FCC 47 CFR § 2.1093

RF EVALUATION REPORT (Digitizer)

FOR

GSM/WCDMA/LTE/5G NR Phone + BT/BLE, DTS/UNII a/b/g/n/ac/ax, NFC,WPT and UWB

MODEL NUMBER: SC-55D, SCG22

FCC ID: A3LSMF946JPN

REPORT NUMBER: 4790841160-S4V1

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Prepared for
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Testing Laboratory

TL-637

Revision History

Rev.	Date	Revisions	Revised By
V1	7/10/2023	Initial Issue	--

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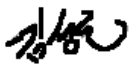
1. Attestation of SAR Characterization

Applicant Name	SAMSUNG ELECTRONICS CO.,LTD.
FCC ID	A3LSMF946JPN
Model Number	SC-55D, SCG22
Applicable Standards	FCC 47 CFR § 2.1093
Exposure Category	Magnetic field strength limit (A/m)
General population / Uncontrolled exposure	1.63
RF Exposure Conditions	The Highest Magnetic field strength (A/m)
	0.734
TER (Total Exposure Ratio)	0.977
Date Tested	7/10/2023
Test Results	Pass

UL Korea, Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Korea, Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by IAS, any agency of the Federal Government, or any agency of any government

Approved & Released By:	Prepared By:
	
Justin Park Operations Leader UL Korea, Ltd. Suwon Laboratory	Sunghoon Kim Senior Laboratory Engineer UL Korea, Ltd. Suwon Laboratory

2. Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with FCC 47 CFR § 2.1093.

- 447498 D04 Interim General RF Exposure Guidance v01

In addition to the above, the following information was used:

- TCB workshop April, 2022; Part18 and Wireless Power Transfer Updates (Part I)
- DASY6 MODULE WPT system handbook (incl. SW module WPT 2.0)

3. Facilities and Accreditation

The test sites and measurement facilities used to collect data are located at

Suwon
SAR 1 Room

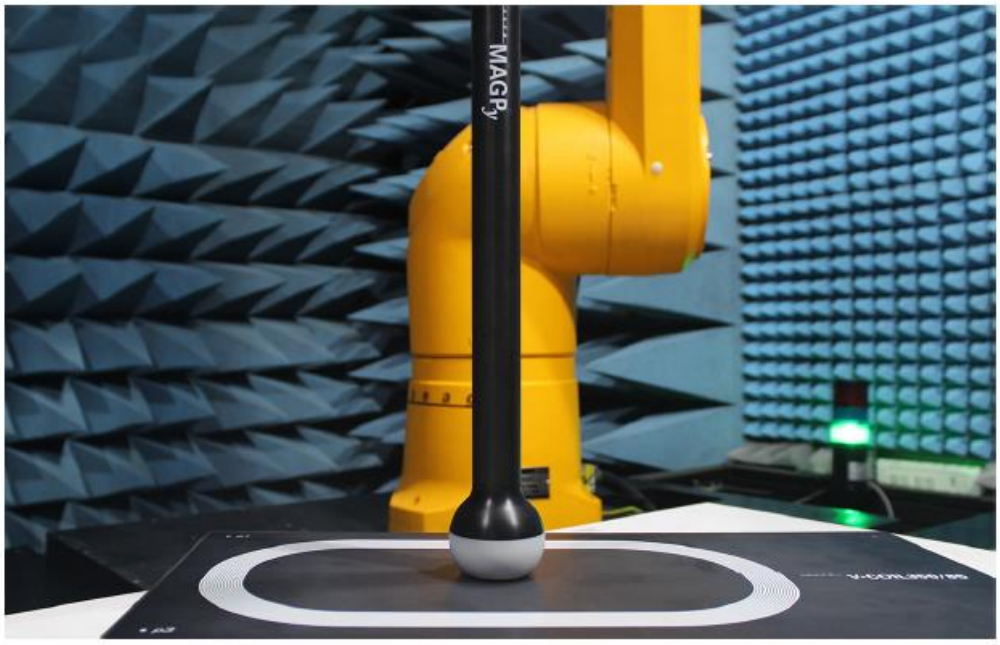
UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-637.
The full scope of accreditation can be viewed at;

https://www.iasonline.org/wp-content/uploads/2017/05/TL-637-cert-New.pdf.

4. H-field Measurement System & Test Equipment

4.1. H-field Measurement System

DASYsystem Module WPT - MAGPy is optimized for evaluation of compliance for wireless power transfer (WPT) systems and any other sources operating in the 3kHz - 10MHz frequency range. Module WPT V2.0 is compatible with the DASY 6 systems and in addition has been extended for easy evaluations of pulsed sources.



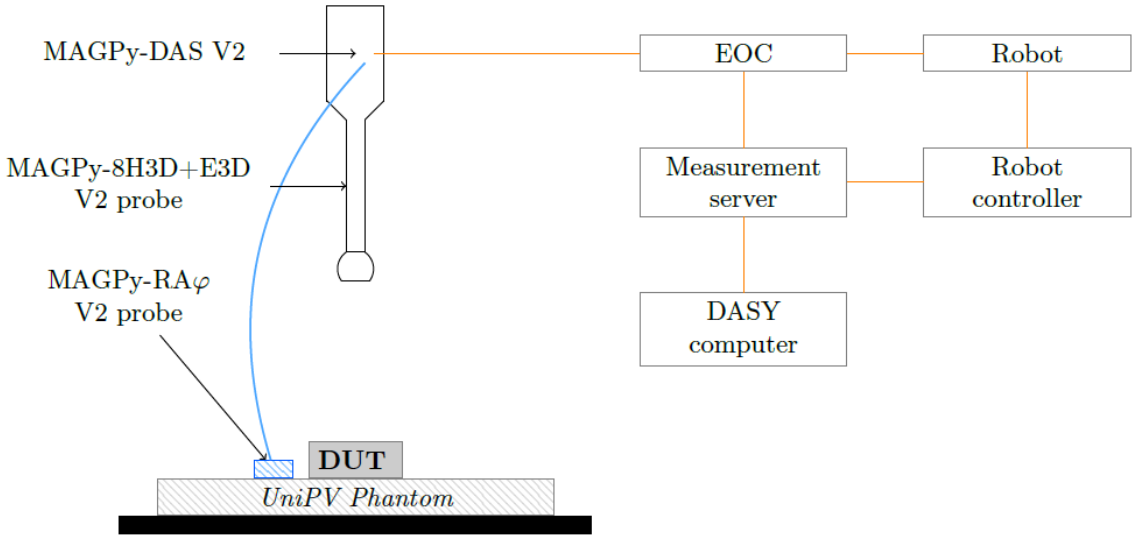


Figure : Typical measurement setup with DASY system Module WPT-MAGPy

DASYsystem Module WPT – MAGPy's Specifications

System	DASY Module WPT is composed of the isotropic probe MAGPy-8H3D+E3D Version 2.0, the reference probe (MAGPy-RAφ), and the data acquisition system (MAGPy-DAS) mounted to the DASY8 robot via the emergency stop (MAGPy-ES). The induced electric (E-) fields and specific absorption rate (SAR) are assessed with Sim4Life's Quasi-Static EM Solver (P-EM-QS) using only the measured data. At each probe location, eight isotropic H-field values are acquired in parallel. The dedicated graphical user interface (GUI) fully automates the testing workflow.
MAGPy-DAS	The MAGPy-DAS includes: • 27x14 Bit ADC Channels with 25 MSPs • Peak detection stage • Hardware supervising unit • Data transfer to the backend • 22 tap FIR Filter
MAGPy-8H3D+E3D V2	The MAGPy-H3D probe consists of eight isotropic H-field sensors and one isotropic E-field sensor: Probe design: • Probe length: 335 mm • Probe tip diameter: 60 mm • 8H3D: eight isotropic 1 cm3-H-field sensors, arranged at the corners of a 22 mm cube • First isotropic H-field sensor plane: 7.5 mm from the tip • E3D: one isotropic E-field sensor (dipole / monopole) Sensor specifications: • Frequency range: 3 kHz – 10 MHz • H-field dynamic range: 0.1 A/m – 3200 A/m (0.12 µT – 4 mT) • H-field extrapolation uncertainty: 0.6 dB (k = 2) • E-field dynamic range: 0.08 V/m – 2000 V/m
MAGPy-RAφV2	The MAGPy-RAφ reference amplitude and phase probe includes: • Frequency range: 3 kHz – 10 MHz • Dynamic range: 0.1 A/m – 3200 A/m (0.12 µT – 4 mT) • Loop coil area (sensor size): 18.9 cm2 • Size: 51 x 51 x 0.2 mm • Sensor center: 25.5 x 25.5 mm
Software	Software components: • DASY8 Module WPT application programming interface (API) • MAGPy-DAS • Sim4Life WPT (vector potential reconstruction, P-EM-QS solver) • Graphic library , Report generator

4.2. H-field measurement & extrapolation using MAGpy probe.

MAGPy probe can measured H-field strength at 7.83 mm distance from DUT's surface. And it is possible to Extrapolated the H-field strength of 0.5 mm using Sim4Life WPT software.

So we can use this function for MAGPy probe to measure H-field strength radiating of digitizer's coil and check the 0mm H-field strength. In order to additionally verify the H-field strength Extrapolated method, we progress to test using Reference source(V-coil50/400) as follows and compared Measured H-field strength and Extrapolated H-field strength at 7.83 mm separation distance from reference source.

(Test A is Measured H-field at 7.83 mm & Extrapolated H-field at 0.5 mm.

Test B is Measured H-field at 14.33 mm & Extrapolated H-field at 7.83 mm.

Test distance	Test A (at 7.83 mm)	Test B (at 14.33 mm)	Diviation(%)	Plot
Measured H-field	**126.02**	72.85	-3.2	1
Extrapolated H-field	234.0	**122.0**		2

Depending on the test results, the deviation between Measured H-field at 7mm and Extrapolated H-field at 7.83 mm is -3.2 %. Therefore, DUT measurement proceeds using the function of that extrapolation method. (The Plots refer to App_C.)

4.3. Test Equipment

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal Date	Cal. Due Date
Probe	SPEAG	MAGPy-8H3D+E3D	3054	1-9-2023	1-9-2024
	SPEAG	MAGPy-DAS	3054	1-9-2023	1-9-2024
System verification Source	SPEAG	V-Coil50/400	1014	10-6-2022	10-6-2023

5. Measurement Uncertainty

Measurement uncertainty of H-field (3 kHz to 10 MHz)
(According to IEC/IEEE 63184)

Error Description	Unc. Value (± dB)	Prob. Distr.	Div.	*ci*	Std. Unc. (± dB)
Probe uncertainty					
Amplitude calibration uncertainty	0.47	Normal	1	1	0.47
Probe anisotropy	0.50	Rectangular	1.732	1	0.29
Probe dynamic linearity	0.15	Rectangular	1.732	1	0.09
Probe frequency domain response	0.25	Rectangular	1.732	1	0.14
Gradient uncertainty	0.10	Rectangular	1.732	1	0.06
Parasitic E-field sensitivuty	0.10	Rectangular	1.732	1	0.06
Detection limit	0.15	Rectangular	1.732	1	0.09
Readout electronics	0.00	Normal	1	1	0.00
Probe positioning	0.19	Normal	1	1	0.19
Repeatability	0.10	Normal	1	1	0.10
Combined Standard Uncertainty (k = 1)					0.63
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =					**1.24**

6. DUT Informations

The manufacturer implemented the FTM mode at 593kHz that forcedly operates one coil among the X-Y axis coils of Digitizer built into the DUT, we tested this FTM mode.

7. RF Exposure Conditions (Test Configurations)

RF Exposure Conditions	Mode (Scanning)	Separation distance of DUT's surface-to-Probe's element	Test Position
Extremity 10-g	FTM mode	7.83 mm	Front

Notes:

1. Digitizer is generally not expected to be used in head & body-worn exposure conditions. It is considered in the Hand exposure condition because it is mainly used by holding it in the hand. And Digitizer's coils operates to radiated to display of DUT. So other surface or edges are not considered.
2. Test distance 7.83 mm means that distance between DUT's surface to Probe's element. In fact, DUT's surface to Probe's tip are almost touched(0.5mm gap).

8. System verification

A set of four system verification sources (3kHz, 85kHz, 400kHz and 6.78 MHz) are available. According to the manufacturer's guide, the system verification was performed in the nearest frequency band with DUT's operate frequency. And The deviation of measured values from the target values of calibration report should be less than the expanded uncertainty (1.24 dB).

Reference Target SAR Values

The reference SAR values can be obtained from the calibration certificate of system validation dipoles.

Verification Source	Serial No.	Cal. Date	Cal.due date	Target Magnetic field strength (A/m)	
				Measured at 7mm	Extrapolated at 2mm
V-coil50/400	1014	10-6-2022	10-6-2023	158.56	245.00

System verification Results

SAR 1 Room

Date Tested	System Source		Measured at 7mm Results (A/m)		Delta (±dB)	Extrapolated at 2mm Results		Delta (±dB)	Plot No.
	Type	Serial #	Test results	Target		Test results	Target		
7-10-2023	V-coil50/400	1014	126.02	158.56	-0.99	212.00	245.00	-0.63	1

Notes:

The deviation of measured values from the target values of calibration report should be less than the expanded uncertainty (1.24 dB).

9. Test results

Test mode	Test positon	Magnetic field strength results (A/m)		Plot No.
		Measured Result at 7.83 mm	Extrapolated Result at 0.5 mm	
FTM mode	Front	0.316	0.734	1

Additional test Guidance

Test mode	Test positon/ Test distance	Magnetic field strength results (A/m)		Deviation (%)	Plot No.
		Measured Result at 7.83 mm	Extrapolated Result at 7.83 mm		
FTM mode	Front / 7.83 mm	0.316		-10.8	1
FTM mode	Front / 14.83 mm		0.282		2

Notes:

1. For Extrapolated Results at 0.5mm, The result are estimated based on the measured Magnetic field strength at 7.83 mm.
2. For Additional test Guidance, It was confirmed that the deviation between Measured H-field and Estimated H-field was within 30% at 7.83 test distance according to 2022.April TCB workshop note (Part.18 and Wireless Power Transfer Updates)

10. TER analysis results

Summation of AG0 and AG1

Configurations		AG0			AG1						SUM
		Ant.A+B	Ant.B	Worst	Ant.F	Ant.G	Ant.H	Ant.H+G	Ant.H+J	Worst	
Extremity 10-g	Front	1.328	1.341	**1.341**	0.764	0.654	0.459	0.999	1.109	**1.109**	**2.450**

Antenna Grouping analysis

Test position	No.	Antenna pairs		AG0		AG1		AG0+AG1 SUM SAR (W/kg)	SPLSR of AG0 & AG1
		AG0	AG1	SAR (W/kg)	Y-axis location (mm)	SAR (W/kg)	Y-axis location (mm)		
Extremity 10-g (Front)	1	Ant.A+B	Ant.F	1.328	N/A	0.764	N/A	2.092	N/A
	2	Ant.A+B	Ant.G	1.328	N/A	0.654	N/A	1.982	N/A
	3	Ant.A+B	Ant.H	1.328	N/A	0.459	N/A	1.787	N/A
	4	Ant.A+B	Ant.H+G	1.328	36.2	0.999	-76.2	2.327	0.03
	5	Ant.A+B	Ant.H+J	1.328	36.2	1.109	-28.1	2.437	0.06
	6	Ant.B	Ant.F	1.341	N/A	0.764	N/A	**2.105**	N/A
	7	Ant.B	Ant.G	1.341	N/A	0.654	N/A	1.995	N/A
	8	Ant.B	Ant.H	1.341	N/A	0.459	N/A	1.800	N/A
	9	Ant.B	Ant.H+G	1.341	75.8	0.999	-76.2	2.340	0.02
	10	Ant.B	Ant.H+J	1.341	75.8	1.109	-28.1	2.450	0.04

Highest Reported SAR and Peak SAR location (only Y-axis location) in each WWAN&WLAN Bands in each Antennas

Antenna Group	Antenna	Bands	SAR (W/kg)	Y-axis(mm) from ERP point	Antenna Group	Antenna	Bands	SAR (W/kg)	Y-axis(mm) from ERP point
AG0	Ant.A+B	GSM 850	0.752	39.3	AG1	Ant.H+G	2.4G MIMO	**0.999**	**-76.2**
		WCDMA B5	1.287	54.5			**Worst configuration**	**0.999**	**-76.2**
		LTE B5	1.262	54.5		Ant.H+J	5G MIMO	**1.109**	-35.4
		LTE B12	1.068	40.5			6G MIMO	0.211	**-28.1**
		LTE B13	0.622	37.8			**Worst configuration**	**1.109**	**-28.1**
		LTE B26	**1.328**	48.1					
		NR Bn5	1.156	**36.2**					
		Worst configuration	**1.328**	**36.2**					
	Ant.B	GSM 1900	0.739	81.1					
		LTE B2	0.963	84.5					
		LTE B41	1.115	**75.8**					
		LTE B66	**1.341**	83.0					
		NR Bn41	0.818	82.0					
		NR Bn66	0.936	80.7					
		Worst configuration	**1.341**	**75.8**					

Note(s):

1. If SPLSR criteria is below 0.10 (10-g respectively) in all antenna pair (AG0 & AG1), additional evaluation is not required.
2. In order to satisfy TER with Digitizer function's ER, additional Antenna Grouping analysis was performed. For SAR results, please refer to Sec.12.1.2.1 and Sec.12.2.2 of Part.1 report.

AG0+AG1+ER

RF Exposure	Test Position	Highest SAR of each groups (W/kg)				SUM SAR (W/kg)
		AG0	AG1	ER-NFC	ER-UWB	
Extremity 10-g	Front	1.341	0.764	0.000	0.000	2.105

TER Analysis

RF Exposure	Test Position	SAR evaluation (AG0 + AG1 + ERs)		Magnetic field strength evaluation (Digitizer)		TER (Total Exposure Ratio)
		SAR (W/kg)	SAR's ER	Magnetic field strength (A/m)	Magnetic field strength's ER	
Extremity (10-g SAR)	Front	2.105	0.526	0.734	0.450	0.977

* SAR's ER = Meas SAR (W/kg) / SAR limit (4.0 W/kg) & Magnetic field strength's ER = Meas H-filed (A/m) / H-field limit (1.63 A/m)

Conclusion;

TER result is below 1.0.

Appendixes

Refer to separated files for the following appendixes.

4790841160-S4 FCC Report Digitizer evaluation _App A_Test setup photos

4790841160-S4 FCC Report Digitizer evaluation _App B_Highest Magnetic field strength Test Plots

4790841160-S4 FCC Report Digitizer evaluation _App C_System verification Plots

4790841160-S4 FCC Report Digitizer evaluation _App D_Probe Cal. Certificates

4790841160-S4 FCC Report Digitizer evaluation _App E_Verification Source Cal. Certificates

END OF REPORT