



In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
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## DASY/EASY – Parameters of Probe: EX3DV4 – SN:3982

### Basic Calibration Parameters

|                                      | Sensor X | Sensor Y | Sensor Z | Unc ( $k=2$ ) |
|--------------------------------------|----------|----------|----------|---------------|
| Norm( $\mu V/(V/m)^2$ ) <sup>A</sup> | 0.55     | 0.56     | 0.50     | $\pm 10.0\%$  |
| DCP(mV) <sup>B</sup>                 | 102.2    | 104.8    | 102.5    |               |

### Modulation Calibration Parameters

| UID | Communication System Name |   | A dB | B dB $\sqrt{\mu V}$ | C   | D dB | VR mV | Unc <sup>E</sup> ( $k=2$ ) |
|-----|---------------------------|---|------|---------------------|-----|------|-------|----------------------------|
| 0   | CW                        | X | 0.0  | 0.0                 | 1.0 | 0.00 | 176.8 | $\pm 2.3\%$                |
|     |                           | Y | 0.0  | 0.0                 | 1.0 |      | 181.5 |                            |
|     |                           | Z | 0.0  | 0.0                 | 1.0 |      | 167.8 |                            |

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution Corresponds to a coverage probability of approximately 95%.

<sup>A</sup> The uncertainties of Norm X, Y, Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Page 4).

<sup>B</sup> Numerical linearization parameter: uncertainty not required.

<sup>E</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

**Probe shall not be used for SAR compliance testing if measured SAR value of the DUT is below 0.025 mW/g.**



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### Calibration Parameter Determined in Head Tissue Simulating Media

| f [MHz] <sup>C</sup> | Relative Permittivity <sup>F</sup> | Conductivity (S/m) <sup>F</sup> | ConvF X | ConvF Y | ConvF Z | Alpha <sup>G</sup> | Depth <sup>G</sup> (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-------------|
| 750                  | 41.9                               | 0.89                            | 10.73   | 10.73   | 10.73   | 0.40               | 0.75                    | ± 12.1%     |
| 835                  | 41.5                               | 0.90                            | 10.32   | 10.32   | 10.32   | 0.28               | 1.03                    | ± 12.1%     |
| 1750                 | 40.1                               | 1.37                            | 8.78    | 8.78    | 8.78    | 0.22               | 1.05                    | ± 12.1%     |
| 1900                 | 40.0                               | 1.40                            | 8.40    | 8.40    | 8.40    | 0.26               | 0.98                    | ± 12.1%     |
| 3300                 | 38.2                               | 2.71                            | 7.41    | 7.41    | 7.41    | 0.40               | 1.01                    | ± 13.3%     |
| 3500                 | 37.9                               | 2.91                            | 7.10    | 7.10    | 7.10    | 0.45               | 0.93                    | ± 13.3%     |
| 3700                 | 37.7                               | 3.12                            | 6.78    | 6.78    | 6.78    | 0.41               | 1.05                    | ± 13.3%     |
| 4100                 | 37.2                               | 3.53                            | 6.71    | 6.71    | 6.71    | 0.40               | 1.20                    | ± 13.3%     |
| 4400                 | 36.9                               | 3.84                            | 6.48    | 6.48    | 6.48    | 0.35               | 1.35                    | ± 13.3%     |
| 4600                 | 36.7                               | 4.04                            | 6.34    | 6.34    | 6.34    | 0.45               | 1.25                    | ± 13.3%     |
| 4800                 | 36.4                               | 4.25                            | 6.30    | 6.30    | 6.30    | 0.45               | 1.30                    | ± 13.3%     |
| 4950                 | 36.3                               | 4.40                            | 5.99    | 5.99    | 5.99    | 0.45               | 1.30                    | ± 13.3%     |
| 5250                 | 35.9                               | 4.71                            | 5.70    | 5.70    | 5.70    | 0.45               | 1.30                    | ± 13.3%     |
| 5600                 | 35.5                               | 5.07                            | 5.12    | 5.12    | 5.12    | 0.50               | 1.20                    | ± 13.3%     |
| 5750                 | 35.4                               | 5.22                            | 5.14    | 5.14    | 5.14    | 0.50               | 1.20                    | ± 13.3%     |

<sup>C</sup> Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

<sup>F</sup> At frequency below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

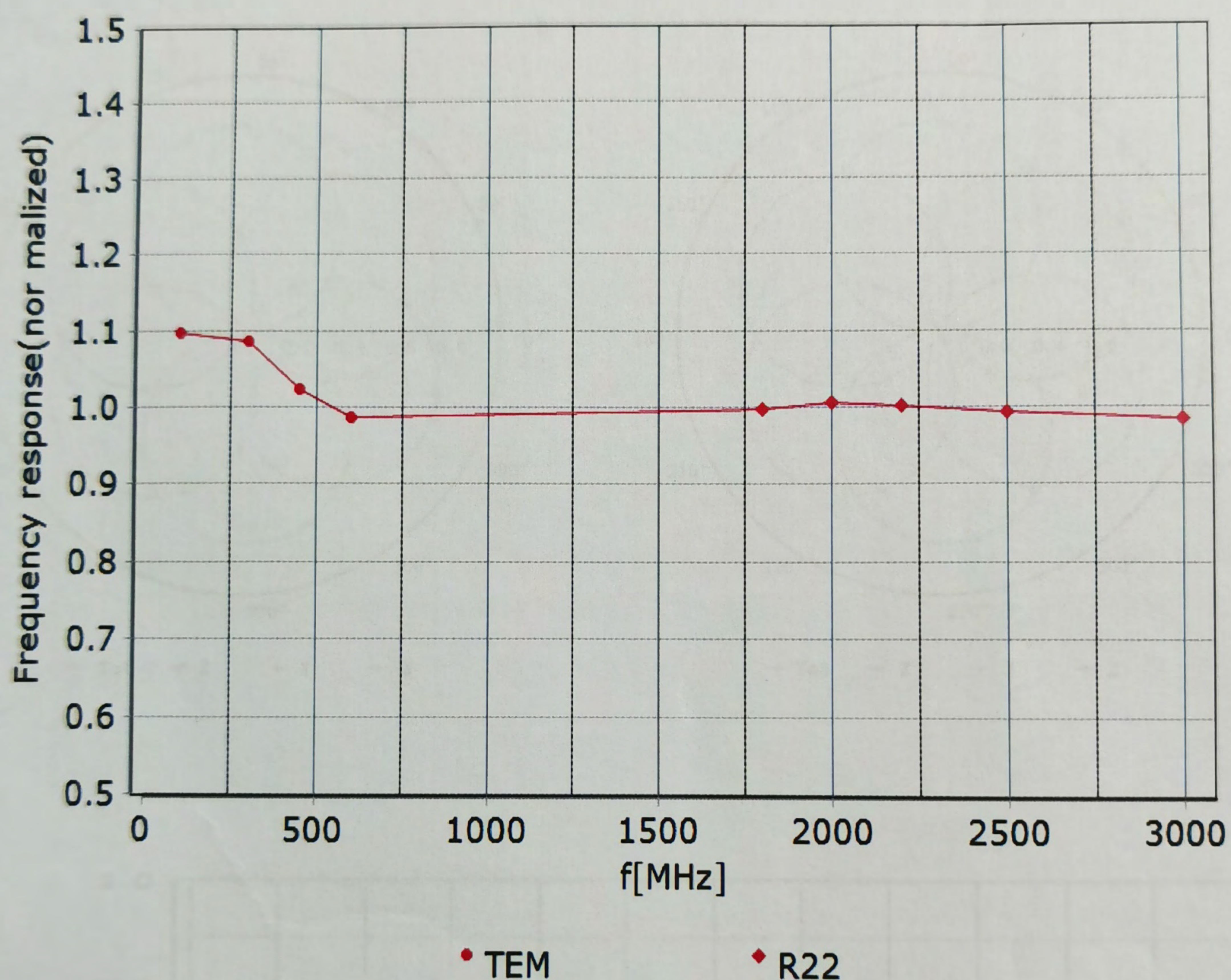
<sup>G</sup> Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.



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## Frequency Response of E-Field (TEM-Cell: ifi110 EXX, Waveguide: R22)

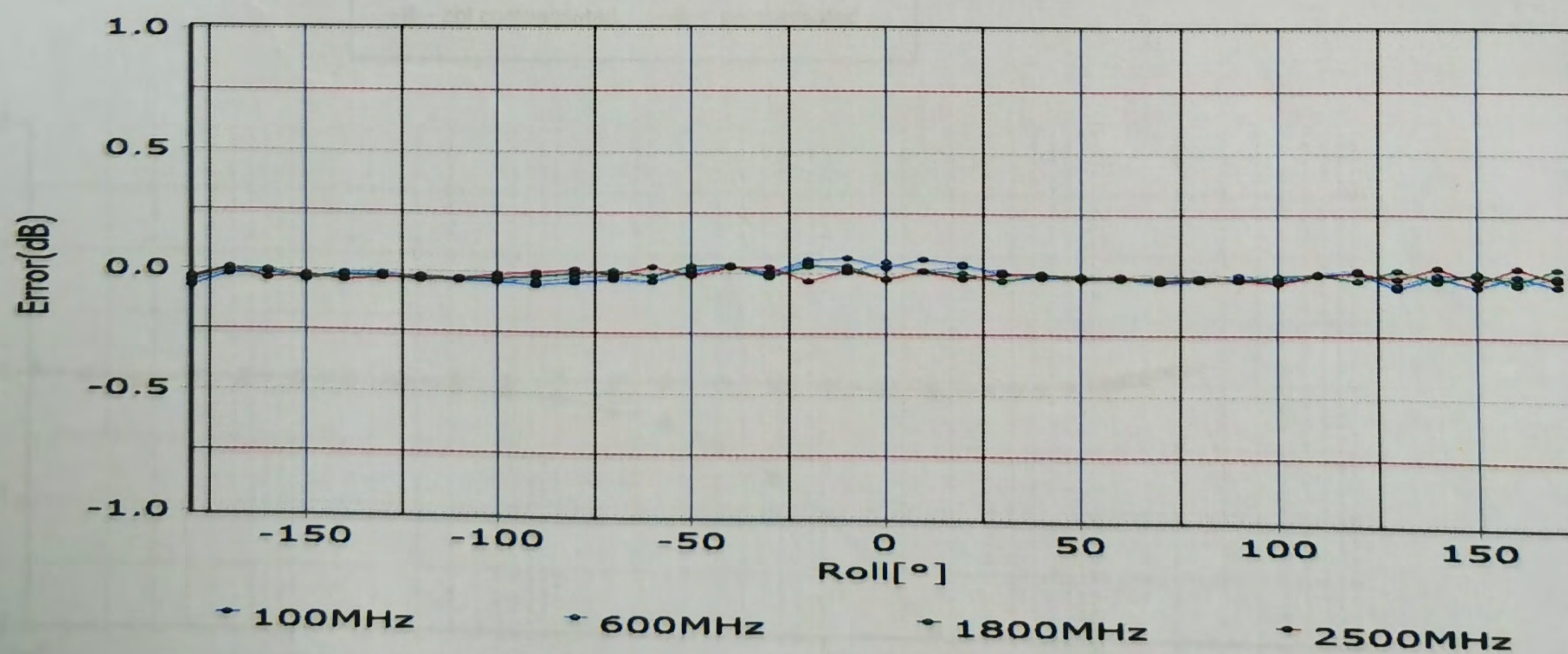
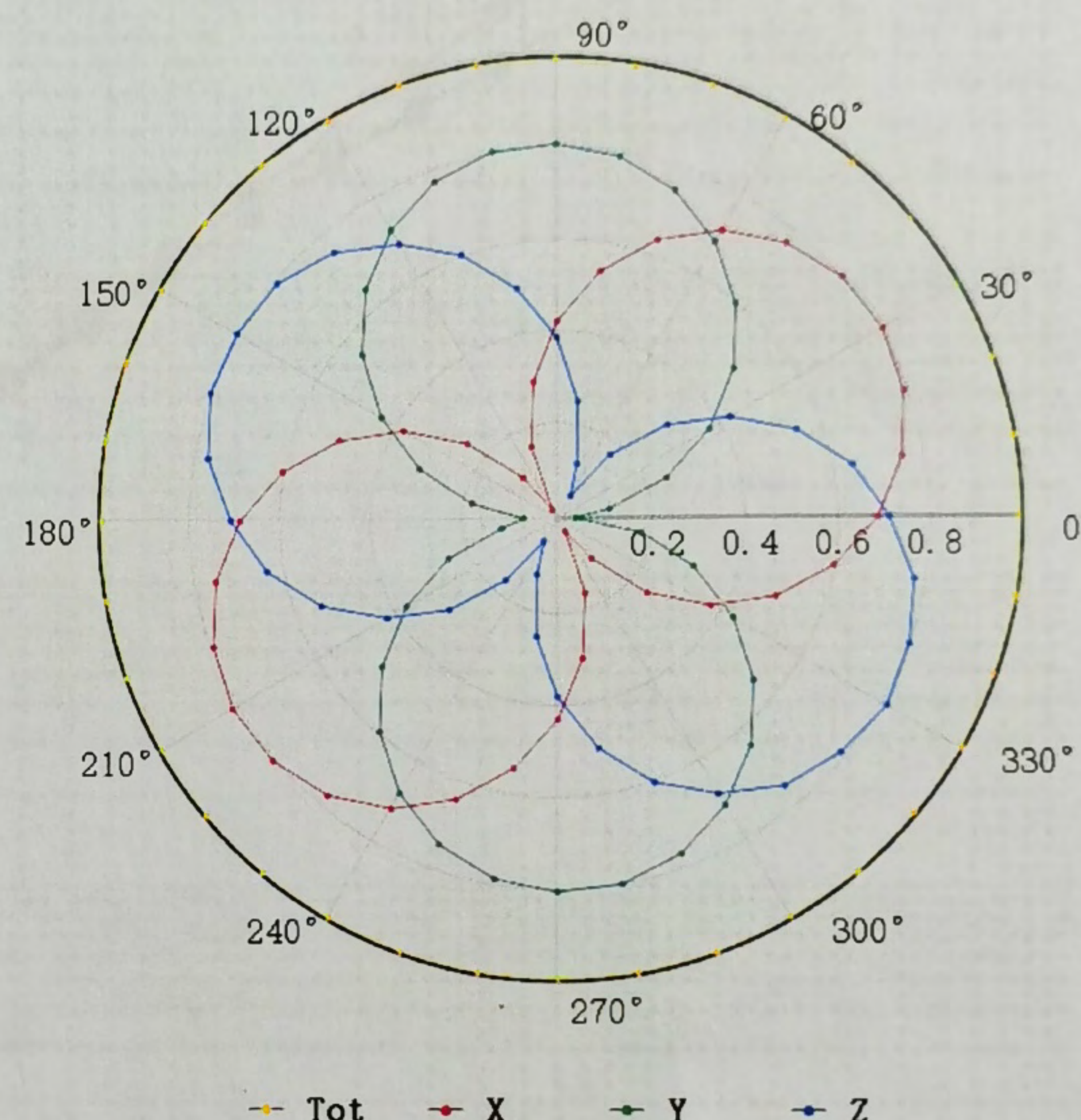
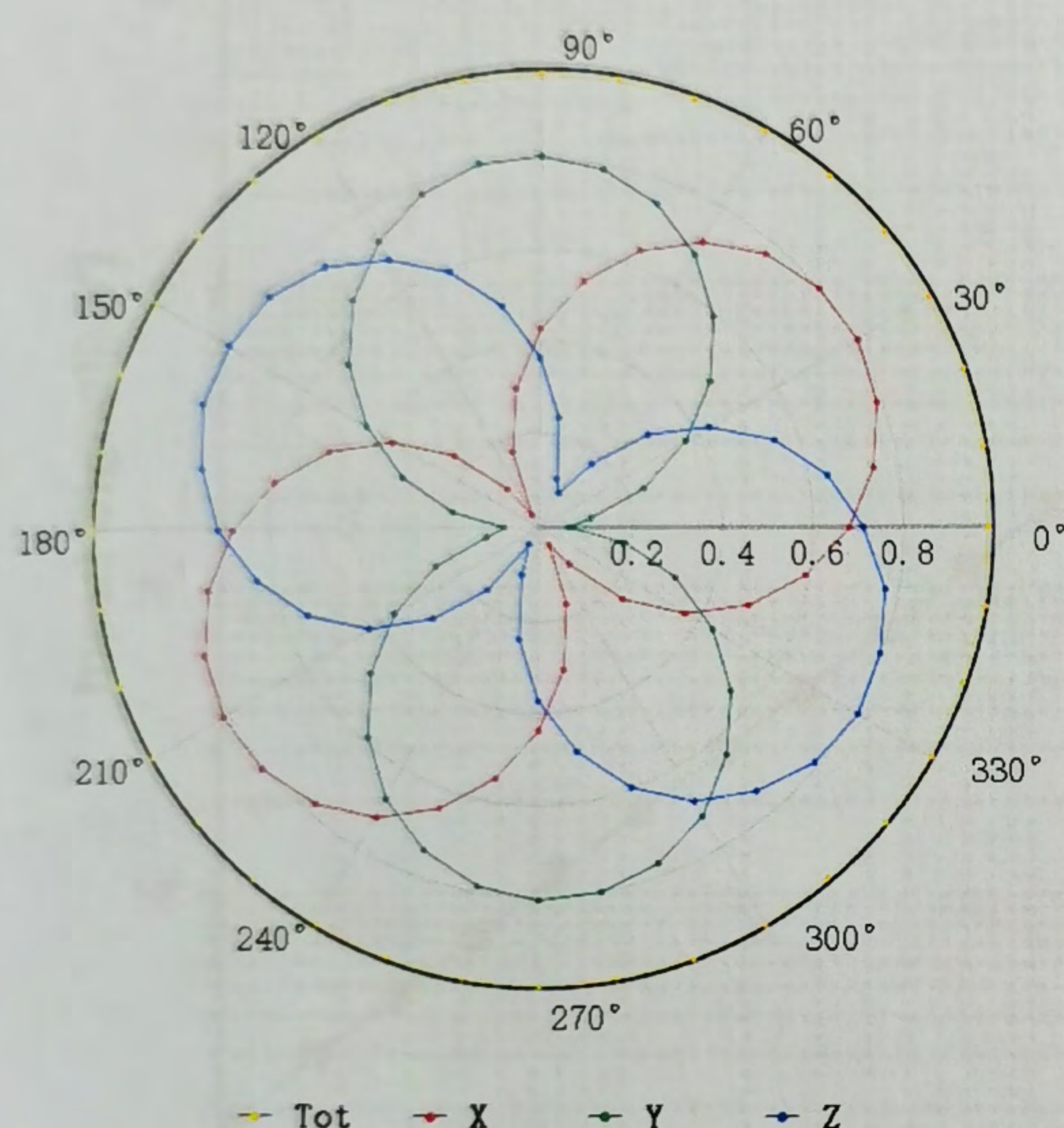


Uncertainty of Frequency Response of E-field:  $\pm 7.4\%$  ( $k=2$ )

## Receiving Pattern ( $\Phi$ ), $\theta=0^\circ$

**f=600 MHz, TEM**

**f=1800 MHz, R22**



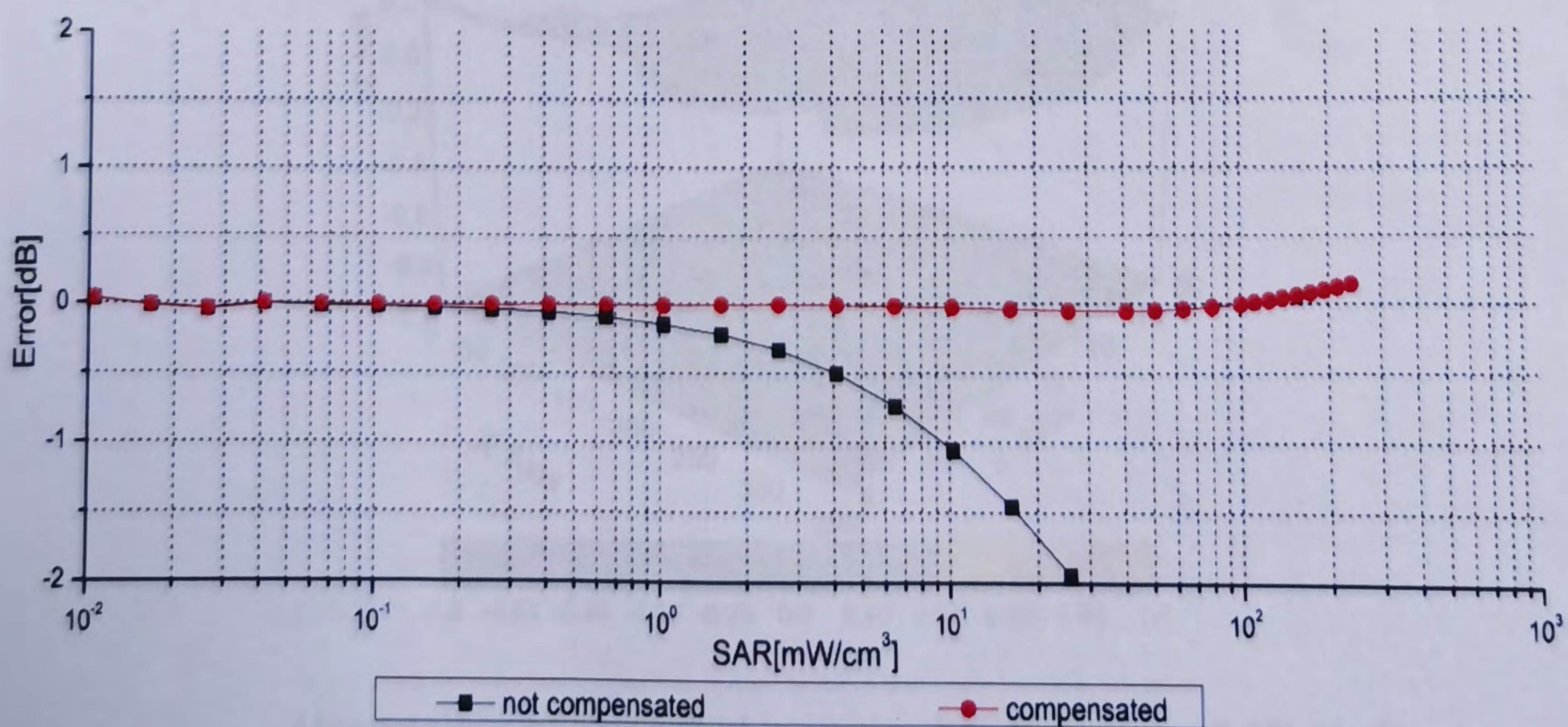
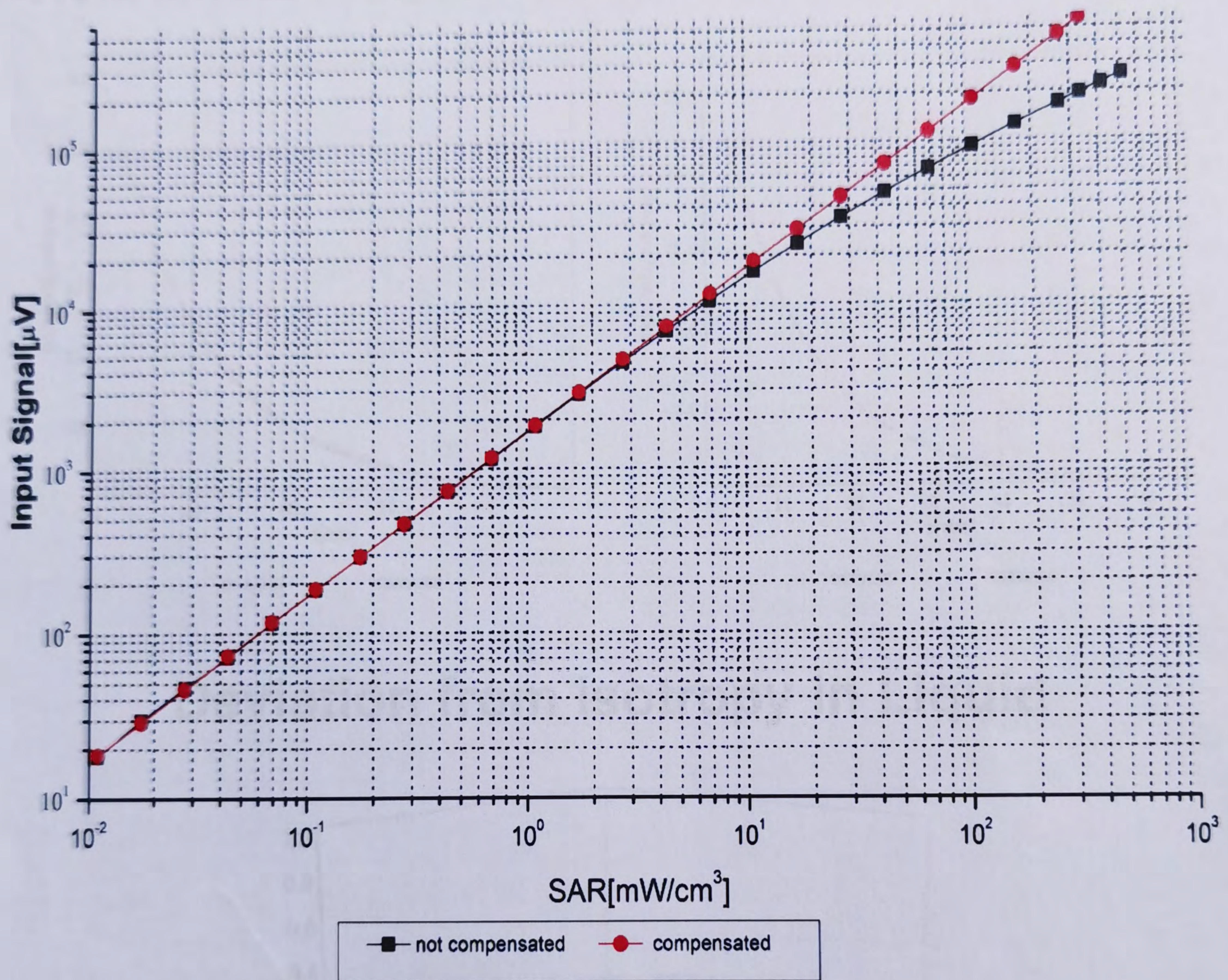
Uncertainty of Axial Isotropy Assessment:  $\pm 1.2\%$  ( $k=2$ )



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## Dynamic Range f(SAR<sub>head</sub>) (TEM cell, f = 900 MHz)



Uncertainty of Linearity Assessment:  $\pm 0.9\%$  ( $k=2$ )



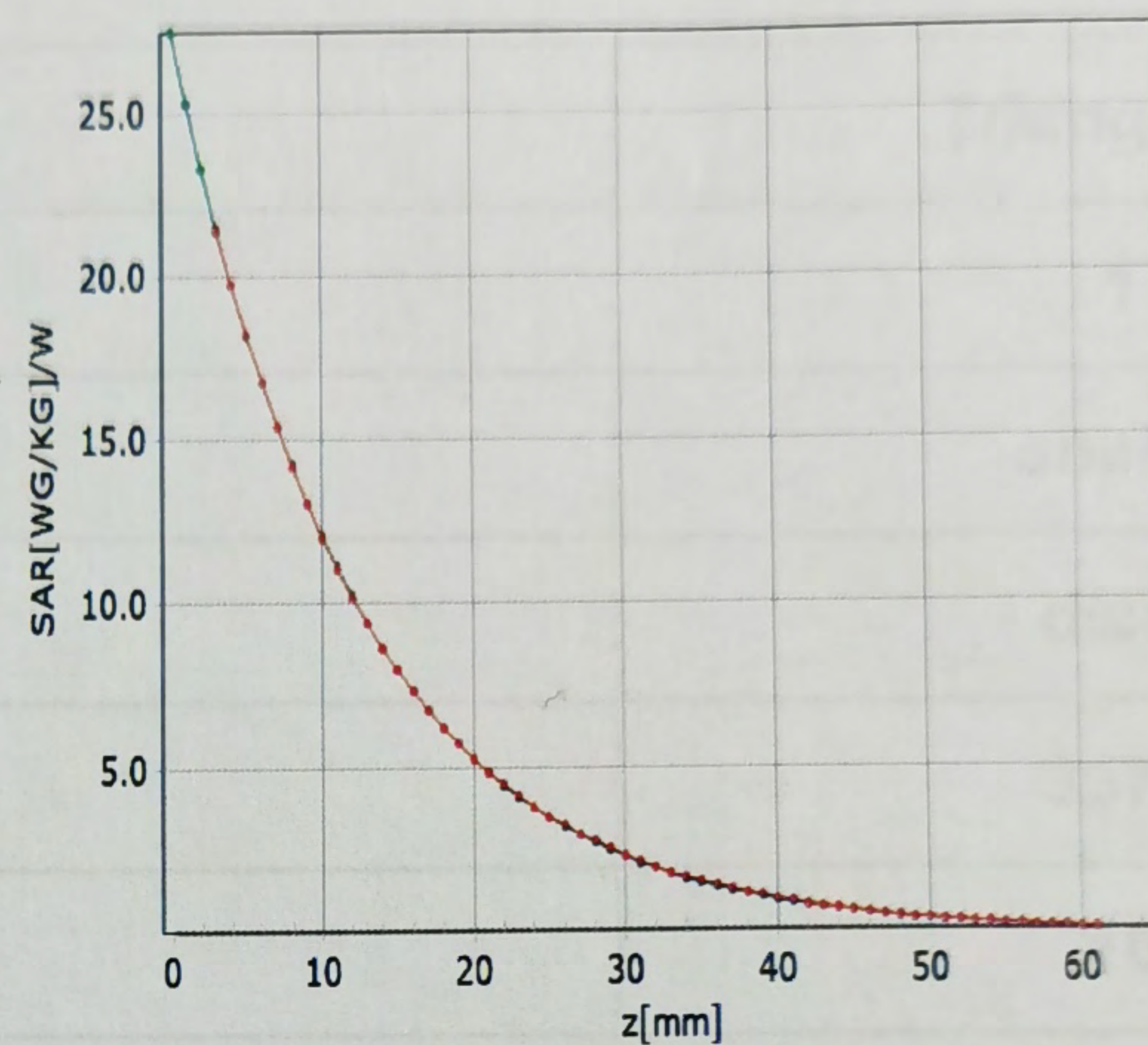
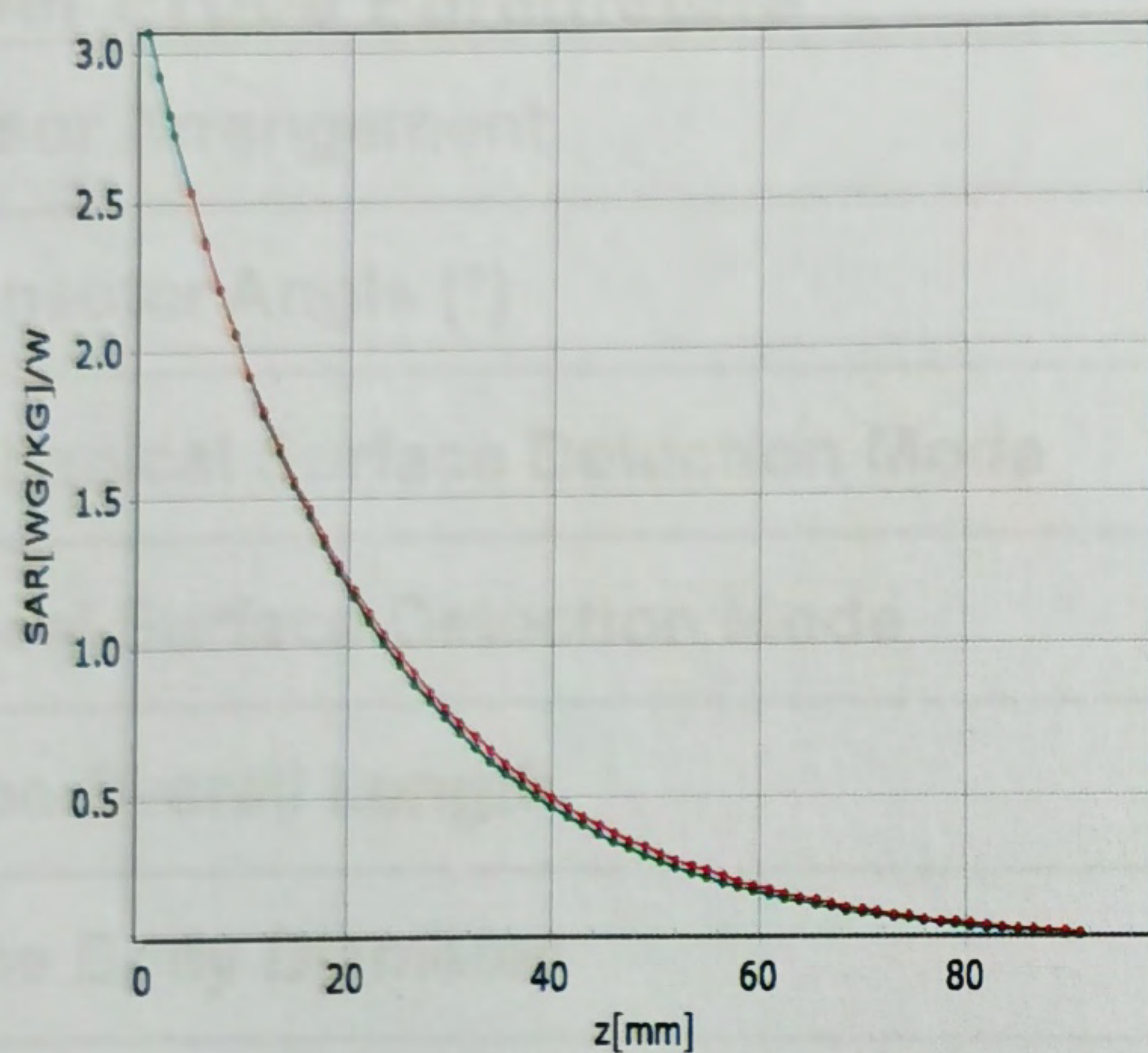
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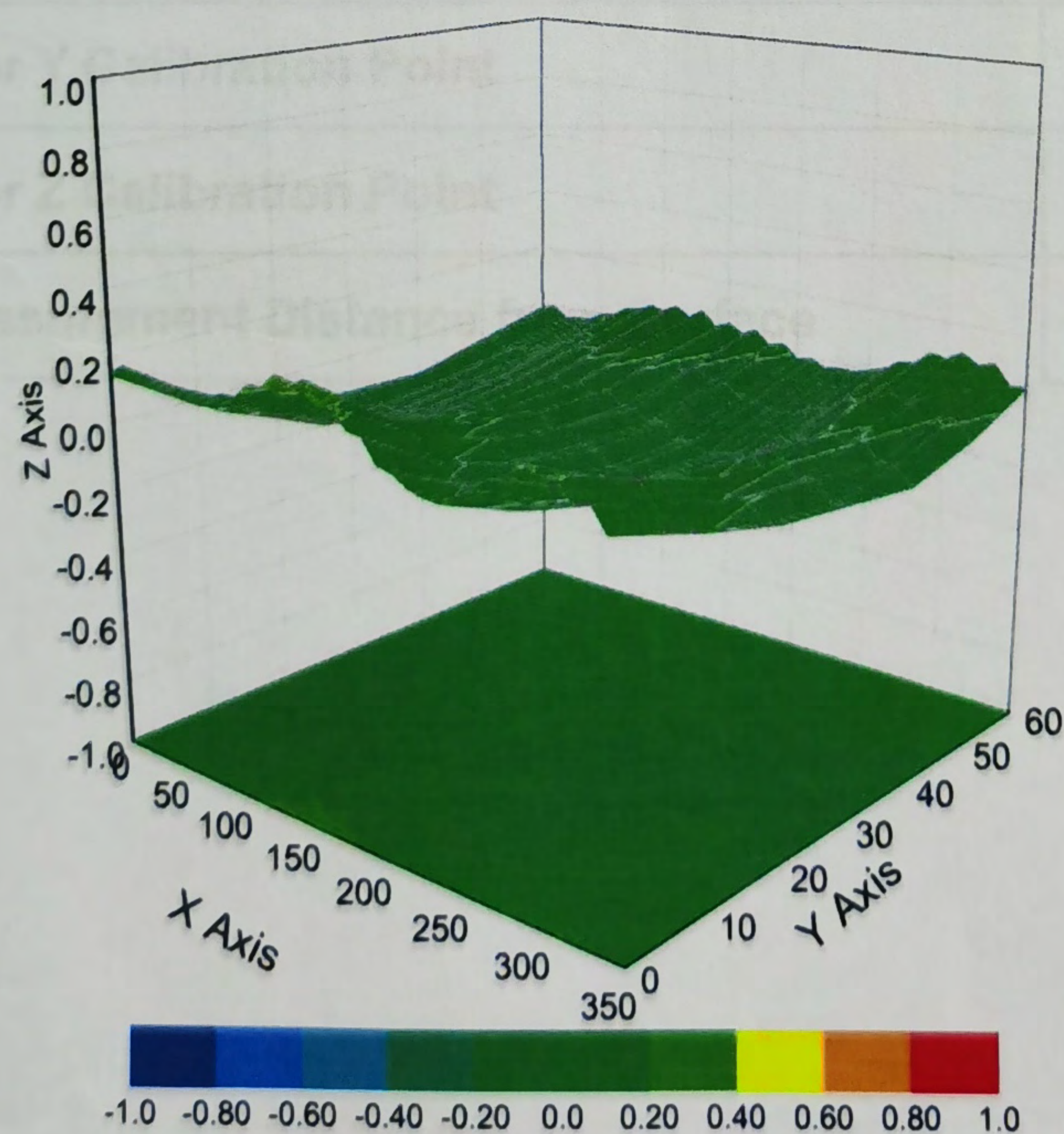
## Conversion Factor Assessment

**f=750 MHz, WGLS R9(H\_convF)**

**f=1750 MHz, WGLS R22(H\_convF)**



## Deviation from Isotropy in Liquid



**Uncertainty of Spherical Isotropy Assessment:  $\pm 3.2\%$  ( $k=2$ )**



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### Other Probe Parameters

|                                               |            |
|-----------------------------------------------|------------|
| Sensor Arrangement                            | Triangular |
| Connector Angle (°)                           | 170.7      |
| Mechanical Surface Detection Mode             | enabled    |
| Optical Surface Detection Mode                | disable    |
| Probe Overall Length                          | 337mm      |
| Probe Body Diameter                           | 10mm       |
| Tip Length                                    | 10mm       |
| Tip Diameter                                  | 2.5mm      |
| Probe Tip to Sensor X Calibration Point       | 1mm        |
| Probe Tip to Sensor Y Calibration Point       | 1mm        |
| Probe Tip to Sensor Z Calibration Point       | 1mm        |
| Recommended Measurement Distance from Surface | 1.4mm      |



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Client

**SGS**

Certificate No: **Z20-60202**

## CALIBRATION CERTIFICATE

Object

EX3DV4 - SN : 3789

Calibration Procedure(s)

FF-Z11-004-01

Calibration Procedures for Dosimetric E-field Probes

Calibration date:

June 16, 2020

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature( $22\pm 3$ ) $^{\circ}\text{C}$  and humidity $<70\%$ .

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards        | ID #        | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
|--------------------------|-------------|------------------------------------------|-----------------------|
| Power Meter NRP2         | 101919      | 18-Jun-19(CTTL, No.J19X05125)            | Jun-20                |
| Power sensor NRP-Z91     | 101547      | 18-Jun-19(CTTL, No.J19X05125)            | Jun-20                |
| Power sensor NRP-Z91     | 101548      | 18-Jun-19(CTTL, No.J19X05125)            | Jun-20                |
| Reference 10dBAttenuator | 18N50W-10dB | 10-Feb-20(CTTL, No.J20X00525)            | Feb-22                |
| Reference 20dBAttenuator | 18N50W-20dB | 10-Feb-20(CTTL, No.J20X00526)            | Feb-22                |
| Reference Probe EX3DV4   | SN 3617     | 30-Jan-20(SPEAG, No.EX3-3617_Jan20/2)    | Jan-21                |
| DAE4                     | SN 1556     | 4-Feb-20(SPEAG, No.DAE4-1556_Feb20)      | Feb-21                |
| Secondary Standards      | ID #        | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
| SignalGenerator MG3700A  | 6201052605  | 18-Jun-19(CTTL, No.J19X05127)            | Jun-20                |
| Network Analyzer E5071C  | MY46110673  | 10-Feb-20(CTTL, No.J20X00515)            | Feb-21                |

|                | Name        | Function           | Signature |
|----------------|-------------|--------------------|-----------|
| Calibrated by: | Yu Zongying | SAR Test Engineer  |           |
| Reviewed by:   | Lin Hao     | SAR Test Engineer  |           |
| Approved by:   | Qi Dianyuan | SAR Project Leader |           |

Issued: June 18, 2020

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.