits listed in FCC 47CFR15.209 / RSS-Gen {see table below}, whichever is less stringent.

Harmonics shall be limited to a maximum level of 0.5 mV/m measured at 3 metres.

**General Field Strength Limits for License-Exempt Transmitters at Frequencies above 30 MHz**

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

n.b. per FCC 47CFR15.35(b) / RSS-Gen 8.1, peak limit is 20 dB above average.

### *11.4 Test Method*

With the EUT setup as per section 9 of this report and connected as per Figure i, the emissions from the EUT were measured on a spectrum analyzer / EMI receiver.

Radiated electromagnetic emissions from the EUT are checked first by preview scans. Preview scans for all spectrum and modulation characteristics are checked, using a peak detector and where applicable worst-case determined for function, operation, orientation, etc. for both vertical and horizontal polarisations. Pre-scan plots are shown with a peak detector and 100 kHz RBW.

If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in ANSI C63.10 are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed, (see EUT setup photographs for more detail).

Emissions between 30 MHz and 1 GHz are measured using calibrated broadband antennas. Emissions above 1 GHz are characterized using standard gain horn antennas. Pre-amplifiers and filters are used where required. Care is taken to ensure that test receiver resolution bandwidth, video bandwidth and detector type(s) meet the regulatory requirements.

For both horizontal and vertical polarizations, the EUT is then rotated through 360 degrees in azimuth until the highest emission is detected. At the previously determined azimuth the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected, this maximum value is recorded.

Power values measured on the test receiver / analyzer are converted to field strength, FS, in dBµV/m at the regulatory distance, using:

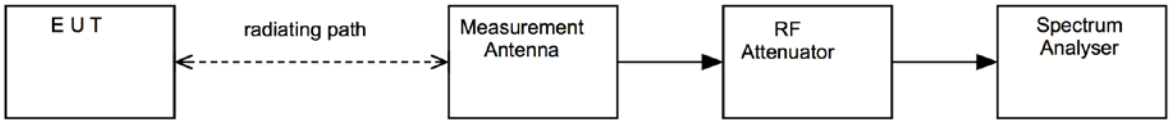
$$FS = PR + CL + AF – PA + DC – CF$$

Where,

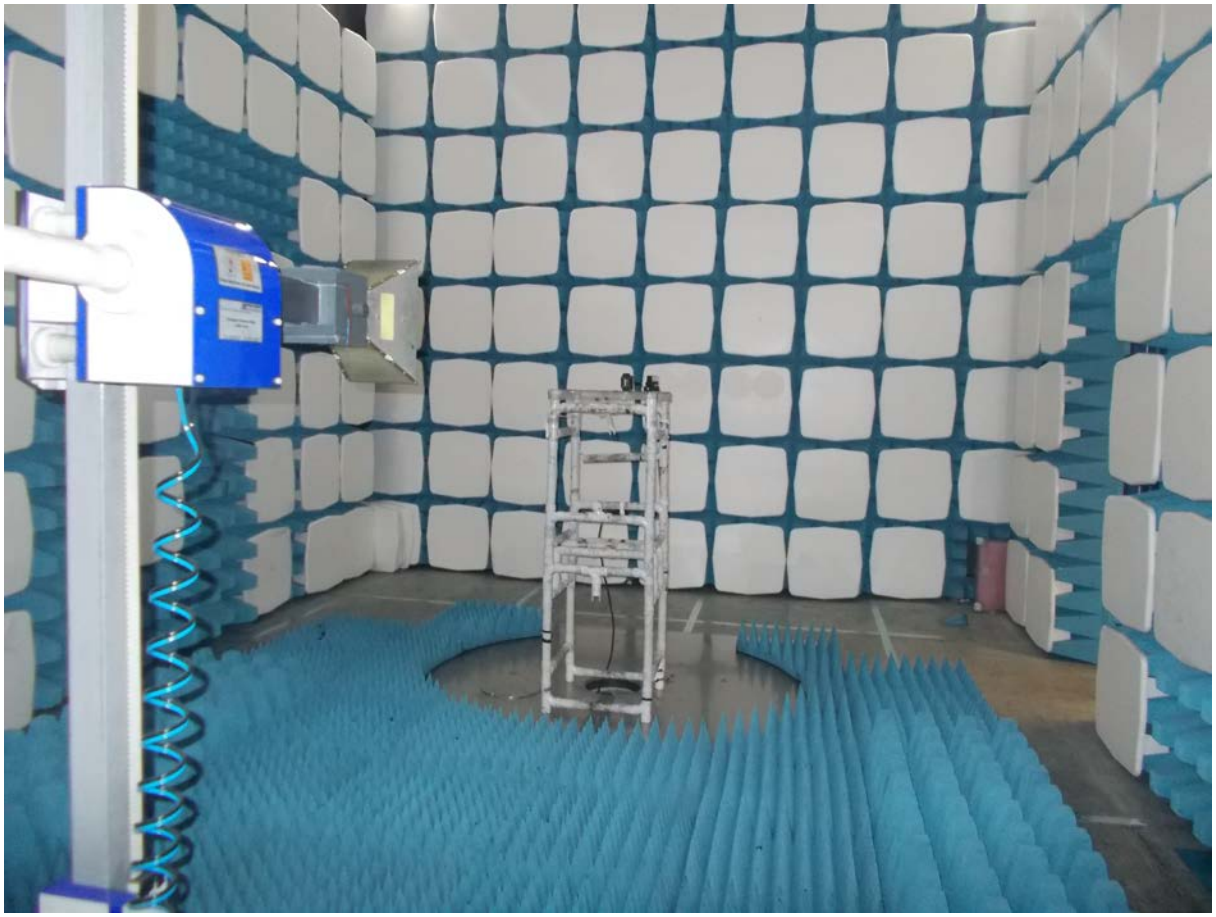
PR is the power recorded on the receiver / spectrum analyzer in dBµV;
CL is the cable loss in dB;
AF is the test antenna factor in dB/m;
PA is the pre-amplifier gain in dB (where used);
DC is the duty correction factor in dB (where used, e.g. harmonics of pulsed fundamental);
CF is the distance factor in dB (where measurement distance different to limit distance);

This field strength value is then compared with the regulatory limit.

**Figure i Test Setup**



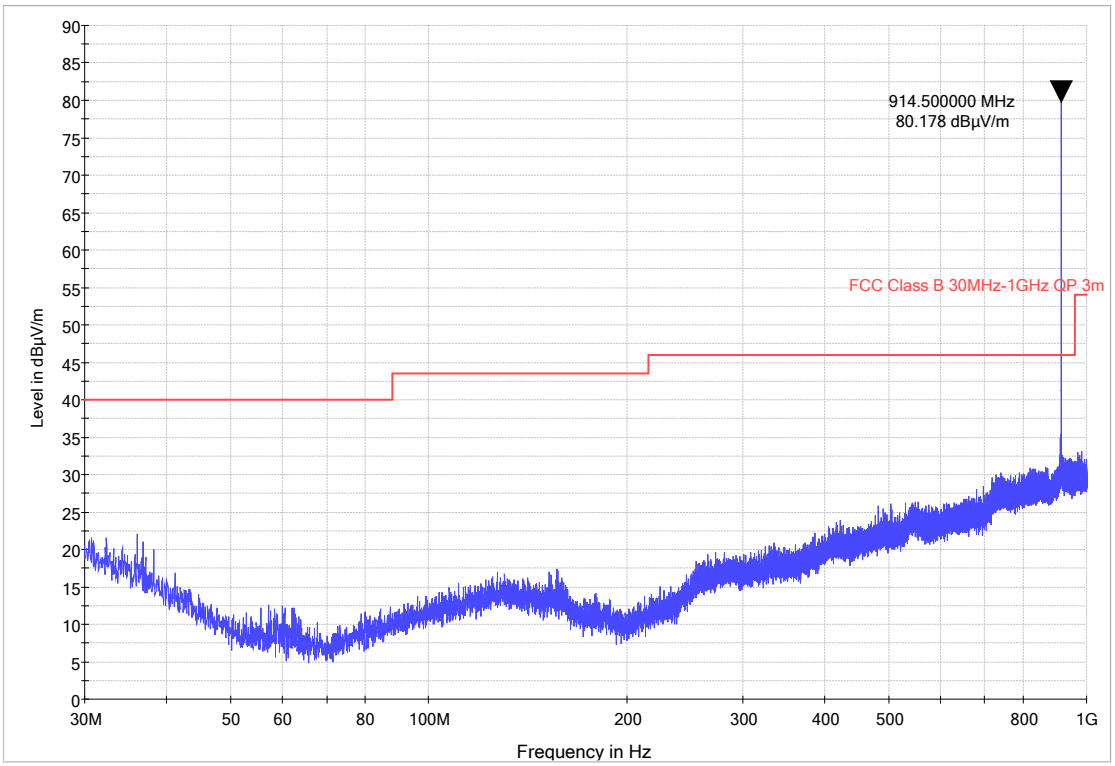
### *11.5 Test Set-up Photograph*

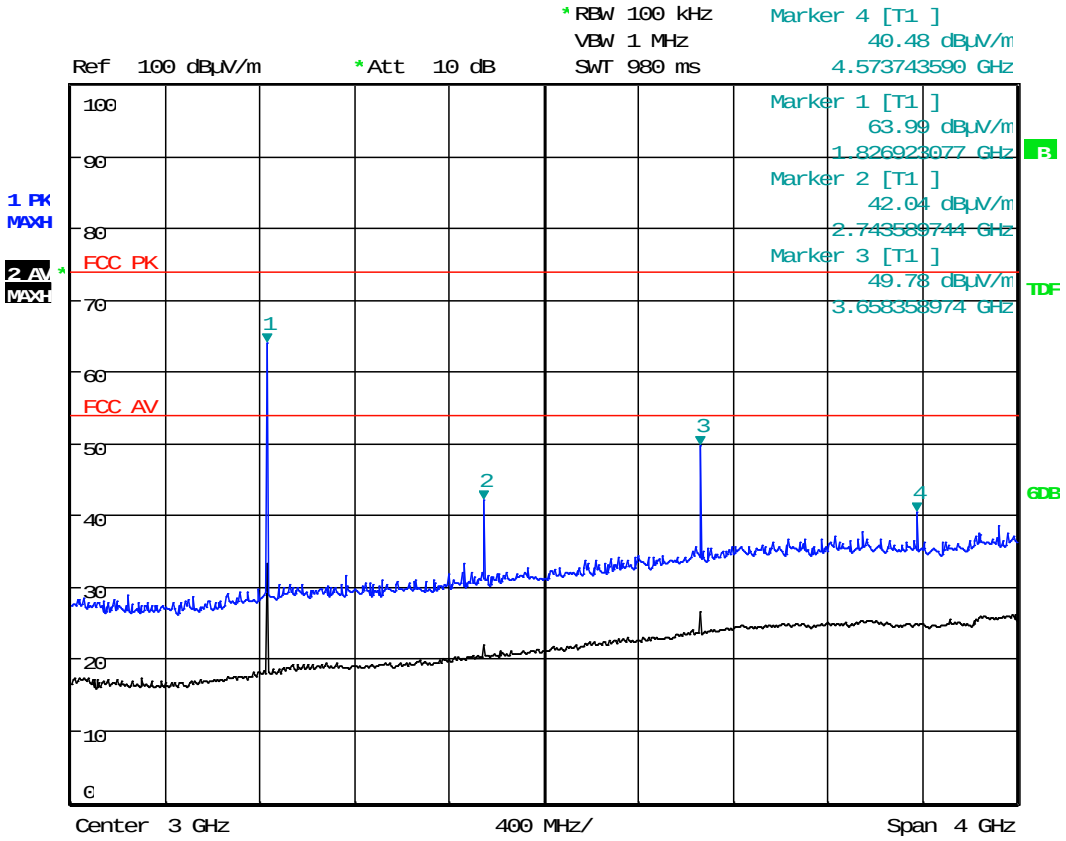


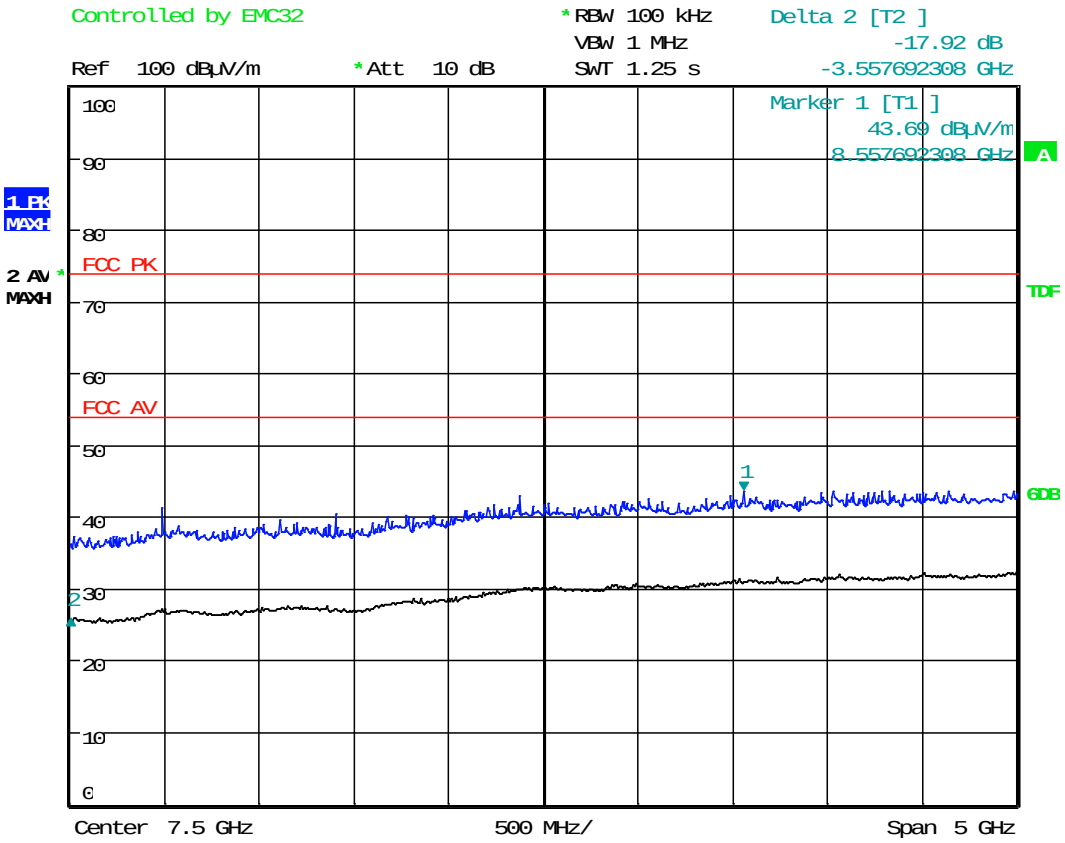
### *11.6 Test Equipment*

| *Type of Equipment* | *Maker/Supplier* | *Model Number* | *Element Number* | *Calibration Due Date* | *Calibration Interval* |
|---|---|---|---|---|---|
| Bilog | Chase | CBL611/A | UH191 | 26/02/2017 | 24 |
| ESVS10 | R&S | ESVS10 | L352 | 07/08/2016 | 12 |
| Spectrum Analyser | R&S | FSU46 | U281 | 07/06/2017 | 12 |
| Horn Antenna | EMCO | 3115 | TRL139 | 20/09/2015 | 24 |
| Pre-Amplifier | Agilent | 8449B | TRL572 | 10/02/2016 | 12 |

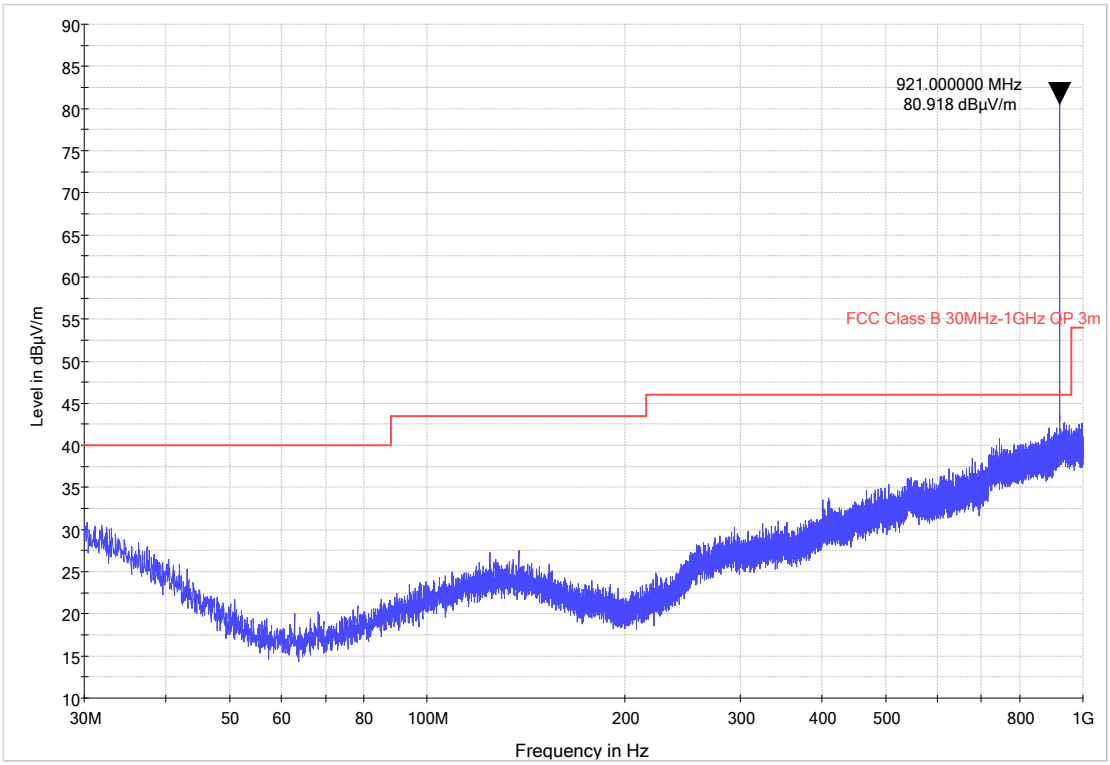
## *11.7 Test Results*

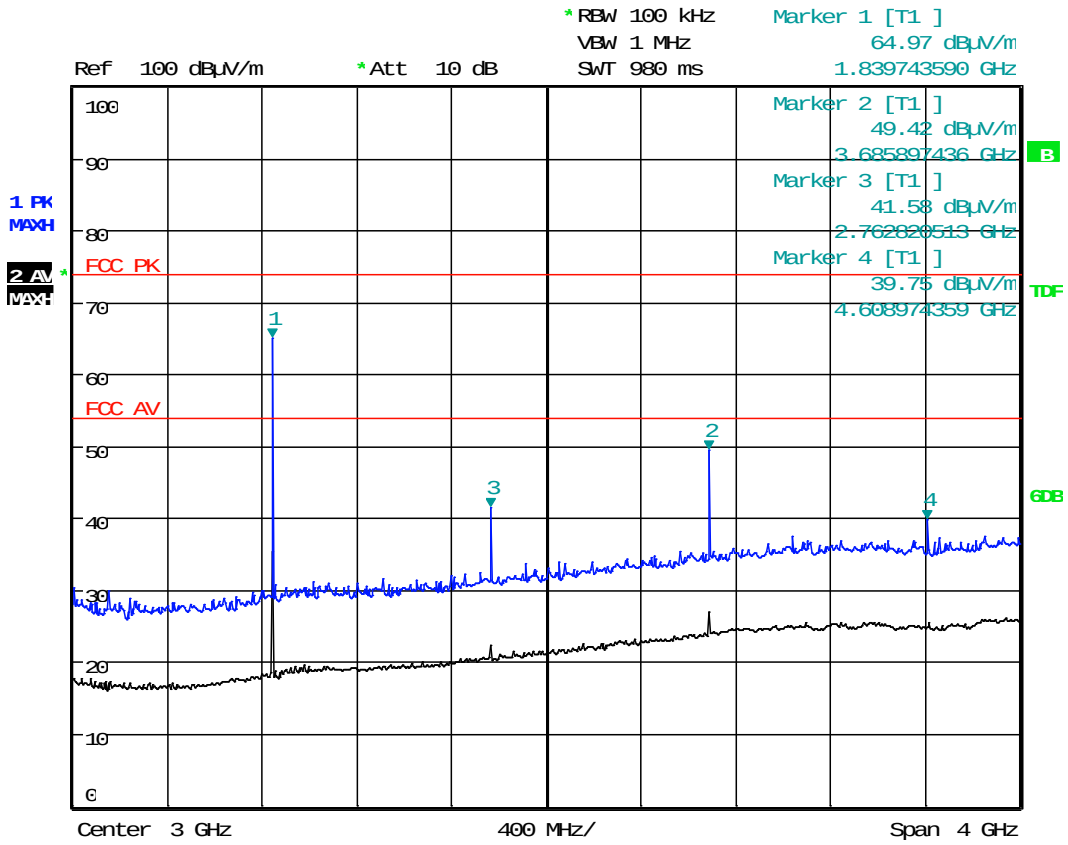


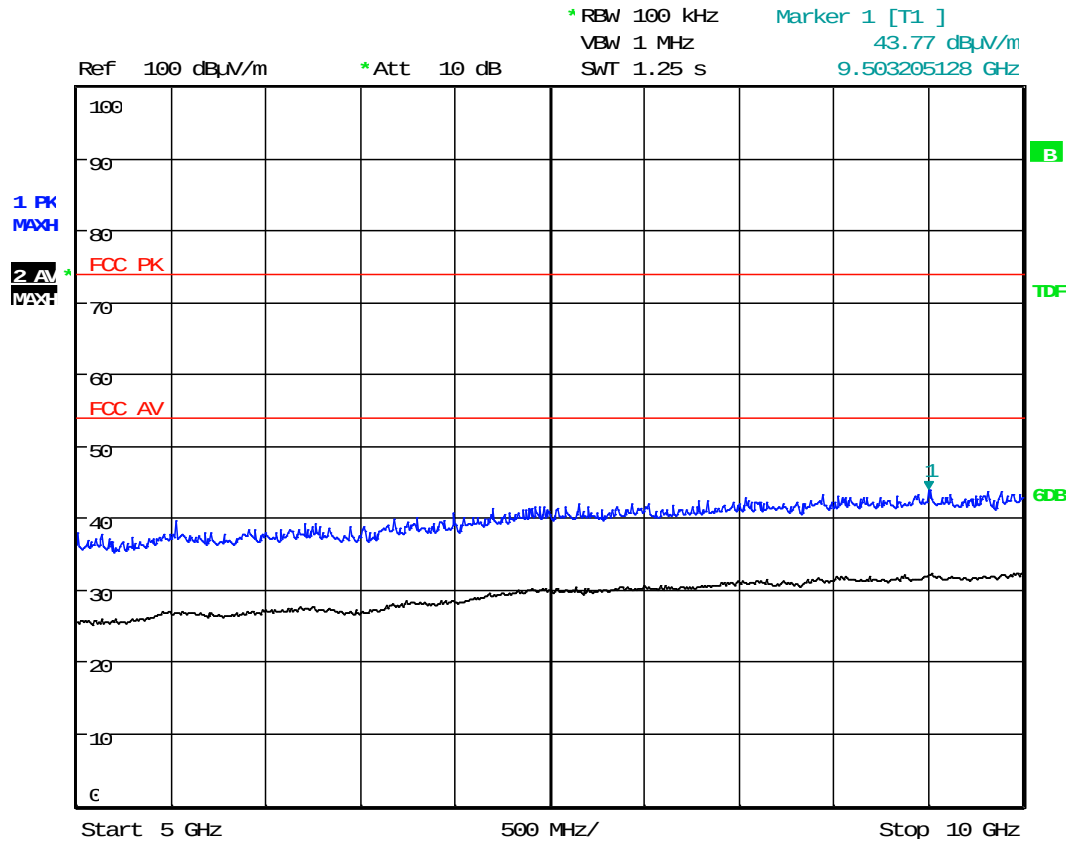






| *High Power; Channel: 914.5 MHz* | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ***DET*** | ***Freq. (MHz)*** | ***Meas'd Emission (dBµV)*** | ***Cable Loss (dB)*** | ***Antenna Factor (dB/m)*** | ***Pre-amp Gain (dB)*** | ***Duty Cycle Corr'n (dB)*** | ***Distance Extrap'n Factor (dB)*** | ***Field Strength (dBµV/m)*** | ***Field Strength (µV/m)*** | ***Limit (µV/m)*** |
| Pk | 1828.99 | 71.23 | 3.00 | 27.10 | 36.08 | 0.00 | 0.00 | 65.25 | 1830.21 | 5012 |
| Av | 1828.99 | 71.23 | 3.00 | 27.10 | 36.08 | -24.81 | 0.00 | 40.44 | 105.24 | 500 |
| Pk | 2743.49 | 52.05 | 3.70 | 29.00 | 36.06 | 0.00 | 0.00 | 48.69 | 271.96 | 5012 |
| Av | 2743.49 | 52.05 | 3.70 | 29.00 | 36.06 | -24.81 | 0.00 | 23.88 | 15.64 | 500 |
| Pk | 3657.99 | 57.20 | 4.20 | 31.70 | 35.71 | 0.00 | 0.00 | 57.39 | 740.46 | 5012 |
| Av | 3657.99 | 57.20 | 4.20 | 31.70 | 35.71 | -24.81 | 0.00 | 32.58 | 42.58 | 500 |
| Pk | 4572.48 | 48.62 | 4.90 | 32.50 | 35.75 | 0.00 | 0.00 | 50.27 | 326.21 | 5012 |
| Av | 4572.48 | 48.62 | 4.90 | 32.50 | 35.75 | -24.81 | 0.00 | 25.46 | 18.76 | 500 |


921.000000 MHz
80.918 dBµV/m
FCC Class B 30MHz-1GHz QP 3m
Level in dBµV/m
Frequency in Hz
30M
50
60
80
100M
200
300
400
500
800
1G


*RBW 100 kHz
VBW 1 MHz
SWT 980 ms
Marker 1 [T1 ]
64.97 dBµV/m
1.839743590 GHz
Marker 2 [T1 ]
49.42 dBµV/m
3.685897436 GHz
Marker 3 [T1 ]
41.58 dBµV/m
2.762820513 GHz
Marker 4 [T1 ]
39.75 dBµV/m
4.608974359 GHz
Ref 100 dBµV/m
*Att 10 dB
1 PK MAXH
2 AV MAXH
FCC PK
FCC AV
B
TDF
6DB
Center 3 GHz
400 MHz/
Span 4 GHz




| High Power; Channel: 921 MHz | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ***DET*** | ***Freq. (MHz)*** | ***Meas'd Emission (dBµV)*** | ***Cable Loss (dB)*** | ***Antenna Factor (dB/m)*** | ***Pre-amp Gain (dB)*** | ***Duty Cycle Corr'n (dB)*** | ***Distance Extrap'n Factor (dB)*** | ***Field Strength (dBµV/m)*** | ***Field Strength (µV/m)*** | ***Limit (µV/m)*** |
| Pk | 1842.08 | 71.43 | 3.00 | 27.20 | 36.08 | 0.00 | 0.00 | 65.55 | 1894.52 | 5012 |
| Av | 1842.08 | 71.43 | 3.00 | 27.20 | 36.08 | -24.81 | 0.00 | 40.74 | 108.94 | 500 |
| Pk | 2763.02 | 51.54 | 3.70 | 29.10 | 36.07 | 0.00 | 0.00 | 48.27 | 259.12 | 5012 |
| Av | 2763.02 | 51.54 | 3.70 | 29.10 | 36.07 | -24.81 | 0.00 | 23.46 | 14.90 | 500 |
| Pk | 3683.70 | 56.04 | 4.30 | 31.70 | 35.70 | 0.00 | 0.00 | 56.34 | 656.15 | 5012 |
| Av | 3683.70 | 56.04 | 4.30 | 31.70 | 35.70 | -24.81 | 0.00 | 31.53 | 37.73 | 500 |
| Pk | 4604.95 | 48.00 | 4.90 | 32.60 | 35.77 | 0.00 | 0.00 | 49.73 | 306.55 | 5012 |
| Av | 4604.95 | 48.00 | 4.90 | 32.60 | 35.77 | -24.81 | 0.00 | 24.92 | 17.63 | 500 |

# 12 Transmitter output power (fundamental radiated emission)

## *12.1 Definition*

The RF power dissipated in the standard output termination when operating under the rated duty cycle selected by the applicant for approval.

## *12.2 Test Parameters*

| | |
|---|---|
| Test Location: | Element Skelmersdale |
| Test Chamber: | Radio Chamber (REF940) |
| Test Standard and Clause: | ANSI C63.10-2013, Clause 6.5 and 6.6 |
| EUT Channels / Frequencies Measured: | 914.5 MHz and 921.0 MHz |
| Deviations From Standard: | None |
| Measurement BW: | 120 kHz |
| Measurement Detector: | Up to 1 GHz: Quasi-peak |
| Voltage Extreme Environment Test Range: | Battery Power = Fully Charged |

**Environmental Conditions (Normal Environment)**

| | |
|---|---|
| Temperature: 23 °C | +15 ºC to +35 ºC (as declared) |
| Humidity: 32 % RH | 20 % RH to 75 % RH (as declared) |

## *12.3 Test Limit*

The field strength measured at 3 metres shall not exceed the limits in the following table:

**Field Strength Limits for License-Exempt Transmitters for Any Application**

| *Fundamental frequency (MHz)* | *Field strength (mV/m at 3 m)* | *Detector* |
|---|---|---|
| 902 to 928 | 50 | Quasi-Peak |

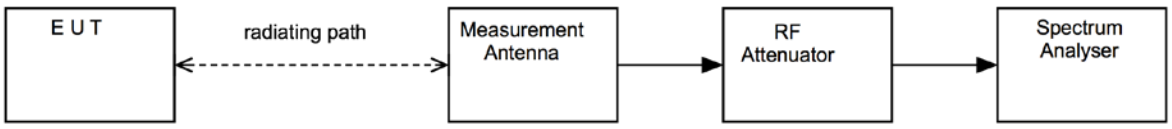
n.b. per FCC 47CFR15.249(e) / RSS-Gen 8.1, peak limit is 20 dB above average.

### *12.4 Test Method*

With the EUT setup as per section 9 of this report and connected as per Figure iv, the resolution bandwidth of the spectrum analyser was increased above the EUT occupied bandwidth and the peak emission data noted.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration in each bandwidth.

**Figure iv Test Setup**




### *12.5 Test Equipment*

| *Type of Equipment* | *Maker/Supplier* | *Model Number* | *Element Number* | *Calibration Due Date* | *Calibration Interval* |
|---|---|---|---|---|---|
| Bilog | Chase | CBL611/A | UH191 | 26/02/2017 | 24 |
| ESVS10 | R&S | ESVS10 | L352 | 07/08/2016 | 12 |

### *12.6 Test Results*

| *Channel Frequency (MHz)* | *Meas'd Emission (dBµV)* | *Cable Loss (dB)* | *Antenna Factor (dB/m)* | *Pre-amp Gain (dB)* | *Field Strength (dBuV/m)* | *Distance Extrap'n Factor (dB)* | *Field Strength (mV/m)* |
|---|---|---|---|---|---|---|---|
| 914.50 | 58.90 | 4.10 | 23.43 | N/A | 86.43 | - | 20.9 |
| 921.00 | 59.20 | 4.10 | 23.65 | N/A | 86.95 | - | 22.3 |

# 13 Duty Cycle

## *13.1 Definition*

The ratio of the sum of all pulse durations to the total period, during a specified period of operation. The duty cycle is determined on the basis of one complete pulse train for pulse trains not exceeding 100 milliseconds. Where the pulse train exceeds 100 milliseconds, the duty cycle is determined on the basis of the 100 millisecond interval with the highest average value of emission.

## *13.2 Test Parameters*

| | |
|---|---|
| Test Location: | Element Skelmersdale |
| Test Chamber: | Radio laboratory |
| Test Standard and Clause: | ANSI C63.10-2013, Clause 6.5 and 6.6 |
| EUT Channels / Frequencies Measured: | 914.5 MHz and 921.0 MHz |
| Deviations From Standard: | None |
| Temperature Extreme Environment Test Range: | N/A |
| Voltage Extreme Environment Test Range: | N/A |

**Environmental Conditions (Normal Environment)**

| | |
|---|---|
| Temperature: 25 °C | +15 ºC to +35 ºC (as declared) |
| Humidity: 48 % RH | 20 % RH to 75 % RH (as declared) |

## *13.3 Test Limit*

N/A.

### *13.4 Test Method*

With the EUT setup as per section 9 of this report and connected as per Figure vii, the duty of the EUT was calculated from the sum of total on and off times over the observation period.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, bandwidths, data rates and power settings were used to observe the worst-case configuration.

[1] Single antenna output devices

Duty was measured at the antenna port / at a distance of 3 m.

[2] Multiple antenna output devices

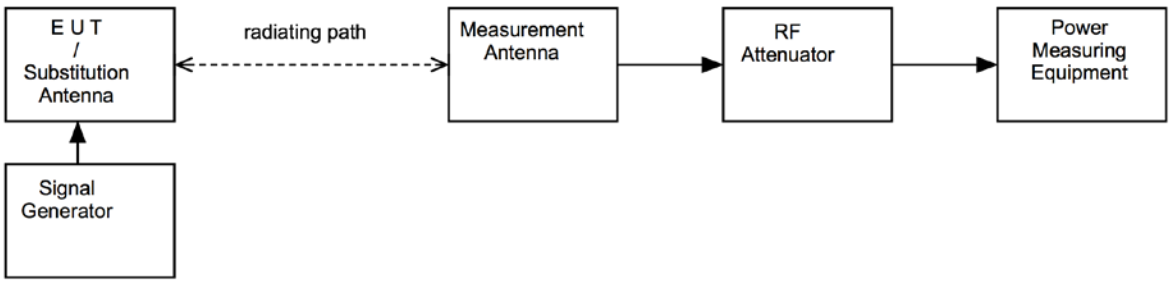
Duty was measured as the combination of all ports simultaneously / at a distance of 3 m.

The duty cycle correction factor, DC, is used to adjust peak emissions (voltage) to give an average value and is calculated by:

$$DC = 20 \log (\text{duty ratio})$$

Where, duty ratio is total on-time divided by total off-time in the worst-case pulse train or 100 ms, whichever is longer.

**Figure vii Test Setup**




### *13.5 Test Equipment*

| *Type of Equipment* | *Maker/Supplier* | *Model Number* | *Element Number* | *Calibration Due Date* | *Calibration Interval* |
|---|---|---|---|---|---|
| Spectrum Analyser | R&S | FSU46 | U281 | 07/06/2017 | 12 |

### *13.6 Test Results*

| *Test Environment* | | *Single Channel TxOn time (ms)* | *Total TxOn time (ms)* | *Observation period (ms)* | *Duty (%)* | *Calculated Factor (dB)* |
|---|---|---|---|---|---|---|
| $V_{nominal}$ | $T_{nominal}$ | 5.75 | 5.75 | 100 | 5.75 | 24.44 |

# 14 Measurement Uncertainty

## Calculated Measurement Uncertainties

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95 % confidence:

**[1] Carrier power**

Uncertainty in test result (Power Meter) = **1.08 dB**
Uncertainty in test result (Spectrum Analyser) = **2.48 dB**

**[2] Spurious emissions**

Uncertainty in test result (30 MHz to 1 GHz) = **4.6 dB**
Uncertainty in test result (1 GHz to 18 GHz) = **4.7 dB**

**[3] AC power line conducted emissions**

Uncertainty in test result = **3.4 dB**

**[4] Occupied bandwidth**

Uncertainty in test result = **15.5 %**

**[5] Maximum frequency error**

Uncertainty in test result (Power Meter) = **0.113 ppm**
Uncertainty in test result (Spectrum Analyser) = **0.265 ppm**

**[6] Duty cycle**

Uncertainty in test result = **7.98 %**