

FCC and ISED Test Report

Sepura Limited

TETRA mobile radio, Model: SCG2221 Standard

In accordance with FCC 47 CFR Part 15B, ICES-003 and
ISED RSS-GEN

Prepared for: Sepura Limited
9000 Cambridge Research Park
Beach Drive, Waterbeach
Cambridge, CB25 9TL
United Kingdom

FCC ID: XX6SCG2221M

IC: 8739A-SCG2221M



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Document 75957883-02 Issue 01

SIGNATURE

A handwritten signature of John Laydon.

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
John Laydon	General Manager	Authorised Signatory	14 August 2023

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD document control rules.

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 15B, ICES-003 and ISED RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Ravi Kishore Darshanam	14 August 2023	A handwritten signature of Ravi Kishore Darshanam.
FCC Accreditation 330364 Bearley Test Laboratory		ISED Accreditation 2932E Bearley Test Laboratory	

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15B: 2021, ICES-003 Issue 7: 2020 and ISEDC RSS-GEN: Issue 5 + A2 (2021-02) for the tests detailed in section 1.3.



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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	14 August 2023

Table 1

1.2 Introduction

Applicant	Sepura Limited
Manufacturer	Sepura Limited
Model Number(s)	SCG2221 Standard
Serial Number(s)	1PR002250GPB2N7
Hardware Version(s)	7
Software Version(s)	1807 004 10138
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15B:2021 ICES-003 Issue 7: 2020 ISED RSS-GEN: Issue 5 + A2 (2021-02)
Order Number	PLC-PO025039-1
Date	20-February-2023
Date of Receipt of EUT	24-March-2023
Start of Test	23-March-2023
Finish of Test	23-March-2023
Name of Engineer(s)	Ravi Kishore Darshanam
Related Document(s)	ANSI C63.4: 2014



1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15B, ICES-003 and ISED RSS is shown below.

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	FCC	ICES	ISEDC			
Configuration and Mode: Standard Unit - Configuration 1						
2.1	15.109	3.2	7.1	Radiated Disturbance	Pass	ANSI C63.4: 2014

Table 2



1.4 Declaration of Build Status

Equipment Description

Technical Description: <i>(Please provide a brief description of the intended use of the equipment including the technologies the product supports)</i>	The SCG2221 is a TETRA mobile radio in the SCG22 series of radios, operating in the VHF band, with TETRA operating frequencies 136-174 MHz. The SCG2221 supports GNSS, Bluetooth, Bluetooth LE, WLAN at 2.4 GHz and a range of accessories and ancillary equipment. The SCG2221 may be installed in a vehicle or in a desk mount unit.		
Manufacturer:	Sepura Limited		
Model:	SCG2221 Standard		
Part Number:	1-8A*60-0****		
Hardware Version:	7		
Software Version:	1807 004 10138		
FCC ID of the product under test – see guidance here	XX6SCG2221M		
IC ID of the product under test – see guidance here	8739A-SCG2221M		
Device Category	Mobile <input checked="" type="checkbox"/>	Portable <input type="checkbox"/>	Fixed <input type="checkbox"/>
Equipment is fitted with an Audio Low Pass Filter	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	

Intentional Radiators

Technology	TETRA	Bluetooth	WLAN 802.11b	WLAN 802.11g	WLAN 802.11n	BLE
Frequency Range (MHz to MHz)	136-174	2402-2480	2412-2462	2412-2462	2412-2462	2402-2480
Conducted Declared Output Power (dBm)	40	8	17	17	17	7.5
Antenna Gain (dBi)	No antenna supplied.	No antenna supplied.	No antenna supplied.	No antenna supplied.	No antenna supplied.	No antenna supplied.
Supported Bandwidth(s) (MHz) (e.g. 1 MHz, 20 MHz, 40 MHz)	0.025	1	20	20	20	2
Modulation Scheme(s) (e.g. GFSK, QPSK etc)	$\pi/4$ DQPSK	GFSK / $\pi/4$ -DPSK / 8-DPSK	CCK / DBPSK / DQPSK	OFDM (BPSK / QPSK / 16-QAM / 64-QAM)	BPSK / QPSK / 16-QAM / 64-QAM)	GFSK
ITU Emission Designator (see guidance here) (not mandatory for Part 15 devices)	20K0DXW	1M01F1D 1M01G1D	19M7G1D	19M7G1D	19M7D1D	1M81F1D
Bottom Frequency (MHz)	136	2402	2412	2412	2412	2402
Middle Frequency (MHz)	155	2441	2437	2437	2437	2441
Top Frequency (MHz)	174	2480	2462	2462	2462	2480



Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	2480 MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	32.768 kHz
Class A Digital Device (Use in commercial, industrial or business environment) <input checked="" type="checkbox"/>	
Class B Digital Device (Use in residential environment only) <input type="checkbox"/>	

AC Power Source

AC supply frequency:		Hz
Voltage		V
Max current:		A
Single Phase <input type="checkbox"/>	Three Phase <input checked="" type="checkbox"/>	

DC Power Source

Nominal voltage:	13.6	V
Extreme upper voltage:	15.6	V
Extreme lower voltage:	10.8	V
Max current:	4	A

Battery Power Source

Voltage:		V
End-point voltage:		V (Point at which the battery will terminate)
Alkaline <input type="checkbox"/> Leclanche <input type="checkbox"/> Lithium <input type="checkbox"/> Nickel Cadmium <input type="checkbox"/> Lead Acid* <input type="checkbox"/> *(Vehicle regulated)		
Other <input type="checkbox"/>	Please detail:	

Charging

Can the EUT transmit whilst being charged	Unit does not charge	Yes <input type="checkbox"/>	No <input type="checkbox"/>
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Temperature

Minimum temperature:	-20	°C
Maximum temperature:	55	°C

Cable Loss

Adapter Cable Loss (Conducted sample)	N/A	dB
--	-----	----



Antenna Characteristics

Antenna connector <input checked="" type="checkbox"/>		State impedance	50	Ohm
Temporary antenna connector <input type="checkbox"/>		State impedance		Ohm
Integral antenna <input type="checkbox"/>	Type:	Gain		dBi
External antenna <input type="checkbox"/>	Type:	Gain		dBi
For external antenna only: Standard Antenna Jack <input type="checkbox"/> If yes, describe how user is prohibited from changing antenna (if not professional installed): Equipment is only ever professionally installed <input checked="" type="checkbox"/> Non-standard Antenna Jack <input type="checkbox"/> All part 15 applications will need to show how the antenna gain was derived either from a manufacturer data sheet or a measurement. Where the gain of the antenna is inherently accounted for as a result of the measurement, such as field strength measurements on a part 15.249 or 15.231 device, so the gain does not necessarily need to be verified. However, enough information regarding the construction of the antenna shall be provided. Such information maybe photographs, length of wire antenna etc.				
Antenna Gains are from https://uk.rs-online.com/web/p/wifi-antennas/7985368 and https://www.panorama-antennas.com/site/Mobile-Radio/PMR-Antennas/AFQNT-VAR				

Ancillaries (if applicable)

Manufacturer:	Panorama Antennas	Part Number:	AFQNT-H5
Model:	TETRA antenna	Country of Origin:	UK
Manufacturer:	Microchip	Part Number:	RN-SMA-4
Model:	WLAN Antenna	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-00063
Model:	GNSS Antenna	Country of Origin:	UK
Manufacturer:	Sepura	Part Number:	300-02012 rev001
Model:	Extended SCG Loudspeaker / IO USB Host lead	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-02010
Model:	SCG Power/ignition Lead	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-00069
Model:	Mobile Remote Cable 5.0M	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-00670
Model:	HBC Interface and Hands-free Box	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-00079
Model:	Remote Microphone And Switch Set	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-00292
Model:	Remote Microphone	Country of Origin:	Unknown



	(Handsfree Kit) 3m		
Manufacturer:	Sepura	Part Number:	300-01801
Model:	Handset Based Console (HBC3)	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-00062
Model:	Fist microphone	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-01808
Model:	SCC3 (colour console)	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-01961
Model:	CC VAC RSM (Long Cable)	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-00719
Model:	Loudspeaker	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-02009
Model:	USB Data/Programming Lead	Country of Origin:	UK
Manufacturer:	Sepura	Part Number:	300-02012
Model:	SCG Loudspeaker / IO USB Host lead	Country of Origin:	UK
Manufacturer:	Sepura	Part Number:	300-00784
Model:	AMPS attachments	Country of Origin:	UK
Manufacturer:	Sepura	Part Number:	300-00068
Model:	Mobile Remote Cable 3.0M	Country of Origin:	UK

I hereby declare that the information supplied is correct and complete.

Name: Chris Beecham
Position held: Conformance Engineer
Date: 21 March 2023

1.5 Product Information

1.5.1 Technical Description

The Equipment under test (EUT) was a Sepura Limited Tetra radio, Model: SCG2221 Standard Unit.

It is a TETRA mobile radio in the SCG22 series of radios operating in the VHF band with TETRA operating frequencies of 136 to 174 MHz.

The EUT supports GNSS, Bluetooth, Bluetooth LE, WLAN at 2.4 GHz and a range of accessories and ancillary equipment.

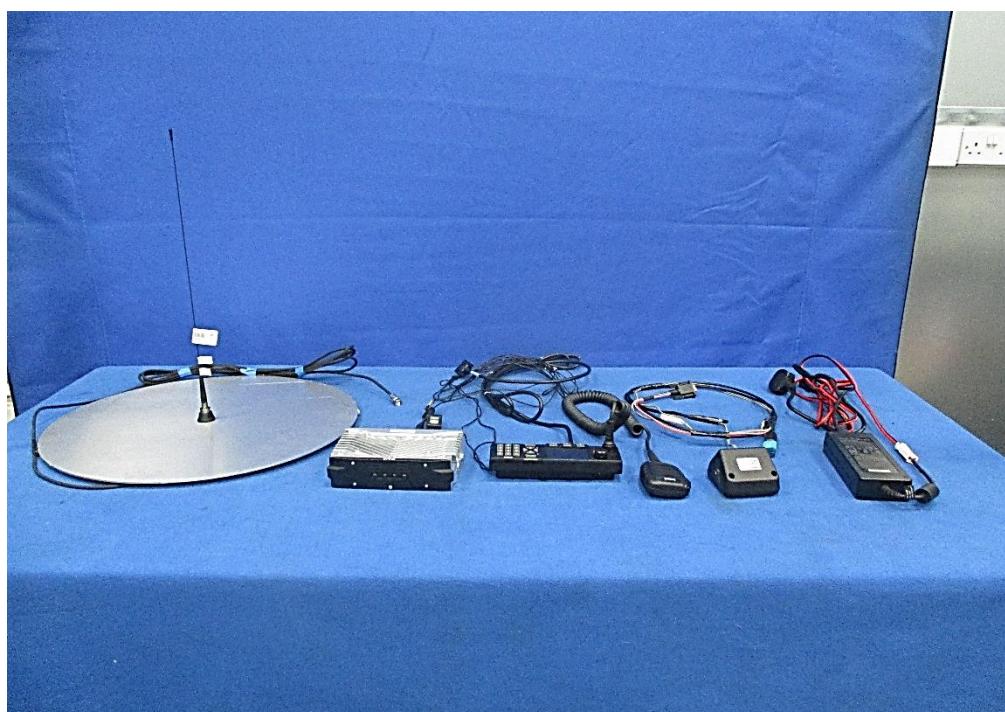


Figure 1 – EUT Overall unit



Figure 2 – Standard Unit Top, Front & LHS View



Figure 3 - Standard Unit Rear, Base & RHS View



Figure 4 – EUT Label

1.5.2 EUT Port/Cable Identification

Port	Max Cable Length specified	Usage	Type	Screened
Tetra Antenna Port	5m	Connection to Tetra Antenna	Data	Coax
AC Power Adapter	2 m	DC Power to EUT	Data	No
Speaker	5 m	Connect to Speaker	Data	No
USB cable	5 m	Connect to USB	Data	No
SCC3 / HBC3 Port	3 m	Connection to SCC3 / HBC3 Port	Data	No
microphone	3m	Connected to SCC3	Data	No
Remote	3m	Connected to SCC3	Data	No

Table 3

1.5.3 Test Configuration

Configuration	Description
Standard Unit	The EUT is powered 13.6V DC through AC adapter The EUT was populated with one SCC3 unit each with a Vehicle RSM connected. Also, a Hands-Free Kit was connected to the SCC3 unit. Loudspeakers of type 300-00719 were connected.

Table 4



1.5.4 Modes of Operation

Mode	Description
Configuration 1	All transmitters were configured to idle. GPS was set to receive. Bi-directional traffic was established.

Table 5

1.6 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.7 EUT Modification Record

The table below details modifications made to the EUT during the test programme.

The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
Model: SCG2221 Standard Unit, Serial Number: 1PR002250GPB2N7			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 6

1.8 Test Location

TÜV SÜD conducted the following tests at our Bearley Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: Standard Unit - Configuration 1		
Radiated Disturbance	Ravi Kishore Darshanam	UKAS

Table 7

Office Address:

Snitterfield Road
Bearley
Warwickshire
CV37 0EX
United Kingdom



2 Test Details

2.1 Radiated Disturbance

2.1.1 Specification Reference

FCC 47 CFR Part 15B Clause 15.107
ICES-003, Clause 3.1
ISED RSS-GEN Clause 7.1

2.1.2 Equipment Under Test and Modification State

SCG2221 Standard, S/N: 1PR002250GPB2N7 - Modification State 0

2.1.3 Date of Test

23-March-2023

2.1.4 Test Method

The EUT was set up on a non-conductive table 0.8 m above a reference ground plane within a semi-anechoic chamber on a remotely controlled turntable.

A pre-scan of the EUT emissions profile using a peak detector was made at a 3 m antenna distance whilst varying the antenna-to-EUT azimuth and polarisation.

For an EUT which could reasonably be used in multiple planes, pre-scans were performed with the EUT orientated in Fixed planes with reference to the ground plane.

Using a list of the highest emissions detected during the pre-scan along with their bearing and associated antenna polarisation, the EUT was then formally measured using a Quasi-Peak, Peak or CISPR Average detector as appropriate.

The readings were maximised by adjusting the antenna height, polarisation and turntable azimuth, in accordance with the specification.

2.1.5 Example Calculation

Below 1 GHz:

Quasi-Peak level (dB μ V/m) = Receiver level (dB μ V) + Correction Factor (dB/m)
Margin (dB) = Quasi-Peak level (dB μ V/m) - Limit (dB μ V/m)

Above 1 GHz:

CISPR Average level (dB μ V/m) = Receiver level (dB μ V) + Correction Factor (dB/m)
Margin (dB) = CISPR Average level (dB μ V/m) - Limit (dB μ V/m)

Peak level (dB μ V/m) = Receiver level (dB μ V) + Correction Factor (dB/m)
Margin (dB) = Peak level (dB μ V/m) - Limit (dB μ V/m)

2.1.6 Example Test Setup Diagram

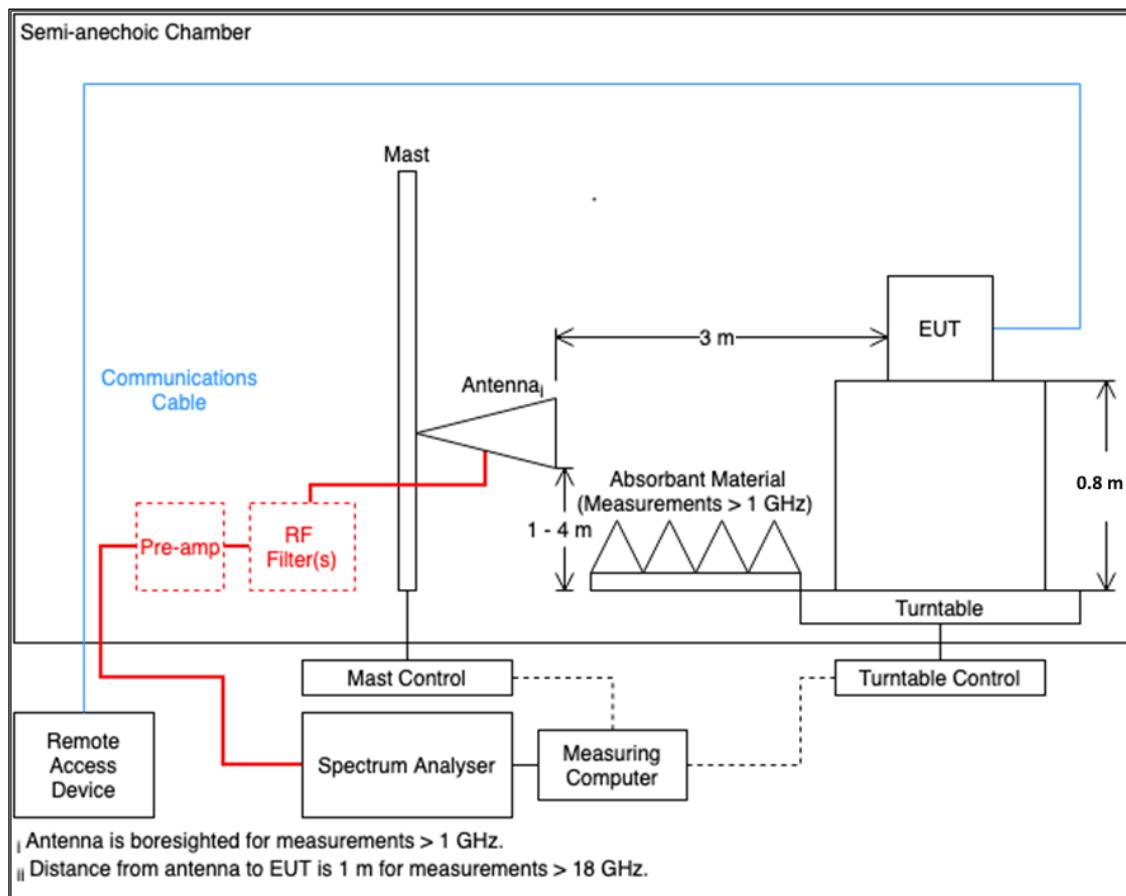


Figure 5 - Radiated Disturbance Example Test Setup

2.1.7 Environmental Conditions

Ambient Temperature 19.8 °C
Relative Humidity 47.3 %
Atmospheric Pressure 1006.0 mbar

2.1.8 Specification Limits

Required Specification Limits, Field Strength - Class B Test Limit at a 3 m Measurement Distance		
Frequency Range (MHz)	Test Limit (µV/m)	Test Limit (dBµV/m)
30 to 88	100	40.0
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

Supplementary information:

Note 1. A Quasi-peak detector is to be used for measurements below 1 GHz.
Note 2. A CISPR Average detector is to be used for measurements above 1 GHz.
Note 3. The Peak test limit above 1 GHz is 20 dB higher than the CISPR Average test limit.

Table 8

2.1.9 Test Results

Results for Configuration and Mode: Basic Unit - Configuration 1.

This test was performed to the requirements of the Class B limits.

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

Highest frequency generated or used within the EUT: 2480MHz
Which necessitates an upper frequency test limit of: 13 GHz

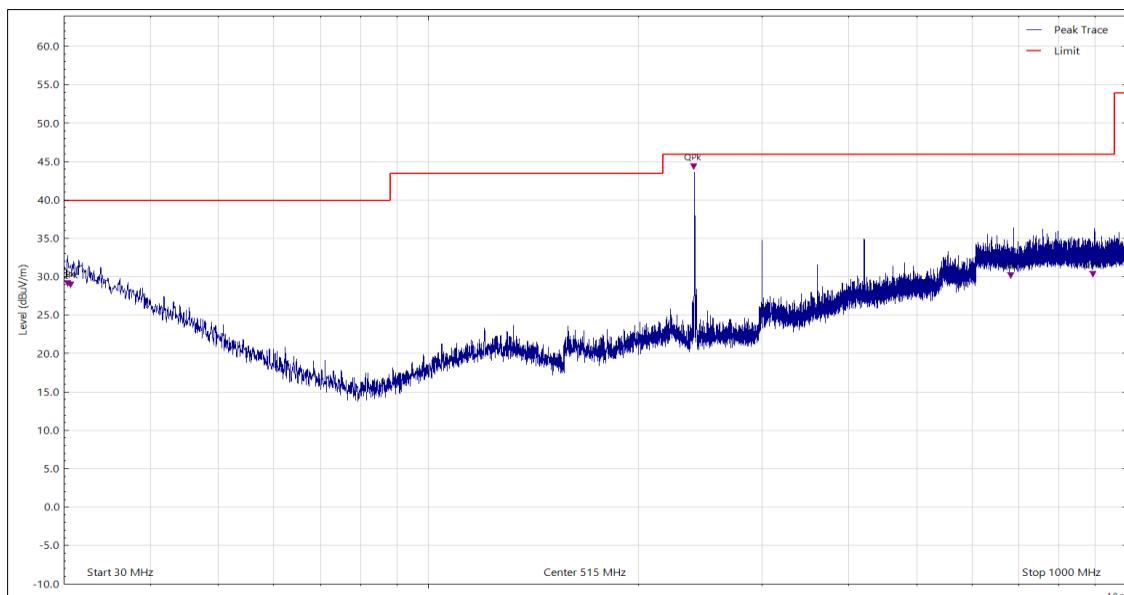


Figure 6 - 30 MHz to 1 GHz, Quasi-Peak, Horizontal

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
30.391	28.53	40.00	-11.47	Q-Peak	356	211	Horizontal
30.678	28.36	40.00	-11.64	Q-Peak	194	100	Horizontal
240.006	43.80	46.00	-2.20	Q-Peak	43	100	Horizontal
682.574	29.59	46.00	-16.41	Q-Peak	165	100	Horizontal
895.059	29.74	46.00	-16.26	Q-Peak	286	344	Horizontal

Table 9

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

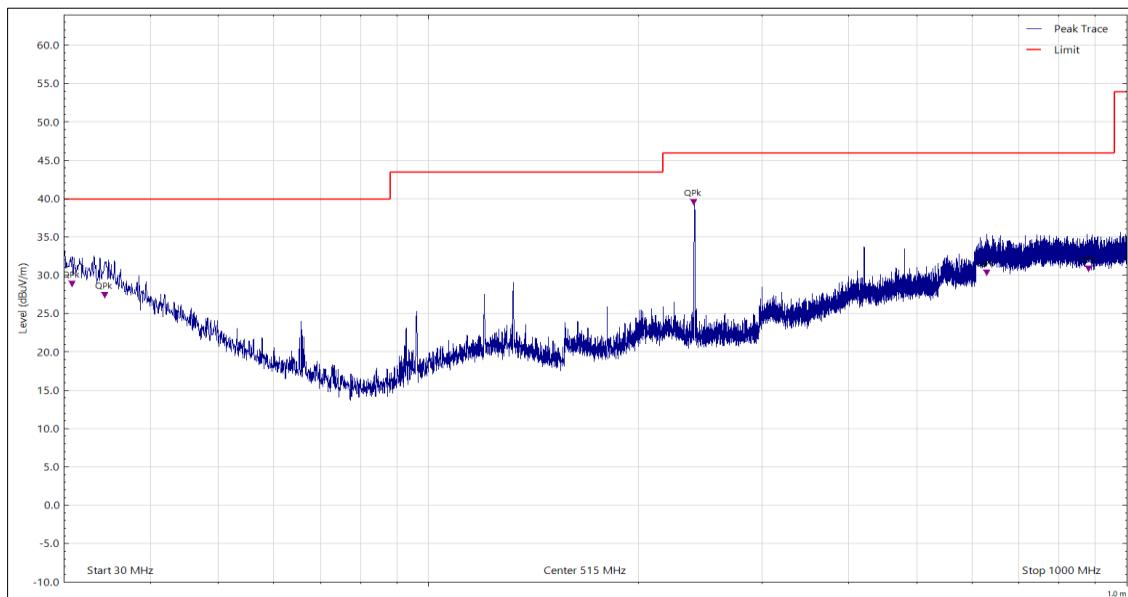


Figure 7 - 30 MHz to 1 GHz, Quasi-Peak, Vertical

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
30.856	28.28	40.00	-11.72	Q-Peak	10	340	Vertical
34.340	26.79	40.00	-13.21	Q-Peak	351	348	Vertical
239.970	38.91	46.00	-7.09	Q-Peak	360	100	Vertical
630.747	29.73	46.00	-16.27	Q-Peak	60	100	Vertical
882.088	30.25	46.00	-15.75	Q-Peak	10	156	Vertical

Table 10

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

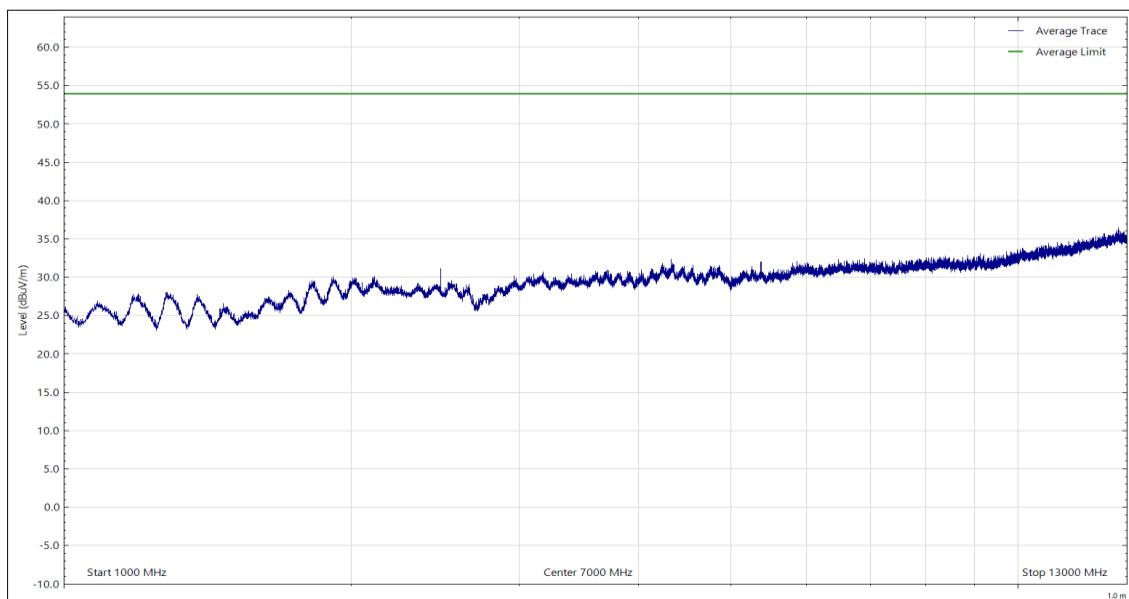


Figure 8 - 1 GHz to 13 GHz, CISPR Average, Horizontal

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
*							

Table 11

*No final measurements were made as all peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

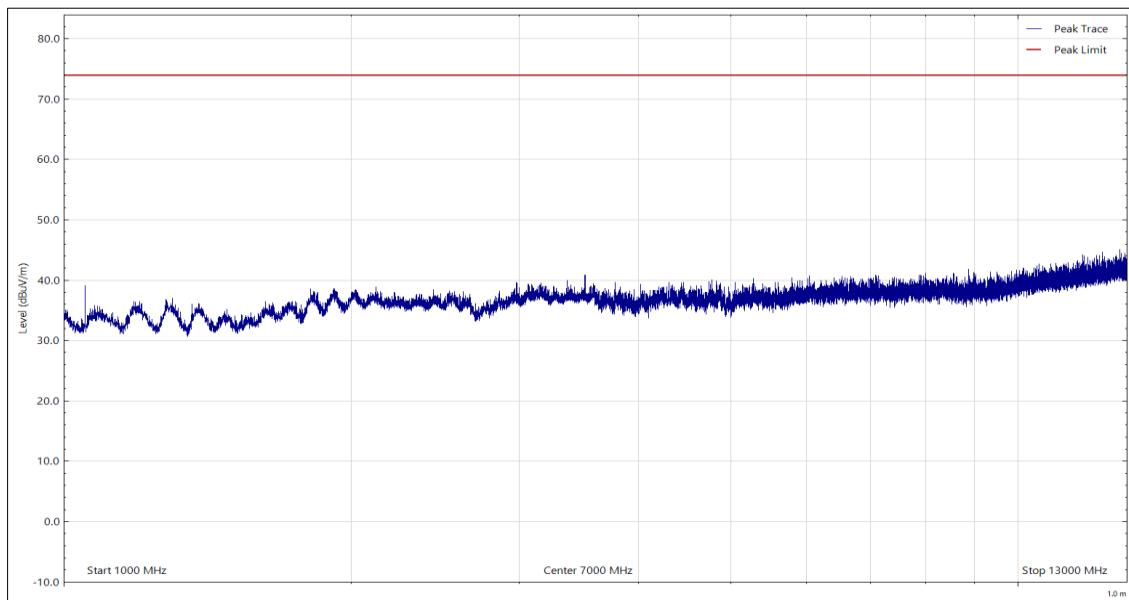


Figure 9 - 1 GHz to 13 GHz, Peak, Horizontal

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
*							

Table 12

No other final measurements were made as all other peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

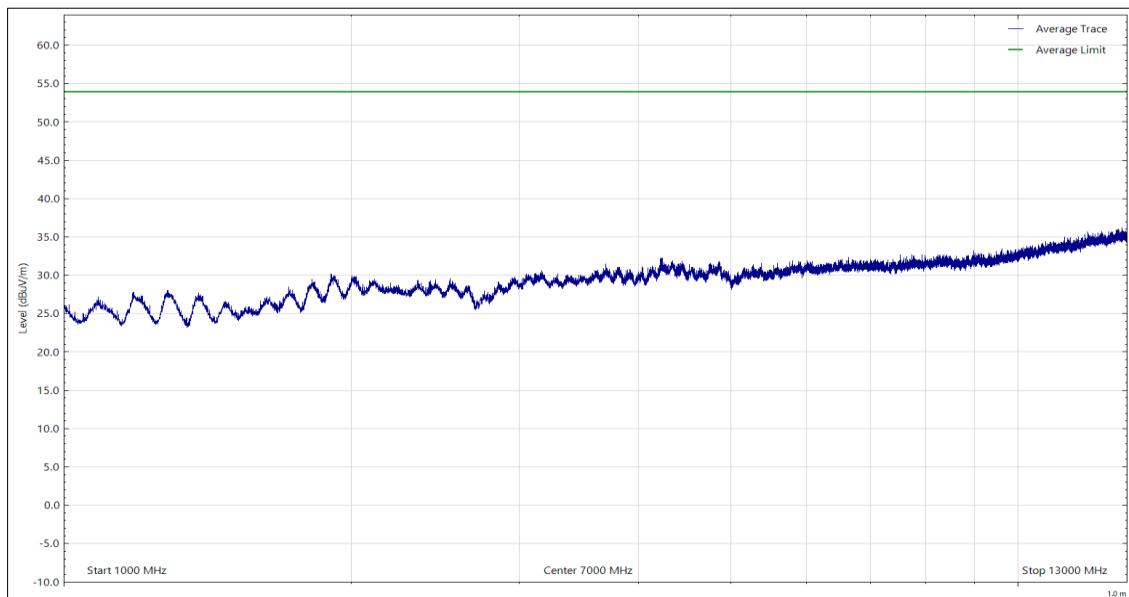


Figure 10 - 1 GHz to 13 GHz, CISPR Average, Vertical

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
*							

Table 13

No other final measurements were made as all other peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.

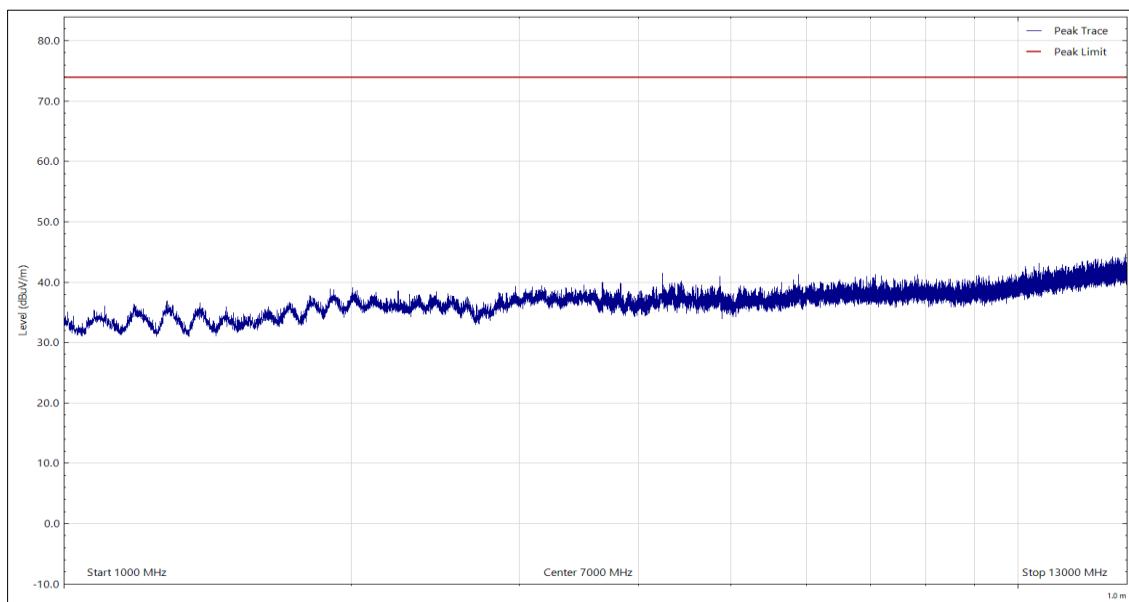


Figure 11 - 1 GHz to 13 GHz, Peak, Vertical

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
*							

Table 14

No other final measurements were made as all other peak emissions seen above the measurement system noise floor during the pre-scan were greater than 10 dB below the test limit.



Figure 12 - Test Setup - 30 MHz to 1 GHz



Figure 13 - Test Setup - 1 GHz to 13 GHz



2.1.10 Test Location and Test Equipment Used

This test was carried out in Bearley EMC Chamber 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Antenna (Bilog, 30 MHz to 3 GHz)	Schaffner	CBL6143	1858	24	30-Apr-2023
Screened Room (1)	Rainford	Hybrid	4160	36	11-Jan-2025
Cable (N-Type to N-Type, 7 m)	Teledyne Storm	SA90-195-7MTR	4173	12	13-Apr-2023
Mast controller	Innco Systems	Controller CO3000	4728	-	TU
Antenna (Double Ridge Guide, 1 GHz to 18 GHz)	ETS-Lindgren	3117	4737	24	11-Mar-2024
Test Receiver	Keysight Technologies	N9038A MXE	4974	12	30-Jan-2024
Emissions Software	TÜV SUD	EmX V3.1.10	5125	-	Software
Cable (N-Type to N-Type, 3 m)	Rosenberger	LU7-036-3000	5163	12	18-Dec-2023
Cable (18GHz SMA 1m)	Rosenberger	LU7-071-1000	5165	12	18-Dec-2023
Turntable Controller	Maturo	Maturo NCD	5275	-	TU
Broadband Pre-Amplifier (0.5 - 18 GHz)	Schwarzbeck	BBV 9718 D	5882	12	01-Mar-2024

Table 15

TU - Traceability Unscheduled



3 Test Equipment Information

3.1 General Test Equipment Used

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Hygrometer	Rotronic	I-1000	2830	12	13-Oct-2023

Table 16



4 Incident Reports

No incidents reports were raised.

5 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Test Name	Measurement Uncertainty
Radiated Disturbance	30 MHz to 1 GHz, Bilog Antenna, ± 5.2 dB 1 GHz to 40 GHz, Horn Antenna, ± 6.3 dB

Table 17

Worst case error for both Time and Frequency measurement 12 parts in 10^6 .

Measurement Uncertainty Decision Rule

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115:2021, Clause 4.4.3 (Procedure 2). The measurement results are directly compared with the test limit to determine conformance with the requirements of the standard.

Risk: The uncertainty of measurement about the measured result is negligible with regard to the final pass/fail decision. The measurement result can be directly compared with the test limit to determine conformance with the requirement (compare IEC Guide 115). The level of risk to falsely accept and falsely reject items is further described in ILAC-G8.