Exposure Test Report

Sepura Limited
TETRA mobile radio, Model: SCG2221

In accordance with FCC CFR 47 Part 1.1310

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

FCC ID: XX6SCG2221M

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Matthew Russell	Chief Engineer (RF)	Authorised Signatory	25 April 2023

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

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY
A sample of this product was tested and found to be compliant with FCC CFR 47 Part 1.1310: 2021 at a minimum distance of 40 cm with time averaging of 6 minutes. If alternative antennas are used with greater gains, the exposure must be retested.

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Contents

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	08-March-2023
2	Add Manufacturers declared variants	25-April-2023

Table 1 – Report Status

1.2 Introduction

Applicant	Sepura Limited
Manufacturer	Sepura Limited
Model Number(s)	SCG2221
Serial Number(s)	1PR002230GP58OM
Hardware Version(s)	B Model
Software Version(s)	1807 007 10138
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 1, Clause 1.1310: 2021 Radiofrequency radiation exposure limits
Order Number	PLC-PO024881-1
Date	31-January-2023
Date of Receipt of EUT	07-November-2022
Start of Test	06-February-2023
Finish of Test	09-February-2023
Name of Engineer(s)	Ravish Foolchund
Related Document(s)	FCC 47 CFR Part 1, Clause 1.1307(b): 2021 Requirements (human exposure to RF) OET65:97 Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields. IEEE C95.1:2005 IEEE Standard for Safety Levels with Respect to Human Exposure to radio Frequency Electromagnetic Fields, 3 kHz to 300 kHz. IEEE C95.3:2002 IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields with Respect to Human Exposure to Such Fields, 100 kHz–300 GHz.

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 1.1310 is shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: TETRA operating frequency 136 -174MHz, supports Bluetooth and 2.4GHz WLAN, simultaneous transmission either TETRA + WLAN or TETRA + BT				
2.1	1.1310 Table 1	Measurement of Electric and Magnetic field exposure	Pass	OET Bulletin 65

Table 2 – Test Summary

1.4 Manufacturer's Declared Variants

The following information was provided by the manufacturer:

General Information
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 and optionally Bluetooth, Bluetooth LE, WLAN at 2.4 GHz and a range of accessories and ancillary equipment.

SCG2221 Basic
The SCG2221 Basic 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 Basic also supports GNSS. It has a single console interface and a USB/IO/Loudspeaker interface.
The SCG2221 Basic has the following identification for North America:
FCC ID: XX6SCG2221X
IC ID: 8739A-SCG2221X

SCG2221 Standard
The SCG2221 Standard 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 Standard also supports GNSS and has a 2.4 GHz Bluetooth/Bluetooth-LE/WLAN interface. It has a single console interface and a USB/IO/Loudspeaker interface.
The SCG2221 Standard has the following identification for North America:
FCC ID: XX6SCG2221M
IC ID: 8739A-SCG2221M

SCG2221 Premium
The SCG2221 Premium 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 Premium also supports GNSS and has a 2.4 GHz Bluetooth/Bluetooth-LE/WLAN interface. It has front and rear console interfaces, a USB/IO/Loudspeaker interface, a Loudspeaker/Multi-IO interface and a PoE interface.
The SCG2221 Premium has the following identification for North America:
FCC ID: XX6SCG2221M
IC ID: 8739A-SCG2221ME

1.5 Product Information

1.5.1 Technical Description

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.

1.5.2 Device Under Test

Figure 1 – Front View

Figure 2 – Rear View

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
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3 – EUT Modification Record

1.8 Test Location

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

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: TETRA operating frequency 136 -174MHz, supports Bluetooth and 2.4GHz WLAN, simultaneous transmission either TETRA + WLAN or TETRA + BT		
Measurement of Electric and Magnetic Field Exposure	Ravish Foolchund	UKAS

Table 4 – Test Location

Office Address:

Octagon House
Concorde Way
Segensworth North
Fareham
Hampshire
PO15 5RL
United Kingdom

2 Test Details

2.1 Measurement of Electric and Magnetic Fields

2.1.1 Specification Reference

FCC CFR 47 Part 1, Clause 1.1310, Table 1 Limits for maximum Permissible Exposure (MPE).
IEEE C95.1, Table 9 MPE
OET Bulletin 65, Section 3 Measuring RF Fields
IEEE C95.3, Section 6.3 Measurement procedures for external fields

2.1.2 Equipment Under Test and Modification State

SCG2221 TETRA mobile radio S/N:1PR002230GP58OM- Modification State 0

2.1.3 Date of Test

06-February-2023

2.1.4 Test Method

Instrumentation:

The specifications allow the use of either a narrowband or broadband instrument therefore a Broadband meter and probe was used with isotropic response (3-axis probe). The measurement values were recorded as average (rms).

Measurement:

Measurements of field strength to determine compliance were made, "at distances 20 cm or greater from any object." (OET Bulletin 65 Section 1).

For the assessment of thermal exposure, the electromagnetic fields are time-averaged over a period of 6 minutes.

Test setup requirements:

The test separation distance was measured from each face of the EUT to the centre of the probe (as this is the calibration point). The EUT was mounted on an 80 cm non-metallic table or floor standing for large equipment.

2.1.5 Limits

FCC CFR 47 Part 1, Clause 1.1310, Table 1 provides electric and magnetic field MPE limits 300 kHz – 300 MHz with averaging time of 6 minutes for the assessment of thermal effects as shown in Table 6.

The applicable MPE limits for electric and magnetic field are shown in Table 5.

The applicable most stringent reference levels for electric and magnetic field for broadband measurement of multiple frequencies at the EUT frequencies are shown in Table 6.

Reference/Action Level Limits	Frequency (MHz)								
	136 – 174			2412 – 2472 NOTE 1			2402 - 2480 NOTE 1		
	Electric Field MPE Level V/m	Magnetic Field MPE Level A/m	Magnetic Field MPE Level µT	Electric Field MPE Level V/m	Magnetic Field MPE Level A/m	Magnetic Field MPE Level µT	Electric Field MPE Level V/m	Magnetic Field MPE Level A/m	Magnetic Field MPE Level µT
General public limits	27.5	0.073	n/a	19.42	0.052	n/a	19.42	0.052	n/a
NOTE 1: The MPE limits above 300 MHz in Table 6 do not provide separate electric (E) and magnetic (H) limits, only power density in mW/cm^2. Therefore the equivalent limits have been calculated from: Power density S W/m^2 = 10 . Power density mW/cm^2 = 1 E = √(S . 377) H = √(S / 377)									

Table 5 – Limits at EUT Frequencies

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(i) Limits for Occupational/Controlled Exposure				
0.3–3.0	614	1.63	*(100)	≤6
3.0–30	1842/f	4.89/f	*($900/f^2$)	<6
30–300	61.4	0.163	1.0	<6
300–1,500			f/300	<6
1,500–100,000			5	<6
(ii) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	<30
1.34–30	824/f	2.19/f	*($180/f^2$)	<30
30–300	27.5	0.073	0.2	<30
300–1,500			f/1500	<30
1,500–100,000			1.0	<30

Table 6 – Limits for Maximum Permissible Exposure (MPE) (FCC CFR 47 Part 1, Clause 1.1310, Table 1)

2.1.6 Environmental Conditions

Ambient Temperature	23.9 °C
Relative Humidity	31.8 %
Ambient Electric Field	0.22 V/m
Ambient Magnetic Field	0.01 A/m

Table 7 – Environmental Conditions

2.1.7 Validation Check Result

Validation Source	50 MHz Baby monitor at 50 mm	
	Electric Field V/m	Magnetic Field A/m
Source level	WPF8 Probe: 24 V/m	WPH1000 Probe: 0.03 A/m
Measured level	WPF8 Probe: 25.2 V/m	WPH1000 Probe: 0.03 A/m

Table 8 – Validation Check

2.1.8 Test Results

Measurement Result (Electric Field Time Averaged)

Field Type	RAT/ Antenna	Frequency (MHz)	Field Strength Result (time averaged rms)	General Public MPE Limit	Units	Test Separation Distance[1] (mm)	Compliance (Yes/No)
Electric field	Tetra AFQNT-H4A	136 - 155	2.66	27.5	V/m	> 400	Yes
Electric field	Tetra AFQNT-H5	149 - 159	2.52	27.5	V/m	> 400	Yes
Electric field	Tetra AFQNT-H6A	155 -174	2.01	27.5	V/m	> 400	Yes
Electric field	WLAN 11b	2412 - 2472	4.01	19.42	V/m	> 400	Yes
Electric field	WLAN 11g	2412 - 2472	3.60	19.42	V/m	> 400	Yes
Electric field	WLAN 11n	2412 - 2472	3.68	19.42	V/m	> 400	Yes
Electric field	Bluetooth	2402 - 2480	1.08	19.42	V/m	> 400	Yes

Table 9 – Electric Field (Time Averaged)

Measurement Result (Magnetic Field Time Averaged)

Field Type	RAT/ Antenna	Frequency (MHz)	Field Strength Result (time averaged rms)	General Public MPE Limit	Units	Test Separation Distance[1] (mm)	Compliance (Yes/No)
Magnetic field	Tetra AFQNT-H4A	136 - 155	0.03	0.073	A/m	> 400	Yes
Magnetic field	Tetra AFQNT-H5	149 - 159	0.02	0.073	A/m	> 400	Yes
Magnetic field	Tetra AFQNT-H6A	155 -174	0.02	0.073	A/m	> 400	Yes
Magnetic field	WLAN 11b	2412 - 2472	0.01*	0.052	A/m	> 400	Yes
Magnetic field	WLAN 11g	2412 - 2472	0.01*	0.052	A/m	> 400	Yes
Magnetic field	WLAN 11n	2412 - 2472	0.01*	0.052	A/m	> 400	Yes
Magnetic field	Bluetooth	2402 - 2480	0.003*	0.052	A/m	> 400	Yes

*Magnetic field calculated from

$S = E^2 / 377$

$H = S / E$

Where

S = Power Density

E = Electric Field

Power density S W/m^2 = 10 . Power density mW/cm^2 = 1

Table 10 – Magnetic Field (Time Averaged)

Note 1: The test separation distance is that declared by the manufacturer or the minimum distance for compliance that is ≥ 40 cm.

2.1.9 Multiple Frequency Summation

The results are combined in accordance with FCC CFR 47 Part 1.1307(b)(3)(ii)(B) equation for power shown below to determine compliance as reported in Table 11 and Table 12. Each broadband probe integrates the entire frequency range covered by the probe.

Σ (Evaluated$_k$ / Exposure Limit$_k$) ≤ 1

Where Evaluated$_k$ is the power density level S and Exposure Limit$_k$ is the power density limit. Since power density is related to field strength by;
$S = E^2 / Z = H^2 Z$ where Z is the wave impedance
The summation ratio for power density can be replaced by field strength by squaring the ratio (Z cancels out in the ratio);

$\Sigma (E_m^2 / E_{MPE\ LIMIT}^2) \leq 1$

where:
E_m = Measured electric field at a specific frequency (i.e. maximum RMS result for each probe frequency band used)
$E_{MPE\ LIMIT}$ = MPE limit for the electric field at the measurement frequency (minimum limit in the frequency range covered by the probe)

$\Sigma (H_m^2 / H_{MPE\ LIMIT}^2) \leq 1$

where:
H_m = Measured magnetic field at a specific frequency (i.e. maximum RMS result for each probe frequency band used)
$H_{MPE\ LIMIT}$ = MPE limit for the magnetic field at the measurement frequency (minimum limit in the frequency range covered by the probe)

Multiple Frequency Summation Measurement Result (Time Averaged Electric Field)

Electric Field - Summation of TETRA + WLAN

Field Type	RAT/ Antenna	E_1 Field Strength Result (time average rms) TETRA 136 MHz	E_2 Field Strength Result (time average rms) WLAN 2412 MHz	Units	Summation : (E_1^2/E_{MPEL}^2) + (E_2^2/E_{MPEL}^2)	Test Separation Distance[2] (mm)	Summation Result ≤1 and compliant?
Electric field	Tetra AFQNT-H4A	2.66	4.01	V/m	0.052	> 400	Pass

Electric Field - Summation of TETRA + Bluetooth

Field Type	RAT/ Antenna	E_1 Field Strength Result (time average rms) TETRA 136 MHz	E_2 Field Strength Result (time average rms) WLAN 2402 MHz	Units	Summation : (E_1^2/E_{MPEL}^2) + (E_2^2/E_{MPEL}^2)	Test Separation Distance[2] (mm)	Summation Result ≤1 and compliant?
Electric field	Tetra AFQNT-H4A	2.66	1.08	V/m	0.013	> 400	Pass

Table 11 – Summation of Electric Field (Time Average)

Multiple Frequency Summation Measurement Result (Time Averaged Magnetic Field)

Magnetic Field - Summation of TETRA + WLAN

Field Type	RAT/ Antenna	H_1 Field Strength Result (time average rms TETRA 136 MHz	H_2 Field Strength Result (time average rms WLAN 2412 MHz	Units	Summation : (H_1^2/H_{MPEL}^2) + (H_2^2/H_{MPEL}^2)	Test Separation Distance[2] (mm)	Summation Result ≤1 and compliant?
Magnetic field	Tetra AFQNT-H4A	0.03	0.01	A/m	0.206	> 400	Pass

Magnetic Field - Summation of TETRA + Bluetooth

Field Type	RAT/ Antenna	H_1 Field Strength Result (time average rms TETRA 136 MHz	H_2 Field Strength Result (time average rms Bluetooth 2402 MHz	Units	Summation : (H_1^2/H_{MPEL}^2) + (H_2^2/H_{MPEL}^2)	Test Separation Distance[2] (mm)	Summation Result ≤1 and compliant?
Magnetic field	Tetra AFQNT-H4A	0.03	0.003	A/m	0.172	> 400	Pass

Table 12 – Summation of Magnetic Field (Time Average)

2.1.10 Spatial Averaging

Spatial averaging is not mandated in FCC CFR 47 Part 1.1310 or the associated documents therefore spatial averaging was not applied and maximum field strength levels were reported.

2.1.11 Test Location and Test Equipment Used

This test was carried out in Screened Room at our Fareham Test Laboratory.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Analyser	Keysight Technologies	EXA	4969	12	07-Feb-2024
EM Field Meter	Wavecontrol	SMP2	5769	24	01-Jun-2023
Field Meter Probe Electric	Wavecontrol	WPF8	5771	24	01-Jun-2023
Field Meter Probe Magnetic	Wavecontrol	WPH60	5772	24	01-Jun-2023
Field Meter Probe Magnetic	Wavecontrol	WPH1000	5871	24	14-Oct-2023
Hygrometer	Rotronic	HP21	5264	12	26-Jul-2023

Table 13 – Test Equipment

2.1.12 Test Setup Photographs

Figure 3 – Photographs

2.2 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Electric field strength V/m	±3.21 dB
Magnetic field strength A/m	± 2.28 dB

Table 14 – Measurement Uncertainty

IEEE C95.3 clause 5.2.13 requires that measurement uncertainty should be known and included in the measurement report. It does not specify a maximum measurement uncertainty but suggests that uncertainties of ±2 dB or even greater may be acceptable if the levels are well below the limits of the MPE.

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115:2007, Clause 4.4.3 and 4.5.1. (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.