

## APPENDIX D: MEASUREMENT UNCERTAINTIES

Applicable for SAR measurements with MAGPy-H3D probe and Module WPT

| Item                         | Uncertainty Source                                                                                  | Tolerance (dB) | Distr. | Div.       | ci | Std.Unc. (dB) |
|------------------------------|-----------------------------------------------------------------------------------------------------|----------------|--------|------------|----|---------------|
| <b>Probe uncertainty</b>     |                                                                                                     |                |        |            |    |               |
| 1                            | Amplitude calibration uncertainty                                                                   | 0.47           | norm   | 1          | 1  | 0.47          |
| 2                            | Gradient calibration uncertainty                                                                    | N/A            | norm   | 1          | 1  | N/A           |
| 3                            | Probe anisotropy                                                                                    | 0.5            | rect   | $\sqrt{3}$ | 1  | 0.29          |
| 4                            | Probe dynamic linearity                                                                             | 0.15           | rect   | $\sqrt{3}$ | 1  | 0.09          |
| 5                            | Probe frequency domain response                                                                     | 0.25           | rect   | $\sqrt{3}$ | 1  | 0.14          |
| 6                            | Modulation response                                                                                 | N/A            | rect   | $\sqrt{3}$ | 1  | N/A           |
| 7                            | Spatial averaging (maximum gradient)                                                                | N/A            | rect   | $\sqrt{3}$ | 1  | N/A           |
| 8                            | Gradient uncertainty                                                                                | 0.1            | rect   | $\sqrt{3}$ | 1  | 0.06          |
| 9                            | Gradient detection uncertainty                                                                      | N/A            | rect   | $\sqrt{3}$ | 1  | N/A           |
| 10                           | Parasitic E-field sensitivity                                                                       | 0.1            | rect   | $\sqrt{3}$ | 1  | 0.06          |
| 11                           | Detection limit                                                                                     | 0.15           | rect   | $\sqrt{3}$ | 1  | 0.09          |
| 12                           | Readout electronics                                                                                 | 0              | norm   | 1          | 1  | 0             |
| 13                           | Response time                                                                                       | N/A            | norm   | 1          | 1  | N/A           |
| 14                           | Probe positioning                                                                                   | 0.19           | norm   | 1          | 1  | 0.19          |
| 15                           | Shaping, filtering, signal conditioning                                                             | N/A            | norm   | 1          | 1  | N/A           |
| 16                           | Nominal position                                                                                    | N/A            | rect   | $\sqrt{3}$ | 1  | N/A           |
| 17                           | Repeatability                                                                                       | 0.1            | norm   | 1          | 1  | 0.10          |
| <b>Numerical simulations</b> |                                                                                                     |                |        |            |    |               |
| 18                           | Numerical method                                                                                    | 0              | rect   | $\sqrt{3}$ | 1  | 0             |
| 19                           | Grid resolution                                                                                     | 0.02           | rect   | $\sqrt{3}$ | 1  | 0.01          |
| 20                           | Tissue parameters                                                                                   | N/A            | rect   | $\sqrt{3}$ | 1  | N/A           |
| 21                           | Averaging method                                                                                    | 0.05           | rect   | $\sqrt{3}$ | 1  | 0.03          |
| 22                           | Model and exposure location                                                                         | 0              | rect   | $\sqrt{3}$ | 1  | 0             |
| 23                           | Convergence                                                                                         | 0              | rect   | $\sqrt{3}$ | 1  | 0             |
| 24                           | Boundary conditions                                                                                 | 0.2            | rect   | $\sqrt{3}$ | 1  | 0.12          |
| 25                           | Post-processing, interpolation                                                                      | 0.30           | rect   | $\sqrt{3}$ | 1  | 0.17          |
| <b>Field reconstruction</b>  |                                                                                                     |                |        |            |    |               |
| 26                           | Reconstruction algorithm; i.e., calculation of vector potential from measured magnetic flux density | 0.09           | rect   | $\sqrt{3}$ | 1  | 0.05          |
|                              | Combined uncertainty (k=1)                                                                          |                |        |            |    | 0.66          |
|                              | Expanded uncertainty (k=2)                                                                          |                |        |            |    | 1.31          |

Applicable for SAR measurements with EX3DVx Probe:

| a                                                                             | b                    | c             | d              | e=<br>f(d,k) | f                     | g                        | h=<br>c x f/e                  | i=<br>c x g/e                    | k              |
|-------------------------------------------------------------------------------|----------------------|---------------|----------------|--------------|-----------------------|--------------------------|--------------------------------|----------------------------------|----------------|
| Uncertainty Component                                                         | IEEE<br>1528<br>Sec. | Tol.<br>(± %) | Prob.<br>Dist. | Div.         | c <sub>i</sub><br>lgm | c <sub>i</sub><br>10 gms | lgm<br>u <sub>i</sub><br>(± %) | 10gms<br>u <sub>i</sub><br>(± %) | v <sub>i</sub> |
| <b>Measurement System</b>                                                     |                      |               |                |              |                       |                          |                                |                                  |                |
| Probe Calibration                                                             | E.2.1                | 9.3           | N              | 1            | 1                     | 1                        | 9.3                            | 9.3                              | ∞              |
| Axial Isotropy                                                                | E.2.2                | 0.25          | N              | 1            | 0.7                   | 0.7                      | 0.2                            | 0.2                              | ∞              |
| Hemishperical Isotropy                                                        | E.2.2                | 1.3           | N              | 1            | 0.7                   | 0.7                      | 0.9                            | 0.9                              | ∞              |
| Boundary Effect                                                               | E.2.3                | 2             | R              | 1.732        | 1                     | 1                        | 1.2                            | 1.2                              | ∞              |
| Linearity                                                                     | E.2.4                | 0.3           | N              | 1            | 1                     | 1                        | 0.3                            | 0.3                              | ∞              |
| System Detection Limits                                                       | E.2.4                | 0.25          | R              | 1.732        | 1                     | 1                        | 0.1                            | 0.1                              | ∞              |
| Readout Electronics                                                           | E.2.6                | 0.3           | N              | 1            | 1                     | 1                        | 0.3                            | 0.3                              | ∞              |
| Response Time                                                                 | E.2.7                | 0.8           | R              | 1.732        | 1                     | 1                        | 0.5                            | 0.5                              | ∞              |
| Integration Time                                                              | E.2.8                | 2.6           | R              | 1.732        | 1                     | 1                        | 1.5                            | 1.5                              | ∞              |
| RF Ambient Conditions - Noise                                                 | E.6.1                | 3             | R              | 1.732        | 1                     | 1                        | 1.7                            | 1.7                              | ∞              |
| RF Ambient Conditions - Reflections                                           | E.6.1                | 3             | R              | 1.732        | 1                     | 1                        | 1.7                            | 1.7                              | ∞              |
| Probe Positioner Mechanical Tolerance                                         | E.6.2                | 0.4           | R              | 1.732        | 1                     | 1                        | 0.2                            | 0.2                              | ∞              |
| Probe Positioning w/ respect to Phantom                                       | E.6.3                | 6.7           | R              | 1.732        | 1                     | 1                        | 3.9                            | 3.9                              | ∞              |
| Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation | E.5                  | 4             | R              | 1.732        | 1                     | 1                        | 2.3                            | 2.3                              | ∞              |
| <b>Test Sample Related</b>                                                    |                      |               |                |              |                       |                          |                                |                                  |                |
| Test Sample Positioning                                                       | E.4.2                | 2.70          | N              | 1            | 1                     | 1                        | 2.7                            | 2.7                              | 35             |
| Device Holder Uncertainty                                                     | E.4.1                | 1.67          | N              | 1            | 1                     | 1                        | 1.7                            | 1.7                              | 5              |
| Output Power Variation - SAR drift measurement                                | E.2.9                | 5             | R              | 1.732        | 1                     | 1                        | 2.9                            | 2.9                              | ∞              |
| SAR Scaling                                                                   | E.6.5                | 0             | R              | 1.732        | 1                     | 1                        | 0.0                            | 0.0                              | ∞              |
| <b>Phantom &amp; Tissue Parameters</b>                                        |                      |               |                |              |                       |                          |                                |                                  |                |
| Phantom Uncertainty (Shape & Thickness tolerances)                            | E.3.1                | 7.6           | R              | 1.73         | 1.0                   | 1.0                      | 4.4                            | 4.4                              | ∞              |
| Liquid Conductivity - measurement uncertainty                                 | E.3.3                | 4.2           | N              | 1            | 0.78                  | 0.71                     | 3.3                            | 3.0                              | 76             |
| Liquid Permittivity - measurement uncertainty                                 | E.3.3                | 4.1           | N              | 1            | 0.23                  | 0.26                     | 0.9                            | 1.1                              | 75             |
| Liquid Conductivity - Temperature Uncertainty                                 | E.3.4                | 3.4           | R              | 1.732        | 0.78                  | 0.71                     | 1.5                            | 1.4                              | ∞              |
| Liquid Permittivity - Temperature Uncertainty                                 | E.3.4                | 0.6           | R              | 1.732        | 0.23                  | 0.26                     | 0.1                            | 0.1                              | ∞              |
| Liquid Conductivity - deviation from target values                            | E.3.2                | 5.0           | R              | 1.73         | 0.64                  | 0.43                     | 1.8                            | 1.2                              | ∞              |
| Liquid Permittivity - deviation from target values                            | E.3.2                | 5.0           | R              | 1.73         | 0.60                  | 0.49                     | 1.7                            | 1.4                              | ∞              |
| <b>Combined Standard Uncertainty (k=1)</b>                                    |                      |               |                |              |                       |                          | RSS                            | 13.3                             | 13.1           |
| <b>Expanded Uncertainty</b><br>(95% CONFIDENCE LEVEL)                         |                      |               |                |              |                       |                          | k=2                            | 26.5                             | 26.1           |

|                               |                                                                       |                                   |
|-------------------------------|-----------------------------------------------------------------------|-----------------------------------|
| FCC ID: A3LSMF721JPN          | FCC URS (UNINTENTIONAL RADIATOR RF SOURCES)<br>RF EXPOSURE EVALUATION | Approved by:<br>Technical Manager |
| DUT Type:<br>Portable Handset |                                                                       | APPENDIX D:<br>Page 2 of 3        |

Applicable for Power Density Measurements:

| a                                                     | b              | c              | d    | e              | f =<br>c x f/e           | g              |
|-------------------------------------------------------|----------------|----------------|------|----------------|--------------------------|----------------|
| Uncertainty Component                                 | Unc.<br>(± dB) | Prob.<br>Dist. | Div. | c <sub>i</sub> | u <sub>i</sub><br>(± dB) | v <sub>i</sub> |
| <b>Measurement System</b>                             |                |                |      |                |                          |                |
| Calibration                                           | 0.49           | N              | 1    | 1              | 0.49                     | ∞              |
| Probe Correction                                      | 0.00           | R              | 1.73 | 1              | 0.00                     | ∞              |
| Frequency Response                                    | 0.20           | R              | 1.73 | 1              | 0.12                     | ∞              |
| Sensor Cross Coupling                                 | 0.00           | R              | 1.73 | 1              | 0.00                     | ∞              |
| Isotropy                                              | 0.50           | R              | 1.73 | 1              | 0.29                     | ∞              |
| Linearity                                             | 0.20           | R              | 1.73 | 1              | 0.12                     | ∞              |
| Probe Scattering                                      | 0.00           | R              | 1.73 | 1              | 0.00                     | ∞              |
| Probe Positioning offset                              | 0.30           | R              | 1.73 | 1              | 0.17                     | ∞              |
| Probe Positioning Repeatability                       | 0.04           | R              | 1.73 | 1              | 0.02                     | ∞              |
| Sensor Mechanical Offset                              | 0.00           | R              | 1.73 | 1              | 0.00                     | ∞              |
| Probe Spatial Resolution                              | 0.00           | R              | 1.73 | 1              | 0.00                     | ∞              |
| Field Impedance Dependence                            | 0.00           | R              | 1.73 | 1              | 0.00                     | ∞              |
| Amplitude and Phase Drift                             | 0.00           | R              | 1.73 | 1              | 0.00                     | ∞              |
| Amplitude and Phase Noise                             | 0.04           | R              | 1.73 | 1              | 0.02                     | ∞              |
| Measurement Area Truncation                           | 0.00           | R              | 1.73 | 1              | 0.00                     | ∞              |
| Data Acquisition                                      | 0.03           | N              | 1    | 1              | 0.03                     | ∞              |
| Sampling                                              | 0.00           | R              | 1.73 | 1              | 0.00                     | ∞              |
| Field Reconstruction                                  | 2.00           | R              | 1.73 | 1              | 1.15                     | ∞              |
| Forward Transformation                                | 0.00           | R              | 1.73 | 1              | 0.00                     | ∞              |
| Power Density Scaling                                 | 0.00           | R              | 1.73 | 1              | 0.00                     | ∞              |
| Spatial Averaging                                     | 0.10           | R              | 1.73 | 1              | 0.06                     | ∞              |
| System Detection Limit                                | 0.04           | R              | 1.73 | 1              | 0.02                     | ∞              |
| <b>Test Sample Related</b>                            |                |                |      |                |                          |                |
| Probe Coupling with DUT                               | 0.00           | R              | 1.73 | 1              | 0.00                     | ∞              |
| Modulation Response                                   | 0.40           | R              | 1.73 | 1              | 0.23                     | ∞              |
| Integration Time                                      | 0.00           | R              | 1.73 | 1              | 0.00                     | ∞              |
| Response Time                                         | 0.00           | R              | 1.73 | 1              | 0.00                     | ∞              |
| Device Holder Influence                               | 0.10           | R              | 1.73 | 1              | 0.06                     | ∞              |
| DUT alignment                                         | 0.00           | R              | 1.73 | 1              | 0.00                     | ∞              |
| RF Ambient Conditions                                 | 0.04           | R              | 1.73 | 1              | 0.02                     | ∞              |
| Ambient Reflections                                   | 0.04           | R              | 1.73 | 1              | 0.02                     | ∞              |
| Immunity/Secondary Reception                          | 0.00           | R              | 1.73 | 1              | 0.00                     | ∞              |
| Drift of DUT                                          | 0.21           | R              | 1.73 | 1              | 0.12                     | ∞              |
| <b>Combined Standard Uncertainty (k=1)</b>            |                |                |      |                | RSS                      | 1.34           |
| <b>Expanded Uncertainty</b><br>(95% CONFIDENCE LEVEL) |                |                |      |                | k=2                      | 2.68           |