

Report on the Radio Testing
For
G4S Technology Ltd T/AS AMAG Technology
on
S884 MK2
Report no. TRA-061464-47-00B
12th December 2025

RF914 9.0



Report Number: TRA-061464-47-00B
Issue: B

REPORT ON THE RADIO TESTING OF A
G4S Technology Ltd T/AS AMAG Technology
S884 MK2
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.225

TEST DATE: 21st - 29th August 2023

Tested by:

D Winstanley
Radio Senior Test Engineer

Approved by:

J Charters
Lab Manager

Date: 12th December 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</i>	<i>Issue Date</i>	<i>Revision History</i>
A	2nd August 2024	Original
B	12th December 2025	Update of ANSI C63.10 to 2020 version

2 Summary

TEST REPORT NUMBER:	TRA-061464-47-00B
WORKS ORDER NUMBER:	TRA-061464-01
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:	47CFR15.225
EQUIPMENT UNDER TEST (EUT):	S884 MK2
FCC IDENTIFIER:	OE5S884C
EUT SERIAL NUMBER:	Not Stated
MANUFACTURER/AGENT:	G4S Technology Ltd T/AS AMAG Technology
ADDRESS:	Challenge House International Drive Tewkesbury Gloucestershire GL20 8UQ United Kingdom
CLIENT CONTACT:	Mr Ian Williams ☎ 01684 850977 ✉ ian.williams@amag.com
ORDER NUMBER:	PUR102373
TEST DATE:	21st - 29th August 2023
TESTED BY:	D Winstanley Element

2.1 Test Summary

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

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).

General notes

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	8
5	Test Specifications	9
5.1	Normative References	9
5.2	Deviations from Test Standards	9
6	Glossary of Terms	10
7	Equipment Under Test	11
7.1	EUT Identification	11
7.2	System Equipment	11
7.3	EUT Mode of Operation	11
7.3.1	Transmission	11
7.4	EUT Radio Parameters	11
7.5	EUT Description	11
8	Modifications	12
9	EUT Test Setup	13
9.1	Block Diagram	13
9.2	General Set-up Photograph	14
9.3	Measurement Software	15
10	General Technical Parameters	16
10.1	Normal Conditions	16
10.2	Varying Test Conditions	16
11	Radiated Emissions Below 30 MHz	17
11.1	Definitions	17
11.2	Test Parameters	17
11.3	Test Limit	18
11.4	Test Method	18
11.5	Test Set-up Photograph	19
11.6	Test Equipment	19
11.7	Test Results	20
12	Radiated Emissions	21
12.1	Definitions	21
12.2	Test Parameters	21
12.3	Test Limit	21
12.4	Test Method	22
12.5	Test Equipment	23
12.6	Test Results	23
13	AC Power-line Conducted Emissions	24
13.1	Definition	24
13.2	Test Parameters	24
13.3	Test Limit	24
13.4	Test Method	25
13.5	Test Set-up Photograph	25
13.6	Test Equipment	25
13.7	Test Results	26
14	Occupied Bandwidth	28
14.1	Definition	28
14.2	Test Parameters	28
14.3	Test Limit	28
14.4	Test Method	29
14.5	Test Equipment	29
14.6	Test Results	29
15	Transmitter Output Power (Fundamental Radiated Emission)	30
15.1	Definition	30
15.2	Test Parameters	30
15.3	Test Limit	30
15.4	Test Method	31
15.5	Test Equipment	31
15.6	Test Results	32
16	Frequency Stability	33
16.1	Definition	33
16.2	Test Parameters	33
16.3	Test Limit	33
16.4	Test Method	34
16.5	Test Equipment	34

16.6	Test Results.....	34
17	Measurement Uncertainty.....	35
18	RF Exposure.....	37

4 Introduction

This report TRA-061464-47-00B presents the results of the Radio testing on a G4S Technology Ltd T/AS AMAG Technology, S884 MK2 to specification 47CFR15 Radio Frequency Devices.

The testing was carried out for G4S Technology Ltd T/AS AMAG Technology by Element, at the address detailed below.

☐	Element Hull Unit E South Orbital Trading Park Hedon Road Hull HU9 1NJ UK	☒	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
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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 Hull	UK2007
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 C63.10-2020 – American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- ANSI C63.4-2014 – American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
- KDB 174176 D01 Line Conducted FAQ v01r01 - AC Power-Line Conducted Emissions Frequently Asked Questions

ANSI C63.10-2020 is ISO/IEC 17025:2017 accredited under Element's flexible scope of accreditation.

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
ATS	Alternative Test Site
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: S884 MK2
- Serial Number: Not Stated
- Model Number: S884 MK2
- Software Revision: Not Applicable
- Build Level / Revision Number: Not Applicable

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.

Element S14 - Access control Power Supply - MN-TRANS-150-UL

Element S15 - Access Card

7.3 EUT Mode of Operation

7.3.1 Transmission

The mode of operation for Tx tests was as follows...

The EUT was permanently transmitting with a card in the field being read.

7.4 EUT Radio Parameters

Frequency of operation:	13.56 MHz
Modulation type:	ASK
Channel spacing:	Wideband
Declared output power(s):	Not Stated
Warning against use of alternative antennas in user manual (yes/no):	N/A
Nominal Supply Voltage:	12 Vdc

7.5 EUT Description

The EUT is an Access control system card reader, for reading access card credentials, obtaining a credential PIN, indicating the door status, and allowing user to send keypad commands to the access control system.

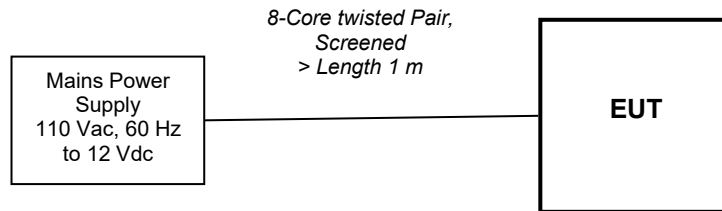
8 Modifications

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 Photographs

The following photographs 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 EUT was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was 12 Vdc from an external power supply.

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:

	Category	Variation
☒	Standard	-20 to +50 C in 10 degree steps
☐	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:

	Category	Nominal	Variation
☐	Mains	110 V ac +/-2 %	85 % and 115 %
☐	Battery	New battery	N/A
☒	Power Supply	12 Vdc	85 % and 115 % 10.2 Vdc – 14.3 Vdc

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:	Radio Chamber
Test Standard and Clause:	ANSI C63.10-2020, Clause 6.4
EUT Frequency Measured:	13.56 MHz
Deviations From Standard:	None
Measurement Distance and Site:	3 m ATS
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: 21 °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 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 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,

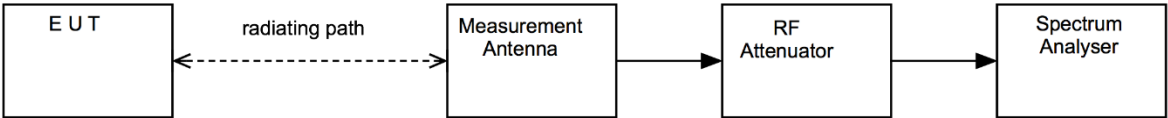
PR is the power recorded on the receiver / spectrum analyzer in dBμV and includes any cable loss, antenna factor and pre-amplifier gain;

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

Per FCC 47CFR15.31(f)(2), 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



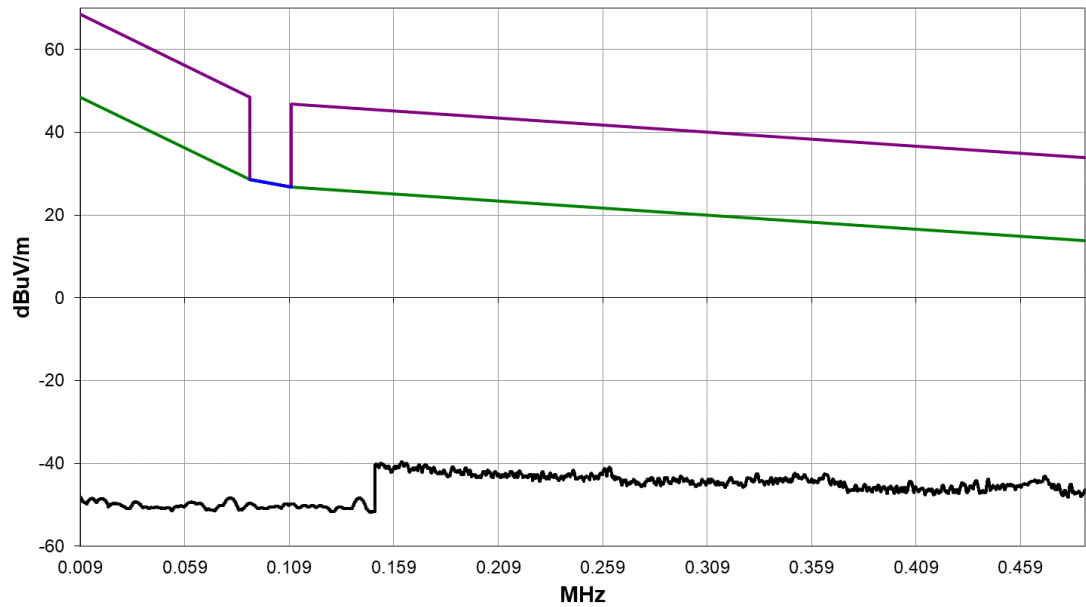
11.5 Test Set-up Photograph



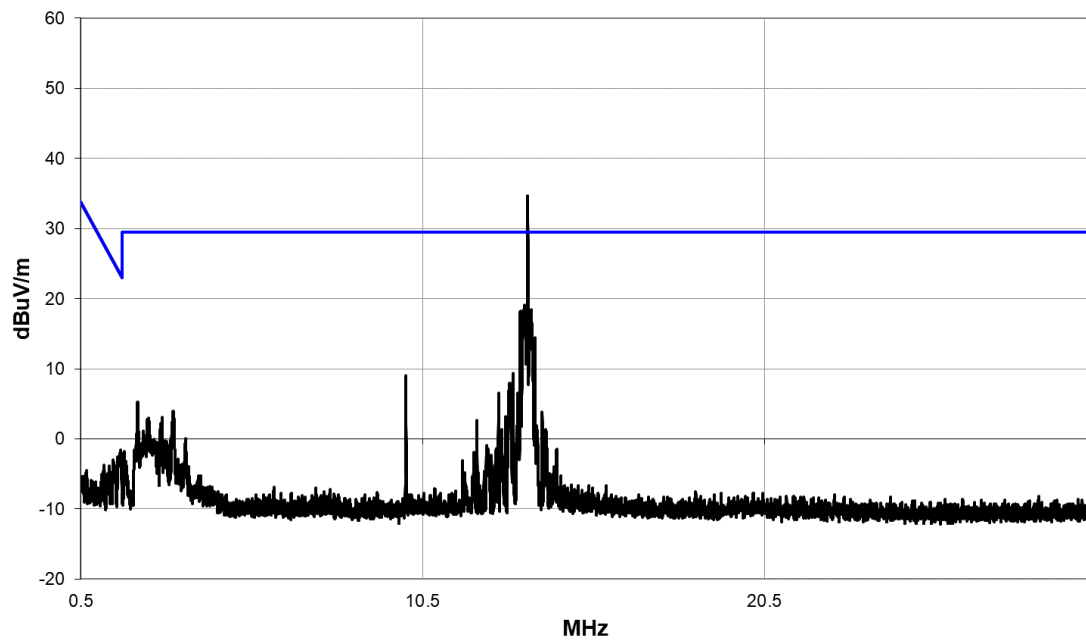
11.6 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
ESR 7	R&S	Spectrum Analyser	U727	2024-05-09
Loop Antenna	R&S	hfh2	L007	2023-09-09
ATS	Rainford EMC	Radio Chamber - PP	REF940	2023-11-06
Emissions R5	Element	Radiated Test Software	REF9000	Cal not required

11.7 Test Results



9 kHz - 490 kHz



490 kHz - 30 MHz

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

Note: The emission shown above the spurious emission line, is the wanted 13.56 MHz fundamental frequency.

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:	Radio Chamber
Test Standard and Clause:	ANSI C63.10-2020, Clause 6.5
EUT Frequency Measured:	13.56 MHz
Deviations From Standard:	None
Measurement BW:	30 MHz to 1000 MHz: 120 kHz
Measurement Detector:	Quasi-peak

Environmental Conditions (Normal Environment)

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

<i>Frequency (MHz)</i>	<i>Field Strength (μV/m at 3 m)</i>
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 μ 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 μ V;

CL is the cable loss in dB;

AF is the test antenna factor in dB/m;

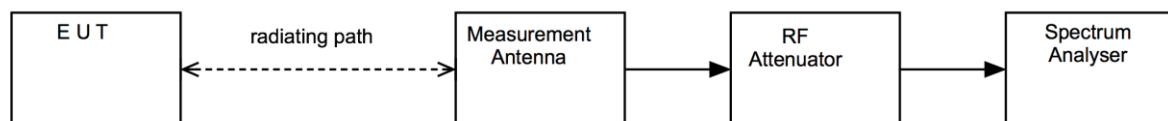
PA is the pre-amplifier gain in dB (where used);

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.

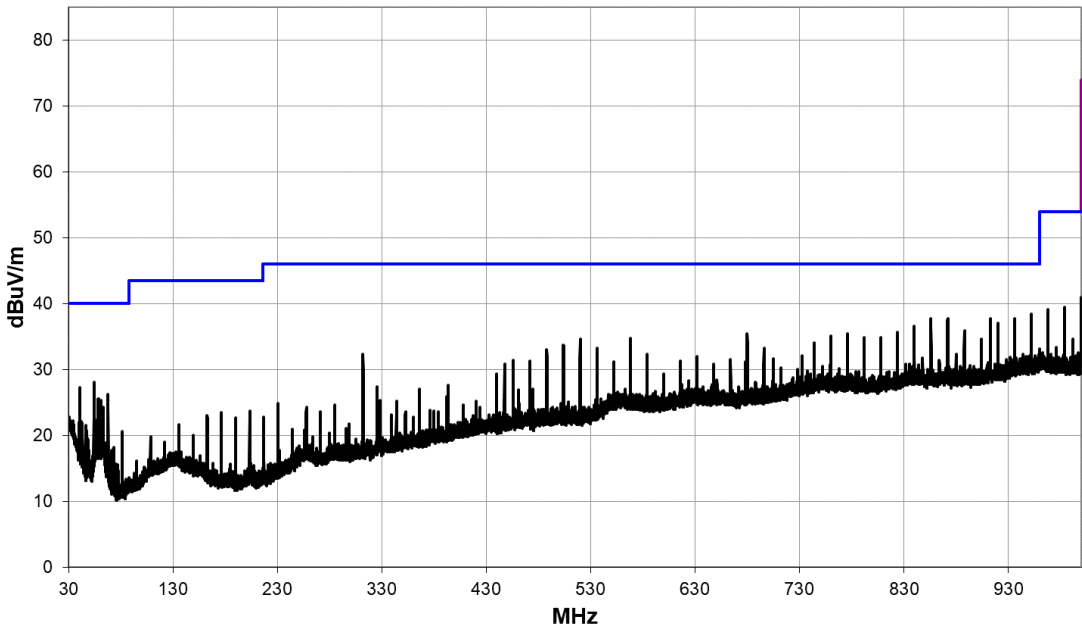
Figure ii Test Setup



12.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
ESR 7	R&S	Spectrum Analyser	U727	2024-05-09
CBL611/B	Chase	Bilog	U573	2024-10-14
6201-69	Watkins Johnson	PreAmp	U372	2024-03-07
ATS	Rainford EMC	Radio Chamber - PP	REF940	2023-11-06
Emissions R5	Element	Radiated Test Software	REF9000	Cal not required

12.6 Test Results



30 MHz-1000 MHz

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Polarity/ Transducer Type	Detector	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
840.019	32.8	4.0	1.12	351.1	Vert	QP	36.8	46.0	-9.2
824.016	33.2	3.6	1.21	328.0	Vert	QP	36.8	46.0	-9.2
952.019	30.5	6.1	1.0	341.0	Vert	QP	36.6	46.0	-9.4
872.018	32.5	4.1	1.0	348.1	Vert	QP	36.6	46.0	-9.4
856.022	32.4	4.1	1.17	328.0	Vert	QP	36.5	46.0	-9.5
808.020	33.2	2.9	1.18	345.0	Vert	QP	36.1	46.0	-9.9

13 AC Power-line Conducted Emissions

13.1 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.

13.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Transient Laboratory (U390)
Test Standard and Clause:	ANSI C63.10-2020, Clause 6.2
EUT Frequency Measured:	13.56 MHz
EUT Channel Bandwidths:	Wideband
EUT Modulation:	ASK
Deviations From Standard:	None
Measurement BW:	9 kHz
Measurement Detectors:	Quasi-Peak and Average, RMS

Environmental Conditions (Normal Environment)

Temperature: 21 °C	+15 °C to +35 °C (as declared)
Humidity: 67 %RH	20 %RH to 75 %RH (as declared)

13.3 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 (dB μ V)	
	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.

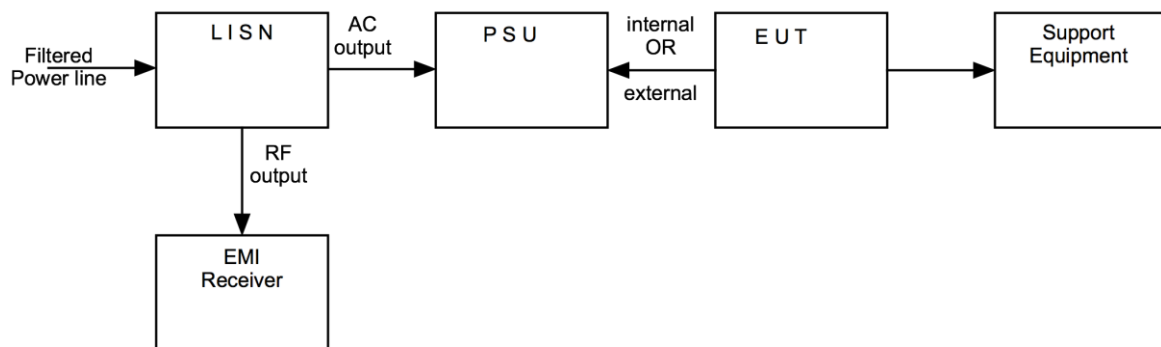
13.4 Test Method

With the EUT setup in a screened room, as per section 9 of this report and connected as per Figure iii, 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 iii Test Setup



13.5 Test Set-up Photograph

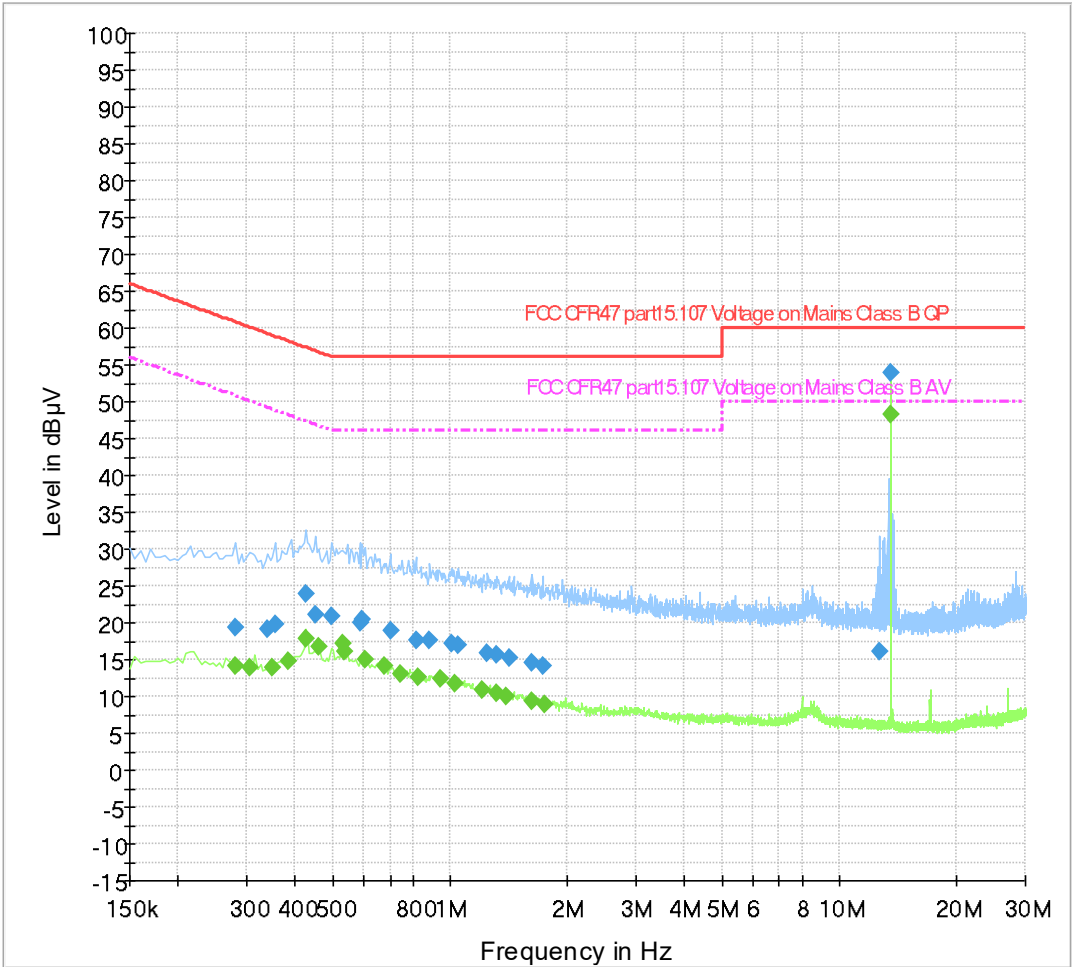


13.6 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
EMI Receiver	R&S	ESR26	U489	2023-09-30
Lisn	R&S	ENV216	U396	2024-05-22
Pulse Limiter	R&S	ESH3-Z2	U559	2024-02-01

13.7 Test Results

CE TransientLab 150kHz - 30MHz (Auto Test) RX FCC



QuasiPeak Results								
Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.280000	19.4	2000.0	9.000	Off	L1	19.8	41.4	60.8
0.340000	19.1	2000.0	9.000	Off	N	19.7	40.1	59.2
0.355000	19.9	2000.0	9.000	Off	L1	19.8	39.0	58.8
0.425000	24.0	2000.0	9.000	Off	L1	19.8	33.4	57.3
0.450000	21.1	2000.0	9.000	Off	N	19.7	35.8	56.9
0.495000	20.9	2000.0	9.000	Off	L1	19.8	35.2	56.1
0.585000	20.0	2000.0	9.000	Off	N	19.7	36.0	56.0
0.595000	20.4	2000.0	9.000	Off	N	19.7	35.6	56.0
0.700000	19.0	2000.0	9.000	Off	N	19.8	37.0	56.0
0.815000	17.7	2000.0	9.000	Off	N	19.8	38.3	56.0
0.885000	17.6	2000.0	9.000	Off	N	19.8	38.4	56.0
1.005000	17.2	2000.0	9.000	Off	L1	19.8	38.8	56.0
1.050000	16.9	2000.0	9.000	Off	L1	19.8	39.1	56.0
1.245000	15.9	2000.0	9.000	Off	L1	19.8	40.1	56.0
1.320000	15.7	2000.0	9.000	Off	N	19.8	40.3	56.0
1.415000	15.3	2000.0	9.000	Off	N	19.8	40.7	56.0
1.615000	14.5	2000.0	9.000	Off	L1	19.8	41.5	56.0
1.730000	14.2	2000.0	9.000	Off	L1	19.8	41.8	56.0
12.715000	16.1	2000.0	9.000	Off	L1	20.5	43.9	60.0
13.560000	54.0	2000.0	9.000	Off	N	20.3	6.0	60.0

Average Results								
Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.280000	14.1	2000.0	9.000	Off	N	19.7	36.7	50.8
0.305000	14.0	2000.0	9.000	Off	L1	19.8	36.2	50.1
0.350000	14.0	2000.0	9.000	Off	N	19.7	34.9	49.0
0.385000	14.9	2000.0	9.000	Off	L1	19.8	33.3	48.2
0.425000	17.9	2000.0	9.000	Off	L1	19.8	29.5	47.3
0.460000	16.8	2000.0	9.000	Off	N	19.7	29.9	46.7
0.530000	17.2	2000.0	9.000	Off	N	19.7	28.8	46.0
0.535000	16.1	2000.0	9.000	Off	L1	19.8	29.9	46.0
0.605000	14.9	2000.0	9.000	Off	N	19.7	31.1	46.0
0.675000	14.2	2000.0	9.000	Off	L1	19.8	31.8	46.0
0.745000	13.1	2000.0	9.000	Off	L1	19.8	32.9	46.0
0.825000	12.6	2000.0	9.000	Off	N	19.8	33.4	46.0
0.945000	12.4	2000.0	9.000	Off	N	19.8	33.6	46.0
1.030000	11.7	2000.0	9.000	Off	N	19.8	34.3	46.0
1.210000	10.8	2000.0	9.000	Off	N	19.8	35.2	46.0
1.320000	10.4	2000.0	9.000	Off	N	19.8	35.6	46.0
1.395000	10.0	2000.0	9.000	Off	N	19.8	36.0	46.0
1.625000	9.3	2000.0	9.000	Off	L1	19.8	36.7	46.0
1.750000	8.9	2000.0	9.000	Off	L1	19.8	37.1	46.0
13.565000	48.2	2000.0	9.000	Off	N	20.3	1.8	50.0

14 Occupied Bandwidth

14.1 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.

14.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Chamber
Test Standard and Clause:	ANSI C63.10-2020, Clause 6.9
EUT Frequency Measured:	13.56 MHz
Deviations From Standard:	None
Measurement BW:	1 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	3 kHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 21 °C	+15 °C to +35 °C (as declared)
Humidity: 46 %RH	20 %RH to 75 %RH (as declared)

14.3 Test Limit

Federal Communications Commission:

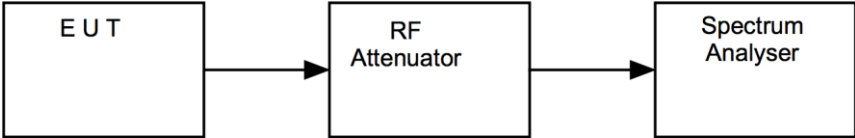
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

14.4 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

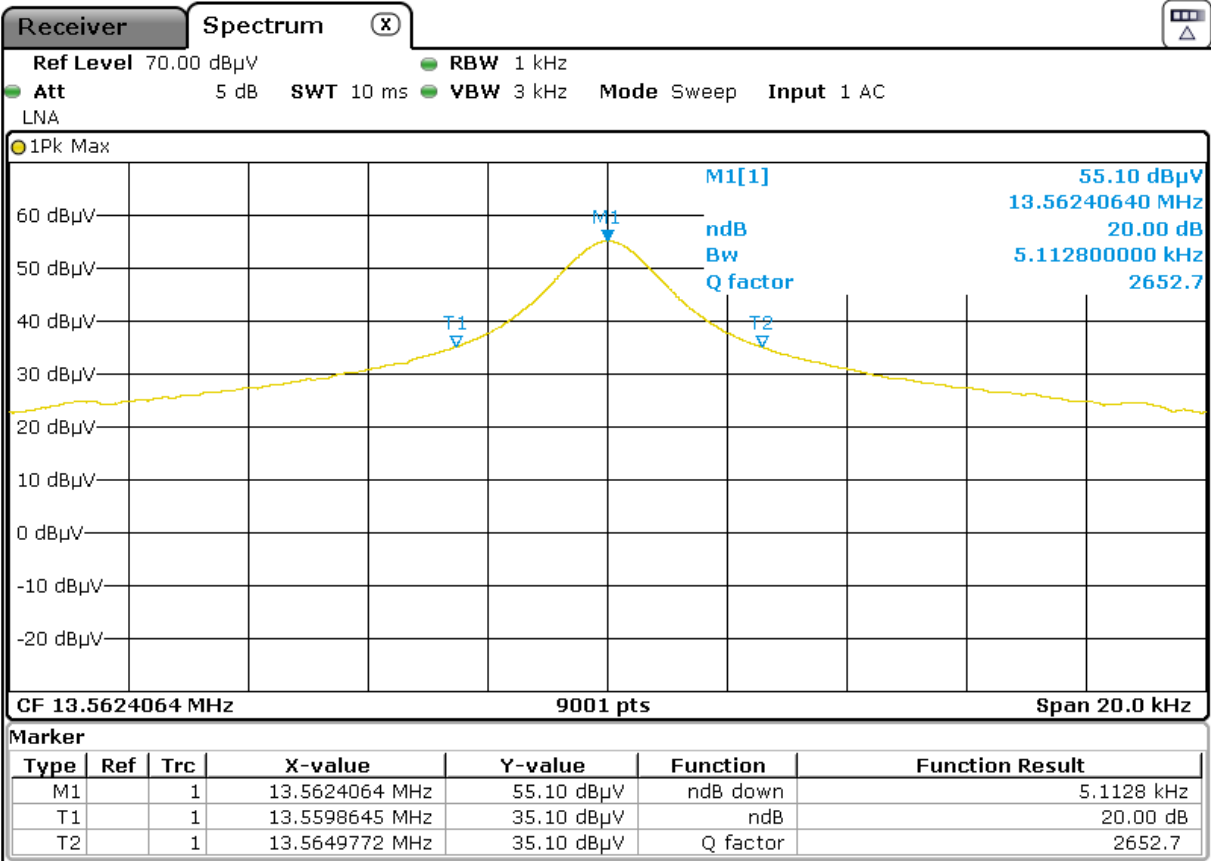


14.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
Spectrum Analyser	R&S	ESR 7	U727	2024-05-09

14.6 Test Results

Channel Frequency (MHz)	FL (MHz)	FH (MHz)	20 dB Bandwidth (kHz)
13.56	13.5598645	13.5649772	5.113



15 Transmitter Output Power (Fundamental Radiated Emission)

15.1 Definition

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

15.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Chamber / OATS
Test Antenna:	Active 60 cm loop
Test Standard and Clause:	ANSI C63.10-2020, Clause 6.3 / 6.4
EUT Frequency Measured:	13.56 MHz
Deviations From Standard:	None
Measurement BW:	9 kHz
Measurement Detector:	Quasi-peak

Environmental Conditions (Normal Environment)

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

15.3 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

15.4 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);

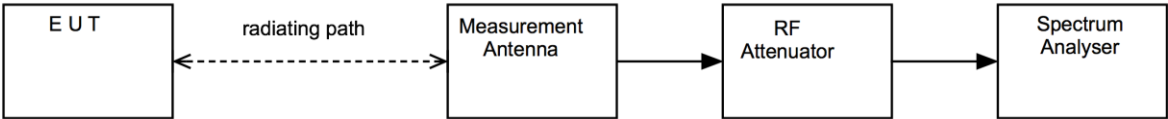
Per FCC 47CFR15.31(f)(2), an extrapolation factor of 40 dB per decade was used for measurements at distances closer than specified.

$$40 \log (\text{wanted distance} \div \text{measured distance})$$

$$40 \log (30 \div 10) \text{ 19.08 distance correction factor}$$

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

Figure v Test Setup

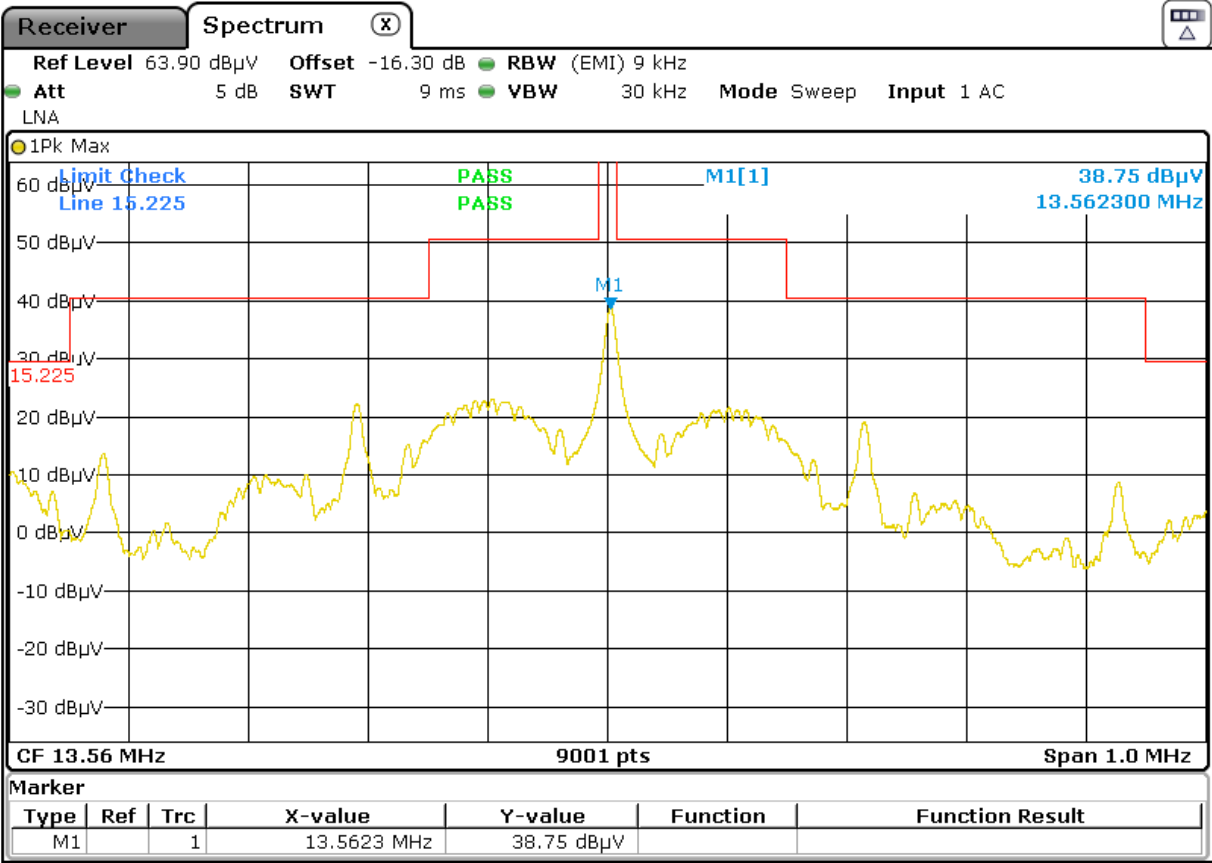


15.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
Spectrum Analyser	R&S	ESR 7	U727	2024-05-09
Loop Antenna	R&S	hfh2	L007	2023-09-09

15.6 Test Results

Channel Frequency (MHz)	Receiver Level (dBμV/m)	Measurement Distance (m)	Limit Distance (m)	Extrapolation Factor (dB)	Field Strength (μV/m)	Result
13.56	57.86	10	30	19.08	86.896	PASS



16 Frequency Stability

16.1 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.

16.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	ANSI C63.10-2020, Clause 6.8
Frequency Measured:	13.56 MHz
Modulation:	Off
Deviations From Standard:	None
Temperature Extreme Environment Test Range:	-20 °C to +50 °C
Voltage Extreme Environment Test Range:	±15 % of Nominal;

Environmental Conditions (Normal Environment)

Temperature: 21 °C	Standard Requirement: +20 °C
Humidity: 64 %RH	20 % RH to 75 % RH (as declared)

16.3 Test Limit

Carrier frequency stability shall be maintained to ±0.01 % (±100 ppm).

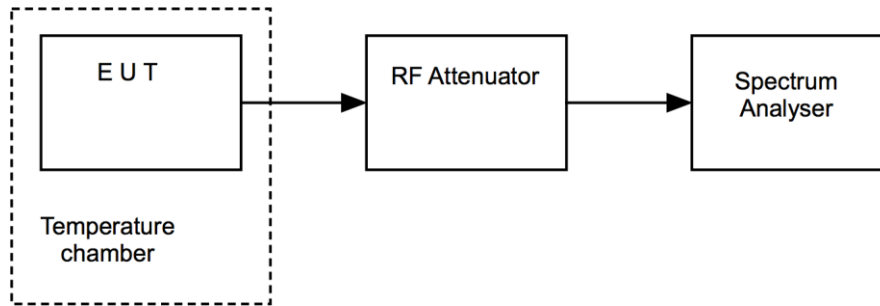
16.4 Test Method

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



16.5 Test Equipment

Equipment		Equipment	Element	Due For
Type	Manufacturer	Description	No	Calibration
FSU50	R&S	Spectrum Analyser	U544	2023-11-18
ETS	ETS-S1000CHS	Temperature Chamber	U522	Use U720
2000T	Digitron	Temperature Indicator	U720	2024-06-01
IPS 303A	ISO-Tech	Power Supply	U748	Use REF976
34405a	Agilent	Multimeter	REF976	2024-01-24

16.6 Test Results

Test Environment		Measured Frequency (MHz)	Frequency error (kHz)	Frequency error (%)	Result
-20 °C	V _{nominal}	13.56231795	-0.182	-0.00134	PASS
-10 °C	V _{nominal}	13.56240385	-0.096	-0.00071	PASS
0 °C	V _{nominal}	13.56243590	-0.064	-0.00047	PASS
+10 °C	V _{nominal}	13.56256410	0.064	0.00047	PASS
+20 °C	V _{minimum}	13.56246795	-0.032	-0.00024	PASS
	V _{nominal}	13.56250000	N/A	N/A	N/A
	V _{maximum}	13.56246795	-0.032	-0.00024	PASS
+30 °C	V _{nominal}	13.56262821	0.128	0.00095	PASS
+40 °C	V _{nominal}	13.56262821	0.128	0.00095	PASS
+50 °C	V _{nominal}	13.56264423	0.144	0.00106	PASS

17 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

Test/Measurement	Budget Number	MU
Conducted RF Power, Power Spectral Density, Adjacent Channel Power and Spurious emissions		
Absolute RF power (via antenna connector) Dare RPR3006W Power Head	MU4001	0.9 dB
Carrier Power and PSD - Spectrum Analysers	MU4004	0.9 dB
Adjacent Channel Power	MU4002	1.9 dB
Transmitter conducted spurious emissions	MU4041	0.9 dB
Conducted power and spurious emissions 40 GHz to 50 GHz	MU4042	2.4 dB
Conducted power and spurious emissions 50 GHz to 75 GHz	MU4043	2.5 dB
Conducted power and spurious emissions 75 GHz to 110 GHz	MU4044	2.4 dB
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
Spurious Emissions Electric and Magnetic Field		
Radiated Spurious Emissions 30 MHz to 1 GHz	MU4037	4.7 dB
Radiated Spurious Emissions 1-18 GHz	MU4032	4.5 dB
E Field Emissions 18GHz to 26 GHz	MU4024	3.2 dB
E Field Emissions 26GHz to 40 GHz	MU4025	3.3 dB
E Field Emissions 40GHz to 50 GHz	MU4026	3.5 dB
E Field Emissions 50GHz to 75 GHz	MU4027	3.6 dB
E Field Emissions 75GHz to 110 GHz	MU4028	3.6 dB
Radiated Magnetic Field Emissions	MU4031	2.3 dB
Frequency Measurements		
Frequency Deviation	MU4022	0.316 kHz
Frequency error using CMTA test set	MU4023	113.441 Hz
Frequency error using GPS locked frequency source	MU4045	0.0413 ppm
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	679 μ s
DFS Generator - Frequency Error	MU4007	92 Hz
DFS Threshold Conducted	MU4008	1.3 dB
DFS Threshold Radiated	MU4009	3.2 dB

Test/Measurement	Budget Number	MU
Receiver Parameters		
EN300328 Receiver Blocking	MU4010	1.1 dB
EN301893 Receiver Blocking	MU4011	1.1 dB
EN303340 Adjacent Channel Selectivity	MU4012	1.1 dB
EN303340 Overloading	MU4013	1.1 dB
EN303340 Receiver Blocking	MU4014	1.1 dB
EN303340 Receiver Sensitivity	MU4015	0.9 dB
EN303372-1 Image Rejection	MU4016	1.4 dB
EN303372-1 Receiver Blocking	MU4017	1.1 dB
EN303372-2 Adjacent Channel Selectivity	MU4018	1.1 dB
EN303372-2 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

18 RF Exposure

General SAR test reduction & exclusion guidance

KDB 447498

Section 4.3 General SAR test reduction and exclusion guidance

For Standalone SAR exclusion consideration, when SAR Exclusion Threshold requirement in KDB 447498 is satisfied, standalone SAR evaluation for general population exposure conditions by measurement or numerical simulation is not required.

The SAR Test Exclusion Threshold for frequencies below 100 MHz, and for test separation distance of ≤ 50 mm, is determined as follows.

$$\text{SAR Exclusion Threshold (SARET)} = [(NT \times TSD_A) / \sqrt{0.1}] \times [1 + \text{Log} (100 / f_{\text{MHz}})] \times 1/2$$

Where,

NT = Numeric Threshold (3.0 for 1-g SAR and 7.5 for 10-g SAR)

$TSD_A = 50$ mm

f_{MHz} = Transmit frequency in MHz

Channel Frequency (MHz)	EIRP (mW)	SAR Exclusion Threshold at 5 mm (mW)	SAR Evaluation
13.56	0.00203	443	Excluded

Therefore standalone SAR evaluation for general population exposure conditions by measurement or numerical simulation is not required.