DEKRA Testing and Certification, S.A.U.
Parque Tecnológico de Andalucía,
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Assessment report No:

NIE: 55553RAN.001

Assessment report
RF EXPOSURE REPORT ACCORDING TO
FCC 47 CFR Part 2.1091
ISED RSS -102 Issue 5:2015

Identification of item tested.....:	Electromechanical lock
Trademark .....:	Ojmar
Model and /or type reference .....:	NEXO NLX1
Other identification of the product .....:	FCC ID: 2ANY7OJM002
Final HW version .....:	Main plate: Hw2.0, Antenna: Hw1.8
Final SW version .....:	Not provided data
Features.....:	Wi-Fi, RFID and NFC.
Manufacturer.....:	OJMAR S.A Polígono Industrial de Lerun s/n 20870, Elgoibar/ Gipuzkoa, SPAIN
Test method requested, standard.....:	FCC 47 CFR Part 2.1091 Radiofrequency radiation exposure evaluation: mobile devices. ISED RSS-102 Issue 5 (2015-03) – Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
Summary.....:	IN COMPLIANCE
Approved by (name / position & signature) .....:	Miguel Lacave Antennas Lab Manager  MIGUEL LACAVE GARCÍA 2018.02.16 10:27:27 +01'00'
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Index

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Identification of the client

OJMAR S.A

Polígono Industrial de Lerun s/n

20870, Elgoibar, Gipuzkoa, SPAIN

General description of the device under evaluation

The device under evaluation consists of a RFID "locker lock" device @ 13,56 MHz power supplied by 4 AA alkaline non-rechargeable batteries, which includes NFC communication for maintenance purposes. Device also includes a WiFi antenna @ 2.4GHz in order to communicate with an already certified router.

Once installed in the door, during its normal use, the separation distance between the device and the body of nearby users will be greater than 20 cm. In order to perform the assessement a conservative separation distance of 20 cm has been used.

As stated into DEKRA Testing and Certification, S.A.U. test report 55553RRF.001, the maximum measured output power values and the maximum antenna gain value declared by the manufacturer are:

Band (MHz)	Band	Technology	Frequency (MHz)	Maximum RF output power (dBm)	Maximum antenna gain (dBi)	Maximum radiated power (E.I.R.P.) (dBm)
2450	ISM	802.11b/g/n	2412	13.15	+2.0	15.15
			2437	13.57	+2.0	15.57
			2462	14.13	+2.0	16.13

Table 1: Maximum output power values and antenna gain for Wi-Fi

According to DEKRA Testing and Certification, S.A.U. test report 55553RRF.002, the maximum measured field strength value for each technology at the operating frequency is:

Operation Mode	Frequency (MHz)	Maximum field strength (dBµV/m) measured at 3 m	Maximum field strength (dBµV/m) measured at 3 m
RFID	13.561	59.50	0.000267
NFC	13.561	59.11	0.000244

Table 2: Measurement Results for RFID and NFC

Transmitter output power has been calculated using Field Strength Approach formula (linear terms):

$E.I.R.P = P_t \times G_t = (Exd)^2/30$

Where:
P_t = transmitter output power in watts
G_t = numeric gain of the transmitting antenna (unitless)
E = electric field strength in V/m, $10^{((dB\mu V/m)/20)}/10^6$
d = measurement distance in meters (m) = 3m

RFID
$P_t = (Exd)^2/(30xG_t)$
Field strength = 59.5 dBµV/m @3m
Antenna gain =0.0 dBi, so numeric gain=1.0
Therefore
$P_t = \{[10^{(59.5/20)}/10^6 x3]^2/(30x1.0)\}x1000$ mW = 0.000267 mW = -35.73 dBm

NFC
$P_t = (Exd)^2/(30xG_t)$
Field strength = 59.11 dBµV/m @3m
Antenna gain =0.0 dBi, so numeric gain=1.0
Therefore
$P_t = \{[10^{(59.11/20)}/10^6 x3]^2/(30x1.0)\}x1000$ mW = 0.000244 mW = -36.11 dBm

Assessment summary

Radiofrequency radiation exposure limits			
FCC 47 CFR § 2.1091 & ISED RSS-102 Issue 5 (2015-03)			
Assessment	**Band (MHz)**	**Technology**	**VERDICT (Pass/Fail)**
1	2450	802.11b/g/n	Pass
2	13.5	RFID	Pass
3	13.5	NFC	Pass

Table 3: Assessment summary

Appendix A – FCC RF Exposure

FCC RF Exposure evaluation for mobile devices

Devices operating in standalone mobile device exposure conditions may contain a single transmitter or multiple transmitters that do not transmit simultaneously. A minimum test separation distance ≥ 20 cm is required between the antenna and radiating structures of the device and nearby persons to apply mobile device exposure limits. The distance must be at least 20 cm and fully supported by the operating and installation configurations of the transmitter and its antenna(s), according to the source-based time-averaged maximum power requirements of § 2.1091(d)(2). In cases where cable losses or other attenuations are applied to determine compliance, the most conservative operating configurations and exposure conditions must be evaluated. The minimum test separation distance required for a device to comply with mobile device exposure conditions must be clearly identified in the installation and operating instructions, for all installation and exposure conditions, to enable users and installers to comply with RF exposure requirements. For mobile devices that have the potential to operate in portable device exposure conditions, similar to the configurations described in § 2.1091(d)(4), a KDB inquiry is required to determine the SAR test requirements for demonstrating compliance.

When a device qualifies for the categorical exclusion provision of § 2.1091(c), the minimum test separation distance may be estimated, when applicable, by simple calculations according to plane-wave equivalent conditions, to ensure the transmitter and its antenna(s) can operate in manners that meet or exceed the estimated distance. The source-based time-averaged maximum radiated power, according to the maximum antenna gain, must be applied to calculate the field strength and power density required to establish the minimum test separation distance. When the estimated test separation distance becomes overly conservative and does not support compliance, MPE measurement or computational modeling may be used to determine the required minimum separation distance.

According to §1.1310 Radiofrequency radiation exposure limits, paragraph (e), the limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields are:

TABLE 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)
(A) 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
(B) 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

FCC MPE Evaluation Results

Each supported transmission technology will be evaluated to determine if they are 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:

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

Minimum compliance distance: $R_{\min}[cm] = \sqrt{\frac{P_{E.I.R.P.}[mW]}{4\Pi S[mW/cm^2]}}$

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)

$R_{\min}$ = distance to the center of radiation of the antenna

Assessment 1 – 802.11b/g/n – 2450 MHz Band

Maximum output power (dBm):	14.13
Antenna Gain (dBi):	2.0
Minimum use distance (cm):	20
Worst Case Frequency (MHz):	2462.0
Maximum EIRP (dBm):	16.13
Maximum EIRP (mW):	41.02
General population - Power density limit (mW/cm^2):	1.0

Power density at minimum use distance:

Power density (mW/cm^2):	0.008
General population - Power density limit (mW/cm^2):	1.0
Verdict for general population:	PASS

The power density level for this transmission mode is below general population exposure power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general population (cm):	1.81
Minimum use distance (cm):	20.0
Verdict for general population:	PASS

The minimum use distance is greater than general population exposure minimum compliance distance

Assessment 2 – RFID – 13.5 MHz Band

Maximum output power (dBm):	-35.73
Antenna Gain (dBi):	N/A
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	13.56
Maximum EIRP (dBm):	-35.73
Maximum EIRP (mW):	0.00027
General population - Power density limit (mW/cm^2):	0.97

Power density at minimum use distance:

Power density (mW/cm^2):	0.00000005
General population - Power density limit (mW/cm^2):	0.97
Verdict for general population:	PASS

The power density level for this transmission mode is below general population exposure power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general population (cm):	0.0047
Minimum use distance (cm):	20.0
Verdict for general population:	PASS

The minimum use distance is greater than general population exposure minimum compliance distance.

Assessment 3 – NFC – 13.5 MHz Band

Maximum output power (dBm):	-36.11
Antenna Gain (dBi):	N/A
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	13.56
Maximum EIRP (dBm):	-36.11
Maximum EIRP (mW):	0.00024
General population - Power density limit (mW/cm^2):	0.97

Power density at minimum use distance:

Power density (mW/cm^2):	0.00000005
General population - Power density limit (mW/cm^2):	0.97
Verdict for general population:	PASS

The power density level for this transmission mode is below general population exposure power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general population (cm):	0.0045
Minimum use distance (cm):	20.0
Verdict for general population:	PASS

The minimum use distance is greater than general population exposure minimum compliance distance

Multiple frequencies assessment

When multiple sources are introduced into an environment, it becomes necessary to address the sources interdependently, since each source will contribute some percentage of the maximum exposure toward the total exposure at a fixed location. The sum of the ratios of the exposure from each source to the corresponding maximum exposure for the frequency of each source must be evaluated.

The exposure complies with the maximum permissible exposure if the sum of the ratios is less than unity:

$$\sum_{i=1}^{n} \frac{S_i}{MPE_i} < 1$$

Where
S_i is the power density of each source;
MPE_i is the power density basic restriction of each source.

$$\frac{0.008}{1} + \frac{0.00000005}{0.97} + \frac{0.00000005}{0.97} = \quad 0.008 < 1 \text{ Limit}$$

Appendix B – ISED RF Exposure

ISED RF Exposure evaluation for mobile devices

According to RSS-102 Issue 5, Paragraph "4. Exposure Limits", Industry of Canada has adopted the RF field strength limits stablished in Healths Canada's RF exposure guideline, Safety code 6:

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10^{21}	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142f^{0.3417}$	$0.008335f^{0.3417}$	$0.02619f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

ISED MPE Evaluation Results

Each supported transmission technology will be evaluated to determine if it is in compliance with RSS102 Issue 5, RF Field Strength Limits for devices used by the General Public.

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:

Power density: $S[W/m^2] = \frac{P_{E.I.R.P.}[W]}{4\Pi R[m]^2}$

Minimum compliance distance: $R_{\min}[m] = \sqrt{\frac{P_{E.I.R.P.}[W]}{4\Pi S[W/m^2]}}$

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)

$R_{\min}$ = distance to the center of radiation of the antenna

Assessment 1 – 802.11b/g/n – 2450 MHz Band

Maximum output power (dBm):	14.13
Maximum antenna gain (dBi):	2.0
Minimum use distance (m):	0.20
Worst Case Frequency (MHz):	2462.0
Maximum EIRP (dBm):	16.13
Maximum EIRP (W):	0.04
General public - Power density limit (W/m^2):	5.44

Power density at minimum use distance:

Power density (W/m^2):	0.082
General public - Power density limit (W/m^2):	5.44
Verdict for general public:	PASS

The power density level for this transmission mode is below general public power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general public (m):	0.024
Minimum use distance (m):	0.20
Verdict for general public:	PASS

Assessment 2 – RFID – 13.5 MHz Band

Maximum output power (dBm):	-35.73
Maximum antenna gain (dBi):	N/A
Minimum use distance (m):	0.2
Worst Case Frequency (MHz):	13.56
Maximum EIRP (dBm):	-35.73
Maximum EIRP (W):	0.0000003
General public - Power density limit (W/m^2):	2.0

Power density at minimum use distance:

Power density (W/m^2):	0.00000005
General public - Power density limit (W/m^2):	2.0
Verdict for general public:	PASS

The power density level for this transmission mode is below general public power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general public (m):	0.000103
Minimum use distance (m):	0.2
Verdict for general public:	PASS

The minimum use distance is greater than general public minimum compliance distance.

Assessment 3 – NFC – 13.5 MHz Band

Maximum output power (dBm):	-36.11
Maximum antenna gain (dBi):	N/A
Minimum use distance (m):	0.2
Worst Case Frequency (MHz):	13.56
Maximum EIRP (dBm):	-36.11
Maximum EIRP (W):	0.00000024
General public - Power density limit (W/m^2):	2.0

Power density at minimum use distance:

Power density (W/m^2):	0.0000005
General public - Power density limit (W/m^2):	2.0
Verdict for general public:	PASS

The power density level for this transmission mode is below general public power density limit.

Minimum compliance distance for this technology:

Minimum compliance distance for general public (m):	0.000099
Minimum use distance (m):	0.2
Verdict for general public:	PASS

The minimum use distance is greater than general public minimum compliance distance.

Multiple frequencies assessment

When multiple sources are introduced into an environment, it becomes necessary to address the sources interdependently, since each source will contribute some percentage of the maximum exposure toward the total exposure at a fixed location. The sum of the ratios of the exposure from each source to the corresponding maximum exposure for the frequency of each source must be evaluated.

The exposure complies with the maximum permissible exposure if the sum of the ratios is less than unity:

$$\sum_{i=1}^{n} \frac{S_i}{MPE_i} < 1$$

Where
S_i is the power density of each source;
MPE_i is the power density basic restriction of each source.

$$\frac{0.082}{5.44} + \frac{0.0000005}{2.0} + \frac{0.0000005}{2.0} = 0.015 < 1 \text{ Limit}$$