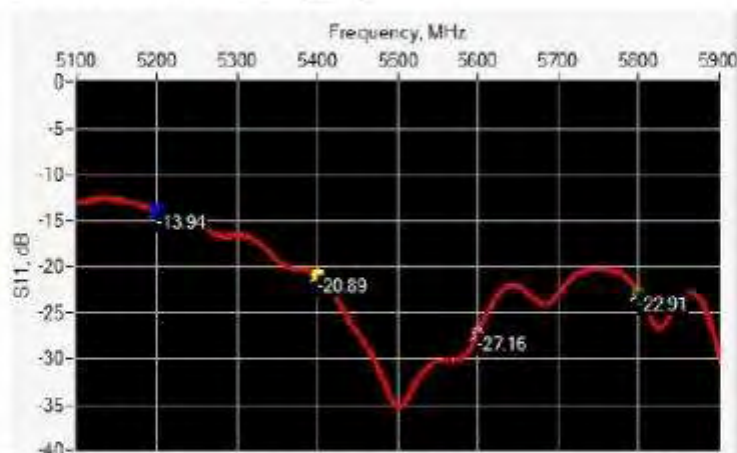




## SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.262.12.14.SATU.A

## 6.2 RETURN LOSS IN BODY LIQUID



| Frequency (MHz) | Return Loss (dB) | Requirement (dB) |
|-----------------|------------------|------------------|
| 5000-6000       | < -13.94         | -8               |

## 6.3 MECHANICAL DIMENSIONS

| Frequency (MHz) | L (mm)       |           | W (mm)       |           | L <sub>r</sub> (mm) |           | W <sub>r</sub> (mm) |           | T (mm)    |           |
|-----------------|--------------|-----------|--------------|-----------|---------------------|-----------|---------------------|-----------|-----------|-----------|
|                 | Require d    | Measure d | Require d    | Measure d | Require d           | Measure d | Require d           | Measure d | Require d | Measure d |
| 5200            | 40.39 ± 0.13 | PASS      | 20.19 ± 0.13 | PASS      | 81.03 ± 0.13        | PASS      | 61.98 ± 0.13        | PASS      | 5.3*      | PASS      |
| 5800            | 40.39 ± 0.13 | PASS      | 20.19 ± 0.13 | PASS      | 81.03 ± 0.13        | PASS      | 61.98 ± 0.13        | PASS      | 4.3*      | PASS      |

\* The tolerance for the matching layer is included in the return loss measurement.

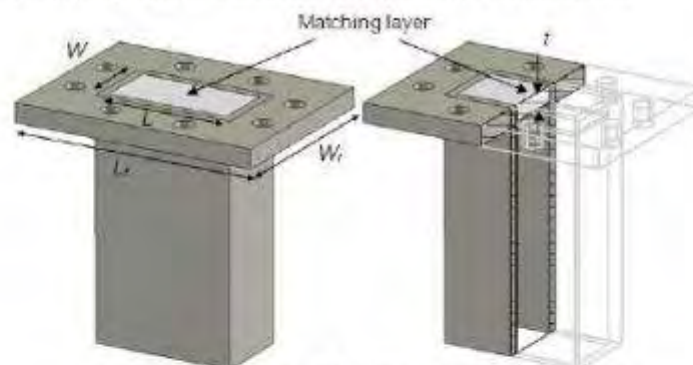


Figure 1: Validation Waveguide Dimensions

## 7 VALIDATION MEASUREMENT

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference waveguide meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed with the matching layer placed in the open end of the waveguide, with the waveguide and matching layer in direct contact with the phantom shell.

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## SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.262.12.14.SATU.A

## 7.1 HEAD LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity ( $\epsilon_r$ ) |          | Conductivity ( $\sigma$ ) S/m |          |
|------------------|--|----------|-------------------------------|----------|
|                  | required                               | measured | required                      | measured |
| 5000             | 36.2 $\pm$ 10 %                        |          | 4.45 $\pm$ 10 %               |          |
| 5100             | 36.1 $\pm$ 10 %                        |          | 4.56 $\pm$ 10 %               |          |
| 5200             | 36.0 $\pm$ 10 %                        | PASS     | 4.66 $\pm$ 10 %               | PASS     |
| 5300             | 35.9 $\pm$ 10 %                        |          | 4.76 $\pm$ 10 %               |          |
| 5400             | 35.8 $\pm$ 10 %                        | PASS     | 4.86 $\pm$ 10 %               | PASS     |
| 5500             | 35.6 $\pm$ 10 %                        |          | 4.97 $\pm$ 10 %               |          |
| 5600             | 35.5 $\pm$ 10 %                        | PASS     | 5.07 $\pm$ 10 %               | PASS     |
| 5700             | 35.4 $\pm$ 10 %                        |          | 5.17 $\pm$ 10 %               |          |
| 5800             | 35.3 $\pm$ 10 %                        | PASS     | 5.27 $\pm$ 10 %               | PASS     |
| 5900             | 35.2 $\pm$ 10 %                        |          | 5.38 $\pm$ 10 %               |          |
| 6000             | 35.1 $\pm$ 10 %                        |          | 5.48 $\pm$ 10 %               |          |

## 7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

At those frequencies, the target SAR value can not be generic. Hereunder is the target SAR value defined by Satimo, within the uncertainty for the system validation. All SAR values are normalized to 1 W net power. In bracket, the measured SAR is given with the used input power.

|  |  |
|--|--|
| Software                                     | OPENSAR V4   |
| Phantom                                      | SN 20/09 SAM71   |
| Probe  | SN 18/11 EPG122  |
| Liquid                                       | Head Liquid Values 5200 MHz: $\epsilon_r$ :36.62 sigma : 4.93<br>Head Liquid Values 5400 MHz: $\epsilon_r$ :35.95 sigma : 5.18<br>Head Liquid Values 5600 MHz: $\epsilon_r$ :36.08 sigma : 5.60<br>Head Liquid Values 5800 MHz: $\epsilon_r$ :34.73 sigma : 5.74 |
| 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<br>5400 MHz<br>5600 MHz<br>5800 MHz   |
| Input power                                  | 20 dBm   |
| Liquid Temperature                           | 21 °C  |
| Lab Temperature                              | 21 °C  |
| Lab Humidity                                 | 45 %   |

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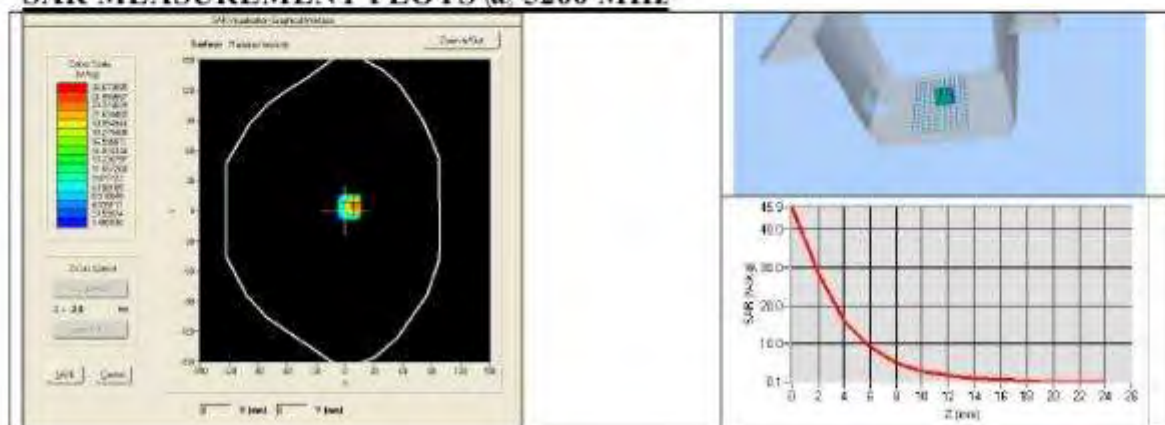


## SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

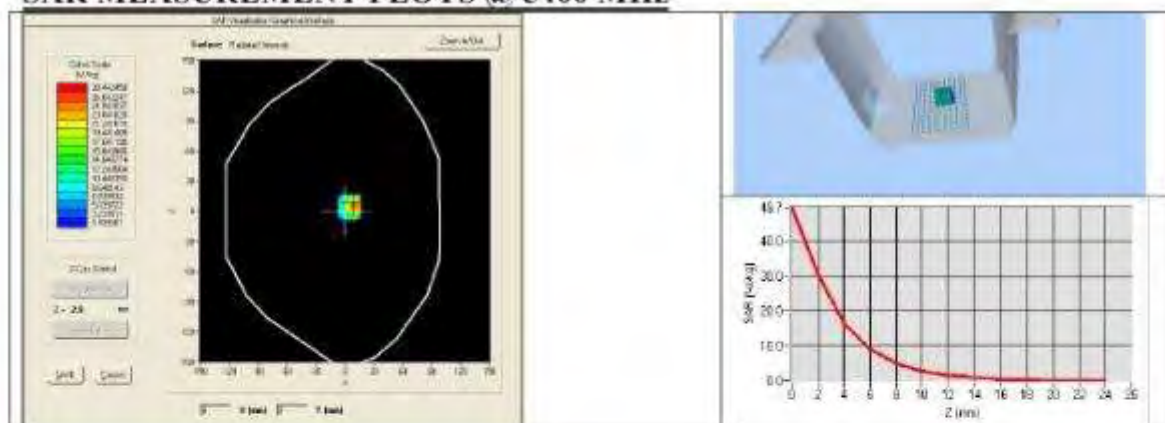
Ref: ACR.262.12.14.SATU.A

| Frequency (MHz) | 1 g SAR (W/kg) |                | 10 g SAR (W/kg) |              |
|-----------------|----------------|----------------|-----------------|--------------|
|                 | required       | measured       | required        | measured     |
| 5200            | 159.00         | 163.88 (16.39) | 56.90           | 57.29 (5.73) |
| 5400            | 166.40         | 172.23 (17.22) | 58.43           | 59.16 (5.92) |
| 5600            | 173.80         | 181.28 (18.13) | 59.97           | 61.57 (6.16) |
| 5800            | 181.20         | 188.95 (18.90) | 61.50           | 63.45 (6.35) |

## SAR MEASUREMENT PLOTS @ 5200 MHz



## SAR MEASUREMENT PLOTS @ 5400 MHz



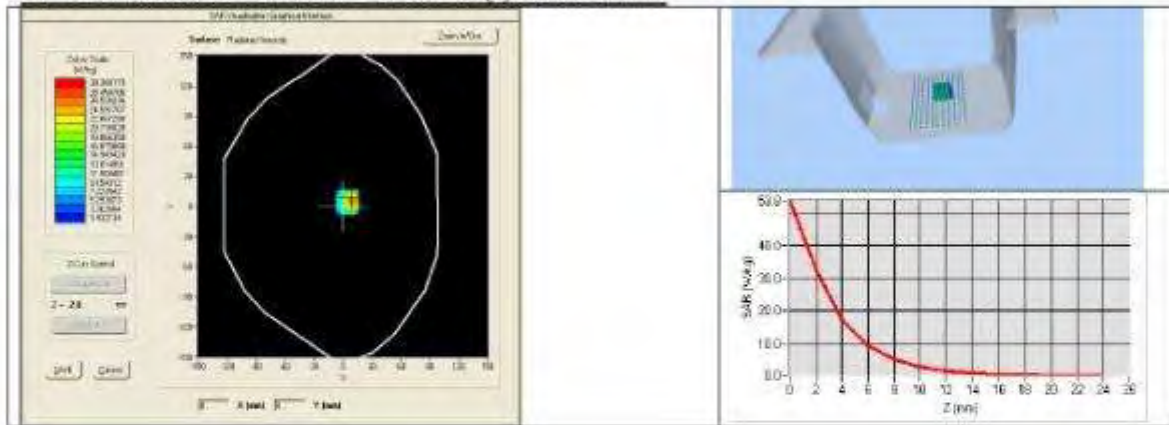




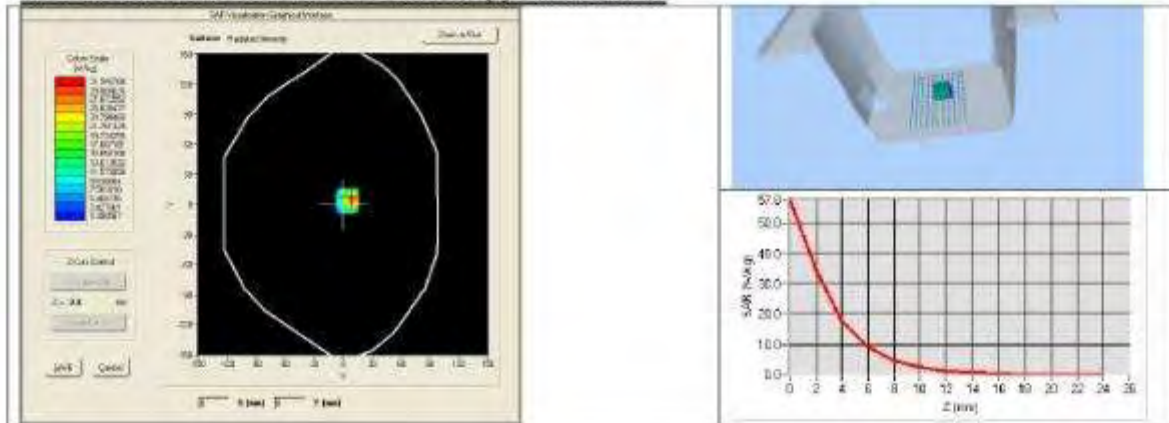
## SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.262.12.14.SATU.A

## SAR MEASUREMENT PLOTS @ 5600 MHz



## SAR MEASUREMENT PLOTS @ 5800 MHz



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## 7.3 BODY LIQUID MEASUREMENT

| Frequency<br>MHz | Relative permittivity ( $\epsilon_r$ ) |          | Conductivity ( $\sigma$ ) 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: $\epsilon_r$ :50.69 sigma : 4.98<br>Body Liquid Values 5400 MHz: $\epsilon_r$ :48.45 sigma : 5.82<br>Body Liquid Values 5600 MHz: $\epsilon_r$ :50.57 sigma : 6.37<br>Body Liquid Values 5800 MHz: $\epsilon_r$ :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<br>5400 MHz<br>5600 MHz<br>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)    |

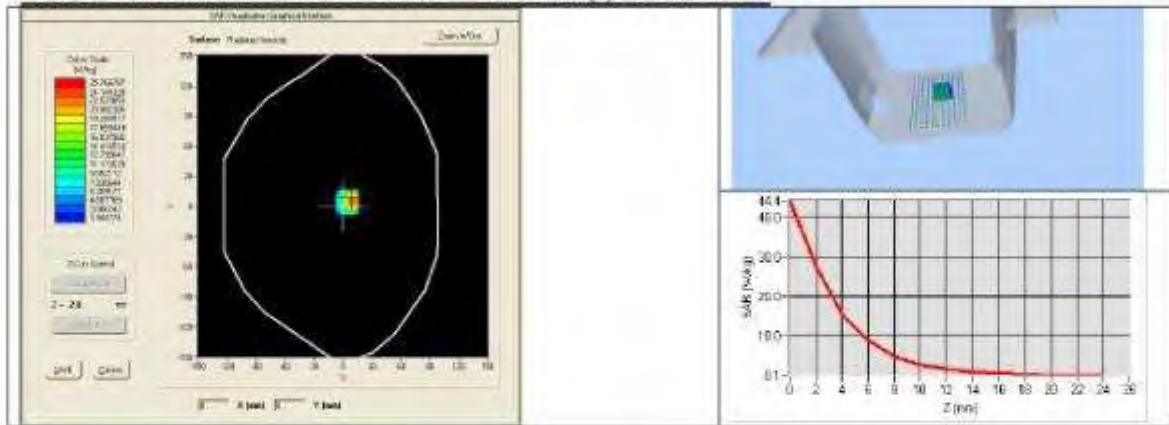
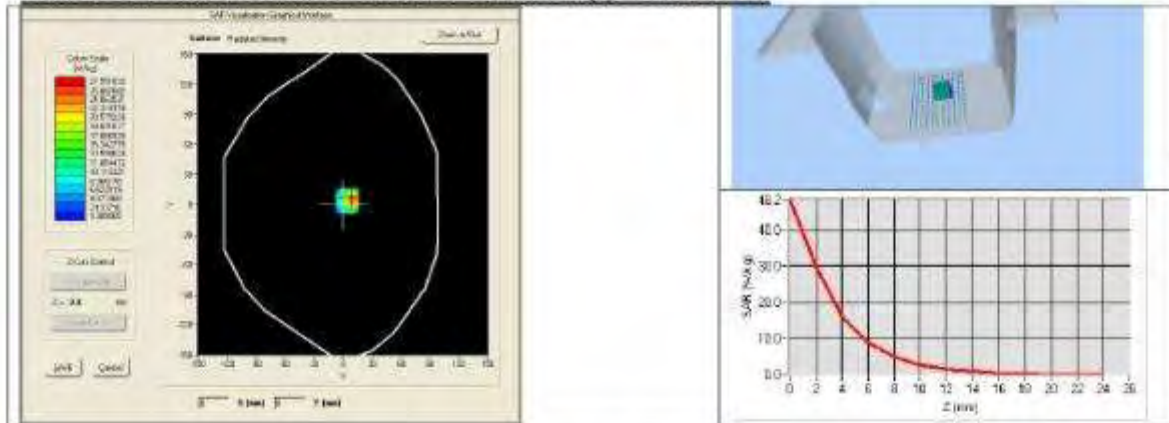
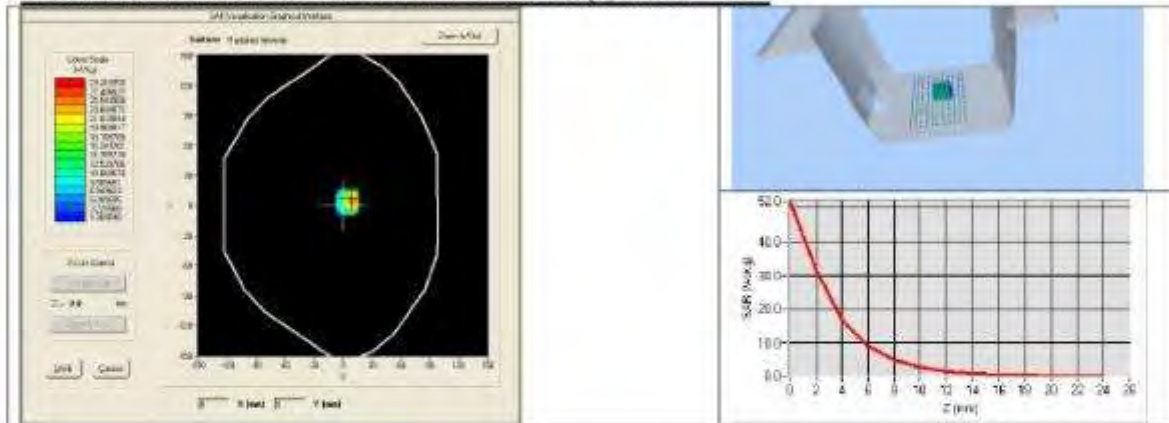
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**BODY SAR MEASUREMENT PLOTS @ 5200 MHz****BODY SAR MEASUREMENT PLOTS @ 5400 MHz****BODY SAR MEASUREMENT PLOTS @ 5600 MHz**

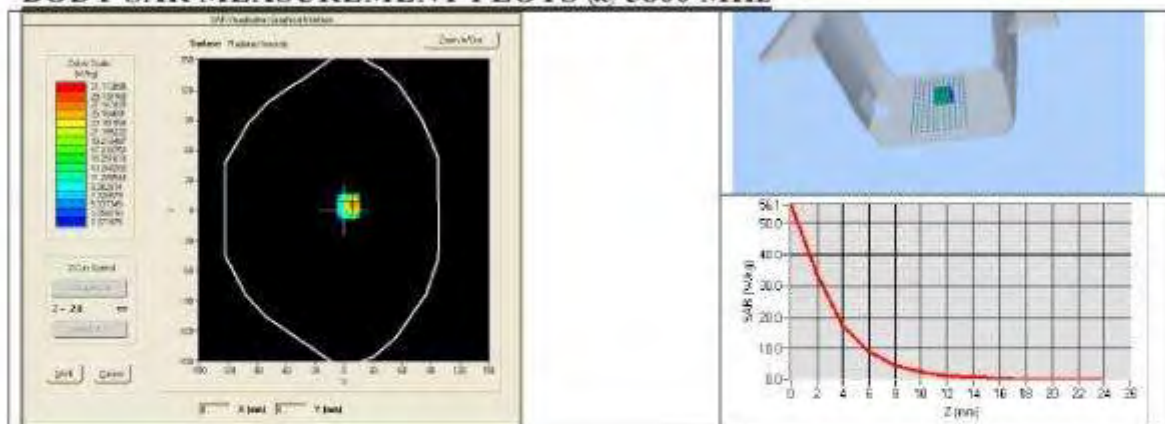




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## BODY SAR MEASUREMENT PLOTS @ 5800 MHz



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## 8 LIST OF EQUIPMENT

| Equipment Summary Sheet         |                      |                    |   |   |
|---------------------------------|----------------------|--------------------|---|---|
| Equipment Description           | Manufacturer / Model | Identification No. | Current Calibration Date                      | Next Calibration Date                         |
| Flat Phantom                    | Satimo               | 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           | 02/2014                                       | 02/2017                                       |
| Calipers                        | Carrera              | CALIPER-01         | 12/2013                                       | 12/2016                                       |
| Reference Probe                 | Satimo               | EPG122 SN 18/11    | 10/2013                                       | 10/2014                                       |
| Multimeter                      | Keithley 2000        | 1188656            | 12/2013                                       | 12/2016                                       |
| Signal Generator                | Agilent E4438C       | MY49070581         | 12/2013                                       | 12/2016                                       |
| Amplifier                       | Aethercomm           | SN 046             | Characterized prior to test. No cal required. | Characterized prior to test. No cal required. |
| Power Meter                     | HP E4418A            | US38261498         | 12/2013                                       | 12/2016                                       |
| Power Sensor                    | HP ECP-E26A          | US37181460         | 12/2013                                       | 12/2016                                       |
| 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      | 11-661-9           | 8/2012  | 8/2015  |

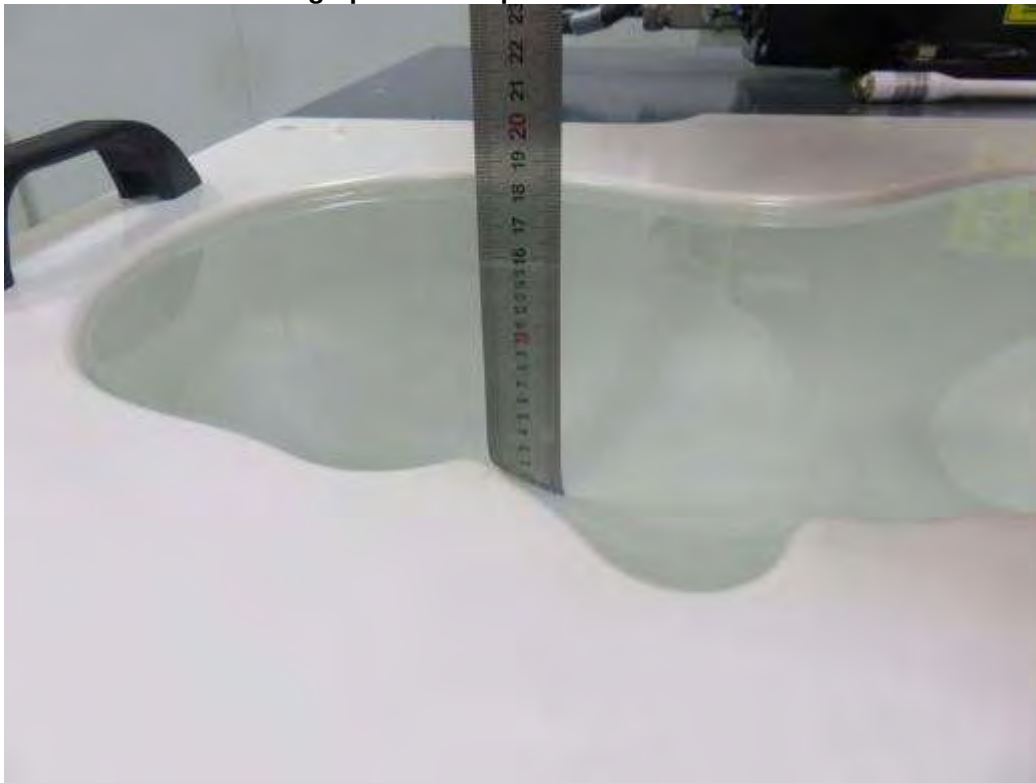
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## 6.EUT TEST PHOTOGRAPHS

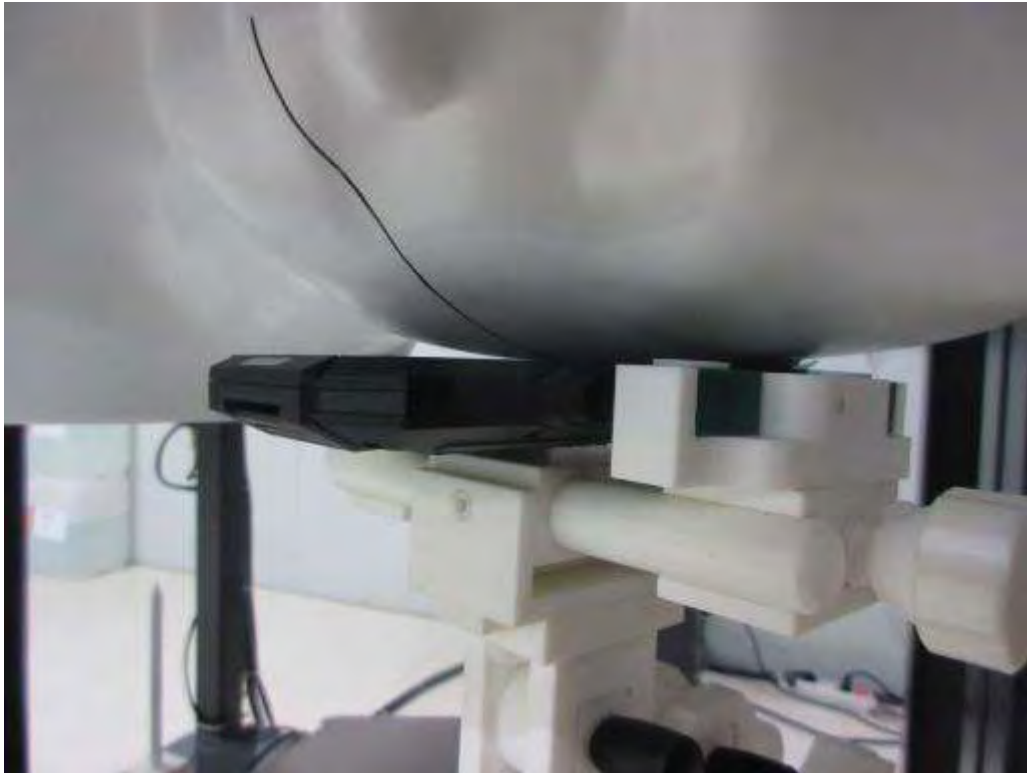
Photograph of the depth in the Head Phantom



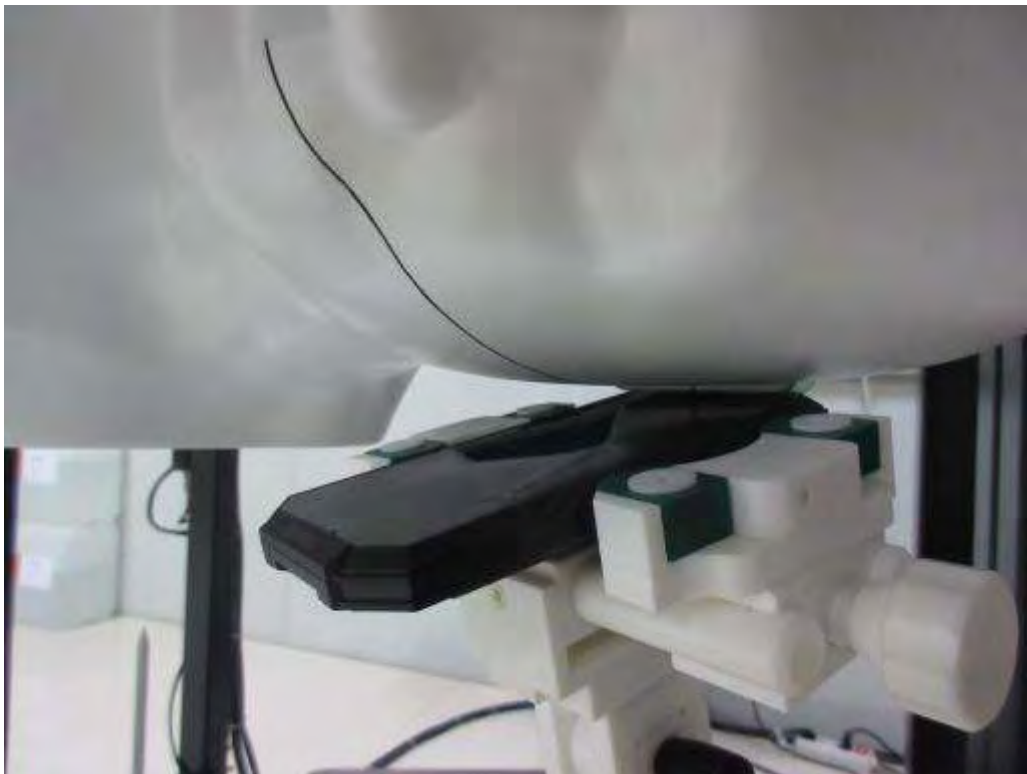
Photograph of the depth in the Body Phantom



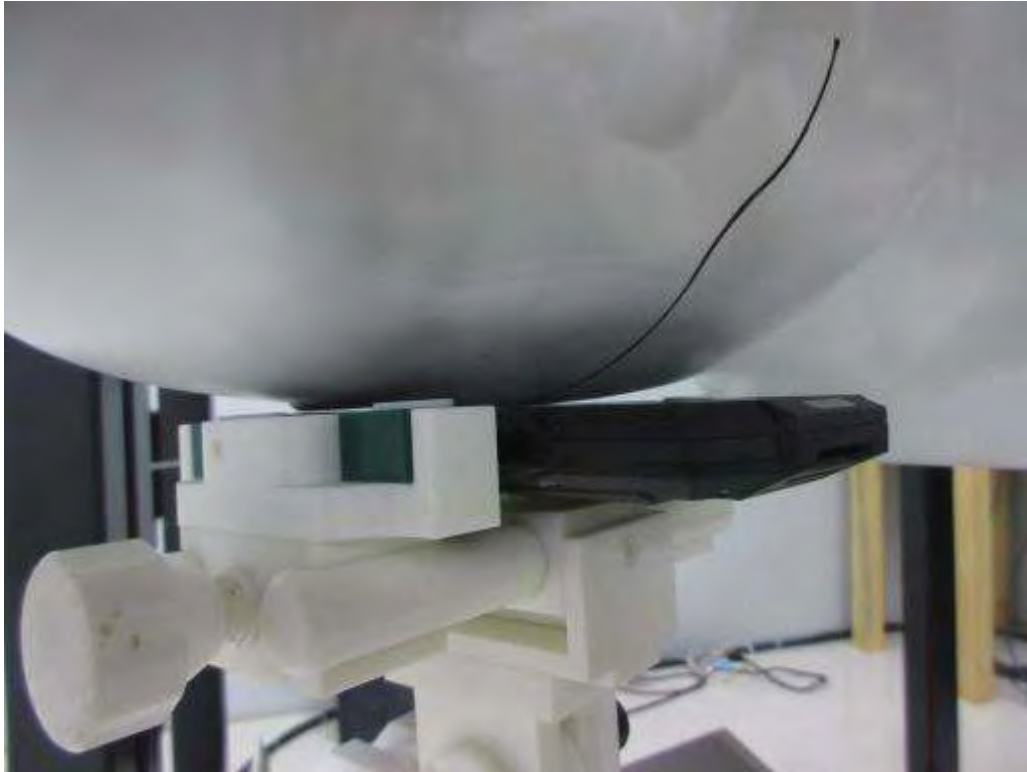
**Head Setup Photo(Left cheek)**



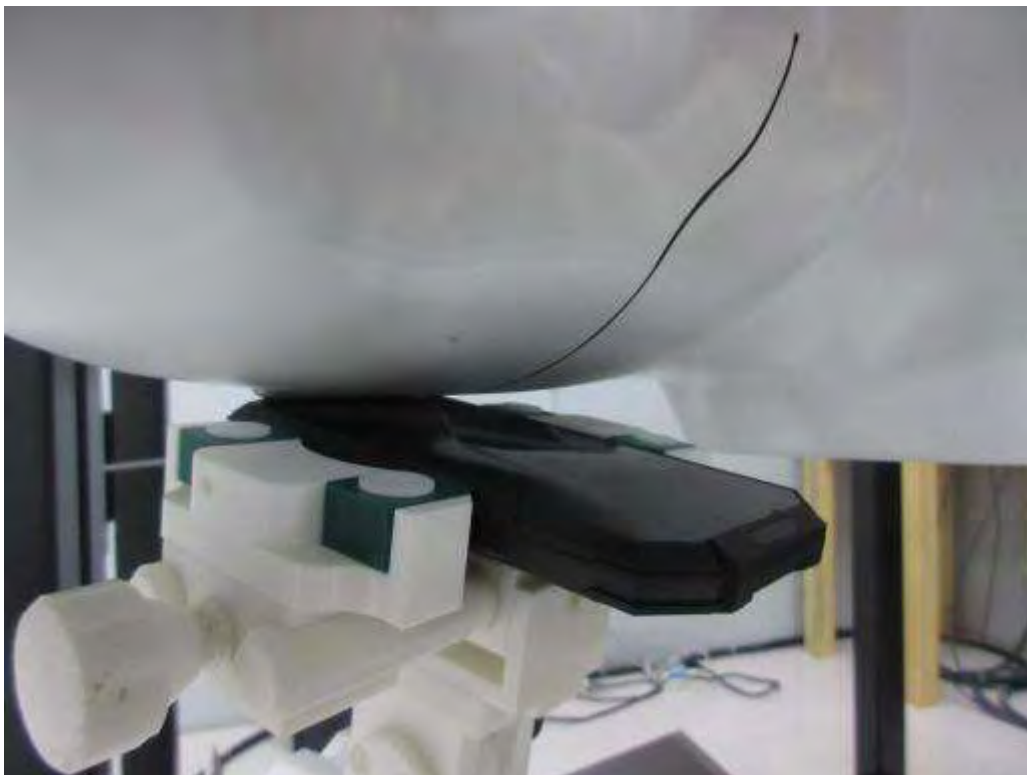
**Head Setup Photo(Left Tilt )**



**Head Setup Photo(Right Cheek )**



**Head Setup Photo(Right Tilt )**





**10mm body-worn Back Side Setup Photo(hotspot)**



**10mm body-worn Front Side Setup Photo(hotspot)**

