Report on the FCC and IC Testing of the GWF AG

Model: ERH

In accordance with FCC 47 CFR Parts 1 and 15 and ISED RSS-102 and RSS-GEN

Product Service

Add value.
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Prepared for: GWF AG
Obergrundstrasse 119
CH-6005 Lucerne
Switzerland

FCC ID: 2A4F7-ERH
IC: 28165-ERH

COMMERCIAL-IN-CONFIDENCE

Date: 2023-09-26
Document Number: TR-713292918-02 | Revision 2

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Alexander Deese	2023-09-26	SIGN-ID 835342
Authorised Signatory	Matthias Stumpe	2023-09-28	SIGN-ID 835774

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

Engineering Statement:

This measurement shown in this report were made in accordance with the procedures described on test pages.
All reporded testing was carried out on a sample equipment to demonstrate limited compilance with with FCC 47 CFR Parts 1 and 15 C and ISED RSS-102 and RSS-GEN.
The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Alexander Deese	2023-09-26	SIGN-ID 835342

Laboratory Accreditation	Laboratory recognition	Industry Canada test site registration
DAkkS Reg. No. D-PL-11321-11-03 DAkkS Reg. No. D-PL-11321-11-04	Registration No. BNetzA-CAB-16/21-15	3050A-2

Executive Statement:

A sample of this product was tested and found to be compliant with FCC 47 CFR Parts 1 and 15 C:2021 and ISED RSS-102:2017 and RSS-GEN:2021

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Content

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1 Report Summary

1.1 Modification Report

Alternations and additions of this report will be issued to the holders of each copy in the form of a complete document.

Revision	*Description of changes*	*Date of Issue*
0	First Issue	2023-02-24
1	ERP and Conducted Output Power added to evaluation. Test separation distance changed to 2 cm.	2023-09-04
2	ERP value in table 5 corrected and results in [mW] added.	2023-09-26

Table 1: Report of Modifications

1.2 Introduction

Applicant	GWF AG Obergrundstrasse 119 CH-6005 Lucerne Switzerland
Manufacturer	ESCATEC Mechatronics Sdn. Bhd. 8 Jalan Firma 2/1 Kawasan Perindustrian Tebrau 1 81100 Johor Bahru Johor Malaysia
Model Number(s)	ERH
Serial Number(s)	---
Hardware Version(s)	---
Software Version(s)	---
Number of Samples Tested	1
Test Specification(s) / Issue / Date	47 CFR Part 1: 2021 47 CFR Part 15: 2021 ISED RSS-102:2017, Amd. 1: February 2021 ISED RSS-GEN, Issue 5, Amd. 1, Amd. 2: February 2021
Test Plan/Issue/Date	N/A
Order Number	5753425 REV 3.0
Date	2023-01-31
Date of Receipt of EUT	2023-02-20
Start of Test	2023-02-20
Finish of Test	2023-02-21
Name of Engineer(s)	Alexander Deese

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1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Parts 1 and 15, ISED RSS-102 is shown below.

Section	*Specification Clause*	*Test Description*	*Result*
2.1	15.247(i) , 1.1307(b)(3)(B)	RF Exposure	Pass

Table 2: Results according to FCC 47 CFR Parts 1 and 15

Section	*Specification Clause*	*Test Description*	*Result*
2.1	3.4	RF Exposure	Pass

Table 3: Results according to RSS-Gen

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1.4 Product Information

1.4.1 Technical Description

The ERH is an external LoRaWAN radio module for water and gas meters.

Frequency Band	902 – 928 MHz
Frequency range	902.3 MHz to 914.9 MHz
Number of frequency channels:	64
Power supply:	Lithium Ion Battery
Supply Voltage nominal:	3 V
Supply Voltage maximum:	3.5 V
Supply Voltage minimum:	2.2 V
Supply Frequency:	DC

1.5 Test Configuration

The EUT was configured as standalone device.

1.6 Modes of Operation

Mode 1:
Continuously transmitting, Carrier frequency 902.3 MHz

Mode 2:
Continuously transmitting, Carrier frequency 908.5 MHz

Mode 3:
Continuously transmitting, Carrier frequency 914.9 MHz

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1.7 EUT Modifications Record

The table below details modifications made to the EUT during the test program.
The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
0	As supplied by the customer	Not Applicable	Not Applicable

Table 4

1.8 Test Location

TÜV SÜD Product Service conducted the following tests at our Straubing test laboratory:

Test Name	*Name of Engineer(s)*
RF Exposure	Alexander Deese

Office Address:
Äußere Frühlingstraße 45
94315 Straubing
Germany

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2 Test Details

2.1 RF Exposure

2.1.1 Specification Reference

47 CFR, Part 1, § 1.1307(b)(3)(B)
47 CFR Part 15 C, Clause 15.247(i)
ISED RSS-Gen, Clause 3.4
ISED RSS-102, Clauses 2.5

2.1.2 Equipment under Test and Modification State

ERH; S/N ---; Modification State 0

2.1.3 Date of Test

2023-02-20 to 2023-02-21

2.1.4 Environmental Conditions

Ambient Temperature	19 °C
Relative Humidity	40 %

2.1.5 Test Method

Estimation is based on output power test.
For details, please refer to section 2.6 of the test report TR-713292918-02.

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2.1.6 Specification Limits

47 CFR, Part 1, § 1.1307(b)(3)

(i) For single RF sources (i.e. any single fixed RF source, mobile device, or portable device, as defined in paragraph(b)(2) of this section): A single RF source is exempt if:

(A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

(B) Or the available maximum time-averaged power or effective radiate power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by

$$P_{th}(\text{mW}) = \begin{cases} ERP_{20\text{cm}}\,(d/20\ cm)^{x}, & d \le 20\ \text{cm}; \\ ERP_{20\text{cm}}, & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases}$$

where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\text{cm}}\sqrt{f}}\right);\ f \text{ in GHz}$$

and

$$ERP_{20\text{cm}}(mW) = \begin{cases} 2040\,f, & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060, & 1.5\ \text{GHz} \le f \le 1.5\ \text{GHz} \end{cases}$$

d = the test separation distance (cm);

(C) Or using the table below and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value described for that frequency. For the exemption in the table to apply, R must be at least $\lambda/2\pi$ where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

RF source frequency (MHz)	*Threshold ERP (Watts)*
0.3 – 1.34	1920 R^2
1.34 – 30	3450 R^2 / f^2
30 – 300	3.83 R^2
300 – 1500	0.0128 $R^2 f^2$
1500 – 100000	19.2 R^2

(ii) For multiple RF sources: Multiple RF sources are exempt if:

(A) The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of 2 cm between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(i)(A).

(B) In case of fixed RF sources operating in the same time-averaging period, or of multiple or portable RF sources within a device in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation:

$$\sum_{i=1}^{a}\frac{P_i}{P_{th,i}} + \sum_{j=1}^{b}\frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^{c}\frac{Evaluated_k}{ExposureLimit_k} \le 1$$

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RSS-102, section 2.5.1

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in the table below:

f (MHz)	*Exemption Limits (mW) at separation distance of*									
	≤ 5 mm	*10 mm*	*15 mm*	*20 mm*	*25 mm*	*30 mm*	*35 mm*	*40 mm*	*45 mm*	*≥ 50 mm*
≤ 300	71	101	132	162	193	223	254	284	315	345
450	52	70	88	106	123	141	159	177	195	213
835	17	30	42	55	67	80	92	105	117	130
1900	7	10	18	34	60	99	153	225	316	431
2450	4	7	15	30	52	83	123	173	235	309
3500	2	6	16	32	55	86	124	170	225	290
5800	1	6	15	27	41	56	71	85	97	106

Output power level shall be the higher of the maximum conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power. For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for route evaluation are multiplied by a factor of 5. For limb-worn devices where the 10 grams value applies, the exemption limits for routine evaluation are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located, linear interpolation shall be applied for the applicable separation distance. For test separation distance less than 5 mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required.

For medical implants devices, the exemption limit for routine evaluation is set at 1 mW. The output power of a medical implant device is defined as the higher of the conducted or e.i.r.p. to determine whether the device is exempt from the SAR evaluation.

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2.1.7 Test Results

Output power was calculated using equation (22) in ANSI C63.10, clause 9.5:

$$EIRP = E_{Meas} + 20\ log(d_{Meas}) - 104.7\ dB$$

EIRP is the equivalent isotropically radiated power, in dBm
E_{Meas} is the field strength of the emission at the measurement distance, in dBµV/m
d_{Meas} is the measurement distance, in m

Frequency Channel	*3 m Fieldstrength [dBµV/m]*	*EIRP [dBm]*	*ERP [dBm]*	*ERP [mW]*	*Conducted Output Power [dBm]*	*Conducted Output Power [mW]*
902.3 MHz	109.00	13.77	11.62	14.52	15.90	38.90
908.5 MHz	110.63	15.40	13.25	21.13	16.07	40.46
914.9 MHz	110.20	14.97	12.82	19.14	15.99	39.72

Table 5: Output Power

Minimum test separation distance was defined as 2 cm.

47 CFR Part 1, § 1.1307(b)(3)(i)(B)

f (MHz)	*ERP (mW)*	*Pth (mW)*	*Rating*
902.3	14.52	63.16	Exempt from standard evaluation
908.5	21.13	62.95	Exempt from standard evaluation
914.9	19.14	62.73	Exempt from standard evaluation

ISED RSS-102, Clause 2.5.1

f (MHz)	*Conducted Output Power (mW)*	*Exemption Limit (mW)*	*Rating*
902.3	38.90	53.67	Exempt from standard evaluation
908.5	40.46	53.55	Exempt from standard evaluation
914.9	39.72	53.42	Exempt from standard evaluation

Exemption Limits were calculated with linear interpolation using values from ISED RSS-102, Clause 2.5.1, table 1 as seen above.

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3 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

The measurement uncertainty in the laboratory is less than or equal to the maximum measurement uncertainty according to CISPR16-4-2: 2011 + A1 + A2 + Cor1 (U_{CISPR}). This normative regulation means that the measured value is also the value to be assessed in relation to the limit value.

Radio Interference Emission Testing		
Test Name	*kp*	*Expanded Uncertainty*
Conducted Voltage Emission		
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB
100 kHz to 200 MHz (50Ω/5µH AMN)	2	± 3.6 dB
Discontinuous Conducted Emission		
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB
Conducted Current Emission		
9 kHz to 200 MHz	2	± 3.5 dB
Magnetic Fieldstrength		
9 kHz to 30 MHz (with loop antenna)	2	± 3.9 dB
9 kHz to 30 MHz (large-loop antenna 2 m)	2	± 3.5 dB
Radiated Emission		
30 MHz to 300 MHz	2	± 4.9 dB
300 MHz to 1 GHz	2	± 5.0 dB
1 GHz to 6 GHz	2	± 4.6 dB
Test distance 10 m		
30 MHz to 300 MHz	2	± 4.9 dB
300 MHz to 1 GHz	2	± 4.9 dB
The expanded uncertainty reported according to to CISPR16-4-2: 2011 + A1 + A2 + Cor1 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%		

Table 6 Measurement uncertainty based on CISPR 16-4-2

Radio Interference Emission Testing		
Test Name	*kp*	*Expanded Uncertainty*
Occupied Bandwdith	2	± 5 %
Conducted Power		
9 kHz ≤ f < 30 MHz	2	± 1.0 dB
30 MHz ≤ f < 1 GHz	2	± 1.5 dB
1 GHz ≤ f ≤ 40 GHz	2	± 2.5 dB
1 MS/s power sensor (TS8997)	2	± 1.5 dB
Occupied Bandwidth	2	± 5 %
Power Spectral Density	2	± 3.0 dB
Radiated Power		
9 kHz ≤ f < 26.5 GHz	2	± 6.5 dB
26.5 GHz ≤ f < 60 GHz	2	± 8.0 dB
60 GHz ≤ f < 325 GHz	2	± 10 dB
Conducted Spurious Emissions	2	± 3.0 dB
Radiated Spurious Emissions	2	± 6.0 dB
Voltage		
DC	2	± 1.0 %
AC	2	± 2.0 %
Time (automatic)	2	± 5 %
Frequency	2	± 10^{-7}
The expanded uncertainty reported according to to ETSI TR 100 028:2001 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%		

Table 7 Measurement uncertainty based on ETSI TR 100 028