



MSA Innovation, LLC

Lunar

FCC 2.1093:2021

Bluetooth

802.15.4 DSSS

802.15.4 FHSS

LTE

SubGHz

Report: MSAS0004.23



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CERTIFICATE OF EVALUATION

Last Date of Evaluation: Wednesday, March 31, 2021
MSA Innovation, LLC
EUT: Lunar

RF Exposure Evaluation

Standards

Specification	Method
FCC 2.1093:2021	FCC 447498 D01 General RF Exposure Guidance v06

Results

Method Clause	Description	Applied	Results	Comments
4.3.1	SAR Test Exclusion	Yes	Pass	None
4.3.2	Simultaneous Transmission SAR Test Exclusion	Yes	Pass	None

Deviations From Evaluation Standards

None

Approved By:



Donald Facteau, Process Architect

Product compliance is the responsibility of the client; therefore, the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test. This report reflects only those tests from the referenced standards shown in the certificate of test. It does not include inspection or verification of labels, identification, marking or user information. As indicated in the Statement of Work sent with the quotation, Element's standard process is to always use the latest published version of the test methods even when earlier versions are cited in the test specification. Issuance of a purchase order was de facto acceptance of this approach. Otherwise, the client would have advised Element in writing of the specific version of the test methods they wanted applied to the subject testing

REVISION HISTORY



Revision Number	Description	Date (yyyy-mm-dd)	Page Number
00	None		

ACCREDITATIONS AND AUTHORIZATIONS



United States

FCC - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

A2LA - Accredited by A2LA to ISO / IEC 17065 as a product certifier. This allows Element to certify transmitters to FCC and IC specifications.

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Canada

ISED - Recognized by Innovation, Science and Economic Development Canada as a Certification Body (CB) and as a CAB for the acceptance of test data.

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European Commission – Recognized as an EU Notified Body validated for the EMCD and RED Directives.

United Kingdom

BEIS – Recognized by the UK as an Approved Body under the UK Radio Equipment and UK EMC Regulations.

Australia/New Zealand

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Korea

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Vietnam

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SCOPE

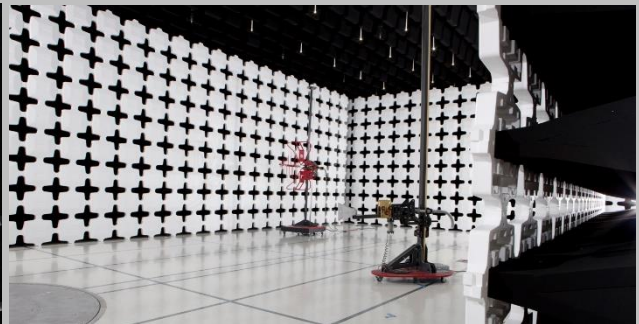
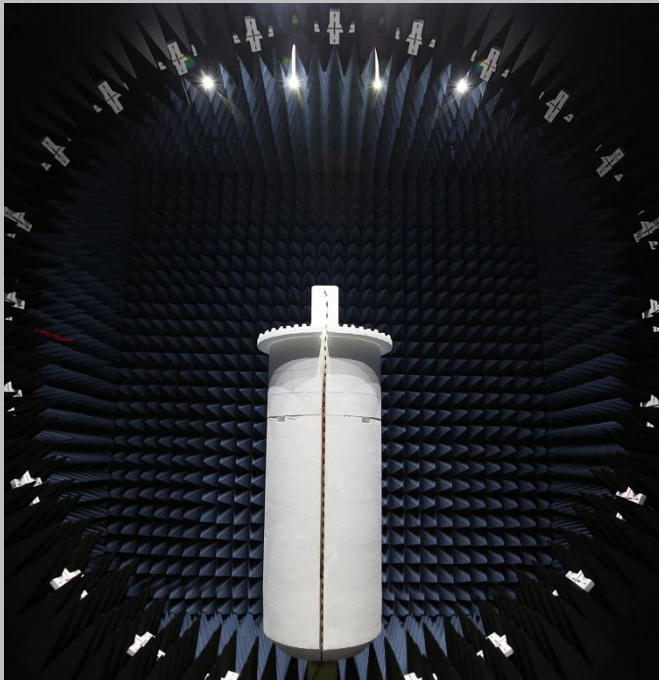
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FACILITIES



California Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Minnesota Labs MN01-11 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Oregon Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Texas Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Washington Labs NC01-05 19201 120 th Ave NE Bothell, WA 98011 (425)984-6600
NVLAP				
NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200630-0	NVLAP Lab Code:201049-0	NVLAP Lab Code: 200629-0
Innovation, Science and Economic Development Canada				
2834B-1, 2834B-3	2834E-1, 2834E-3	2834D-1	2834G-1	2834F-1
BSMI				
SL2-IN-E-1154R	SL2-IN-E-1152R	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI				
A-0029	A-0109	A-0108	A-0201	A-0110
Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRR, MIC, MOC, NCC, OFCA				
US0158	US0175	US0017	US0191	US0157



PRODUCT DESCRIPTION

Client and Equipment Under Evaluation Information

Company Name:	MSA Innovation, LLC
Address:	1100 Cranberry Woods Road
City, State, Zip:	Cranberry Township, PA 16066
Evaluation Requested By:	Dustin Morris
EUT:	Lunar
Date of Evaluation:	Wednesday, March 31, 2021

Information Provided by the Party Requesting the Evaluation

Functional Description of the Equipment:

LUNAR aims to be the definitive utility tool for first responders (fire fighters) by combining thermal imaging, connectivity, and search & rescue functionality on a small-format wireless device with an immersive 3.5" display.

LTE-M For alarm status and device info
 GNSS for location information (receive only).
 802.15.4 2.4 GHz DSSS for ad-hoc alarm network
 802.15.4 2.4 GHz FHSS for device to device ranging
 Bluetooth for configuration and connectivity with other devices
 SubGHz radio as a redundant ad-hoc alarm network

Product Dimensions:
 8.0" x 3.6" x 3.0", L x W x H
 (204 x 91 x 77 mm)

Objective:

To demonstrate compliance with FCC RF exposure requirements for 2.1093 portable devices.

RF Exposure Condition

The following RF Exposure conditions were used for the assessment documented in this report:

Intended Use	Portable
Location on Body (if applicable)	Head/Torso
How is the Device Used	The Lunar is handheld or hung on the body of the user.
Radios Contained in the Same Host Device	Bluetooth FCC ID: WAP3028 802.15.4 DSSS referred to as DSSS FCC ID: P9R-10213012 802.15.4 FHSS referred to as FHSS FCC ID: P9R-10213012 LTE FCC ID: XPY2AGQN4NNN SubGHz FCC ID: P9R-10213012
Simultaneous Transmitting Radios	Bluetooth, LTE, SubGHz Bluetooth, DSSS, LTE Bluetooth, FHSS, LTE
Body Worn Accessories	None
Environment	General Population/Uncontrolled Exposure

Duty Cycle Information:

The following duty cycle information was provided by Clinton Fleming, Principal Software Engineer II at MSA Innovations, LLC.

Radio	Max Duty Cycle: over 6 minutes	Max Duty Cycle: over 30 minutes
Bluetooth – FCC ID: WAP3028	1%	1%
2.4 GHz DSSS – Ant 1	9.26%	9.26%
2.4 GHz DSSS – Ant 2	0%	0%
2.4 GHz FHSS – Ant 1	2%	2%
2.4 GHz FHSS – Ant 2	2%	2%
SubGHz	1%	1%
LTE – FCC ID: XPY2AGQN4NNN	1.3%	1.3%

Duty cycle analysis is provided in the operational description for this application.
When two antennas are listed, the worst case was considered in the RF exposure assessment.

SAR TEST EXCLUSION



OVERVIEW

Human exposure to RF emissions from portable devices (47 CFR §2.1093) used with the radiating antenna closer than 20 cm to the user requires Specific Absorption Rate (SAR) to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation.

COMPLIANCE WITH FCC 2.1093

“Portable devices that operate in the Cellular Radiotelephone Service pursuant to part 22 of this chapter; the Personal Communications Service (PCS) pursuant to part 24 of this chapter; the Satellite Communications Services pursuant to part 25 of this chapter; the Miscellaneous Wireless Communications Services pursuant to part 27 of this chapter; the Maritime Services (ship earth station devices only) pursuant to part 80 of this chapter; the Specialized Mobile Radio Service, the 4.9 GHz Band Service, and the 3650 MHz Wireless Broadband Service pursuant to part 90 of this chapter; the Wireless Medical Telemetry Service (WMTS) and the Medical Device Radiocommunication Service (MedRadio), pursuant to subparts H and I of part 95 of this chapter, respectively, unlicensed personal communication service, unlicensed NII devices and millimeter wave devices authorized under §§15.253(f), 15.255(g), 15.257(g), 15.319(i), and 15.407(f) of this chapter; and the Citizens Broadband Radio Service pursuant to part 96 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use. All other portable transmitting devices are categorically excluded from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in §§1.1307(c) and 1.1307(d) of this chapter. Applications for equipment authorization of portable transmitting devices subject to routine environmental evaluation must contain a statement confirming compliance with the limits specified in paragraph (d) of this section. Technical information showing the basis for this statement must be submitted to the Commission upon request.”

The EUT will be used with a separation distance of less than 20 centimeters between the radiating antenna and the body of the user or nearby persons and must therefore be considered a portable transmitter per 47 CFR 2.1093(b).

COMPLIANCE WITH FCC KDB 447498 D01 General RF Exposure Guidance v06

“KDB 447498 D01 General RF Exposure Guidance v06” provides the procedures, requirements, and authorization policies for mobile and portable devices.

Standalone radio SAR test exclusion is covered under section 4.3.1. Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Test Exclusion Thresholds are met as shown in the Limits section below.

Simultaneous transmission SAR test exclusion is covered under section 4.3.2. SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneously transmitting antenna. When the sum of 1-g or 10-g SAR of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit, SAR test exclusion applies to that simultaneous transmission configuration.

SAR TEST EXCLUSION

LIMITS

Limits for General Population /Uncontrolled Exposure: 47 CFR 1.1310 (c)

The SAR limits for general population/uncontrolled exposure are 0.08 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 1.6 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit is 4 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Exposure may be averaged over a time period not to exceed 30 minutes to determine compliance with general population/uncontrolled SAR limits.

For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the SAR test exclusion thresholds are 1-g for head and body SAR and 10-g SAR for extremity SAR.

ASSESSMENT

For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:

$$\left[\frac{(\text{max. power of channel, including tune-up tolerance, mW})}{(\text{min. test separation distance, mm})} \right] \cdot [\sqrt{f(\text{GHz})}] = \begin{matrix} 3.0 \text{ for 1-g SAR} \\ 7.5 \text{ for 10-g extremity SAR} \end{matrix}$$

Where:

- $f(\text{GHz})$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 4.1f) is applied to determine SAR test exclusion.

The SAR Test Exclusion Threshold is summarized in the following table(s):

Radio	Transmit Frequency (MHz)	Measured Conducted Output Power	Units	Duty Cycle	Minimum Separation Distance (mm)	Exclusion Threshold	Limit	Compliant
FHSS	2480	20	dBm	2.0%	5	0.6	3.0	Yes

The information in the table above was obtained from:

Customer supplied information. Rated power of 20 dBm exceeds measured value in Element report MSAS0004

Radio	Transmit Frequency (MHz)	Measured Conducted Output Power	Units	Duty Cycle	Minimum Separation Distance (mm)	Exclusion Threshold	Limit	Compliant
DSSS	2475	20	dBm	9.3%	5	2.9	3.0	Yes

The information in the table above was obtained from:

Customer supplied information. Rated power of 20 dBm exceeds measured value in Element report MSAS0004.1

SAR TEST EXCLUSION

Radio	Transmit Frequency (MHz)	Measured Conducted Output Power	Units	Duty Cycle	Minimum Separation Distance (mm)	Exclusion Threshold	Limit	Compliant
Bluetooth	2480	2.9	mW	1.0%	5	0.0	3.0	Yes

The information in the table above was obtained from:

Customer supplied information and FDD ID: WAP3028 output power listing on grant

Radio	Transmit Frequency (MHz)	Measured Conducted Output Power	Units	Duty Cycle	Minimum Separation Distance (mm)	Exclusion Threshold	Limit	Compliant
SubGHz	918	22.649	dBm	1.0%	5	0.4	3.0	Yes

The information in the table above was obtained from:

Customer supplied information and Element report MSAS0004.2. Measure power is equivalent to rated power.

Radio	Transmit Frequency (MHz)	Measured Conducted Output Power	Units	Duty Cycle	Minimum Separation Distance (mm)	Exclusion Threshold	Limit	Compliant
LTE: B4	1755	25	dBm	1.3%	5	1.1	3.0	Yes
LTE: B2	1910	25	dBm	1.3%	5	1.1	3.0	Yes
LTE: B12	716	25	dBm	1.3%	5	0.7	3.0	Yes

The information in the table above was obtained from:

Customer supplied information and TUV SUD report SD72128174-0517A, rated power used.

ESTIMATED SAR

METHOD OF EVALUATION – SIMULTANEOUS TRANSMISSION CONFIGURATION

KDB 447498 D01 General RF Exposure Guidance v06, Section 4.3.2(b)

“When an antenna qualifies for the standalone SAR test exclusion of 4.3.1 and also transmits simultaneously with other antennas, the standalone SAR value must be estimated according to the following to determine the simultaneous transmission SAR test exclusion criteria:

- 1) $\left[\frac{(\text{max. power of channel, including tune-up tolerance, mW})}{(\text{min. test separation distance, mm})} \right] \cdot \sqrt{f(\text{GHz})/x}$, for test separation distances $\leq 50\text{mm}$;

where $x = 7.5$ for 1-g SAR and $x = 18.75$ for 10-g SAR.

- 2) 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distance is $> 50 \text{ mm}$.

This SAR estimation formula has been considered in conjunction with the SAR Test Exclusion Thresholds to result in substantially conservative SAR values of $= 0.4 \text{ W/kg}$. When SAR is estimated, the peak SAR location is assumed to be at the feed-point or geometric center of the antenna, whichever provides a smaller antenna separation distance, and this location must be clearly identified in test reports. The estimated SAR is used only to determine simultaneous transmission SAR test exclusion; it should not be reported as the standalone SAR. When SAR is estimated, it must be applied to determine the sum of 1-g SAR test exclusion. When SAR to peak location separation ratio test exclusion is applied, the highest reported SAR for simultaneous transmission can be an estimated standalone SAR if the estimated SAR is the highest among the simultaneously transmitting antennas (see also KDB Publication 690783 D01). For situations where the estimated SAR is overly conservative for certain conditions, the test lab may choose to perform standalone SAR measurements, then use the measured SAR to determine simultaneous transmission SAR test exclusion. Estimated SAR values at selected frequencies, distances, and power levels are illustrated in Appendix D.

In the tables below, the estimated stand-alone SAR for the radio(s) capable of simultaneous transmission is listed. The estimated values have been summed and compared to the SAR limit. The result of the calculation is well below the limit therefore the unit is excluded from simultaneous SAR evaluation and deemed compliant with FCC RF exposure requirements.

ESTIMATED SAR

Radio	Band	Transmit Frequency (GHz)	Test Separation (mm)	Duty Cycle Adjusted Output Power (mW)	Duty Cycle	Estimated SAR (W/kg)	Specification (W/kg)
LTE	B2	1.91	5	4.1	0.013	0.1	1.6
SubGHz		0.918	5	1.8	0.01	0.1	1.6
Bluetooth		2.48	5	0	0.01	0	1.6
Estimated Summed SAR						0.2	1.6

The information in the table above was obtained from:
See standalone document above

Radio	Band	Transmit Frequency (GHz)	Test Separation (mm)	Duty Cycle Adjusted Output Power (mW)	Duty Cycle	Estimated SAR (W/kg)	Specification (W/kg)
LTE	B2	1.91	5	4.1	0.013	0.1	1.6
Bluetooth		2.48	5	0	0.01	0	1.6
DSSS		2.475	5	9.3	0.0926	0.4	1.6
Estimated Summed SAR						0.5	1.6

The information in the table above was obtained from:
See standalone document above

Radio	Band	Transmit Frequency (GHz)	Test Separation (mm)	Duty Cycle Adjusted Output Power (mW)	Duty Cycle	Estimated SAR (W/kg)	Specification (W/kg)
LTE	B2	1.91	5	4.1	0.013	0.1	1.6
Bluetooth		2.48	5	0	0.01	0	1.6
FHSS		2.48	5	2	0.02	0.1	1.6
Estimated Summed SAR						0.2	1.6

The information in the table above was obtained from:
See standalone document above

End of Test Report