Report Number: TRA-065901-47-00C
Issue: C

Report on The Radio Testing of a
Phare Labs Inc
Phare C1
With Respect to Specification
FCC 47CFR 15.249

Test Date: 2025-03-17 to 2025-03-18

Tested by: S Garwell

Written by: S Garwell
Radio Test Engineer

Approved by: Digitally signed by John Charters
Date: 2025.06.13 14:40:57 +01'00'
J Charters
Lab Manager

Date: 2025-06-13

1 Revision Record

Issue	*Issue Date*	*Revision History*
A	2025-03-26	Original
B	2025-05-16	Correct formatting errors in document
C	2025-06-13	General corrections throughout document

2 Summary

Test Report Number:	TRA-065901-47-00C
Works Order Number:	TRA-065901-01
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:	47CFR15.249
Equipment Under Test (EUT):	Phare C1
FCC Identifier:	2BMW7-PHAREC1
EUT Serial Number:	PH01_05_ID11
Manufacturer:	Phare Labs Inc
Address:	251 Little Falls Drive Wilmington, New Castle County, Delaware 19808 United States of America
Client Contact:	Arnau Donate ☎ +44 7438 22 1440 ✉ arnau@pharelabs.com
Order Number:	005-1
Test Date:	2025-03-17 to 2025-03-18
Tested By:	S Garwell Element

2.1 Test Summary

Test Method and Description	*Requirement Clause*	*Applicable to this Equipment*	*Result / Note*
	47CFR15		
Radiated Spurious Emissions	15.249(d)	☒	*Pass*
AC Power Line Conducted Emissions	15.207	☒	*Pass*
Occupied Bandwidth	15.215(c)	☒	*Pass*
Field Strength of Fundamental	15.249(a)	☒	*Pass*
Calculation of Duty Correction	15.35(c)	☐	*N/A*

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.

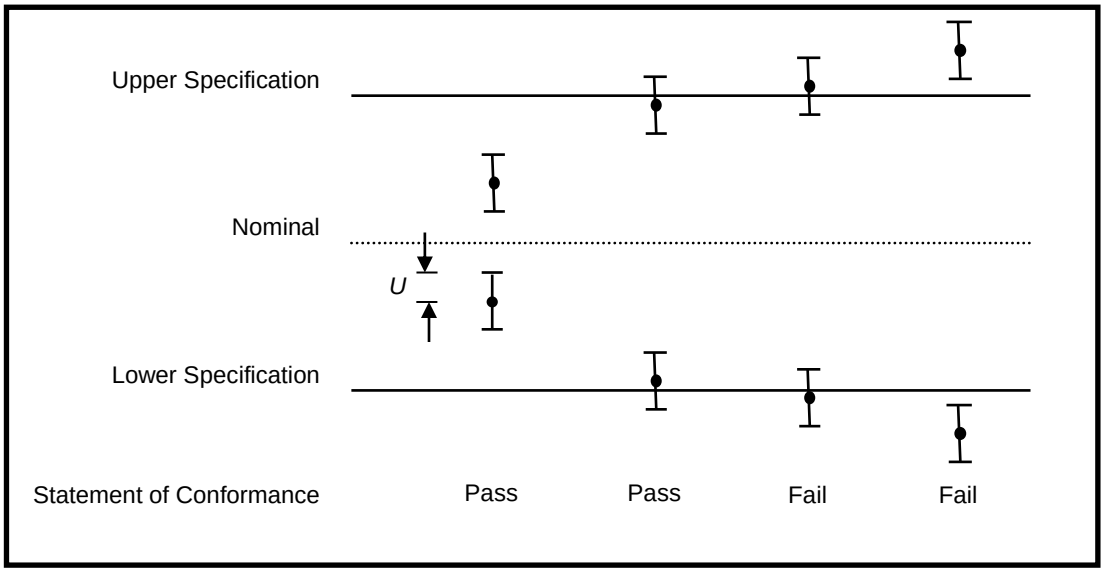
The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only. Any modifications made are identified in Section 8 of this report.

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

The decision rule for compliance is inherent within this specification. The measured value related to the corresponding limit is used to decide whether an equipment meets the requirements of the test specification.

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

3 Contents

4 Introduction

This report TRA-065901-47-00C presents the results of the Radio testing on a Phare Labs Inc, Phare C1 to specification 47CFR15 Radio Frequency Devices.

The testing was carried out for Phare Labs Inc by Element, at the address detailed below.

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

☐ 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 ISO/IEC 17025:2017 accredited 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 Surrey Hills	UK2027
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

5.2 Deviations from Test Standards

There were no deviations from the test standard.

6 Glossary of Terms

§	denotes a section reference from the standard, not this document
AC	Alternating Current
ANSI	American National Standards Institute
BW	bandwidth
°C	Degrees 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
EUT	Equipment Under Test
e.i.r.p.	Equivalent Isotropically Radiated Power
e.r.p.	Effective Radiated Power
FCC	Federal Communications Commission
FHSS	Frequency Hopping Spread Spectrum
Hz	hertz
IC	Industry Canada
ITU	International Telecommunication Union
LBT	Listen Before Talk
m	metre
max	maximum
MIMO	Multiple Input and Multiple Output
min	minimum
MRA	Mutual Recognition Agreement
N/A	Not Applicable
PCB	Printed Circuit Board
PDF	Portable Document Format
Pt-mpt	Point-to-multipoint
Pt-pt	Point-to-point
RF	Radio Frequency
RH	Relative Humidity
RMS	Root Mean Square
Rx	receiver
s	second
SISO	Single Input and Single Output
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: Phare C1
- Serial Number: PH01_05_ID11
- Model Number: PH01_05
- Software Revision: ESP-v0.1.0-cert / EFR-v0.1.1-cert
- Build Level / Revision Number: Production

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

7.3.1 Transmission

The mode of operation for Transmitter tests was as follows…

The EUT was transmitting at full power on the frequency as indicated.

7.4 EUT Radio Parameters

7.4.1 General

Frequency of Operation:	24.150 GHz
Band of Operation:	24000 MHz – 24250 MHz
Modulation Type:	CW, Doppler Radar
Occupied Channel Bandwidth:	573 kHz
ITU Emission Designator:	573KN0N
Declared Output Power:	≤10 dBm
Nominal Supply Voltage:	110 Vac 60 Hz
Duty Cycle:	0.25%
Antenna Type and Gain:	PCB Antenna, Peak Gain 10 dBi

7.5 EUT Description

The EUT is a multiple detection device for smoke, fire, intruder and environment monitoring sensor.

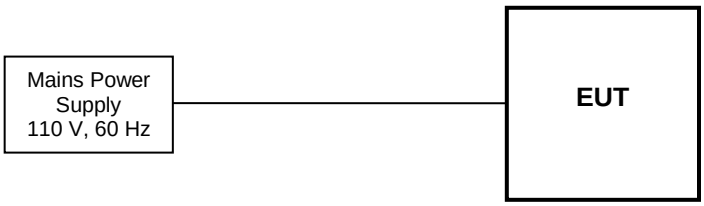
8 Modifications

No modifications were performed during this assessment.

9 EUT Test Setup

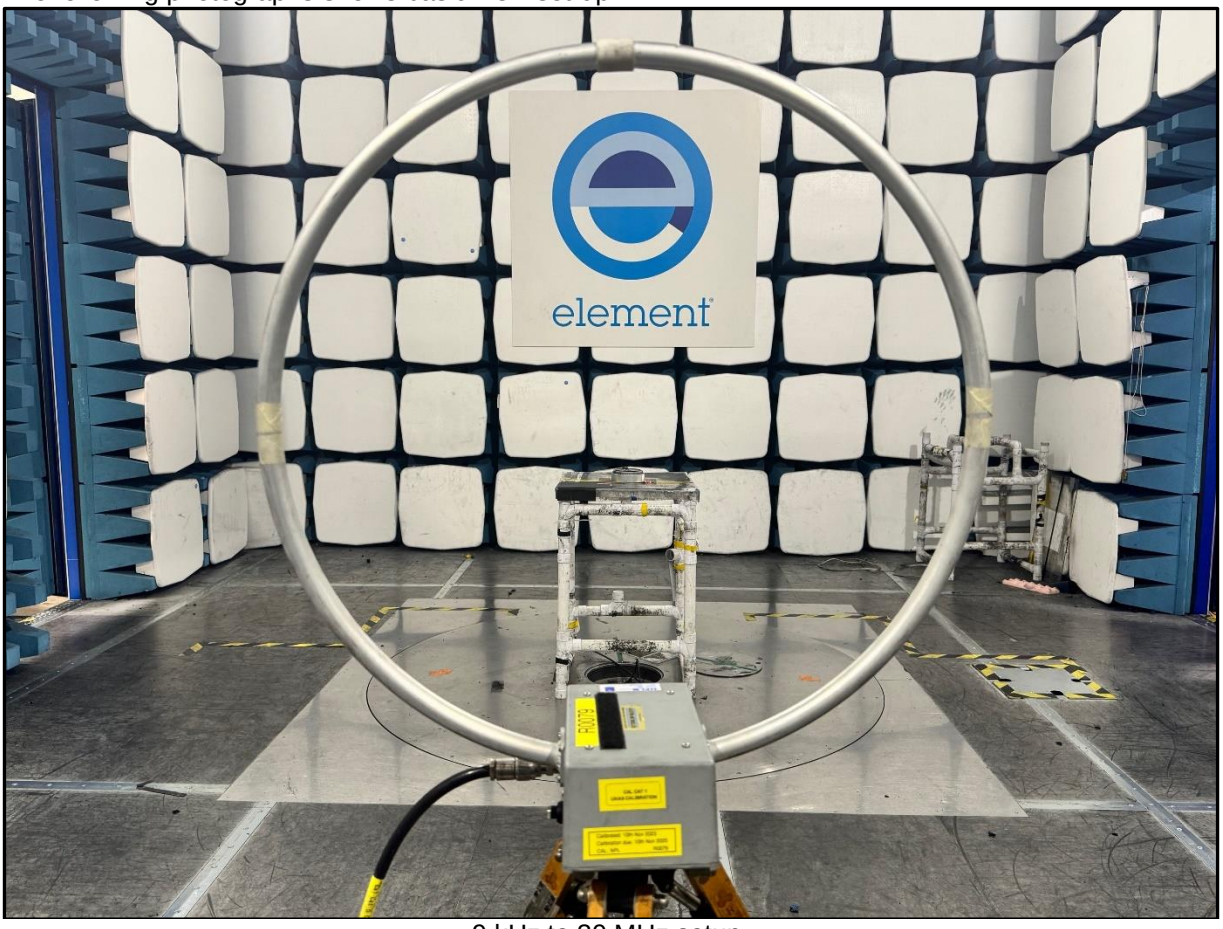
9.1 Block Diagram

The following diagram shows basic EUT interconnections:



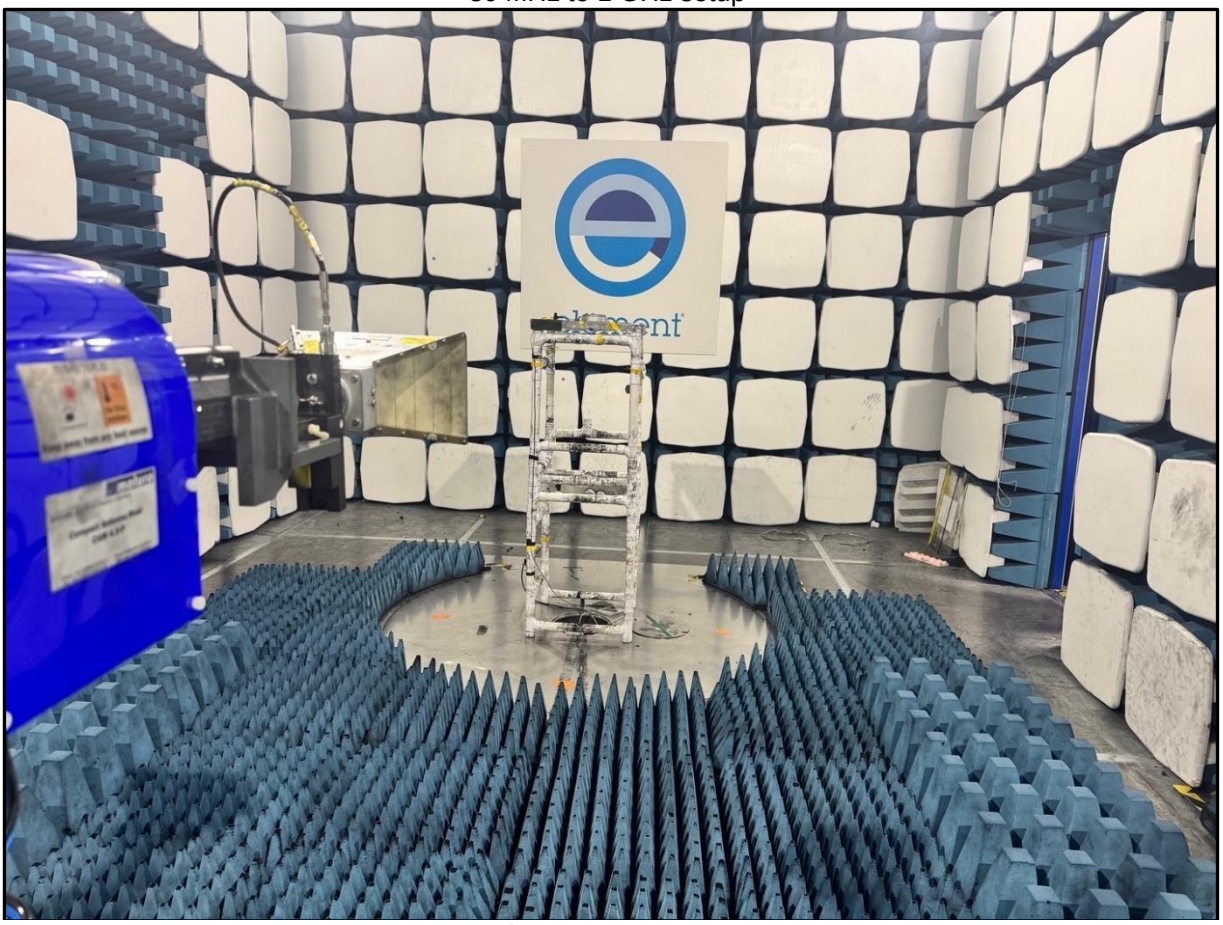
9.2 General Set-up Photographs

The following photographs shows basic EUT set-up:



9 kHz to 30 MHz setup

30 MHz to 1 GHz setup



Above 1 GHz setup

9.3 Measurement Software

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

Element Emissions R5.

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 110 Vac, 60 Hz, from the mains.

10.2 Varying Test Conditions

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

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

	Category	***Nominal***	***Variation***
☒	Mains	110 Vac +/-2 %	85 % and 115 %
☐	Battery	New Battery	N/A

11 Radiated emissions

11.1 Definitions

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

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

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

11.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	REF940
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Frequencies Measured:	24.150 GHz
EUT Channel Bandwidths:	573 kHz
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: 23 °C	+15 ºC to +35 ºC (as declared)
Humidity: 31 % RH	20 % RH to 75 % RH (as declared)
Supply: 110 Vac	110 Vac (as declared)

11.3 Test Limit

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

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

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

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

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

11.4 Test Method

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

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

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

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

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

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

$$FS = PR + CL + AF – PA + DC – CF$$

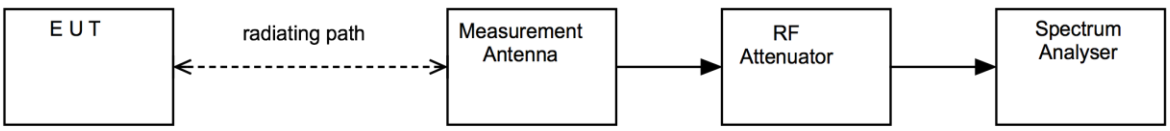
$$Factor = CL + AF – PA$$

Where,

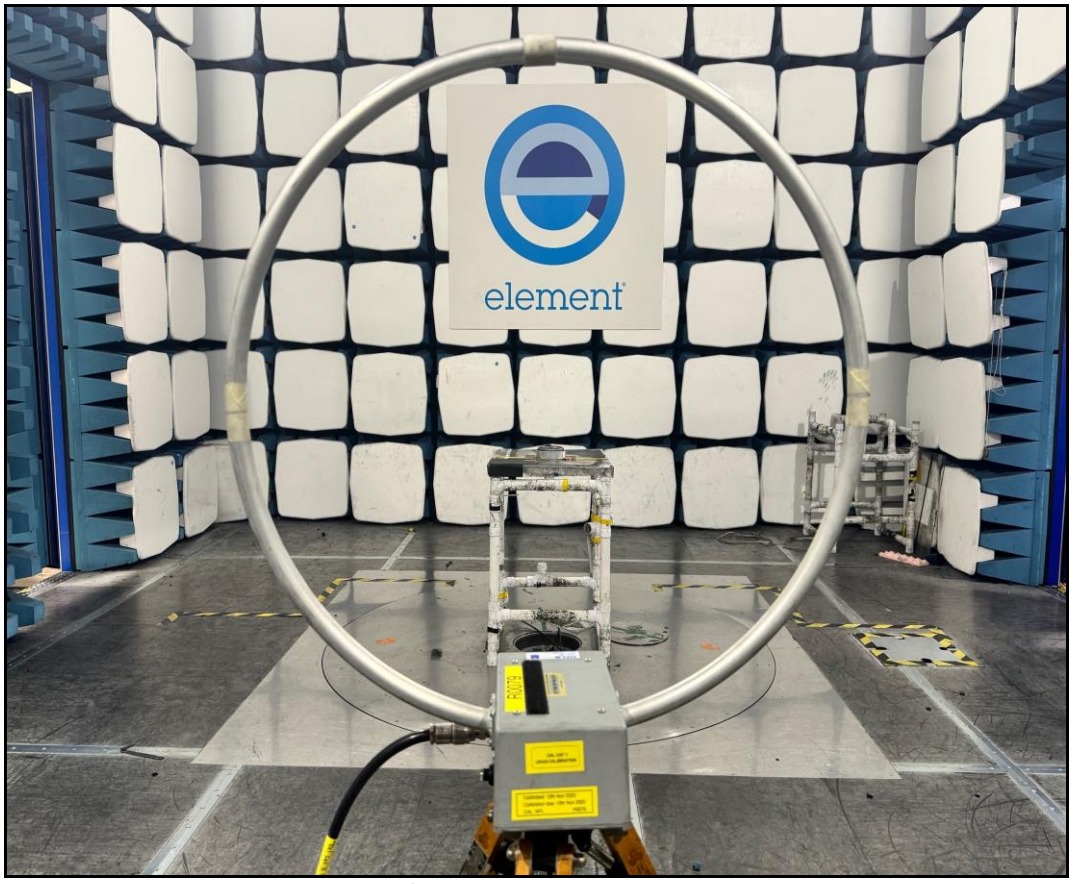
PR is the power recorded on the receiver / spectrum analyzer in dBµV;
CL is the cable loss in dB;
AF is the test antenna factor in dB/m;
PA is the pre-amplifier gain in dB (where used);
DC is the duty correction factor in dB (where used, e.g. harmonics of pulsed fundamental);
CF is the distance factor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

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

Figure i Test Setup

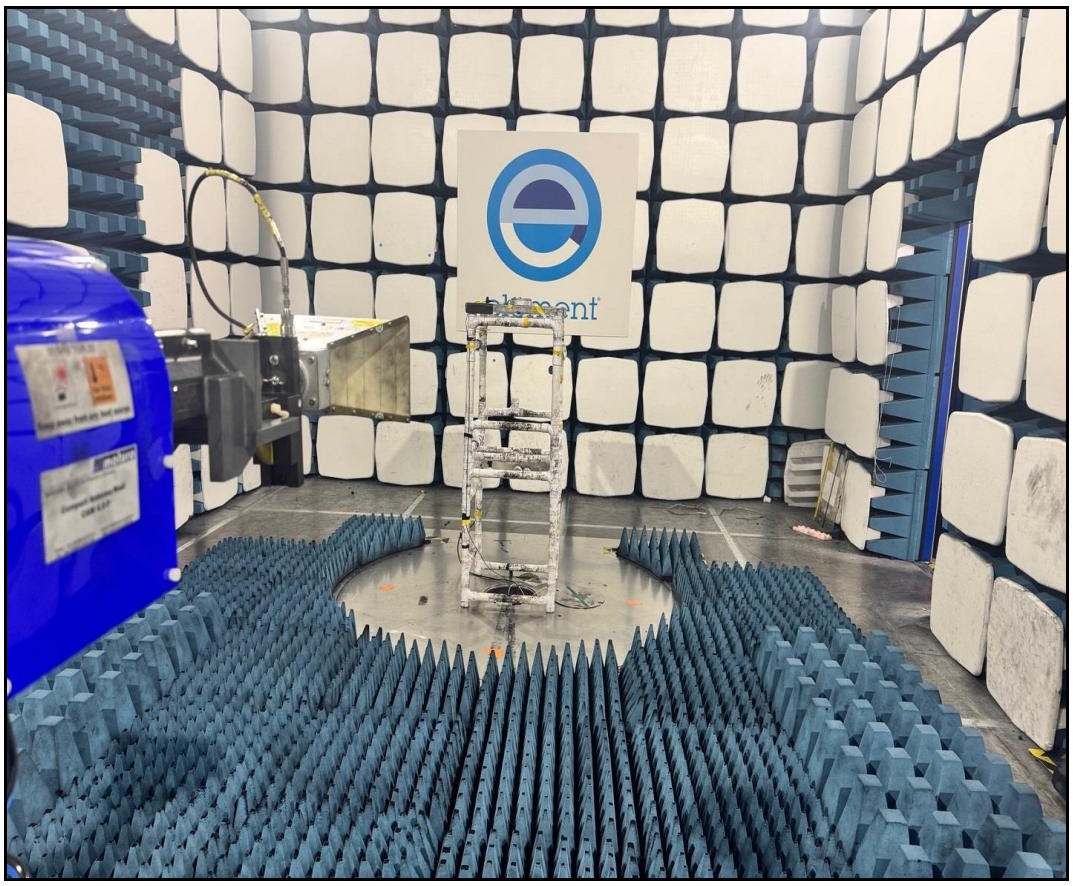


11.5 Test Set-up Photographs



9 kHz to 30 MHz – Setup

30 MHz to 1 GHz – Setup

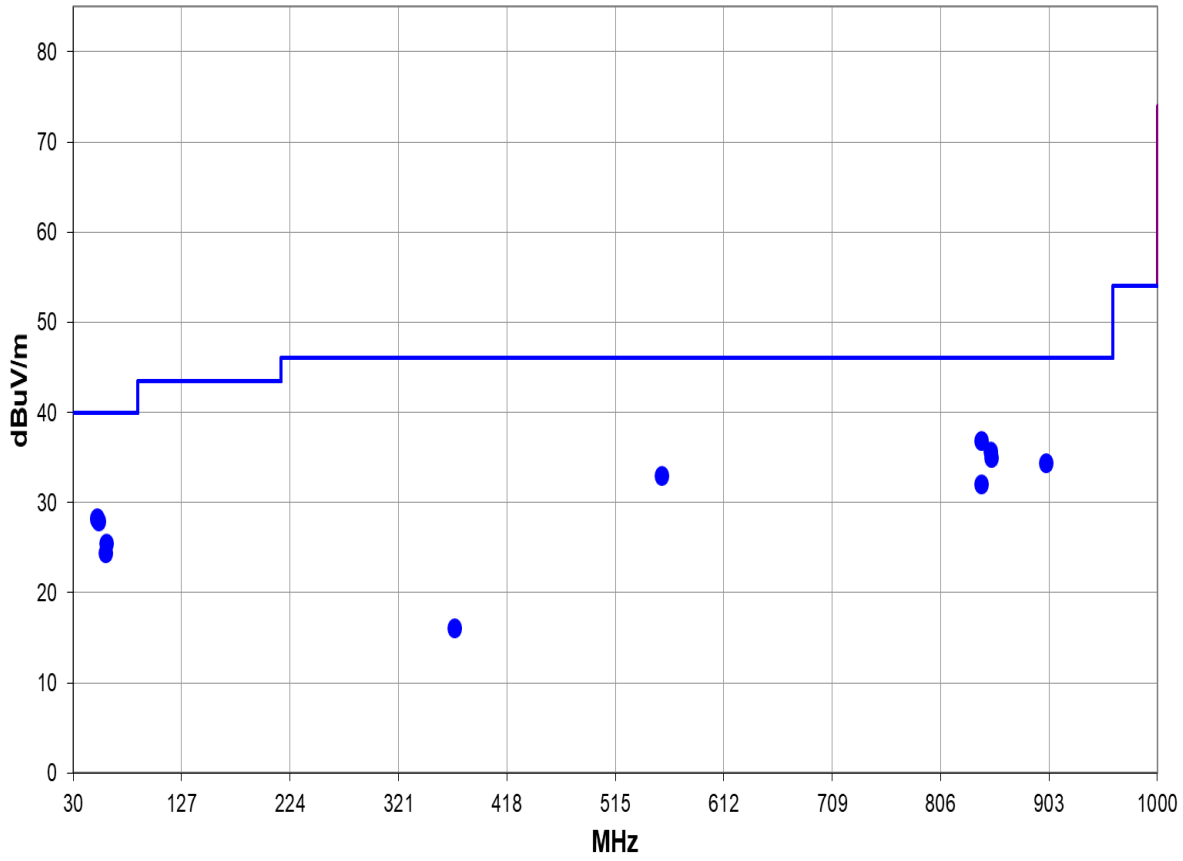


Above 1 GHz setup

11.6 Test Equipment

Equipment Type	*Manufacturer*	*Equipment Description*	*Element No*	*Due For Calibration*
Spectrum Analyser	R&S	ESR 7	U727	2025-05-17
Spectrum Analyser	R&S	FSU26	U405	2025-06-07
Spectrum Analyser	Agilent	N9030A	REF2167	2025-05-02
Active Loop Antenna	EMCO	6502	R0079	2026-01-10
1-18GHz Horn	EMCO	3115	L139	2025-08-21
Pre Amp	Agilent	8449B	L572	2025-11-13
Bilog	Chase	CBL611/B	U573	2025-11-04
Pre Amp	AMETEK	LNA6901	U711	2025-04-11
Horn Antenna	A Info Inc	A-INFOMW LB-180400-25-C-KF	REF2246	2025-10-08
Pre-Amp (18 - 40 GHz)	Com-Power	PAM-840A	REF2390	2025-10-17
Harmonic Mixer (33-50)	Agilent	11970Q	U365	2025-05-30
Harmonic Mixer (50-75)	Agilent	11970V	U366	2025-06-23
Harmonic Mixer (75-110)	Agilent	11970W	U367	2025-06-25
Standard Gain Horn 33-50	Flann	23240-20	L264A	2025-07-18
Standard Gain Horn (50-75)	Flann	25240-20	U368	2025-07-12
Standard Gain Horn (75-110)	Flann	27240-20	U369	2025-07-13
Radio Chamber - PP	Rainford EMC	ATS	REF940	2026-01-29
Radiated Test Software	Element	Emissions R5	REF9000	Cal Not Required

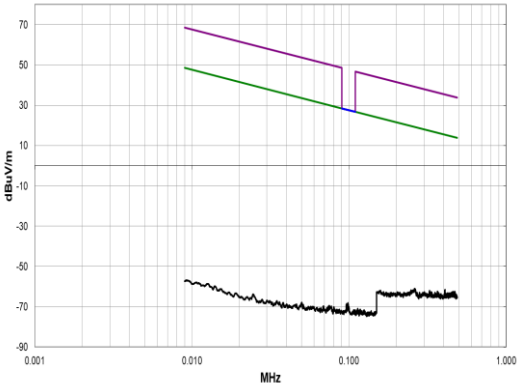
11.7 Test Results



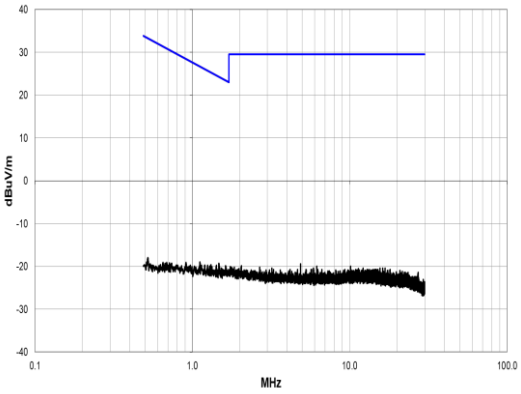
30 MHz to 1 GHz - Measurements

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)
842.600	32.4	4.4	4.0	360.1	3.0	0.0	Horz	QP	0.0	36.8	46.0	-9.2
850.735	31.2	4.5	3.5	180.1	3.0	0.0	Horz	QP	0.0	35.7	46.0	-10.3
851.406	30.5	4.5	3.5	45.0	3.0	0.0	Vert	QP	0.0	35.0	46.0	-11.0
900.511	30.1	4.3	3.5	315.0	3.0	0.0	Vert	QP	0.0	34.4	46.0	-11.6
51.745	42.6	-14.3	1.0	342.1	3.0	0.0	Vert	QP	0.0	28.3	40.0	-11.7
51.713	42.4	-14.3	1.0	315.0	3.0	0.0	Vert	QP	0.0	28.1	40.0	-11.9
53.026	42.7	-14.8	1.0	330.0	3.0	0.0	Vert	QP	0.0	27.9	40.0	-12.1
556.735	32.7	0.3	1.5	252.0	3.0	0.0	Horz	QP	0.0	33.0	46.0	-13.0
842.683	27.6	4.4	2.8	315.1	3.0	0.0	Vert	QP	0.0	32.0	46.0	-14.0
59.515	41.1	-15.7	1.0	356.9	3.0	0.0	Vert	QP	0.0	25.4	40.0	-14.6
59.413	40.1	-15.7	1.0	127.0	3.0	0.0	Vert	QP	0.0	24.4	40.0	-15.6

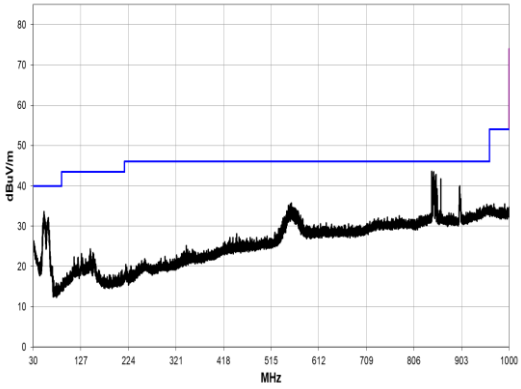
24 GHz Doppler Radar; Frequency: 24.150 GHz; Modulation: CW; Power Setting: Default



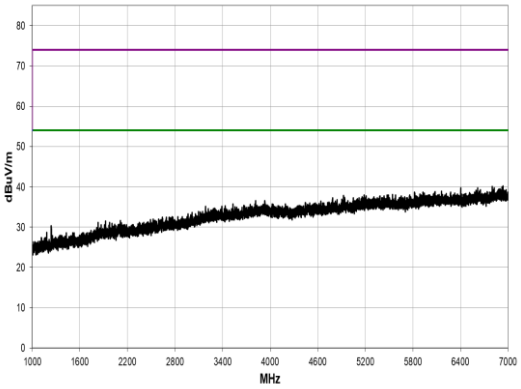
9 kHz to 490 kHz



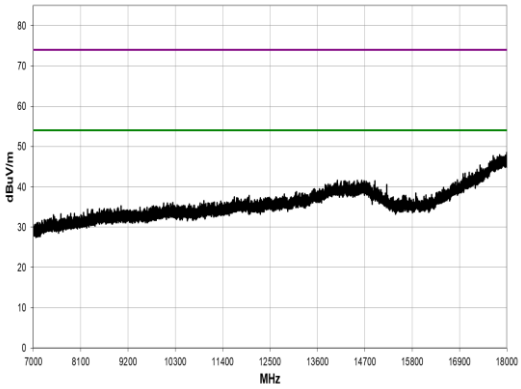
490 kHz to 30 MHz



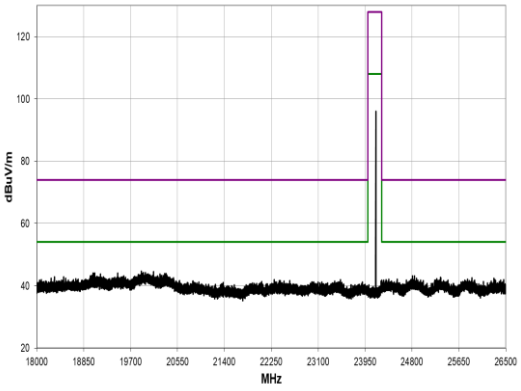
30 MHz to 1 GHz



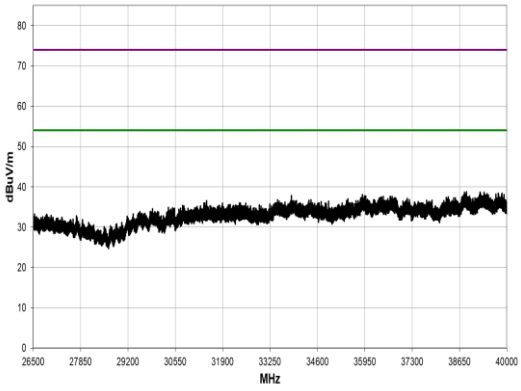
1 GHz to 7 GHz



7 GHz to 18 GHz



18 GHz to 26.5 GHz

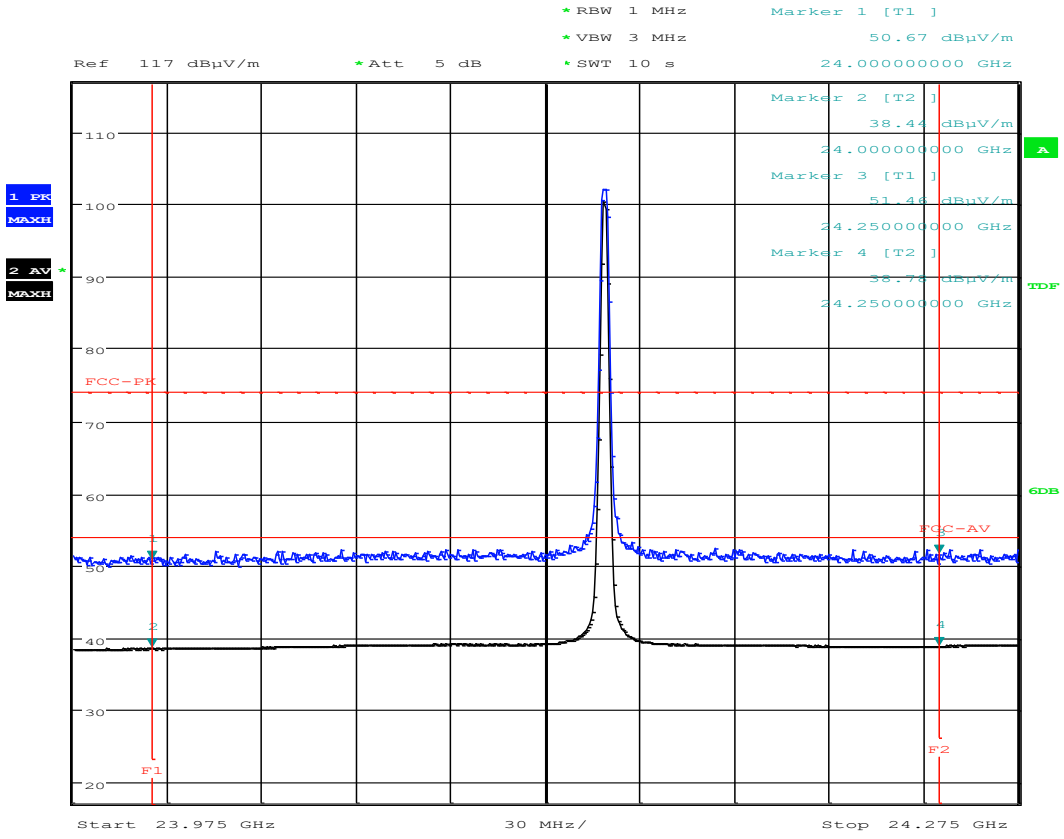


26.5 GHz to 40 GHz

Note: The spectrum was investigated from 40 GHz to 100 GHz and any significant emissions are recorded in the table below.

24 GHz Doppler Radar; Frequency: 24.150 GHz; Modulation: CW; Power Setting: Default								
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Factor (dB/m)***	***Duty Cycle Corr'n (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
Pk	48287.375	40.90	45.51	0	-29.5	56.91	700.648	2500
AV	48287.196	34.42	45.51	0	-29.5	50.43	332.277	2500

Radiated Band Edge – Lower / Upper



12 AC power-line conducted emissions

12.1 Definition

Line-to-ground radio-noise voltage that is conducted from all of the EUT current-carrying power input terminals that are directly (or indirectly via separate transformers or power supplies) connected to a public power network.

12.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Transient Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.2
EUT Frequencies Measured:	24.150 GHz
EUT Channel Bandwidths:	573 kHz
EUT Modulation:	CW
Deviations From Standard:	None
Measurement BW:	9 kHz
Measurement Detectors:	Quasi-Peak and Average, RMS

Environmental Conditions (Normal Environment)

Temperature: 19 °C	+15 ºC to +35 ºC (as declared)
Humidity: 34 % RH	20 % RH to 75 % RH (as declared)
Supply: 110 Vac	110 Vac (as declared)

12.3 Test Limit

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz, shall not exceed the limits in Table 3.

Table 3 – AC Power Line Conducted Emission Limits

Frequency (MHz)	***Conducted limit (dBµV)***	
	Quasi-Peak	***Average****
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

*The level decreases linearly with the logarithm of the frequency.
**A linear average detector is required.

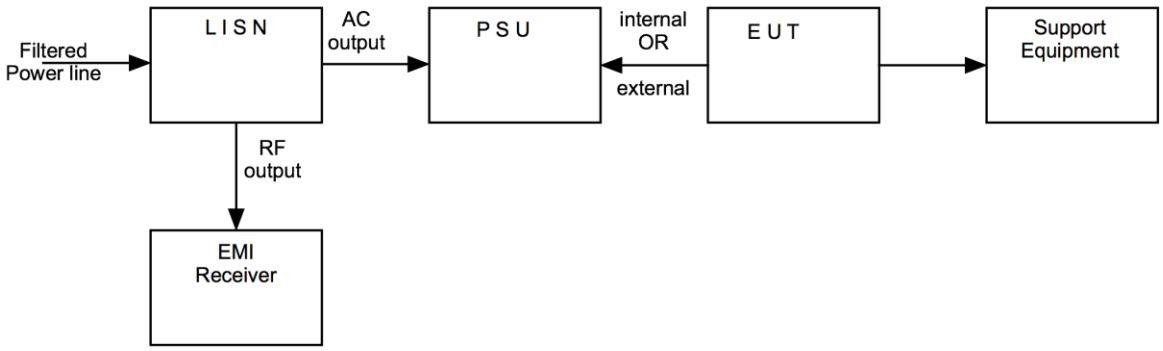
12.4 Test Method

With the EUT setup in a screened room, as per section 9 of this report and connected as per Figure ii, the power line emissions were measured on a spectrum analyzer / EMI receiver.

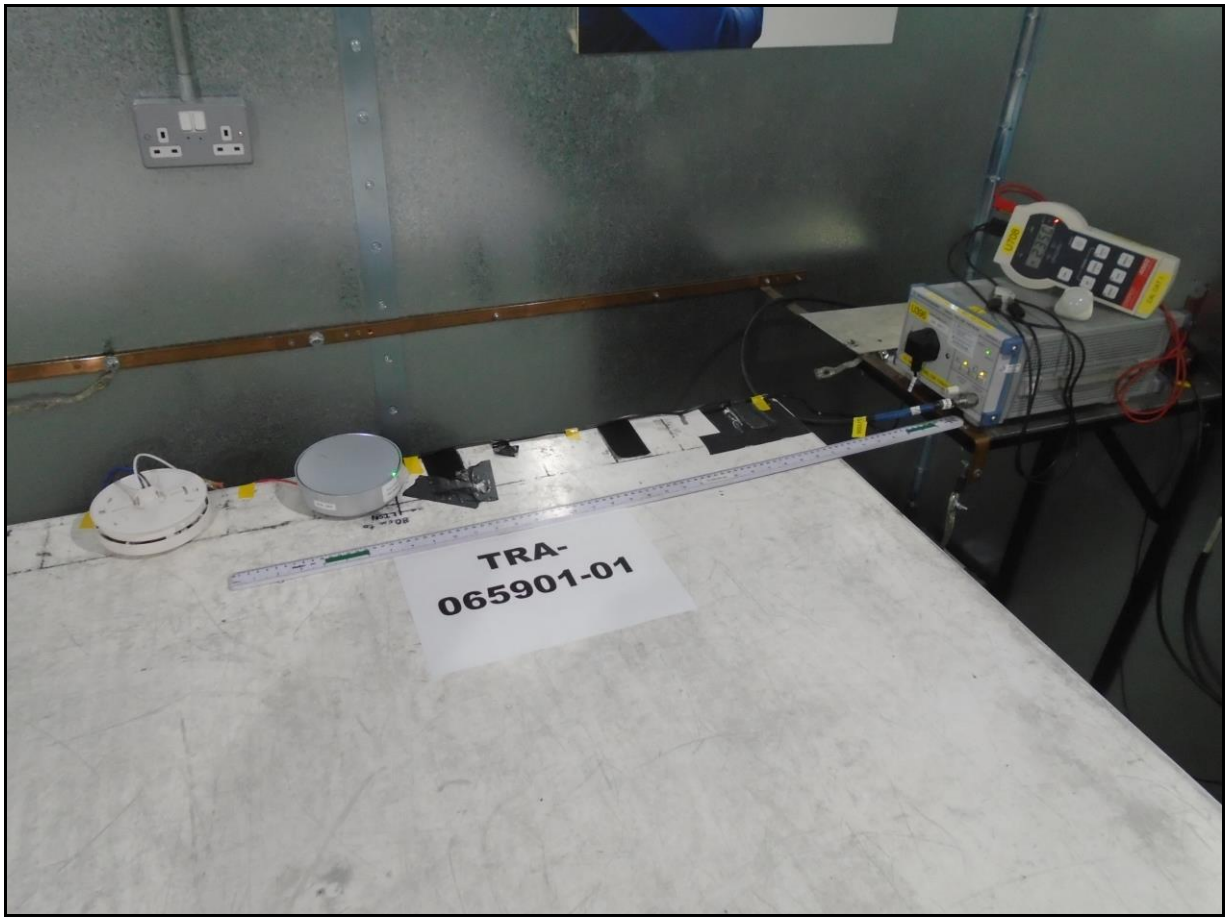
AC power line conducted emissions from the EUT are checked first by preview scans with peak and average detectors covering both live and neutral lines. A spectrum analyzer is used to determine if any periodic emissions are present.

Formal measurements using the correct detector(s) and bandwidth are made on frequencies identified from the preview scans. Final measurements were performed with EUT set at its maximum duty in transmit and receive modes.

Figure ii Test Setup



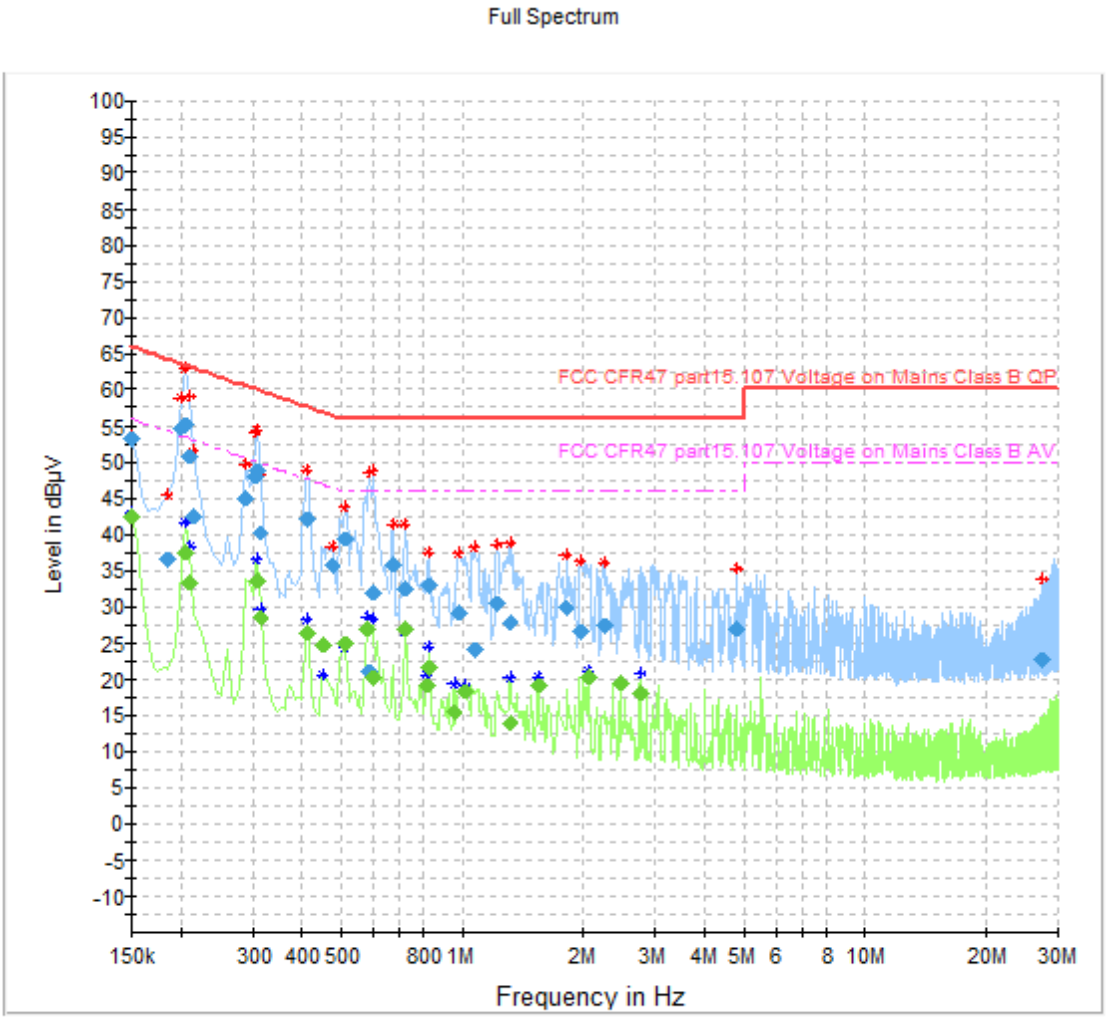
12.5 Test Set-up Photograph



12.6 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
Spectrum Analyser	R&S	ESR 7	U727	2025-05-17
ENV216	R&S	Lisn	U396	2025-05-16
ESH3-Z2	R&S	Pulse Limiter	U559	2026-02-27

12.7 Test Results



Final Results Quasi-Peak

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.150000	53.20	66.00	12.80	2000.0	9.000	L1	OFF	19.6
0.185000	36.49	64.26	27.77	2000.0	9.000	N	OFF	19.6
0.200000	54.78	63.61	8.83	2000.0	9.000	N	OFF	19.6
0.205000	55.15	63.41	8.25	2000.0	9.000	N	OFF	19.6
0.210000	50.87	63.21	12.33	2000.0	9.000	N	OFF	19.6
0.215000	42.59	63.01	20.42	2000.0	9.000	N	OFF	19.6
0.290000	44.90	60.52	15.62	2000.0	9.000	N	OFF	19.6
0.305000	48.19	60.11	11.92	2000.0	9.000	N	OFF	19.6
0.310000	48.80	59.97	11.17	2000.0	9.000	N	OFF	19.6
0.315000	40.27	59.84	19.57	2000.0	9.000	N	OFF	19.6
0.410000	42.02	57.65	15.63	2000.0	9.000	N	OFF	19.6
0.475000	35.58	56.43	20.84	2000.0	9.000	N	OFF	19.6
0.510000	39.38	56.00	16.62	2000.0	9.000	L1	OFF	19.6
0.585000	21.07	56.00	34.93	2000.0	9.000	N	OFF	19.7
0.600000	31.86	56.00	24.14	2000.0	9.000	N	OFF	19.7
0.670000	35.87	56.00	20.13	2000.0	9.000	L1	OFF	19.7
0.715000	32.50	56.00	23.50	2000.0	9.000	N	OFF	19.7
0.820000	32.97	56.00	23.03	2000.0	9.000	N	OFF	19.7
0.980000	29.18	56.00	26.82	2000.0	9.000	N	OFF	19.7
1.070000	24.06	56.00	31.94	2000.0	9.000	N	OFF	19.7
1.215000	30.46	56.00	25.54	2000.0	9.000	N	OFF	19.7
1.310000	27.90	56.00	28.10	2000.0	9.000	N	OFF	19.7
1.815000	29.80	56.00	26.20	2000.0	9.000	N	OFF	19.8
1.960000	26.65	56.00	29.35	2000.0	9.000	N	OFF	19.8
2.255000	27.50	56.00	28.50	2000.0	9.000	N	OFF	19.8
4.820000	27.00	56.00	29.00	2000.0	9.000	N	OFF	19.9
27.545000	22.55	60.00	37.45	2000.0	9.000	N	OFF	21.4

Final Result Cispr-Average

Frequency (MHz)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.150000	42.41	56.00	13.59	2000.0	9.000	L1	OFF	19.6
0.205000	37.57	53.41	15.83	2000.0	9.000	N	OFF	19.6
0.210000	33.35	53.21	19.86	2000.0	9.000	N	OFF	19.6
0.310000	33.59	49.97	16.38	2000.0	9.000	N	OFF	19.6
0.315000	28.38	49.84	21.45	2000.0	9.000	N	OFF	19.6
0.410000	26.41	47.65	21.24	2000.0	9.000	L1	OFF	19.6
0.450000	24.77	46.88	22.10	2000.0	9.000	N	OFF	19.6
0.510000	24.88	46.00	21.12	2000.0	9.000	N	OFF	19.6
0.580000	26.95	46.00	19.05	2000.0	9.000	N	OFF	19.7
0.595000	20.17	46.00	25.83	2000.0	9.000	N	OFF	19.7
0.720000	26.96	46.00	19.04	2000.0	9.000	N	OFF	19.7
0.815000	19.17	46.00	26.83	2000.0	9.000	N	OFF	19.7
0.820000	21.59	46.00	24.41	2000.0	9.000	N	OFF	19.7
0.950000	15.34	46.00	30.66	2000.0	9.000	N	OFF	19.7
1.020000	18.30	46.00	27.70	2000.0	9.000	N	OFF	19.7
1.310000	14.05	46.00	31.95	2000.0	9.000	N	OFF	19.7
1.540000	19.21	46.00	26.79	2000.0	9.000	L1	OFF	19.7
2.050000	20.36	46.00	25.64	2000.0	9.000	L1	OFF	19.8
2.460000	19.47	46.00	26.53	2000.0	9.000	N	OFF	19.8
2.770000	18.07	46.00	27.93	2000.0	9.000	N	OFF	19.8

13 Occupied Bandwidth

13.1 Definitions

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:	REF940
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.9
EUT Frequencies Measured:	24.150 GHz
EUT Channel Bandwidths:	573 kHz
Deviations From Standard:	None
Measurement BW: (requirement: 1 % to 5 % OBW)	10 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	30 kHz
Measurement Span: (requirement 2 to 5 times OBW)	1 MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 ºC to +35 ºC (as declared)
Humidity: 31 % RH	20 % RH to 75 % RH (as declared)
Supply: 110 Vac	110 Vac (as declared)

13.3 Test Limit

Industry Canada:
If the frequency stability of the license-exempt radio apparatus is not specified in the applicable standard (RSS), measurement of the frequency stability is not required provided that the occupied bandwidth of the license-exempt radio apparatus lies entirely outside the restricted bands and the prohibited TV bands of 54 to 72 MHz, 76 to 88 MHz, 174 to 216 MHz, 470 to 608 MHz and 614 to 806 MHz.

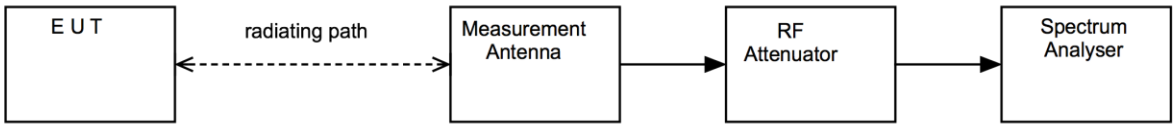
Federal Communications Commission:
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise 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 iii, 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 iii Test Setup

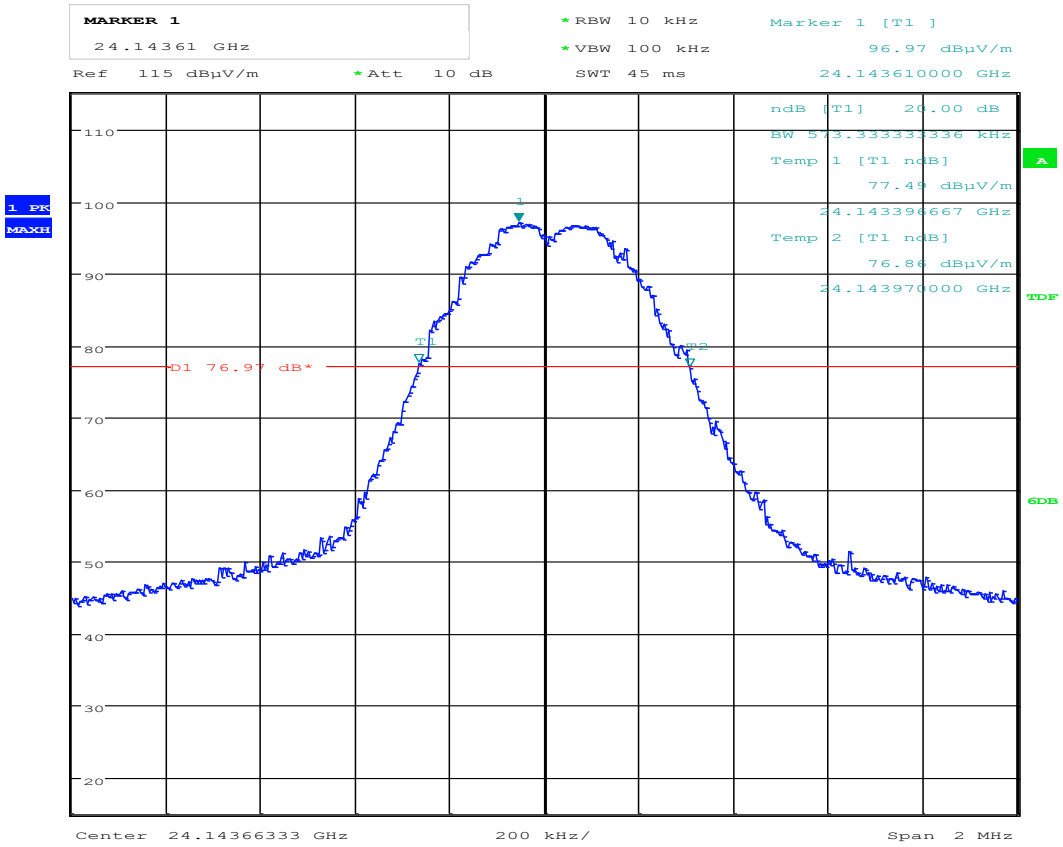


13.5 Test Equipment

Equipment Type	*Manufacturer*	*Equipment Description*	*Element No*	*Due For Calibration*
Spectrum Analyser	Agilent	N9030A	REF2167	2025-05-02
Horn Antenna	A Info Inc	A-INFOMW LB-180400-25-C-KF	REF2246	2025-10-08
Pre-Amp (18 - 40 GHz)	Com-Power	PAM-840A	REF2390	2025-10-17
Radio Chamber - PP	Rainford EMC	ATS	REF940	2026-01-29
Radiated Test Software	Element	Emissions R5	REF9000	Cal Not Required

13.6 Test Results

FCC 15.249. Modulation: CW; Power Setting: High				
Channel Frequency (MHz)	F_L (MHz)	F_H (MHz)	20dB Bandwidth (kHz)	Result
24150.00	24143.396667	24143.970000	573.33	Pass



Date: 18.MAR.2025 09:41:34

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:	REF940
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 / 6.6
EUT Frequencies Measured:	24.150 GHz
EUT Channel Bandwidths:	573 kHz
Deviations From Standard:	None
Measurement BW:	1 MHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	3 MHz
Measurement Detector:	Up to 1 GHz: Quasi-peak Above 1 GHz: Average RMS and Peak
Voltage Extreme Environment Test Range:	Mains Power = 85 % and 115 % of Nominal (FCC only requirement);

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 ºC to +35 ºC (as declared)
Humidity: 31 % RH	20 % RH to 75 % RH (as declared)

14.3 Test Limit

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

Field Strength Limits for License-Exempt Transmitters for Any Application

Fundamental frequency (MHz)	*Field strength (mV/m at 3 m)*	*Detector*
902 to 928	50	Quasi-Peak
2400 to 2483.5	50	Average RMS
5725 to 5875	50	Average RMS

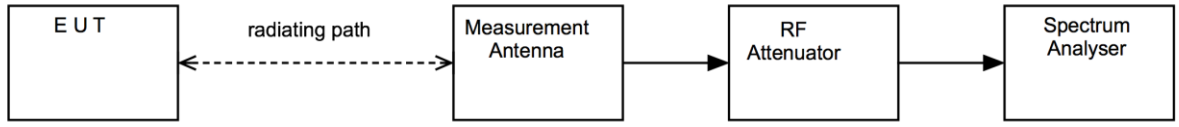
n.b. per FCC 47CFR15.249(e) / RSS-Gen 8.1, peak limit is 20 dB above average.

14.4 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



14.5 Test Equipment

Equipment Type	*Manufacturer*	*Equipment Description*	*Element No*	*Due For Calibration*
Spectrum Analyser	Agilent	N9030A	REF2167	2025-05-02
Horn Antenna	A Info Inc	A-INFOMW LB-180400-25-C-KF	REF2246	2025-10-08
Pre-Amp (18 - 40 GHz)	Com-Power	PAM-840A	REF2390	2025-10-17
Radio Chamber - PP	Rainford EMC	ATS	REF940	2026-01-29
Radiated Test Software	Element	Emissions R5	REF9000	Cal Not Required

14.6 Test Results

Detector	*Freq. (MHz)*	*Meas'd Emission (dBµV)*	*Factor (dB/m)*	*Duty Cycle Corr'n (dB)*	*Measurement Distance (m)*	*Field Strength (dBµV/m)*	*Field Strength (mV/m)*	*Limit (mV/m)*
Pk	24150.0	99.6	3.1	0	3	102.7	136.458	250
AV	24150.0	98.7	3.1	0	3	101.8	123.026	250

15 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 connecter) 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 (3450-3980 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**

Test/Measurement	***Budget Number***	***MU***
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**

16 RF Exposure

16.1 MPE Calculation

Prediction of MPE limit at a given distance

For purposes of these requirements mobile devices are defined by the FCC as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limits. As the 20 cm separation specified under FCC rules may not be achievable under normal operation of the EUT, an RF exposure calculation is needed to show the minimum distance required to be less than the power density limit, as required under FCC rules.

Equation from IEEE C95.1

$$S = \frac{EIRP}{4\pi R^2} \quad \text{re-arranged } R = \sqrt{\frac{EIRP}{S4\pi}}$$

Where:

S = power density
R = distance to the centre of radiation of the antenna
EIRP = EUT Maximum power

Result

Channel Frequency (MHz)	***EIRP (mW)***	***Power density limit (S) (mW/cm²)***	***Distance (R) cm required to be less than the power density limit***
24150	10.0	1.0	0.9

Notes: The information in the table above was obtained from:

1. The calculation result is based on maximum manufacturer rated power.
2. The calculation result is based on 100% duty cycle.