

Assessment report No:

NIE: 52481RAN.004

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

Identification of item tested.....:	Radio transceiver
Trademark	IKUSI
Model and /or type reference	PVTTR2400-EMB/ PVTTR2400-MCX
Other identification of the product	FCC ID: PVTTR2400-EMB IC: 4166A-TR2400EMB FCC ID: PVTTR2400-MCX IC: 4166A-TR2400MCX
Final HW version	123662
Final SW version	V2.4.0
Manufacturer.....:	IKUSI ELECTRONICA SL Paseo Miramón, 170, 20014, San Sebastián, Guipúzcoa (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
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Identification of the client

IKUSI ELECTRONICA SL

Paseo Miramón, 170, 20014, San Sebastián, Guipúzcoa (SPAIN)

General description of the device under evaluation

The device under evaluation consists of a radio transceiver module which will be installed into host devices that will be used at a distance greater than 20 cm from the user. The evaluation distance used for this assessment has been 20 cm.

The equipment specifications declared by the manufacturer for each PVTTR2400 version are:

Assessment	Version	Antenna type	Band (MHz)	Technology	Maximum RF output power (dBm)	Max. Antenna gain (dBi)	Maximum E.I.R.P. (dBm)
1	PVTTR2400-EMB	Embedded antenna	2405-2475	Proprietary	20.5	+0.0	20.5
2	PVTTR2400-MCX	Antenna ports for external antenna	2405-2475	Proprietary	20.5	+0.5	21.0

Table 1: Equipment specifications

Assessment summary

Radiofrequency radiation exposure limits				
FCC 47 CFR § 2.1091 & ISED RSS-102 Issue 5 (2015-03)				
Assessment	Band (MHz)	Technology	Band	VERDICT (Pass/Fail)
1	2450	Proprietary	ISM	Pass
2	2450	Proprietary	ISM	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/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

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

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

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

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 – PVTTR2400-EMB module - Proprietary Protocol – 2450 MHz Band

Maximum output power (dBm):	20.5
Antenna Gain (dBi):	0.0
Minimum use distance (cm):	20
Worst Case Frequency (MHz):	2405
Maximum EIRP (dBm):	20.5
Maximum EIRP (mW):	112.20
General public - Power density limit (mW/cm2):	1.0

Power density at minimum use distance:

Power density (mW/cm2):	0.02
Verdict for general public:	PASS

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

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	2.99
Verdict for general public:	PASS

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

Assessment 2 – PVTTR2400-MCX module - Proprietary Protocol – 2450 MHz Band

Maximum output power (dBm):	20.5
Antenna Gain (dBi):	0.5
Minimum use distance (cm):	20
Worst Case Frequency (MHz):	2405
Maximum EIRP (dBm):	21.0
Maximum EIRP (mW):	125.9
General public - Power density limit (mW/cm ²):	1.0

Power density at minimum use distance:

Power density (mW/cm ²):	0.03
Verdict for general public:	PASS

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

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	3.17
Verdict for general public:	PASS

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

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 established in Health 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/ <i>f</i>	-	6**
1.1-10	87/ <i>f</i> ^{0.5}	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ <i>f</i> ^{0.25}	0.1540/ <i>f</i> ^{0.25}	8.944/ <i>f</i> ^{0.5}	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 <i>f</i> ^{0.3417}	0.008335 <i>f</i> ^{0.3417}	0.02619 <i>f</i> ^{0.6834}	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ <i>f</i> ^{1.2}
150000-300000	0.158 <i>f</i> ^{0.5}	4.21 x 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 x 10 ⁻⁵ <i>f</i>	616000/ <i>f</i> ^{1.2}
Note: <i>f</i> 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 for the module versions, the following equations have been used for the calculations:

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

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

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 – PVTTR2400-EMB module - Proprietary Protocol – 2450 MHz Band

Maximum output power (dBm):	20.5
Antenna Gain (dBi):	0.0
Minimum use distance (cm):	20
Worst Case Frequency (MHz):	2405
Maximum EIRP (dBm):	20.5
Maximum EIRP (mW):	112.20
General public - Power density limit (W/m2):	5.35

Power density at minimum use distance:

Power density (W/m2):	0.22
Verdict for general public:	PASS

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

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	4.08
Verdict for general public:	PASS

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

Assessment 2 – PVTTR2400-MCX module - Proprietary Protocol – 2450 MHz Band

Maximum output power (dBm):	20.5
Antenna Gain (dBi):	0.5
Minimum use distance (cm):	20
Worst Case Frequency (MHz):	2405
Maximum EIRP (dBm):	21.0
Maximum EIRP (mW):	125.9
General public - Power density limit (W/m2):	5.35

Power density at minimum use distance:

Power density (W/m2):	0.25
Verdict for general public:	PASS

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

Minimum compliance distance for this technology:

Minimum distance for general public (cm):	4.33
Verdict for general public:	PASS

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