

# Test Report

## 20-1-0017101T05a-C1



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

<b>Number of pages:</b>	15	<b>Date of Report:</b>	2021-Aug-04
<b>Testing company:</b>	CETECOM GmbH Im Teelbruch 116 45219 Essen Germany Tel. + 49 (0) 20 54 / 95 19-0 Fax: + 49 (0) 20 54 / 95 19-150	<b>Applicant:</b>	SICK AG
<b>Product:</b>	UWB Tag		
<b>Model:</b>	LOCU101-0110		
<b>FCC ID:</b>	WRMLOCU1		
<b>Testing has been carried out in accordance with:</b>	<b>FCC Regulations</b> Part 1.1310 Part 2.1093  Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method and limit".		
<b>Tested Technology:</b>	2.4 GHz WPAN according to IEEE 802.15.1, UWB		
<b>Test Results:</b>	<input checked="" type="checkbox"/> <b>The EUT complies with the requirements in respect of all parameters subject to the test.</b> The test results relate only to devices specified in this document  The current version of Test Report CETECOM_TR20_1_0017101T05a_C01 replaces the test report CETECOM_TR20_1_0017101T05a dated 2021-Jul-27. The replaced test report is herewith invalid.		
<b>Signatures:</b>	<div style="display: flex; justify-content: space-between;"><div style="width: 45%;"><p>Dipl.-Ing. Ninovic Perez Test Lab Manager Authorization of test report</p></div><div style="width: 45%; text-align: right;"><p>B.Eng. Martin Nunier Testing Expert Responsible of test report</p></div></div>		

## Table of Contents

Table of Annex.....	3
1 General information .....	4
1.1 Disclaimer and Notes .....	4
1.2 Summary of Test Results .....	5
2 Administrative Data .....	6
2.1 Identification of the Testing Laboratory.....	6
2.2 General limits for environmental conditions .....	6
2.3 Test Laboratories sub-contracted .....	6
2.4 Organizational Items .....	6
2.5 Applicant’s details .....	6
2.6 Manufacturer’s details .....	6
2.7 EUT: Type, S/N etc. and short descriptions used in this test report.....	7
2.8 Auxiliary Equipment (AE): Type, S/N etc. and short descriptions.....	7
2.9 Connected cables .....	7
2.10 Software.....	7
2.11 EUT set-ups .....	7
2.12 EUT operation modes.....	8
3 Equipment under test (EUT) .....	8
3.1 General Data of Main EUT as Declared by Applicant .....	8
3.2 Detailed Technical data of Main EUT as Declared by Applicant .....	8
4 Measurements.....	9
4.1 Radio Frequency Exposure Evaluation §2.1093 .....	9
4.2 MPE Calculation method .....	10
4.3 Evaluation Method.....	10
4.4 Results for mobile and portable operations.....	11
5 Abbreviations used in this report .....	13
6 Measurement Uncertainty valid for conducted/radiated measurements .....	14
7 Versions of test reports (change history) .....	15

<b>Table of Annex</b>			
<b>Annex No.</b>	<b>Contents</b>	<b>Reference Description</b>	<b>Total Pages</b>
<b>Annex 1</b>	External photographs of EUT	<b>CETECOM_TR20_1_0017101T05a_A1_C1</b>	3
<b>Annex 2</b>	Tune up information	<b>MPE Information Requirements v1.4</b>	1
<b>Annex 3</b>	UWB module datasheet	<b>DWM1001 Datasheet</b>	31
<b>Annex 4</b>	HW change description v1.2	<b>CETECOM_TR20-1-0017101T05a_A4_C1</b>	4
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.

The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM.

The testing service provided by CETECOM has been rendered under the current "General Terms and Conditions for CETECOM". CETECOM will not be liable for any loss or damage resulting from false, inaccurate, inappropriate or incomplete product information provided by the customer.

Under no circumstances does the CETECOM test report include any endorsement or warranty regarding the functionality, quality or performance of any other product or service provided.

Under no circumstances does the CETECOM test report include or imply any product or service warranties from CETECOM, including, without limitation, any implied warranties of merchantability, fitness for purpose, or non-infringement, all of which are expressly disclaimed by CETECOM.

All rights and remedies regarding vendor's products and services for which CETECOM has prepared this test report shall be provided by the party offering such products or services and not by CETECOM.

In no case this test report can be considered as a Letter of Approval.

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.

The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory. The documentation of the testing performed on the tested devices is archived for 10 years at CETECOM.

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 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 following RF Transceiver:

<b>RF Transceiver</b>	2.4 GHz WPAN according to IEEE 802.15.1 UWB
-----------------------	--

Other implemented wireless technologies were not considered within this test report.

Following tests have been performed to show compliance with applicable FCC Part 2.1093 and FCC Part 1.1310 of the FCC CFR 47 Rules.

RF-Exposure Evaluation (separation distance user to RF-radiating element greater 20cm)						
Test cases	Port	References & Limits		EUT set-up	EUT op. mode	Result
		FCC Standard	Test Limit			
Radio frequency radiation exposure Requirements	Cabinet	§1.1310 §2.1093	RF-Field Strength Limits: FCC: "general population/ uncontrolled" environment	1	1 - 2	PASSED

**Remark:** Calculations based on Datasheet delivered by applicant

- PASSED                      The EUT complies with the essential requirements in the standard.
- FAILED                     The EUT does not comply with the essential requirements in the standard.
- NP                            The test was not performed by the CETECOM Laboratory.
- N/A                            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:	<a href="#">DAkkS Webpage</a>
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:	
---------------	--

### 2.4 Organizational Items

Responsible test manager:	B.Eng. Martin Nunier
Receipt of EUT:	--
Date(s) of test:	---
Version of template:	21.1

### 2.5 Applicant's details

Applicant's name:	SICK AG
Address:	Erwin-Sick-Str. 1 79183 Waldkirch Germany
Contact Person:	Tobias Hofmann
Contact Person's Email:	tobias.hofmann@sick.de

### 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	20-1-00171S23_C01	UWB Tag	LOCU101-0110	--	1950 0112	v1r3	3.125.7
EUT 02 **	--	UWB Tag	LOCU101-0110	--	1950 0112	v1r3.1	3.125.7

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

\*\*)The listed additional variants/models are not tested nor object of evaluated of compliance. For further information please see annex 4.

## 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 1	--	--	--	--	--	--

\*) 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	2.4 GHz WPAN according to IEEE 802.15.1	Only theoretical calculation
op. 2	UWB	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

<b>Product</b>	UWB Tag
<b>Model</b>	LOCU101-0110
<b>Type</b>	--
<b>Radio access technology</b>	2.4 GHz WPAN according to IEEE 802.15.1 UWB
For further details refer Applicants Declaration and technical documents	

### 3.2 Detailed Technical data of Main EUT as Declared by Applicant

<b>Frequency Band</b>	2.4 GHz WPAN according to IEEE 802.15.1 UWB
<b>Antenna Type(s)</b>	Internal antenna
<b>Antenna Gain(s)</b>	Please refer to Annex 3: ➤ <b>MPE Information Requirements v1.4</b>
<b>FCC label attached</b>	No
For further details refer Applicants Declaration and technical documents	



## 4 Measurements

### 4.1 Radio Frequency Exposure Evaluation §2.1093

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

<b>Test location</b>	See Chapter 2.1
<b>Equipment</b>	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 it is subject for evaluation of the RF exposure prior to equipment authorization.
FCC § 2.1093	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 portable device is defined by the FCC as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that the RF source's radiating structure(s) is/are within 20 centimeters of the body of the user.

##### 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 <sup>2</sup> ]	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 <sup>2</sup> )	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 mW/cm <sup>2</sup> 1500–100.000 MHz: 1.0 mW/cm <sup>2</sup>
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
KDBs	No. 447498 D01 DR04

## 4.2 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

## 4.3 Evaluation Method

Please find in the following tables **the calculations based on applicants information** and measured source-based available maximum time-averaged (matched conducted) output power.

#### 4.4 Results for mobile and portable operations

##### 4.4.1 FCC SAR exemption based on low power for 2.4 GHZ WPAN

According KDB 447498 D01 General RF Exposure Guidance DR04-44307 appendix B.4 the following table is given for separation distances from 0.5cm to 40cm and at frequencies from 0.3GHz to 6GHz:

Table B.2—Example Power Thresholds (mW)

Frequency (MHz)	Distance (mm)										
	5	10	15	20	25	30	35	40	45	50	
300	39	65	88	110	129	148	166	184	201	217	
450	22	44	67	89	112	135	158	180	203	226	
835	9	25	44	66	90	116	145	175	207	240	
1900	3	12	26	44	66	92	122	157	195	236	
2450	3	10	22	38	59	83	111	143	179	219	
3600	2	8	18	32	49	71	96	125	158	195	
5800	1	6	14	25	40	58	80	106	136	169	

With a separation distance of 5mm for 2450 MHz  $P_{\text{threshold}}(\text{mW})$  should  $< 3\text{mW}$  to fulfill the SAR exemption rules.

According tune-up information  $3\text{ dBm} + 0.5\text{ dBi} = 3.5\text{ dBm} = 2.2\text{ mW} < 3\text{ mW}$

**Conclusion:** SAR Exemption fulfilled.

##### 4.4.2 FCC SAR exemption based on low power for UWB

According KDB 447498 D01 General RF Exposure Guidance DR04-44307 chapter 2.12 the following is given:

###### 2.1.2 1-mW Test Exemption

Per §1.1307(b)(3)(i)(A), a single RF source is *exempt RF device* (from the requirement to show data demonstrating compliance to RF exposure limits, as previously mentioned) if the available maximum time-averaged power is no more than 1 mW, regardless of separation distance.

This exemption applies to all operating configurations and exposure conditions, for the frequency range 100 kHz to 100 GHz, regardless of fixed, mobile, or portable device exposure conditions. This is a standalone exemption, and it cannot be applied in conjunction with any other test exemption.

Measured source-based available maximum time-averaged (matched conducted) output power =  $-11.90\text{ dBm} = 0.065\text{ mW}$   
 Calculated EIRP = output power + antenna gain =  $-11.90 + 2.5\text{ dBi} = -9.40\text{ dBm} = 0.115\text{ mW}$

**Conclusion:** 1 mW test exemption fulfilled.

#### **4.4.3 Co-location assessment (scenario)**

No assesment. No co-location possible between 2.4 GHz WPAN and UWB.

## 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 ( <i>U</i> <sub>CISPR</sub> )	-	9 kHz - 150 kHz	4.0 dB						-
		150 kHz - 30 MHz	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	5.01dB						Magnetic field strength
		30 MHz - 1 GHz	5.83 dB						Electrical Field strength
		1 GHz - 18 GHz	4.91 dB						
		18-26.5 GHz	5.06 dB						

## 7 Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2021-Jul-27
C1	\$2.1093 instead of \$2.1091 stated, updated Tune up information	2021-Aug-04
--	--	--

# End Of Test Report