TÜV SÜD, Octagon House,
Concorde Way, Segensworth North, Fareham,
Hampshire, United Kingdom, PO15 5RL
Tel: +44 (0) 1489 558100
Website: www.tuvsud.com/en

SAR EXCLUSION DOCUMENT

Document 75956356 -11 Issue 01

16 MHz, 866.5 MHz and 2.4 GHz Bluetooth Low Energy Transmitter:

Product standard: EN 50663:2017 Generic standard for assessment of low power electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (10 MHz - 300 GHz)
Basic standard: EN 62479:2010 Assessment of the compliance of low power electronic and electrical equipment with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz)

EN 62479 Section 4.1 Route B and 4.2 Low-power exclusion level P_{max}

EN 62479 Section 4.1 states: If the electrical power used by or radiated by the equipment is sufficiently low, the electromagnetic fields emitted will be incapable of producing exposures that exceed the basic restrictions.

Four routes A, B, C or D can be used to demonstrate compliance. The route selected is B;

B The input power level to electrical or electronic components that are capable of radiating electromagnetic energy in the relevant frequency range is so low that the available antenna power and/or the average total radiated power cannot exceed the low-power exclusion level defined below.

The applicable low power exclusion level P_{max} from EN 62479 Table A.1 is 20 mW corresponding to;

- ICNIRP (guideline in accordance with Council Recommendation 1999/519/EC),
- General Public (exposure tier)
- <Head and trunk (region of body)>

Low Power Exclusion Result:

Frequency (MHz)	Power Output mW	Antenna Gain Ratio	Duty Cycle %	Maximum Power (EIRP) * (mW)	Separation Distance mm	P_{max} Exemption Limit ** (mW)	SAR Test Exclusion (Yes/No)
16	1	1	100	1	20	20	Yes
866.5	25.11886432	0.250610925	0.06	0.003777037	20	20	Yes
2402	5.011872336	1.462177174	32	2.345038506	20	20	Yes

Table 1

The Low Power exclusion threshold has been evaluated using the method described above from information supplied by the manufacturer. Based on the evaluation above, the EUT is categorically excluded from SAR/RF exposure testing.

Approved by ..... **Date** 23 November 2022

Matt Russell
Authorised Signatory

Determination of the Equivalent Isotropically Radiated Power (EIRP) of an RF Transmitting System

Direct calculation from the DUT power measured in a radiated test configuration

When the DUT power is measured using a radiated test configuration, the EIRP can be directly determined using the field strength (linear) approach by applying Equation:

$EIRP = P_t \times G_t = (E \times d)^2/30$

- EIRP is the equivalent isotropically radiated power in watts.
- P_t transmitter output power in watts (not required)
- G_t numeric gain of the transmitting antenna (unitless) (not required)
- E electric field strength in V/m
- D measurement distance in meters (m)

Measure the electric field strength E at test distance d m.

If magnetic field strength is measured, convert to electric field strength in accordance with the antenna manufacturers' conversion factors.

Calculate the EIRP using the equation above. Increase the EIRP to include any declared tune-up tolerance value to give the maximum output power.

The result is the Maximum Power (Tune up Value) required in the SAR exclusion assessment.

Frequency (MHz)	Magnetic Field Strength (dBµA/m)[1]	Conversion Factor H to E Field (dB)[2]	Electric Field Strength (dBµV/m)	Electric Field Strength (V/m)	Test Distance (m)	EIRP (W)	EIRP (mW)	Tune-up Tolerance (%)	Maximum Power (Tune up Value) (mW)
16	-27.55	51.5	24.0	0.0000158	3	7.4494E-11	0.00	0	0.0

Table 2

Note 1: Maximum magnetic field strength measured at 3 m from Manufacturer's declaration.
Note 2: Since Electric and magnetic fields are related by their wave impedance:
E/H=377 ohms; E (dBµV/m) = H (dBµA/m) + 51.5 (dB)
377 ohms assumes worst case plane wave conditions for an inductive loop antenna, actual wave impedance would be lower giving lower result.

Manufacturer's Declaration of Product information (extract):

Equipment Description

Technical Description: *(Please provide a brief description of the intended use of the equipment)*	The SOLO3 is ankle tagging SRD with BLE, WiFi, GNSS and 2G/3G/4G cellular capabilities
Manufacturer:	G4S Monitoring Technologies LTD
Model:	SOLO3 Rev D
Part Number:	

If more than one frequency band is supported, please confirm which combinations of bands are capable of Simultaneous Transmit.	

Frequency Band 1: 16 MHz

Antenna Model:	32000309-01	
Antenna length:	1.9	cm
Bottom frequency:	16	MHz
Middle frequency:		MHz
Top frequency:		MHz

Maximum power (input to the antenna including a tolerance):		dBm
Antenna gain (or maximum gain allowed):	0	dBi

Or

Field Strength Measurement:	-27.55	dBµA/M
Measurement Distance:	3	cm

Separation distance from antenna to the user/bystander	2	cm
Transmitter Duty Cycle:	100	%

Frequency Band 2: 866.5 MHz

Antenna Model:	CZ0005-1M03	
Antenna length:	3.5	cm
Bottom frequency:	866.5	MHz
Middle frequency:		MHz
Top frequency:		MHz

Maximum power (input to the antenna including a tolerance):	14	dBm
Antenna gain (or maximum gain allowed):	-6.01	dBi

Or

Field Strength Measurement:		dBµA/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	2	cm
Transmitter Duty Cycle:	0.06	%

Frequency Band 3: 2.4 GHz Bluetooth Low Energy

Antenna Model:	Aulin SZP-C-0W01	
Antenna length:	0.5	cm
Bottom frequency:	2402	MHz
Middle frequency:		MHz
Top frequency:		MHz

Maximum power (input to the antenna including a tolerance):	7	dBm
Antenna gain (or maximum gain allowed):	1.65	dBi

Or

Field Strength Measurement:		dBµA/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	2	cm
Transmitter Duty Cycle:	32	%

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

Name: Kelvin Wong
Position held: Senior RF and Electronics Engineer
Date: 20/10/2022

Note: the maximum radiated power output EIRP shown in the low power exclusion result is given by:

$P_{EIRP} = P_o \times G_i \times$ Duty Factor
P_{EIRP} = 25.11886432 mW x 0.250610925x 0.0006= 0.003777037 mW
Where:
P_o = 10^(14 dBm/10) = 25.11886432 mW
G_i = 10^(-6.01 dBi/10) = 0.250610925
Duty factor = 0.06%/100 = 0.0006

$P_{EIRP} = P_o \times G_i \times$ Duty Factor
P_{EIRP} = 5.011872336 mW x 1.462177174 x 0.32 = 2.345038506 mW
Where:
P_o = 10^(7 dBm/10) = 5.011872336 mW
G_i = 10^(1.65 dBi/10) = 1.462177174
Duty factor = 32 %/100 = 0.32