

Test Report

20-1-0167901T04a



Deutsche
Akkreditierungsstelle
D-PL-12047-01-01
D-PL-12047-01-03
D-PL-12047-01-04

Number of pages:	16	Date of Report:	2021-Oct-12
Testing company:	CETECOM GmbH Im Teelbruch 116 45219 Essen Germany Tel. + 49 (0) 20 54 / 95 19-0 Fax: + 49 (0) 20 54 / 95 19-150	Applicant:	Geolux d.o.o.
Product:	Water Level Sensor		
Model:	LX80		
FCC ID:	2AN9XLX801	IC:	26475-LX801
Testing has been carried out in accordance with:	FCC Regulations Part 1.1310 Part 2.1091 IC-Regulations RSS-102, Issue 5 Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method and limit".		
Tested Technology:	FMCW Radar		
Test Results:	<input checked="" type="checkbox"/> The EUT complies with the requirements in respect of all parameters subject to the test. The test results relate only to devices specified in this document The current version of the Test Report CETECOM_TR20-1-0167901T04a-C1 replaces the Test Report CETECOM_TR20-1-0167901T04a dated 2021-Jun-30. The replaced test report is herewith invalid.		
Signatures:	<div></div> <div>Dipl.-Ing. Niels Jeß Head of Compliance Testing Authorization of test report</div> <div>Dipl.-Ing. Ninovic Perez Senior Test Manager Responsible of test report</div>		

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The listed attachments are separate documents.			

1 General information

1.1 Disclaimer and Notes

The test results of this test report relate exclusively to the test item specified in this test report as specified in chapter 2.7. CETECOM does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.

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This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

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Also we refer on special conditions which the applicant should fulfill according §2.927 to §2.948, special focus regarding modification of the equipment and availability of sample equipment for market surveillance tests.

1.2 Attestation

I declare that all measurements were performed by me or under my supervision and that all measurements have been performed and are correct to my best knowledge and belief to Industry Canada standards. All of the above requirements are met in accordance with enumerated standards.

1.3 Summary of Test Results

The test results apply exclusively to the test samples as presented in this Report. The CETECOM GmbH does not assume responsibility for any conclusions and generalizations taken in conjunction with other specimens or samples of the type of the item presented to tests.

The presented Equipment Under Test (in this report, hereinafter referred as EUT) integrates a FMCW Radar RF Transceiver. Other implemented wireless technologies were not considered within this test report.

Following tests have been performed to show compliance with applicable FCC Part 2.1091 and FCC Part 1.1310 of the FCC CFR 47 Rules and ICED RSS standards.

RF-Exposure Evaluation (separation distance user to RF-radiating element greater 20 cm)								
Test cases	Port	References & Limits				EUT set-up	EUT op. mode	Result
		FCC Standard	Test Limit	RSS Standard	Test Limit			
Radio frequency radiation exposure Requirements	Cabinet	§1.1310 §2.1091	RF-Field Strength Limits: FCC: "general population/uncontrolled" environment	RSS-102, Issue 5	Chapter 4 Table 4	1	1	PASSED

Remark: Calculations based on Datasheet delivered by applicant

PASSED
FAILED
NP
NT
N/A

The EUT complies with the essential requirements in the standard.
The EUT does not comply with the essential requirements in the standard.
The test was not performed by the CETECOM Laboratory.
Not tested
Not applicable

2 Administrative Data

2.1 Identification of the Testing Laboratory

Company name:	CETECOM GmbH
Address:	Im Teelbruch 116 45219 Essen - Kettwig Germany
Responsible for testing laboratory:	Dipl.-Ing. Ninovic Perez
Accreditation scope:	DAkkS Webpage
Test location:	CETECOM GmbH; Im Teelbruch 116; 45219 Essen - Kettwig

2.2 General limits for environmental conditions

Temperature:	22±2 °C
Relative. humidity:	45±15 % rH

2.3 Test Laboratories sub-contracted

Company name:	
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2.4 Organizational Items

Responsible test manager:	Dipl.-Ing. Ninovic Perez
Receipt of EUT:	2021-Feb-09
Date(s) of test:	2021-Mar-05 – 2021-Mar-05
Version of template:	21.1

2.5 Applicant's details

Applicant's name:	Geolux d.o.o.
Address:	Ljudevita Gaja 62 10430, Samobor Croatia
Contact Person:	Tomislav Grubesa
Contact Person's Email:	tomislav.grubesa@geolux.hr

2.6 Manufacturer's details

Manufacturer's name:	See applicant's details
Address:	See applicant's details

2.7 EUT: Type, S/N etc. and short descriptions used in this test report

Short description*)	PMT Sample No.	Product	Model	Type	S/N	HW status	SW status
EUT 01	--	Water Level Sensor	LX80	LX80-15	--	RevB	2.2.9

*) EUT short description is used to simplify the identification of the EUT in this test report.

2.8 Auxiliary Equipment (AE): Type, S/N etc. and short descriptions

Short description*)	PMT Sample No.	Auxiliary Equipment	Type	S/N	HW status	SW status
	--	--	--	--	--	--

*) AE short description is used to simplify the identification of the auxiliary equipment in this test report.

2.9 Connected cables

Short description*)	PMT Sample No.	Cable type	Connectors	Length
	--	--	--	--

*) CAB short description is used to simplify the identification of the connected cables in this test report.

2.10 Software

Short description*)	PMT Sample No.	Software	Type	S/N	HW status	SW status
	--	--	--	--	--	--

*) SW short description is used to simplify the identification of the used software in this test report.

2.11 EUT set-ups

set-up no. *)	Combination of EUT and AE	Description
SET 01	EUT 01	Used for theoretical calculation

*) EUT set-up no. is used to simplify the identification of the EUT set-up in this test report.

2.12 EUT operation modes

EUT operating mode no. *)	Operating modes	Additional information
op. 1	FMCW Radar	Only theoretical calculation

*) EUT operating mode no. is used to simplify the test report.

3 Equipment under test (EUT)

3.1 General Data of Main EUT as Declared by Applicant

Product	Water Level Sensor
Model	LX80
Type	LX80-15
Radio access technology	FMCW Radar
For further details refer Applicants Declaration and technical documents	

3.2 Detailed Technical data of Main EUT as Declared by Applicant

Frequency Band	FMCW Radar	77000 MHz to 81000 MHz
Antenna Type(s)	Integrated antenna	
Antenna Gain(s)	Please refer to Annex 2	
FCC label attached	No	
For further details refer Applicants Declaration and technical documents		

4 Measurements

4.1 Radio Frequency Exposure Evaluation §2.1091

4.1.1 Test location and equipment (for reference numbers please see chapter 'List of test equipment')

Test location	See Chapter 2.1
Equipment	For Evaluation instruments are not needed. Results are determined by calculation based on applicants delivered Tune-Up procedure.

4.1.2 Requirements

FCC: §1.1310	The criteria used for the evaluation of human exposure to radio frequency radiation is table 1 according FCC §1.1310 and table chapter 4.2 of RSS-102 standard and it is subject for evaluation of the RF exposure prior to equipment authorization. As the mobile equipment is authorized under Part 22 (Subpart H) and Part 24 of the FCC Rules, it is subject for evaluation of the RF exposure prior to equipment authorization.
FCC § 2.1091	Further information on evaluating compliance with these limits can be found in the FCC's OST/OET Bulletin Number 65, "Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radiofrequency Radiation." For purposes of these requirements mobile devices are defined by the FCC as transmitters 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 radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limits given in Table 1 of Appendix A.

4.1.2.1 Valid for FCC

Table 1: LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)				
Frequency range [MHz]	Electric field strength [V/m]	Magnetic field strength [A/m]	Power density [mW/cm ²]	Averaging time [minutes]
30 - 300	61.4	0.163	1.0	6
300 - 1500	-	-	f/300	6
1500 - 100.000	-	-	5	6
(B) Limits for General Population / Uncontrolled Exposure				
0.3 - 1.34	614	1.63	*(100)	30
1.34 - 30	824/f	2.19/f	*(180/f ²)	30
30 - 300	27.5	0.073	0.2	30
300 - 1500	-	-	f/1500	30
1500 - 100.0	-	-	1.0	30

f= frequency in MHz

*Plane-wave equivalent power density

NOTE1: 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. These limits apply to amateur station licensees and members of their immediate household as discussed in the text.

NOTE2: 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. As discussed in the text, these limits apply to neighbors living near amateur radio stations.

4.1.3 General Limits:

FCC: §1.1307	Cellular Radiotelephone Service (subpart H of part 22) Non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 1000 W ERP (1640 W EIRP)
FCC §1.1307	Personal Communications Services (part 24) Broadband PCS (subpart E): non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 2000 W ERP (3280 W EIRP)
FCC §1.1310	LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE) Table 1(B) Limits for General Population/Uncontrolled Exposure 300–1500 MHz: $f/1500 \text{ mW/cm}^2$ 1500–100.000 MHz: 1.0 mW/cm^2
FCC §2.1091	Subject to routine evaluation is required when the device operate at frequencies of 1.5 GHz or below and their effective radiated power (ERP) is 1.5 watts or more, or if they operate at frequencies above 1.5 GHz and their ERP is 3 watts or more.
FCC §24.232	(a) Base stations are limited to 1640 watts peak equivalent isotropically radiated power (e.i.r.p.) with an antenna height up to 300 meters HAAT. b) Mobile/portable stations are limited to 2 watts e.i.r.p. peak power, ...
FCC §22.913	(a) Maximum ERP. The effective radiated power (ERP) of base transmitters and cellular repeaters must not exceed 500 Watts. The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.
FCC §27.50 (C)(10)	(10) Portable stations (hand-held devices) are limited to 3 watts ERP; and
FCC §27.50(d)	(4) Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band are limited to 1 watt EIRP.
KDBs	No. 447498 D01 v06

4.2 Requirements and limits for RSS Standard

RSS-102, Issue 5

2.5 Exemption Limits for Routine Evaluation

All transmitters are exempt from routine SAR and RF exposure evaluations provided that they comply with the requirements of [sections 2.5.1 or 2.5.2](#). **If the equipment under test (EUT) meets the requirements of sections 2.5.1 or 2.5.2, applicants are only required to submit a properly signed declaration of compliance (see [Annex C](#))**. The information contained in the RF exposure technical brief may be limited to the value(s) of the maximum output power, the information that demonstrates how the maximum output power of the transmitter was derived and the rationale for the separation distances applied (see [Table 1](#)), which must be based on the most conservative exposure condition for the applicable module or host platform test procedure requirements.

2.5.2 Exemption Limits for Routine Evaluation — RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- **at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;**
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

2.6 User Manual Requirements

The applicant is responsible for providing proper instructions to the user of the radio device, and any usage restrictions, including limits of exposure durations. The user manual shall provide installation and operation instructions, as well as any special usage conditions (e.g. proper accessory required, including the proper orientation of the device in the accessory, maximum antenna gain in the case of detachable antenna), in order to ensure compliance with SAR and/or RF field strength limits. For instance, compliance distance shall be clearly stated in the user manual.

The user manual of devices intended for controlled use shall also include information relating to the operating characteristics of the device; the operating instructions to ensure compliance with SAR and/or RF field strength limits; information on the installation and operation of accessories to ensure compliance with SAR and/or RF field strength limits; and contact information where the user can obtain Canadian information on RF exposure and compliance. Other related information may also be included.

4.3 MPE Calculation method

Predication of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{EIRP}{4\pi R^2} = \frac{P * G}{4\pi R^2}$$

$$G_{NUMERIC} = \frac{S * 4\pi R^2}{P}$$

Where: S= power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

4.4 Evaluation Method

Please find in the following tables **the calculations based on applicants information**

For duty cycle factor please refer to radio report **CETECOM_TR20-1-0167901T02a_C1**.

4.5 Results for fixed and mobile operations

4.5.1 Results for FCC Standard

4.5.1.1 Results for FMCW Radar

Operation Mode	Frequency on channel (MHz)	Declared maximum conducted output power	Max. positive tolerance according manufacturer (dB)	Antenna Gain (dBi)	Declared maximum ERP (Measured+ Tune-up) (dBm)	Duty cycle (%)	Declared Maximum ERP (W)	Equivalent ERP (maximum ERP x duty cycle) (mW)	MPE Limit accord. Table 1 (mW/cm ²)	MPE-Value (mW/cm ²)	Margin to Limit:	Fraction for Co-Location calculations	Max. Fraction-Value within Frequency-Band
FMCW	77000.0	12.0	1.0	26.0	39.0	10.9%	7.9433	864.6	1.0000	0.1720	0.8280	0.172002	0.2165373
	79000.0	12.0	1.0	27.0	40.0		10.0000	1088.4	1.0000	0.2165	0.7835	0.216537	
	81000.0	12.0	1.0	26.0	39.0		7.9433	864.6	1.0000	0.1720	0.8280	0.172002	

Maximum calculated MPE value:		
Lowest MPE-Limit:	1.0000	[mW/cm ²]
Highest MPE value:	0.2165	[mW/cm ²]
Lowest Margin to limit:	0.7835	[mW/cm ²]

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure of mobile device.

4.5.2 Results for RSS Standard

4.5.2.1 Results for FMCW Radar

Operation Mode	Frequency on channel (MHz)	Declared maximum conducted output power (dBm)	Max. positive tolerance according manufacturer's tune-up info (dB)	Declared Antenna Gain (dBi)	Calculated maximum ERP (Measured+ Tune-up) (dBm)	Duty-Cycle (%)	Calculated Maximum ERP (W)	Equivalent ERP (maximum ERP x duty cycle) (W)
FMCW	77000.0	12.0	1.0	26.0	39.0	10.9%	0.864575	0.094103
	79000.0	12.0	1.0	27.0	40.0	10.9%	1.088435	0.118469
	81000.0	12.0	1.0	26.0	39.0	10.9%	0.864575	0.094103

Conclusion: According RSS-102 section 2.5.2. RF exposure evaluation is exempted when the source based, time averaged maximum e.i.r.p of the device is equal to or less than 5 W (adjusted for the tune-up tolerance)

⇒ Equivalent EIRP 0.118469 W < 5 W => RF exposure evaluation exempted

5 Abbreviations used in this report

The abbreviations	
ANSI	American National Standards Institute
AV , AVG, CAV	Average detector
EIRP	Equivalent isotropically radiated power, determined within a separate measurement
EGPRS	Enhanced General Packet Radio Service
ERP	Effective radiated power
EUT	Equipment Under Test
FCC	Federal Communications Commission, USA
ISED	Innovation, Science and Economic Development Canada
IC	Industry Canada
n.a.	not applicable
Op-Mode	Operating mode of the equipment
PK	Peak
RBW	resolution bandwidth
RF	Radio frequency
RSS	Radio Standards Specification, Documents from Industry Canada
Rx	Receiver
TCH	Traffic channel
Tx	Transmitter
QP	Quasi peak detector
VBW	Video bandwidth

6 Measurement Uncertainty valid for conducted/radiated measurements

The reported uncertainties are calculated based on the standard uncertainty multiplied with the appropriate coverage factor k , such that a confidence level of approximately 95% is achieved. For uncertainty determination, each component used in the concrete measurement set-up was taken in account and its contribution to the overall uncertainty according its statistical distribution calculated.

RF-Measurement	Reference	Frequency range	Calculated uncertainty based on a confidence level of 95%						Remarks
Conducted emissions (U _{CISPR})	-	9 kHz - 150 kHz 150 kHz - 30 MHz	4.0 dB 3.6 dB						-
Power Output radiated	-	30 MHz - 4 GHz	3.17 dB						Substitution method
Power Output conducted	-	Set-up No.	Cel-C1	Cel-C2	BT1	W1	W2	--	-
		9 kHz - 12.75 GHz	N/A	0.60	0.7	0.25	N/A	--	
		12.75 GHz - 26.5 GHz	N/A	0.82	--	N/A	N/A	--	
Conducted emissions on RF-port	-	9 kHz - 2.8 GHz	0.70	N/A	0.70	N/A	0.69	--	N/A - not applicable
		2.8 GHz - 12.75 GHz	1.48	N/A	1.51	N/A	1.43	--	
		12.75 GHz – 18 GHz	1.81	N/A	1.83	N/A	1.77	--	
		18 GHz - 26.5 GHz	1.83	N/A	1.85	N/A	1.79	--	
Occupied bandwidth	-	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)						Frequency error
			1.0 dB						Power
Emission bandwidth	-	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)						Frequency error
	-		See above: 0.70 dB						Power
Frequency stability	-	9 kHz - 20 GHz	0.0636 ppm						-
Radiated emissions Enclosure	-	150 kHz - 30 MHz	5.01 dB						Magnetic field strength
		30 MHz - 1 GHz	5.83 dB						Electrical Field strength
		1 GHz - 18 GHz	4.91 dB						
		18 GHz - 26.5 GHz	5.06 dB						

7 Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2021-Jun-30
C1	Duty cycle factor corrected, used from radio report "CETECOM_TR20-1-0167901T02a_C1"	2021-Oct-12
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End Of Test Report