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RF-EXPOSURE ASSESSMENT REPORT

FCC 47 CFR Part 2.1091
Industry Canada RSS-102

RF-Exposure evaluation of mobile equipment

Report Reference No.....:	G0M-1412-4419-TFC091ME-V01
Testing Laboratory.....:	Eurofins Product Service GmbH
Address.....:	Storkower Str. 38c 15526 Reichenwalde Germany
Accreditation.....:	A2LA Accredited Testing Laboratory, Certificate No.: 1983.01 FCC Filed Test Laboratory, Reg.-No.: 96970 IC OATS Filing assigned code: 3470A
Applicant's name.....:	MKW electronics GmbH
Address.....:	Jutogasse 3 4675 Weibern Austria
Test specification:	
Standard.....:	47 CFR 1.1310 / 47 CFR 2.1091 / 47 CFR 2.1093 OET Bulletin 65:1997 RSS-102, Issue 5:2015-03 Safety Code 6:2015-03
Equipment under test (EUT):	
Product description	Chirp spread spectrum based transceiver used for wireless location
Model No.	W010
Additional Model(s)	None
Brand Name(s)	Smartbow
Hardware version	BNAHOST03
Firmware / Software version	FW 2.0.7
	FCC-ID: 2ADP3W010 IC: 12561A-W010
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 ..... :	2015-01-13
Date (s) of assessment ..... :	2015-05-28
Compiled by ..... :	Matthias Handrik
Assessed by (+ signature) ..... : (Responsible for Assessment)	Matthias Handrik
Approved by (+ signature) ..... : (Head of Lab)	Toralf Jahn
Date of issue ..... :	2015-05-28
Total number of pages ..... :	13

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.

Additional comments:

Version History

Version	Issue Date	Remarks	Revised by
01	2015-05-28	Initial Release	

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

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1 Equipment (Test item) Description

Description	Chirp spread spectrum based transceiver used for wireless location
Model	W010
Additional Model(s)	None
Brand Name(s)	Smartbow
Serial number	180b52000e2f
Hardware version	BNAHOST03
Software / Firmware version	FW 2.0.7
FCC-ID	2ADP3W010
IC	12561A-W010
Equipment type	Radio module

1.1 Reference Documents

Document type	Document No.	Issued by	Date
Radio Test Report	G0M-1412-4419-TFC247ZB-V01	Eurofins Product Service GmbH	2015-05-13

1.2 Standalone Radiation Sources

Mode #	Description	
CCS	Frequency range [MHz]	2412 – 2468.5
	Channels	1
	Transmission modes	CCS
	Modulations	None
	Maximum radiated power [dBm]	19.6
	Maximum transmission duty cycle [%]	100
	Antenna gain [dBi]	4
	Antenna diameter [cm]	17

1.3 Multi-transmitter Modes

No multi-transmitter modes supported.

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 @ 20cm below limit	PASS	
RSS-102 2.5.2	Maximum permissible exposure @ 20cm 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 – 47 CFR 2.1091 / RSS-102

MPE Assessment acc. to 47 CFR 2.1091 / IC RSS-102				Verdict: PASS
Assessment according to reference	Reference Method			
	FCC OET Bulletin 65 / RSS-102 & Safety Code 6			
Device type	mobile			
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.

Assessment results - CCS		
Transmission mode		
Operating mode frequency range [MHz]	2412 – 2468.5	
Assessment frequency (f) [MHz]	2412	
Transmission duty cycle (DC) [%]	100	
Peak conducted power (P_C) [dBm]	19.60	
Peak radiated power (P_R) [dBm e.i.r.p.]	21.60	
Peak Antenna gain (G) [dBi]	2.00	
Maximum Antenna Diameter D [cm]	20.0	
Antenna far-field distance		
Transmission frequency wavelength (λ)	0.124 m	12.44 cm
Antenna far-field distance (R_{FF})	0.643 m	64.32 cm
Power evaluation		
Peak conducted power (P_C)	91.20 mW	19.60 dBm
Peak Antenna Gain (G)	1.58	2.00 dBi
Calculated peak radiated power ($P_{R\text{-}Calc}$)	144.54 mW	21.60 dBm
Measured peak radiated power (P_R)	144.54 mW	21.60 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)	144.54 mW	21.60 dBm
Averaged peak radiated power (P_{RAVG})	144.54 mW	21.60 dBm
Power density		
Compliance power density limit FCC	1.000 mW/cm^2	10.00 W/m^2
Compliance power density limit IC	0.537 mW/cm2	5.37 W/m2
Power density @ Antenna far-field distance	0.003 mW/cm^2	0.028 W/m^2
Power density @ 20cm	0.029 mW/cm^2	0.288 W/m^2
Distance for compliance power density FCC	0.034 m	3.39 cm
Distance for compliance power density IC	0.046 m	4.63 cm
Verdict		
The power density of the EUT at 20cm is below the FCC MPE limit!		
The power density of the EUT at 20cm is below the IC MPE limit!		
Comments:		