



SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.256.12.15.SATU.A

7.3 BODY LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ϵ_r')		Conductivity (σ) S/m	
	required	measured	required	measured
5200	49.0 \pm 10 %	PASS	5.30 \pm 10 %	PASS
5300	48.9 \pm 10 %		5.42 \pm 10 %	
5400	48.7 \pm 10 %	PASS	5.53 \pm 10 %	PASS
5500	48.6 \pm 10 %		5.65 \pm 10 %	
5600	48.5 \pm 10 %	PASS	5.77 \pm 10 %	PASS
5800	48.2 \pm 10 %	PASS	6.00 \pm 10 %	PASS

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values 5200 MHz: ϵ_r' :50.69 sigma : 4.98 Body Liquid Values 5400 MHz: ϵ_r' :48.45 sigma : 5.82 Body Liquid Values 5600 MHz: ϵ_r' :50.57 sigma : 6.37 Body Liquid Values 5800 MHz: ϵ_r' :48.19 sigma : 6.45
Distance between dipole waveguide and liquid	0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=4mm/dy=4m/dz=2mm
Frequency	5200 MHz 5400 MHz 5600 MHz 5800 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

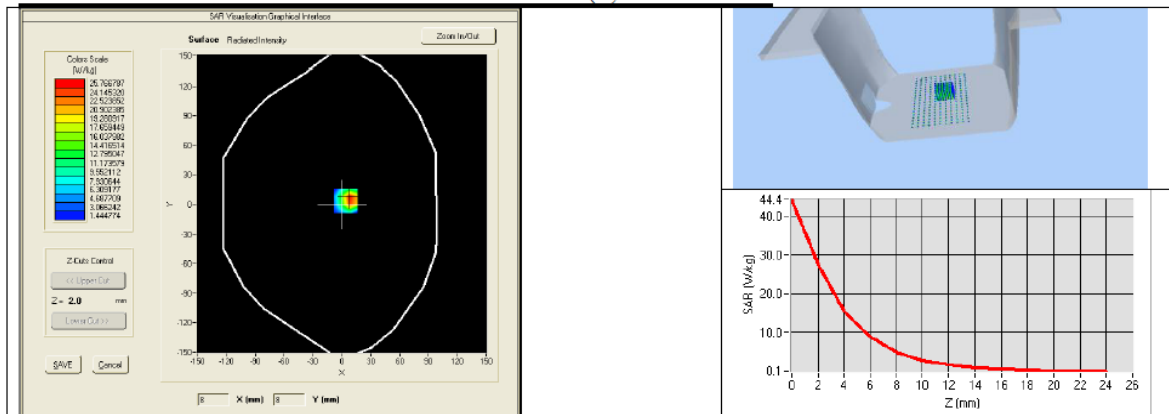
Frequency (MHz)	1 g SAR (W/kg)	10 g SAR (W/kg)
	measured	measured
5200	158.49 (15.85)	55.40 (5.54)
5400	167.20 (16.72)	57.39 (5.74)
5600	175.65 (17.57)	59.48 (5.95)
5800	183.06 (18.31)	61.62 (6.16)



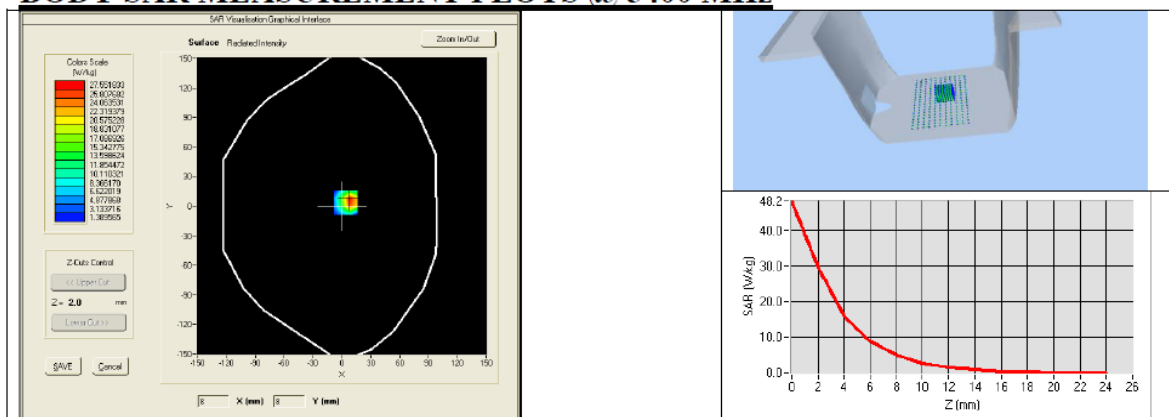
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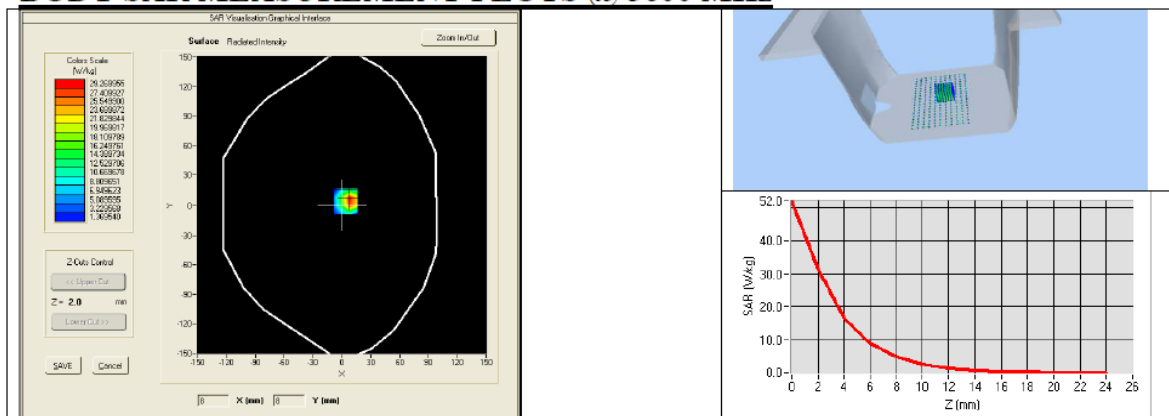
BODY SAR MEASUREMENT PLOTS @ 5200 MHz



BODY SAR MEASUREMENT PLOTS @ 5400 MHz



BODY SAR MEASUREMENT PLOTS @ 5600 MHz

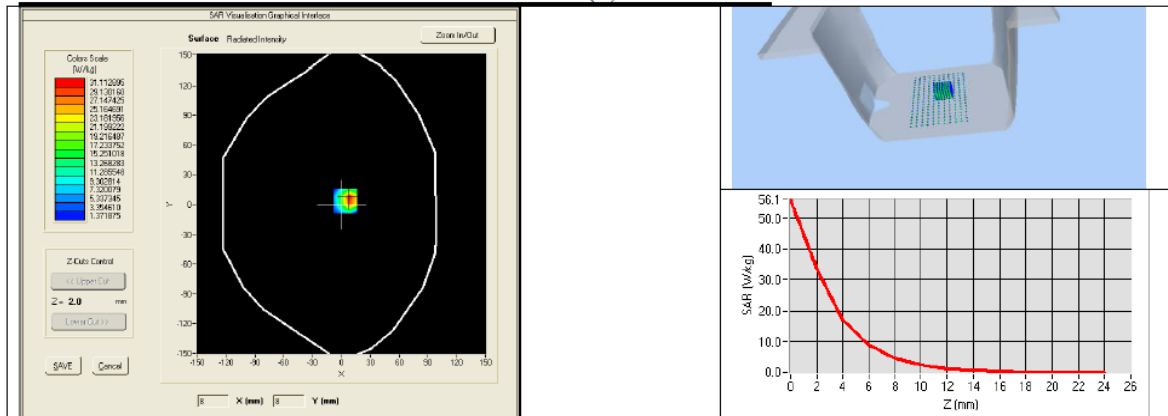




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BODY SAR MEASUREMENT PLOTS @ 5800 MHz





8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
Flat Phantom	MVG	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2019	02/2022
Calipers	Carrera	CALIPER-01	01/2020	01/2023
Reference Probe	MVG	EPG122 SN 18/11	10/2021	10/2022
Multimeter	Keithley 2000	1188656	01/2020	01/2023
Signal Generator	Agilent E4438C	MY49070581	01/2020	01/2023
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	01/2020	01/2023
Power Sensor	HP ECP-E26A	US37181460	01/2020	01/2023
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	150798832	10/2021	10/2022

Appendix E: SAR SYSTEM VALIDATION

Per FCC KDB 865664 D02v01, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in FCC KDB 865664 D01 v01 and IEEE 1528-2013. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

SAR System Validation Summary

Date	Freq. [MHz]	Probe S/N	Tissue type	COND. PERM.	COND. PERM.	CW Validation			Mod. Validation		
				(σ)	(ϵ_r)	sensitivity	Probe linearity	Probe isotropy	Mod. type	Duty factor	Peak to average power ratio
12/13/2021	835	SN 36/20 EPGO 346	Body	55.13	0.95	PASS	PASS	PASS	GMSK	PASS	N/A
12/13/2021	1800	SN 36/20 EPGO 346	Body	53.60	1.50	PASS	PASS	PASS	GMSK	PASS	N/A
12/13/2021	1900	SN 36/20 EPGO 346	Body	53.11	1.56	PASS	PASS	PASS	GMSK	PASS	N/A
12/13/2021	2450	SN 36/20 EPGO 346	Body	52.10	2.01	PASS	PASS	PASS	OFDM	PASS	N/A
12/13/2021	5200	SN 36/20 EPGO 346	Body	2.08	49.01	PASS	PASS	PASS	GMSK	PASS	N/A
12/13/2021	5300	SN 36/20 EPGO 346	Body	1.99	49.54	PASS	PASS	PASS	OFDM	PASS	N/A
12/13/2021	5600	SN 36/20 EPGO 346	Body	2.12	47.60	PASS	PASS	PASS	OFDM	PASS	N/A

NOTE: While the probes have been calibrated for both a CW and modulated signals, all measurements were performed using communication systems calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as OFDM according to KDB 865664.

Appendix F: The Check Data of Impedance and Return Loss

The information are included in the SAR report to qualify for the three-year extended calibration interval;

Impedance in body liquid							Date: 12/13/2021
Freq. (MHz)	Temp (°C)	Dipole Impedance Re(z)			Dipole Impedance Im(z)		
		measured	Target	Δ ($\pm 5\Omega$)	measured	Target	Δ ($\pm 5\Omega$)
835	22	49.3	47.1	2.2	6.3	5.60	0.7
1800	22	46.5	47.2	-0.7	-6.1	-5.10	-1.0
1900	22	50.3	48.1	2.2	5.3	6.40	-1.1
2450	22	45.9	48.7	-2.8	0.6	-1.90	2.5
2600	22	52.3	51.8	0.5	5.7	5.5	0.2
5200	22	49.02	50.01	-0.99	5.52	5.70	-0.18
5300	22	49.55	51.11	-1.56	5.46	5.64	-0.18
5600	22	47.60	48.59	-0.99	5.39	5.52	-0.13

Return loss in body liquid					Date: 12/13/2021
Freq. (MHz)	Temp (°C)	Return loss(dB)			
		measured	Target	Δ ($\pm 20\%$)	
835	22	-25.99	-23.99	8.34	
1800	22	-23.66	-24.67	-4.09	
1900	22	-21.65	-23.50	-7.87	
2450	22	-34.65	-32.86	5.45	
2600	22	-23.56	-24.71	-4.65	
5200	22	-32.66	-34.56	1.90	
5300	22	-33.71	-31.44	-2.27	
5600	22	-34.22	-32.85	-1.37	

liquid	Freq. (MHz)	Temp (°C)	ϵ_r / relative permittivity			σ (s/m) / conductivity			ρ (kg/m ³)
			measured	Target	Δ ($\pm 5\%$)	measured	Target	Δ ($\pm 5\%$)	
Body	835	22	55.13	55.20	-0.13	0.95	0.97	-2.06	1000
	1800	22	53.60	53.30	0.56	1.50	1.52	-1.32	1000
	1900	22	53.11	53.30	-0.36	1.56	1.52	2.63	1000
	2450	22	52.10	52.70	-1.14	2.01	1.95	4.00	1000
	2600	22	52.31	52.50	-0.36	2.12	2.16	-1.85	1000
	5200	22	49.02	50.01	-0.99	5.52	5.70	-0.18	1000
	5300	22	49.55	51.11	-1.56	5.46	5.64	-0.18	1000
	5600	22	47.60	48.59	-0.99	5.39	5.52	-0.13	1000

Test Equipment	Manufacturer	Model	Serial Number	Calibration	
				Calibration Date (D.M.Y)	Calibration Due (D.M.Y)
Signal Generator	Agilent	N5182A	MY47070282	Jul. 28, 2021	Jul. 27, 2022
Multimeter	Keithley	Multimeter 2000	4078275	Jul. 28, 2021	Jul. 27, 2022
Network Analyzer	Agilent	8753E	US38432457	Jul. 28, 2021	Jul. 27, 2022
Power Meter	Agilent	E4418B	GB43312526	Jul. 28, 2021	Jul. 27, 2022
Power Sensor	Agilent	E9301A	MY41497725	Jul. 28, 2021	Jul. 27, 2022
Power Amplifier	PE	PE15A4019	112342	N/A	N/A
Temperature / Humidity Sensor	Control company	TH101B	152470214	Jul. 28, 2021	Jul. 27, 2022

*******END OF REPORT*******