RF-EXPOSURE ASSESSMENT REPORT

FCC 47 CFR Part 2.1091
Industry Canada RSS-102

RF-Exposure evaluation of mobile equipment

Report Reference No.....:	G0M-1801-7152-TFC091ME-V01
Testing Laboratory.....:	Eurofins Product Service GmbH
Address.....:	Storkower Str. 38c 15526 Reichenwalde Germany
Accreditation.....:	FCC Test Firm Designation Number: DE0008 IC Testing Laboratory site: 3470A-2
Applicant's name.....:	Kamstrup A/S
Address.....:	Industrivej 28 8660 Skanderborg DENMARK
Test specification:	
Standard.....:	47 CFR 2.1091 KDB 447498 D01 v06:2015-10-23 RSS-102, Issue 5:2015-03
Equipment under test (EUT):	
Product description	Kamstrup READy Collector Top
Model No.	Kamstrup READy Collector Top
Additional Model(s)	None
Brand Name(s)	None
Hardware version	RFboard: F1. CPUboard: D4 Complete box: A1
Firmware / Software version	C1
	FCC-ID: OUY-READYAMI IC: N/A
Test result	**Passed**

Possible test case verdicts:	
- neither assessed nor tested ..... :	N/N
- required by standard but not appl. to test object..... :	N/A
- required by standard but not tested..... :	N/T
- not required by standard for the test object ..... :	N/R
- test object does meet the requirement..... :	P (Pass)
- test object does not meet the requirement..... :	F (Fail)

Testing:		
Test Lab Temperature ..... :	20 – 23 °C	
Test Lab Humidity ..... :	32 – 38 %	
Date of receipt of test item ..... :	2018-02-20	
Date (s) of assessment ..... :	2018-02-26	
Compiled by ..... :	Toralf Jahn	
Assessed by (+ signature) ..... : (Responsible for Assessment)	Toralf Jahn	.....
Approved by (+ signature) ..... : (Head of Lab)	Christian Weber	.....
Date of issue ..... :	2018-03-20	
Total number of pages ..... :	12	

General remarks:

The test results presented in this report relate only to the object tested.

The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.

This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.

Additional comments:

Version History

Version	Issue Date	Remarks	Revised by
01	2018-03-20	Initial Release	

Eurofins Product Service GmbH
Storkower Str. 38c, D-15526 Reichenwalde, Germany

REPORT INDEX

1 Equipment (Test item) Description

Description	Kamstrup READy Collector Top
Model	Kamstrup READy Collector Top
Additional Model(s)	None
Brand Name(s)	None
Serial number	None
Hardware version	RFboard: F1. CPUboard: D4 Complete box: A1
Software / Firmware version	C1
PMN	None
HVIN	None
FVIN	None
HMN	None
FCC-ID	OUY-READYAMI
IC	N/A
Equipment type	End product

1.1 Reference Documents

Document type	Document No.	Issued by	Date
FCC 90I Test Report	G0M-1801-7152-TFC90PMR-V01	Eurofins Product Service GmbH	2018-03-07

1.2 Standalone Radiation Sources

Mode #	Description	
PMR	Frequency range [MHz]	451 - 470
	Transmission modes	4-FSK
	Maximum conducted power [dBm]	37.62
	Maximum radiated power eirp [dBm]	42.62
	Maximum transmission duty cycle [%]	100
	Antenna gain [dBi]	5.0
	Antenna diameter [cm]	150.0
	Assessment Frequency [MHz]	470

2 Result Summary

FCC 47 CFR Part 2.1091, IC RSS-102			
Product Specific Standard Section	**Requirement**	**Result**	**Remarks**
47 CFR 2.1091	Maximum permissible exposure @ 68cm below limit	PASS	
RSS-102 2.5.2	Maximum permissible exposure @ 91cm below limit	PASS	
Remarks:			

3 RF-Exposure Classifications

Device Types	
Fixed	A fixed device is defined as a device physically secured at one fixed location and cannot be easily re-located.
Mobile	A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons. (47 CFR 2.1091)
Portable	A portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user. (47 CFR 2.1093)
Exposure Categories	
Occupational / Controlled	Limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
General population / uncontrolled	Exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

4 Assessment

4.1 MPE Assessment Conditions – 47 CFR 2.1091 / RSS-102

MPE ASSESSMENT ACC. TO 47 CFR 2.1091 / ISED RSS-102				VERDICT: PASS
Assessment according to reference	Reference Method			
	FCC OET Bulletin 65 / RSS-102 & Safety Code 6			
Device type	fixed			
Exposure category	General public			
IC Limits – Occupational / Controlled Exposure				
Frequency range [MHz]	Electric field strength [V/M]	Magnetic field strength [A/M]	Power density [W/m^2]	Averaging time [min]
0.003-10*	170	180	-	Instantaneous*
0.1-10	-	1.6 / f	-	6**
1.29-10	193 / $f^{0.5}$	-	-	6**
10-20	61.4	0.163	-10	6
20-48	129.8 / $f^{0.25}$	0.3444 / $f^{0.25}$	44.72 / $f^{0.5}$	6
48-100	49.33	0.1309	6.455	6
100-6000	15.60 $f^{0.25}$	0.04138 $f^{0.25}$	0.6455 $f^{0.5}$	6
6000-15000	137	0.364	50	6
15000-150000	137	0.364	50	616000 / $f^{1.2}$
150000-300000	0.354 $f^{0.5}$	9.40 x 10^{-4} $f^{0.5}$	3.33 x 10^{-4} f	616000 / $f^{1.2}$
IC Limits – General Population / Uncontrolled Exposure				
Frequency range [MHz]	Electric field strength [V/M]	Magnetic field strength [A/M]	Power density [W/m^2]	Averaging time [min]
0.003-10*	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	3.142 $f^{0.3417}$	0.008335 $f^{0.3417}$	0.02619 $f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000 / $f^{1.2}$
150000-300000	0.158 $f^{0.5}$	4.21 x 10^{-4} $f^{0.5}$	6.67 x 10^{-5} f	616000 /$f^{1.2}$
* = Based on nerve stimulation ** = Bases on specific absorption rate				

FCC Limits – Occupational / Controlled Exposure				
Frequency range [MHz]	Electric field strength [V/M]	Magnetic field strength [A/M]	Power density [mW/cm^2]	Averaging time [min]
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 - 1500	N/A	N/A	f / 300	6
1500 - 100000	N/A	N/A	5.0	6
FCC Limits – General Population / Uncontrolled Exposure				
Frequency range [MHz]	Electric field strength [V/M]	Magnetic field strength [A/M]	Power density [mW/cm^2]	Averaging time [min]
0.3 – 1.34	614	1.63	(100)*	30
1.34 - 30	842 / f	2.19 / f	(180 / f^2)*	30
30 - 300	27.5	0.073	0.2	30
300 - 1500	N/A	N/A	f / 1500	30
1500 - 100000	N/A	N/A	1.0	30
* = Plane wave equivalent power density; f in MHz				

Assessment Relations

$$\lambda[m] = \frac{c\left[\frac{m}{s}\right]}{f[Hz]} \; ; \; R_{FF}[m] \geq \frac{2 \cdot D[m]^2}{\lambda[m]}$$

$$S[mW/cm^2] = \frac{P_{E.I.R.P.}[mW]}{4\pi R[cm]^2} \; ; \; R[cm] = \sqrt{\frac{P_{E.I.R.P.}[mW]}{4\pi S[mW/cm^2]}}$$

$$P_R[mW] = P_C[mW] \cdot G \; ; \; P_R[dBm] = P_C[dBm] + G[dBi]$$

$$DCC\ [dB] = 10 \cdot Log_{10}\left(\frac{DC[\%]}{100}\right)$$

Assessment procedure

For each radio and frequency band the worst case transmission mode with the highest peak conducted or radiated power is evaluated at the frequency that results in the most restrictive rf-exposure limit. From the peak power values, antenna gains and duty cycles taken from the reference documents, the source average radiated power values are calculated. From the average radiated power the power densities at antenna far-field distance, at 20cm separation distance from the radiation source is calculated. Compliance with the RF-Exposure limit is determined at 20cm separation distance.

4.2 Single-Transmitter Assessment – 47 CFR 2.1091 / RSS-102

Assessment result - PMR		
Transmission mode		
Operating mode frequency range [MHz]	451 - 470	
Assessment frequency (f) [MHz]	470	
Transmission duty cycle (DC) [%]	100	
Peak conducted power (P_C) [dBm]	37.62	
Peak radiated power (P_R) [dBm e.i.r.p.]	42.62	
Peak Antenna gain (G) [dBi]	5.0	
Maximum Antenna Diameter D [cm]	150.0	
Antenna far-field distance		
Transmission frequency wavelength (λ)	0.638 m	63.83 cm
Antenna far-field distance (R_{FF})	7.050 m	705.00 cm
Power evaluation		
Peak conducted power (P_C)	5780.96 mW	37.62 dBm
Peak Antenna Gain (G)	3.16	5.00 dBi
Calculated peak radiated power ($P_{R\text{-}Calc}$)	18281.00 mW	42.62 dBm
Measured peak radiated power (P_R)	18281.00 mW	42.62 dBm
Source average Power		
Maximum transmission duty cycle (DC)	100.0 %	
Duty cycle correction (DCC)	1.00	0.00 dB
Measured peak radiated power (P_R)	18281.00 mW	42.62 dBm
Averaged peak radiated power (P_{RAVG})	18281.00 mW	42.62 dBm
Power density		
Compliance power density limit FCC	0.313 mW/cm^2	3.13 W/m^2
Compliance power density limit IC	0.175 mW/cm^2	1.75 W/m^2
Power density @ Antenna far-field distance	0.003 mW/cm^2	0.029 W/m^2
Power density @ 20cm	3.637 mW/cm^2	36.369 W/m^2
Distance for compliance power density FCC	0.681 m	68.14 cm
Distance for compliance power density IC	0.910 m	91.05 cm
Verdict		
The EUT fulfills the FCC MPE limit @ 68.14 cm		
The EUT fulfills the IC MPE limit @ 91.05 cm!		
Comments:		