

Report on the Radio Testing  
For  
Draeger Safety UK Ltd  
on  
Dräger PSS AirBoss Sentinel  
Report no. TRA-051967-47-15B  
2025-06-19

RF914 9.0



Report Number: TRA-051967-47-15B  
Issue: B

REPORT ON THE RADIO TESTING OF A  
Draeger Safety UK Ltd  
Dräger PSS AirBoss Sentinel  
WITH RESPECT TO SPECIFICATION  
FCC 47CFR 15.225

TEST DATE: 2023-04-19 to 2024-04-12

Tested by:



S Garwell, D Winstanley  
Radio Test Engineer's

Written by:



S Garwell  
Radio Test Engineer

Approved by:

J Charters  
Lab Manager

Date: 2025-06-19

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

RF914 9.0



1 Revision Record

<i>Issue Number</i>	<i>Issue Date</i>	<i>Revision History</i>
A	2024-05-29	Original
B	2025-06-19	General updates and corrections throughout document.

## 2 Summary

TEST REPORT NUMBER:	TRA-051967-47-15B
WORKS ORDER NUMBER:	TRA-051967-21
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.
TEST SPECIFICATION:	47CFR15.225
EQUIPMENT UNDER TEST (EUT):	Dräger PSS AirBoss Sentinel
FCC IDENTIFIER:	SIZ-AB001
EUT SERIAL NUMBER:	ARTB 3955 ARTA 0005 01/24
MANUFACTURER/AGENT:	Draeger Safety UK Ltd
ADDRESS:	Ullswater Close Blyth Riverside Business Park Blyth NE24 4RG United Kingdom
CLIENT CONTACT:	Eoghan Quigley ☎ 01670 352 891 ✉ eoghan.quigley@draeger.com
ORDER NUMBER:	4303193234
TEST DATE:	2023-04-19 to 2024-04-12
TESTED BY:	S Garwell, D Winstanley Element

## 2.1 Test Summary

Test Method and Description	Requirement Clause	Applicable to this equipment	Result / Note
	47CFR15		
Radiated spurious emissions, below 30 MHz	15.225(d)	<input checked="" type="checkbox"/>	Pass
Radiated spurious emissions	15.209	<input checked="" type="checkbox"/>	Pass
AC power line conducted emissions	15.207	<input type="checkbox"/>	Note 1
Occupied bandwidth	15.215(c)	<input checked="" type="checkbox"/>	Pass
Field strength of fundamental	15.225(a), (b) and (c)	<input checked="" type="checkbox"/>	Pass
Frequency stability	15.225(e)	<input checked="" type="checkbox"/>	Pass

### Specific notes:

**Note 1:** The EUT is a battery powered device

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.

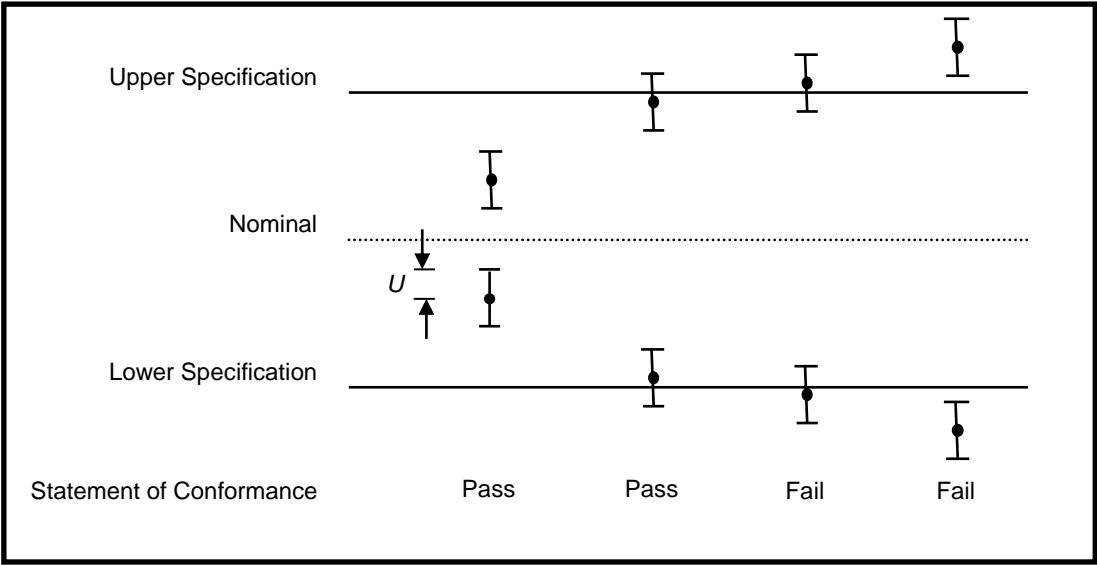
### General notes:

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).

The decision rule for compliance is not inherent within this specification and compliance is based on the customer requesting a simple acceptance rule based on understanding and acceptance of Elements Measurement Uncertainty values.

Graphical Representation of a Pass / Fail Binary Statement - Simple Acceptance



● = Measured value  
U = 95 % expanded measurement uncertainty

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## 4 Introduction

This report TRA-051967-47-15B presents the results of the Radio testing on a Draeger Safety UK Ltd, Dräger PSS AirBoss Sentinel to specification 47CFR15 Radio Frequency Devices.

The testing was carried out for Draeger Safety UK Ltd by Element, at the address detailed below.

<input checked="" type="checkbox"/>	Element Skelmersdale Unit 1 Pendle Place Skelmersdale West Lancashire WN8 9PN UK	<input type="checkbox"/>	Element Surrey Hills Unit 15 B Henley Business Park Pirbright Road Normandy Guildford GU3 2DX UK
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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.

FCC Site Listing:

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

Element Skelmersdale	UK2020
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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.

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

There were no deviations from the test standard.

## 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 (now ISED)
<b>ISED</b>	Innovation, Science and Economic Development 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: Dräger PSS AirBoss Sentinel
- Serial Number: ARTB 3955 ARTA 0005 01/24
- Model Number: 3722330
- Software Revision: V6
- Build Level / Revision Number: Rev 02

### 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.

1. Laptop Computer – Dell Latitude E6410

### 7.3 EUT Mode of Operation

#### 7.3.1 Transmission

The mode of operation for Transmitter tests was as follows:

The EUT was transmitting on the frequencies as indicated, the frequencies were programmed using Hterm 0.8.5 software which was supplied on a test laptop.

### 7.4 EUT Radio Parameters

#### 7.4.1 General

<b>Frequency of operation:</b>	13.56 MHz
<b>Modulation type:</b>	ASK
<b>Declared output power:</b>	Not Stated
<b>Nominal Supply Voltage:</b>	7.5 V dc via 5 X AA Alkaline cells

### 7.5 EUT Description

The EUT is an Open circuit breathing apparatus with compressed air cylinder used for Fire Fighting.

This report covers the testing of the 13.56 MHz RFID radio only.

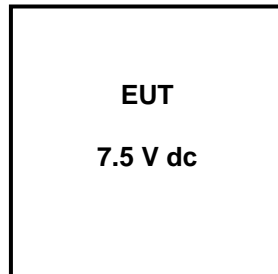
## **8 Modifications**

No modifications were performed during this assessment.

## 9 EUT Test Setup

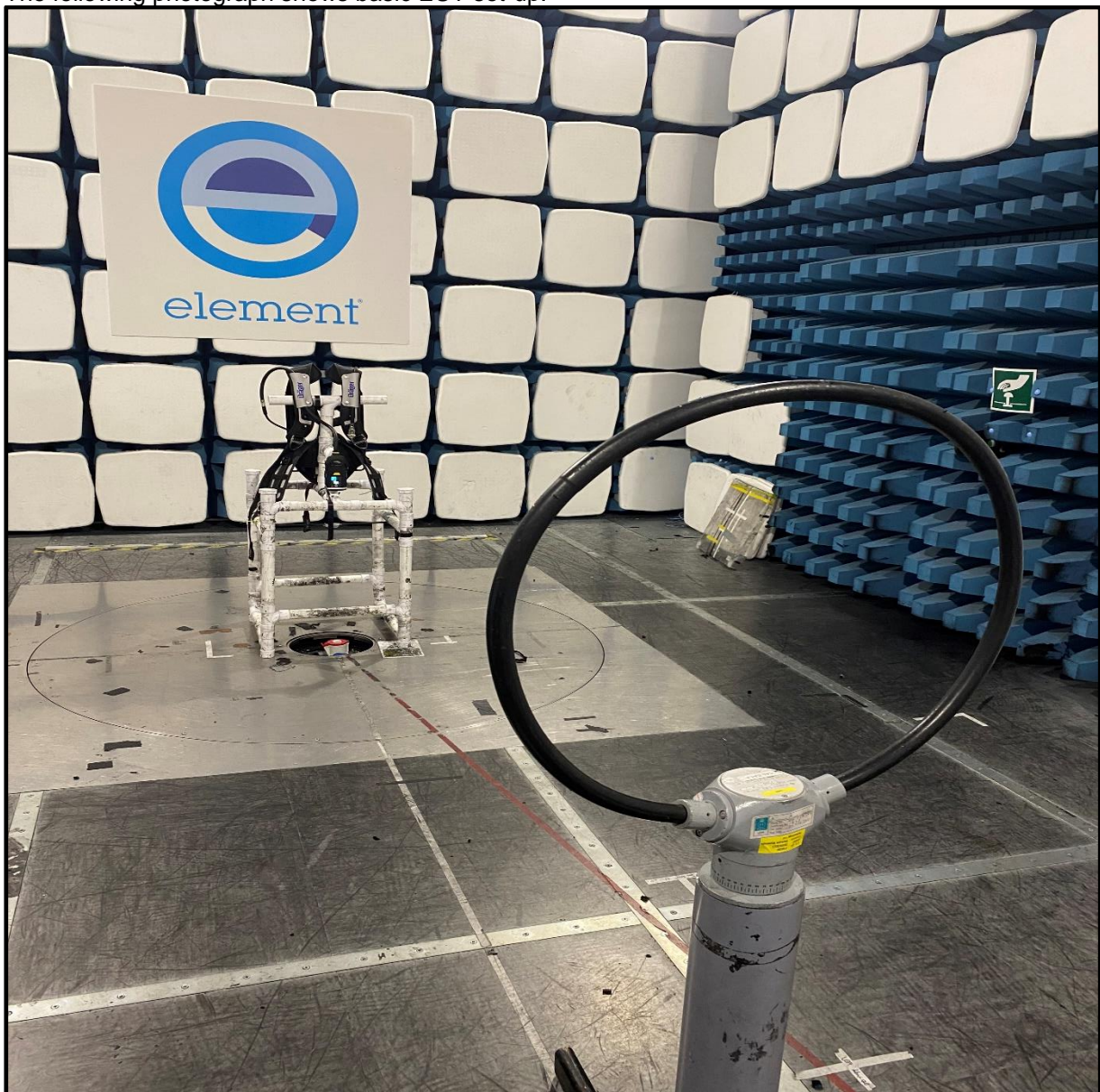
### 9.1 Block Diagram

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

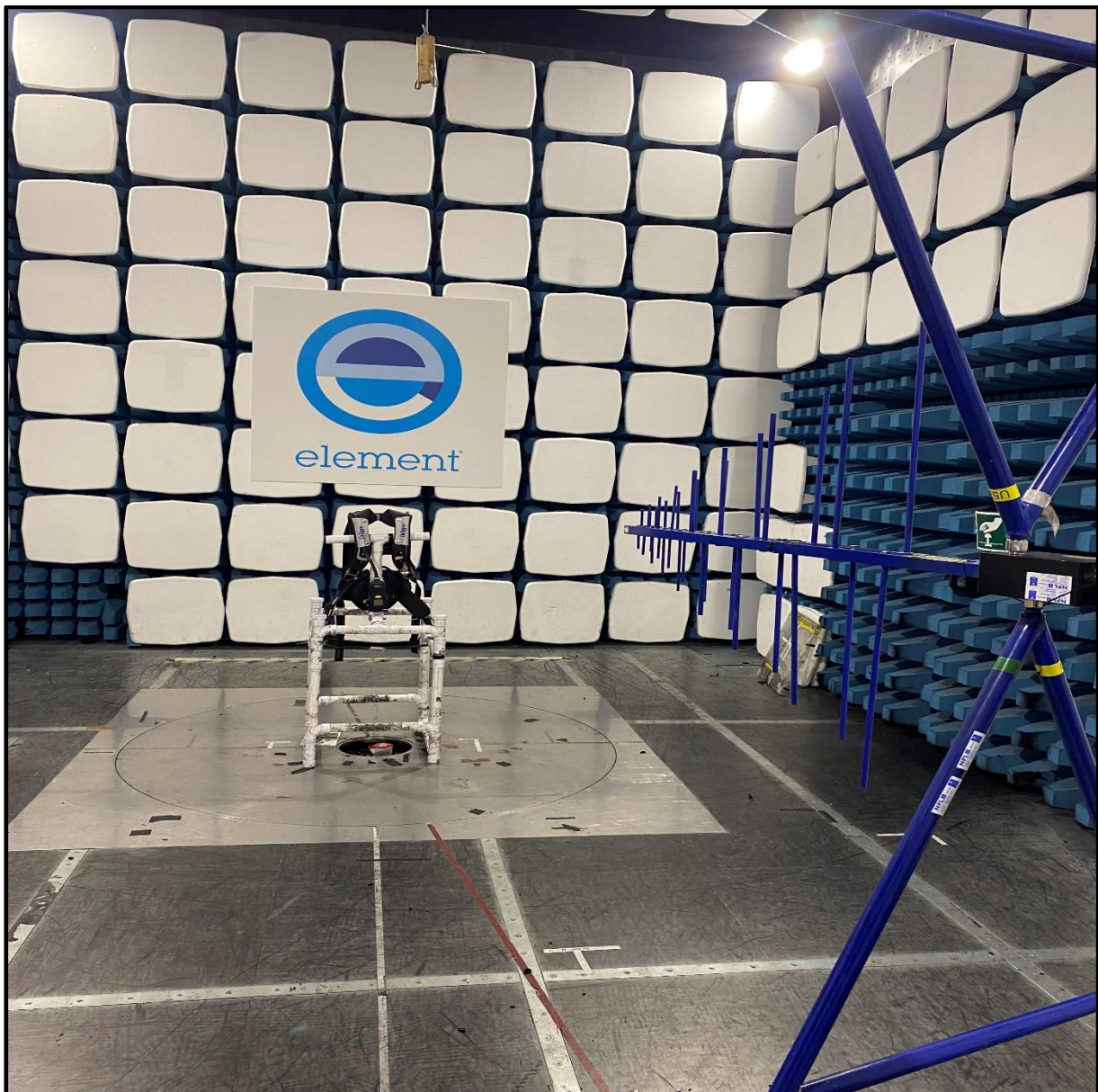


### 9.2 General Set-up Photograph

The following photograph shows basic EUT set-up:







### 9.3 *Measurement software*

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

Element Emissions R5 (See Note)  
Element Transmitter Bench Test (See Note)  
ETS Lindgren EMPower V1.0.4.2

Note:

The version of the Element software used is recorded in the results sheets contained within this report.

## 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 7.5 V dc from 5 x AA Alkaline batteries.

### 10.2 Varying Test Conditions

Variation of temperature is required to ensure stability of the declared fundamental frequency. During frequency error testing the following variations were made:

	<b>Category</b>	<b>Variation</b>
<input checked="" type="checkbox"/>	Standard	-20 to +50 C in 10 degree steps
<input type="checkbox"/>	Extended	

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

	<b>Category</b>	<b>Nominal</b>	<b>Variation</b>
<input type="checkbox"/>	Mains	110 V ac +/- 2 %	85 % and 115 %
<input checked="" type="checkbox"/>	Battery	New battery	7.5 V dc +/- 15% of rated voltage

## 11 Radiated emissions below 30 MHz

### 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:	Chamber 1
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.4
EUT Frequencies Measured:	13.56 MHz
Deviations From Standard:	None
Measurement Distance and Site	10 m, OATS without ground plane.
EUT Height:	1 m
Measurement Antenna and Height:	60 cm shielded loop; 1 m
Measurement BW:	9 kHz to 150 kHz: 200 Hz; 150 kHz to 30 MHz: 9 kHz
Measurement Detector:	9 kHz to 90 kHz and 110 kHz to 490 kHz: Average, RMS Other frequencies below 30 MHz: Quasi-peak.

### Environmental Conditions (Normal Environment)

Temperature: +22 °C	+15 °C to +35 °C (as declared)
Humidity: 31 % RH	20 % RH to 75 % RH (as declared)
Supply: 7.5 V dc	7.5 V dc (as declared)



### 11.3 Test Limit

Emissions from license-exempt transmitters shall comply with the field strength limits shown in the table below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

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

<i>Frequency, f (kHz)</i>	<i>Field Strength</i>	<i>Measurement Distance (m)</i>
9 to 490	2,400 / 377.f (μA/m) 2,400 / f (μV/m)	300
490 to 1,750	24,000 / 377.f (μA/m) 24,000 / f (μV/m)	30
1,750 to 30,000	30 (μV/m)	30

n.b. Devices operated pursuant to §15.225 / RSS-210 A2.6 are exempt from complying with the restricted band requirements for the 13.36–13.41 MHz band only.

### 11.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure i, the EUT fundamental frequency was maximised by rotating the EUT through 360°, in three orthogonal planes, and adjusting the measurement antenna azimuth.

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 9 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 9 kHz and 30 MHz are measured using a calibrated 60cm active loop antenna. 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.

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

$$FS = 10^{(PR - CF) / 20}$$

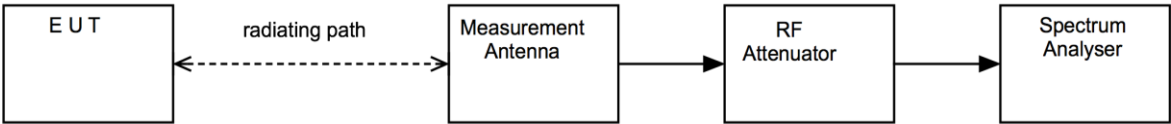
Where,

PR is the power recorded on the receiver / spectrum analyzer in dBμV and includes any cable loss, antenna factor and pre-amplifier gain;  
CF is the distance extrapolation factor in dB (where measurement distance different to limit distance);

Per FCC 47CFR15.31(f)(2) / RSS-Gen 6.4, an extrapolation factor of 40 dB per decade was used for measurements at distances closer than specified.

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

Figure i Test Setup



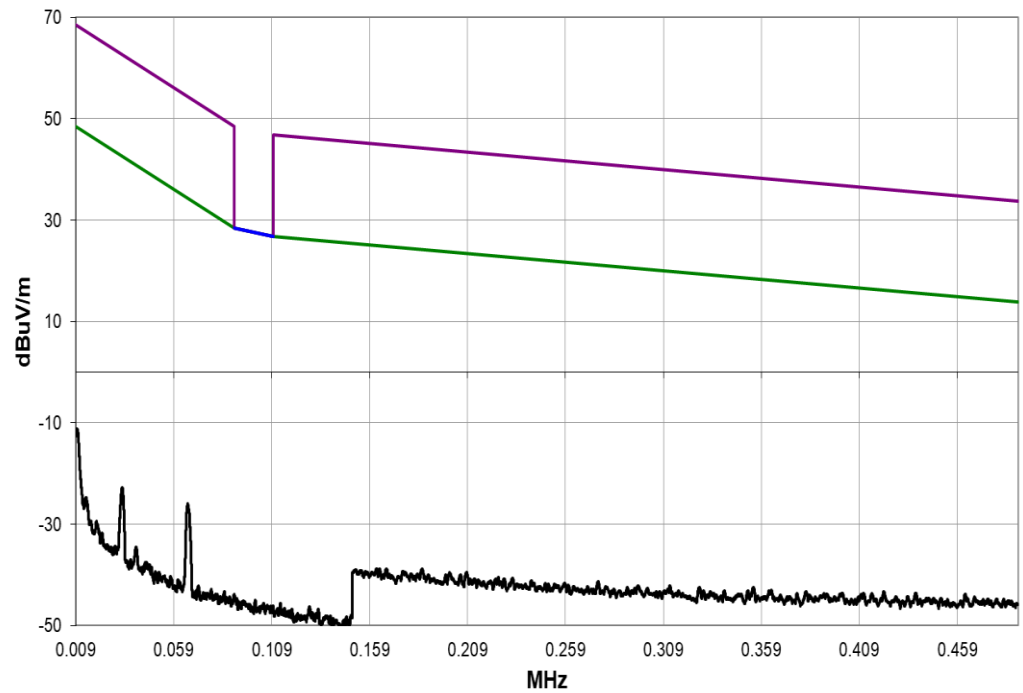
11.5 Test Set-up Photograph



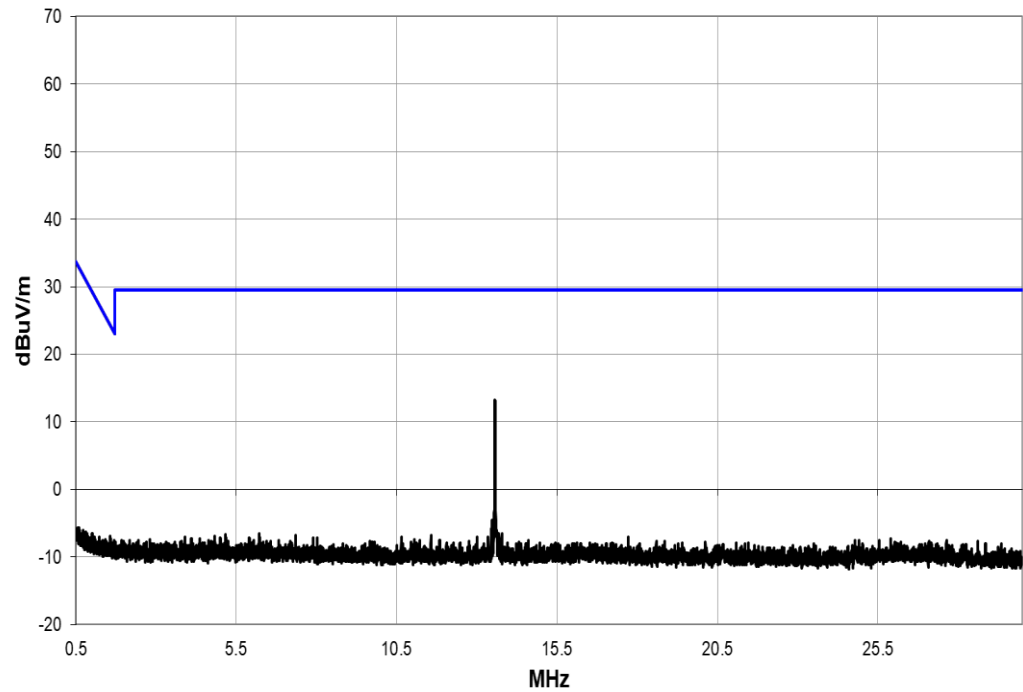
11.6 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
EMI Receiver	R&S	ESR26	U489	2024-10-11
Loop Antenna	R&S	hfh2	L007	2024-10-11
Chamber 1	Rainford EMC	ATS	U387	2026-01-24
Radiated Test Software	Element	Emissions R5	REF9000	Cal not required

11.7 Test Results



9 kHz to 490 kHz



490 kHz to 30 MHz

Frequency: 13.56 MHz; Modulation: ASK						
Emission Frequency (MHz)	Receiver Level (dBµV/m)	Measurement Distance (m)	Limit Distance (m)	Extrapolation Factor (dB)	Field Strength (µV/m)	Result
No significant emissions within 20 dB of the limit						Pass

## 12 Radiated emissions

### 12.1 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.

### 12.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Chamber 1
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5
EUT Frequencies Measured:	13.56 MHz
Deviations From Standard:	None
Measurement BW:	30 MHz to 300 MHz: 120 kHz
Measurement Detector:	Quasi-peak

#### Environmental Conditions (Normal Environment)

Temperature: +22 °C	+15 °C to +35 °C (as declared)
Humidity: 31 % RH	20 % RH to 75 % RH (as declared)
Supply: 7.5 V dc	7.5 V dc (as declared)

### 12.3 Test Limit

Emissions from license-exempt transmitters shall comply with the field strength limits shown in the table below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

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

<b>Frequency (MHz)</b>	<b>Field Strength (<math>\mu\text{V/m}</math> at 3 m)</b>
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

## 12.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure ii, 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;

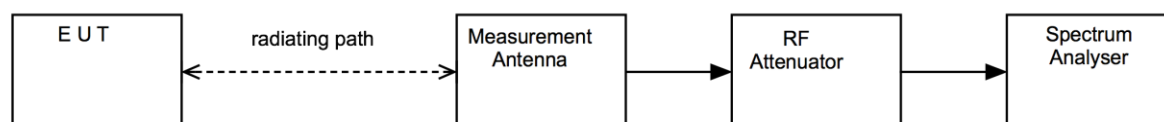
PA is the pre-amplifier gain in dB (where used);

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 is different to limit distance);

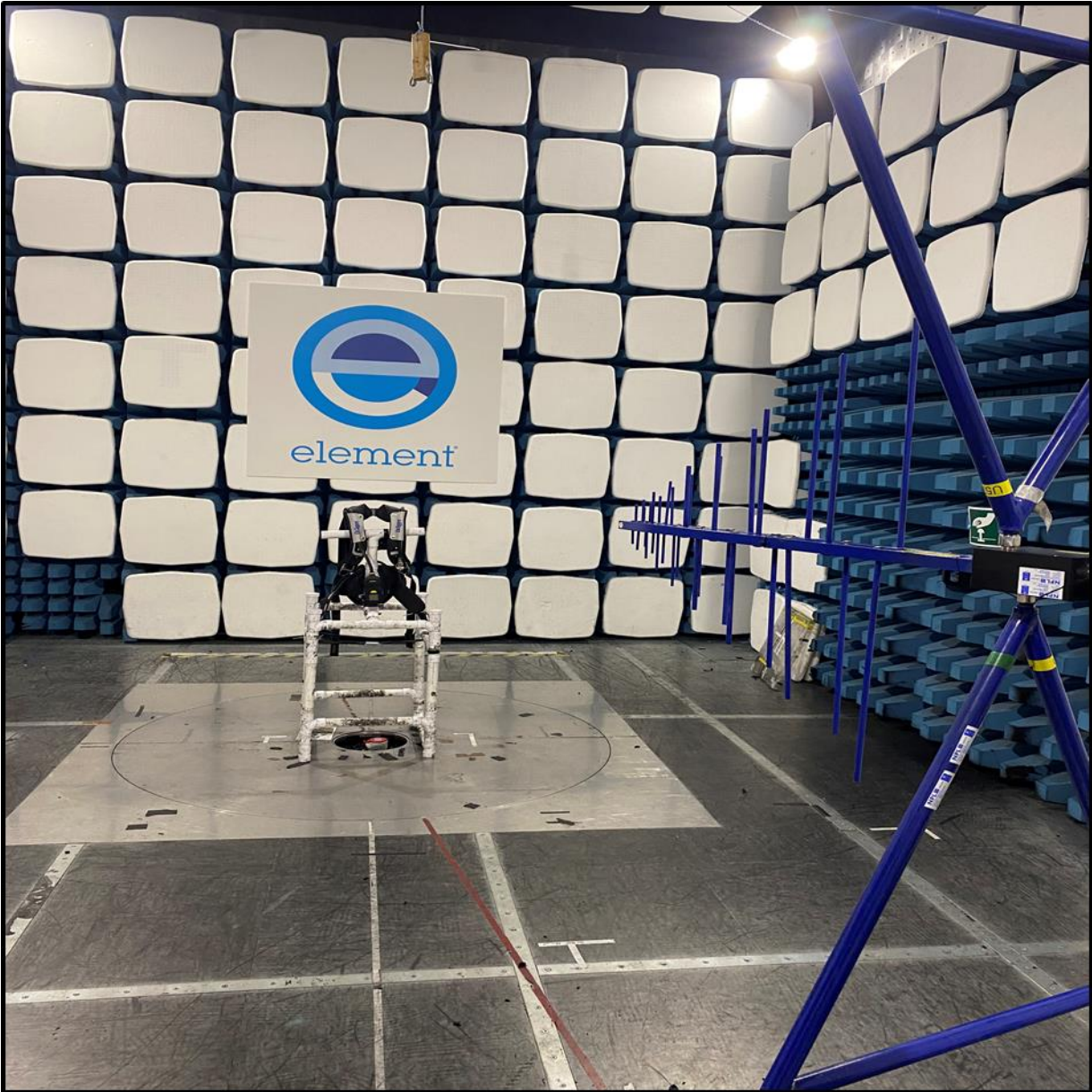
This field strength value is then compared with the regulatory limit.

**Figure ii Test Setup**





12.5 Test Set-up Photograph

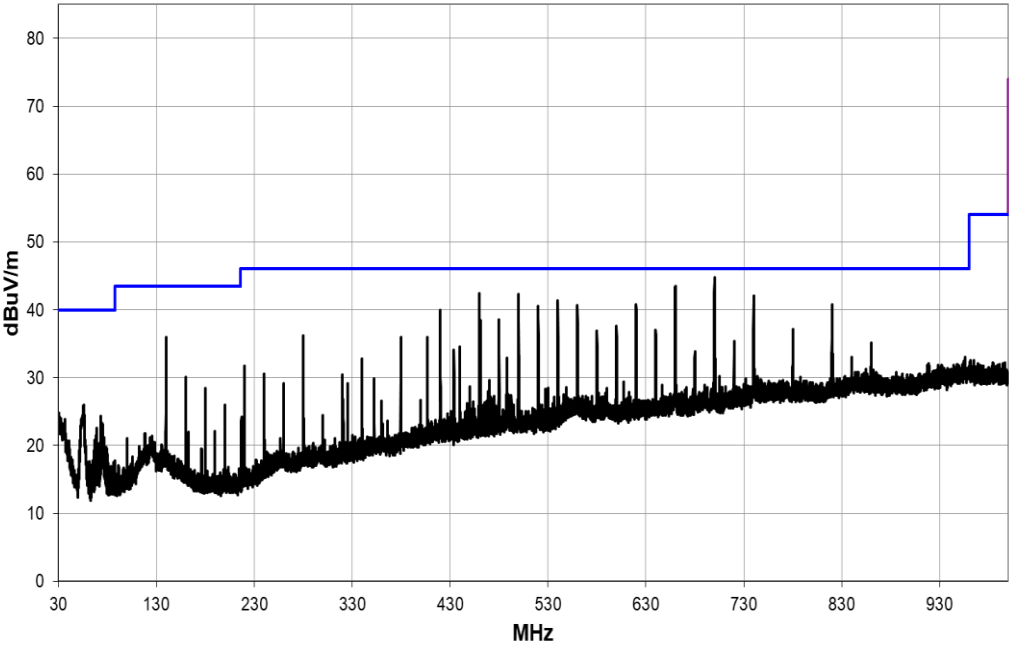


12.6 Test Equipment

<i>Equipment Type</i>	<i>Manufacturer</i>	<i>Equipment Description</i>	<i>Element No</i>	<i>Due For Calibration</i>
EMI Receiver	R&S	ESR26	U489	2024-10-11
Bilog	Chase	CBL611/B	U573	2024-10-14
Pre Amp	AMETEK	LNA6901	U711*	2024-04-12
Chamber 1	Rainford EMC	ATS	U387	2026-01-24
Radiated Test Software	Element	Emissions R5	REF9000	Cal not required

Note: U711 was in calibration at the time of test.

12.7 Test Results



30 MHz to 1 GHz

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
660.035	45.7	0.0	1.0	90.1	3.0	0.0	Vert	QP	0.0	45.7	46.0	-0.3
740.002	36.9	2.0	1.5	89.9	3.0	0.0	Vert	QP	0.0	38.9	46.0	-7.1
460.048	40.2	-3.5	1.5	135.1	3.0	0.0	Horz	QP	0.0	36.7	46.0	-9.3
699.945	36.1	0.5	1.5	180.0	3.0	0.0	Vert	QP	0.0	36.6	46.0	-9.4
620.306	35.2	-0.1	1.0	179.9	3.0	0.0	Vert	QP	0.0	35.1	46.0	-10.9
499.941	37.0	-2.8	1.0	224.9	3.0	0.0	Vert	QP	0.0	34.2	46.0	-11.8
819.954	30.6	2.6	1.5	180.1	3.0	0.0	Vert	QP	0.0	33.2	46.0	-12.8
520.101	34.4	-2.6	1.5	134.9	3.0	0.0	Horz	QP	0.0	31.8	46.0	-14.2
420.079	35.6	-4.1	1.5	314.9	3.0	0.0	Horz	QP	0.0	31.5	46.0	-14.5
140.102	36.9	-9.4	1.0	90.2	3.0	0.0	Vert	QP	0.0	27.5	43.5	-16.0
539.774	31.8	-1.9	1.0	118.0	3.0	0.0	Vert	QP	0.0	29.9	46.0	-16.1
559.664	30.2	-0.3	1.0	225.0	3.0	0.0	Vert	QP	0.0	29.9	46.0	-16.1
459.862	32.7	-3.5	1.0	179.9	3.0	0.0	Vert	QP	0.0	29.2	46.0	-16.8
659.677	28.3	0.0	1.5	270.0	3.0	0.0	Horz	QP	0.0	28.3	46.0	-17.7
220.011	39.6	-11.5	1.5	359.8	3.0	0.0	Horz	QP	0.0	28.1	46.0	-17.9
519.686	29.3	-2.6	1.5	134.9	3.0	0.0	Vert	QP	0.0	26.7	46.0	-19.3
55.693	35.5	-15.7	3.0	224.8	3.0	0.0	Vert	QP	0.0	19.8	40.0	-20.2

## 13 Occupied Bandwidth

### 13.1 Definition

#### *Occupied bandwidth*

The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5 % of the emitted power. This is also known as the 99 % *emission bandwidth*. For transmitters in which there are multiple carriers, contiguous or non-contiguous in frequency, the occupied bandwidth is to be the sum of the occupied bandwidths of the individual carriers.

#### *20 dB bandwidth*

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal.

### 13.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.9
EUT Frequencies Measured:	13.56 MHz
EUT Test Modulations:	ASK
Deviations From Standard:	None
Measurement BW:	1 kHz
(requirement: 1% to 5% OBW)	
Spectrum Analyzer Video BW:	3 kHz
(requirement at least 3x RBW)	
Measurement Span:	20 kHz
(requirement 2 to 5 times OBW)	
Measurement Detector:	Peak

### Environmental Conditions (Normal Environment)

Temperature: +21 °C	+15 °C to +35 °C (as declared)
Humidity: 37 % RH	20 % RH to 75 % RH (as declared)
Supply: 7.5 V dc	7.5 V dc (as declared)

### 13.3 Test Limit

#### Industry Canada:

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99 % emission bandwidth, as calculated or measured.

#### Federal Communications Commission:

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that 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.

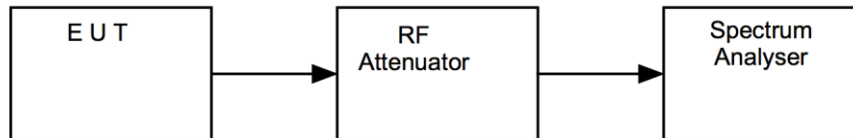


### 13.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure iv, the bandwidth of the EUT was measured on a spectrum analyser.

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

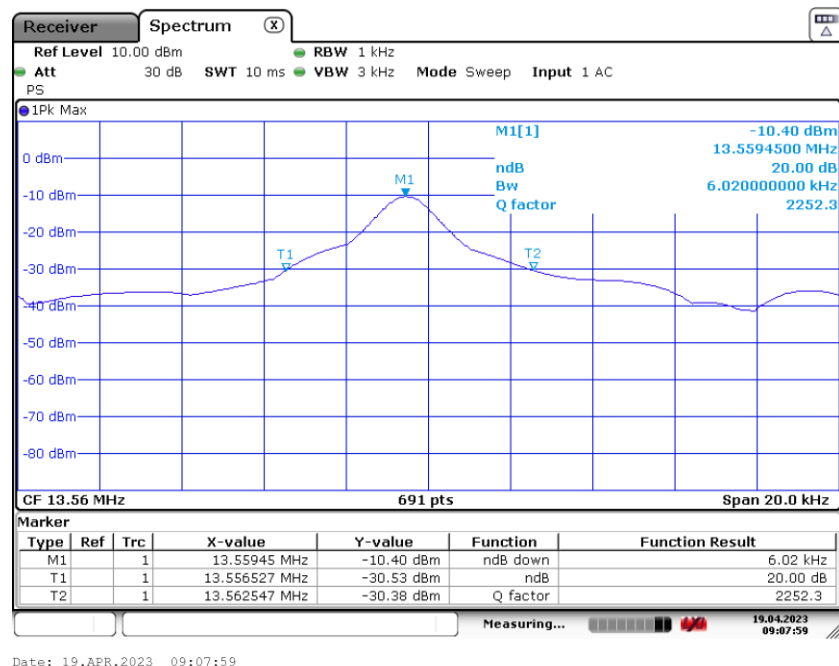


### 13.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
EMI Receiver	R&S	ESR26	U489	2024-10-11

### 13.6 Test Results

15.225; Modulation: ASK; Frequency: 13.56 MHz			
Channel Frequency (MHz)	$F_L$ (MHz)	$F_H$ (MHz)	20 dB Bandwidth (kHz)
13.56	13.556527	13.562547	6.020000



## 14 Transmitter output power (fundamental radiated emission)

### 14.1 Definition

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

### 14.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Chamber 1
Test Antenna:	Active 60cm loop
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.3 / 6.4
EUT Frequencies Measured:	13.56 MHz
Deviations From Standard:	None
Measurement BW:	9 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	30 kHz
Measurement Detector:	Quasi-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: 37 % RH	20 % RH to 75 % RH (as declared)

### 14.3 Test Limit

The field strength measured at 30 m shall not exceed the limits in the following table:

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

<i>Frequency range (MHz)</i>	<i>Field strength (μV/m at 30m)</i>	<i>Field strength (dBμV/m at 30m)</i>
13.110 – 13.410	106	40.5
13.410 – 13.553	334	50.5
13.553 – 13.567	15,848	84.0
13.567 – 13.710	334	50.5
13.710 – 14.010	106	40.5

#### 14.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure v, 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.

Power values measured on the test receiver / analyzer are converted to field strength, FS, in  $\mu\text{V/m}$  at the regulatory distance, using:

$$FS = 10 (PR - CF) / 20$$

Where,

PR is the power recorded on the receiver / spectrum analyzer in  $\text{dB}\mu\text{V}$  and includes any cable loss, antenna factor and pre-amplifier gain;

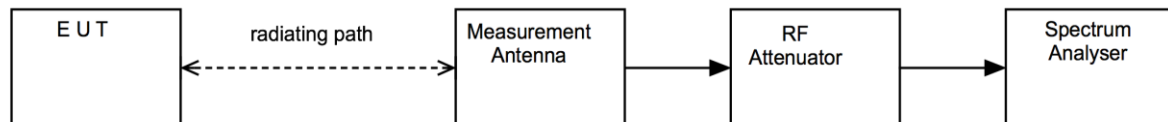
CF is the distance extrapolation factor in dB (where measurement distance different to limit distance);

Per FCC 47CFR15.31(f)(2) / RSS-Gen 6.4, an extrapolation factor of 40 dB per decade was used for measurements from 3 metres to 30 metres

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

The plot shown in section 14.7 of this test report shows the emissions profile of the transmission compared to the Field Strength Limits for License-Exempt Transmitters for Any Application limits. The fundamental and limits are setup based on the measured fundamental field strength at a distance of 30m. The analyser was offset to be as close as possible to the measured field strength, Due to the nature of the transmission an exact level was not possible.

**Figure v Test Setup**



#### 14.5 Test Equipment

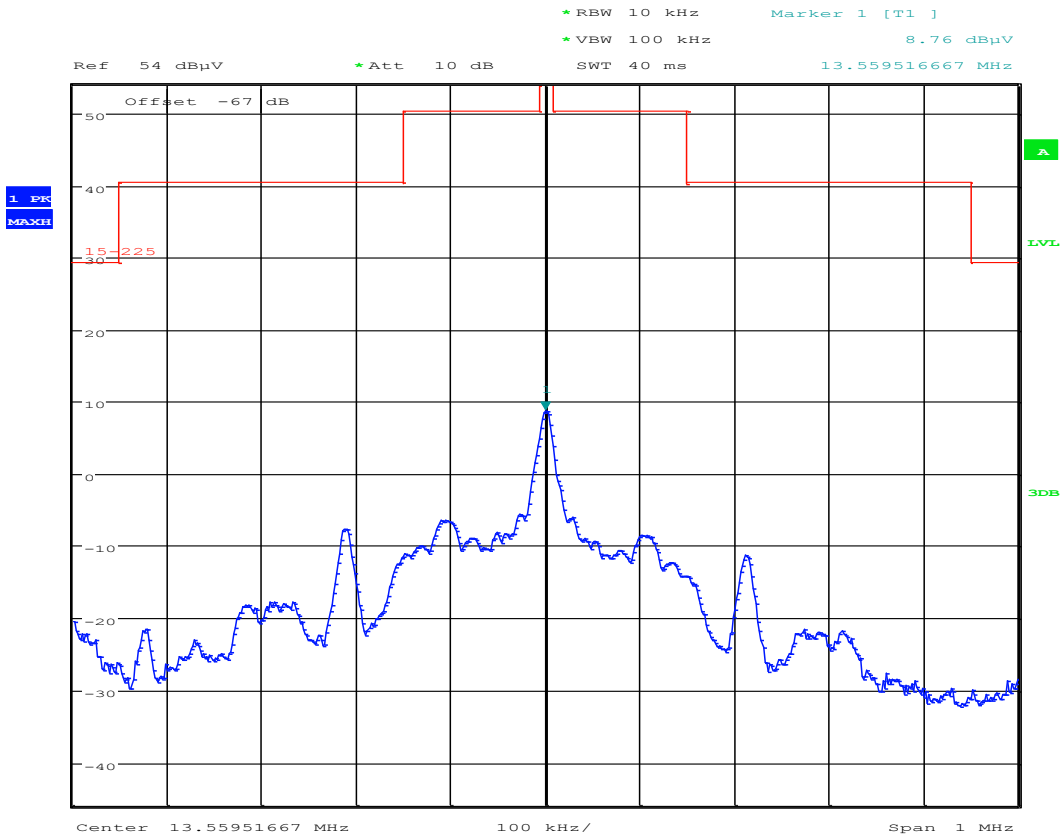
<i>Equipment Type</i>	<i>Manufacturer</i>	<i>Equipment Description</i>	<i>Element No</i>	<i>Due For Calibration</i>
EMI Receiver	R&S	ESR26	U489	2024-10-11
Loop Antenna	R&S	hfh2	L007	2024-10-11
Chamber 1	Rainford EMC	ATS	U387	2026-01-24
Radiated Test Software	Element	Emissions R5	REF9000	Cal not required

#### 14.6 Test Set-up Photograph



14.7 Test Results

Modulation: ASK; Frequency: 13.56 MHz							
Channel Frequency (MHz)	Receiver Level (dBµV)	Factor (dBm)	Measurement Distance (m)	Limit Distance (m)	Extrapolation Factor (dB)	Field Strength (dBµV/m)	Result
13.56	29.3	19.3	3	30	40	8.6	Pass



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## 15 Frequency stability

### 15.1 Definition

Frequency stability is a measure of frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at an appropriate reference temperature and the rated supply voltage.

### 15.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.8
EUT Frequencies Measured:	13.56 MHz
Modulation:	Off
Deviations From Standard:	None
Temperature Extreme Environment Test Range:	-20 to +50 C
Voltage Extreme Environment Test Range:	7.5 V dc = $\pm 15\%$ of Rated Voltage;

### Environmental Conditions (Normal Environment)

Temperature: +22 °C	Standard Requirement: +20 °C
Humidity: 35 %RH	20 % RH to 75 % RH (as declared)

### 15.3 Test Limit

Carrier frequency stability shall be maintained to  $\pm 0.01\%$  ( $\pm 100$  ppm).

### 15.4 Test Method

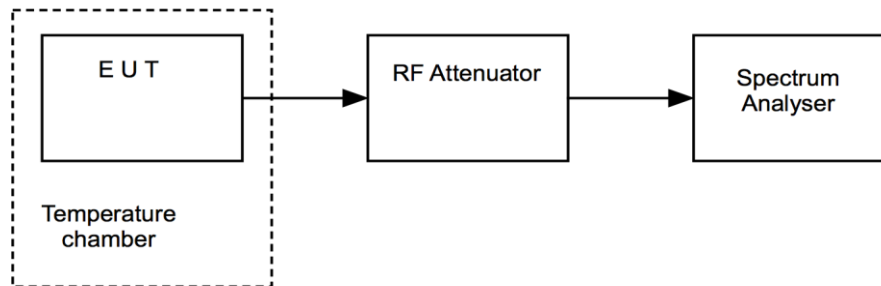
With the EUT setup as per section 9 of this report and connected as per Figure v, the frequency was measured under varying conditions of temperature and supply voltage.

The measurements were performed with EUT set in a CW mode of operation.

Measurements were made once temperature stability was achieved at each temperature.

Per ANSI C63.4, measurements were made, once temperature stabilisation was reached at intervals of zero, two, five and ten minutes after switching on the EUT. Only the worst case results are given.

**Figure v Test Setup**



### 15.5 Test Equipment

<i>Equipment Type</i>	<i>Manufacturer</i>	<i>Equipment Description</i>	<i>Element No</i>	<i>Due For Calibration</i>
EMI Receiver	R&S	ESR26	U489	2024-10-11
VT 4002	Votsch	Temperature Chamber	U521	Use L426
Temperature Indicator	Digitron	2000T	U720	2023-05-09
Power Supply	ISO-Tech	IPS 303A	U748	Use REF976
Multimeter	Agilent	34405a	REF976	2024-01-24

Note: U720 was in calibration at the time of test.

Note: REF976 was in calibration at the time of test.

Test Date: 2023-04-18

**15.6 Test Results**

<b><i>EUT Frequency: 13.56 MHz; Power On</i></b>				
<b><i>Test Environment</i></b>		<b><i>Measured Frequency (MHz)</i></b>	<b><i>Frequency error (kHz)</i></b>	<b><i>Result</i></b>
-20 °C	V <sub>nominal</sub>	13.55942	0.0000	Pass
-10 °C	V <sub>nominal</sub>	13.55942	0.0000	Pass
0 °C	V <sub>nominal</sub>	13.55942	0.0000	Pass
+10 °C	V <sub>nominal</sub>	13.55942	0.0000	Pass
+20 °C	V <sub>minimum</sub>	13.55942	0.0000	Pass
	V <sub>nominal</sub>	13.55942	0.0000	N/A
	V <sub>maximum</sub>	13.55942	0.0000	Pass
+30 °C	V <sub>nominal</sub>	13.55942	0.0000	Pass
+40 °C	V <sub>nominal</sub>	13.55942	0.0000	Pass
+50 °C	V <sub>nominal</sub>	13.55942	0.0000	Pass



## 16 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.

<b>Test/Measurement</b>	<b>Budget Number</b>	<b>MU</b>
<b>Conducted RF Power, Power Spectral Density, Adjacent Channel Power and Spurious emissions</b>		
Absolute RF power (via antenna connector) Sampling Power Meter to 8 GHz	MU4001	<b>0.9 dB</b>
Carrier Power and PSD - Spectrum Analysers	MU4004	<b>1.7 dB</b>
Adjacent Channel Power	MU4002	<b>1.9 dB</b>
Transmitter conducted spurious emissions (Including emissions due to intermodulation)	MU4041	<b>0.9 dB</b>
Conducted power and spurious emissions 40 GHz to 50 GHz	MU4042	<b>2.4 dB</b>
Conducted power and spurious emissions 50 GHz to 75 GHz	MU4043	<b>2.5 dB</b>
Conducted power and spurious emissions 75 GHz to 110 GHz	MU4044	<b>2.4 dB</b>
<b>Radiated RF Power and Spurious emissions ERP and EIRP</b>		
Effective Radiated Power Reverb Chamber	MU4020	<b>3.7 dB</b>
Effective Radiated Power	MU4021	<b>4.7 dB</b>
TRP Emissions 30 MHz to 1 GHz using CBL6111 or CBL6112 Bilog Antenna	MU4046	<b>5.3 dB</b>
TRP Emissions 1 GHz to 18 GHz using HL050 Log Periodic Antenna	MU4047	<b>5.1 dB</b>
TRP Emissions 18 GHz to 26.5 GHz using Standard Gain Horn	MU4048	<b>2.7 dB</b>
TRP Emissions 26.5 GHz to 40 GHz using Standard Gain Horn	MU4049	<b>2.7 dB</b>
In-band (3450-3650 MHz) TRP using CATR_ASH_B2	MU4051	<b>4.1 dB</b>
Cellular Radiated Spurious Emissions in a SAC 30 MHz to 180 MHz	MU4052	<b>6.3 dB</b>
Cellular Radiated Spurious Emissions in a SAC 180 MHz to 18 GHz	MU4052	<b>3.6 dB</b>
Cellular Radiated Spurious Emissions in a FAR 30 MHz to 180 MHz	MU4052	<b>5.4 dB</b>
Cellular Radiated Spurious Emissions in a FAR 180 MHz to 18 GHz	MU4052	<b>3.0 dB</b>
<b>Spurious Emissions Electric and Magnetic Field</b>		
Radiated Spurious Emissions 30 MHz to 1 GHz (Including emissions due to intermodulation)	MU4037	<b>4.8 dB</b>
Radiated Spurious Emissions 1-18 GHz (Including emissions due to intermodulation)	MU4032	<b>4.5 dB</b>
E Field Emissions 18 GHz to 26 GHz	MU4024	<b>3.2 dB</b>
E Field Emissions 26 GHz to 40 GHz	MU4025	<b>3.3 dB</b>
E Field Emissions 40 GHz to 50 GHz	MU4026	<b>3.5 dB</b>
E Field Emissions 50 GHz to 75 GHz	MU4027	<b>3.6 dB</b>
E Field Emissions 75 GHz to 110 GHz	MU4028	<b>3.6 dB</b>
Radiated Magnetic Field Emissions	MU4031	<b>2.3 dB</b>

<b>Test/Measurement</b>	<b>Budget Number</b>	<b>MU</b>
<b>Frequency Measurements</b>		
Frequency Deviation	MU4022	<b>3.7 kHz</b>
Frequency error using CMTA test set	MU4023	<b>113.441 Hz</b>
Frequency error using GPS locked frequency source	MU4045	<b>0.0413 ppm</b>
<b>Bandwidth/Spectral Mask Measurements</b>		
Channel Bandwidth	MU4005	<b>3.87%</b>
Transmitter Mask Amplitude	MU4039	<b>1.3 dB</b>
Transmitter Mask Frequency	MU4040	<b>2.59%</b>
<b>Time Domain Measurements</b>		
Transmission Time	MU4038	<b>4.40%</b>
<b>Dynamic Frequency Selection (DFS) Parameters</b>		
DFS Analyser - Measurement Time	MU4006	<b>678.984 µs</b>
DFS Generator - Frequency Error	MU4007	<b>91.650 Hz</b>
DFS Threshold Conducted	MU4008	<b>1.3 dB</b>
DFS Threshold Radiated	MU4009	<b>3.2 dB</b>
<b>Receiver Parameters</b>		
EN 300 328 Receiver Blocking	MU4010	<b>1.1 dB</b>
EN 301 893 Receiver Blocking	MU4011	<b>1.1 dB</b>
EN 303 340 Adjacent Channel Selectivity	MU4012	<b>1.1 dB</b>
EN 303 340 Overloading	MU4013	<b>1.1 dB</b>
EN 303 340 Receiver Blocking	MU4014	<b>1.1 dB</b>
EN 303 340 Receiver Sensitivity	MU4015	<b>0.9 dB</b>
EN 303 372-1 Image Rejection	MU4016	<b>1.4 dB</b>
EN 303 372-1 Receiver Blocking	MU4017	<b>1.1 dB</b>
EN 303 372-2 Adjacent Channel Selectivity	MU4018	<b>1.1 dB</b>
EN 303 372-2 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>

<b>Test/Measurement</b>	<b>Budget Number</b>	<b>MU</b>
<b>Rohde &amp; Schwarz TS8997</b>		
Carrier frequency	MU4050	<b>5.2 ppm</b>
RF Output Power	MU4050	<b>1.0 dB</b>
Peak Power	MU4050	<b>0.8 dB</b>
Power Spectral Density	MU4050	<b>1.0 dB</b>
Occupied Channel Bandwidth	MU4050	<b>2.08 %</b>
Transmitter unwanted emissions in-band	MU4050	<b>0.9 dB</b>
Transmitter unwanted emissions in the spurious domain 30 MHz to 1 GHz	MU4050	<b>0.6 dB</b>
Transmitter unwanted emissions in the spurious domain 1 GHz to 12.75 GHz	MU4050	<b>1.8 dB</b>
Receiver Spurious emission 30 MHz to 1 GHz	MU4050	<b>0.6 dB</b>
Receiver Spurious emission 1 GHz to 12.75 GHz	MU4050	<b>1.8 dB</b>
Duty Cycle	MU4050	<b>0.02 %</b>
Tx Sequence	MU4050	<b>0.02 %</b>
Tx Gap	MU4050	<b>0.02 %</b>
Medium Utilisation	MU4050	<b>0.1 %</b>
Accumulated Transmit Time	MU4050	<b>0.01 %</b>
Minimum Frequency Occupation Time	MU4050	<b>0.01 %</b>
Hopping Frequency Separation	MU4050	<b>0.6 %</b>
Receiver blocking (for bit streams)	MU4050	<b>3.0 dB</b>
Channel Access Mechanism / Adaptivity / DFS / Contention Based Protocol	MU4050	<b>1.8 dB</b>

17 Appendix A

17.1 Antenna Information

