

Report on the Radio Testing

For

Elvie

on

Elvie Pump

Report no. TRA-056398-47-03A

2023-02-13

RF915 10.0



Report Number: TRA-056398-47-03A  
Issue: A

REPORT ON THE RADIO TESTING OF A  
Elvie  
Elvie Pump  
WITH RESPECT TO SPECIFICATION  
FCC 47CFR 15.247  
TO SATISFY PERMISSIVE CHANGE REQUIREMENTS OF  
KDB 178919 D01 Permissive Change Policy v06

TEST DATE: 2023-02-10

Tested by:



Steven Garwell, Sing Lung  
Siu

Written by:



Steven Garwell  
Radio Test Engineer

Approved by:

Daniel Winstanley  
Senior Radio Test Engineer

Date:

2023-02-13

Disclaimers:

- [1] THIS DOCUMENT MAY BE REPRODUCED ONLY IN ITS ENTIRETY AND WITHOUT CHANGE
- [2] THE RESULTS CONTAINED IN THIS DOCUMENT RELATE ONLY TO THE ITEM(S) TESTED

## 1 Revision Record

<i>Issue Number</i>	<i>Issue Date</i>	<i>Revision History</i>
A	2023-02-13	Original

## 2 Summary

TEST REPORT NUMBER: TRA-056398-47-03A

WORKS ORDER NUMBER: TRA-056398-09

PURPOSE OF TEST: Class II Permissive Change

TEST SPECIFICATION: 47CFR15.247

EQUIPMENT UNDER TEST (EUT): Elvie Pump

FCC IDENTIFIER: 2AEHI-EP0121

EUT SERIAL NUMBER: 001396-2-8

MANUFACTURER/AGENT: Elvie

ADDRESS: 2nd Floor  
63-66 Hatton Garden  
London  
EC1N 8LE  
United Kingdom

CLIENT CONTACT: Shiva Golchi  
☎ +44 (0)203 745 5201  
✉ shiva.golchi@chiaro.co.uk

ORDER NUMBER: PO0184392

TEST DATE: 2023-02-10

TESTED BY: Steven Garwell, Sing Lung Siu  
Element

## 2.1 Test Summary

<i>Test Method and Description</i>		<i>Requirement Clause 47CFR15</i>	<i>Applicable to this equipment</i>	<i>Result / Note</i>
Radiated spurious emissions (restricted bands of operation and cabinet radiation)		15.247 (d)	<input checked="" type="checkbox"/>	PASS
AC power line conducted emissions		15.207	<input type="checkbox"/>	Note 1
Occupied bandwidth		15.247 (a) (2)	<input type="checkbox"/>	Note 1
Conducted carrier power	Peak	15.247 (b) (3)	<input checked="" type="checkbox"/>	PASS
	Max.		<input type="checkbox"/>	
Out of band emissions		15.247 (d)	<input type="checkbox"/>	Note 1
Power spectral density		15.247 (e)	<input type="checkbox"/>	Note 1
Calculation of duty correction		-	<input checked="" type="checkbox"/>	-

### Specific Note:

**Note 1:** Limited testing of Radiated spurious emissions (restricted bands of operation and cabinet radiation) and Conducted carrier power to support Class II permissive change as requested by the client.

### General Notes:

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).

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## 4 Introduction

This report TRA-056398-47-03A presents the results of the Radio testing on a Elvie Pump to specification 47CFR15 Radio Frequency Devices.

The testing was carried out for Elvie by Element, at the address detailed below.

- |  |   |
|--|---|
| <input type="checkbox"/> Element Hull<br>Unit E<br>South Orbital Trading Park<br>Hedon Road<br>Hull<br>HU9 1NJ<br>UK | <input checked="" type="checkbox"/> Element Skelmersdale<br>Unit 1<br>Pendle Place<br>Skemersdale<br>West Lancashire<br>WN8 9PN<br>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:

The test laboratory is accredited for the above sites under the following US-UK MRA, Designation numbers.

Element Hull	UK2007
Element Skelmersdale	UK2020

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

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.
- KDB 178919 D01 Permissive Change Policy v06

### **5.2 Deviations from Test Standards**

Limited testing of Radiated spurious emissions (restricted bands of operation and cabinet radiation) and Conducted carrier power to support Class II permissive change as requested by the client.



## 6 Glossary of Terms

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

## 7 Equipment under Test

### 7.1 EUT Identification

- Name: Elvie Pump
- Serial Number: 001396-2-8
- Model Number: EP01
- Software Revision: 10.7.1 bt-cert
- Build Level / Revision Number: 001396-debug-v3.1.0

### 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.

*Not Applicable – No support/monitoring equipment required.*

### 7.3 EUT Mode of Operation

The EUT was transmitting a modulated carrier on the frequencies as indicated. This was selectable by pressing buttons on the control pad and the correct mode of operation was indicated via a flashing LED.

### 7.4 EUT Radio Parameters

#### 7.4.1 General

<b>Frequency of operation:</b>	2402 MHz to 2480 MHz
<b>Modulation type:</b>	GFSK
<b>Occupied channel bandwidth(s):</b>	2 MHz
<b>Channel spacing:</b>	2 MHz
<b>Declared output power(s):</b>	≤ 3 dBm
<b>Nominal Supply Voltage:</b>	3.7 Vdc

#### 7.4.2 Antennas

<b>Type:</b>	Integral (Pulse Larsen – W3008)
<b>Frequency range:</b>	1.1 dBi

### 7.5 EUT Description

The EUT is an electric breast pump containing a BLE radio.

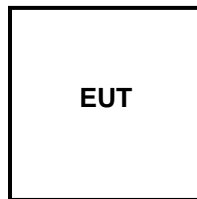
## 8 Modifications

No modifications were performed during this assessment.

## 9 EUT Test Setup

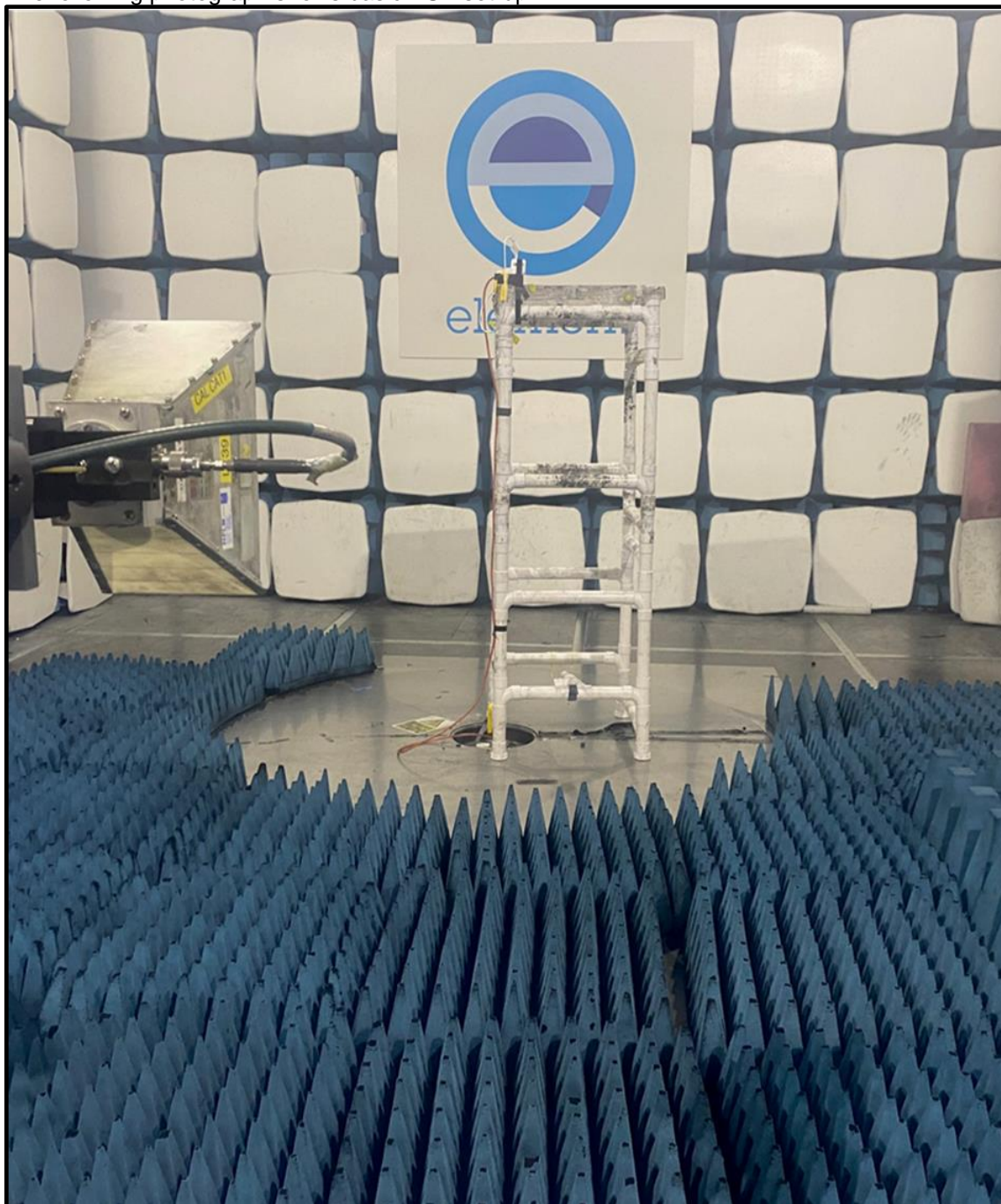
### 9.1 *Block Diagram*

The following diagram shows basic EUT interconnections:  
EUT is a Battery powered standalone device.



## 9.2 General Set-up Photograph

The following photograph shows basic EUT set-up:



## 9.3 Measurement software

Where applicable, the following software was used to perform measurements contained within this report.

Element Emissions R5  
Element Transmitter Bench Test  
ETS Lindgren EMPower V1.0.4.2

## **10 General Technical Parameters**

### **10.1 Normal Conditions**

The EUT was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was 3.7 Vdc from an internal Lithium battery.

## 11 Radiated emissions

### 11.1 Definitions

#### *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:	SK03 Radio Chamber
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Frequencies Measured:	2402 MHz, 2442 MHz & 2480 MHz
Deviations from Standard:	None
Measurement BW:	30 MHz to 1 GHz: 120 kHz; Above 1 GHz: 1 MHz
Measurement Detector:	Up to 1 GHz: quasi-peak; Above 1 GHz: RMS average and Peak

### Environmental Conditions (Normal Environment)

Temperature: 20 °C	+15 °C to +35 °C (as declared)
Humidity: 34 % RH	20 % RH to 75 % RH (as declared)
Supply: 3.7 Vdc	3.7 Vdc (as declared)

### 11.3 Test Limit

Unwanted emissions that fall within the restricted frequency bands shall comply with the limits specified:

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

<i>Frequency (MHz)</i>	<i>Field Strength (µV/m at 3 m)</i>	<i>Field Strength (dBµV/m at 3 m)</i>
30 to 88	100	40.0
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

On frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function. On frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit.

## 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 dB $\mu$ V/m at the regulatory distance, using:

$$FS = PR + CL + AF - PA + DC - CF$$

$$\text{Factor} = CL + AF - PA$$

Where,

PR is the power recorded on the receiver / spectrum analyzer in dB $\mu$ V;

CL is the cable loss in dB;

AF is the test antenna factor in dB/m;

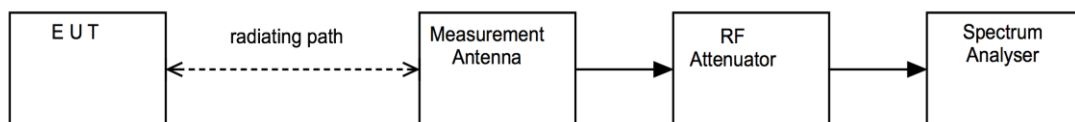
PA is the pre-amplifier gain in dB (where used);

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**



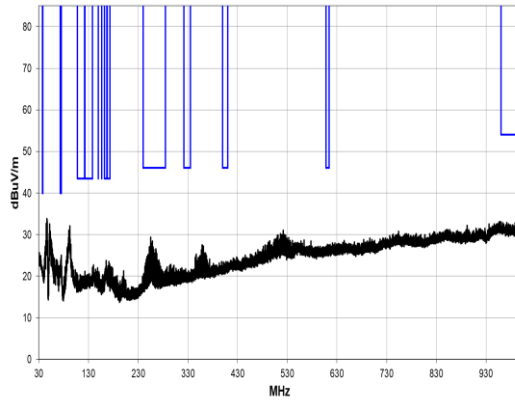
**11.5 Test Equipment**

<b>Equipment Type</b>	<b>Manufacturer</b>	<b>Equipment Description</b>	<b>Element No</b>	<b>Due For Calibration</b>
Spectrum Analyser	R&S	FSU50	U544	2023-11-18
EMI Receiver	R&S	ESR26	U489	2023-03-04
Bilog	Chase	CBL611/B	U573	2024-10-14
1-18GHz Horn	EMCO	3115	L139	2024-07-01
Horn 18-26GHz (&U330)	Flann	20240-20	L300	2024-06-30
PreAmp	Watkins Johnson	6201-69	U372	2023-03-01
Pre Amp	Agilent	8449B	L572	2023-10-24
2.4G Band Stop Filter	BSC	SN 4478	U543	2024-02-08
Radio Chamber - PP	Rainford EMC	ATS	REF940	2023-11-06
Radiated Test Software	Element	Emissions R5	REF9000	Cal not required

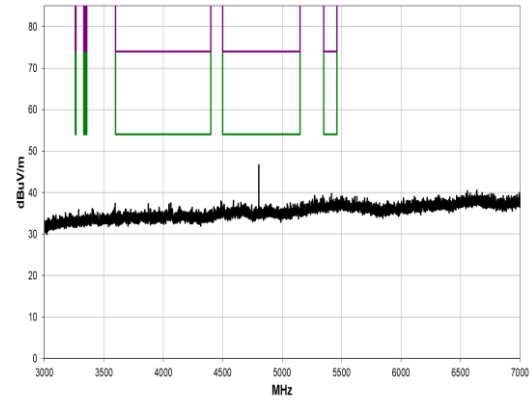
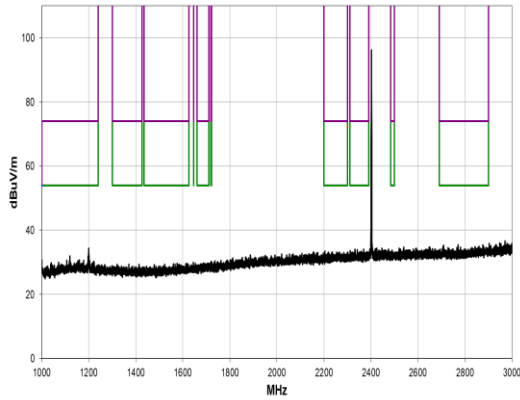


### 11.6 Test Results

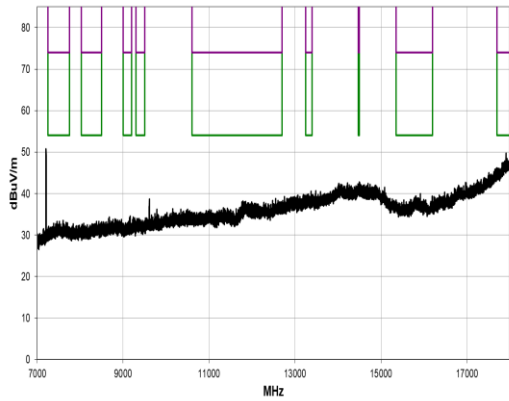
Bottom Channel: 2402 MHz



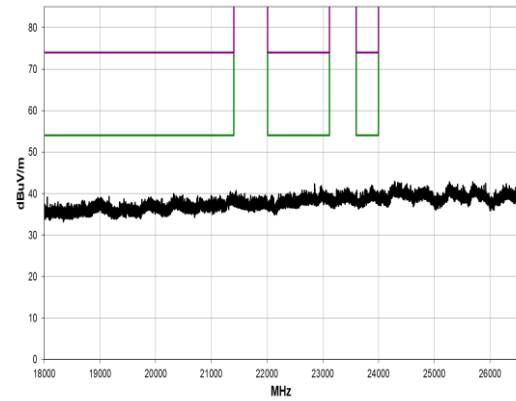
30 MHz to 1 GHz



1 GHz to 3 GHz



3 GHz to 7 GHz

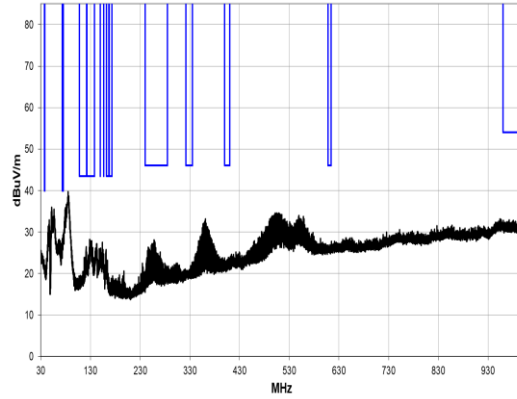


7 GHz to 18 GHz

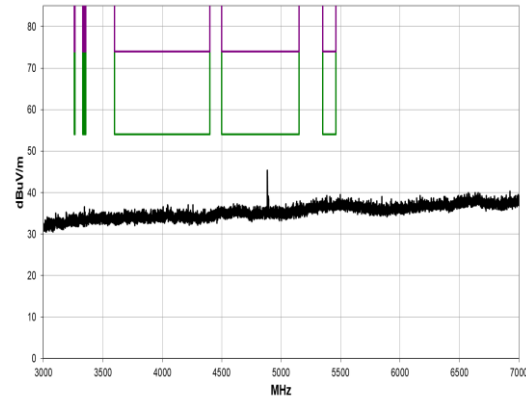
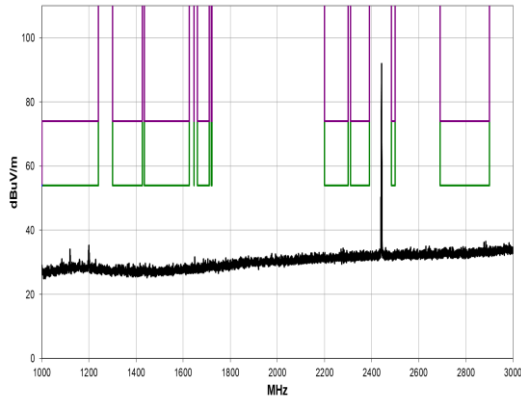
18 GHz to 26.5 GHz

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
4803.500	38.8	2.7	1.5	74.0	3.6	0.0	Horz	AV	0.0	45.1	54.0	-8.9
4803.567	36.4	2.7	1.5	237.0	3.6	0.0	Vert	AV	0.0	42.7	54.0	-11.3
4803.342	50.7	2.7	1.5	74.0	0.0	0.0	Horz	PK	0.0	53.4	74.0	-20.6
4803.542	48.8	2.7	1.5	237.0	0.0	0.0	Vert	PK	0.0	51.5	74.0	-22.5

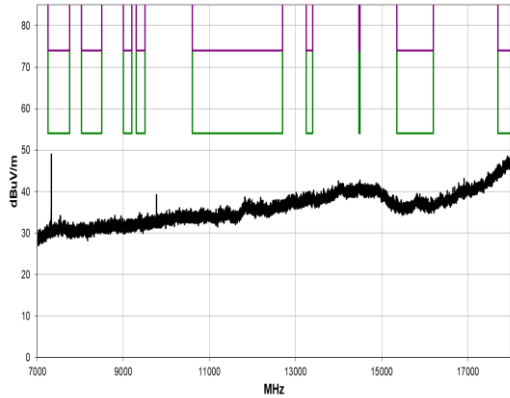
Middle Channel: 2442 MHz



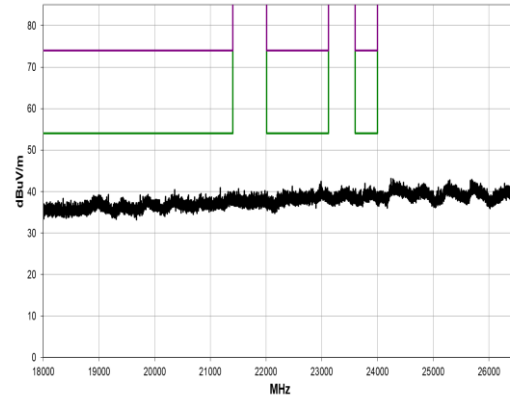
30 MHz to 1 GHz



1 GHz to 3 GHz



3 GHz to 7 GHz

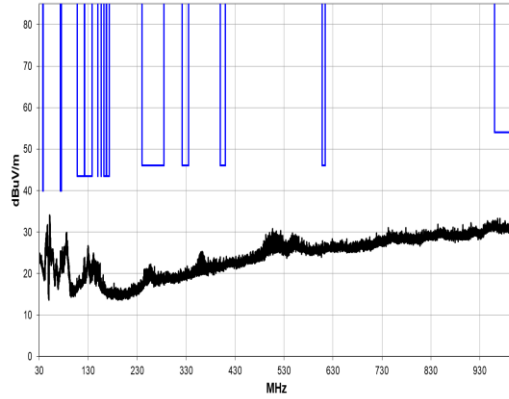


7 GHz to 18 GHz

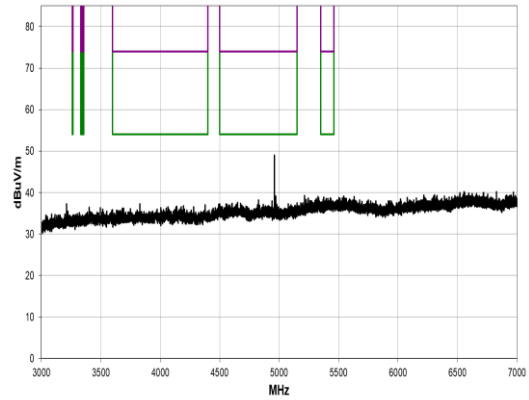
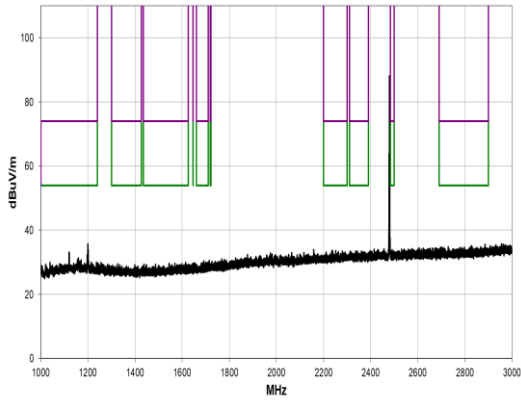
18 GHz to 26.5 GHz

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
4883.600	39.6	3.0	1.3	80.0	3.6	0.0	Horz	AV	0.0	46.2	54.0	-7.8
4884.500	37.6	3.0	1.4	354.0	3.6	0.0	Vert	AV	0.0	44.2	54.0	-9.8
4883.417	50.6	3.0	1.3	80.0	0.0	0.0	Horz	PK	0.0	53.6	74.0	-20.4
4884.358	50.0	3.0	1.4	354.0	0.0	0.0	Vert	PK	0.0	53.0	74.0	-21.0
7325.283	46.5	7.4	1.5	345.1	3.6	0.0	Horz	AV	-9.5	48.0	54.0	-6.0
7326.808	45.5	7.4	1.5	344.1	3.6	0.0	Vert	AV	-9.5	47.0	54.0	-7.0
7326.717	57.9	7.4	1.5	344.1	0.0	0.0	Vert	PK	-9.5	55.8	74.0	-18.2
7325.200	57.5	7.4	1.5	345.1	0.0	0.0	Horz	PK	-9.5	55.4	74.0	-18.6

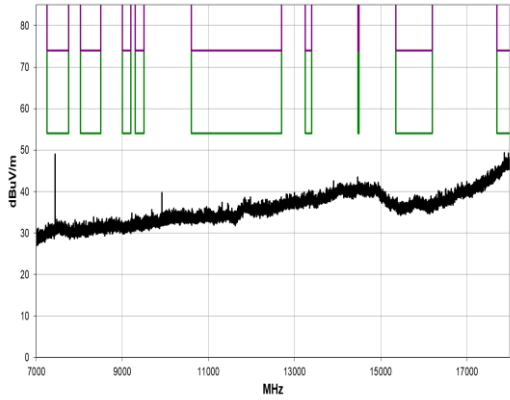
Top Channel: 2480 MHz



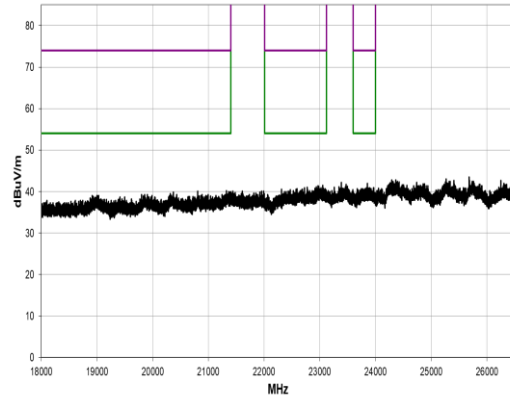
30 MHz to 1 GHz



1 GHz to 3 GHz



3 GHz to 7 GHz

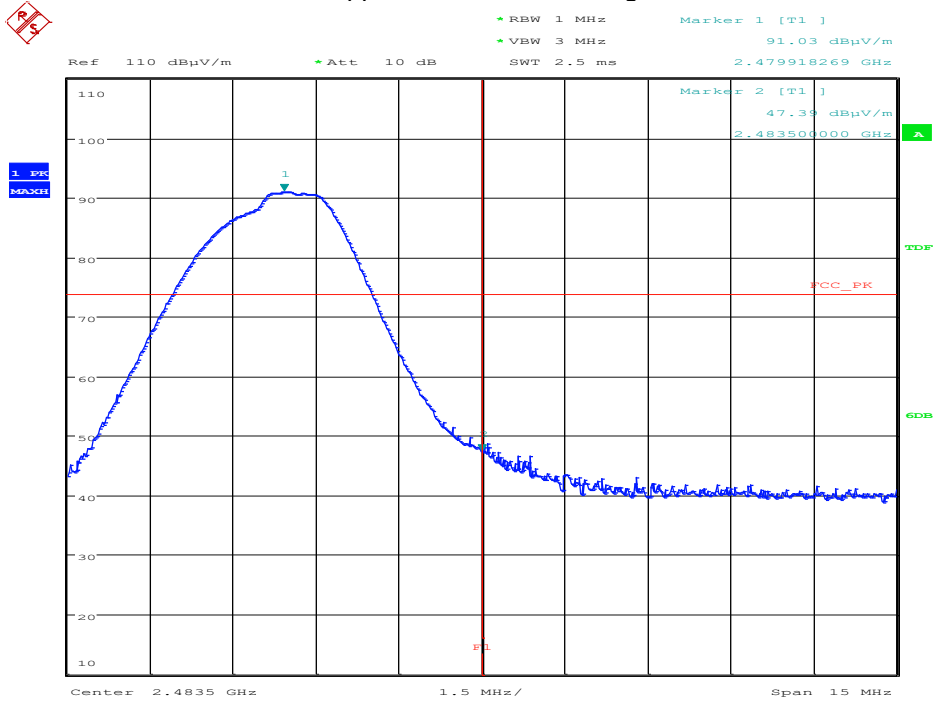


7 GHz to 18 GHz

18 GHz to 26.5 GHz

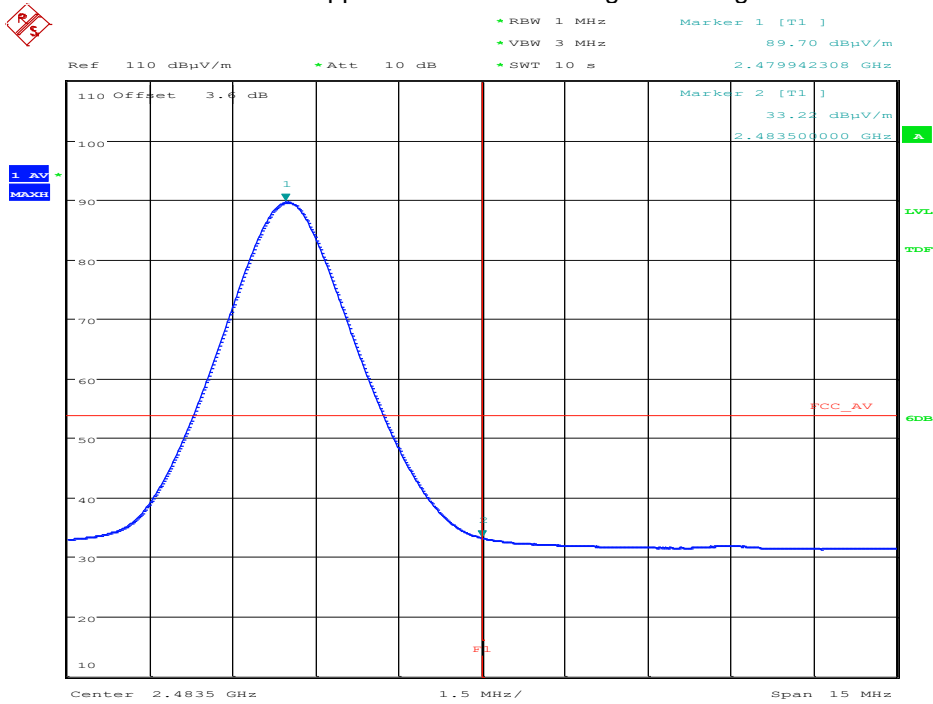
Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
4960.483	40.4	3.2	1.5	73.1	3.6	0.0	Horz	AV	0.0	47.2	54.0	-6.8
4959.492	39.6	3.2	1.3	58.0	3.6	0.0	Vert	AV	0.0	46.4	54.0	-7.6
4960.392	52.3	3.2	1.5	73.1	0.0	0.0	Horz	PK	0.0	55.5	74.0	-18.5
4960.317	51.6	3.2	1.3	58.0	0.0	0.0	Vert	PK	0.0	54.8	74.0	-19.2
7439.258	46.9	7.4	1.5	346.0	3.6	0.0	Horz	AV	-9.5	48.4	54.0	-5.6
7439.350	46.7	7.4	1.5	348.0	3.6	0.0	Vert	AV	-9.5	48.2	54.0	-5.8
7439.258	57.9	7.4	1.5	346.0	0.0	0.0	Horz	PK	-9.5	55.8	74.0	-18.2
7439.125	57.5	7.4	1.5	348.0	0.0	0.0	Vert	PK	-9.5	55.4	74.0	-18.6

### Upper Radiated Band Edge – Peak



Date: 10.FEB.2023 10:58:53

### Upper Radiated Band Edge – Average



Date: 10.FEB.2023 10:56:34

## 12 Maximum peak conducted output power

### 12.1 Definition

The maximum peak conducted output power is defined as the maximum power level measured with a peak detector using a filter with width and shape of which is sufficient to accept the signal bandwidth.

### 12.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	SK03 Radio Chamber
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.9.1
EUT Frequencies Measured:	2402 MHz, 2442 MHz & 2480 MHz
EUT Channel Bandwidths:	1 MHz
Deviations From Standard:	None
Measurement BW:	3 MHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	10 MHz
Measurement Detector:	Peak
Voltage Extreme Environment Test Range:	Mains Power = 85 % and 115 % of Nominal (FCC only requirement); Battery Power = new battery.

### Environmental Conditions (Normal Environment)

Temperature: 21 °C	+15 °C to +35 °C (as declared)
Humidity: 35 % RH	20 % RH to 75 % RH (as declared)

### 12.3 Test Limit

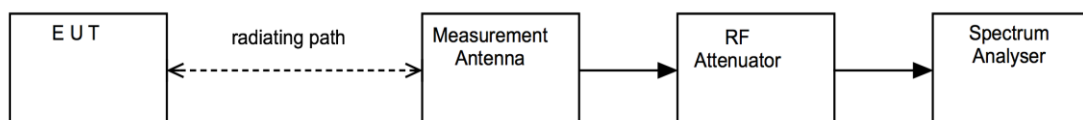
For systems employing digital modulation techniques operating in the bands 902 to 928 MHz, 2400 to 2483.5 MHz and 5725 to 5850 MHz, the maximum peak conducted output power shall not exceed 1 W.

### 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

<b>Equipment Type</b>	<b>Manufacturer</b>	<b>Equipment Description</b>	<b>Element No</b>	<b>Due For Calibration</b>
Spectrum Analyser	R&S	FSU50	U544	2023-11-18
1-18GHz Horn	EMCO	3115	L139	2024-07-01
Pre Amp	Agilent	8449B	L572	2023-10-24
Radio Chamber - PP	Rainford EMC	ATS	REF940	2023-11-06
Radiated Test Software	Element	Emissions R5	REF9000	Cal not required

## 12.6 Test Results

The following formula was used to convert field strength ( $E$ ) in volts/metre to conducted output power in watts:

$$\text{Conducted Output Power} = (E \times d)^2 / (30 \times G)$$

Where,

$E$  is the electric field strength in V/m

$d$  is the measurement distance in meters (m)

$G$  is the antenna numerical gain referenced to isotropic gain = 1.29

<b>Frequency (MHz)</b>	<b>Peak Field Strength (dBuv/m)</b>	<b>Peak Field Strength (V/m)</b>	<b>Distance (m)</b>	<b>Numeric Gain (G)</b>	<b>Peak Conducted Output Power (W)</b>
2402	97.6	0.07586	3	1.29	0.00134
2442	95.8	0.06166	3	1.29	0.00089
2480	90.9	0.03508	3	1.29	0.00029

## 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.

### 13.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	SK03 Radio Chamber
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.6
EUT Frequencies Measured:	2442 MHz
Deviations From Standard:	None
Temperature Extreme Environment Test Range:	N/A
Voltage Extreme Environment Test Range:	N/A

### Environmental Conditions (Normal Environment)

Temperature: 21 °C	+15 °C to +35 °C (as declared)
Humidity: 5 % RH	20 % RH to 75 % RH (as declared)
Supply: 3.7 Vdc	3.7 Vdc (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 measured

[1] Single antenna output devices

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

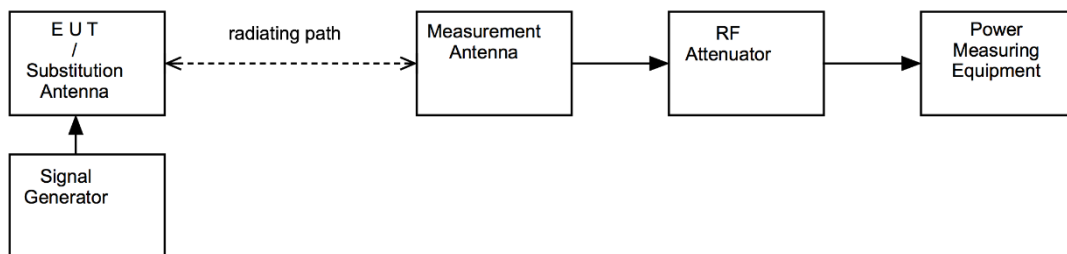
[2] Multiple antenna output devices

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

The duty cycle correction factor, DC, shall be added to the measurement results prior to comparing with the emission limit to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as:

- 1) If power averaging (rms) mode was used in step f), then the applicable correction factor is  $[10 \log (1 / D)]$ , where  $D$  is the duty cycle.
- 2) If linear voltage averaging mode was used in step f), then the applicable correction factor is  $[20 \log (1 / D)]$ , where  $D$  is the duty cycle.
- 3) If a specific emission is demonstrated to be continuous ( $D \geq 98\%$ ) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

**Figure vii Test Setup**



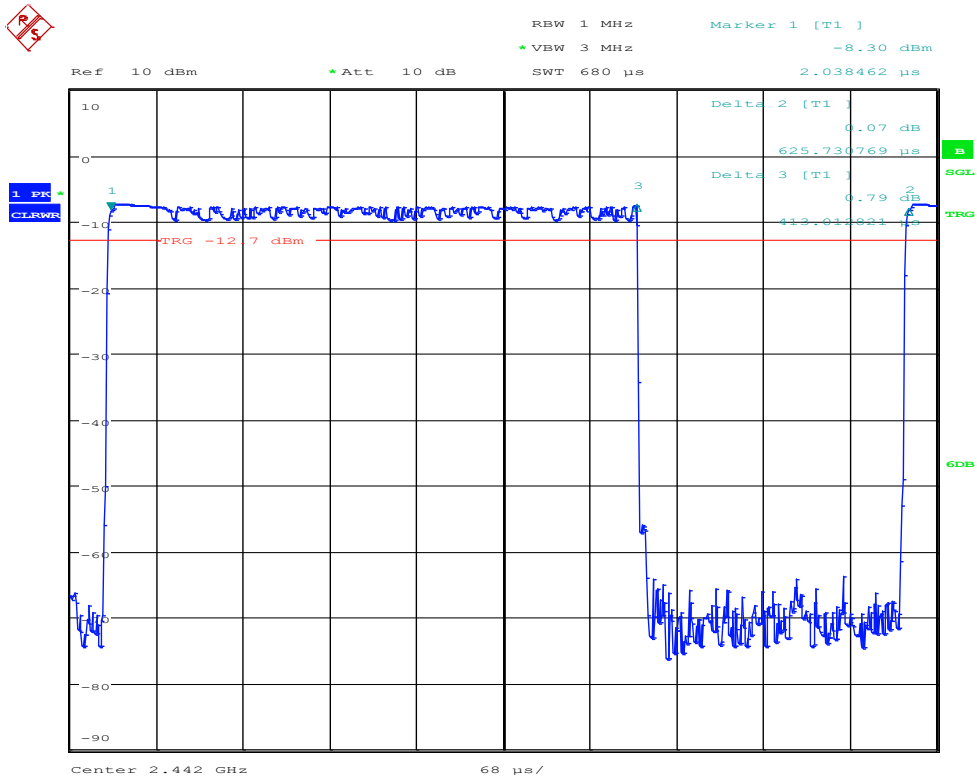
### 13.5 Test Equipment

<b>Equipment Type</b>	<b>Manufacturer</b>	<b>Equipment Description</b>	<b>Element No</b>	<b>Due For Calibration</b>
Spectrum Analyser	R&S	FSU50	U544	2023-11-18
1-18GHz Horn	EMCO	3115	L139	2024-07-01
Pre Amp	Agilent	8449B	L572	2023-10-24
Radio Chamber - PP	Rainford EMC	ATS	REF940	2023-11-06
Radiated Test Software	Element	Emissions R5	REF9000	Cal not required



### 13.6 Test Results

Frequency: 2442 MHz				
Test Environment		TxOn time (μs)	Frame Period (μs)	Calculated Factor (dB)
V <sub>nominal</sub>	T <sub>nominal</sub>	625.730769	413.012821	3.6



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## 14 Measurement Uncertainty

### Radio Testing – General Uncertainty Schedule

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95 % confidence where no required test level exists.

Test/Measurement	Budget Number	MU
<b>Conducted RF Power, Power Spectral Density, Adjacent Channel Power and Spurious emissions</b>		
Absolute RF power (via antenna connector) Dare RPR3006W Power Head	MU4001	0.9 dB
Carrier Power and PSD - Spectrum Analysers	MU4004	0.9 dB
Adjacent Channel Power	MU4002	1.9 dB
Transmitter conducted spurious emissions	MU4041	0.9 dB
Conducted power and spurious emissions 40 GHz to 50 GHz	MU4042	2.4 dB
Conducted power and spurious emissions 50 GHz to 75 GHz	MU4043	2.5 dB
Conducted power and spurious emissions 75 GHz to 110 GHz	MU4044	2.4 dB
<b>Radiated RF Power and Spurious emissions ERP and EIRP</b>		
Effective Radiated Power Reverb Chamber	MU4020	3.7 dB
Effective Radiated Power	MU4021	4.7 dB
TRP Emissions 30 MHz to 1 GHz using CBL6111 or CBL6112 Bilog Antenna	MU4046	5.3 dB
TRP Emissions 1 GHz to 18 GHz using HL050 Log Periodic Antenna	MU4047	5.1 dB
TRP Emissions 18 GHz to 26.5 GHz using Standard Gain Horn	MU4048	2.7 dB
TRP Emissions 26.5 GHz to 40 GHz using Standard Gain Horn	MU4049	2.7 dB
<b>Spurious Emissions Electric and Magnetic Field</b>		
Radiated Spurious Emissions 30 MHz to 1 GHz	MU4037	4.7 dB
Radiated Spurious Emissions 1-18 GHz	MU4032	4.5 dB
E Field Emissions 18GHz to 26 GHz	MU4024	3.2 dB
E Field Emissions 26GHz to 40 GHz	MU4025	3.3 dB
E Field Emissions 40GHz to 50 GHz	MU4026	3.5 dB
E Field Emissions 50GHz to 75 GHz	MU4027	3.6 dB
E Field Emissions 75GHz to 110 GHz	MU4028	3.6 dB
Radiated Magnetic Field Emissions	MU4031	2.3 dB
<b>Frequency Measurements</b>		
Frequency Deviation	MU4022	0.316 kHz
Frequency error using CMTA test set	MU4023	113.441 Hz
Frequency error using GPS locked frequency source	MU4045	0.0413 ppm
<b>Bandwidth/Spectral Mask Measurements</b>		
Channel Bandwidth	MU4005	3.87 %
Transmitter Mask Amplitude	MU4039	1.3 dB
Transmitter Mask Frequency	MU4040	2.59 %
<b>Time Domain Measurements</b>		
Transmission Time	MU4038	4.40 %
<b>Dynamic Frequency Selection (DFS) Parameters)</b>		
DFS Analyser - Measurement Time	MU4006	679 $\mu$ s
DFS Generator - Frequency Error	MU4007	92 Hz
DFS Threshold Conducted	MU4008	1.3 dB
DFS Threshold Radiated	MU4009	3.2 dB

<b>Test/Measurement</b>	<b>Budget Number</b>	<b>MU</b>
<b>Receiver Parameters</b>		
EN300328 Receiver Blocking	MU4010	<b>1.1 dB</b>
EN301893 Receiver Blocking	MU4011	<b>1.1 dB</b>
EN303340 Adjacent Channel Selectivity	MU4012	<b>1.1 dB</b>
EN303340 Overloading	MU4013	<b>1.1 dB</b>
EN303340 Receiver Blocking	MU4014	<b>1.1 dB</b>
EN303340 Receiver Sensitivity	MU4015	<b>0.9 dB</b>
EN303372-1 Image Rejection	MU4016	<b>1.4 dB</b>
EN303372-1 Receiver Blocking	MU4017	<b>1.1 dB</b>
EN303372-2 Adjacent Channel Selectivity	MU4018	<b>1.1 dB</b>
EN303372-2 Dynamic Range	MU4019	<b>0.9 dB</b>
Receiver Blocking Talk Mode Conducted	MU4033	<b>1.2 dB</b>
Receiver Blocking Talk Mode- radiated	MU4034	<b>3.4 dB</b>
Rx Blocking, listen mode, blocking level	MU4035	<b>3.2 dB</b>
Rx Blocking, listen mode, radiated Threshold Measurement	MU4036	<b>3.4 dB</b>
Adjacent Sub Band Selectivity	MU4003	<b>4.2 dB</b>

## 15 Antenna Information

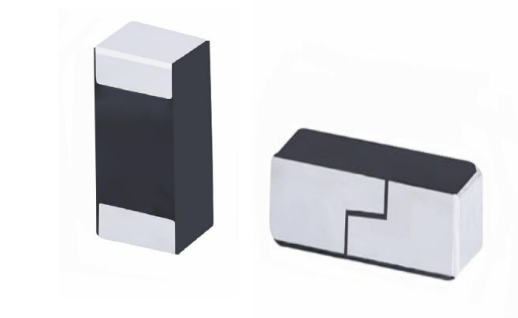


Series: Chip Antenna

### TECHNICAL DATA SHEET

Description: 2.4-2.4835GHz Ceramic SMT antenna, 4x4.25mm keep out area

PART NUMBER: W3008



#### Features:

- 2400-2483.5MHz
- Size: 3.2 x 1.6 x 1.1mm
- Efficiency: 66 %
- Gain: 1.1 dBi
- Polarization: Linear
- Power Handling: 5W
- RoHS Compliant
- Moisture Sensitivity Level MSL1

#### Applications:

- Bluetooth, BLE, Zigbee, WiFi
- 2.4GHz ISM band radios

All dimensions are in mm / inches

#### Issue: 1946

In the effort to improve our products, we reserve the right to make changes judged to be necessary.

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For more information:

Pulse Worldwide Headquarters  
15255 Innovation Drive #100  
San Diego, CA 92128  
USA  
Tel: 1-858-674-8100

Pulse/Larsen Antennas  
18110 SE 34<sup>th</sup> St Bldg 2 Suite 250  
Vancouver, WA 98683  
USA  
Tel: 1-360-944-7551

Europe Headquarters  
Pulse GmbH & Co, KG  
Zeppelinstrasse 15  
Herrenberg, Germany  
Tel: 49 7032 7806 0

Pulse (Suzhou) Wireless Products Co, Inc.  
99 Huo Ju Road(#29 Bldg,4<sup>th</sup> Phase  
Suzhou New District  
Jiangsu Province, Suzhou 215009 PR China  
Tel: 86 512 6807 9998



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