

Test report No:
NIE: 72449RAN.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	XS4 Original+ Electronic Lock Series including all mechanical variants
(*) Trademark	SALTO
(*) Model and /or type reference	W41M / Type reference: E2131
(*) Other identification of the product	HW version: 1.0 SW Version: 0174 (Control FW) + 0186 (FUS FW) + 0187 (BLE FW) + 0202 (Motor FW) FCC ID: UKCW41M IC ID: 10088A-W41M
(*) Features	Bluetooth LE
(*) Manufacturer	SALTO SYSTEMS, S.L. Arkotz 9, Polígono Lanbarren 20180, Oiartzun (Gipuzkoa) - Spain
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	2023-03-07
Report template No	FAN36_02 (* "Data provided by the client")

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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", "Other identification of the product", "Features", "Manufacturer" and "General description of the device").
2. Maximum antenna gain and use distance information.

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

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Document history

Report number	Date	Description
72449RAN.001	2023-03-07	First release

Appendix A: FCC RF Exposure assessment result

General description of the device under evaluation

The device under evaluation consists of an electronic lock series with RFID Mifare (ISO14443A & ISO15693 standard based) and Bluetooth LE technology.

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 20 cm. In order to perform the assessment a conservative evaluation distance of 20 cm has been used.

The equipment specifications for each supported technology are shown in Table 1. Values corresponding to BTLE output power and antenna gain have been measured and stated into DEKRA Testing and Certification, S.A.U. test report num. 72449RRF.004.

Values corresponding to RFID output power have been measured and stated into DEKRA Testing and Certification, S.A.U. test report num. 72449RRF.005. The power levels expressed as dBµV/m have been extrapolated to the minimum use distance following calculation stated in Appendix B, section RF Exposure Evaluation in this document:

Technology / Mode	Operating Band	Frequency under evaluation (MHz)	Maximum Conducted Output Power (Incl. Tune-Up) (dBm)	Antenna peak gain (dBi)	Measured E-field at 3 m (dBµV/m)	Maximum E.R.P. (dBm)	Maximum E.R.P. (mW)	Maximum E.I.R.P. (dBm)	Maximum E.I.R.P. (mW)
BTLE	2.4 GHz	2400 - 2483.5	3.67	0.50	-	2.02	1.59	4.17	2.61
RFID	13.56	13.56	-	-	54.39	-	-	-	-

Table 1: Equipment specifications

Evaluation Results

RF Exposure Exemption evaluation:

Technology / Mode	Operating Band	Frequency under evaluation (MHz)	Distance (cm)	Maximum E.R.P. (mW)	§1.1307(b)(3).i.(C) Exposure Limit (mW)	Verdict for exemption § 1.1307(b)(3).i
BTLE	2.4 GHz	2400 - 2483.5	20.00	1.59	768.00	Pass
RFID	13.56	13.56	20.00	N/A	N/A	MPE required

Table 2: 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)	Verdict
BTLE	2.4 GHz	2400 - 2483.5	20.00	0.001	1.00	Pass
RFID	13.56	13.56	20.00	0.000004	0.98	Pass

Table 3: 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 ($\sum \leq 1$)
BTLE 2.4 GHz + RFID 13.56	0.001	Pass

Table 4: Simultaneous Transmission 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	19.2R 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 is 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 P_{th}, 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.

P_i = 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).

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

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

ERP_{th,j} = exemption threshold ERP for fixed, mobile, or portable RF source j, at a distance of at least λ/2π 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

RFID output power calculation

Output power values corresponding to RFID technology shown in Table 1 of “General description of the device under evaluation” section are calculated from maximum measured field strength values stated into DEKRA Testing and Certification test report num. 72449RRF.005 (see table below) following the calculation described below:

Operation Mode	Frequency (MHz)	Maximum E-field strength (dBµA/m) measured at 3 m
RFID	13.56	54.39

Table 5: Measurement Results

According to ANSI C63.10-2013, section 6.4.4.2:

If the Maximum E-field strength measured is at a distance greater than $\lambda/2\pi$, then extrapolation to the limit distance shall be calculated using the following equation:

$$FS_{\text{limit}} = FS_{\text{max}} - 20 \log \left(\frac{d_{\text{limit}}}{d_{\text{measure}}} \right)$$

If both the Maximum E-field strength measured and the limit distance are equal to or closer to the EUT than $\lambda/2\pi$ the extrapolation to the limit distance shall be calculated using the following equation:

$$FS_{\text{limit}} = FS_{\text{max}} - 40 \log \left(\frac{d_{\text{limit}}}{d_{\text{measure}}} \right)$$

Where:

- FS_{limit} is the calculation of field strength at the limit distance, expressed in dBµV/m
- FS_{max} is the measured field strength, expressed in dBµV/m
- d_{measured} is the distance of the measurement point from the EUT
- d_{limit} is the reference distance or the distance of the $\lambda/2\pi$ point.

As a result of this calculation, equivalent output power (dBµV/m) at minimum distance of use between user and device is obtained, which is converted to Power Density units as follows:

$$PD (W/m^2) = FS_{\text{limit}} (V/m)^2 / 377$$