

 Test Report No.:
 T43580-02-00FX
 16. August 2022

 Date of issue
 Date of issue



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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Contents

1	TEST STANDARDS	3
2 [EQUIPMENT UNDER TEST	4
2.1	Photo documentation of the EUT – Detailed photos see ATTACHMENT A1 and A2	4
2.3	Equipment type	4
2.4	Short description of the equipment under test (EUT)	4
2.5	Variants of the EUT	4
2.6	Operation frequency and channel plan	4
2.7	Transmit operating modes	4
2.8	Antenna	5
2.9	Power supply system utilised	5
2.10	Peripheral devices and interface cables	5
2.11	Determination of worst case conditions for final measurement	5
3	FEST RESULT SUMMARY	6
3.1	Final assessment	7
4	FEST ENVIRONMENT	8
4.1	Address of the test laboratory	8
4.2	Environmental conditions	8
4.3	Statement of the measurement uncertainty	9
4.4	Measurement protocol for FCC and ISED	10
5	FEST CONDITIONS AND RESULTS	12
5.1	UWB Bandwidth	12
5.2	Radiated Emissions 9 kHz to 40 GHz	14
5.3	Radiated Emissions at 1164-1240 MHz and 1559-1610 MHz	20
5.4	Peak Power radiated	22
5.5	Signal deactivation	24
5.6	Antenna application	26
6	JSED TEST EQUIPMENT AND ACCESSORIES	27

ATTACHMENT A1, A2 and B as separate supplements

File No. **T43580-02-00FX**, page **2** of 27



1 <u>TEST STANDARDS</u>

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September 2018)

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (September 2018)

Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204	External radio frequency power amplifiers and antenna modifications
Part 15, Subpart C, Section 15.205	Restricted bands of operation
Part 15, Subpart C, Section 15.207	Conducted limits
Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements

FCC Rules and Regulations Part 15, Subpart F – Ultra Wideband Operation (October 2018)

Part 15, Subpart F, Section 15.503	Definitions
Part 15, Subpart F, Section 15.505	Cross reference
Part 15, Subpart F, Section 15.519	Technical requirements for hand held UWB systems
Part 15, Subpart F, Section 15.521	Technical requirements applicable to all UWB devices
ANSI C63.10: 2013	Testing Unlicensed Wireless Devices
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



2 EQUIPMENT UNDER TEST

2.1 Photo documentation of the EUT – Detailed photos see ATTACHMENT A1 and A2

2.2 General remarks

The technology is used in industrial environments. The person tag module communicates with the truck mounted anchors and the tag's position in relation to the forklift is obtained.

Additionally, the EUT contains integrated low-energy RFID- and Bluetooth- modules including antennas.

2.3 Equipment type

Part of Portable UWB Device

2.4 Short description of the equipment under test (EUT)

The EUT is one of 4 anchors, mounted on a truck. These anchors are communicating with the truck via CAN-bus and with one person tag via UWB. The operator wears the person tag on the body. After an initial pairing process between the EUT and the person tag (by NFC or UWB), the 4 anchors can localize the position of the person tag related to a truck fixed coordinate system. If there are no obstacles, the truck follows the EUT (in driving direction).

Number of tested samples:	1
Serial number:	187100000748
Firmware version:	V2.07
UWB driver version:	V2.5.9

EUT configuration:

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

2.5 Variants of the EUT

There are no variants.

2.6 Operation frequency and channel plan

The operating frequency band is 3100 MHz to 10600 MHz.

Channel plan:

Channel number	Center frequency
Channel 2	3993.6 MHz

2.7 Transmit operating modes

Modulation: variable pulse position modulation (PPM) in combination with binary phase shift keying (BPSK)

Data rate: 6.8 Mbit/s

File No. T43580-02-00FX, page 4 of 27



2.8 Antenna

The EUT uses an integrated UWB antenna.

2.9 Power supply system utilised

Power supply voltage, V_{nom} : 24 V DC

2.10 Peripheral devices and interface cables

The following peripheral devices and interface cables are connected during the measurements:

-	CAN Dongle	Model :	PEAK System
-	Notebook	Model :	Fujitsu Lifebook, E751
-		Model :	

2.11 Determination of worst case conditions for final measurement

Measurements are made in all three orthogonal axes with horizontal and vertical antenna positions to determine the worst case condition.

2.11.1 Test jig

No test jig is used.

2.11.2 Test software

Special test software provided by the manufacturer is used.



3 TEST RESULT SUMMARY

Operating in the 3100 MHz – 10600 MHz:

FCC Rule Part	Description	Result
15.207(a) 15.521(j)	AC power line conducted emissions	passed
15.519(b) 15.521(e)	UWB Bandwidth	passed
15.209(a) 15.519(c) 15.521(c)(d)(h)	Radiated Emissions 9 kHz to 40 GHz	passed
15.519(d)	Radiated Emissions at 1164-1240 MHz and 1559-1610 MHz	passed
15.519(e) 15.521(g)	Peak Power radiated	passed
15.519(a)	Signal deactivation	passed
15.203 15.521(b)	Antenna requirement	passed *1
15.204(a)-(d) 15.521(b)	External radio frequency power amplifiers and antenna modifications	passed *1
15.521(a)(b)(f)(i)	Technical requirements applicable to all UWB devices	passed *2

*1: According to the applicant, the EUT has an internal antenna. No other antennas can be connected to the EUT. Therefor, the requirements are regarded as fulfilled.

*2: According to the applicant, the EUT will be used as a system in industrial truck vehicles only. For details refer to the user manual. The EUT is no imaging system.

15.207(a) Not applicable, the EUT can not be connected to the public utility (AC) power line.



3.1 Final assessment

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

Date of receipt of test sample

: acc. to storage records

Testing commenced on

: <u>31 May 2019</u>

Testing concluded on

: 22 September 2021

Checked by:

Tested by:

Klaus Gegenfurtner Teamleader Radio Franz-Xaver Schrettenbrunner Radio Team



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 %

86-106 kPa

Atmospheric pressure:



4.3 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 / 11.2003 "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.

Measurement Type	Range	Confidence Level	Calculated Uncertainty
AC power line conducted emissions	0.15 MHz to 30 MHz	95%	± 3.29 dB
EBW and OBW	2400 MHz to 3000 MHz	95%	± 2.5 x 10 ⁻⁷
Maximum peak conducted output power	2400 MHz to 3000 MHz	95%	± 0.62 dB
Power spectral density	2400 MHz to 3000 MHz	95%	± 0.62 dB
Conducted Spurious Emissions	9 kHz to 10000 MHz	95%	± 2.15 dB
Conducted Spurious Emissions	10000 MHz to 40000 MHz	95%	± 3.47 dB
Radiated Spurious Emissions	9 kHz to 30 MHz	95%	± 3.53 dB
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	± 3.71 dB
Radiated Spurious Emissions	1000 MHz to 10000 MHz	95%	± 2.34 dB
Field strength of the fundamental	100 kHz to 100 MHz	95%	± 3.53 dB



4.4 Measurement protocol for FCC and ISED

4.4.1 General information

CSA Group Bayern GmbH is recognized as wireless testing laboratory under the CAB identifier:

FCC: DE 0011 ISED: DE0009

4.4.2 General Standard information

The test methods used comply with ANSI C63.10 - "Testing Unlicensed Wireless Devices".

4.4.2.1 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.4.2.2 Radiated emission (electrical field 30 MHz - 1 GHz)

Spurious emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m nonconducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is established in accordance with ANSI C63.10.The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so that they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 metres horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees. The final level in dBµV/m is calculated by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (dB). The FCC limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The resolution bandwidth setting: 30 MHz – 1000 MHz: RBW: 120 kHz

Example:

Level	+	Factor	=	Level -	Limit	=
(dBµV)		(dB)		(dBµV/m)	(dBµV/m)	(dB)
75.0	+	32.6	=	107.6 -	110.0	= -2.4
	(dBµV)	(dBµV)	(dBµV) (dB)	(dBµV) (dB)	(dBµV) (dB) (dBµV/m)	(dBµV) (dB) (dBµV/m) (dBµV/m)



4.4.2.3 Radiated emission (electrical field 1 GHz - 40 GHz)

Spurious emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is established in accordance with ANSI C63.10.The interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so that they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 metres horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees. The final level in dBµV/m is calculated by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (dB). The FCC limit is subtracted from this result in order to provide the limit

margin listed in the measurement protocol.



5 TEST CONDITIONS AND RESULTS

5.1 UWB Bandwidth

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

5.1.1 Description of the test location

Test location: Anechoic chamber 1

5.1.2 Photo documentation of the test set-up – see ATTACHMENT B

5.1.3 Applicable standard

According to FCC Part 15, Section 15.519(b):

The UWB bandwidth of a UWB system operating under the provisions of this section must be contained between 3100 MHz and 10600 MHz.

According to FCC Part 15, Section 15.503(d):

Ultra-wideband (UWB) transmitter. An intentional radiator that, at any point in time, has a fractional bandwidth equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth.

5.1.4 Description of Measurement

The measurement was performed radiated at a distance of 3 m. The bandwidth was measured at an amplitude level reduced from the reference level of a modulated channel by a ratio of -10 dB.

Spectrum analyser settings: RBW: 1 MHz, VBW: 3 MHz, Detector: Peak

5.1.5 Test result

channel	lowest frequency f∟ (MHz)	highest frequency f _H (MHz)	permitted frequency range (GHz)	UWB bandwidth (MHz)	required UWB bandwidth (MHz)	result
2	3649.75	4337.75	3.1 to 10.6	688.00	> 500	passed

The requirements are **FULFILLED**.

Remarks:

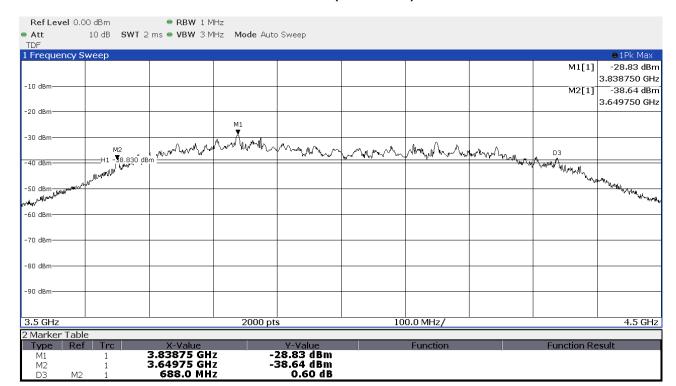
For detailed test results please refer to following test protocols.

File No. T43580-02-00FX, page 12 of 27



5.1.6 Test protocol EBW

Channel 2 (3993.6 MHz)





5.2 Radiated Emissions 9 kHz to 40 GHz

For test instruments and accessories used see section 6 Part SER 2 and SER 3.

5.2.1 Description of the test location

Test location:	OATS 1
Test location:	Anechoic chamber 1

5.2.2 Photo documentation of the test set-up – see ATTACHMENT B

5.2.3 Applicable standard

According to FCC Part 15, Section 15.519(c):

The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in §15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the average limits when measured using a resolution bandwidth of 1 MHz.

5.2.4 Analyser settings

9 kHz – 150 kHz	RBW: 200 Hz			
150 kHz - 30 MHz	RBW: 9 kHz			
30 MHz – 960 MHz	RBW: 120 kHz	Detector: QP		
960 MHz – 40 GHz	RBW: 1 MHz	VBW: 3 MHz	Detector: RMS	Sweeptime: 1ms per MHz

5.2.5 Test result

5.2.5.1 Measurement 9 kHz to 30 MHz

Note: Pre-measurements have shown, there are no detectable emissions in this frequency range.

5.2.5.2 Measurement 30 MHz to 960 MHz

Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Limit (dBµV/m)	Dlimit (dB)
47.34	12.0	5.7	15.2	14.1	27.2	19.8	40.0	-12.8
144.00	6.0	10.9	13.6	14.4	19.6	25.3	43.5	-18.2
216.98	24.5	16.2	12.1	12.6	36.6	28.8	46.0	-9.4
416.63	1.4	3.1	20.3	20.0	21.7	23.1	46.0	-22.9
650.93	3.5	8.9	26.2	25.9	29.7	34.8	46.0	-11.2
918.00	-1.9	-1.4	31.3	30.9	29.4	29.5	46.0	-16.5



5.2.5.3 Measurement 960 MHz to 40 GHz

According to § 15.521(c), missions from digital circuitry used to enable the operation of the UWB transmitter shall comply with the limits in § 15.209. The average limit is given by $54dB\mu V/m$ at 3 meter distance, which corresponds to an EIRP of -41.3 dBm according to ANSI C63.10 2013 clause 10.3.9.

As proven in the following measurements, no emissions outside the UWB transmission can be detected in in the frequency range 960 MHz and 40 GHz and the highest emissions occurs by the UWB emission itself, which lies under the UWB limit of -41.3 dBm. Therefor, the requirements according to § 15.209 can be regarded as fulfilled.

Mean Power:

Ref Level 0.	00 dBm	● RBW 1 MH	lz						
Att	10 dB 👄 SWT 🕻	2 s 👄 VBW 3 MH	z Mode Auto	Sweep					
TDF									
1 Frequency S	Sweep								●1Rm Max
								M1[1]	-41.90 dBm
									3.857750 GHz
-10 dBm									01007700 0112
-10 uBm									
-20 dBm									
20 000									
-30 dBm									
00 0011									
-40 dBm			M1						
UWB_FCC_MEAN		سى يىس	montheman	and a second					
		and a second second		and have have		man man	man and a second		
-50 dBm							~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	man and a second se	
	and the second							and the start	
	J.M.							- No.	w.
-60 dBm	ſ								- New Mark
and a start of the									and wanter
and a second second									- marine
-70 dBm									
-80 dBm									
-90 dBm									
3.5 GHz	1	1	2000 pt	s	10	0.0 MHz/	1	1	4.5 GHz



Att	0.00 dBm 🛛 🖷 RB	W 1 MHz			
	2 dB ● SWT 8 s ● VB :_1-18_3117_1M" DC	W 3 MHz Mode Sweep			
1 Frequency Sv					o 1Rm M
					M3[1] -72.01 d
-20 dBm					
-30 dBm					3.806034
-40 dBm					M1
-50 dBm					
-60 dBm					
-70 dBm JWB_FCC_15-519	M3 M4				
-80-dBm		- markan - markan			
-90 dBm					
-90 UBIII					
-100 dBm					
960.0 MHz		8001 pts		Hz/	4.0 (
2 Marker Peak	List	0001 pt3	00110111	1127	10 (
No 1	X-Value 1.408530 GHz	Y-Value -72.015 dBm		X-Value 06030 GHz	<u>Y-Value</u> -41.344 dBm
1	1.400000 012	-72.015 dbm	2 5.0	00000 GHZ	-41.544 dbm
MHz to 4 (3Hz LIWB OFF		Bm		
Ref Level -10		W 1 MHz			
RefLevel -10 Att	0.00 dBm 🔍 🖷 RB	W 1 MHz W 3 MHz Mode Sweep			
Ref Level -10 Att TDF "UWB_FCC	0.00 dBm ● RB 2 dB ● SWT 8 s ● VB :_1-18_3117_1M" DC				
Ref Level -10 Att TDF "UWB_FCC, 1 Frequency St	0.00 dBm ● RB 2 dB ● SWT 8 s ● VB :_1-18_3117_1M" DC				M3[1] -70.52 d
Ref Level -10 Att TDF "UWB_FCC 1 Frequency S -20 dBm-	0.00 dBm ● RB 2 dB ● SWT 8 s ● VB :_1-18_3117_1M" DC				1.408520 M1[1] -70.29 d
Ref Level -10 Att TDF "UWB_FCC, 1 Frequency St	0.00 dBm ● RB 2 dB ● SWT 8 s ● VB :_1-18_3117_1M" DC				M3[1] -70.52 d 1.408520
Ref Level -10 Att TDF "UWB_FCC 1 Frequency S -20 dBm-	0.00 dBm ● RB 2 dB ● SWT 8 s ● VB :_1-18_3117_1M" DC				M3[1] -70.52 (1.408520 M1[1] -70.29 (
Ref Level -10 Att TDF "UWB_FCC, 1 Frequency S' -20 dBm	0.00 dBm ● RB 2 dB ● SWT 8 s ● VB :_1-18_3117_1M" DC				M3[1] -70.52 (1.408520 M1[1] -70.29 (
Ref Level -10 Att TDF "UWB_FCC 1 Frequency State -20 dBm -30 dBm -40 dBm -50 dBm	0.00 dBm ● RB 2 dB ● SWT 8 s ● VB :_1-18_3117_1M" DC				M3[1] -70.52 (1.408520 M1[1] -70.29 (
Ref Level -10 Att TDF "UWB_FCC 1 Frequency St -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm	0.00 dBm ● RB 2 dB ● SWT 8 s ● VB :_1-18_3117_1M" DC				M3[1] -70.52 (1.408520 M1[1] -70.29 (
Ref Level -10 Att TDF "UWB_FCC 1 Frequency State -20 dBm -30 dBm -40 dBm -50 dBm	0.00 dBm				M3[1] -70.52 (1.408520 M1[1] -70.29 (
Ref Level -10 Att TDF "UWB_FCC 1 Frequency St -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm	0.00 dBm				M3[1] -70.52 (1.408520 M1[1] -70.29 (
Ref Level - 10 Att TDF "UWB_FCC 1 Frequency State -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm -70 dBm	0.00 dBm				M3[1] -70.52 (1.408520 M1[1] -70.29 (
Ref Level - 10 Att TDF "UWB_FCC 1 Frequency St -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm -70 dBm -90 dBm	0.00 dBm				M3[1] -70.52 (1.408520 M1[1] -70.29 (
Ref Level -10 Att TDF "UWB_FCC. 1 Frequency State -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm -70 dBm -780.dBm	0.00 dBm				M3[1] -70.52 (1.408520 M1[1] -70.29 (
Ref Level -10 Att TDF "UWB_FCC. 1 Frequency S -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm -70 dBm -90 dBm -90 dBm -100 dBm -100 dBm	0.00 dBm • RB 2 dB • SWT 8 s • VB :_1-18_3117_1M" DC weep			Hz/	M3[1] -70.52 (1.408520 M1[1] -70.29 (
Ref Level - 10 Att TDF "UWB_FCC 1 Frequency State -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm -70 dBm -90 dBm -90 dBm -100 dBm	0.00 dBm • RB 2 dB • SWT 8 s • VB :_1-18_3117_1M" DC weep	W 3 MHz Mode Sweep		· ·	M3[1] -70.52 (1.408520 M1[1] -70.29 (1.407774
Ref Level -10 Att TDF "UWB_FCC. 1 Frequency S -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm -70 dBm -90 dBm -90 dBm -100 dBm -100 dBm	0.00 dBm • RB 2 dB • SWT 8 s • VB :_1-18_3117_1M" DC weep	W 3 MHz Mode Sweep	304.0 M	Hz/	M3[1] -70.52 (1.408520 M1[1] -70.29 (1.407774
Ref Level - 10 Att TDF "UWB_FCC 1 Frequency State -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm -70 dBm -70 dBm -70 dBm -90 dBm -100 dBm -100 dBm 2 Marker Peak No	0.00 dBm • RB 2 dB • SWT 8 s • VB :_11-18_3117_1M" DC weep	W 3 MHz Mode Sweep	304.0 M	X-Value	M3[1] -70.52 c 1.408520 M1[1] -70.29 c 1.407774
Ref Level - 10 Att TDF "UWB_FCC 1 Frequency State -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm -70 dBm -70 dBm -70 dBm -90 dBm -100 dBm -100 dBm 2 Marker Peak No	0.00 dBm • RB 2 dB • SWT 8 s • VB 	W 3 MHz Mode Sweep	304.0 M	X-Value	M3[1] -70.52 c 1.408520 M1[1] -70.29 c 1.407774

Note: The emissions exceeding the limit of -75.3 dBm are not part of the UWB technology and can not be reviewed according to 15.519(c). They do not exceed the general limit of § 15.209, which is $500 \,\mu$ V/m at 3m distance respectively -41.3 dBm (see equation (34) in section 10.3.9 of ANSI C63.10).



Iz to 12.7	5 GHZ						
Ref Level -2	.00 dBm 😐 RE	SW 1 MHz					
Att	10 dB 👄 SWT 18 s 👄 VB	W 3 MHz Mode Sw	еер				
	C_1-18_3117_1M" DC						
1 Frequency S							o1Rm M
						M1[1]] -44.64 (
-10 dBm							4.137330
-10 dBiii-							
-20 dBm							
-30 dBm							+
-#0 dBm						 	+
JW8_FCC_15-519							
-50 dBm							
1			5				
-60 dBm			4				
			2 1 7 7				
-70 dBm						 	
-70 dbiii-		~~~~	and a second				
-80 dBm							
-90 dBm							
-100 dBm							
4.0 GHz		18000 p	ts		875.0 MHz/		12.75
2 Marker Pea							
No	X-Value	Y-Va		No	X-Valu	Y-Va	
1	4.136840 GHz	-44.605		5	7.987330	-55.432	
2 3	7.613020 GHz 7.737470 GHz	-65.804 -63.627		6 7	8.111770 8.236700	-63.292 -65.753	dBm
3 4	7.737470 GHz 7.862400 GHz	-63.627 -61.226		8	8.236700 12.741980	-65.753 -66.417	

12.75 GHz to 18 GHz

Ref Level -10.0	00 dBm	 RBW 1 	ı MHz						
 Att 			3 MHz Mode Sv	меер					
TDF "UWB_FCC_		1" DC			_		_	_	O D m May
1 Frequency Sw	/eép							M1[1]	O1Rm Max
	I			í '	'			M1[1]	-65.51 dBm 7.931090 GHz
-20 dBm		 	ļ	ļ′	<u> </u> '				7.931090 0Hz
	I			í '	'				1
-30 dBm]	<u> </u>	I	l	<u> </u> '			[_]	
	I			1	'				
-40 dBm		<u> </u>	├ ────		<u> </u> '	+			
	I			1	'				1
-50 dBm				'	<u> </u> '				
	I			1	'				
UL&B_dEFA_15-519		<u> </u>	╞──── ┘	F	 '	+		├────	M1
				h					
-70 dBm				· · · · · ·					
	I			1	'				
-80 dBm				1				1	
20.40.0	I			í '	'				
-90 dBm									
-100 dBm			I	I!	'				
-100 uBm				!					
			I	ļ!					
12.75 GHz			12000 pt	.s	52	25.0 MHz/			18.0 GHz
2 Marker Peak L		_			No	V U-1		V 14-	
No 1	X-Value 17.928470		Y-Val -65.500		INO	X-Value	2	Y-Val	ue
-	111220110	0112							



Att	2 dB 🖷 SWT	44 s 🖷	VBW 3 MHz N	Node Sweep			
TDF DC Frequency Sv	veep						●1Rm M
						M1[1]	-68.83 c
						:	9.783250
-40 dBm							
-50 dBm							
-60 dBm	 H1 -61.300 dBm						
-70 dBm							m
			a s su m	_	 	 \sim	
80 dBm		********		~~~~~~		~	
-90 dBm							
-100 dBm							
100 000							
-110 dBm							
120 dBm							



Limits:

Limit according §15.209(a) in the frequency range 9 kHz 960 MHz:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

Limit according §15.519(c) in the frequency range 960 MHz to 40 GHz:

Frequency in MHz	EIRP in dBm
960-1610	-75.3
1610-1990	-63.3
1990-3100	-61.3
3100-10600	-41.3
Above 10600	-61.3

The requirements are **FULFILLED.**

Remarks:

None.



5.3 Radiated Emissions at 1164-1240 MHz and 1559-1610 MHz

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

5.3.1 Description of the test location

Test location: Anechoic chamber 1

5.3.2 Photo documentation of the test set-up – see ATTACHMENT B

5.3.3 Applicable standard

According to FCC Part 15, Section 15.519(d):

In addition to the radiated emission limits specified in the table in paragraph (c) of this section, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz.

5.3.4 Analyser settings

RBW: 1 kHz,	VBW: 3 kHz,	Detector: RMS,	Sweep time: 1 ms/1kHz,
-------------	-------------	----------------	------------------------

5.3.5 Test result

1164 MHz to 1240 MHz

Ref Level -30		RBW 1	kHz						
 Att 	10 dB 🖷 SWI	10 s 👄 VBW 3	kHz Mode Sw	veep					
TDF DC									
1 Frequency S	weep								●1Rm Max
								M1[1]	-92.54 dBm
								1.	22049460 GHz
-40 dBm									
-50 dBm									
-60 dBm									
-70 dBm									
-80 dBm									
	——Н1 -85.300 dB	m							
-90 dBm							M1		
		c .	8				1		
1100 dBm -	4 5	7				9			
المرابعة الفريطين والمرابع		ر بالمعدية المعدية المراجع المراجع	ليان الديم براير را . 10 مولفتك التوسيل ا	ى يەر يەر يەلەر ئەلەر (مەر يەم يەر يەر يە	فقر الأردارين أربيان المام مشتقده و	սյանովարտեն հայ հ.	والمريقية المطالعة فمدريها	استبت بسرياطير اللبرية لفتر لطيابا	فأبول تدهر بالبوجي إيارين ا
-110 dBm	an ta dalah kata mangan kata mangan	ny lay na shanala kurkila hu		وتداعا وتداخل ودياراتهم الراعظ	إسارتها ويستعلقها والشروا	والتنابية الإيلاء تعتد يتلب ألك	والمراجع والمتحاط والله المتحاد والم	A the left port the distribution of the second	والمساور والمتعالم والمتعادية
110 0000 1									1 .
-120 dBm									
1.164 GHz			10000 pt	S	7	.6 MHz/			1.24 GHz
2 Marker Peak	List					· · · ·			
No	X-Valu	e	Y-Va		No	X-Value	2	Y-Va	
1	1.164475 0		-98.996		6	1.185603 0		-97.405	
2 3	1.167424 0		-100.356		7	1.186097 0		-100.601	
3	1.170008 0 1.174302 0		-99.232 -99.747		8	1.193370 G 1.210660 G		-95.739 -100.685	
5	1.176263 0		-100.690		10	1.220495 0		-92.538	
<u> </u>	1.1.0200 0		100.000		10	1.220.000		52.000	



1

FCC ID: 2AK6M-EP20FMMASTER

Ref Level -3		● RBW 1 k							
Att TDF DC	10 dB 😑 SWT 10 s	s – vbw 3k	Hz Mode Sv	veep					
1 Frequency S	Sween								⊜1Rm Ma
r roquonoy c								M1[1]	-91.99 dE
									60020040 G
-40 dBm	+							1,	0020040 0
-50 dBm	+								
-60 dBm									
00 00									
-70 dBm									
vo ubm									
-80 dBm									
	H1 -85.300 dBm							M1	
90 dBm								1	
		f L		_					
100 dBm	N N		4				7	a <u>1</u> 1	
	n i na i sin juna u presidente i na sel i na se Na sel i na sel na sel na sel i na sel na sel na sel i na	وبالفانية المتأثرة ومقرقه	والمعتران ومراجعا الار		إعانا الاعترا العالية إذاع والمتقاط والمحا		الشمشان والاردد الله ويتشاد	والمراجع المسالية والمراجع	الالحديا أحالتها التنتل وراتنا
110 dBm	at in the state of	ها المعالمة الهالية. عاطفه	يه ريل . ها قا ليا . هوا ليله جل رياي ر	. ایر شهریوایا د. میر بایدی <u>ایر</u> ان (الاری)	وياربل مرزاول خفر بطرفير واحقت ولي	ر في تعادية المعلق بيم يو	والملق بالارد ويقطعها فالمحملين مل	إمار روراؤله ومعالل بمتسللها والمسالط	and the second
120 dBm									
120 UBIII-									
1.559 GHz			10000 pt	S	5	.1 MHz/			1.61 G
Marker Pea	k List								
	X-Value		Y-Va	lue	No	X-Value	e	Y-Va	ue
No			-100.510 dBm			6 1.593963			
1	1.560497 GHz				6			-100.848	
1 2	1.560497 GHz 1.573079 GHz		-94.729	∙ dBm	7	1.598456 G	iHz	-100.566	dBm
1	1.560497 GHz			∙dBm ∙dBm	6 7 8 9		iHz iHz		dBm dBm

Limit according §15.519(d) in the frequency

Frequency in MHz	EIRP in dBm			
1164-1240	-85.3			
1559-1610	-85.3			

The requirements are **FULFILLED.**

Remarks: Tests were performed with vertical and horizontal antenna.

The plots show the worst case scenario.



5.4 Peak Power radiated

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

5.4.1 Description of the test location

Test location: Anechoic chamber 1

5.4.2 Photo documentation of the test set-up – see ATTACHMENT B

5.4.3 Applicable standard

According to FCC Part 15, Section 15.519(e):

There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, f_M . That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in §15.521.

5.4.4 Analyser settings

RBW: 50 MHz, VBW: 80 MHz,	Detector: Peak,	Trace Mode: Max hold
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5.4.5 Test result

CH1

Ref Level 1		● RBW 5							
Att IDF	10 dB SWT	2 ms 🖷 VBW 8	OMHZ Mode A	luto Sweep					
Frequency	Sween								⊜1Pk Ma
- i oquonoy								M1[1]	
									3.741250 0
-dBm	H1 0.000 dBm								
		M1							
10 dBm			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		the second and	here	And a constraints		
	at worker	C. Marker					and have		
20 dBm	American							and Annone	
20 000	Hand and Market							and and a second	
Acres									The and any of the state
30 dBm									- NA WAY
Webernat									
40 dBm									
40 UBM									
50 dBm									
60 dBm									
70 dBm									
80 dBm				1					
3.5 GHz			2000 pt			0.0 MHz/			4.5 G



Min. limit margin:

7.99 dB at 3.741 GHz

The requirements are **FULFILLED.**

None.

Remarks:



5.5 Signal deactivation

For test instruments and accessories used see section 6 Part MB.

5.5.1 Description of the test location

Test location: Shielded room S6

5.5.2 Photo documentation of the test set-up – see ATTACHMENT B

5.5.3 Applicable standard

According to FCC Part 15, Section 15.519(a)(1):

A UWB device operating under the provisions of this section shall transmit only when it is sending information to an associated receiver. The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continue to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting.

According to KDB 393764 D01 UWB FAQ v02 section 4:

An acknowledgement of reception must continue to be received by the UWB device at least once every 10 seconds, or else the device shall cease transmission of any information other than periodic signals for use in the establishment or re-establishment of a communications link with an associated receiver.

5.5.4 Description of Measurement

The measurement was performed radiated.

Spectrum analyser settings: RBW: 50 MHz, VBW: 80 MHz, Detector: peak, zero span



5.5.5 Test result

Ref Level -3	0.00 dBm	● RBW 5	i0 MHz						SGL
 Att 	0 dB 🖷 SW	T 25 s 👄 VBW 8	0 MHz						
1 Zero Span									●1Pk Clrw
								M1[1]	
									7.6359 s
-35 dBm									
-40 dBm									
10 dbiii									
-45 dBm									
de danta		ماياسمى	M1						
-50 dBm	n <mark>a tha tha tha ta bara an an</mark>								
1 -55 dBm									
l -60 d8m									
Set dan t		11.000							
V MALLI MALA	and the second	na chailtean a	ورور مراه الإسماد الم	the marge Marger decases	and a second	little to wheel to see	need, by he have	Land Dudoulus	have washe in
165 dBm +1 - 4444	Charles Contraction and a state	a calante state contra	in Audole - Ind Color Color and Au	date to d'Attor - Caser Maria alles	a Annah at March 2011 (Sanda Para	nt of Part of Shew Marine	and the bar of the second	and her build and the star	an waa waa waa ka ka waa
-70 dBm									
-75 dBm									
-75 ubm									
CF 4.0 GHz	1			1000) pts				2.5 s/

Explanation:

At the time M1 the companion device was powered off. The EUT immediately stops transmission.

According to the manufacturer, The EUT does not transmit when the power is switched on. Only a receive mode is active. The EUT is only sending information and ranging data, if it is addressed by a radio control unit. When the radio control unit stops, the EUT stops transmitting information or ranging data. UWB can not be switched on by a user.

This behaviour is in accordance with the applicable standards.

The requirements are FULFILLED.

None.

Remarks:



5.6 Antenna application

5.6.1 Applicable standard

According to FCC Part 15C, Section 15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit that broken antennas can be replaced by the user, but the use of a standard antenna jack is prohibited.

The EUT has an integrated antenna. No other antenna can be used with the device.

All supplied antennas meet the requirements of part 15.203 and 15.204.

Remarks: None.



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.
CPR 3	FSW43 AMF-6D-01002000-22-10P	02-02/11-15-001 02-02/17-15-004	08/04/2020	08/04/2019		
	LOBB 18	02-02/24-05-026	26/02/2020	26/02/2019		
	18N-20	02-02/50-17-003				
	NMS111-GL200SC01-NMS11	02-02/50-17-012				
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	02-02/50-18-016				
SER 2	ESVS 30	02-02/03-05-006	06/06/2019	06/06/2018		
	VULB 9168	02-02/24-05-005	18/04/2020	28/07/2018		
	LOBB 18	02-02/24-05-026	26/02/2020	26/02/2019		
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 3	FSW43	02-02/11-15-001	08/04/2020	08/04/2019		
	JS4-18004000-30-5A	02-02/17-05-017				
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	AFS4-01000400-10-10P-4	02-02/17-13-002				
	AMF-4F-04001200-15-10P	02-02/17-13-003				
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	BBHA 9120 E 251	02-02/24-05-006	07/05/2019	07/05/2018	11/07/2019	11/01/2019
	BBHA 9170	02-02/24-05-014	12/06/2021	12/06/2018	12/12/2019	12/12/2018
	WBH2-18NHG	02-02/24-08-002	07/05/2019	07/05/2018	11/07/2019	11/01/2019
	Sucoflex N-2000-SMA	02-02/50-05-075				
	WHK 3.0/18G-10EF	02-02/50-05-180				
	KMS102-0.2 m	02-02/50-11-020				
	SF104/11SMA/11N/2000MM	02-02/50-15-003				
	SF104/11SMA/11N/2000MM	02-02/50-15-004				
	18N-20 NMS111-GL200SC01-NMS11	02-02/50-17-003 02-02/50-17-012				
	BAM 4.5-P	02-02/50-17-012				
	NCD	02-02/50-17-024				
	KK-SF106-2X11N-6,5M	02-02/50-17-025				
	кк-91°100-2/х1119-0,9191	02-02/30-10-010				
MB	FSW43	02-02/11-15-001	06/04/2022	06/04/2021		

CPR 3, SER 2 and SER 3 measurements were performed between 31^{st} May and 14^{th} June 2019. SER 2 measurements were performed on 3^{rd} June 2019. MB measurements were performed on 22^{nd} September 2021.