RF-EXPOSURE REPORT

FCC 47 CFR Part 2.1093
ISED RSS-102

RF-Exposure evaluation of portable equipment

Report Reference No	G0M-2008-9229-TFC093PE-V02
Testing Laboratory	Eurofins Product Service GmbH
Address	Storkower Str. 38c 15526 Reichenwalde Germany
Accreditation	A2LA Accredited Testing Laboratory, Certificate No.: 1983.01 FCC Test Firm Designation Number: DE0008 ISED Testing Laboratory site: 3470A-2
Applicant	Hempel A/S
Address	Lundtoftegaardsvej 91 2800 Kgs. Lyngby Denmark
Test Specification	According to FCC/ISED rules
Standard	FCC 47 CFR 2.1093 ISED RSS-102 Issue 5
Non-Standard Test Method	None
Equipment under Test (EUT):	
Product Description	Temperature and humidity logger with BLE and LoRa communication
Model(s)	915 MHz
Additional Model(s)	None
Brand Name(s)	None
Hardware Version(s)	1.3.0
Software Version(s)	BLE v1.0.0, LoRa v1.4.0
FCC-ID	2AXRV-HT915
IC	-/-
Test Result	**PASSED**

Possible test case verdicts:	
required by standard but not tested	N/T
not required by standard	N/R
test object does meet the requirement	P(PASS)
test object does not meet the requirement	F(FAIL)
Testing:	
Test Lab Temperature	20 °C - 30 °C
Test Lab Humidity	25 % - 55 %
Date of receipt of test item	2020-09-08
Report:	
Compiled by	Charline Graf
Tested by (+ signature) (Responsible for Test)	Charline Graf .....
Approved by (+ signature) (Deputy Head of Lab)	Toralf Jahn .....
Date of Issue	2021-01-12
Total number of pages	15
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 History			
Version	Issue Date	Remarks	Revised By
01	2021-01-11	Initial Release	
02	2021-01-12	Replaced document: G0M-2008-9229-TFC093PE-V01 Replaced by: G0M-2008-9229-TFC093PE-V02 Reason: Limits for extremities for 914.2 MHz are corrected for FCC and ISED	C.Graf

ABBREVIATIONS AND ACRONYMS

Acronyms	
Acronym	Description
EIRP	Equivalent Isotropic Radiated Power
ERP	Effective Radiated Power
EUT	Equipment Under Test
LPE	Low Power Exclusion

REPORT INDEX

1 Equipment (Test Item) Under Test

Description	Temperature and humidity logger with BLE and LoRa communication
Model	915 MHz
Additional Model(s)	None
Brand Name(s)	None
Serial Number(s)	None
Hardware Version(s)	1.3.0
Software Version(s)	BLE v1.0.0, LoRa v1.4.0
PMN	-/-
HVIN	-/-
FVIN	-/-
HMN	-/-
FCC ID	2AXRV-HT915
IC	-/-
Equipment type	End Product
Environment	General public
Use case	Extremities

1.1 Reference Documents

Document Type	Document No.	Issued by	Date
Radio Test Report FCC 47 CFR Part 15C ISED Canada RSS-247	G0M-2008-9229-TFC247BL-V01	Eurofins Product Service GmbH	2020-12-21
Radio Test Report FCC 47 CFR Part 15C ISED Canada RSS-247	G0M-2008-9229-TFC247DT-V01	Eurofins Product Service GmbH	2020-12-21

1.2 Standalone radiation sources

Standalone radiation sources					
Mode	**Operating Frequency [MHz]**	**Maximum conducted power [dBm]**	**Maximum radiated power [dBm EIRP]**	**Maximum duty cycle [%]**	**Antenna distance to body [mm]**
Bluetooth LE	2402	-5.395	-5.395	100	5.0
	2440	-5.356	-5.356	100	5.0
	2480	-6.217	-6.217	100	5.0
LoRa 902-928 MHz	903.0	14.566	14.566	100	5.0
	909.4	13.785	13.785	100	5.0
	914.2	14.348	14.348	100	5.0
Comment:					

1.3 Concurrent Sources

No concurrent radiation sources

2 Result Summary

Standalone sources - FCC KDB 447498				
Product Standard Reference	**Requirement**	**Reference Method**	**Mode**	**Verdict**
KDB 447498	SAR Test Exclusion	KDB 447498 4.3.1	Bluetooth LE	PASS
KDB 447498	SAR Test Exclusion	KDB 447498 4.3.1	LoRa 902-928 MHz	PASS
Comment: The evaluation refers only to the extremity use case.				

Standalone sources - ISED RSS-102				
Product Standard Reference	**Requirement**	**Reference Method**	**Mode**	**Verdict**
ISED RSS-102	SAR Test Exclusion	ISED RSS-102 2.5.1	Bluetooth LE	PASS
ISED RSS-102	SAR Test Exclusion	ISED RSS-102 2.5.1	LoRa 902-928 MHz	PASS
Comment: The evaluation refers only to the extremity use case.				

3 RF-Exposure classification

RF-Exposure Categories	
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.
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.

RF-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 RF-Exposure limits and exclusion thresholds

4.1 SAR limits

SAR Limits		
Type	**Occupational SAR values [W / kg]**	**General population SAR values [W / kg]**
Whole-body SAR averaging mass = entire body	0.4	0.08
Partial-body Localized Head, Neck and Trunk SAR averaging mass = 1g	8.0	1.6
Hands, Wrists, Feet and Ankles Localized Limbs SAR averaging mass = 10g	20.0	4

4.2 SAR standalone test exclusion threshold

SAR test exclusion power acc. to FCC KDB 447498 D01 – Standalone operation

Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied. These test exclusion conditions are based on source-based time-averaged maximum conducted output power of the RF channel requiring evaluation, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions.

The minimum test separation distance is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

a) For 100 MHz to 6 GHz and test separation distances ≤ 50 mm

$$\frac{max.\ power\ of\ channel\ [mW]}{min.\ test\ separation\ distance\ [mm]} \cdot \sqrt{f[GHz]} \leq \begin{cases} 3.0 & 1g\ SAR \\ 7.5 & 10g\ SAR \end{cases}$$

b) For 100 MHz to 6 GHz and test separation distances > 50 mm

1) For 100 to 1500 MHz

$$\left\{Power\ allowed\ at\ numeric\ threshold\ for\ 50\ mm\ in\ step\ a + (\text{test separation distance} - 50\text{mm}) \cdot \frac{f(MHz)}{150}\right\}, mW$$

2) for > 1500 MHz and ≤ 6 GHz

$$\{Power\ allowed\ at\ numeric\ threshold\ for\ 50\ mm\ in\ step\ a + (\text{test separation distance} - 50\text{mm}) \cdot 10\}, mW$$

c) for frequencies below 100 MHz:

1) test separation distances > 50 mm and < 200 mm:

the power threshold at the corresponding test separation distance at 100 MHz in step b) is multiplied by

$$\left(1 + \log\left(\frac{100}{f(MHz)}\right)\right)$$

2) test separation distances ≤ 50 mm:

the power threshold determined by the equation in c) 1) for 50 mm and 100 MHz is multiplied by ½

SAR test exclusion power acc. to ISED RSS-102 – Standalone Operation

SAR evaluation is required if the separation distance between the user and the radiating element of the device is less than or equal to 20 cm, except when the device operates at a power level below the following threshold limits:

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation are multiplied by a factor of 2.5.

For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in the Tables are multiplied by a factor of 5

4.3 SAR concurrent test exclusion threshold

SAR test exclusion acc. to ISED RSS-102 + FCC KDB 447498 D01 – Concurrent operation

When the sum of 1-g or 10-g SAR of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit, SAR test exclusion applies to that simultaneous transmission configuration.

For the test exclusion to apply, the maximum output power, duty factor, and other applicable parameters used in the standalone SAR tests, must be the same or more conservative than those required for simultaneous transmission.

When an antenna qualifies for the standalone SAR test exclusion of 4.3.1 and also transmits simultaneously with other antennas, the standalone SAR value must be estimated according to the following to determine the simultaneous transmission SAR test exclusion criteria:

1) $\frac{\text{max.power of channel,including tune-up tolerance,mW}}{\text{min.test separation distance,mm}} \cdot \frac{\sqrt{f(GHz)}}{x}$, for test separation distances ≤ 50 mm

   where x = 7.5 for 1-g SAR and x = 18.75 for 10-g SAR

2) 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distance is > 50 mm

5 RF-Exposure Evaluation

Evaluation procedure acc. to FCC KDB 447498
Standalone operational modes 1) For each standalone operational mode the associated frequencies, conducted output power values, duty cycles and antenna separation distances to the human body are specified 2) From the conducted power and the duty cycle the source-based time averaged conducted output power is calculated 3) The transmission frequency, average power and separation distance is used to determine the SAR test exclustion power threshold value acc. to FCC KDB 447498 D01 4) If the time averaged ouput power of the transmission mode is lower than the SAR test exclusion power threshold value, the mode califies for SAR test exclusion and no further SAR evaluation is needed Concurrent operational modes 1) For each operational mode that participates in the concurrent operational mode, the estimated SAR is calculated from the source-based time average conducted ouput power and the separation distance to the human body for each transmission frequency of the operation mode 2) The maximum estimated SAR value for each operational is determined 3) The sum of SAR values of the maximum estimated SAR values for each operational mode is calculated 4) If the sum of SAR values is below the corresponding SAR limit, the concurrent operational mode califies for SAR test exclusion and no further evaluation is needed

Evaluation procedure acc. to ISED RSS-102
Standalone operational modes 1) For each standalone operational mode the associated frequencies, conducted and radiated output power values, duty cycles and antenna separation distances to the human body are specified 2) From the higher of the conducted or radiated power and the duty cycle the source-based time averaged output power is calculated 3) The transmission frequency, average power and separation distance is used to determine the SAR test exclustion power threshold value acc. to ISED RSS-102 4) If the time averaged ouput power of the transmission mode is lower than the SAR test exclusion power threshold value, the mode califies for SAR test exclusion and no further SAR evaluation is needed Concurrent operational modes 1) For each operational mode that participates in the concurrent operational mode, the estimated SAR is calculated from the source-based time average conducted ouput power and the separation distance to the human body for each transmission frequency of the operation mode 2) The maximum estimated SAR value for each operational is determined 3) The sum of SAR values of the maximum estimated SAR values for each operational mode is calculated 4) If the sum of SAR values is below the corresponding SAR limit, the concurrent operational mode califies for SAR test exclusion and no further evaluation is needed

6 Single Source Evaluation Results - FCC

Results – Standalone Operational Modes							
Mode	Frequency [MHz]	Power [mW]	Duty Cycle	Average Power [mW]	Distance [mm]	Power Limit [mW]	Verdict
Bluetooth LE	2402	0.29	1.00	0.29	5.0	24	PASS
	2440	0.29	1.00	0.29	5.0	24	PASS
	2480	0.24	1.00	0.24	5.0	24	PASS
LoRa 902-928 MHz	903.0	28.62	1.00	28.62	5.0	39	PASS
	909.4	23.91	1.00	23.91	5.0	39	PASS
	914.2	27.21	1.00	27.21	5.0	39	PASS
Comment:							

7 Single Source Evaluation Results - ISED

Results – Standalone Operational Modes							
Mode	Frequency [MHz]	Power [mW]	Duty Cycle	Average Power [mW]	Distance [mm]	Power Limit [mW]	Verdict
Bluetooth LE	2402	0.29	1.00	0.29	5.0	10.7	PASS
	2440	0.29	1.00	0.29	5.0	10.1	PASS
	2480	0.24	1.00	0.24	5.0	9.9	PASS
LoRa 902-928 MHz	903.0	28.62	1.00	28.62	5.0	40.9	PASS
	909.4	23.91	1.00	23.91	5.0	40.8	PASS
	914.2	27.21	1.00	27.21	5.0	40.6	PASS
Comment:							

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