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Assessment report No:

NIE: 51934RAN.002

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

Identification of item tested.....:	Mobile Data Gateway
Trademark .....:	Imr / AIUT
Model and /or type reference .....:	OKO 5875
Other identification of the product .....:	FCC ID: 2AKQSOKO5875 IC ID: 22378-OKO5875
Final HW version .....:	3
Final SW version .....:	C1
IMEI TAC .....:	35696107
Features.....:	Mobile Data Gateway supporting FDD 2, 4, 5, 12, 13 LTE bands and FDD II, V UMTS bands
Manufacturer.....:	AIUT SP. Z O.O. ul. Wyczólkowskiego 113, 44-109 Gliwice, Poland.
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 2017.03.03 13:16:57 +01'00'
Date of issue .....:	2017-03-03
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Identification of the client

AIUT SP. Z O.O.

ul. Wyczólkowskiego 113, 44-109 Gliwice, Poland.

General description of the device under evaluation

The device under evaluation consists of a compact, battery-powered mobile data gateway, which receives via radio measurements from assigned smart level sensors installed on tanks, to collect the tank level/volume data and retransmit the current stock information, archive measurement and status of the device via cellular networks to acquisition server.

The equipment specifications declared by the manufacturer for each supported feature are:

Assessment	Technology	Band	Band (MHz)	Maximum RF output power (dBm)	Maximum antenna gain (dBi)	Average radiated power (E.I.R.P.) (dBm)
1	25K0F1D	900	900	-1.23	+0.0	1.23
2	WCDMA	II	1900	24.0	+6.0	30.0
3	WCDMA	V	950	24.0	+6.0	30.0
4	LTE	2	1900	23.0	+6.0	29.0
5	LTE	4	1700	23.0	+6.0	29.0
6	LTE	5	850	23.0	+6.0	29.0
7	LTE	12	700	23.0	+6.0	29.0
8	LTE	13	750	23.0	+6.0	29.0

Table 1: Equipment specifications

Assessment summary

Radiofrequency radiation exposure limits				
FCC 47 CFR § 2.1091 & ISED RSS-102 Issue 5 (2015-03)				
Assessment	**Technology**	**Band**	**Band (MHz)**	**VERDICT (Pass/Fail)**
1	25K0F1D	900	900	Pass
2	WCDMA	II	1900	Pass
3	WCDMA	V	950	Pass
4	LTE	2	1900	Pass
5	LTE	4	1700	Pass
6	LTE	5	850	Pass
7	LTE	12	700	Pass
8	LTE	13	750	Pass

Table 2: 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/cm²)	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/f²	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/f²	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

In order to perform the assessment, the following equations have been used for the calculations:

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

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

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 – RF 900 MHz

Maximum output power (dBm):	-1.23
Antenna Gain (dBi):	0.02
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	902.0
Maximum EIRP (dBm):	-1.23
Maximum EIRP (mW):	0.75
General public - Power density limit (mW/cm2):	0.601

Power density at minimum use distance:

Power density (mW/cm2):	0.00015
Verdict for general public:	PASS

The power density level for this transmission mode is below general public and controlled exposure power density limits.

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	0.32
Verdict for general public:	PASS

The minimum use distance is larger than general public and controlled exposure minimum compliance distances.

Assessment 2 - WCDMA Band II

Maximum output power (dBm):	24.0
Antenna Gain (dBi):	6.0
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	1850.0
Maximum EIRP (dBm):	30.0
Maximum EIRP (mW):	1000.00
General public - Power density limit (mW/cm2):	1

Power density at minimum use distance:

Power density (mW/cm2):	0.199
Verdict for general public:	PASS

The power density level for this transmission mode is below general public and controlled exposure power density limits.

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	8.92
Verdict for general public:	PASS

The minimum use distance is larger than general public and controlled exposure minimum compliance distances.

Assessment 3 - WCDMA Band V

Maximum output power (dBm):	24.0
Antenna Gain (dBi):	6.0
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	824.0
Maximum EIRP (dBm):	30.0
Maximum EIRP (mW):	1000.00
General public - Power density limit (mW/cm2):	0.549

Power density at minimum use distance:

Power density (mW/cm2):	0.199
Verdict for general public:	PASS

The power density level for this transmission mode is below general public and controlled exposure power density limits.

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	12.04
Verdict for general public:	PASS

The minimum use distance is larger than general public and controlled exposure minimum compliance distances.

Assessment 4 - LTE Band 2

Maximum output power (dBm):	23.0
Antenna Gain (dBi):	6.0
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	1850.0
Maximum EIRP (dBm):	29.0
Maximum EIRP (mW):	794.33
General public - Power density limit (mW/cm2):	1

Power density at minimum use distance:

Power density (mW/cm2):	0.16
Verdict for general public:	PASS

The power density level for this transmission mode is below general public and controlled exposure power density limits.

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	7.95
Verdict for general public:	PASS

The minimum use distance is larger than general public and controlled exposure minimum compliance distances.

Assessment 5 - LTE Band 4

Maximum output power (dBm):	23.0
Antenna Gain (dBi):	6.0
Minimum use distance (cm):	20
Worst Case Frequency (MHz):	1710.0
Maximum EIRP (dBm):	29.0
Maximum EIRP (mW):	794.33
General public - Power density limit (mW/cm2):	1

Power density at minimum use distance:

Power density (mW/cm2):	0.16
Verdict for general public:	PASS

The power density level for this transmission mode is below general public and controlled exposure power density limits.

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	7.95
Verdict for general public:	PASS

The minimum use distance is larger than general public and controlled exposure minimum compliance distances.

Assessment 6 - LTE Band 5

Maximum output power (dBm):	23.0
Antenna Gain (dBi):	6.0
Minimum use distance (cm):	20
Worst Case Frequency (MHz):	824.0
Maximum EIRP (dBm):	29.0
Maximum EIRP (mW):	794.33
General public - Power density limit (mW/cm2):	0.5491

Power density at minimum use distance:

Power density (mW/cm2):	0.16
Verdict for general public:	PASS

The power density level for this transmission mode is below general public and controlled exposure power density limits.

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	10.73
Verdict for general public:	PASS

The minimum use distance is larger than general public and controlled exposure minimum compliance distances.

Assessment 7 - LTE Band 12

Maximum output power (dBm):	23.0
Antenna Gain (dBi):	6.0
Minimum use distance (cm):	20
Worst Case Frequency (MHz):	699.0
Maximum EIRP (dBm):	29.0
Maximum EIRP (mW):	794.33
General public - Power density limit (mW/cm2):	0.466

Power density at minimum use distance:

Power density (mW/cm2):	0.16
Verdict for general public:	PASS

The power density level for this transmission mode is below general public and controlled exposure power density limits.

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	11.65
Verdict for general public:	PASS

The minimum use distance is larger than general public and controlled exposure minimum compliance distances.

Assessment 8 - LTE Band 13

Maximum output power (dBm):	23.0
Antenna Gain (dBi):	6.0
Minimum use distance (cm):	20
Worst Case Frequency (MHz):	777.0
Maximum EIRP (dBm):	29.0
Maximum EIRP (mW):	794.33
General public - Power density limit (mW/cm2):	2.59

Power density at minimum use distance:

Power density (mW/cm2):	0.16
Verdict for general public:	PASS

The power density level for this transmission mode is below general public and controlled exposure power density limits.

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	11.05
Verdict for general public:	PASS

The minimum use distance is larger than general public and controlled exposure minimum compliance distances.

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.

The device can transmit using 25K0F1D and cellular technologies at the same time, so the worst case for simultaneous transmission will be:

$$\frac{0.00015}{0.601} + \frac{0.199}{0.549} = 0.00025+0.363=0.3633 < 1 \text{ Limit}$$

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)
$0.003\text{-}10^{21}$	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

In order to perform the assessment, the following equations have been used for the calculations:

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 – RF 900 MHz

Maximum output power (dBm):	-1.23
Antenna Gain (dBi):	0
Minimum use distance (cm):	20
Worst Case Frequency (MHz):	902.0
Maximum EIRP (dBm):	-1.23
Maximum EIRP (mW):	0.75
General public - Power density limit (W/m2):	2.74

Power density at minimum use distance:

Power density (W/m2):	0.0015
Verdict for general public:	PASS

The power density level for this transmission mode is below general public and controlled exposure power density limits.

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	0.47
Verdict for general public:	PASS

The minimum use distance is larger than general public and controlled exposure minimum compliance distances.

Assessment 2 - WCDMA Band II

Maximum output power (dBm):	24.0
Antenna Gain (dBi):	6.0
Minimum use distance (cm):	20
Worst Case Frequency (MHz):	1850.0
Maximum EIRP (dBm):	30.0
Maximum EIRP (mW):	1000.00
General public - Power density limit (W/m2):	4.476

Power density at minimum use distance:

Power density (W/m2):	1.99
Verdict for general public:	PASS

The power density level for this transmission mode is below general public and controlled exposure power density limits.

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	13.33
Verdict for general public:	PASS

The minimum use distance is larger than general public and controlled exposure minimum compliance distances.

Assessment 3 - WCDMA Band V

Maximum output power (dBm):	24.0
Antenna Gain (dBi):	6.0
Minimum use distance (cm):	20
Worst Case Frequency (MHz):	824.0
Maximum EIRP (dBm):	30.00
Maximum EIRP (mW):	1000.00
General public - Power density limit (W/m2):	2.58

Power density at minimum use distance:

Power density (W/m2):	1.99
Verdict for general public:	PASS

The power density level for this transmission mode is below general public and controlled exposure power density limits.

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	17.58
Verdict for general public:	PASS

The minimum use distance is larger than general public and controlled exposure minimum compliance distances.

Assessment 4 - LTE Band 2

Maximum output power (dBm):	23.0
Antenna Gain (dBi):	6.0
Minimum use distance (cm):	20
Worst Case Frequency (MHz):	1850.0
Maximum EIRP (dBm):	29.0
Maximum EIRP (mW):	794.33
General public - Power density limit (W/m2):	4.476

Power density at minimum use distance:

Power density (W/m2):	1.58
Verdict for general public:	PASS

The power density level for this transmission mode is below general public and controlled exposure power density limits.

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	11.88
Verdict for general public:	PASS

The minimum use distance is larger than general public and controlled exposure minimum compliance distances.

Assessment 5 - LTE Band 4

Maximum output power (dBm):	23.0
Antenna Gain (dBi):	6.0
Minimum use distance (cm):	20
Worst Case Frequency (MHz):	1710.0
Maximum EIRP (dBm):	29.0
Maximum EIRP (mW):	794.33
General public - Power density limit (W/m2):	4.242

Power density at minimum use distance:

Power density (W/m2):	1.58
Verdict for general public:	PASS

The power density level for this transmission mode is below general public and controlled exposure power density limits.

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	12.21
Verdict for general public:	PASS

The minimum use distance is larger than general public and controlled exposure minimum compliance distances.

Assessment 6 - LTE Band 5

Maximum output power (dBm):	23.0
Antenna Gain (dBi):	6.0
Minimum use distance (cm):	20
Worst Case Frequency (MHz):	824.0
Maximum EIRP (dBm):	29.0
Maximum EIRP (mW):	794.33
General public - Power density limit (W/m2):	2.576

Power density at minimum use distance:

Power density (W/m2):	1.58
Verdict for general public:	PASS

The power density level for this transmission mode is below general public and controlled exposure power density limits.

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	15.67
Verdict for general public:	PASS

The minimum use distance is larger than general public and controlled exposure minimum compliance distances.

Assessment 7 - LTE Band 12

Maximum output power (dBm):	23.0
Antenna Gain (dBi):	6.0
Minimum use distance (cm):	20
Worst Case Frequency (MHz):	699.0
Maximum EIRP (dBm):	29.0
Maximum EIRP (mW):	794.33
General public - Power density limit (W/m2):	2.302

Power density at minimum use distance:

Power density (W/m2):	1.58
Verdict for general public:	PASS

The power density level for this transmission mode is below general public and controlled exposure power density limits.

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	16.57
Verdict for general public:	PASS

The minimum use distance is larger than general public and controlled exposure minimum compliance distances.

Assessment 8 - LTE Band 13

Maximum output power (dBm):	23.0
Antenna Gain (dBi):	6.0
Minimum use distance (cm):	20
Worst Case Frequency (MHz):	777.0
Maximum EIRP (dBm):	29.0
Maximum EIRP (mW):	794.33
General public - Power density limit (W/m2):	2.474

Power density at minimum use distance:

Power density (W/m2):	1.58
Verdict for general public:	PASS

The power density level for this transmission mode is below general public and controlled exposure power density limits.

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	15.98
Verdict for general public:	PASS

The minimum use distance is larger than general public and controlled exposure minimum compliance distances.

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.

The device can transmit using 25K0F1D and cellular technologies at the same time, so the worst case for simultaneous transmission will be:

$$\frac{0.0015}{2.74} + \frac{1.99}{2.58} = 0.00055+0.771=0.772 < 1 \text{ Limit}$$