

Test report No:
NIE: 73315RAN.001

Assessment report

RF EXPOSURE REPORT ACCORDING TO FCC 47 CFR Part 2.1091; FCC 47 CFR Part 1.1307 FCC 47 CFR Part 1.1310

(*) Identification of item under evaluation	SCG2229
(*) Trademark	SEPURA
(*) Model and /or type reference	SCG2229
(*) Other identification of the product	FCC ID: XX6SCG2229M IC ID: 8739A-SCG2229ME and 8739A-SCG2229M
(*) Features	TETRA (380-470 MHz), BT, BLE, GNSS, 802.11 b,g,n (20 MHz, 2.4 GHz) HW version: PLX-890155A0-01 (H/W mod state 7) SW version: 1810 002 10138
(*) Manufacturer	Sepura Limited 9000 Cambridge Research Park, Beach Drive, Waterbeach, Cambridge CB25 9TL, UK
Test method requested, standard	FCC 47 CFR Part 2.1091 Radiofrequency radiation exposure evaluation: mobile devices. FCC 47 CFR Part 1.1307: Actions that may have a significant environmental effect, for which Environmental Assessments (EAs) must be prepared. FCC 47 CFR Part 1.1310: Radiofrequency radiation exposure limits.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Miguel Lacave Antennas Lab Manager
Date of issue	2023-02-09
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Index

- Competences and guarantees3
- General conditions3
- Data provided by the client.....3
- Identification of the client.....3
- Document history3
- Appendix A: FCC RF Exposure assessment result4
 - General description of the device under evaluation5
 - Evaluation Results.....6
- Appendix B: FCC RF Exposure information8
 - RF Exposure determination of exemption.....9
 - RF Exposure evaluation 11

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Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item under evaluation", "Trademark", "Model and/or type reference", "General description of the device", "Other identification of the product").
2. Wi-Fi and Bluetooth maximum output power, maximum antenna gain and use distance information.
3. The device under evaluation consists of a SCG2229. TETRA mobile radio in frequency range 380-470MHz with BT, Wi-Fi and GNSS option.

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

Identification of the client

Sepura Limited

9000 Cambridge Research Park, Beach Drive, Waterbeach, Cambridge CB25 9TL, UK

Document history

Report number	Date	Description
73315RAN.001	2023-02-09	First release

Appendix A: FCC RF Exposure assessment result

General description of the device under evaluation

The device under evaluation consists of a SCG2229. TETRA mobile radio in frequency range 380-470MHz with BT, Wi-Fi and GNSS option.

According to the manufacturer, during its normal use, the separation distance between the radiating structures of the device and nearby users will be greater than 120 cm. The assessment is done at 120 cm, stating separately the minimum compliance separation distance according to the equipment specifications.

Only one antenna per technology is used by the device, but TETRA technology can use different antennas (see table below). Due to antenna peak gain values are 2 or 7 dBi, the evaluation is done for two possible scenarios in which the antennas are named as 'Antenna 2 dBi' and 'Antenna 7 dBi'.

Freq range	Antenna details	Gain(dBi)	Sepura Part number
380-430MHz	1/4 wave M8 Standard Mount, 5m cable 2dBi	2	310-00006
430-472MHz	1/4 wave M8 Standard Mount, 5m cable 2dBi	2	330-00009
380-430MHz	Flexi-whip/GPS vehicle antenna, 5m cable, 2dBi	2	360-00001
380-430MHz	Flexi-whip vehicle antenna, 5m lead, 2dBi	2	390-00005
380-430MHz	Flexi-whip mag-mount vehicle antenna, 5m cable 2dBi	2	390-00006
400-430MHz	5/8 wave M8 Standard Mount, 5m cable 7dBi	7	320-00008
430-472MHz	5/8 wave M8 Standard Mount, 5m cable 7dBi	7	330-00010
380-410MHz	5/8 wave, 7dBi	7	310-00007

Table 1: TETRA antennas

The equipment specifications for each supported technology are shown in Table 1. Values corresponding to 802.11b/g/n, Bluetooth and Bluetooth Low Energy technologies as well as all antenna gain have been declared by the manufacturer. Values corresponding to TETRA output power have been measured and stated into DEKRA Testing and Certification, S.A.U. test report num. 73315RFF.002.

Technology / Mode	Operating Band	Frequency under evaluation (MHz)	Maximum Conducted Output Power (dBm)	Duty Cycle (%)	Time Averaged Conducted Power (dBm)	Antenna peak gain (dBi)	Maximum Averaged E.R.P (dBm)	Maximum Averaged E.R.P (mW)
802.11b/g/n	2.4 GHz	2412 - 2484	17.00	98.00	16.91	1.00	15.76	37.69
Bluetooth	2.4 GHz	2400 - 2483.5	7.94	77.50	6.83	1.00	5.68	3.70
BTLE	2.4 GHz	2400 - 2483.5	8.81	77.50	7.70	1.00	6.55	4.52
TETRA - Antenna 7 dBi	380-470 MHz	380 - 470	40.36	50.00	37.35	7.00	42.20	16594.72
TETRA - Antenna 2 dBi	380-470 MHz	380 - 470	40.36	50.00	37.35	2.00	40.21	10495.42

Table 2: Equipment specifications

Evaluation Results

RF Exposure Exemption evaluation:

Technology / Mode	Operating Band	Frequency under evaluation (MHz)	Distance (cm)	Maximum Averaged E.R.P (mW)	§1.1307(b)(3).i.(C) Exposure Limit (mW)	Verdict for exemption § 1.1307(b)(3).i
802.11b/g/n	2.4 GHz	2412 - 2484	120.00	37.69	27648.00	Pass
Bluetooth	2.4 GHz	2400 - 2483.5	120.00	3.70	27648.00	Pass
BTLE	2.4 GHz	2400 - 2483.5	120.00	4.52	27648.00	Pass
TETRA - Antenna 7 dBi	380-470 MHz	380 - 470	120.00	16594.72	7004.16	MPE required
TETRA - Antenna 2 dBi	380-470 MHz	380 - 470	120.00	N/A	7004.16	MPE required

Table 3: FCC Exemption Evaluation Results

The device fails to comply with applicable §1.1307(b)(3).i. exemption limits, so Maximum Permissible Exposure (MPE) evaluation is necessary to demonstrate compliance.

RF Exposure MPE evaluation:

Technology / Mode	Operating Band	Frequency under evaluation (MHz)	Distance (cm)	Power density (mW/cm ²)	FCC General Population Limit (mW/cm ²)	FCC Occupational Exposure Limit (mW/cm ²)	Verdict
802.11b/g/n	2.4 GHz	2412 - 2484	120.00	0.00	1.00	5.00	Pass
Bluetooth	2.4 GHz	2400 - 2483.5	120.00	0.00	1.00	5.00	Pass
BTLE	2.4 GHz	2400 - 2483.5	120.00	0.00	1.00	5.00	Pass
TETRA - Antenna 7 dBi	380-470 MHz	380 - 470	120.00	0.15	0.25	1.27	Pass
TETRA - Antenna 2 dBi	380-470 MHz	380 - 470	120.00	0.10	0.25	1.27	Pass

Table 4: FCC Evaluation Results

The computed value(s) are below the limit(s), so these modes meet the requirements stated in FCC 47 CFR Part 1.1310.

Simultaneous transmission assessment:

Simultaneous technologies and modes	Result (\sum of Pout/Pmax ratios)	Verdict ($\sum \leq 1$)
802.11b/g/n + TETRA (Antenna 7 dBi)	0.59	Pass
BTLE + TETRA (Antenna 7 dBi)	0.59	Pass
802.11b/g/n + TETRA (Antenna 2 dBi)	0.38	Pass
BTLE + TETRA (Antenna 2 dBi)	0.38	Pass

Table 5: Simultaneous Transmission assessment

Minimum compliance distance for each possible TETRA antenna:

Simultaneous technologies and modes	TETRA Antenna	Minimum compliance distance according to: (cm)	
		FCC General Population Limits	FCC Occupational Exposure Limit
802.11b/g/n 2.4 GHz + TETRA 380-470 MHz	Antenna 7 dBi	93	42
	Antenna 2 dBi	74	33
BTLE 2.4 GHz + TETRA 380-470 MHz	Antenna 7 dBi	93	42
	Antenna 2 dBi	74	33

Table 6: Minimum compliance distance assessment

Appendix B: FCC RF Exposure information

RF Exposure determination of exemption

According to FCC 47 CFR §1.1307 (b)(3) Determination of exemption:

(i) For single RF sources (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2), a single RF source is exempt if:

(A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

(B) Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the separation distance (cm);

(C) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

TABLE 1 TO §1.1307(b)(3)(i)(C)—SINGLE RF SOURCES SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	$1,920 R^2$.
1.34-30	$3,450 R^2/f^2$.
30-300	$3.83 R^2$.
300-1,500	$0.0128 R^2 f$.
1,500-100,000	$19.2 R^2$.

(ii) For multiple RF sources: Multiple RF sources are exempt if:

(A) The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(i)(A).

(B) in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

Where:

a = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(B) of this section for Pth, including existing exempt transmitters and those being added.

b = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(C) of this section for Threshold ERP, including existing exempt transmitters and those being added.

c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters.

Pi = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive).

Pth,i = the exemption threshold power (Pth) according to paragraph (b)(3)(i)(B) of this section for fixed, mobile, or portable RF source i.

ERPj = the ERP of fixed, mobile, or portable RF source j.

ERPth,j = exemption threshold ERP for fixed, mobile, or portable RF source j, at a distance of at least $\lambda/2\pi$ according to the applicable formula of paragraph (b)(3)(i)(C) of this section.

Evaluated,k = the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation at the location of exposure.

Exposure Limit,k = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source k, as applicable from §1.1310 of this chapter.

RF Exposure evaluation

Limits for Maximum Permissible Exposure (MPE) for RF sources are defined in FCC 47 CFR “§1.1310 Radiation Exposure limits, paragraph (e)”:

TABLE 1 TO §1.1310(E)(1)—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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

f = frequency in MHz. * = Plane-wave equivalent power density.

Each supported transmission technology will be evaluated to determine if it is in compliance with limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields.

In order to perform the assessment, the following equations have been used for the calculations; these equations are accurate in the far-field of an antenna and will over-predict power density in the near field, where they could be used for making a "worst-case" or conservative prediction:

$$\text{Power density: } S[mW/cm^2] = \frac{P_{E.I.R.P.}[mW]}{4\pi R[cm]^2}$$

Where:

S = power density

$P_{E.I.R.P.}$ = Equivalent isotropically radiated power

R = distance to the center of radiation of the antenna (evaluation distance)

$$P_{E.I.R.P.} = P_T + G_T - L_C$$

Where:

P_T = transmitter time-averaged output power (including Duty Cycle and tune-up tolerance, if applicable)

G_T = gain of the transmitting antenna

L_C = signal attenuation in the connecting cable between the transmitter and the antenna if applicable