

Report on the Radio Testing
For
Magicard Ltd
on
Magicard 600
Report no. TRA-064783-47-08B
25th April 2025

Report Number: TRA-064783-47-08B
Issue: B

REPORT ON THE RADIO TESTING OF A
Magicard Ltd
Magicard 600
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.225 & 15.209
TO SATISFY MODULAR INTEGRATION REQUIREMENTS OF
KDB 996369 D04 v01

TEST DATE: 8th June 2024 to 19th July 2024

Tested by: D Winstanley / S Hodgkinson

Written by:

D Winstanley / S Garwell
Radio Test Engineer's

Approved by:

J Charters
Lab Manager

Date: 25th April 2025

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	14 th August 2024	Original
B	25 th April 2025	TCB Amendment.

2 Summary

TEST REPORT NUMBER:	TRA-064783-47-08B
WORKS ORDER NUMBER:	TRA-064783-00
PURPOSE OF TEST:	Modular Integration.
TEST SPECIFICATION(S):	47CFR15.225 & 15.209
EQUIPMENT UNDER TEST (EUT):	Magicard 600
CONTAINS FCC IDENTIFIER:	WP5TWN4F3
EUT SERIAL NUMBER:	75852501
MANUFACTURER/AGENT:	Magicard Ltd
ADDRESS:	Hampshire Road
CLIENT CONTACT:	William Macer ☎ 07775491564 ✉ will.macer@bradycorp.com
ORDER NUMBER:	13660
TEST DATE:	8th June 2024 to 19th July 2024
TESTED BY:	D Winstanley / S Hodgkinson Element

2.1 Test Summary

Test Method and Description	Requirement Clause CFR47		Applicable to this equipment	Result / Note
	125 kHz operation	13.56 MHz operation		
Radiated spurious emissions, below 30 MHz	15.209	15.225(d)	<input checked="" type="checkbox"/>	Pass
Radiated spurious emissions	15.209	15.209	<input checked="" type="checkbox"/>	Pass
AC power line conducted emissions	15.207	15.207	<input type="checkbox"/>	Note 1
Occupied bandwidth	15.215(c)	15.215(c)	<input type="checkbox"/>	Note 1
Field strength of fundamental	15.209	15.225(a), (b) and (c)	<input checked="" type="checkbox"/>	Pass
Frequency stability	-	15.225(e)	<input type="checkbox"/>	Note 1

Specific Notes:

1: Limited testing was performed to check Carrier power / & transmitter radiated spurious emissions only, as requested by the client, to satisfy modular integration requirements of KDB996369 D04 v01.

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).

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.

3 Contents

1	Revision Record	3
2	Summary	4
2.1	Test Summary	5
3	Contents	6
4	Introduction	7
5	Test Specifications	8
5.1	Normative References	8
5.2	Deviations from Test Standards	8
6	Glossary of Terms	9
7	Equipment under Test	10
7.1	EUT Identification	10
7.2	System Equipment	10
7.3	EUT Mode of Operation	10
7.3.1	Transmission	10
7.4	EUT Radio Parameters	10
7.4.1	General	10
7.5	EUT Description	10
8	Modifications	11
9	EUT Test Setup	12
9.1	Block Diagram	12
9.2	General Set-up Photograph	13
9.3	Measurement software	13
	General Technical Parameters	14
9.4	Normal Conditions	14
9.5	Varying Test Conditions	14
10	Radiated emissions below 30 MHz	15
10.1	Definitions	15
10.2	Test Parameters	15
10.3	Test Limit	16
10.4	Test Method	16
10.5	Test Set-up Photograph	17
10.6	Test Equipment	17
10.7	Test Results	18
11	Radiated emissions	20
11.1	Definitions	20
11.2	Test Parameters	20
11.3	Test Limit	20
11.4	Test Method	21
11.5	Test Set-up Photograph	22
11.6	Test Equipment	22
11.7	Test Results	23
12	Transmitter output power (fundamental radiated emission)	27
12.1	Definition	27
12.2	Test Parameters	27
12.3	Test Limit	28
12.4	Test Method	29
12.5	Test Equipment	29
12.6	Test Results	30
13	Measurement Uncertainty	31

4 Introduction

This report TRA-064783-47-08B presents the results of the Radio testing on a Magicard Ltd, Magicard 600 to specification 47CFR15 Radio Frequency Devices.

The testing was carried out for Magicard 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
-------------------------------------	--	--------------------------	---

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
----------------------	--------

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.
- KDB996369 D04 Module Integration Guide V01 - Modular Transmitter Integration Guide - Guidance for Host Product Manufacturers.

5.2 Deviations from Test Standards

Limited testing was performed to check Carrier power / & transmitter radiated spurious emissions only, as requested by the client, to satisfy modular integration requirements of KDB996369 D04 v01.

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 (now ISED)
ISED	Innovation, Science and Economic Development 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: Magicard 600
- Serial Number: 75852501
- Model Number: Magicard 600
- Software Revision: 0.12
- Build Level / Revision Number: Production Build

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.

Equipment Description	Manufacturer	Serial / Asset No(s)
Network Switch	TpLink	TL-R470T
Support Laptop	HP Pro Book	5CD01315SG

7.3 EUT Mode of Operation

7.3.1 Transmission

The mode of operation for Transmitter tests was as follows.

The EUT was transmitting with a tag in the field.

7.4 EUT Radio Parameters

7.4.1 General

Frequency of operation:	125 kHz / 13.56 MHz
Modulation type(s):	ASK
Occupied channel bandwidth(s):	N/A Wideband
Channel spacing:	N/A Wideband
Antenna Type and Gain:	Inductive Loop
Nominal Supply Voltage:	24 Vdc Via supplied 120 Vac switch mode power supply

7.5 EUT Description

The EUT is an ID Card Printer that makes use of a 13.56 MHz Inductive loop system.

This report covers the integration testing of the 125 kHz / 13.56 MHz RFID radio only.

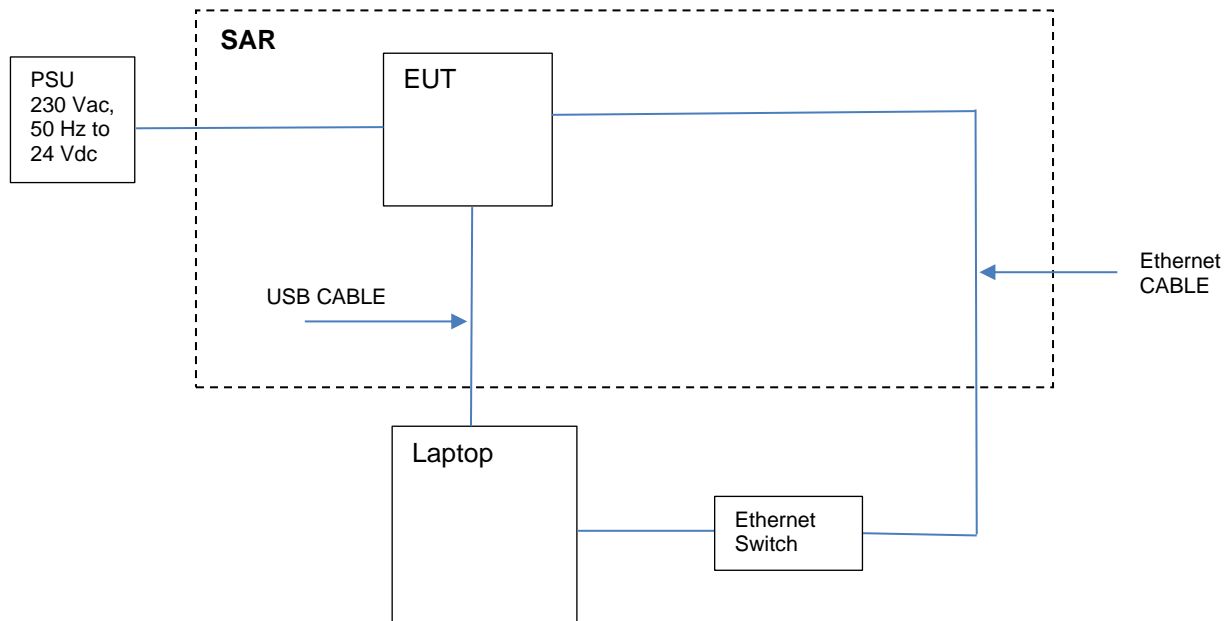
8 Modifications

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.

General Technical Parameters

9.4 *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 24 V dc from the 120 Vac power supply.

9.5 *Varying Test Conditions*

No variation of temperature or voltage was required during test.

10 Radiated emissions below 30 MHz

10.1 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.

10.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Chamber / OATS
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.4
EUT Frequency Measured:	125 kHz / 13.56 MHz
EUT Channel Bandwidths:	Wideband
Deviations From Standard:	None
Measurement Distance and Site	3m ATS / 0 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: 20 °C	+15 °C to +35 °C (as declared)
Humidity: 51 % RH	20 % RH to 75 % RH (as declared)

10.3 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.

10.4 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:

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

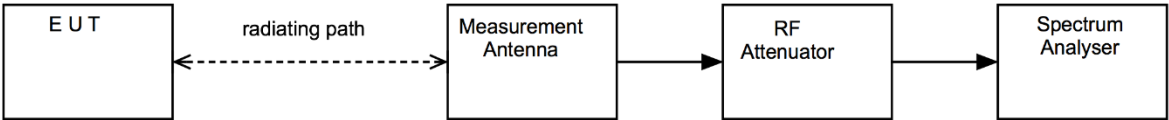
Where,

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);

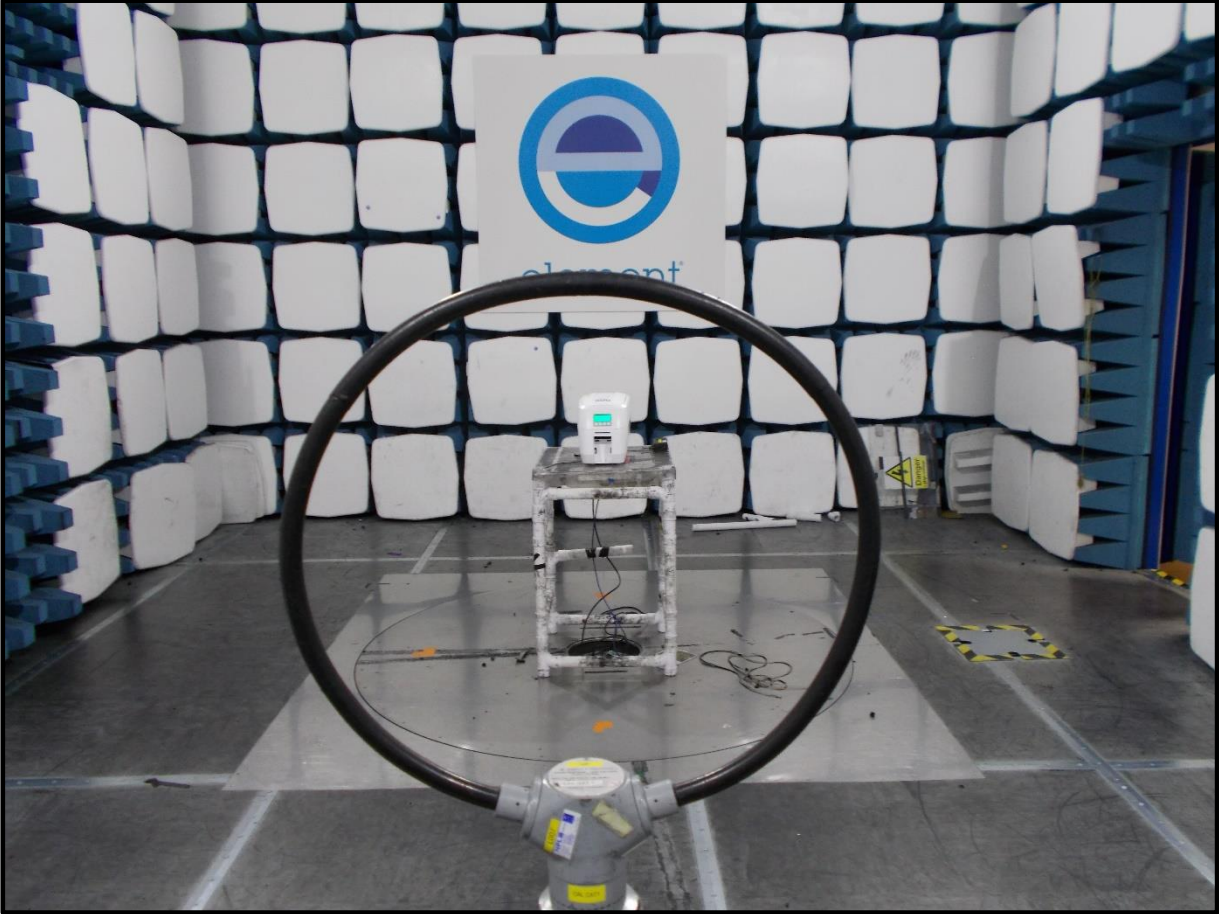
Per FCC 47CFR15.31(f)(2) / RSS-Gen 6.4, an extrapolation factor of 40 dB per decade was used for measurements at distances closer than specified.

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

Figure i Test Setup



10.5 Test Set-up Photograph

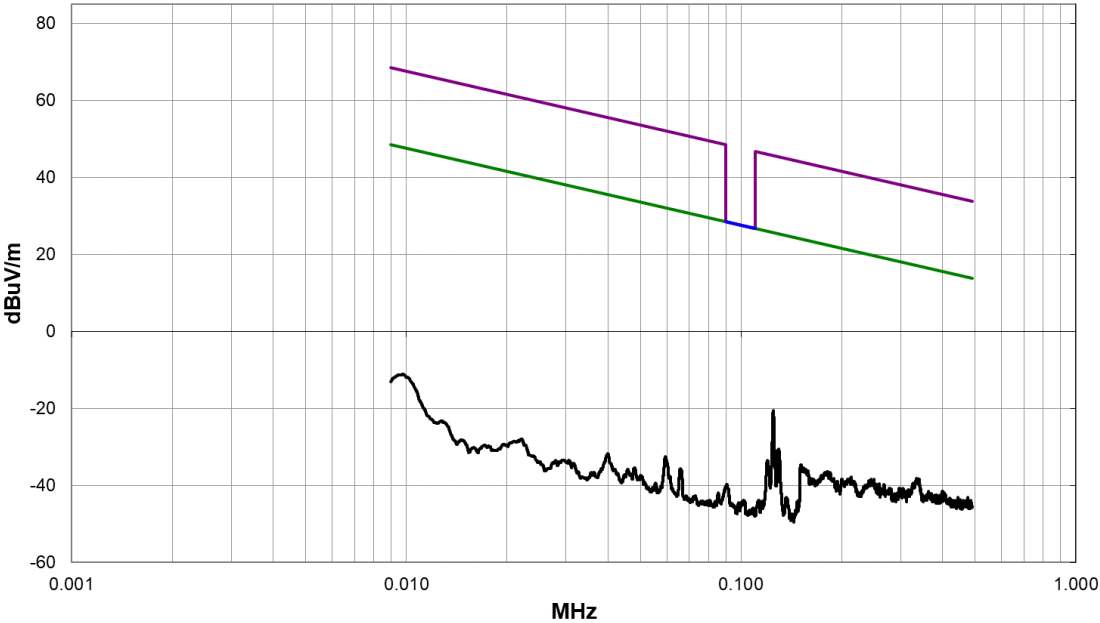


10.6 Test Equipment

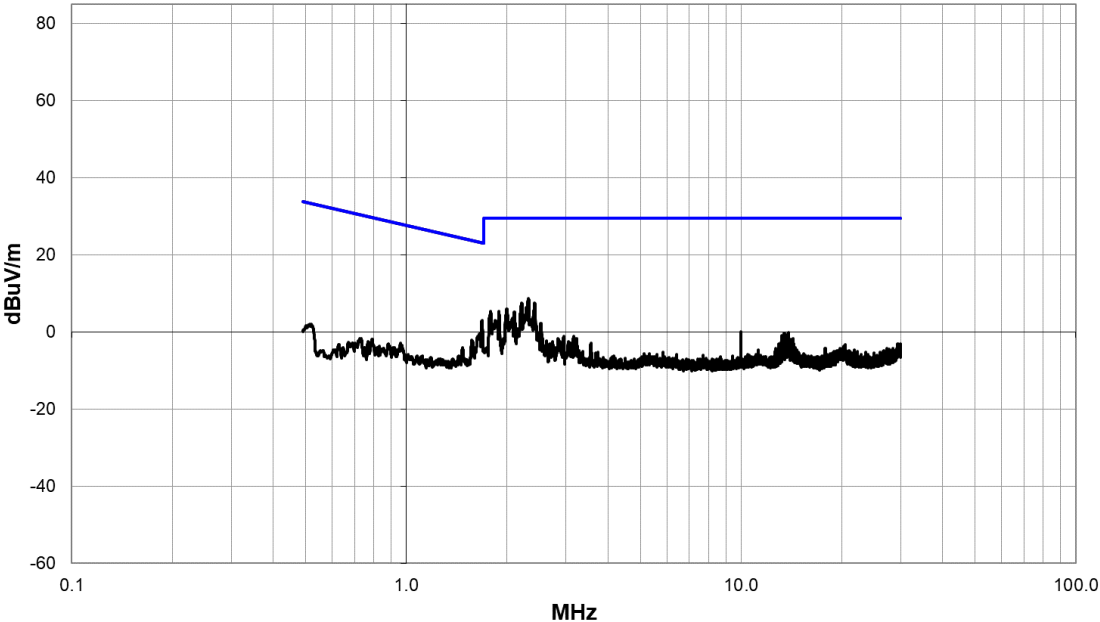
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
ESR 7	R&S	Spectrum Analyser	U727	2025-05-17
hfh2	R&S	Loop Antenna	L007	2024-10-11
ATS	Rainford EMC	Radio Chamber - PP	REF940	2026-01-29
Emissions R5	Element	Radiated Test Software	REF9000	Cal Not Required

10.7 Test Results

125 kHz Operation						
Emission Frequency (MHz)	Receiver Level (dBμV/m)	Measurement Distance (m)	Limit Distance (m)	Extrapolation Factor (dB)	Field Strength (μV/m)	Result
No Significant emissions						

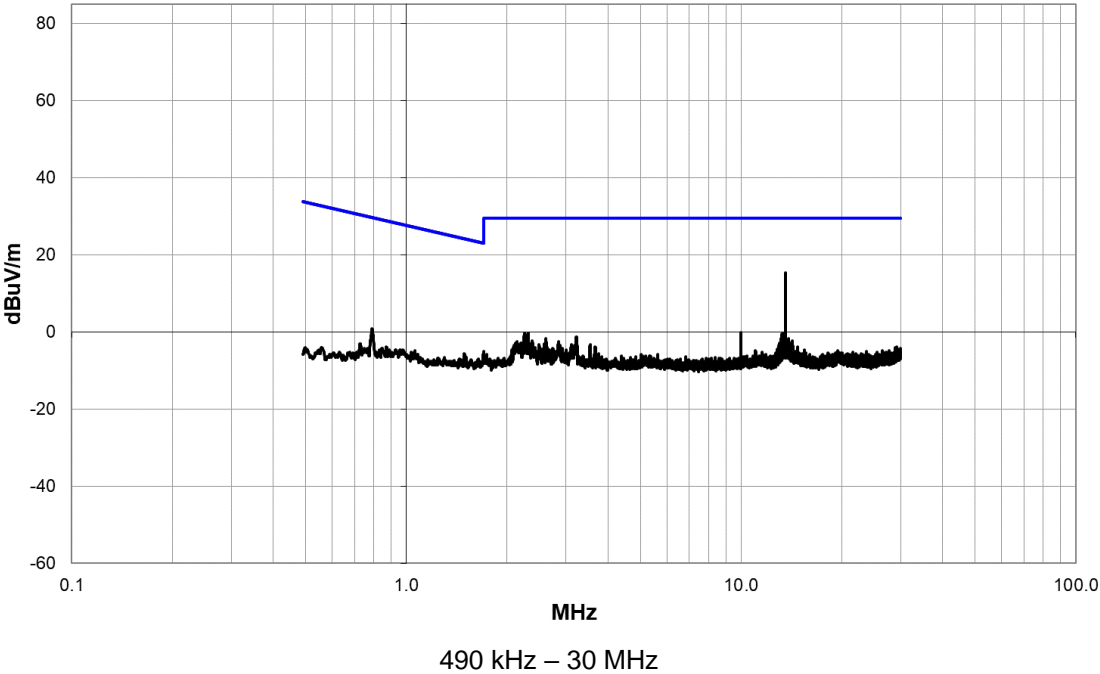
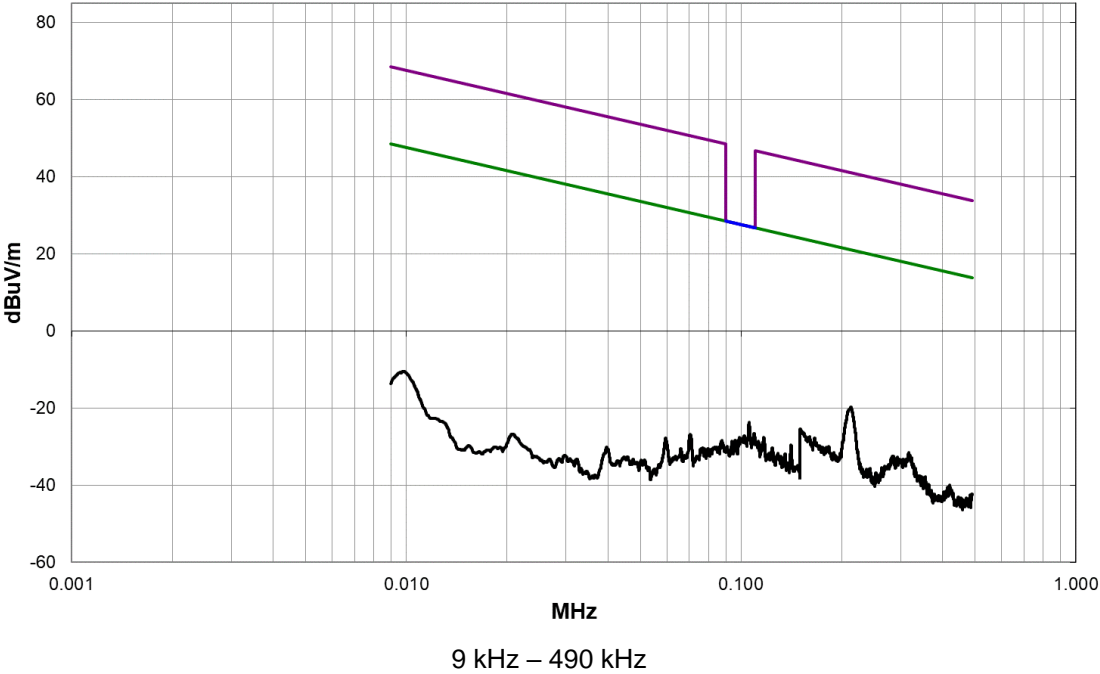


9 kHz – 490 kHz



490 kHz – 30 MHz

13.56 MHz Operation						
Emission Frequency (MHz)	Receiver Level (dBµV/m)	Measurement Distance (m)	Limit Distance (m)	Extrapolation Factor (dB)	Field Strength (µV/m)	Result
No Significant emissions						



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
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5
EUT Frequency Measured:	125 kHz / 13.56 MHz
EUT Channel Bandwidths:	Wideband
Deviations From Standard:	None
Measurement BW:	30 MHz to 300 MHz: 120 kHz
Measurement Detector:	Quasi-peak

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 °C to +35 °C (as declared)
Humidity: 54 % RH	20 % RH to 75 % RH (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 above 30 MHz

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

11.4 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 dBμV/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 dBμV;

CL is the cable loss in dB;

AF is the test antenna factor in dB/m;

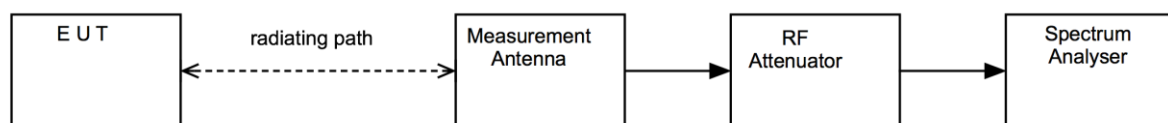
PA is the pre-amplifier gain in dB (where used);

DC is the duty correction factor in dB (where used, e.g. harmonics of pulsed fundamental);

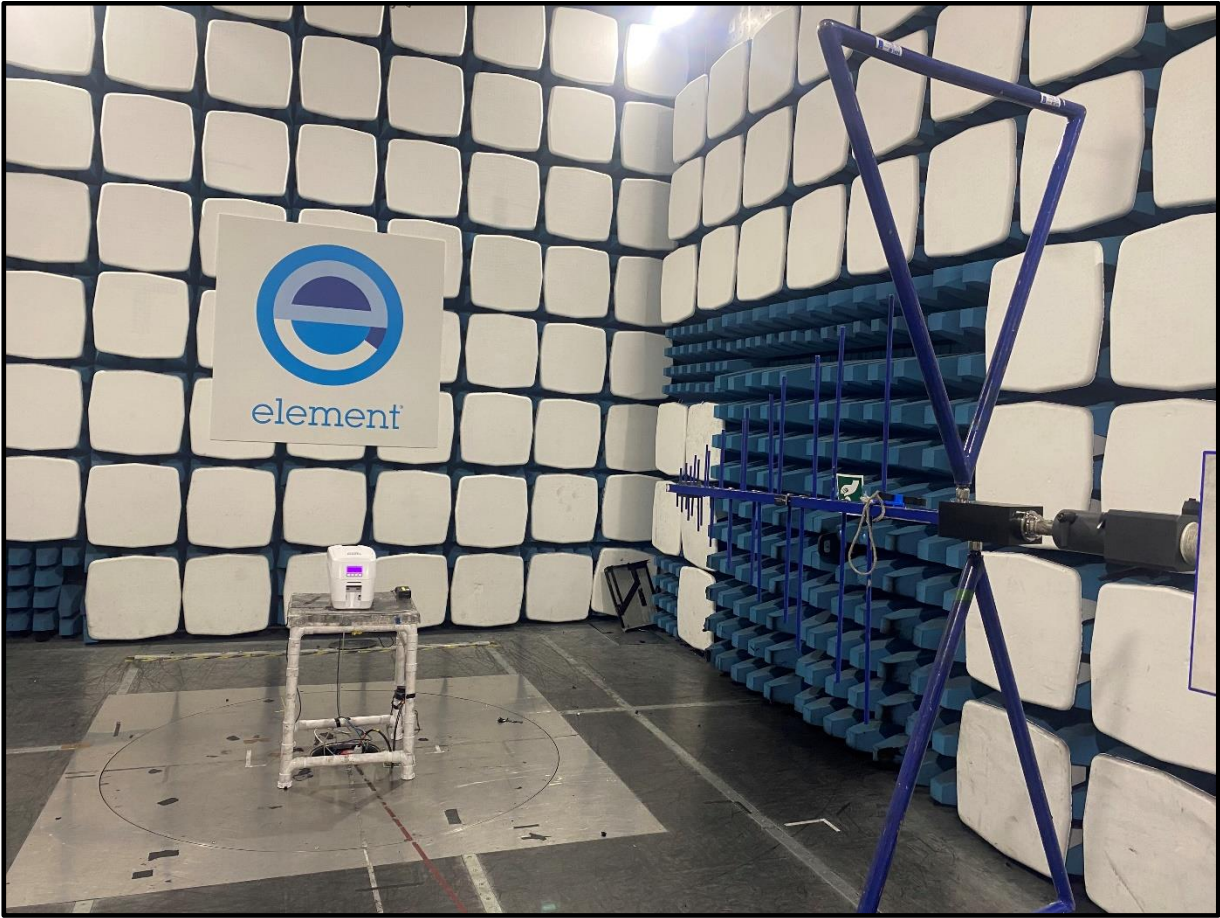
CF is the distance factor in dB (where measurement distance is different to limit distance);

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

Figure ii Test Setup



11.5 Test Set-up Photograph



11.6 Test Equipment

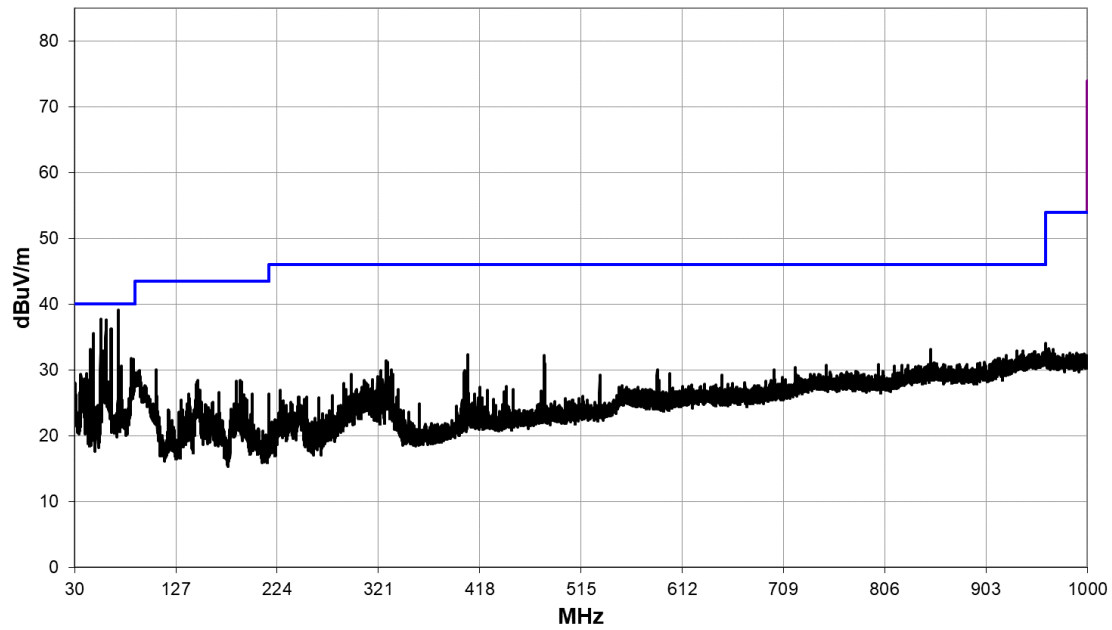
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
Emissions R5	Element	Radiated Test Software	REF9000	Cal Not Required
ATS	Rainford EMC	Radio Chamber - PP	REF940	2026-01-29
ESR 7	R&S	Spectrum Analyser	U727	2025-05-17
CBL611/B	Chase	Bilog	U573	2024-10-14
6201-69	Watkins Johnson	PreAmp	U372	2025-03-15
hfh2	R&S	Loop Antenna	L007	2024-10-11
8449B	Agilent	Pre Amp	U457	2025-01-26
3115*	EMCO	1-18GHz Horn	L139	2024-07-12

Note:3115* was within the calibration period, the testing was performed on 17/06/2024

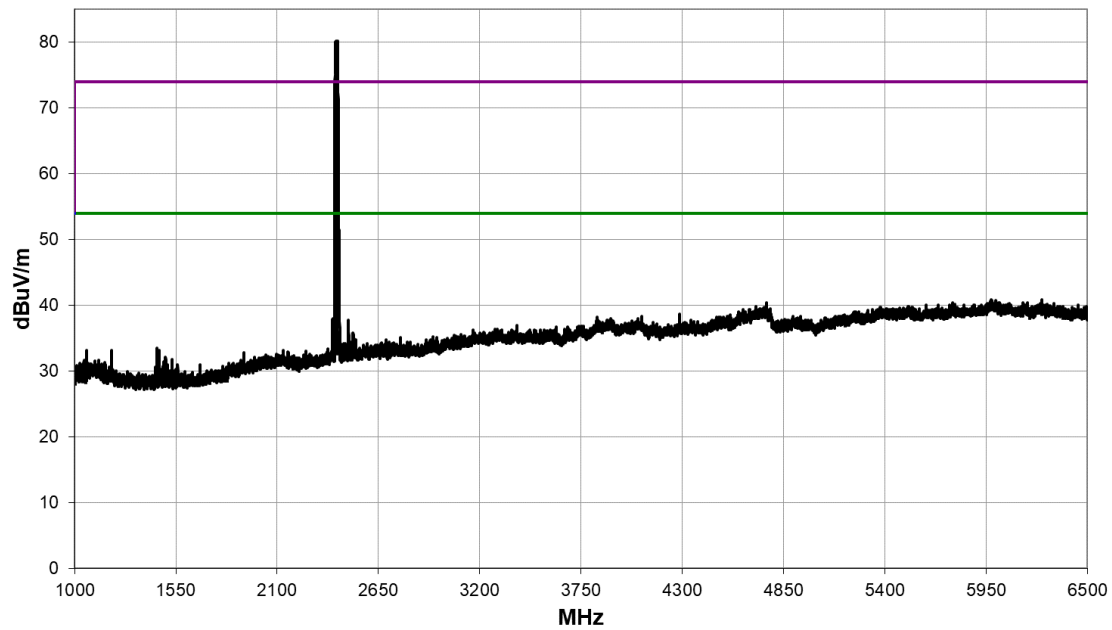
11.7 Test Results

125 kHz Operation								
<i>Freq (MHz)</i>	<i>Amplitude (dBuV)</i>	<i>Factor (dB/m)</i>	<i>Polarity/ Transducer Type</i>	<i>Detector</i>	<i>Distance Adjustment (dB)</i>	<i>Adjusted (dBuV/m)</i>	<i>Spec. Limit (dBuV/m)</i>	<i>Compared to Spec. (dB)</i>
60.030	52.5	-16.3	Vert	QP	0.0	36.2	40.0	-3.8
65.026	51.8	-16.2	Vert	QP	0.0	35.6	40.0	-4.4
55.030	50.8	-15.7	Vert	QP	0.0	35.1	40.0	-4.9
72.031	47.6	-15.6	Vert	QP	0.0	32.0	40.0	-8.0
48.027	43.9	-12.9	Vert	QP	0.0	31.0	40.0	-9.0
45.028	41.7	-11.3	Vert	QP	0.0	30.4	40.0	-9.6
85.499	42.4	-14.0	Vert	QP	0.0	28.4	40.0	-11.6
85.528	42.4	-14.0	Vert	QP	0.0	28.4	40.0	-11.6
57.166	44.0	-16.1	Vert	QP	0.0	27.9	40.0	-12.1
75.027	43.3	-15.4	Vert	QP	0.0	27.9	40.0	-12.1
41.634	35.5	-9.4	Vert	QP	0.0	26.1	40.0	-13.9
55.027	41.7	-15.7	Horz	QP	0.0	26.0	40.0	-14.0
850.105	27.5	4.1	Horz	QP	0.0	31.6	46.0	-14.4
84.048	38.8	-14.2	Vert	QP	0.0	24.6	40.0	-15.4

Note: Emission at 2.4 GHz is polling transmission from Wi-Fi radio in EUT



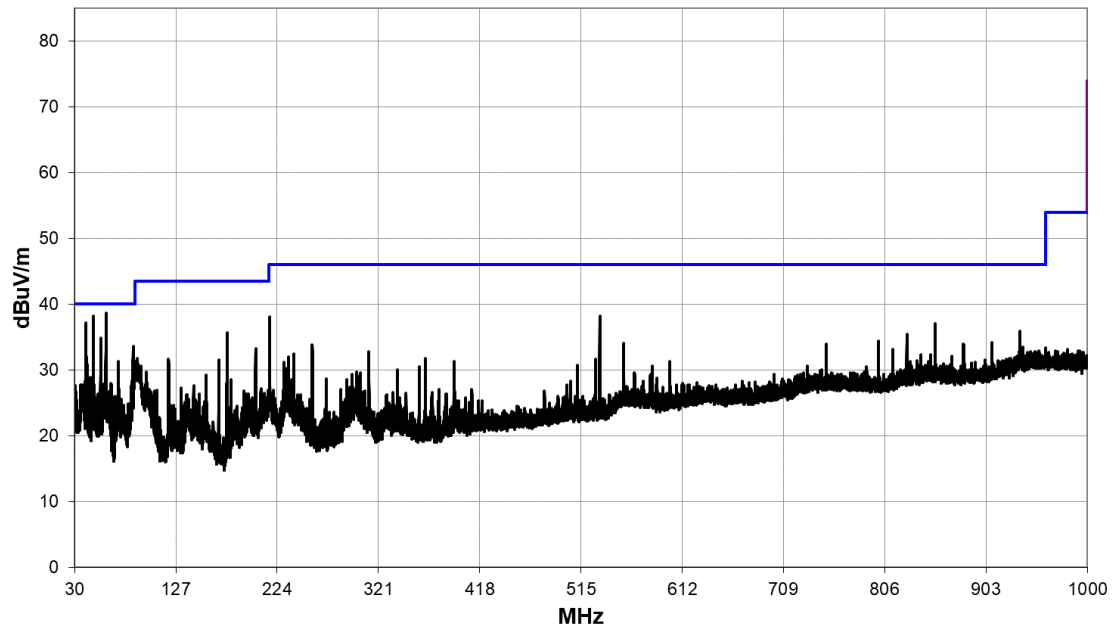
125 kHz Operation - 30 MHz – 1 GHz



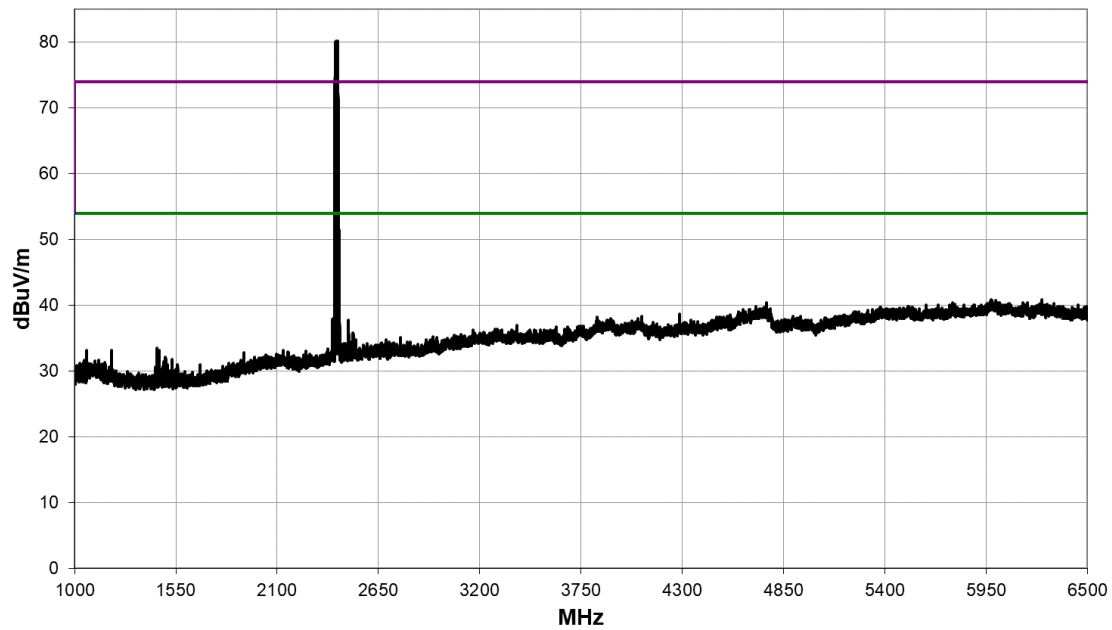
125 kHz Operation - 1 GHz – 6.5 GHz

13.56 MHz Operation								
<i>Freq (MHz)</i>	<i>Amplitude (dBuV)</i>	<i>Factor (dB/m)</i>	<i>Polarity/ Transducer Type</i>	<i>Detector</i>	<i>Distance Adjustment (dB)</i>	<i>Adjusted (dBuV/m)</i>	<i>Spec. Limit (dBuV/m)</i>	<i>Compared to Spec. (dB)</i>
48.027	48.4	-12.9	Vert	QP	0.0	35.5	40.0	-4.5
40.704	44.1	-9.0	Vert	QP	0.0	35.1	40.0	-4.9
55.025	48.5	-15.7	Vert	QP	0.0	32.8	40.0	-7.2
176.304	47.3	-12.4	Horz	QP	0.0	34.9	43.5	-8.6
60.034	47.1	-16.3	Vert	QP	0.0	30.8	40.0	-9.2
86.085	44.0	-13.9	Vert	QP	0.0	30.1	40.0	-9.9
216.984	47.7	-11.6	Horz	QP	0.0	36.1	46.0	-9.9
41.638	38.0	-9.4	Vert	QP	0.0	28.6	40.0	-11.4
41.639	37.9	-9.4	Vert	QP	0.0	28.5	40.0	-11.5
72.032	43.6	-15.6	Vert	QP	0.0	28.0	40.0	-12.0
854.323	29.5	4.2	Horz	QP	0.0	33.7	46.0	-12.3
87.497	41.1	-13.7	Vert	QP	0.0	27.4	40.0	-12.6

Note: Emission at 2.4 GHz is polling transmission from Wi-Fi radio in EUT



13.56 MHz Operation - 30 MHz – 1 GHz



13.56 MHz Operation - 1 GHz – 6.5 GHz

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 / OATS
Test Antenna:	Active 60cm loop
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.3 / 6.4
EUT Frequency Measured:	125 kHz / 13.56 MHz
EUT Channel Bandwidths:	Wideband
Deviations From Standard:	See section 5.2
Measurement BW:	9 kHz / 200 Hz
Measurement Detector:	Quasi-peak / Average

Environmental Conditions (Normal Environment)

Temperature: 20 °C	+15 °C to +35 °C (as declared)
Humidity: 51 % RH	20 % RH to 75 % RH (as declared)

12.3 Test Limit

CFR47 Part 15.225

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 ($\mu\text{V/m}$ at 30m)</i>	<i>Field strength ($\text{dB}\mu\text{V/m}$ 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

CFR47 Part 15.209

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	$2,400 / 377.f$ ($\mu\text{A/m}$) $2,400 / f$ ($\mu\text{V/m}$)	300
490 to 1,750	$24,000 / 377.f$ ($\mu\text{A/m}$) $24,000 / f$ ($\mu\text{V/m}$)	30
1,750 to 30,000	30 ($\mu\text{V/m}$)	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.

12.4 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 $\mu\text{V}/\text{m}$ 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;

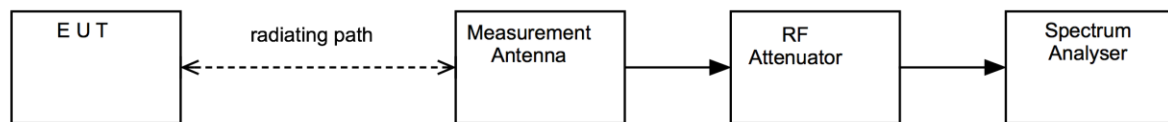
CF is the distance extrapolation factor in dB (where measurement distance different to limit distance);

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

Per FCC 47CFR15.31(f)(2) / RSS-Gen 6.4, for 125 kHz operation an extrapolation factor from 1 m to 3 m of 19.6 dB was determined from measurements at 1 and 3 metres.

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

Figure v Test Setup



12.5 Test Equipment

<i>Equipment Type</i>	<i>Manufacturer</i>	<i>Equipment Description</i>	<i>Element No</i>	<i>Due For Calibration</i>
ESR 7	R&S	Spectrum Analyser	U727	2025-05-17
FSU46	R&S	Spectrum Analyser	REF910	2025-01-30
hfh2	R&S	Loop Antenna	L007	2024-10-11

12.6 Test Results

Modulation: ASK; Frequency 125 kHz						
Channel Frequency (kHz)	Receiver Level (dBμV/m)	Measurement Distance (m)	Limit Distance (m)	Extrapolation Factor (dB)	Field Strength (μV/m)	Result
125	77.40	1	300	99.60	0.078	Pass
125	57.80	3	300	80.00	0.078	Pass

Modulation: ASK; Frequency 13.56 MHz						
Channel Frequency (MHz)	Receiver Level (dBμV/m)	Measurement Distance (m)	Limit Distance (m)	Extrapolation Factor (dB)	Field Strength (μV/m)	Result
13.56	40.3	10	30	19.08	11.51	Pass

13 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
Conducted RF Power, Power Spectral Density, Adjacent Channel Power and Spurious emissions		
Absolute RF power (via antenna connector) Sampling Power Meter to 8 GHz	MU4001	0.9 dB
Carrier Power and PSD - Spectrum Analysers	MU4004	1.7 dB
Adjacent Channel Power	MU4002	1.9 dB
Transmitter conducted spurious emissions (Including emissions due to intermodulation)	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
Radiated RF Power and Spurious emissions ERP and EIRP		
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
In-band (3450-3650 MHz) TRP using CATR_ASH_B2	MU4051	4.1 dB
Cellular Radiated Spurious Emissions in a SAC 30 MHz to 180 MHz	MU4052	6.3 dB
Cellular Radiated Spurious Emissions in a SAC 180 MHz to 18 GHz	MU4052	3.6 dB
Cellular Radiated Spurious Emissions in a FAR 30 MHz to 180 MHz	MU4052	5.4 dB
Cellular Radiated Spurious Emissions in a FAR 180 MHz to 18 GHz	MU4052	3.0 dB
Spurious Emissions Electric and Magnetic Field		
Radiated Spurious Emissions 30 MHz to 1 GHz (Including emissions due to intermodulation)	MU4037	4.7 dB
Radiated Spurious Emissions 1-18 GHz (Including emissions due to intermodulation)	MU4032	4.5 dB
E Field Emissions 18 GHz to 26 GHz	MU4024	3.2 dB
E Field Emissions 26 GHz to 40 GHz	MU4025	3.3 dB
E Field Emissions 40 GHz to 50 GHz	MU4026	3.5 dB
E Field Emissions 50 GHz to 75 GHz	MU4027	3.6 dB
E Field Emissions 75 GHz to 110 GHz	MU4028	3.6 dB
Radiated Magnetic Field Emissions	MU4031	2.3 dB

Test/Measurement	Budget Number	MU
Frequency Measurements		
Frequency Deviation	MU4022	3.7 kHz
Frequency error using CMTA test set	MU4023	113.441 Hz
Frequency error using GPS locked frequency source	MU4045	0.0413 ppm
Bandwidth/Spectral Mask Measurements		
Channel Bandwidth	MU4005	3.87%
Transmitter Mask Amplitude	MU4039	1.3 dB
Transmitter Mask Frequency	MU4040	2.59%
Time Domain Measurements		
Transmission Time	MU4038	4.40%
Dynamic Frequency Selection (DFS) Parameters		
DFS Analyser - Measurement Time	MU4006	678.984 µs
DFS Generator - Frequency Error	MU4007	91.650 Hz
DFS Threshold Conducted	MU4008	1.3 dB
DFS Threshold Radiated	MU4009	3.2 dB
Receiver Parameters		
EN 300 328 Receiver Blocking	MU4010	1.1 dB
EN 301 893 Receiver Blocking	MU4011	1.1 dB
EN 303 340 Adjacent Channel Selectivity	MU4012	1.1 dB
EN 303 340 Overloading	MU4013	1.1 dB
EN 303 340 Receiver Blocking	MU4014	1.1 dB
EN 303 340 Receiver Sensitivity	MU4015	0.9 dB
EN 303 372-1 Image Rejection	MU4016	1.4 dB
EN 303 372-1 Receiver Blocking	MU4017	1.1 dB
EN 303 372-2 Adjacent Channel Selectivity	MU4018	1.1 dB
EN 303 372-2 Dynamic Range	MU4019	0.9 dB
Receiver Blocking Talk Mode Conducted	MU4033	1.2 dB
Receiver Blocking Talk Mode- radiated	MU4034	3.4 dB
Rx Blocking, listen mode, blocking level	MU4035	3.2 dB
Rx Blocking, listen mode, radiated Threshold Measurement	MU4036	3.4 dB
Adjacent Sub Band Selectivity	MU4003	4.2 dB

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