

<b>Test Report</b> USA FCC Part 15.519, 15.521, RSS-Gen RF Measurement of Ultra-Wideband 10600 MHz	FCC LISTED, REGISTRATION Test Report No:   NUMBER: 2764.01 Test Report No:   ISED LISTED REGISTRATION 4235ERM.003A1   NUMBER: 23595-1 4235ERM.003A1   15.207, 15.209, 15.212, 1; & CANADA RSS-220, (UWB) devices operating within the band 3100 MHz and			
(*) Identification of item tested	VAS2			
(*) Trademark	Vehicle Access System 2.0			
(*) Model and /or type reference	Vehicle Access System 2.0			
Other identification of the product	FCC ID: 2AW3A-2WWG23VAS IC: 26958-2WWG23VAS			
(*) Features	UWB/BLE			
Manufacturer	Rivian Automotive LLC. 14600 Myford Road Irvine, CA 92606, USA			
Test method requested, standard	USA FCC Part 15.519 (2020): Technical requirements for hand held UWB systems. USA FCC Part 15.521 (2020): Technical requirements applicable to all UWB devices. USA FCC Part 15.209 (2021): Radiated emission limits; general requirements. USA FCC Part 15.207 (2020): Conducted emission limits. USA FCC Part 15.212 (2020): Modular transmitters. CANADA RSS-220 Issue 1 (July 2018) CANADA RSS-Gen Issue 5 amendment 1 (March 2019). ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.			
Summary	IN COMPLIANCE			
Approved by (name / position & signature)	Domingo Galvez EMC&RF Lab Manager			
Date of issue	03-04-2024			
Report template No	FDT08_23 (*) "Data provided by the client"			



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# Acronyms

Acronym ID	Acronym Description	
# of Tx Chains	Number of Transmission Chains	
26Ebw	Emission Bandwidth	
Avg COT	Average Channel Occupancy Time	
BW	Bandwidth	
Equipment	Equipment Type	
Freq	Frequency	
Freq Sep	Frequency Separation	
Inband Peak Lvl	Inband Peak Level	
Lvi	Level	
MP	Measurement Point	
Mod	Modulation	
NHC	Number of Hopping Channels	
NHp	Number of hops over the period	
Occ Ch BW	Occupied Channel Bandwidth	
Peak Power	Maximum Peak Conducted Output Power	
Port	Active Port	

# Competences and guarantees

DEKRA Certification Inc. is a testing laboratory accredited by A2LA (The American Association for Laboratory Accreditation), to perform the tests indicated in the Certificate 2764.01

DEKRA Certification Inc. is a testing laboratory competent to carry out the tests described in this report.

In order to assure the traceability to other national and international laboratories, DEKRA Certification Inc. has a calibration and maintenance program for its measurement equipment.

DEKRA Certification Inc. guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Certification at the time of performance of the test.

DEKRA Certification Inc. is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

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# **General conditions**

- 1. This report is only referred to the item that has undergone the test.
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# Uncertainty

Uncertainty (factor k=2) was calculated according to the DEKRA Certification internal document PODT000.

Test case	Frequency (MHz)	U (k=2)	Units
Radiated Spurious Emission	30-180	4.27	dB
	180-1000	3.14	dB
	1000-18000	3.30	dB
	18000-40000	3.49	dB

# Data provided by the client

The following data has been provided by the client:

- 1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").
- 2. The sample consists of a Vehicle Access System Sensor based of KW45 BLE and DW3300 UWB.

DEKRA declines any responsibility with respect to the information provided by the client and that may affect the validity of results.



# Usage of samples

Samples undergoing test have been selected by: The client.

The sample(s) is composed of the following elements, accessories and auxiliary equipment:

ld	Control Number	Description	Manufacturer / Model	Serial Nº	Date of Reception	Application
S/01	4235/01	VAS2 Sample	Rivian Automotive / Vehicle Access System 2.0	000366	12-07-2023	Element Under Test
S/01	4250/05	PCAN-USB Adapter	Phytools / PEAK-System	031650	09-20-2023	Accessory
S/01	4250/06	Harness	Rivian Automotive		09-20-2023	Accessory
S/01	1482	Laptop	LENOVO / V14 G2 ITL	PF3QAFFH		Auxiliary Element

Notes referenced to samples during the project:

ld	Туре	Note
S/01	Commercial	Sample S/01 was used for: All Radiated test(s) indicated in appendix A.



# Test sample description

Test Sample description (compulsory information for EMC and RF testing services

Ports:			Cable						
	Port name and description		Specified max length [m]	Atta durin	ched g test	Shielde	d C	Coupled to patient <sup>(3)</sup>	
	RF (ra	adiated)		[	]	[]		[]	
				[]		[]		[]	
				[]		[]		[]	
				[	[] []		[]		
				[]		[]	[]		
				] [	[] []			[]	
Supplementary information to the ports:	No Da	ata provided.							
Rated power supply	Voltar	and Frequency			R	eference p	oles		
	voltag	je and Frequency		L1	L2	L3	N	PE	
	[]	AC:		[]	[]	[]	[]	[]	
	[]	AC:		[]	[]	[]	[]	[]	
	[X]	DC: 13.5 Nominal	(9.8~16V)						
	[] DC:								
Rated Power:	6W								
Clock frequencies	38.4 MHz, 32.768 kHz, 32MHz								
Other parameters:	No Data provided								
Software version:	23.46.3								
Hardware version:	D								
Dimensions in (W x H x D):	2 x 2 x0.5 inches								
Mounting position	[]	Table top equipme	ent						
	[]	Wall/Ceiling moun	ted equipmer	ted equipment					
	[]	Floor standing equ	uipment						
	[]	Hand-held equipm	nent						
	[X]	Other: Vehicular							
Modules/parts	Modu	le/parts of test item			Т	уре	Mar	nufacturer	
	N/A								
Accessories (not part of the test item)	Description				Туре Ма		Manufacturer		
	N/A								



Documents as provided by the	Description	File name	Issue date
applicant :	Declaration Equipment Data	FDT30_18 Declaration Equipment Data filled DEC 12 2023	12/12/2023
	Operational Description	VAS2OPSDES	TBD
	Vehicle User Manual	UM	TBD
	Sch/Bom (Long Term Confidential)	SCH_BOM	TBD
	Label Sample	LS	TBD

<sup>(3)</sup>Only for Medical Equipment

# Identification of the client

Rivian Automotive LLC. 14600 Myford Road Irvine, CA 92606, USA

# Testing period and place

Test Location	DEKRA Certification Inc.
Date (start)	12-06-2023
Date (finish)	02-29-2024

# Document history

Report number	Date	Description
4235ERM.003	02-02-2024	First release.
4235ERM.003A1	03-04-2024	Second release. Standard information was updated in cover page. Occupied bandwidth (or 99% emission bandwidth) and 10 dB Bandwidth test results are added to Appendix A of the test report. This modified report cancels and replaces the report 4235ERM.003.



# **Environmental conditions**

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 30 % Max. = 75 %
Air pressure	Min. = 860mbar Max. = 1060mbar

In the semi anechoic chamber, the following limits were not exceeded during the test.

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 30 % Max. = 75 %
Air pressure	Min. = 860mbar Max. = 1060mbar

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 30 % Max. = 75 %
Air pressure	Min. = 860mbar Max. = 1060mbar

# Remarks and comments

• The tests have been performed by the technical personnel: Juliana Cherry, Yuqi Wang, Yuri Barone, Victor Albrecht, and Koji Nishimoto.



# **Testing verdicts**

Fail	F
Inconclusive	I
Not applicable	N/A
Not measured	N/M
Pass	Р

# Summary

# Appendix A: Ultra-Wideband Operation

	FCC PART 15F PARAGRAPH / RSS-220										
Requirement	Test case	Verdict	Remark								
RSS-GEN 6.7 – Occupied ba	andwidth (or 99% emission bandwidth)	Р	N/A								
RSS-GEN 8.8 / FCC 15.207	- Conducted Emission limits.	N/A	Refer 1								
RSS GEN 8.9 RSS -220 5.3	.1(d) / FCC 15.519 (c) - Radiated Emissions	Р	N/A								
RSS -220 5.3.1(e) / FCC 15.	519 (d) - Radiated Emission in GPS band	Р	N/A								
RSS -220 5.3.1(b) / FCC 15.	519 (a) - Transmitter On/Off Requirement	Р	N/A								
RSS -220 5.1(a) / FCC 15.5	19 (b) - 10 dB Bandwidth	Р	N/A								
RSS -220 5.3.1(g) / FCC 15.	519 (e) / FCC 15.521 (g) - Peak level of Emission	P	N/A								

Supplementary information and remarks:

1) According with the requirements of FCC Rules and Regulations, title 47, Chapter I, Subchapter A, Part 15, Subpart C, §15.207 (c), Conducted limits, Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation, and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provision for, the use of battery chargers which permit operating while charging, AC adaptors or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.



# List of equipment used during the test

## Radiated Measurements

Control No.	Equipment	Model	Manufacturer	Next Calibration
1010	EMI Test Receiver	ESR7	Rhode & Schwarz	2024-10-14
1014	Signal Analyzer 40GHz	FSV40	Rhode & Schwarz	2024-08-01
1055	Double-Ridged Waveguide Horn Antenna (18-40GHz)	3116C	ETS Lindgren	2026-02-06
1057	Double-Ridged Waveguide Horn Antenna (750 MHz-18 GHz)	3115	ETS Lindgren	2026-07-18
1064	Biconilog Antenna	3142E	ETS Lindgren	2024-12-13
1108	Ethernet SNMP Thermometer- SAC1 Room	HWg-STE Plain	HW Group	2024-10-17
1111	Ethernet SNMP Thermometer- CR1 Room	HWg-STE Plain	HW Group	2024-10-18
1179	Semi-Anechoic Chamber	SAC 3plus 'L'	Frankonia	
1217	Frankonia Transparent Test Table 1	FFT-Square	Frankonia	
1314	Wireless Measurement Software R&S EMC32		Rhode & Schwarz	



# Appendix A: Ultra-Wideband Operation



# Appendix A

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# **PRODUCT INFORMATION**

The following information is provided by the client

Information	Description					
Modulation	BPSK					
Operation mode:						
Operating Frequency Range	Ch5 Freq = 6489.6 MHz,					
	Ch9 Freq = 7987.2 MHz					
Nominal Channel Bandwidth	UWB: 499.2MHz					
RF output Power	- 41.3dBm/MHz EIRP					
Antenna type	Integral PCB antenna					
Antenna gain	Channel 5 = 4.32dBic					
	Channel 9 = 4.81dBic					
Nominal Voltage						
Supply Voltage	13.5 Vdc					
Type of power source	DC voltage					
Equipment type	UWB					
Data Rates	6.8 mbit/s					
	850 kbit/s					

# **TEST CONDITIONS**

(\*): Data provided by the client.

TEST CONDITIONS	DESCRIPTION
TC/01	Power supply (V): Temperature:   Vnominal: 13.5 Vdc Tnominal: +15 to +35 °C   Modulation: BPSK   Test Frequencies for Conducted/Radiated tests:
	Ch5 Freq: 6489.6 MHz Ch9 Freq: 7987.2 MHz



# TEST CASES DETAILS

# RSS-GEN 6.7 – Occupied bandwidth (or 99% emission bandwidth)

## Limits

No Limit has been set to this test case.

Data Rates	Channel	Freq (MHz)	BW (MHz)	Occ Ch BW (MHz)
6 9 mbita	Channel 5	6489.6	1	611.2
0.0 110115	Channel 9	7987.2	1	593.6
950 khita	Channel 5	6489.6	1	645.0
OOU KDIIS	Channel 9	7987.2	1	615.0

# Verdict

Pass



#### Attachments

## Channel 5:

## Data Rate: 6.8 Mbits

Spectrur	n										
Ref Leve	l -10.00 dB	3m Offset	1.30 dB 😑	RBW 5 M	Hz						
👄 Att	0	dB 👄 SWT	160 ms 👄	<b>VBW</b> 20 M	Hz Mod	e Sweep	2				
Controlled b	Controlled by EMC32										
						D3[1]			0.01 dB		
-20 dBm-								53	20.800 MHz		
						Occ Bw		611.2000	00000 MHz		
-30 dBm		Mt				M1[1]			35.24 dBm		
		X	5 D				N 1	6.3	34000 GHz		
-40 dBm—	02	In manyor lo	mpry	Hthere and the state of the sta	- Darage	An all and	whyper a	.03			
50.10	-01 -45,240	) dBm				_	1 way	MAN 12			
-50 dBm	C. C.							Margay Di	N.B.		
60 dem									Mul		
-Olympic Bill									. Materia		
-70 dBm											
-80 dBm											
-90 dBm											
-100 dBm-						_					
CF 6.5 GH	z	1		1000	pts			Spant	300.0 MHz		
Marker									1		
Type   Re	ef   Trc	X-value		Y-value	Fun	ction	Fun	ction Result	: 1		
M1	1	6.334	4 GHz	-35.24 dB	m						
T1	1	6.1852	2 GHz	-50.31 dB	m	Occ Bw			611.2 MHz		
T2	1	6.7964	4 GHz	-51.20 dB	m						
D2 N	/1 1	-101.6	MHz	-10.17 c	В						
D3 I	02  1	520.8	3 MHz	0.01 c	В						

## Data Rate: 850 Kbits

Spect	rum											
Ref L	evel	-10.00	dBm Offset	: 1.30 dB 🧉	<b>RBW</b> 5 M	Hz						
👄 Att		(	) dB 😑 SWT	160 ms 🧉	• <b>VBW</b> 20 M	IHz	Mode St	weep				
Controlle	Controlled by EMC32 ●1Pk View											
							D3[1	1]				0.00 dB
-20 dBn												500.800 MHz
20 001					M1		Occ	Bw			593.60	10000000 MHz
-30 dBn	י—⊢				The second secon		M1[:	1]				-29.70 dBm
		DS	man	mannon	markadera	fund	monaun	when	Ann.	della an	DB	6.488400 GHz
-40 dBn		11 -39.Z	00 dBm						-	- may and	China and	
	~	Horn									When 2	h
-50 dBn	and -											Now No
C dente												MA
-00 UBN	1											tran
-70 dBn	n—											
-80 dBn	n											
-90 dBn	ו											
-100 dB	m—											
CF 6.5	GHz				1000	) pts					Spa	an 800.0 MHz
Marker												
Туре	Ref	Trc	X-value		Y-value		Functio	n		Fur	nction Res	sult
M1		1	6.48	84 GHz	-29.70 dB	m						
T1		1	6.19	48 GHz	-45.58 dB	m	Occ	Bw				593.6 MHz
T2		1	6.78	84 GHz	-48.73 dB	m						
D2	M1	1	-251	.2 MHz	-10.01 a	1B						
D3	D2	1	500	.8 MHZ	0.00 0	3B						]



#### Channel 9:

#### Data Rate: 6.8 Mbits

Spectrum											
Ref Level	-8.00 dBm	Offset	1.30 dB	RBW	5 MHz						
🛛 Att	10 dB	SWT	45 ms	👄 VBW	20 MHz	Mode .	Auto SN	weep			
Controlled by	ЕМСЗ2 😑	1Pk View									
						D	2[1]				-10.13 dB
										-1	00.000 MHz
-20 dBm						0	cc Bw			645.000	000000 MHz
20.40-			M1			M	1[1]				-32.08 dBm
-30 uBm				mi ha	Law Marine	alas kas				7.	830500 GHz
-40 dBm		Dank	mand par	want add	Warne wa	wall the particular	mul	AAL	02		
D	1 -42.080	dBm						- SU	ALL ALLY	T2	
-50 dBm	LIPU	rv							No.	ANT A	-
invertere bushine	menter ()									Whatywas	menorhernspensor
-60 dBm											-
-70 dBm											
ee dem											
-ou ubili											
-90 dBm											
-100 dBm											
CF 7.99 GHz					1000 pt	s				Sp	an 1.0 GHz
Marker											
Type Ref	Trc	X-value		Y-v	alue	Func	tion		Fund	ction Resu	lt
M1	1	7.83	05 GHz	-32	2.08 dBm						
T1	1	7.66	15 GHz	-50	.73 dBm	0	cc Bw				645.0 MHz
T2	1	8.30	65 GHz	-50	).20 dBm						
D2 M1	1	-100	.0 MHz	-	10.13 dB						
D3 D2	1	509	.0 MHz		-0.28 dB						
						Ĩ.	Me	asuring			<b>//</b>

## Data Rate: 850 Kbits

Spect	rum									
Ref L	evel	-8.00	dBm Offset	1.30 dB 🌘	RBW 5 MH	z				<b>`</b>
🗎 Att		10	) dB 👄 SWT	45 ms (	🛯 <b>VBW</b> 20 MH	z M	lode Auto S	weep		
Controll	ed by	EMC32	: 🔵 1Pk View							
							D3[1]			0.08 dB
									5	500.000 MHz
-20 dBn	n — —				MI		Occ Bw		615.000	000000 MHz
-20 dBn					N		M1[1]			-28.11 dBm
-30 001			D2	ameretynes	Manushan	howing	munpularel	AN L D2	7.	985500 GHz
-40 dBn	n D	1 -38.	110 dBm					with the second		
			Kurverhur					~	When the	
-50 dBn	n —	14	led .						Dargui	-
muturhiled	hundress.	orthan all							"the	ward ward and a second
-60 dBn	n									
-70 dBn										
-70 001										
-80 dBn	n –									
-90 dBn	n —									
-100 dB	Sm -									
05.7.0	0.011-				1000	nte				
Manlan	9 GHZ				1000	prs				
Marker	<b>D</b> -6	[	¥	. 1		1	E			<b>IF</b> 1
Type	Ret	1	7 00		-29 11 de		Function		-unction Resu	n
T1		1	7.67	75 GHz	-45.01 dBi	m	Occ Bw			615.0 MHz
T2		1	8.29	25 GHz	-46.44 dBi	n	200 01			02010 Mile
D2	M1	1	-249	.0 MHz	-10.20 d	в				
D3	D2	1	500	.0 MHz	0.08 d	В				
		1					Me	asuring	<b>.</b>	**
								asaringin		



## RSS GEN 8.9 RSS -220 5.3.1(d) / FCC 15.519 (c) - Radiated Emissions

#### Limits

**FCC 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 following average limits when measured using a resolution bandwidth of 1 MHz.

Fundamental frequency (MHz)	EIRP in dBm
960-1610	-75.3
1610-1990	-63.3
1990-3100	-61.3
3100-10600	-41.3
Above 10600	-61.3

**FCC 15.209 (c):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
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	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c) / RSS-Gen):

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.



Note 1: The lower limit shall apply at the transition frequency.

Note 2: Distance refers to the distance in meters between the measuring instrument antenna and the close point of any part of the device or system.

Note 3: E field strength  $(dB\mu V/m) = 20 \log E$  field strength  $(\mu V/m)$ 

Note 4: E field strength (dBµV/m) = EIRP (dBm) + 95.2

#### RSS-GEN Clause 8.9 and RSS 220 Clause 5.3(c)(d)

Frequency (MHz)	Field Strength (Microvolts/m)	Distance(m)	E.i.r.p. (dBmW)
0.009-0.490	2,400/F (F in kHz)	300	10 log (17.28 / F²) (F in kHz)
0.490-1.705	24,000/F (F in kHz)	30	10 log (17.28 / F²) (F in kHz)
1.705-30.0	30	30	-45.7
30-88	100	3	-45.7
88-216	150	3	-51.7
216-960	200	3	-49.2

Radiated emissions at or below 960 MHz from a device shall not exceed the limits in section 3.4 (table above).

Radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Hand-held (Outdoor) Communication, Measurement, Location Sensing, and TrackingDevices				
Fundamental frequency (MHz)	EIRP in a Resolution Bandwidth of 1 MHz (dBm)			
960-1610	-75.3			
1610-4750	-70.0			
4750-10600	-41.3			
Above 10600	-61.3			



#### Test Setup:

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at 3 m for the frequency range 30-1000 MHz (Bilog antenna) and 1-18 GHz Double ridge horn antennas, and 1m for the frequency range 18 GHz- 40 GHz Double ridge horn antenna.

For radiated emissions in the range 18 - 40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.



Fig A1: Radiated measurements Setup f < 1 GHz

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Fig A2: Radiated measurements setup f > 1-18 GHz



Fig A3: Radiated measurements setup f > 18 GHz

## Verdict

Pass

Modulation: UWB (BPSK)

#### Results

#### Frequency range 0.03 - 1 GHz

The spurious emissions below 1 GHz do not depend on the operating channel selected in the EUT.

#### Channel 5

## Frequency MHz = Ch5, Data Rate = 850 kbit/s, Modulation = UWB (BPSK), Frequency Range GHz = [0.03, 1]

#### Images:



RF\_FCC\_15.519\_E Field\_30MHz\_1GHz

PK+\_MAXH

TX limits to Spurious Emission FCC15.519 (30MHz to 960MHz) MaxPeak-PK+ (Single)

 $\stackrel{\nabla}{\times}$ QuasiPeak-QPK (Single)

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol	Margin - QPK (dB)	Limit - QPK (dBµV/m)
37.905000	25.9	11.9	V	28.1	40.0
73.896000	25.0	5.0	V	35.0	40.0
118.815000	20.1	5.9	V	37.6	43.5
164.803500	20.2	8.3	Н	35.3	43.5
263.290500	26.9	15.9	Н	30.1	46.0
407.394000	29.4	17.7	V	28.3	46.0





## Frequency range 0.96 - 18 GHz

#### Channel 5

Frequency MHz = Ch5, Data Rate = 6.8 Mbits/s, Modulation = UWB (BPSK), Frequency Range GHz = [0.96, 18]



Frequency (MHz)	RMS_MAXH (dBµV/m)	Pol Margin - RMS (dB)		Limit - RMS (dBµV/m)	Comment
1151.864375	19.1	V	0.7	19.9	
6547.656250	45.9	Н	8.0	53.9	Fundamental
12979.100000	31.9	V	2.0	33.9	2nd Harmonic



# Frequency MHz = Ch5, Data Rate = 850 kbits/s, Modulation = UWB (BPSK), Frequency Range GHz = [0.96, 18]



Frequency (MHz)	RMS_MAXH (dBµV/m)	Pol Margin - RMS (dB)		Limit - RMS (dBµV/m)	Comment
1152.131875	18.2	Н	1.7	19.9	
6431.406250	46.3	Н	7.6	53.9	Fundamental
12979.100000	31.9	V	2.0	33.9	2nd Harmonic



## Channel 9

Frequency MHz = Ch9, Data Rate = 6.8 Mbits/s, Modulation = UWB (BPSK), Frequency Range GHz = [0.96, 18]



Frequency (MHz)	RMS_MAXH (dBµV/m)	Pol	Margin - RMS (dB)	Limit - RMS (dBµV/m)	Comment
1151.864375	18.5	Н	1.4	19.9	
7987.187500	45.5	V	8.4	53.9	Fundamental
13303.775000	27.3	V	6.6	33.9	2nd Harmonic



# Frequency MHz = Ch9, Data Rate = 850 kbits/s, Modulation = UWB (BPSK), Frequency Range GHz = [0.96, 18]



Frequency (MHz)	RMS_MAXH (dBµV/m)	Pol Margin - RMS (dB)		Limit - RMS (dBµV/m)	Comment
1151.931250	17.4	V	2.5	19.9	
7988.125000	46.5	V	7.4	53.9	Fundamental
16257.300000	27.3	V	6.6	33.9	2nd Harmonic



## Frequency range 18 - 40 GHz

#### Channel 5

Frequency MHz = Ch5, Data Rate = 6.8 Mbits/s, Modulation = UWB (BPSK), Frequency Range GHz = [18, 40]

## Images:



RMS MAXH

RMS\_CLRWR

TX limits to Spurious Emissions FCC15.519 (18GHz to 40GHz)

Frequency (MHz)	RMS_MAXH (dBµV/m)	Pol	Margin - RMS (dB)	Limit - RMS (dBµV/m)
19322.750000	21.7	V	12.2	33.9
31863.437500	23.6	Н	10.3	33.9
38990.062500	26.8	V	7.1	33.9



Frequency MHz = Ch5, Data Rate = 850 kbits/s, Modulation = UWB (BPSK), Frequency Range GHz = [18, 40] Images:



Frequency (MHz)	RMS_MAXH (dBµV/m)	Pol	Margin - RMS (dB)	Limit - RMS (dBµV/m)
20576.750000	22.2	V	11.2	33.9
31873.062500	23.6	Н	10.3	33.9
39531.125000	27.2	V	6.7	33.9



### Channel 9

Frequency MHz = Ch9, Data Rate = 6.8 Mbits/s, Modulation = UWB (BPSK), Frequency Range GHz = [18, 40] Images:



RMS\_MAXH RMS\_CLRWR

TX limits to Spurious Emissions FCC15.519 (18GHz to 40GHz)

Frequency (MHz)	RMS_MAXH (dBµV/m)	Pol	Margin - RMS (dB)	Limit - RMS (dBµV/m)
20961.750000	23.4	V	10.5	33.9
30235.437500	24.7	V	9.2	33.9
39599.187500	28.7	Н	5.2	33.9



# Frequency MHz = Ch9, Data Rate = 850 kbits/s, Modulation = UWB (BPSK), Frequency Range GHz = [18, 40] Images:



RMS\_MAXH RMS\_CLRWR

TX limits to Spurious Emissions FCC15.519 (18GHz to 40GHz)

Frequency (MHz)	RMS_MAXH (dBµV/m)	Pol	Margin - RMS (dB)	Limit - RMS (dBµV/m)
20911.562500	22.9	V	11.0	33.9
31871.000000	23.7	V	10.2	33.9
39529.750000	27.7	Н	6.2	33.9



## **Spectrum Analyzer Parameters**

Subrange	Step Size	Detectors	Bandwidth	Sweep Time
30 MHz - 960 MHz	46.5 kHz	PK+	100 kHz	1 s
960 MHz - 1 GHz	2 kHz	PK+	100 kHz	1 s

Spectrum Analyzer Parameters												
	Subrange	Step Size	Detectors	Bandwidth	Sweep Time							
	960 MHz - 3.1 GHz	66.875 kHz	RMS	1 MHz	0.7 s							
	3.1 GHz - 10.6 GHz	468.75 kHz	RMS	1 MHz	0.7 s							
	10.6 GHz - 18 GHz	462.5 kHz	RMS	1 MHz	0.7 s							

Spectrum Analyzer Parameters											
Subrange	Step Size	Detectors	Bandwidth	Sweep Time							
18 GHz - 40 GHz	500.0 kHz	RMS	1 MHz	1 s							



## RSS -220 5.3.1(e) / FCC 15.519 (d) - Radiated Emission in GPS band

#### Limits

**FCC 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:

Fundamental Frequency (MHz)	EIRP in dBm
1164-1240	-85.3
1559-1610	-85.3

#### Test Setup:

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at 1 m for the frequency range 960 MHz -18 GHz (1-18 GHz Double ridge horn antenna).

For radiated emissions in the range 960 MHz - 18 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.



Fig A4: Radiated measurements setup f > 960 MHz

#### The following tables and plots show the results for the worst case

#### Verdict

Pass



### Channel 5

# Frequency MHz = Ch5, Data Rate = 6.8 Mbits/s, Modulation = UWB (BPSK), Frequency Range GHz = [0.96, 18]

1164 MHz – 1240 MHz



Frequency	RMS_MAXH	Pol	Margin - RMS	Limit - RMS
(MHz)	(dBµV/m)		(dB)	(dBµV/m)
1234.632500	0.8	V	9.1	9.9



# Frequency MHz = Ch5, Data Rate = 6.8 Mbits/s, Modulation = UWB (BPSK), Frequency Range GHz = [0.96, 18]

1559 MHz –1610 MHz



Frequency	RMS_MAXH	Pol	Margin - RMS	Limit - RMS
(MHz)	(dBµV/m)		(dB)	(dBµV/m)
1600.012500	2.0	V	7.9	9.9



#### Channel 9

# Frequency MHz = Ch5, Data Rate = 6.8 Mbits/s, Modulation = UWB (BPSK), Frequency Range GHz = [0.96, 18]

1164 MHz – 1240 MHz





Frequency	RMS_MAXH	Pol	Margin - RMS	Limit - RMS
(MHz)	(dBµV/m)		(dB)	(dBµV/m)
1234.680000	0.6	V	9.3	9.9



# Frequency MHz = Ch5, Data Rate = 6.8 Mbits/s, Modulation = UWB (BPSK), Frequency Range GHz = [0.96, 18]

1559 MHz –1610 MHz



Frequency	RMS_MAXH	Pol	Margin - RMS	Limit - RMS
(MHz)	(dBµV/m)		(dB)	(dBµV/m)
1600.055000	1.9	V	8.0	9.9



# RSS -220 5.3.1(b) / FCC 15.519 (a) - Transmitter On/Off Requirement

#### Limits

**FCC 15.519 (a):** 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 acknowledgement of reception must continue to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting.

Frequency (MHz)	Measurement result (sec):	Limit (sec)	Test Result			
6489.6	0.17	10	Р			
7987.2	0.23	10	Р			

#### Test Setup:



#### Verdict

Pass

Marker M1: Associated receiver stopped transmission to send acknowledgement.

Marker D2: Transmitter device stopped transmission

#### Attachments

### Channel 5

# Images:

							(B)
Receiv	ver		Spectrum 🔊				(m)
Rof		-20.00					
Att	ever .	-39.00			Input 1	40	
			0 UD 🖶 3WI 20 5		Input 17	AC	
	iow						
OTHE V	0 10			_	D2[1]		-0.40 dB
					Da[1]		10 12506 s
-50 dBm	ו—				M1[1]		-87 23 dBm
					CONTRACT.		7.67384 s
-60 dBm	η <u>–</u>						
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						- Executive research	
es latable	بالباه الخابة	. It old	، وإلى في صفر في أولة والأمراني، إن هيها الألق ، إنه الأربي، فقد والأرب	. با باذر، را با بران في باروانية ، مقار الارب ا	. M. I. Isala K. K. K. Marka and J. K.	han bian di	n dia 1 dia dia 41 dia 4.
CF 6.4	9 GHz			2000 pts	5		2.0 s/
Marker							
Type	Ref	Trc	X-value	Y-value	Function	Function F	Result
M1		1	7.6738 s	-87.23 dBm			
D2	M1	1	170.1 ms	0.44 dB			
D3	M1	1	10.1251 s	-0.40 dB			
	_				Maa	curing	
					mea	isuring	100 Mar 100

# Channel 9

## Images:

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Receiv	/er	ſ	Spe	ctru	ım		X	ſ																		ſ	
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PS PA																											
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															D3	[1]									-0	.22	dB
-50 dBm																									10.2	351	2 s
00 0011															M1	[1]								-	89.6	6 dE	3m
-60 dBm										_					_										6.6	333	2 s
		ET L	T L	5.6	T.L																						
-70 dBm	+++				╈	╈				-					-						_						
							Ш																				
-80 dBm		+++	+++		++	Ħ	H	-		-					-						-						
							P	62															53.				
CF 8.0	t ha GHz	Lullur	1.11			atinh	4. m24	111	لد	i.c.alı	41.04	ar 11. 2000	ni d pts	h a D a C d	61	. <b>L</b> 11.	r Irola	.14.	<b>4</b> ,41100	ar alli.	atula	والعرار	ull1	1.4.1	t.at.a.	2.0 s	. I
Marker																											
Туре	Ref	Trc		3	X-V	alu	•			Y-	valı	ue		Fu	nct	ion				F	unc	tion	Res	sult			
M1		1				6	633	33 s	-	-8	39.6	6 dB	m				_										
D2	M1	1	-			23	0.1	ms 1 c	-		0	.49 0	18				-										_
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## RSS -220 5.1(a) / FCC 15.519 (b) - 10 dB Bandwidth

#### Limits

FCC 15.519 (b): The UWB bandwidth of a device operating under the provisions of this section must be contained between 3100 MHz and 10,600 MHz.

**FCC 15.503 (d):** 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.

## Data Rate: 6.8 Mbits

Frequency	Lower	Upper	10 dB	Limit	_	
(MHz)	Frequency (MHz)	Frequency (MHz)	Bandwidth (MHz)	Lower Frequency	Upper Frequency	Result
6334.0	6232.4	6753.2	520.8	3100	10600	Р
7830.5	7730.5	8239.5	509.0	3100	10600	Р

#### Data Rate: 850 Kbits

Frequency	Frequency Lower Upper		10 dB	Limit	_	
(MHz)	Frequency (MHz)	Frequency (MHz)	Bandwidth (MHz)	Lower Frequency	Upper Frequency	Result
6488.4	6237.2	6738.0	500.8	3100	10600	Р
7985.5	7736.5	8236.5	500.0	3100	10600	Р

#### Verdict

Pass

#### Attachments Data Rate: 6.8 Mbits

#### Channel 5:

## Images:

Spect	rum											
Ref L	evel -	-10.00	dBm Offset	1.30 dB	😑 RBW 5 N	1Hz						
🖷 Att			0 dB 👄 SWT	160 ms	👄 VBW 20 N	1Hz	Mode	Sweep	)			
Controlle	ed by	EMC32	●1Pk View									
							DS	8[1]				0.01 dB
-20 dBm	-										5:	20.800 MHz
							Oc	C Bw			611.2000	00000 MHz
-30 dBm	η <u> </u>		MI				M:	1[1]				-35.24 dBm
			X		AAL Ale -				A. I.		6.3	334000 GHz
-40 dBm	1-	D2	a to when the	hrow h	Conflighter the	1 mar	J. Papelan	all a support	al blogh	man	D3	
E0 dbg		1 -45	240 dBm							alle which	May 12	
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-60.dem												With
algertal												andoneno
-70 dBm	1					-						
-80 dBm	1											
00 d0m												
-90 ubn	·											
-100 dB	m —											
CE 6 5	CHZ				100	Inte					Snan	
Markor	GI 12				1000	s pe	2				opun	000.0 MHZ
Tuno	Pof	Tre	V-valuo	1	V-ualuo	1	Eunet	ion		Euro	tion Posul	F 1
M1	Ker	1	6 33	4 GHz	-35 24 di	3m	runci			run	LION RESUL	·
T1		1	6.185	52 GHz	-50.31 df	3m	00	C BW				611.2 MHz
T2		1	6.796	64 GHz	-51.20 di	3m						
D2	M1	1	-101	6 MHz	-10.17	dB						
D3	D2	1	520.	8 MHz	0.01	dB						

## Channel 9:

Spect	rum									
Ref L	evel	-8.00 dB	m Offset	1.30 dB	RBW 5 MH:	Z				
🗕 Att		10 (	ib 👄 SWT	45 ms	<b>VBW</b> 20 MH:	z Mode	Auto S	weep		
Controlle	Controlled by EMC32 ●1Pk View									
						D	2[1]			-10.13 dB
									-10	0.000 MHz
-20 dBn	1					C	CC BW		645.0000	00000 MHz
- 20 dbm				M1		M	1[1]		-	32.08 dBm
-30 UBI				0.00	un da in m	nal se kr			7.8	30500 GHz
-40 dBn			D2 what	many bar	man where we	ward hard	white	MALL DR		
- TO GDI	D	1 -42.08	IO dBm					Aur	T2	
-50 dBn	n——	NIET I	abatar					W	4.45	
encounterpre	tenshere	maline							White	unorthernspecture
-60 dBn	1		-							
-70 dBn										
00 40 -										
-80 UBII										
-90 dBn	-									
50 0.011	°									
-100 dB	m—									
CF 7.9	9 GHz	2			1000	pts			Spa	n 1.0 GHz
Marker										
Type	Ref	Trc	X-value	e	Y-value	Fund	tion	Fund	ction Result	
M1		1	7.83	05 GHz	-32.08 dBr	n				
T1		1	7.66	15 GHz	-51.73 dBr	n C	occ Bw			645.0 MHz
T2		1	8.30	65 GHz	-50.20 dBr	n				
D2	M1	1	-100	.0 MHz	-10.13 d	В				
D3	D2	1	509	.0 MHz	-0.28 d	B				



## Data Rate: 850 Kbits

## Channel 5:

# Images:

Spect	rum											
Ref L	evel	-10.00 dBi	m Offset	1.30 dB 🤅	RBW 9	MHz						
🔵 Att		0 d	B 🔵 SWT	160 ms 📢	<b>VBW</b> 20	) MHz	Mode	Sweep	5			
Controlle	ed by	EMC32 😑	1Pk View									
							D3	[1]				0.00 dB
-20 dBm	n											500.800 MHz
						11	Oc	CBW			593.600	000000 MHz
-30 dBm	n					<u>.</u>	M1	[1]	0.			-29.70 dBm
		D2	march	yangunan	montral	" your	James March March	num	why	1.41%	DB 6	.488400 GHz
-40 dBm		1 -39.700	dBm							- way	MAN TO	
	A	Auron									When 2	
-50 dBm	Ville											www.
60 dDm												Ma.
-00 UBI												Lunger
-70 dBm	n —											
-80 dBm	n —					_						
-90 dBm	n					+						
100 10												
-100 dB	m					-						
CF 6.5	GHz				10	00 pt	5				Spar	1 800.0 MHz
Marker												
Туре	Ref	Trc	X-value		Y-value	,	Funct	ion		Fu	nction Resu	ılt
M1		1	6.488	34 GHz	-29.70	dBm						
T1		1	6.19	48 GHz	-45.58	dBm	00	C BW				593.6 MHz
T2		1	6.788	34 GHz	-48.73	dBm						
D2	M1	1	-251	2 MHZ	-10.0	I dB						
	02	1	500	.8 MHZ	0.0	υαв						

#### Channel 9:

Spectr	um										
Ref Le	vel ·	-8.00 dBr	n Offset	1.30 dB	RBW	5 MHz					
🖷 Att		10 d	B 👄 SWT	45 ms 🧉	• VBW 2	0 MHz	Mode /	Auto SN	weep		
Controlle	d by	ЕМСЗ2 🧲	1Pk View								
							D3	3[1]			0.08 dB
										50	00.000 MHz
-20 dBm	-					MI	00	C Bw		615.0000	00000 MHz
DO dDes							M	1[1]			28.11 dBm
-30 UBIII			0.0	marchard	monormy	new the	Mon marine	when welles	D2	7.9	85500 GHz
-40 dBm	D	1 -38.11	dBm	4					White D3	-	
i o abii		X	and have						mill Used	12	
-50 dBm		d append	24 (2020)		_					and the	
unitertal	and stages	Whent								Whent	Almerican and a market
-60 dBm	_				-						(**)
-70 dBm	+										
-80 dBm	+										
-90 dBm	-										
A contraint											
-100 aBI	n										
CE 7.00						1000 pt					n 1 0 CHz
Markor						1000 pt	3			эрс	
Tupo	Pof	Tre	V_uslu	<b>.</b> 1	V-ual		Eunet	ion	Eup	ction Pocult	
M1	Kei	1	7 99	55 GHz	-28.1	ue L1 dBm	Funct	.1011	run	ction Result	
T1		1	7.67	75 GHz	-45.0	11 dBm	Or	co Bw			615.0 MHz
T2		1	8.29	25 GHz	-46.4	14 dBm					
D2	M1	1	-249	.0 MHz	-10	1.20 dB					
D3	D2	1	500	.0 MHz	0	1.08 dB					





## RSS -220 5.3.1(g) / FCC 15.519 (e) / FCC 15.521 (g) - Peak level of Emission

#### Limits

**FCC 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, fM. 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.

**FCC 15.521 (g):** When a peak measurement is required, it is acceptable to use a resolution bandwidth other than the 50 MHz specified in this subpart. This resolution bandwidth shall not be lower than 1 MHz or greater than 50 MHz, and the measurement shall be centered on the frequency at which the highest radiated emission occurs, fM. If a resolution bandwidth other than 50 MHz is employed, the peak EIRP limit shall be 20 log (RBW/50) dBm where RBW is the resolution bandwidth in megahertz that is employed. This may be converted to a peak field strength level at 3 meters using E (dB $\mu$ V/m) = P (dBm EIRP) + 95.2.

#### Test Setup:



Note: The RBW = 10 MHz, so the RBW correction is 20 log (10/50) = -14.0 dB.

Limit in dBµV/m @RBW 10 MHz = 0 + 95.2 - 14.0 = 81.2 dBµV/m - This value is shown in the plot below.

#### Plot shows below represents worst case of the DUT Orientation

Verdict

Pass



#### Attachments

## Channel 5

## Data Rate = 6.8 Mbits/s

Images:



RMS\_MAXH

RMS\_MAXIT RMS\_CLRWR@RE0101\_R6-9GHz\_TX UWB CH5 DataRate\_SP3 TX limits to Peak Level Emission FCC15.519 (6GHz to 9GHz) @RBW10MHz

Frequency (MHz)	RMS_CLRWR (dBµV/m)	RMS_MAXH (dBµV/m)	Pol	Margin - RMS (dB)	Limit - RMS (dBµV/m)	Comment
6539.250000	38.2	48.4	V	43.0	81.2	Fundamental
8651.718750	32.9	34.0	V	48.4	81.2	



#### Data Rate = 850 kbits/s

#### Images:



RMS\_CLRWR@RE0101\_R6-9GHz\_TX UWB CH5 DataRate\_SP3 TX limits to Peak Level Emission FCC15.519 (6GHz to 9GHz) @RBW10MHz

RMS\_MAXH

Frequency (MHz)	RMS_CLRWR (dBµV/m)	RMS_MAXH (dBµV/m)	Pol	Margin - RMS (dB)	Limit - RMS (dBµV/m)	Comment
6490.312500	45.1	50.5	V	36.1	81.2	Fundamental
8031.937500	30.4	31.5	V	50.8	81.2	



#### Channel 9

Data Rate = 6.8 Mbits/s Images:



RMS\_CLRWR@RE0101\_R6-9GHz\_TX UWB CH5 DataRate\_SP3 TX limits to Peak Level Emission FCC15.519 (6GHz to 9GHz) @RBW10MHz RMS\_MAXH

Frequency (MHz)	RMS_CLRWR (dBµV/m)	RMS_MAXH (dBµV/m)	Pol	Margin - RMS (dB)	Limit - RMS (dBµV/m)	Comment
6429.375000	31.3	32.0	V	49.9	81.2	
7932.656250	46.8	48.6	V	34.4	81.2	Fundamental



#### Data Rate = 850 kbits/s

Images:



RMS\_CLRWR@RE0101\_R6-9GHz\_TX UWB CH5 DataRate\_SP3 TX limits to Peak Level Emission FCC15.519 (6GHz to 9GHz) @RBW10MHz RMS\_MAXH

Frequency (MHz)	RMS_CLRWR (dBµV/m)	RMS_MAXH (dBµV/m)	Pol	Margin - RMS (dB)	Limit - RMS (dBµV/m)	Comment
6443.718750	31.5	32.5	V	49.7	81.2	
7987.312500	36.5	51.0	V	44.7	81.2	Fundamental

# **Spectrum Analyzer Parameters**

Subrange	Step Size	Detectors	Bandwidth	Sweep Time
6 GHz - 9 GHz	93.75 kHz	RMS	10 MHz	1 s