



RF - TEST REPORT

- Human Exposure -

Type / Model Name : smaXtec Classic Bolus SX.2, smaXtec pH Plus Bolus SX.2

Product Description : Animal sensor with RF interface

Applicant : smaXtec animal care GmbH

Address : Belgiergasse 3
8020 GRAZ, AUSTRIA

Manufacturer : RSG Elotech Elektronische Baugruppen GmbH

Address : Richard-Köcher-Straße 35
07356 BAD LOBENSTEIN, GERMANY

Test Result according to the standards listed in clause 1 test standards:	POSITIVE
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Test Report No. : T47447-00-02HS	11. May 2021 <hr/> Date of issue
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Deutsche
Akkreditierungsstelle
D-PL-12030-01-03
D-PL-12030-01-04

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ATTACHMENT A as separate supplement

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 1, Subpart I - Procedures Implementing the National Environmental Policy Act of 1969

Part 1, Subpart I, Section 1.1310	Radiofrequency radiation exposure limits
Part 1, Subpart 2, Section 2.1091	Radiofrequency radiation exposure evaluation: mobile devices .
Part 1, Subpart 2, Section 2.1093	Radiofrequency radiation exposure evaluation: portable devices .
KDB 447498 D01 v06	RF Exposure procedures and equipment authorisation policies for mobile and portable devices, October 23, 2015.
ANSI C95.1: 2005	IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
ETSI TR 100 028 V1.3.1: 2001-03,	Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Uncertainties in the Measurement of Mobile Radio Equipment Characteristics—Part 1 and Part 2

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2 EQUIPMENT UNDER TEST

2.1 Information provided by the Client

Please note, we do not take any responsibility for information provided by the client or his representative which may have an influence on the validity of the test results.

2.2 Sampling

The customer is responsible for the choice of sample. Sample configuration, start-up and operation is carried out by the customer or according his/her instructions.

2.3 Photo documentation of the EUT – See ATTACHMENT A

2.4 Equipment type, category

LoRa device, portable equipment.

2.5 Short description of the equipment under test (EUT)

The EUT use a RF interface with LoRa modulation. The EUT is intended to be used inside of a cow in order to monitor the animal well-being.

Number of tested samples: 1 conducted sample
 Serial number: 1B00000002
 Firmware version: v10

EUT configuration:
 (The CDF filled by the applicant can be viewed at the test laboratory.)

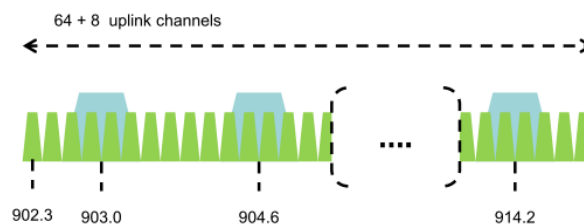
2.6 Variants of the EUT

There are two variants:
 1. smaXtec Classic Bolus SX.2
 2. smaXtec pH Plus Bolus SX.2, additional pH sensor.

Note: For testing the smaXtec pH Plus Bolus SX.2 is used.

2.7 Operation frequency

The EUT use the operating frequency and channels of the lora US902-928 regional parameters with upload frequencies in range of 902.3 to 914.2 MHz.



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2.8 Transmit operating modes

DataRate	Configuration	Indicative physical bit rate (bit/sec)
0	LoRa: SF10 / 125 kHz	250
1	LoRa: SF9 / 125 kHz	1760
2	LoRa: SF8 / 125 kHz	3125
3	LoRa: SF7 / 125 kHz	5470
4	LoRa: SF8 / 500 kHz	12500
5:7	RFU	

2.9 Antenna

The following antenna shall be used with the EUT:
 PCB-meander-antenna, Gain = -13.3 dbi.

2.10 Power supply system utilised

Power supply voltage, V_{nom} : 3.0 VDC (lithium battery)

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3 TEST RESULT SUMMARY

LoRa device using digital modulation:

Operating in the 902 MHz – 915 MHz band:

FCC Rule Part	RSS Rule Part	Description	Result
KDB 447498, 7.1	RSS 102, 2.5.2	MPE	not applicable
KDB 447498, 4.3.1	RSS 102, 2.5.1	SAR exclusion consideration	passed
KDB 447498, 7.2	RSS102, 3.2	Co-location, Co-transmission	not applicable

The mentioned RSS Rule Parts in the above table are related to:
RSS 102, Issue 5, March 2015

3.1 Final assessment

The equipment under test fulfills the requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 26 April 2021

Testing concluded on : 28 April 2021

Checked by:

Tested by:

Klaus Gegenfurtner
Teamleader Radio

Hermann Smetana
Radio Team

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4 TEST ENVIRONMENT

4.1 Address of the test laboratory

**CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY**

4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15 - 35 °C

Humidity: 30 - 60 %

Atmospheric pressure: 86 - 106 kPa

4.1 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor $k = 2$. The true value is located in the corresponding interval with a probability of 95 %. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 2011 + A1 / 2014 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

4.2 Conformity Decision Rule

The conformity decision rule is based on the ILAC G8 published at the time of reporting.

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5 HUMAN EXPOSURE

5.1 Maximum permissible exposure (MPE)

For test instruments and accessories used see section 6 Part **CPC 3**.

5.1.1 Description of the test location

Test location: NONE

Remarks: Not applicable, the EUT is handheld device

5.2 Co-location and Co-transmission

Applicable standard:

OET Bulletin 65, Edition 97-01, Section 2: Multiple-transmitter sites and Complex Environments

The FCC's MPE limits vary with frequency. Therefore, in mixed or broadband RF fields where several sources and frequencies are involved, the fraction of the recommended limit (in terms of power density or square of the electric or magnetic field strength) incurred within each frequency interval should be determined, and the sum of all fractional contributions should not exceed 1.0, or 100 % in terms of percentage.

Remarks: Not applicable, the EUT has one transmitter only.

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5.3 SAR test exclusion considerations

5.3.1 Applicable standard

According to RF exposure guidance:

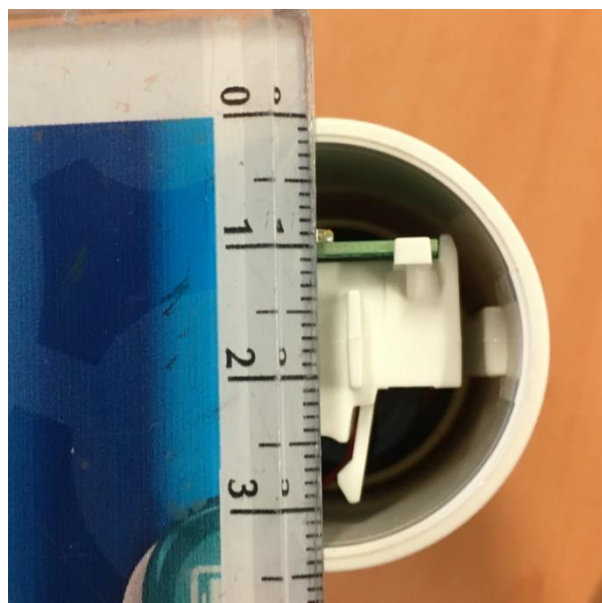
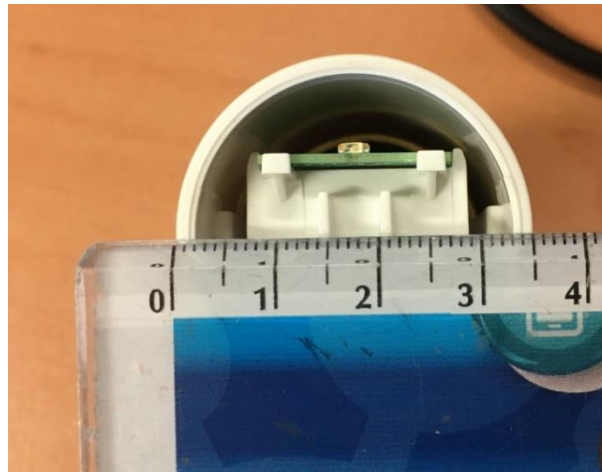
Systems operating under the provisions of this section shall be operated in a manner that the public is not exposed to radio frequency energy levels in excess of the Commission’s guidelines.

5.3.2 Determination of the standalone SAR test exclusion threshold

The minimum separation distance results from the application of the Voxter which is handled by hand. This distance is assumed to ≤ 50 mm from antenna to the hand of the user.

The hand of the user is the nearest extremity of a human being which is in contact before the bolus is applied to a cow. After application the bolus is inserted to the cow the bolus will stay in the stomach of the cow. This application is the worst case and therefore the body SAR applies. **The threshold for 1-g is determined.**

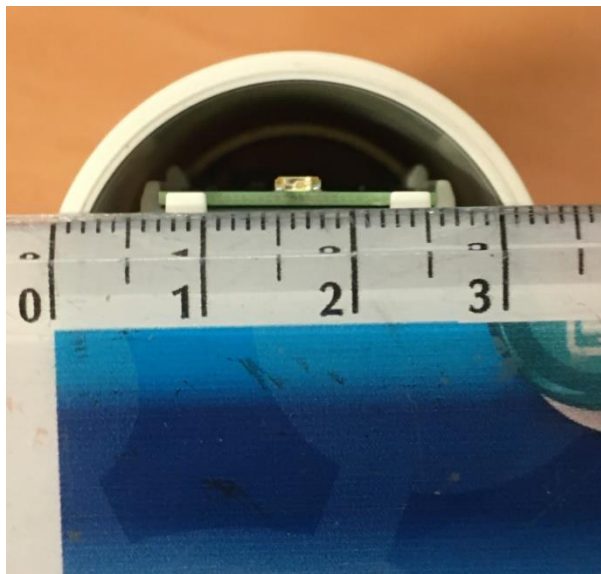
5.3.2.1 Minimum distance:



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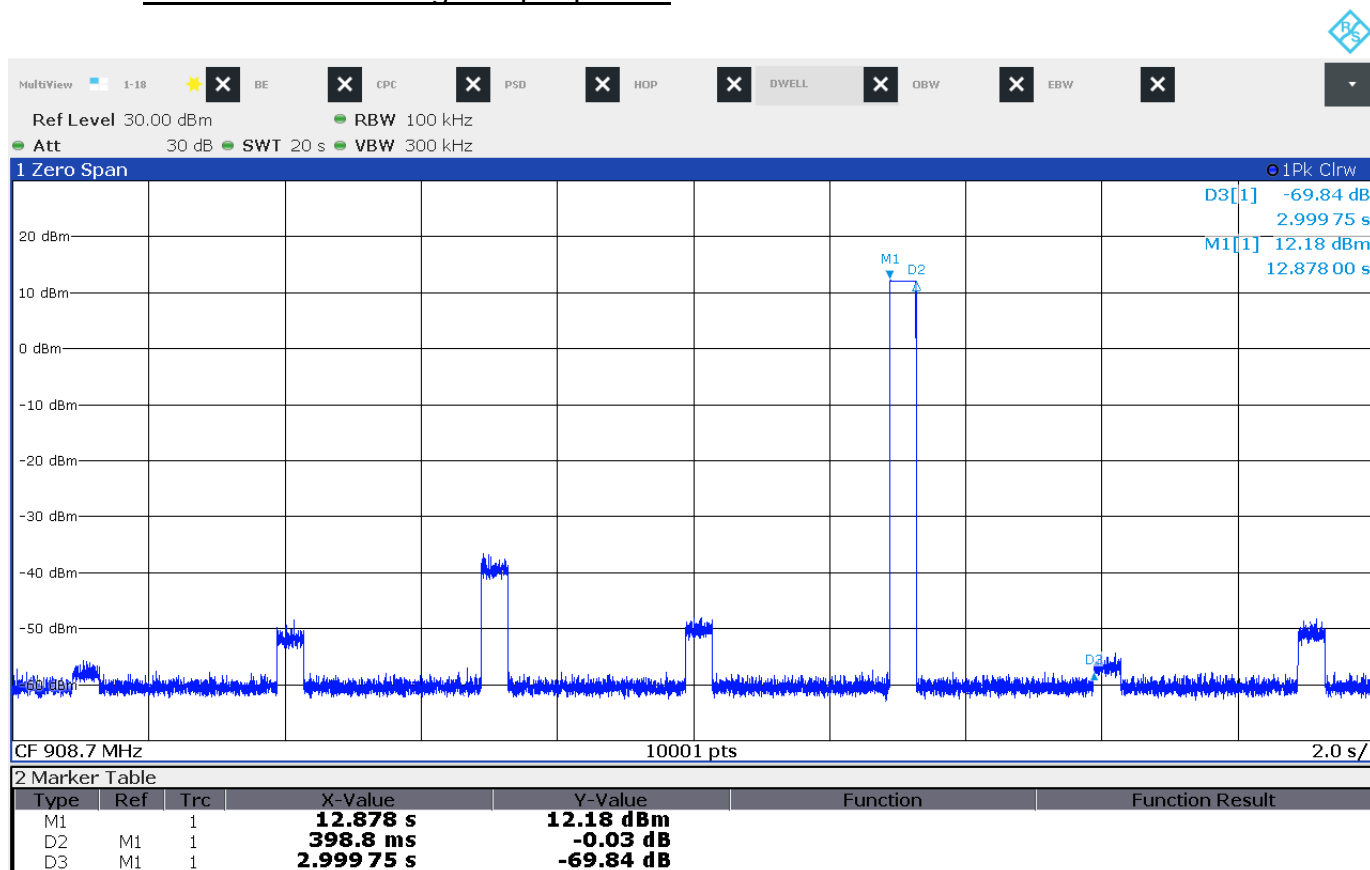
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The minimum distance is 7 mm between radiating structure and outer case.

5.3.2.2 Determination average output power:



Average output power = peak power + Duty cycle

Duty cycle = $10\log(t/T) = 10\log(0.4\text{ s} / 3\text{ s}) = -8.8\text{ dB}$

Peak power = 11.6 dBm

Average output power = 11.6 dBm – 8.8 dB = 2.8 dBm

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5.3.2.3 Determination threshold level

The formula under 4.3.1 1) for 100 MHz to 6 GHz for standalone equipment is used:
 $[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] * [\sqrt{f(\text{GHz})}] \leq 7.5;$

The max conducted peak power is according to the test report T47447-00-00HS by CSA Group Bayern GmbH :

Rated average output power conducted:	2.0 mW	3.0 dBm
Tune-up tolerance:	2.0 dB	
Maximum output power:	5.0 dBm	3.2 mW
Antenna gain max:	-13.3 dBi	
Maximum EIRP:	-8.3 dBm	0.1 mW
Minimum distance r:	7.0 mm	

Channel frequency (MHz)	A (mW)	Threshold level	Limit 1g	Limit 10g	Magin 1g	Magin 10g
902.75	3.2	0.43	3.0	7.5	-2.6	-7.1
908.7	3.2	0.43	3.0	7.5	-2.6	-7.1
914.9	3.2	0.43	3.0	7.5	-2.6	-7.1

Conclusion: The Threshold level is much lower than the limit, SAR measurement is NOT necessary.

Remarks:

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5.4 Exemption limits for routine evaluation - SAR evaluation

5.4.1 Applicable standard

According to RSS-102, item 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 Table 1.

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance 4, 5

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

4 The exemption limits in Table 1 are based on measurements and simulations of half-wave dipole antennas at separation distances of 5 mm to 25 mm from a flat phantom, providing a SAR value of approximately 0.4 W/kg for 1 g of tissue. For low frequencies (300 MHz to 835 MHz), the exemption limits are derived from a linear fit. For high frequencies (1900 MHz and above), the exemption limits are derived from a third order polynomial fit.

5 Transmitters operating between 0.003-10 MHz, meeting the exemption from routine SAR evaluation, shall demonstrate compliance to the instantaneous limits in Section 4.

The table 1 shows the exemption limit for 835 MHz only but not for the 902 MHz user frequency. The KDB 447498 table of Annex A gives a better approximation to the real frequency. This value is used to show the exemption.

Appendix A

SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distances are illustrated in the following Table. The equation and threshold in 4.3.1 must be applied to determine SAR test exclusion.

MHz	5	10	15	20	25	mm
150	39	77	116	155	194	SAR Test Exclusion Threshold (mW)
300	27	55	82	110	137	
450	22	45	67	89	112	
835	16	33	49	66	82	
900	16	32	47	63	79	
1500	12	24	37	49	61	
1900	11	22	33	44	54	
2450	10	19	29	38	48	

The applied exemption limit is 16 mW at 900 MHz.

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5.4.2 Conclusion according RSS-102.

Rated average output power conducted:	2.0 mW	3.0 dBm
Tune-up tolerance:	2.0 dB	
Maximum output power:	5.0 dBm	3.2 mW
Antenna gain max:	-13.3 dBi	
Maximum EIRP:	-8.3 dBm	0.1 mW
Minimum distance r:	7.0 mm	

Maximum EIRP output power **0.1 mW is < 16 mW**;

Conclusion: The power level is much lower than the limit, SAR measurement is NOT necessary.

Remarks:

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6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
-	-	-	-	-	-	-