

TEST REPORT

Test Report No. : UL-RPT-RP14880601-2516A

Customer	:	Tedee Sp. z.o.o.
Model No.	:	TLV2.0
FCC ID	:	2BCK5TLV20
Technology	:	Bluetooth – Low Energy
Test Standard(s)	:	FCC Parts 15.209(a) & 15.247
Test Laboratory	:	UL International (UK) Ltd, Basingstoke, Hampshire, RG24 8AH, United Kingdom

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- 2. The results in this report apply only to the sample(s) tested.
- 3. The sample tested is in compliance with the above standard(s).
- 4. The test results in this report are traceable to the national or international standards.
- 5. Version 2.0 supersedes all previous versions.

Date of Issue:

27 October 2023

Checked by:

Ben Mercer Lead Project Engineer, Radio Laboratory

Company Signatory:

WELDER.

Sarah Williams RF Operations Leader, Radio Laboratory



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Customer Information

Company Name:	Tedee Sp. z.o.o.
Address:	UI. Karola Bohdanowicza 21/57, 02-127 Warsaw, Poland

Report Revision History

Version Number	Issue Date	Revision Details	Revised By
1.0	23/10/2023	Initial Version	Ben Mercer
2.0	27/10/2023	TCB requested updates	Ben Mercer

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1 Attestation of Test Results

1.1 Description of EUT

The equipment under test was a smart lock for accessing doors.

1.2 General Information

Specification Reference:	47CFR15.247	
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) – Section 15.247	
Specification Reference:	47CFR15.209	
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) – Section 15.209	
Site Registration:	FCC: 685609	
FCC Lab. Designation No.:	UK2011	
Location of Testing:	Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, G24 8AH, United Kingdom	
Test Dates:	19 September 2023 to 05 October 2023	

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FCC Reference (47CFR)	Measurement	Result		
Part 15.247(a)(2) Transmitter Minimum 6 dB Bandwidth		0		
Part 15.247(b)(3)	Transmitter Maximum Peak Output Power	0		
Part 15.247(e)	Transmitter Power Spectral Density	Note 1		
Part 15.247(d) & 15.209(a)	Transmitter Radiated Emissions	0		
Part 15.247(d) & 15.209(a) Transmitter Band Edge Radiated Emissions				
Key to Results				
Second Complex Comply				

Note(s):

1. In accordance with ANSI C63.10 Section 11.10.1, PSD measurements are not required if the maximum conducted output power is less than the PSD limit of 8 dBm / 3 kHz. The PSD level is therefore deemed to be equal to the measured output power.

1.4 Deviations from the Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

2 Summary of Testing

2.1 Facilities and Accreditation

The test site and measurement facilities used to collect data are located at Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom. The following table identifies which facilities were utilised for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

Site 1	Х
Site 2	-
Site 17	Х

UL International (UK) Ltd is accredited by the United Kingdom Accreditation Service (UKAS). UKAS is one of the signatories to the International Laboratory Accreditation Co-operation (ILAC) Arrangement for the mutual recognition of test reports. The tests reported herein have been performed in accordance with its terms of accreditation.

2.2 Methods and Procedures

Reference:	ANSI C63.10-2013
Title:	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Reference:	KDB 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019
Title:	Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC Rules

2.3 Calibration and Uncertainty

Measuring Instrument Calibration

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

Measurement Uncertainty & Decision Rule

<u>Overview</u>

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

Decision Rule

Measurement system instrumentation shall be used with an accuracy specification meeting the accuracy specification limits according to IEC/IECEE OD-5014.

As applicable, unless specified otherwise in this report, the compliance "Decision Rule" is based on Simple Acceptance. If the measured value is on the limit, the result is defined as a pass. In this case the risk of a false positive is 50%. For further information regarding risk assessment refer to ILAC G8:09/2019.

Measurement Uncertainty

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document "approximately" is interpreted as meaning "effectively" or "for most practical purposes".

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Minimum 6 dB Bandwidth	2.4 GHz to 2.4835 GHz	95%	±4.59 %
Conducted Maximum Peak Output Power	2.4 GHz to 2.4835 GHz	95%	±1.13 dB
Radiated Spurious Emissions	9 kHz to 30 MHz	95%	±5.32 dB
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±3.30 dB
Radiated Spurious Emissions	1 GHz to 25 GHz	95%	±3.16 dB

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

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2.4 Test and Measurement Equipment

Test Equipment Used for Transmitter Conducted Tests

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2042	Thermohygrometer	Testo	608-H1	45124926	09 Dec 2023	12
K240279	Phoenix-1	Anyload	Test 1	#1	Calibrated before use	-
M231906	Signal Analyser	Keysight Technologies Inc	N9020B	MY63430177	03 Dec 2023	12
A231990	Signal Distribution Box	Mini-Circuits	ZT-400	12211020009	Calibrated before use	-
M225506	Power Sensor	Boonton Electronics	RTP5008	12329	12 Oct 2023	12
A220131	Attenuator	Pasternack Enterprises	PE7013- 10	#5	Calibrated before use	-

Test Measurement Software/Firmware Used for Transmitter Conducted Tests

Name	Version	Release Date
Phoenix	1.4.0	19 September 2023

Test and Measurement Equipment (continued)

Test Equipment Used for Transmitter Radiated Emissions Tests

Asset No.	Instrument	Manufacturer	Туре No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2003	Thermohygrometer	Testo	608-H1	45046641	09 Dec 2023	12
K0017	3m RSE Chamber	Rainford EMC	N/A	N/A	08 Nov 2023	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	02 Nov 2023	12
A2889	Antenna	Schwarzbeck	BBHA 9120 B	00653	02 Nov 2023	12
A2863	Pre-Amplifier	Keysight Technologies Inc	8449B	3008A02100	07 Nov 2023	12
A2914	High Pass Filter	AtlanTecRF	AFH-03000	2155	25 Jan 2024	12
A2916	Attenuator	AtlanTecRF	AN18W5-10	832827#2	25 Jan 2024	12
A2892	Antenna	Schwarzbeck	BBHA 9170	9170-727	31 Oct 2023	12
A3265	Pre-Amplifier	Schwarzbeck	BBV 9721	9721-069	31 Oct 2023	12
M2040	Thermohygrometer	Testo	608-H1	45124934	09 Dec 2023	12
K0001	3m RSE Chamber	MVG Industries UK Ltd.	N/A	N/A	06 Sep 2024	12
M236226	Test Receiver	Rohde & Schwarz	ESW26	103134	21 Apr 2024	12
A3095	High Pass Filter	AtlanTecRF	AFH-07000	18051600012	27 Jan 2024	12
A3139	Antenna	Schwarzbeck	HWRD750	00027	23 Aug 2024	12
A3224	Pre-Amplifier	Schwarzbeck	BBV 9718 C	00071	09 Mar 2024	12
A2523	Attenuator	AtlanTecRF	AN18W5-10	832827#1	26 Jan 2024	12
A3165	Mag Loop Antenna	ETS-Lindgren	6502	00224383	13 Apr 2024	12
A3010	Attenuator	AtlanTecRF	AN18-06	208801#5	27 Apr 2024	12
A231925	Antenna	Teseq, Inc	CBL6111D	63584	27 Apr 2024	12
A3154	Pre-Amplifier	Com Power	PAM-103	18020012	21 Aug 2024	12

Test Equipment Used for Transmitter Band Edge Radiated Emissions Tests

Asset No.	Instrument	Manufacturer	Туре No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2040	Thermohygrometer	Testo	608-H1	45124934	09 Dec 2023	12
K0001	3m RSE Chamber	MVG Industries UK Ltd.	N/A	N/A	06 Sep 2024	12
M236226	Test Receiver	Rohde & Schwarz	ESW26	103134	21 Apr 2024	12
A3224	Pre-Amplifier	Schwarzbeck	BBV 9718 C	00071	09 Mar 2024	12
A2523	Attenuator	AtlanTecRF	AN18W5-10	832827#1	26 Jan 2024	12

<u>3 Equipment Under Test (EUT)</u>

3.1 Identification of Equipment Under Test (EUT)

Brand Name:	Tedee
Model Name or Number:	TLV2.0
Test Sample Serial Number:	Not marked or stated (Conducted sample #1, UL ID 6287460)
Hardware Version:	TLV2.0
Software Version:	2.0
FCC ID:	2BCK5TLV20
Date Of Receipt:	01 September 2023

Brand Name:	Tedee
Model Name or Number:	TLV2.0
Test Sample Serial Number:	Not marked or stated (Radiated sample #1, UL ID 6287459)
Hardware Version:	TLV2.0
Firmware Version:	2.0
FCC ID:	2BCK5TLV20
Date Of Receipt:	01 September 2023

3.2 Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.3 Additional Information Related to Testing

Technology Tested:	Bluetooth Low Energ	y (Digital Transmission	System)
Type of Unit:	Transceiver		
Channel Spacing:	2 MHz		
Modulation:	GFSK		
Data Rate: LE	1 Mbps		
Data Rate: LE2M	2 Mbps		
Power Supply Requirement(s):	Nominal	9.0 VDC	
Maximum Conducted Output Power:	7.39 dBm		
Transmit Frequency Range:	2402 MHz to 2480 M	IHz	
Transmit Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	37	2402
	Middle	17	2440
	Тор	39	2480

3.4 Description of Available Antennas

The radio utilizes an integrated antenna, with the following maximum gain:

Frequency Range (MHz)	Antenna Gain (dBi)
2402	-6.41
2440	-5.54
2480	-5.80

3.5 Description of Test Setup

Support Equipment

The following support equipment was used to exercise the EUT during testing:

Description:	Laptop
Brand Name:	Lenovo
Model Name or Number:	ThinkPad L440
Serial Number:	R9-019E9Z
Description:	USB to UART Converter Board

2000 iptioni	
Brand Name:	Tedee
Model Name or Number:	Not marked or stated
Serial Number:	6407243

Description:	USB A to USB Mini A Cable (Length: 2m)
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Operating Modes

The EUT was tested in the following operating mode(s):

- Transmitting at maximum power in *Bluetooth* LE mode with modulation, maximum possible data length available and Pseudorandom Bit Sequence 9.
- Transmitting at maximum power in *Bluetooth* LE2M mode with modulation, maximum possible data length available and Pseudorandom Bit Sequence 9.

Configuration and Peripherals

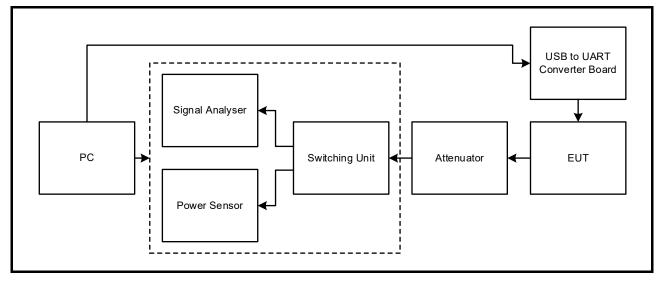
The EUT was tested in the following configuration(s):

- Controlled in test mode using a set of commands entered into a terminal application on a test laptop. The commands were used to enable a continuous transmission and to select the test channels as required.
- The EUT was powered by 3 fully charged CR123A batteries. The battery voltage was monitored throughout testing.
- Transmitter radiated spurious emissions tests were performed with the EUT transmitting in LE2M mode as this was found to transmit the highest power.
- Transmitter radiated spurious emissions tests were performed with the EUT in the worst-case position, there were no active ports to terminate.
- The customer supplied U.FL test cables to facilitate conducted measurements. The resulting additional path loss was accounted for during conducted measurements.

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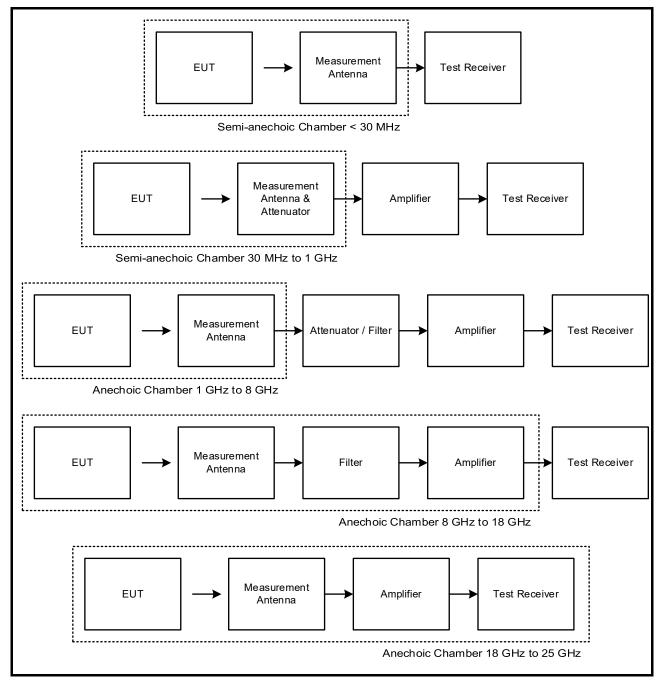
Test Setup Diagrams

Conducted Tests:



Test Setup Diagrams (continued)

Test Setup for Transmitter Radiated Emissions



4 Antenna Port Test Results

4.1 Transmitter Minimum 6 dB Bandwidth

Test Summary:

Test Engineers:	Jerome Moyo & Max Passell	Test Date:	19 September 2023
Test Sample Serial Number:	UL ID 6287460		

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	50

Note(s):

- 1. 6 dB DTS bandwidth tests were performed using a signal analyser in accordance with ANSI C63.10 Section 11.8.1 Option 1 measurement procedure. The signal analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The DTS bandwidth was measured at 6 dB down from the peak of the signal.
- 2. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.
- 3. Example plots are provided for middle channel. Plots for all channels are stored on the UL server and available for inspection upon request.

Transmitter Minimum 6 dB Bandwidth (continued)

Results:

Frequency Range:	2400-24	83.5 MHz	Ban	d:	2.4	GHz	
Limit Clause:	15.247 (a)(2)	Test	t Method:	AN	SI C63.10	11.8.1
Antenna Configuration:		SISO	Mode:			LE	
Test Port:		1 Rate/M		/Modulation:		LE 1M (GFSK)	
						1	,
T			C dD David				,
Test Frequency (MHz)				width (MHz)			Limit (kHz)
(MHz)		1	6 dB Band 2	width (MHz)		4	Limit (kHz)
	0.	1 708					Limit
(MHz)		1 708 724					Limit (kHz)



Channel 17

Transmitter Minimum 6 dB Bandwidth (continued)

Frequency Range:	2400-248	3.5 MHz	Bar	Band: 2.4		.4 GHz		
Limit Clause:	15.247 (a	15.247 (a)(2)		Test Method:		ANSI C63.10 11.8.		
Antenna Configuration:		SISO	Mode:			LE		
Test Port:			Rate/M	odulation:	LE 2M (G		GFSK)	
						•	,	
						, , , , , , , , , , , , , , , , , , ,		
Test Frequency			6 dB Band	dwidth (MHz)			Limit	
Test Frequency (MHz)	1		6 dB Banc 2	dwidth (MHz)		4	Limit (kHz)	
	1 1.1					4	-	
(MHz)	1 1.1 1.1	68				4	(kHz)	



Channel 17

4.2 Transmitter Maximum Peak Output Power

Test Summary:

Test Engineer:	Jerome Moyo & Max Passell	Test Date:	19 September 2023
Test Sample Serial Number:	UL ID 6287460		

Environmental Conditions:

Temperature (°C):	23.1
Relative Humidity (%):	50

Note(s):

- 1. Conducted power tests were performed using a peak power meter in accordance with ANSI C63.10 Section 11.9.1.3 with the PKPM1 peak power meter method.
- 2. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.
- 3. The conducted power was added to the measured antenna gain to obtain the EIRP.

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Transmitter Maximum Peak Output Power (continued)

		-									
Frequency F	Range:	2400-2483.5 MHz			483.5 MHz Band: 2.4			4 GHz			
Limit Clause	e:	15.	247 (b)	(3)	Test	Method:	AN	ISI C63.1	0 11.9.1	.3	
Antenna Configuration: SISO Mode: LE											
Test Port:		1			Rate/Mo	Rate/Modulation:			LE 1M (GFSK)		
Burst Tx	Stability: <	±2%	Duty	y Cycle (%):	50.41	41 Period (ms): 4.260			0 Width (ms): 2.113		
Test Frequency (MHz)	Maxim		m Conducted Output Power (dBm)			Margin (dB)	Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)	

			(,		(/	(/	((()
(MHz)	1	2	3	4	Σ					(dBm)	(dB)
2402 (CH37)	7.39	-	-	-	-	30.00	22.61	-6.41	0.98	36.00	35.02
2440 (CH17)	7.38	-	I	-	-	30.00	22.62	-5.54	1.84	36.00	34.16
2480 (CH39)	7.38	-	-	-	-	30.00	22.62	-5.80	1.58	36.00	34.42

Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause:	15.247 (b)(3)	Test Method:	ANSI C63.10 11.9.1.3

Antenna Configuration:	SISO	Mode:	LE
Test Port:	1	Rate/Modulation:	LE 2M (GFSK)

Burst Tx Stability: < ±2%

Duty Cycle (%): 50.92

Period (ms): 2.167

Width (ms): 1.067

Test Frequency	Maximum Conducted Output Power (dBm)				Limit (dBm)	Margin (dB)	Gain (dBi)	EIRP (dBm)	EIRP Limit	EIRP Margin	
(MHz)	1	2	3	4	Σ					(dBm)	(dB)
2402 (CH37)	7.39	-	-	-	-	30.00	22.61	-6.41	0.98	36.00	35.02
2440 (CH17)	7.38	-	-	-	-	30.00	22.62	-5.54	1.84	36.00	34.16
2480 (CH39)	7.34	-	-	-	-	30.00	22.66	-5.80	1.54	36.00	34.46

5 Radiated Test Results

5.1 Transmitter Radiated Emissions <1 GHz

Test Summary:

Test Engineer:	Nick Steele	Test Date:	05 October 2023
Test Sample Serial Number:	UL ID 6287459		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:ANSI C63.10 Sections 6.3, 6.4 and 6.5	
Frequency Range	9 kHz to 1000 MHz

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	47

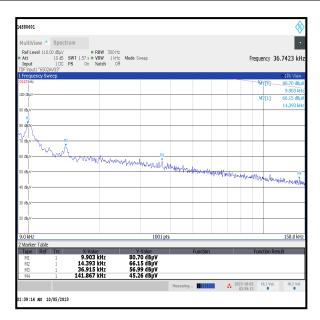
Note(s):

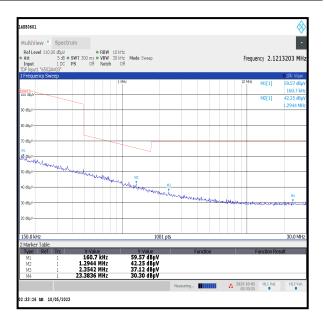
- 1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
- 2. No spurious emissions were detected above the noise floor of the measuring receiver therefore the highest peak noise floor reading of the measuring receiver was recorded as shown in the table below.
- 3. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
- 4. Pre-scans were performed and markers placed on the highest measured levels. The test receiver was configured as follows: For 9 kHz to 150 kHz, the resolution bandwidth was set to 300 Hz and video bandwidth 1 kHz. A peak detector was used and trace mode was Max Hold. For 150 kHz to 30 MHz, the resolution bandwidth was set to 10 kHz and video bandwidth 30 kHz, trace mode was Max Hold. For 30 MHz to 1 GHz, the resolution bandwidth was set to 120 kHz and video bandwidth 500 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.

Transmitter Radiated Emissions (continued)

Results: Quasi-Peak / Middle Channel / LE2M

Frequency	Antenna	Level	Limit	Margin	Result
(MHz)	Polarity	(dBµV/m)	(dBµV/m)	(dB)	
1000.0	Vertical	37.0	54.0	17.0	Complied





Pattern 100.05.00 * RBW (GSR) 100.162	Att 0.68 SW1 155 ms VBW 500 Hz Mode Sweep Imput 1.40 PS 0.6 Notch 00F 0.6 TErrospectory 100 M4 0.6 0.6 0.6 0.6 0.6 50 db/r 0.6	Frequency 173.2050808 MH
Att 0.06 SWT 13 ms + VBW 500 Hrz Mode Sweep Frequency 173.20550808 M UEF SD PUX 0.0 Note 0.0 Note 0.0 Note UEF SD PUX 0.0 Note	* Att 0 06 SVT 155m * VBW 500 Hz Mode Sweep Threaden 2 Start Star	01Fk View M2[1] 22.98 dBj
If requency Sweep 00 Pkr w 01 Pkr w 01 Pkr w 50 dg/- 100 Pkr w 101 Pkr w 101 Pkr w 50 dg/- 100 Pkr w 101 Pkr w 101 Pkr w 50 dg/- 100 Pkr w 101 Pkr w 101 Pkr w 50 dg/- 100 Pkr w 101 Pkr w 101 Pkr w 50 dg/- 100 Pkr w 101 Pkr w 101 Pkr w 50 dg/- 100 Pkr w 101 Pkr w 101 Pkr w 50 dg/- 100 Pkr w 101 Pkr w 101 Pkr w 50 dg/- 100 Pkr w 1001 Pkr w 1001 Pkr w 50 dg/- 101 Pkr w 1001 Pkr w 1001 Pkr w 50 dg/- 101 Pkr w 1001 Pkr w 1001 Pkr w 101 Pkr k 1001 Pkr w 1001 Pkr w 1001 Pkr w 101 Pkr k 1001 Pkr w 1001 Pkr w 1001 Pkr w 101 Pkr k 1001 Pkr w 1001 Pkr w 100 Pkr w 101 Pkr k 1001 Pkr w 1001 Pkr w 100 Pkr w 101 Pkr k 1001 Pkr w 1001 Pkr w 100 Pkr w	100 M42 100 M4	M2[1] 22.98 dB
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88 80,000 89 80,000 80 90,000 80 90,0000 80 90,0000 8		131,297 M
50 du/ 50 du/		
00 m/m 00 m/m 10 m/m	2.9% s	M1[1] 30.12 dB
10 dy/ 10 dy/	2.9% s	31.289 M
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10 day 10 day	San	
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-10 dp/ -0 dp/ -0 dp/ 20 Mm/cr Table Mm/cr Table Monter Table Monter 1 33.289 MHz 30.12 dp/ M = 1 33.289 MHz 30.22 dp/ M = 1 33.289 MHz 30.4 dp/ M = 1 33.289 MHz 30.4 dp/ M = 1 33.289 MHz 30.5 dp/ M		
-20 dp// -20 dp// 20 0 MHz 1001 pts 1.0 G 20 0 MHz 1001 pts 1.0 G -20 dp// -20 dp/// -20 dp// -20 dp/// -20 dp// -20	0 d8µV	
20 dg// Marker Table 1001 pts 1.0 G 50.0 MHz 1001 pts 1.0 G Marker Table 7.0 dg// 1.0 gg//		
Structure 1001 pts 1.0 G Structure 1001 pts 1.0 G Type: Ref. Trct KValue M1 131.289 HHZ 301.21 dByV Function M2 1 331.289 HHZ 302.12 dByV Function M2 1 331.289 HHZ 36.34 dByV Function M3 1 945.44 HHZ 36.34 dByV Function M4 1 0.0 GHZ 36.37 dByV Function	-10 dBµV	
Structure 1001 pts 1.0 G Structure 1001 pts 1.0 G Type: Ref. Trct KValue M1 131.289 HHZ 301.21 dByV Function M2 1 331.289 HHZ 302.12 dByV Function M2 1 331.289 HHZ 36.34 dByV Function M3 1 945.44 HHZ 36.34 dByV Function M4 1 0.0 GHZ 36.37 dByV Function		
Marker Table M Value M Value M Value Function Type: Ref. Trc: X Value Function Function M1 1 31.289 MHz 30.12 GyV Function Function M2 1 31.297 HHz 23.98 GyV Function Function M3 1 94.54.44 HX 36.43 GyV Function Function Function Function M4 1 1.0 GHz 36.97 GByV Function Function Function Function	20 dBuV	
Marker Table M Value M Value M Value Function Type: Ref. Trc: X Value Function Function M1 1 31.289 MHz 30.12 GyV Function Function M2 1 31.297 HHz 23.98 GyV Function Function M3 1 94.54.44 HX 36.43 GyV Function Function Function Function M4 1 1.0 GHz 36.97 GByV Function Function Function Function		
Marker Table M Volum M Volum Function Type: Ref. Trc X Volum Function M1 1 31.289 MHz 30.12 By V M2 1 31.297 HHz 23.96 By V M3 1 94.54.44 HK 36.34 By V M4 1 0.0 RHz 36.97 By V		
Tipe: Perf. PK V-Value Function Function M1 1 31,269 HHZ 30,12 dByV M2 1 31,269 HHZ 20,92 dByV M3 1 94.544 HHZ 36,34 dByV M4 1 1.0 GHZ 36,97 dByV		1.0 GH
M1 1 31.289 HHz 230.12 dByv M2 1 31.297 HHz 23.88 dByv M2 1 31.297 HHz 23.88 dByv M3 1 945.44 HHz 36.34 dByv M4 1 1.0 GHz 36.97 dByv		
M2 1 131.297 HHz 22.98 dbjV M3 1 94544 HHz 3634 dbjV M4 1 1.0 GHz 36.97 dbjV M4 1 1.0 GHz 36.97 dbjV		-unction Result
N3 1 945.44 MHz 36.34 dBjV N4 1 1.0 GHz 36.97 dBjV 1 1.0 GHz 36.97 dBjV		
2023-10-05 HL1 Val. HL2 Va	M3 945.44 MHz 36.34 dBuV	
- Measuring 1000 + 2023-10-05 HLL Val. HL2 Va	M4 1 1.0 GHz 36.97 dBµV	
03:25:29	Measuring	2023-10-05 HL1 Val. HL2 Val.

5.2 Transmitter Radiated Emissions >1 GHz

Test Summary:

Test Engineers:	Andrew Harding & John Ferdinand	Test Dates:	27 September 2023 to 04 October 2023
Test Sample Serial Number:	UL ID 6287459		
FCC Reference:	Parts 15.247(d) & 15.209(a)		

Test Method Used:	FCC KDB 558074 Sections 8.1 c)3), 8.5 & 8.6 referencing ANSI C63.10 Sections 6.3, 6.6, 11.11 & 11.12
Frequency Range	1 GHz to 25 GHz

Environmental Conditions:

Temperature (°C):	22 to 24
Relative Humidity (%):	47 to 51

Note(s):

- 1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
- 2. All other emissions shown on the pre-scans were investigated and found to be ambient, or > 20 dB below the appropriate limit or below the noise floor of the measurement system.
- 3. The emission shown on the 1 GHz to 3 GHz plot is the EUT fundamental.
- 4. Final measurements above 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 m above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
- 5. Pre-scans were performed and a marker placed on the highest measured level of the appropriate plot. The test receiver resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz. The sweep time was set to auto. Peak and average measurements were performed with their own appropriate detectors during the pre-scan measurements.

Transmitter Radiated Emissions (continued)

Results: Middle Channel / Peak / LE2M

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
7321.438	Vertical	55.7	74.0	18.3	Complied

Results: Middle Channel / Average / LE2M

Frequency	Antenna	Level	Limit	Margin	Result
(MHz)	Polarity	(dBµV/m)	(dBµV/m)	(dB)	
7321.313	Vertical	47.8	54.0	6.2	Complied

Results: Top Channel / Peak / LE2M

Frequency	Antenna	Level	Limit	Margin	Result
(MHz)	Polarity	(dBµV/m)	(dBµV/m)	(dB)	
7441.588	Vertical	56.2	74.0	17.8	Complied

Results: Top Channel / Average / LE2M

Frequency	Antenna	Level	Limit	Margin	Result
(MHz)	Polarity	(dBµV/m)	(dBµV/m)	(dB)	
7441.450	Vertical	48.4	54.0	5.6	Complied

Transmitter Radiated Emissions (continued)

*RBW 1 MHz *VBW 3 MHz SWT 45 ms
 MultiView
 Receiver
 X
 Spectrum
 X

 RefLevel 10.00 dbu/
 Offset 9.90 db + R8W
 1/htz
 X
 X

 Att
 5 db SWT
 40 mm s+ VBW
 3/htz
 Mode Auto Sw

 Input
 1/AC
 PS
 Off Notch
 Off

 PrSURPACE
 0ff
 Notch
 Off
 Ref 80 dBuV • Att Frequency 2.0000000 GH 2 RM VIEW Ť. r"l H1 74.000 H2 54. Stop 4001 pts 200.0 MHz/ 1.0 GHz 3.0 GH + 2023-10-03 HL1 Val. 14:16:42 0 п 0601 2:16:43 PM 10/03/2023 ■: 27.SEP.2023 12:12:22 4880601 Ì TDF: S17F40B *RBW 1 MHz *VBW 3 MHz Marker 1 [T1] 48.60
 MultiView
 Receiver
 X
 Spectrum
 X

 Ref Level 80.00 db/v
 Offset 0.60 db * RBW
 1 MHz
 Node Auto Sweep

 Imput
 1 AC
 PS
 0 ff Notch
 0 ff
 Ref 80 dBµ\ SWT 65 m Frequency 13.000000 GH Pł RM M2[1] 8.0 GHz 20001 pts 1.0 GHz/ 18.0 Gł Stop 26 GHz Start 18 GH: 800 MHz/ X-Value 9.75816 GHz 12.20304 GHz 17.52777 GHz V-Value 38.35 dBµV 39.35 dBµV 39.52 dBµV Measuring... HL1 Yal. HL2 V 30601 te: 28.SEP.2023 02:15:14

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Note: The above plots are pre-scans for indication purposes only. For final measurements, see accompanying tables.

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10:18:39 AM 10/04/2023

5.3 Transmitter Band Edge Radiated Emissions

Test Summary:

Test Engineer:	John Ferdinand	Test Date:	04 October 2023
Test Sample Serial Number:	UL ID 6287459		

FCC Reference:	Parts 15.247(d) & 15.209(a)
I LEST METROA LISEA.	KDB 558074 Section 8.7 referencing ANSI C63.10 Sections 11.11, 11.12 & 11.13

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	42

Note(s):

- 1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
- 2. As the lower band edge is adjacent to a non-restricted band, only peak measurements are required. In accordance with ANSI C63.10 Section 11.11.1, the test method in Section 11.11.3 was followed: the test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The test receiver was left to sweep for a sufficient length of time in order to maximise the carrier level and out-of-band emissions. A marker and corresponding reference level line were placed on the peak of the carrier. As the maximum peak conducted output power was measured using an peak detector in accordance with ANSI C63.10 Section 11.9.1.1 an out-of-band limit line was placed 20 dB (ANSI C63.10 Section 11.11.1(a)) below the peak level. A marker was placed on the band edge spot frequencies. Marker frequency and levels were recorded.
- 3. As the upper band edge is adjacent to a restricted band, both peak and average measurements were recorded by placing a marker at the edge of the band. For peak measurements the test receiver resolution bandwidth was set to 1 MHz and the video bandwidth 3 MHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. For average measurements the test receiver resolution bandwidth was set to 1 MHz and the video bandwidth 3 MHz. A nr RMS detector was used, sweep time was set to auto and trace mode was Max Hold. For average measurements the test receiver resolution bandwidth was set to 1 MHz and the video bandwidth 3 MHz. An RMS detector was used, sweep time was set to auto and trace mode was Max Hold. A marker was placed on the band edge spot frequencies and a second marker placed on the highest emission level in the adjacent restricted band of operation (where a higher level emission was present). Marker frequencies and levels were recorded.
- 4. There is a restricted band 10 MHz below the lower band edge. The test receiver was set up as follows: the RBW set to 1 MHz, the VBW set to 3 MHz, with the sweep time set to auto couple. Peak and average measurements were performed with peak and RMS detectors respectively. Markers were placed on the highest point on each trace.
- 5. * -20 dBc limit.

Transmitter Band Edge Radiated Emissions (continued)

Results: Peak / LE

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2400.000	Vertical	43.9	75.4*	31.5	Complied
2483.500	Vertical	50.3	74.0	23.7	Complied
2483.900	Vertical	51.9	74.0	22.1	Complied

Results: Average / LE

Frequency	Antenna	Level	Limit	Margin	Result
(MHz)	Polarity	(dBµV/m)	(dBµV/m)	(dB)	
2483.500	Vertical	40.1	54.0	13.9	Complied

Results: 2310 MHz to 2390 MHz Restricted Band / Peak / LE

Frequency	Antenna	Level	Limit	Margin	Result
(MHz)	Polarity	(dBµV/m)	(dBµV/m)	(dB)	
2311.399	Vertical	53.4	74.0	20.6	Complied

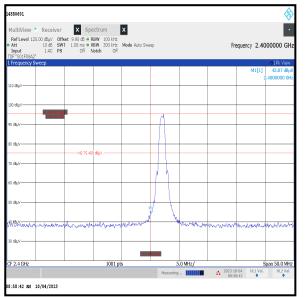
Results: 2310 MHz to 2390 MHz Restricted Band / Average / LE

Frequency	Antenna	Level	Limit	Margin	Result
(MHz)	Polarity	(dBµV/m)	(dBµV/m)	(dB)	
2311.958	Vertical	42.4	54.0	11.6	Complied

ISSUE DATE: 27 OCTOBER 2023

Transmitter Band Edge Radiated Emissions (continued)

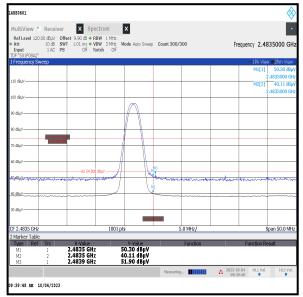
Results: LE



Lower Band Edge

880601		_	_					8
IultiView 🍍 I			×					-
Att		dB • RBW 1 MHz ms • VBW 3 MHz Off Notch Off	Mode Auto Swee	ep Count 300/S	100	Fre	quency 2.3!	500000 GH
Frequency Swee	:p						e 1Pk Vie	v e2Rm View
							M1[1]	53.35 dBµ
.0 dBµ//								.3113990 GH
							M2[2]	42.37 dBµ 3119580 GH
0 dBµV								G3119580 GH
) dBµ//								
dBµ//								
dBu//	6 20.000 d8							
oppy-								
) dBu//								
41		H2 54.000 d8µV H3						
D GBUV	and a stand of a stand and a stand of a stan		When the second second	And the second second	not marine	-	and the second	the second second
N2		M4						
dbu//		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~						
) dBµ//								
.31 GHz		1001	pts	8	.0 MHz/			2.39 GH
Marker Table								
Type Ref : M1		alue 99 GHz	Y-Value 53.35 dBµV		Function		Function Re	esuit
M2	2 2.3119	58 GHz	42.37 dBµV					
M3 M4		72 GHz 12 GHz	52.04 dBµV 42.23 dBµV					
194	2 2.3360	12 012	42.23 aphA			- 2022-10	04 HL1 Val.	HL2 Val.
				 Measuring 		+ 2023-10 09:28	:10 PILI Vol.	PILZ Val.

2310 MHz to 2390 MHz Restricted Band



Upper Band Edge

Transmitter Band Edge Radiated Emissions (continued)

Results: Peak / LE2M

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2400.000	Vertical	63.3	74.9*	11.6	Complied
2483.500	Vertical	54.6	74.0	19.4	Complied

Results: Average / LE2M

Frequency	Antenna	Level	Limit	Margin	Result
(MHz)	Polarity	(dBµV/m)	(dBµV/m)	(dB)	
2483.500	Vertical	44.1	54.0	9.9	Complied

Results: 2310 MHz to 2390 MHz Restricted Band / Peak / LE2M

Frequency	Antenna	Level	Limit	Margin	Result
(MHz)	Polarity	(dBµV/m)	(dBµV/m)	(dB)	
2312.517	Vertical	53.4	74.0	20.6	Complied

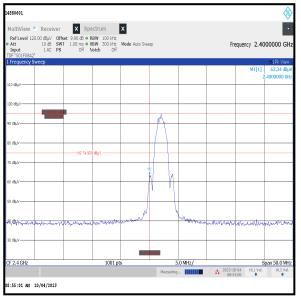
Results: 2310 MHz to 2390 MHz Restricted Band / Average / LE2M

Frequency	Antenna	Level	Limit	Margin	Result
(MHz)	Polarity	(dBµV/m)	(dBµV/m)	(dB)	
2312.597	Vertical	42.3	54.0	11.7	Complied

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Transmitter Band Edge Radiated Emissions (continued)

Results: LE2M

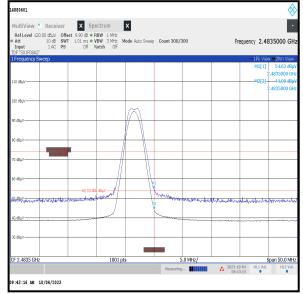


Lower Band Edge

ultiView 🍍 Re	ceiver X S	Spectrum	×					
	BuV Offset 9.90 dB		*					
Att 10	dB SWT 1.01 ms		lode Auto Sweep	Count 300/3	00	Fre	quency 2.3	500000 GH
Frequency Sweep							o 1Pk Vie	w e2Rm View
							M1[1]	53.41 dBµ
D dBuV								2.3125170 GH
							M2[2]	42.31 dBµ
D dBuV								2.3125970 GH
dBµ//								
dBµ//								
	74.000 (B.W							
dBu//	s 20.000 d8							
dBu//								
M1	10.10	4.000 d8µV						
BUTHWARM	menter and some	and approximation	www.ulm	and the second states of the s	Marca Artes	and the second second	and the second second	and the second second
N2		114						
dBu//								
dBu//								
01.01-		1001			0.181-7			2.39 GH
31 GHz		1001 pt	\$	8	.0 MHz/			2.39 GH
Marker Table	c X-Value		Y-Value		Function		Function R	orult
M1 1	2.312517	GHz 5	3.41 dBuV		TuncaUII		TURCOTIK	count
M2 2	2.312597	GHz 4	2.31 dBuV					
M3 1	2.337932 2.338092	GHz 5	2.04 dBµV					
M4 2	2.338092	UNZ 4	1.84 dBµV					
				 Measuring. 		+ 2023-10- 09:30:	04 HL1 Val. 59 9	HL2 Val.



--- END OF REPORT ---



Upper Band Edge