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FCC 47 CFR §2.1091 - RF EXPOSURE TEST REPORT

FCC ID: **Model:**	**2AJE7SMC-WEX09** **IN574-138-1**
Device Type:	Wireless Transfer Power Device
Report Issue Date:	October 28, 2024

SMC Corporation

4-2-2, Kinunodai,
Tsukubamirai-Shi, Ibaraki-ken,
Japan 300-2493

Certification

psSAR (W/kg)	0.13
FCC psSAR Limit (W/kg)	1.60
wbSAR (W/kg)	0.017
FCC wbSAR Limit (W/kg)	0.08

The measurement evaluations presented in this report are based on the maximum performance of the tested device(s), which has been shown to be capable of compliance for the whole-body and localized specific absorption rate (SAR) for uncontrolled environment/ general population exposure federal limits in 47CFR § 1.1310 and has been tested in accordance with the measurement procedures specified within this report.

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1. DUT Specifics

1.1. Device Under Test

Table 1-1
DUT Information

Mode/Band	Frequency (MHz)	Description
WPT	918.0 or 919.2	Wireless Power Transfer

The device under test is a transmitter capable of wireless charging up to < 1 meter in distance. During wireless charging operations, it operates as a fixed device and does not operate as a portable device.

The manufacturer has confirmed that the device is within operational tolerances expected for production units and has the same physical, mechanical, and thermal characteristics expected for production units. The serial number of the device used for each test is indicated alongside the results.

1.2. Test Guidance Applied

- FCC KDB Publication 680106 D01v04 (Wireless Power Transfer)
- FCC KDB Publication 447498 D04v01 (General SAR Guidance)
- FCC KDB Publication 865664 D02v01r02 (SAR Measurements up to 6 GHz)
- IEC 62232:2022
- IEC TR 63377:2022
- IEC/IEEE 62209-1528

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2. DUT RF Output Power

Table 2-1
RF Output Power

Frequency [MHz]	Reading [dBm]	Cable Loss [dB]	Attenuation Loss [dB]	Result (Time Avg)		Duty Factor	Result (Burst Power Avg)	
				[dBm]	[mW]		[dBm]	[mW]
918.0	-9.86	0.35	39.65	30.14	1032.76	1.015	30.20	1047.13
919.2	-9.73	0.35	39.65	30.27	1064.14	1.015	30.33	1078.95

Note: Measured by UL Japan per Test Report S/N: 15367106H-A

3. RF Exposure Test Results

Table 3-1
RF Exposure Test Results

Exposure Condition	DUT SN	Power Drift [dB]	Measured Duty Cycle [%]	Duty Cycle Scaling	Frequency [MHz]	Measured Power [W]	Maximum Allowed Power [W]	Separation Distance [mm]	Position	Measured 1g SAR [W/kg]	Reported 1g SAR [W/kg]	Test Plot
Body	40012	-0.10	98.5%	1.015	918.0	1.03	1.1	200	Front	0.124	0.134	
Body	40012	0.00	98.5%	1.015	919.2	1.06	1.1	200	Front	0.128	0.134	1

Exposure Condition	DUT SN	Power Drift [dB]	Measured Duty Cycle [%]	Duty Cycle Scaling	Frequency [MHz]	Measured Power [W]	Maximum Allowed Power [W]	Separation Distance [mm]	Position	Total Absorbed Power [W]	Measured Whole Body SAR [W/kg]	Reported Whole Body SAR [W/kg]	Test Plot
Whole Body	40012	0.00	98.5%	1.015	919.2	1.06	1.1	200	Front	0.148	0.017	0.017	2

3.1. Testing Notes

1. A separation distance of 200mm (20cm) was considered as this device will not be used closer than 200mm to any person. Testing was performed for front side parallel to the phantom at 200mm to assess the localized SAR. The whole-body SAR was assessed at 200mm. The test setup photos appendix contains the details about the physical setup.
2. Liquid tissue depth was at least 15.0 cm for all frequencies.
3. Device was configured with manufacturer's software not available to the end user to transmit continuously at the maximum output power.
4. Both frequencies were tested for psSAR. The condition with the worst-case output power as additionally evaluated to determine wbSAR compliance.

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5. Whole-body SAR was measured and calculated calculated based on the total measured absorbed power per the procedures in IEC 62232 and IEC TR 63377. A mass volume of 12.5kg was used in the calculation based on the general public requirements and CF3 was calculated to be 1.4.
6. Fast volume scan was used to assess the total absorbed power inside the entire phantom.
7. This device does not have any simultaneous transmission capabilities.

4. General Introduction

Title 47 of the Code of Federal Regulations (CFR) pertains to United States Federal regulation for Telecommunications. The Federal Communications Commission (FCC) is the agency responsible for implementing and enforcing these regulations. The rules define a radiofrequency device as any device which in its operation is capable of emitting radiofrequency energy by radiation, conduction, or other means.

47CFR §2.1091(b) states, “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 RF source's radiating structure(s) and the body of the user or nearby persons.”

Also, 47CFR §1.1310(e)(3) states, that General population/uncontrolled exposure limits defined in §1.1310 “General population/uncontrolled exposure limits apply in situations in which the general public may be exposed, or in which persons who are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.”

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5. Background on Radiofrequency (RF) Exposure Limits

5.1. Uncontrolled Environment

Uncontrolled environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

5.2. Controlled Environment

Controlled environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

5.3. RF Exposure Limits for 100 kHz – 100 GHz

Per FCC 47 CFR §1.1310, the SAR limits are applied for frequencies 100kHz ~ 6 GHz as shown below.

Table 5-1

Human Exposure to RF Radiation Limits in 47 CFR §1.1310 - SAR Basic Restrictions

Environment	Condition	SAR	Averaging Volume
Uncontrolled / General Population	Head, Neck, Trunk	1.6 W/kg	1g Cube
	Extremity	4.0 W/kg	10g Cube
Controlled	Head/Trunk	8.0 W/Kg	1g Cube
	Extremity /Limbs	20.0 W/kg	10g Cube
Uncontrolled / General Population	Whole Body	0.08 W/kg	Whole body
Controlled	Whole Body	0.4 W/kg	Whole body

6. RF Safety Laboratory Measurement System

6.1. Measurement Hardware and Software

Measurements are performed using a DASY8 robot system with cDASY8 module SAR software. The DASY8 is made by SPEAG in Switzerland and consists of a 6-axis robot, robot controller, computer, dosimetric probe, and probe alignment light beam unit.

6.2. E-Field Probe

Manufacturer	Schmid & Partner Engineering AG
Model	EX3DV4
Description	Smallest isotropic electric (E-) field probe for high precision specific absorption rate (SAR) measurements
Frequency Range	10 MHz - 10.0 GHz
Dynamic Range	10 µW/g – >100 mW/g
Overall Length (mm)	337
Body Diameter (mm)	12
Tip Length (mm)	337
Tip Diameter (mm)	2.5
Probe Tip to Sensor X Calibration Point (mm)	1
Probe Tip to Sensor Y Calibration Point (mm)	1
Applications	High precision dosimetric measurements in any exposure scenario (e.g. very strong gradient fields); the only probe that enables compliance testing for frequencies up to 6 GHz with precision of better than 30%
Compatibility	DASY8 robot + cDASY8 module SAR software

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6.3. Peak Spatially Averaged SAR (psSAR) Measurements

SAR Evaluations are performed using the following procedure compliant to FCC KDB Publication 865664 D01v01r04, IEEE 1528:2013 and IEC/IEEE 62209-1528:

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface, and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01r04, IEEE 1528:2013 and IEC/IEEE 62209-1528.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01r04, IEEE 1528:2013 and IEC/IEEE 62209-1528. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):
   a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 4-1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).
   b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.
   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
   d. The zoom scan is confirmed to meet both of the following parameters if the result is > 0.1 W/kg. If the result does not meet the below parameters, it is re-measured with a finer resolution scan until the below parameters are met.
      (1) The smallest horizontal distance from the local SAR peaks to all points 3 dB below the SAR peak shall be larger than the horizontal grid steps in both x- and y-directions.
      (2) The ratio of the SAR at the second measured point (M2) to the SAR at the closest measured point (Ml) at the x-y location of the measured maximum SAR value shall be at least 30%
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

6.4. Whole-Body SAR (wbSAR) Measurements

wbSAR Evaluations are performed using the procedure in IEC 62232 and IEC TR 63377. The wbSAR was determined based on the measured absorbed power in the phantom per the following calculation:

$$wbSAR(d) = \frac{P_A(d) * CF_3(d) * CF_4(f)}{M}$$

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6.5. RF Safety Laboratory System Measurement Uncertainty

SAR Uncertainty for DUTs
According to 62209-1528

Symbol	Input Quantity (Xi) (Source of Uncertainty)	62209-1528 Ref	Unc. (xi)	Prob. Dist. PDFi	Div(qi)	ci (1g)	ci (10g)	Std Unc (1g)	Std. Unc (10g)	vi
Measurement System Errors										
CF	Probe Calibration	8.4.1.1	18.6%	N (k=2)	2	1	1	9.30%	9.3%	∞
CFdrift	Probe Calibration Drift	8.4.1.2	1.7%	R	√3	1	1	1.0%	1.0%	∞
LIN	Probe Linearity and Detection Limit	8.4.1.3	4.7%	R	√3	1	1	2.7%	2.7%	∞
BBS	Broadband Signal	8.4.1.4	2.8%	R	√3	1	1	1.6%	1.6%	∞
ISO	Probe Isotropy	8.4.1.5	7.6%	R	√3	1	1	4.4%	4.4%	∞
DAE	Other probe and data acquisition errors	8.4.1.6	2.4%	N	1	1	1	2.4%	2.4%	∞
AMB	RF Ambient and Noise	8.4.1.7	1.8%	N	1	1	1	1.8%	1.8%	∞
Δxyz	Probe Positioning Errors	8.4.1.8	0.005 mm	N	1	0.5	0.5	0.3%	0.3%	
DAT	Data Processing Errors	8.4.1.9	3.5%	N	1	1	1	3.5%	3.5%	∞
Phantom and Device Errors										
LIQ(σ)	Measurement of Phantom Conductivity	8.4.2.1	2.5%	N	1	0.78	0.71	2.0%	1.8%	∞
LIQ(Tc)	Temperature Effects (Medium)	8.4.2.2	3.4%	R	√3	0.78	0.71	1.5%	1.4%	∞
EPS	Shell Permittivity	8.4.2.3	14.0%	R	√3	0.5	0.5	4.0%	4.0%	∞
DIS	Distance between the radiating element of the DUT and the phantom medium	8.4.2.4	2.0%	N	1	2	2	4.0%	4.0%	∞
Dxyz	Repeatability of Positioning the DUT or source against the phantom	8.4.2.5	1.0%	N	1	1	1	1.0%	1.0%	5
H	Device Holder Effects	8.4.2.6	3.6%	N	1	1	1	3.6%	3.6%	8
MOD	Effect of Operating mode on probe sensitivity	8.4.2.7	2.4%	R	√3	1	1	1.4%	1.4%	∞
RFdrift	Variation in SAR due to Drift in ouptput of DUT	8.4.2.9	2.5%	N	1	1	1	2.5%	2.5%	∞
VAL	Validation Antenna Uncertainty (Validation measurement only)	8.4.2.10	0.0%	N	1	1	1	0.0%	0.0%	∞
Pin	Uncertianty in Accepted Power (Validation Measurement only)	8.4.2.11	0.0%	N	1	1	1	0.0%	0.0%	∞
Correction to the SAR Results										
C(ε′,σ)	Phantom Deviation from Target (ε′,σ)	8.4.3.1	1.9%	N	1	1	0.84	1.9%	1.6%	∞
C(R)	SAR Scaling	8.4.3.2	0.0%	R	√3	1	1	0.0%	0.0%	∞
u(ΔS AR)	Combined Uncertainty							14.2%	14.1%	∞
U	Expanded Uncertainty and Effective Degrees of Freedom (k=2)							28.4%	28.3%	

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7. Testing Equipment List

Manufacturer	Model	Description	Serial Number	Calibration Date	Calibration Due	CBT	Column1
Amplifier Research	15S4G8AM1	RF Broadband Amplifier (4 - 8 GHz)	0554497			✓	
Amplifier Research	5S1G4	RF Broadband Amplifier (800 MHz - 4.2 GHz)	331258			✓	
Anritsu	MA24118A	Microwave USB Power Sensor (10MHz - 18 GHz)	2123500	11/15/2023	11/14/2024		
Anritsu	S820E	Vector Network Analyzer	2348026	11/30/2023	11/30/2024		
Control Company	4040	Ambient Thermometer	230581662	8/28/2023	8/28/2025		
Control Company	4352	Long Stem Liquid Thermometer	230662291	9/28/2023	9/28/2025		
Micro-Coax	UFB205A-0-0240-30x30	SMA M-F RF test Cable (DC - 18 GHz)	-			✓	
Mini-Circuits	BW-N20W20+	20dB RF Fixed Attenuator (DC - 18 GHz)	-			✓	
Mini-Circuits	BW-N20W20+	20dB RF Fixed Attenuator (DC - 18 GHz)	-			✓	
Mini-Circuits	BW-S3W2+	3dB RF Fixed Attenuator (DC - 18 GHz)	-			✓	
Mini-Circuits	BW-S3W2+	3dB RF Fixed Attenuator (DC - 18 GHz)	-			✓	
Mini-Circuits	CBL-6FT-SMNM+	Precision Test Cable SMA/N (DC - 18 GHz)	3318			✓	
Mini-Circuits	CBL-6FT-SMNM+	Precision Test Cable SMA/N (DC - 18 GHz)	3335			✓	
Mini-Circuits	CBL-6FT-SMNM+	Precision Test Cable SMA/N (DC - 18 GHz)	3329			✓	
Mini-Circuits	NF-SF50+	RF Adapter N Male to SMA Female (DC - 18 GHz)	-			✓	
Mini-Circuits	VLF-1000+	Coaxial Low Pass Filter (DC - 1 GHz)	-			✓	
Narda	4226-20 (26733)	20 dB SMA Directional Coupler (0.5 - 18 GHz)	0201			✓	
Rohde & Schwarz	SMCV100B	R&S SMCV100B Vector Signal Generator (VSG)	103882	12/21/2023	12/19/2025		
SPEAG	D835V2	835 MHz System Validation Dipole	4d311	10/9/2023	10/9/2024		
SPEAG	DAE4ip	Data Acquisition Electrionics with Integ. Power	1844	11/2/2023	11/2/2024		
SPEAG	DAK-3.5	DAK-3.5 Dielectric Probe	1349	10/5/2023	10/5/2024		
SPEAG	EX3DV4	SAR Measurement Probe	7859	12/19/2023	12/19/2024		
SPEAG	Powersource1	Signal Generator	4341	1/5/2024	1/5/2025		
SPEAG	SE UMS 171 EA	MAIA Modulation and Interference Analyzer	1815				

8. Conclusion

This evaluation indicates that the DUT is capable of compliance with the RF radiation exposure limits of the FCC, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.