

TEST REPORT

Applicant: Arduino S.r.l.
Address: Via Andrea Appiani, 25, 20900 MONZA (Italy)
Equipment Type: Arduino Stella
Model Name: ABX00131
Brand Name: Arduino
FCC ID: 2AN9S-ABX00131
Test Standard: 47 CFR Part 2.1091
KDB 447498 D04 v01
Sample Arrival Date: Oct. 15, 2024
Test Date: Oct. 18, 2024 - Nov. 08, 2024
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ISSUED BY:

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Revision History

<u>Version</u>	<u>Issue Date</u>	<u>Revisions Content</u>
<u>Rev. 01</u>	<u>Dec. 23, 2024</u>	<u>Initial Issue</u>
<u>Rev. 02</u>	<u>Feb. 06, 2024</u>	<u>Updated data of UWB on page 8, Section 5.1</u>
<u>Rev. 03</u>	<u>Feb. 14, 2024</u>	<u>Added a note that cannot be transmitted simultaneously in page 9</u>

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1 GENERAL INFORMATION

1.1 Test Laboratory

Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Phone Number	+86 755 6685 0100

1.2 Test Location

Name	Shenzhen BALUN Technology Co., Ltd.
Location	☐ Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
	☒ 1/F, Building B, Ganghongji High-tech Intelligent Industrial Park, No. 1008, Songbai Road, Yangguang Community, Xili Sub-district, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Accreditation Certificate	The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196.

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	Arduino S.r.l.
Address	Via Andrea Appiani, 25, 20900 MONZA (Italy)

2.2 Manufacturer Information

Manufacturer	Arduino S.r.l.
Address	Via Andrea Appiani, 25, 20900 MONZA (Italy)

2.3 General Description for Equipment under Test (EUT)

EUT Name	Arduino Stella
Model Name Under Test	ABX00131
Series Model Name	N/A
Description of Model name differentiation	N/A
Hardware Version	N/A
Software Version	N/A
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A

2.4 Technical Information

Network and Wireless connectivity	Bluetooth (BLE), UWB
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The requirement for the following technical information of the EUT was tested in this report:

Operating Mode	Bluetooth; UWB	
Frequency Range	Bluetooth	2402 ~ 2480 MHz
	UWB	6000 ~ 8000 MHz
Antenna Type	Bluetooth	PCB Antenna
	UWB	PCB Antenna
Exposure Category	General Population/Uncontrolled Exposure	
Product Type	Mobile Device	

3 SUMMARY OF TEST RESULT

3.1 Test Standards

No.	Identity	Document Title
1	KDB 447498 D04 v01	447498 D04 Interim General RF Exposure Guidance v01

3.2 Limit Standards

No.	Identity	Document Title
1	47 CFR Part 2.1091	Radiofrequency radiation exposure evaluation: mobile devices

4 DEVICE CATEGORY AND LEVELS LIMITS

Mobile Devices:

CFR Title 47 §2.1091(b)

(b) For purposes of this section, a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons.

FCC KDB 447498 D04 General RF Exposure Guidance v01 Limit

For 300MHz to 6000Mhz

Evaluation of compliance with the exposure limits in § 1.1310 is necessary if the ERP of the device is greater than ERP_{20cm} in Formula (B.1) [repeated from § 2.1091(c)(1) and § 1.1307(b)(1)(i)(B)].

$$P_{th} \text{ (mW)} = ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases} \quad (\text{B.1})$$

If the ERP is not easily obtained, then the available maximum time-averaged power may be used (i. e., without consideration of ERP only if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole.

SAR-based exemptions are constant at separation distances between 20 cm and 40 cm to avoid discontinuities in the threshold when transitioning between SAR-based and MPE-based exemption criteria at 40 cm, considering the importance of reflections.

The SAR-based exemption formula of § 1.1307(b)(3)(i)(B), repeated here as Formula (B.2), applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power or effective radiated power (ERP), whichever is greater, of less than or equal to the threshold P_{th} (mW).

This method shall only be used at separation distances from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by Formula (B.2).

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases} \quad (\text{B. 2})$$

where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right)$$

and f is in GHz, d is the separation distance (cm), and $ERP_{20 \text{ cm}}$ is per Formula (B.1).
The example values shown in Table B.2 are for illustration only.

Table B.2—Example Power Thresholds (mW)

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

For 6000MHz to 10000Mhz

Frequencies above 300 kHz but at distances $R > \lambda / 2 \pi$, R is the antenna-person separation distance.
 λ =wavelength of transmitted signal.

Can calculate from the frequency of operation using $v=f* \lambda$

v =speed of light= $3*10^8$ m/s

f =frequency(Hz)

Primarily an MPE-based exclusion but also SAR-based where $\lambda / 2 \pi$ is $< 20 \text{ cm}$.

TABLE B.1—THRESHOLDS FOR SINGLE RF SOURCES
SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION

RF Source Frequency		Minimum Distance		Threshold ERP
f_L MHz	f_H MHz	$\lambda_L / 2\pi$	$\lambda_H / 2\pi$	W
0.3	1.34	159 m	35.6 m	$1,920 R^2$
1.34	30	35.6 m	1.6 m	$3,450 R^2 / f^2$
30	300	1.6 m	159 mm	$3.83 R^2$
300	1,500	159 mm	31.8 mm	$0.0128 R^2 f$
1,500	100,000	31.8 mm	0.5 mm	$19.2 R^2$

Subscripts L and H are low and high; λ is wavelength.
From § 1.1307(b)(3)(i)(C), modified by adding Minimum Distance columns.

5 ASSESSMENT RESULT

5.1 Output Power

Mode	Bluetooth
Conducted Power (dBm)	7.75
Antenna Gain (dBi)	1.89
EIRP (dBm)	9.64
Note: This report listed the worst case conducted power value, please refer to BL-SZ24A0346-601 report for more details.	

UWB		
Mode	CH5	CH9
EIRP (dBm)	-1.10	-1.70
Antenna Gain (dBi)	4.50	3.80
Conducted Power (dBm)	-5.60	-5.50
Note: This report listed the worst case EIRP power value, please refer to BL-SZ24A0346-602 report for more details.		

5.2 Tune-up power

Mode	Conducted Power Range (dBm)	EIRP Range (dBm)	ERP Range (dBm)
Bluetooth	[6.00, 8.00]	[8.00, 10.00]	[5.85, 7.85]
UWB CH5	[-7.00, -5.00]	[-3.00, -1.00]	[-5.15, -3.15]
UWB CH9	[-7.00, -5.00]	[-3.00, -1.00]	[-5.15, -3.15]
Note1: ERP= EIRP -2.15dB.			
Note2: According KDB 447498 D04, used the greater of maximum conducted power and ERP to compare with the threshold value Pth.			

5.3 RF Exposure Evaluation Result

For 300MHz to 6000MHz

Evolution Mode	Calculation Frequency (MHz)	Tune-up limit power (dBm)	Tune-up limit power (mW)	Threshold Value (mW)	Verdict
Bluetooth	2480	8.00	6.31	3060	Pass

For 6000MHz to 10000MHz

Evolution mode	Distance (mm)	$\lambda / 2 \pi$ (m)	$\lambda / 2 \pi$ (mm)	$R >$ $\lambda / 2 \pi$
UWB CH5	200	0.007	7.000	Yes
UWB CH9	200	0.006	6.000	Yes

Evolution Mode	Frequency (MHz)	Threshold Value (W)	Tune-up power (dBm)	Tune-up power (W)	Verdict
UWB CH5	6500	76.800	-3.15	0.0005	Pass
UWB CH9	8000	76.800	-3.15	0.0005	Pass

Note: UWB and Bluetooth of this product cannot be transmitted simultaneously, so simultaneous transmission evaluation is not required for this report.

5.4 Conclusion

This EUT is deemed to comply with the reference level limits, therefore the basic restrictions are compliant with human exposure limits.

Statement

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--END OF REPORT--