Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2014/5/5

System Check_Body_2450MHz_140505

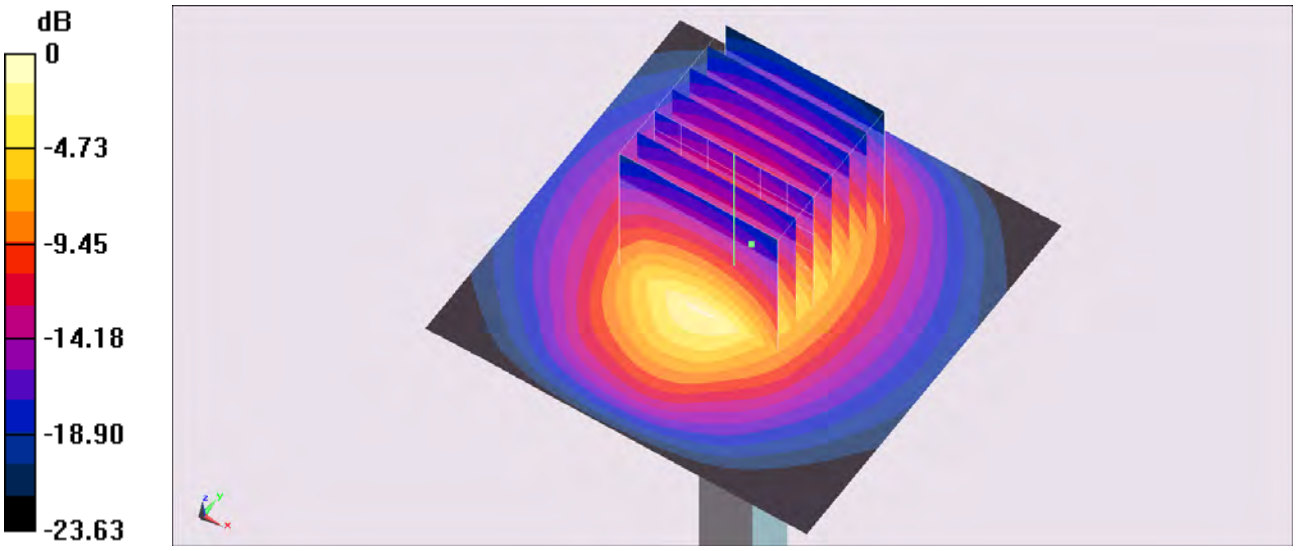
DUT: D2450V2-924

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: MSL_2450_140505 Medium parameters used: f = 2450 MHz; σ = 1.957 S/m; ε_r = 53.837; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃； Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: ES3DV3 - SN3270; ConvF(4.28, 4.28, 4.28); Calibrated: 2013/9/24;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2013/8/21
- Phantom: ELI 4.0_Front; Type: QDOVA001BB; Serial: 1026
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 16.5 W/kg

Configuration/Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 89.000 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 24.0 W/kg
SAR(1 g) = 11.6 W/kg; SAR(10 g) = 5.45 W/kg
Maximum value of SAR (measured) = 15.0 W/kg



0 dB = 15.0 W/kg = 11.76 dBW/kg

System Check_Body_2450MHz_140724

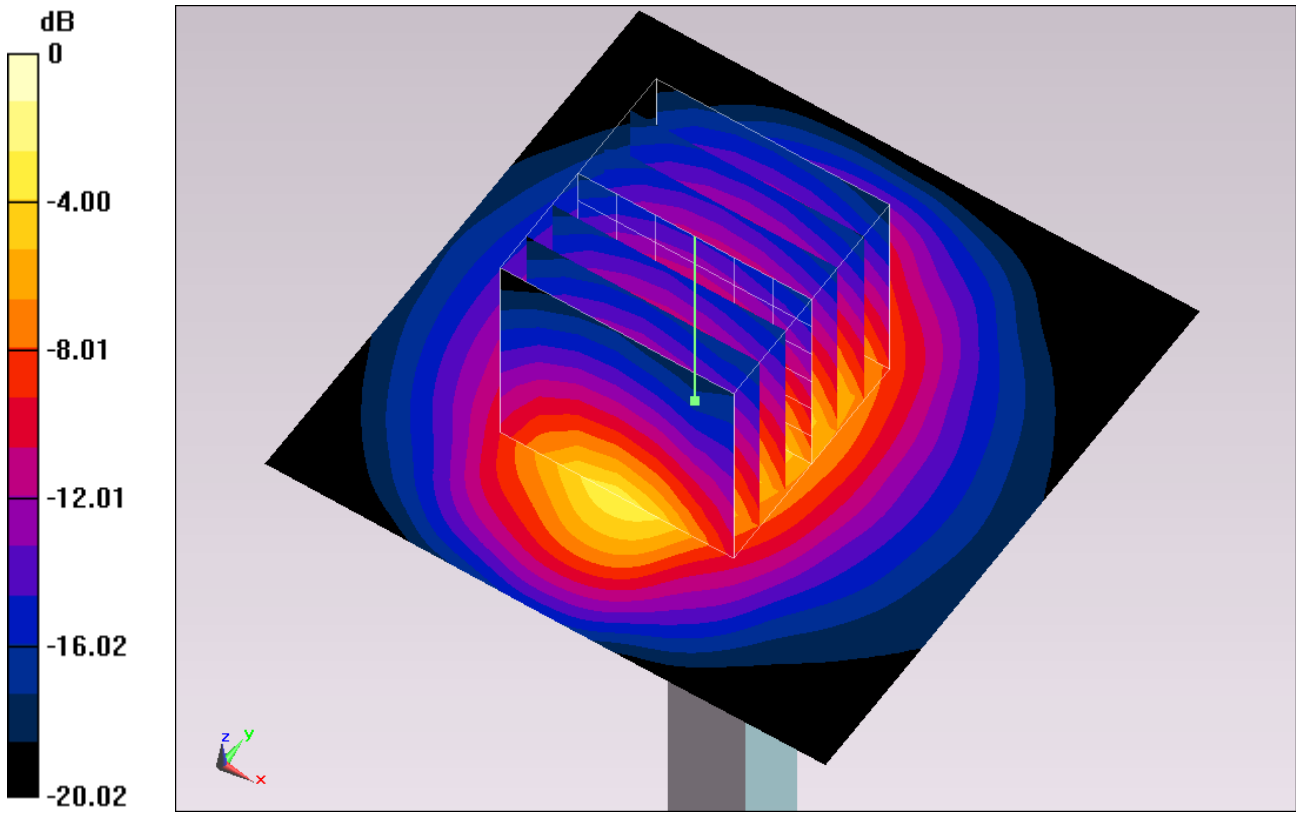
DUT: D2450V2-924

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: MSL_2450_140724 Medium parameters used: f = 2450 MHz; σ = 2.005 S/m; ε_r = 53.959; ρ = 1000 kg/m^3
Ambient Temperature：23.6 ℃； Liquid Temperature：22.6 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3954; ConvF(7.34, 7.34, 7.34); Calibrated: 2013/11/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1425; Calibrated: 2014/3/3
- Phantom: ELI 4.0_Front; Type: QDOVA001BB; Serial: 1029
- Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 21.8 W/kg

Configuration/Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 105.0 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 24.8 W/kg
SAR(1 g) = 12.7 W/kg; SAR(10 g) = 6.04 W/kg
Maximum value of SAR (measured) = 18.9 W/kg



0 dB = 18.9 W/kg = 12.76 dBW/kg

System Check_Body_2450MHz_140730

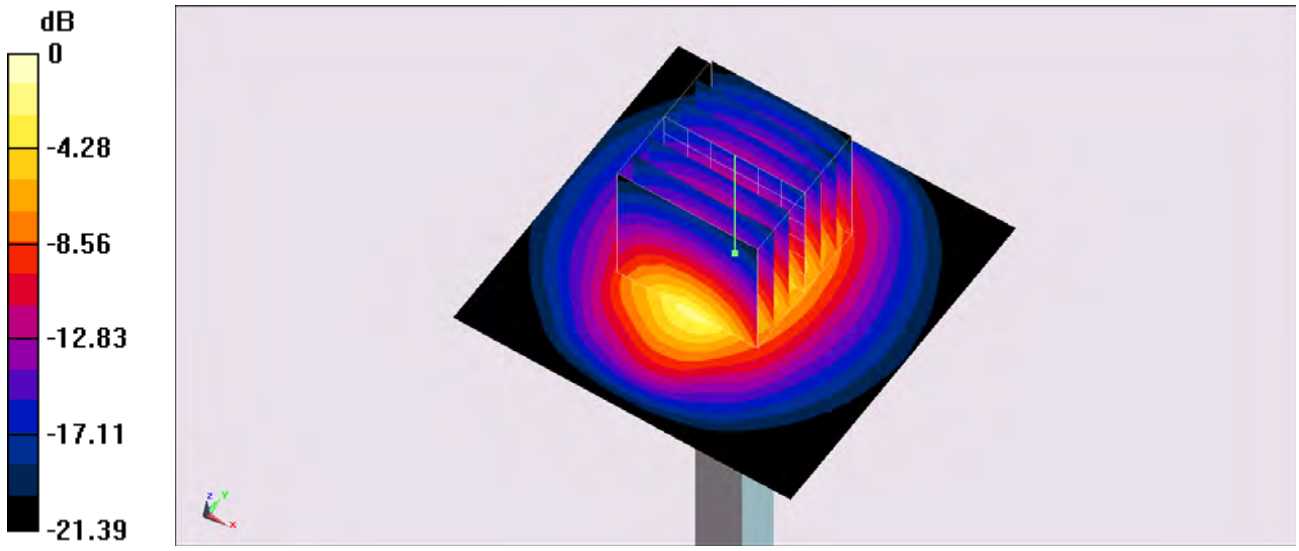
DUT: D2450V2-924

Communication System: CW ; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: MSL_2450_140730 Medium parameters used: f = 2450 MHz; σ = 1.93 S/m; ε_r = 53.269; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃； Liquid Temperature：22.3 ℃

DASY5 Configuration
- Probe: EX3DV4 - SN3931; ConvF(7.24, 7.24, 7.24); Calibrated: 2013/9/10;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2014/5/15
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1173
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 19.4 W/kg

Configuration/Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 98.334 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 26.0 W/kg
SAR(1 g) = 12.6 W/kg; SAR(10 g) = 5.88 W/kg
Maximum value of SAR (measured) = 19.2 W/kg



0 dB = 19.2 W/kg = 12.83 dBW/kg

System Check_Body_5200MHz_140506

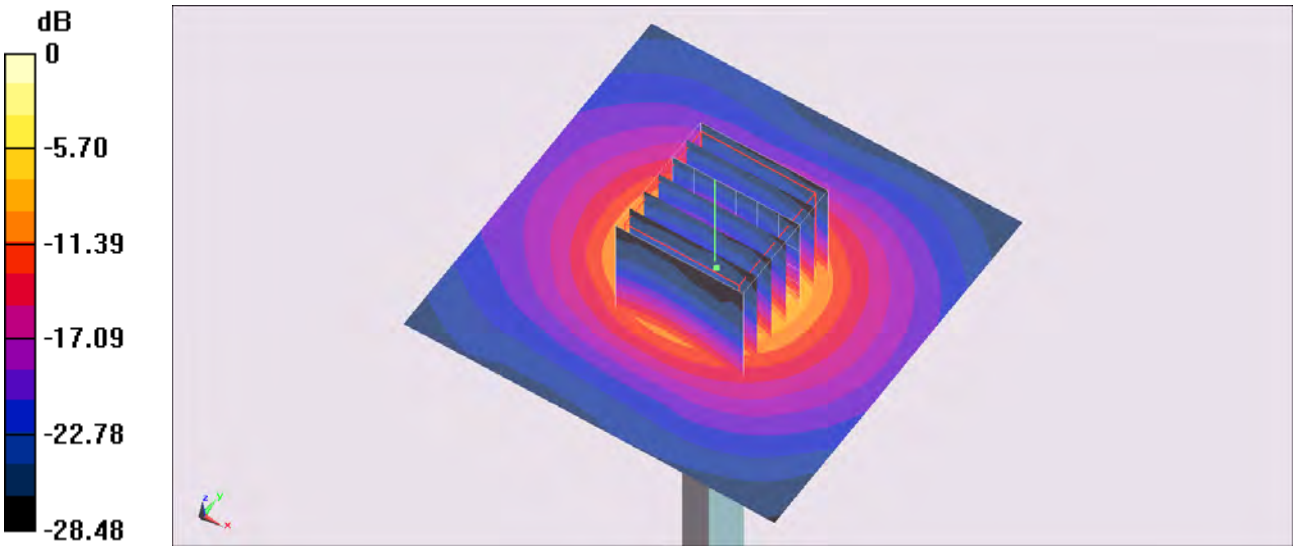
DUT: D5GHzV2-1128

Communication System: CW; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: MSL_5G_140506 Medium parameters used: f = 5200 MHz; σ = 5.084 S/m; ε_r = 48.917; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃； Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3935; ConvF(4.61, 4.61, 4.61); Calibrated: 2013/11/4;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2013/11/5
- Phantom: ELI 4.0_Front; Type: QDOVA001BB; Serial: 1026
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 18.6 W/kg

Configuration/Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 65.380 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 29.3 W/kg
SAR(1 g) = 7.36 W/kg; SAR(10 g) = 2.07 W/kg
Maximum value of SAR (measured) = 18.4 W/kg



0 dB = 18.4 W/kg = 12.65 dBW/kg

System Check_Body_5200MHz_140507

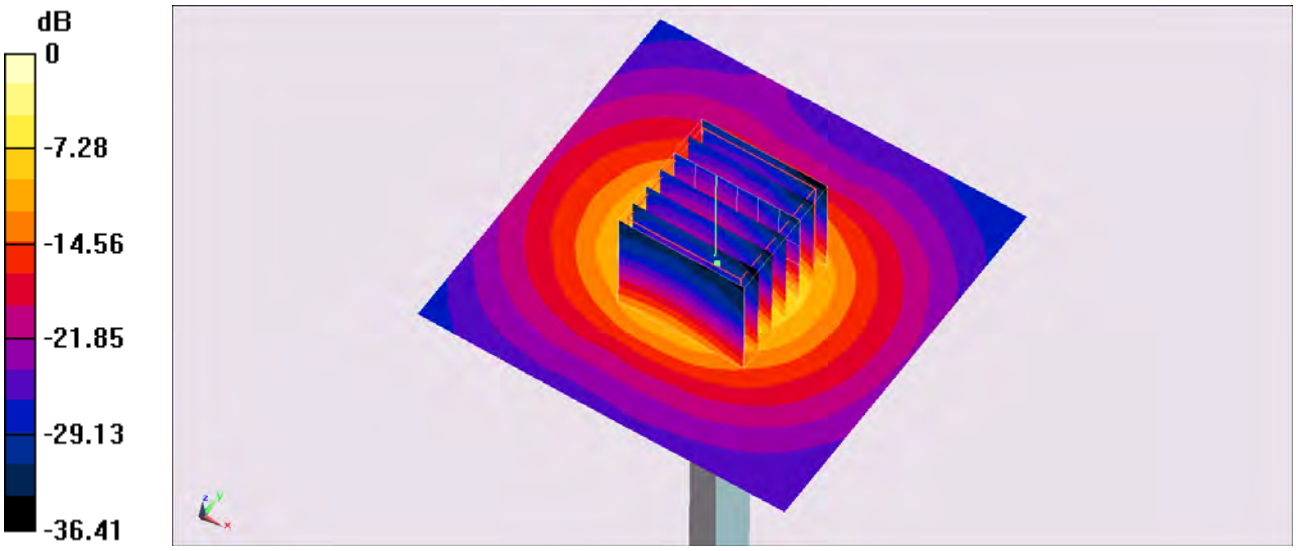
DUT: D5GHzV2-1128

Communication System: CW; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: MSL_5G_140507 Medium parameters used: f = 5200 MHz; σ = 5.279 S/m; ε_r = 48.534; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃； Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3954; ConvF(4.52, 4.52, 4.52); Calibrated: 2013/11/4;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2014/1/30
- Phantom: ELI 4.0_Front; Type: QDOVA001BB; Serial: 1026
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 18.0 W/kg

Configuration/Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 66.452 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 31.0 W/kg
SAR(1 g) = 7.37 W/kg; SAR(10 g) = 2.01 W/kg
Maximum value of SAR (measured) = 18.4 W/kg



0 dB = 18.4 W/kg = 12.65 dBW/kg

System Check_Body_5300MHz_140417

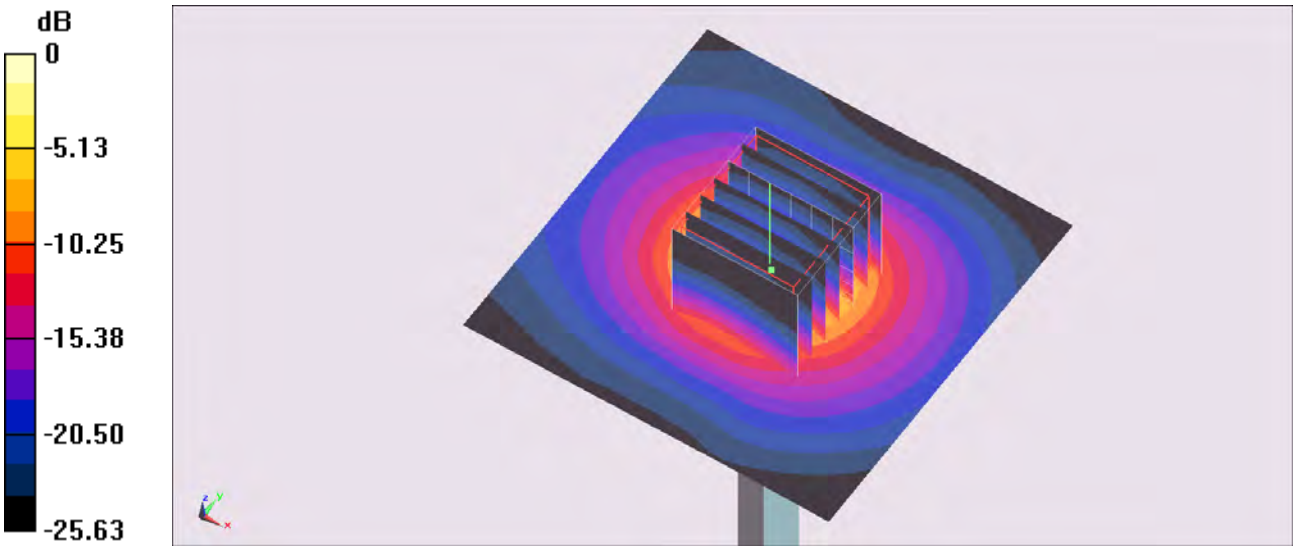
DUT: D5GHzV2-1128

Communication System: CW ; Frequency: 5300 MHz;Duty Cycle: 1:1
Medium: MSL_5G_140417 Medium parameters used: f = 5300 MHz; σ = 5.457 S/m; ε_r = 47.597; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃； Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3935; ConvF(4.18, 4.18, 4.18); Calibrated: 2013/11/4;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2013/11/5
- Phantom: ELI 4.0_Front; Type: QDOVA001BB; Serial: 1026
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 19.7 W/kg

Configuration/Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 66.458 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 27.5 W/kg
SAR(1 g) = 7.69 W/kg; SAR(10 g) = 2.18 W/kg
Maximum value of SAR (measured) = 18.5 W/kg



0 dB = 18.5 W/kg = 12.67 dBW/kg

System Check_Body_5300MHz_140506

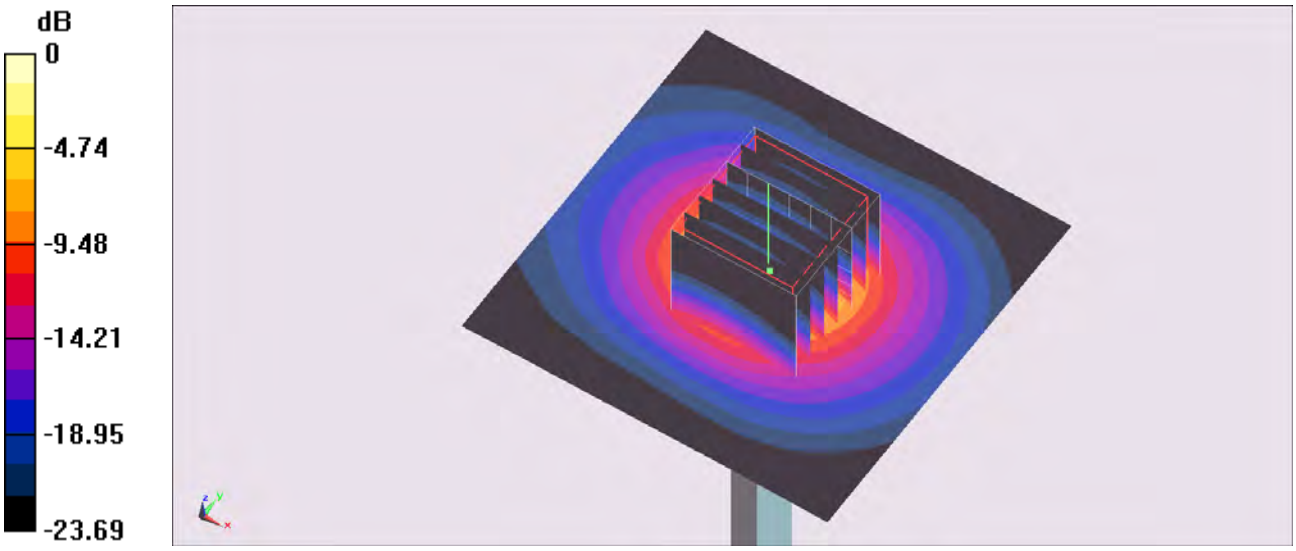
DUT: D5GHzV2-1128

Communication System: CW ; Frequency: 5300 MHz;Duty Cycle: 1:1
Medium: MSL_5G_140506 Medium parameters used: f = 5300 MHz; σ = 5.268 S/m; ε_r = 48.783; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃； Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3935; ConvF(4.18, 4.18, 4.18); Calibrated: 2013/11/4;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2013/11/5
- Phantom: ELI 4.0_Front; Type: QDOVA001BB; Serial: 1026
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 19.3 W/kg

Configuration/Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.990 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 27.6 W/kg
SAR(1 g) = 7.77 W/kg; SAR(10 g) = 2.21 W/kg
Maximum value of SAR (measured) = 18.6 W/kg



0 dB = 18.6 W/kg = 12.70 dBW/kg

System Check_Body_5300MHz_140507

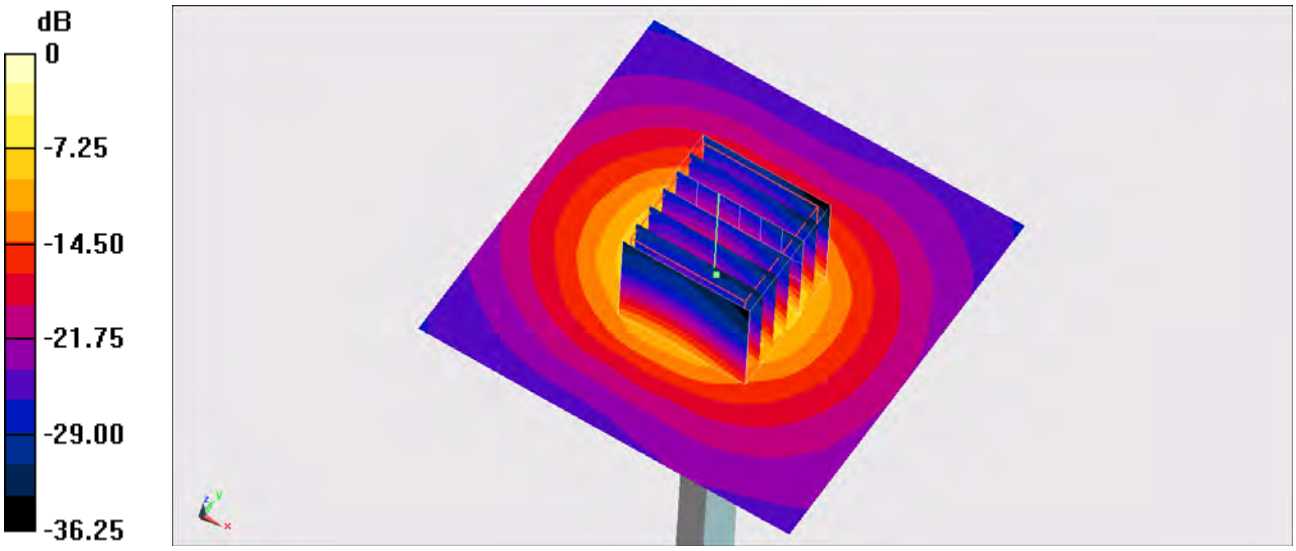
DUT: D5GHzV2-1128

Communication System: CW; Frequency: 5300 MHz;Duty Cycle: 1:1
Medium: MSL_5G_140507 Medium parameters used: f = 5300 MHz; σ = 5.418 S/m; ε_r = 48.319; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃； Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3954; ConvF(4.28, 4.28, 4.28); Calibrated: 2013/11/4;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2014/1/30
- Phantom: ELI 4.0_Front; Type: QDOVA001BB; Serial: 1026
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 18.2 W/kg

Configuration/Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 66.090 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 30.8 W/kg
SAR(1 g) = 7.36 W/kg; SAR(10 g) = 2 W/kg
Maximum value of SAR (measured) = 18.6 W/kg



0 dB = 18.6 W/kg = 12.70 dBW/kg

System Check_Body_5600MHz_140506

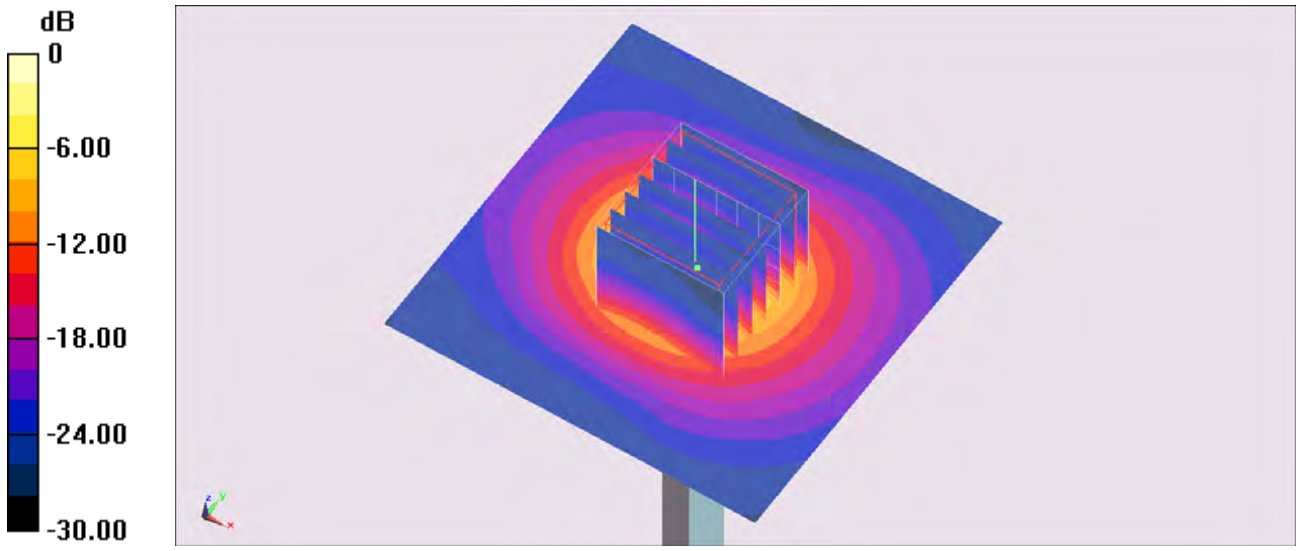
DUT: D5GHzV2-1128

Communication System: CW; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium: MSL_5G_140506 Medium parameters used: f = 5600 MHz; σ = 5.681 S/m; ε_r = 48.192; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃； Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3935; ConvF(3.69, 3.69, 3.69); Calibrated: 2013/11/4;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2013/11/5
- Phantom: ELI 4.0_Front; Type: QDOVA001BB; Serial: 1026
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 20.3 W/kg

Configuration/Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.127 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 29.3 W/kg
SAR(1 g) = 7.8 W/kg; SAR(10 g) = 2.18 W/kg
Maximum value of SAR (measured) = 19.2 W/kg



0 dB = 19.2 W/kg = 12.83 dBW/kg

System Check_Body_5600MHz_140507

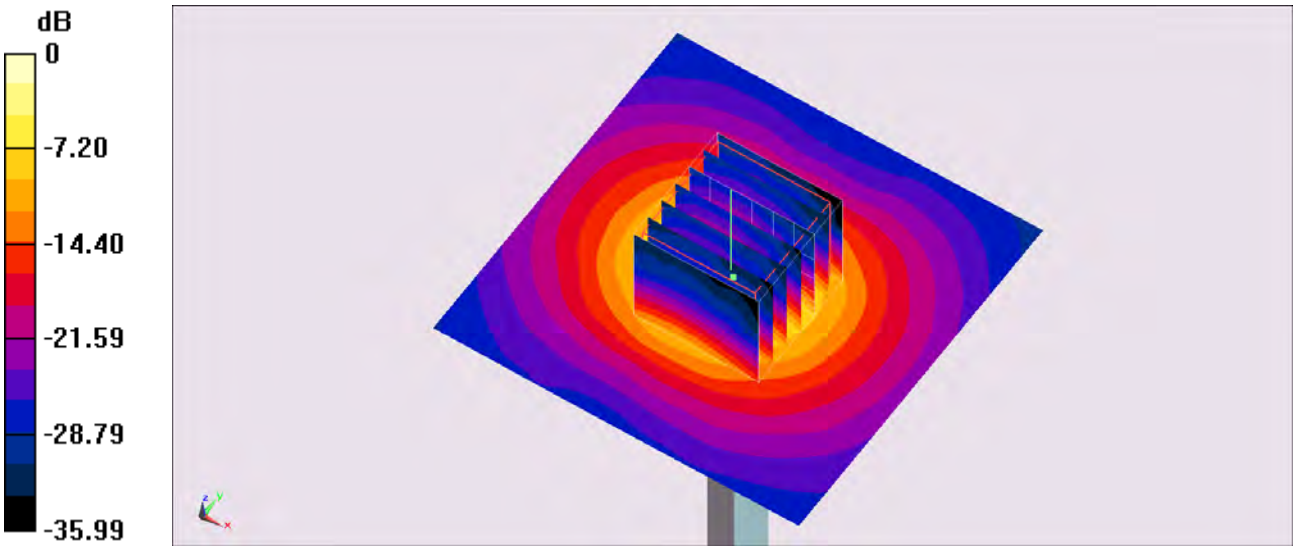
DUT: D5GHzV2-1128

Communication System: CW; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium: MSL_5G_140507 Medium parameters used: f = 5600 MHz; σ = 5.849 S/m; ε_r = 47.666; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃； Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3954; ConvF(3.97, 3.97, 3.97); Calibrated: 2013/11/4;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2014/1/30
- Phantom: ELI 4.0_Front; Type: QDOVA001BB; Serial: 1026
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 19.8 W/kg

Configuration/Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 65.303 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 36.0 W/kg
SAR(1 g) = 7.82 W/kg; SAR(10 g) = 2.1 W/kg
Maximum value of SAR (measured) = 20.3 W/kg



0 dB = 20.3 W/kg = 13.07 dBW/kg

System Check_Body_5800MHz_140417

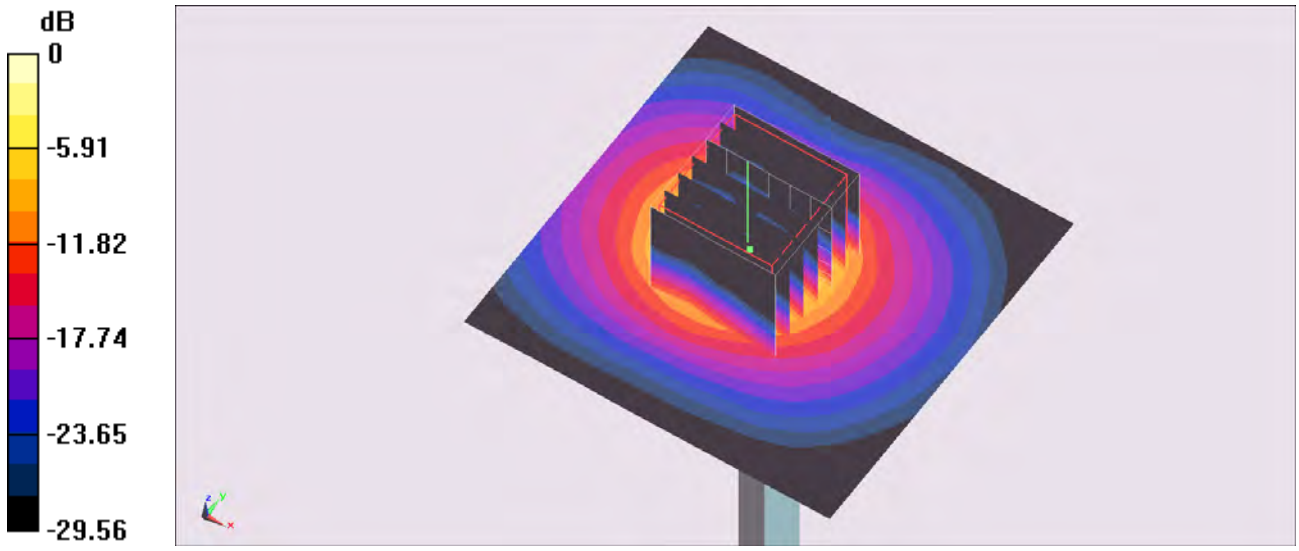
DUT: D5GHzV2-1128

Communication System: CW; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: MSL_5G_140417 Medium parameters used: f = 5800 MHz; σ = 6.168 S/m; ε_r = 46.453; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃； Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3935; ConvF(4.09, 4.09, 4.09); Calibrated: 2013/11/4;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2013/11/5
- Phantom: ELI 4.0_Front; Type: QDOVA001BB; Serial: 1026
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 19.4 W/kg

Configuration/Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 50.529 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 33.4 W/kg
SAR(1 g) = 7.26 W/kg; SAR(10 g) = 1.95 W/kg
Maximum value of SAR (measured) = 19.2 W/kg



0 dB = 19.2 W/kg = 12.83 dBW/kg

System Check_Body_5800MHz_140418

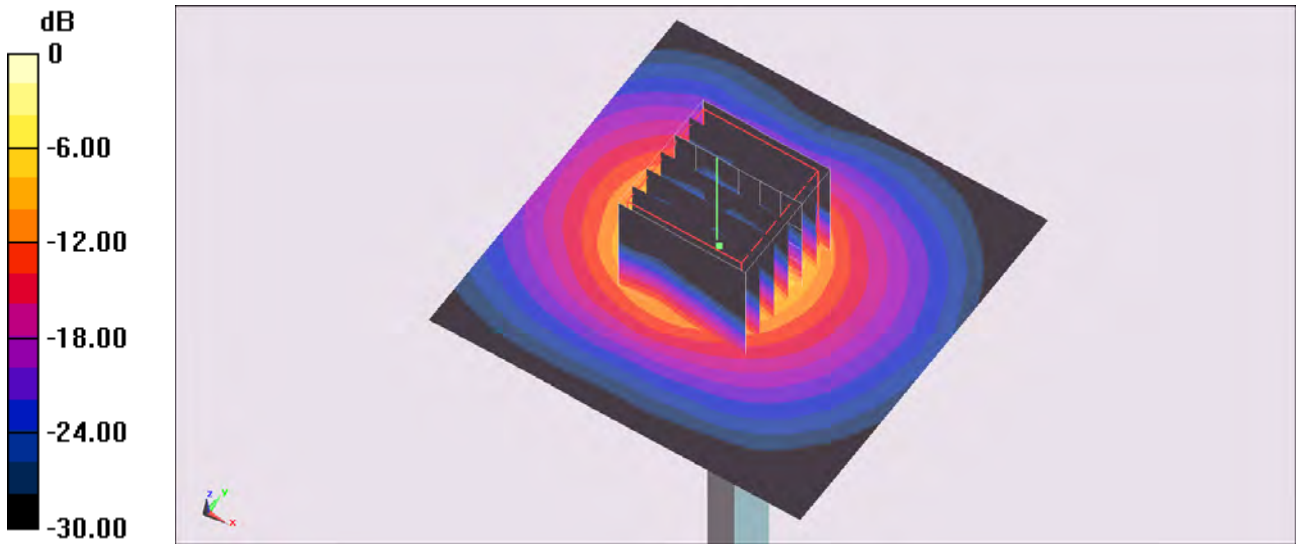
DUT: D5GHzV2-1128

Communication System: CW; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: MSL_5G_140418 Medium parameters used: f = 5800 MHz; σ = 6.228 S/m; ε_r = 47.321; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃； Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3935; ConvF(4.09, 4.09, 4.09); Calibrated: 2013/11/4;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2013/11/5
- Phantom: ELI 4.0_Front; Type: QDOVA001BB; Serial: 1026
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 19.6 W/kg

Configuration/Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 50.529 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 33.7 W/kg
SAR(1 g) = 7.33 W/kg; SAR(10 g) = 1.96 W/kg
Maximum value of SAR (measured) = 19.3 W/kg



0 dB = 19.3 W/kg = 12.86 dBW/kg

System Check_Body_5800MHz_140507

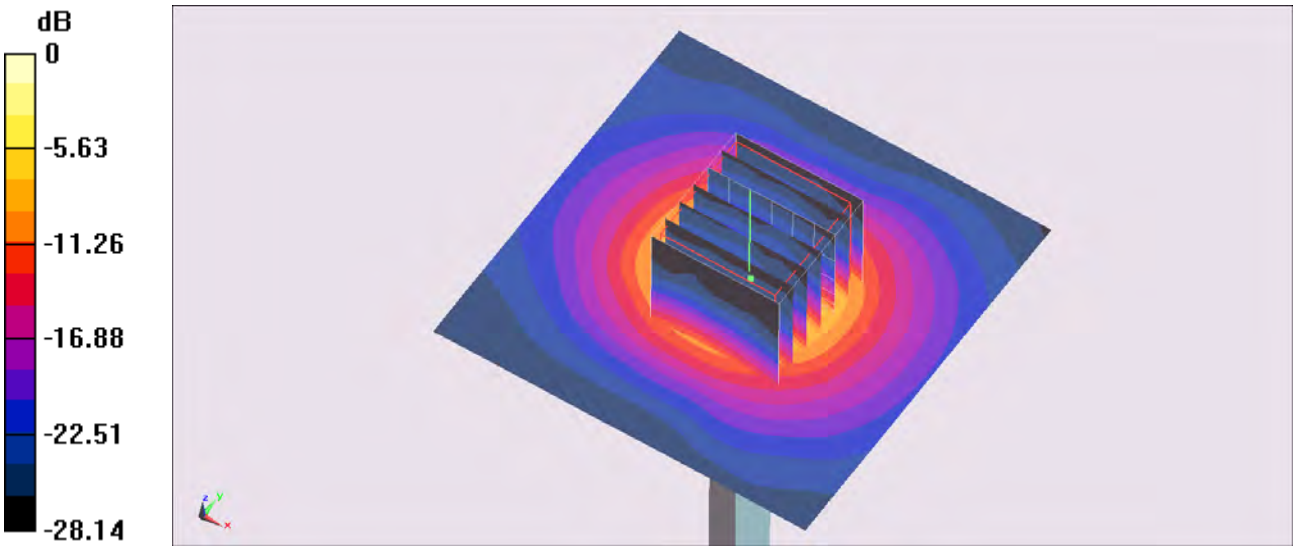
DUT: D5GHzV2-1128

Communication System: CW; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: MSL_5G_140507 Medium parameters used: f = 5800 MHz; σ = 6.113 S/m; ε_r = 47.156; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃； Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3954; ConvF(4.08, 4.08, 4.08); Calibrated: 2013/11/4;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2014/1/30
- Phantom: ELI 4.0_Front; Type: QDOVA001BB; Serial: 1026
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 19.9 W/kg

Configuration/Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.117 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 31.9 W/kg
SAR(1 g) = 7.36 W/kg; SAR(10 g) = 2.05 W/kg
Maximum value of SAR (measured) = 19.1 W/kg



0 dB = 19.1 W/kg = 12.81 dBW/kg

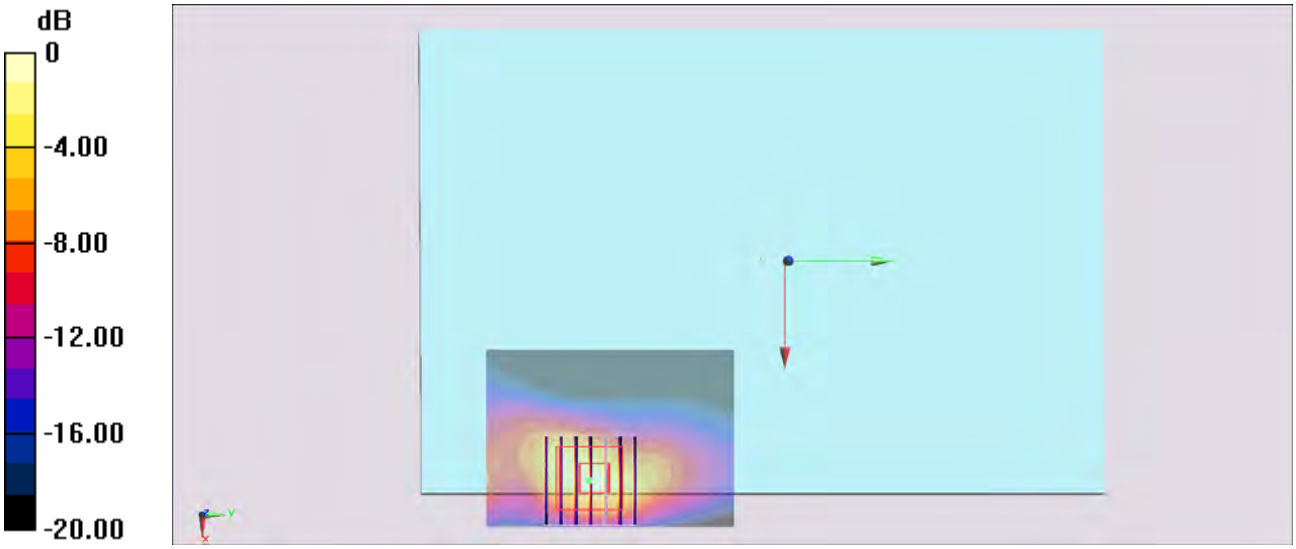
#01_WLAN2.4GHz_802.11n-HT20 MCS0_Bottom Face - Slant of Edge 1_0cm_Ch6;Ant 1

Communication System: 802.11n ; Frequency: 2437 MHz;Duty Cycle: 1:1.078
Medium: MSL_2450_140505 Medium parameters used: f = 2437 MHz; σ = 1.938 S/m; ε_r = 53.878; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: ES3DV3 - SN3270; ConvF(4.28, 4.28, 4.28); Calibrated: 2013/9/24;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2013/8/21
- Phantom: ELI 4.0_Front; Type: QDOVA001BB; Serial: 1026
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Ch6/Area Scan (51x71x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 1.36 W/kg

Configuration/Ch6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 28.640 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 2.77 W/kg
SAR(1 g) = 1.06 W/kg; SAR(10 g) = 0.409 W/kg
Maximum value of SAR (measured) = 1.50 W/kg



0 dB = 1.50 W/kg = 1.76 dBW/kg

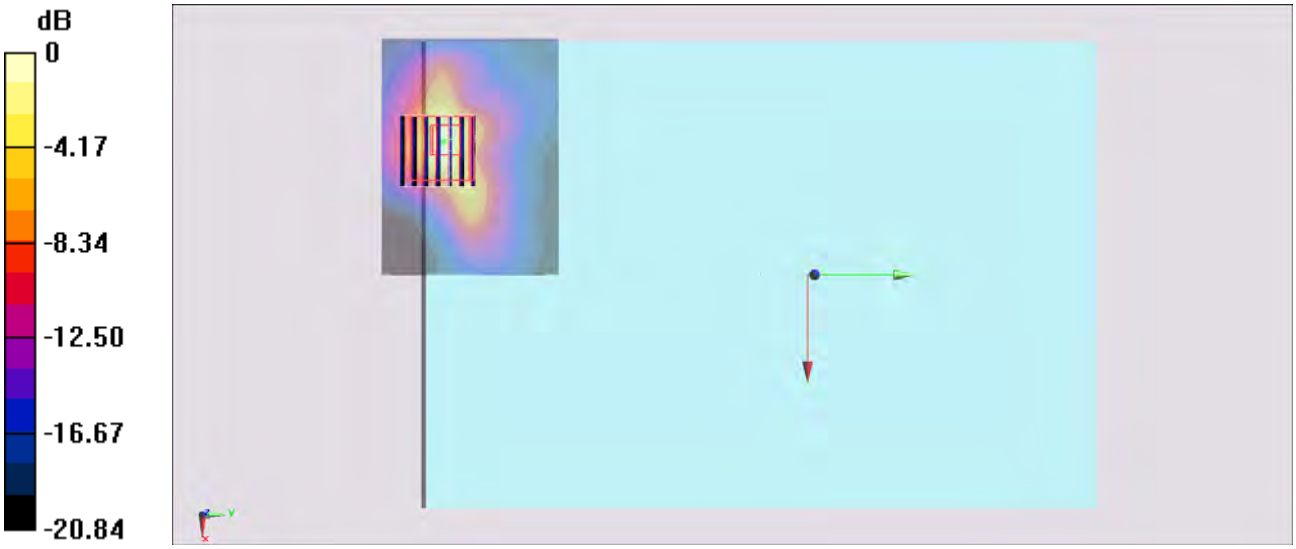
#02_WLAN5GHz_802.11n-HT40 MCS0_Bottom Face - Slant of Edge 4 _0cm_Ch46;Ant 2

Communication System: 802.11n ; Frequency: 5230 MHz;Duty Cycle: 1:1.153
Medium: MSL_5G_140507 Medium parameters used : f = 5230 MHz; σ = 5.324 S/m; ε_r = 48.489; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3954; ConvF(4.52, 4.52, 4.52); Calibrated: 2013/11/4;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2014/1/30
- Phantom: ELI 4.0_Front; Type: QDOVA001BB; Serial: 1026
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Ch46/Area Scan (81x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.98 W/kg

Configuration/Ch46/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 27.674 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 5.40 W/kg
SAR(1 g) = 1.27 W/kg; SAR(10 g) = 0.371 W/kg
Maximum value of SAR (measured) = 3.25 W/kg



0 dB = 3.25 W/kg = 5.12 dBW/kg

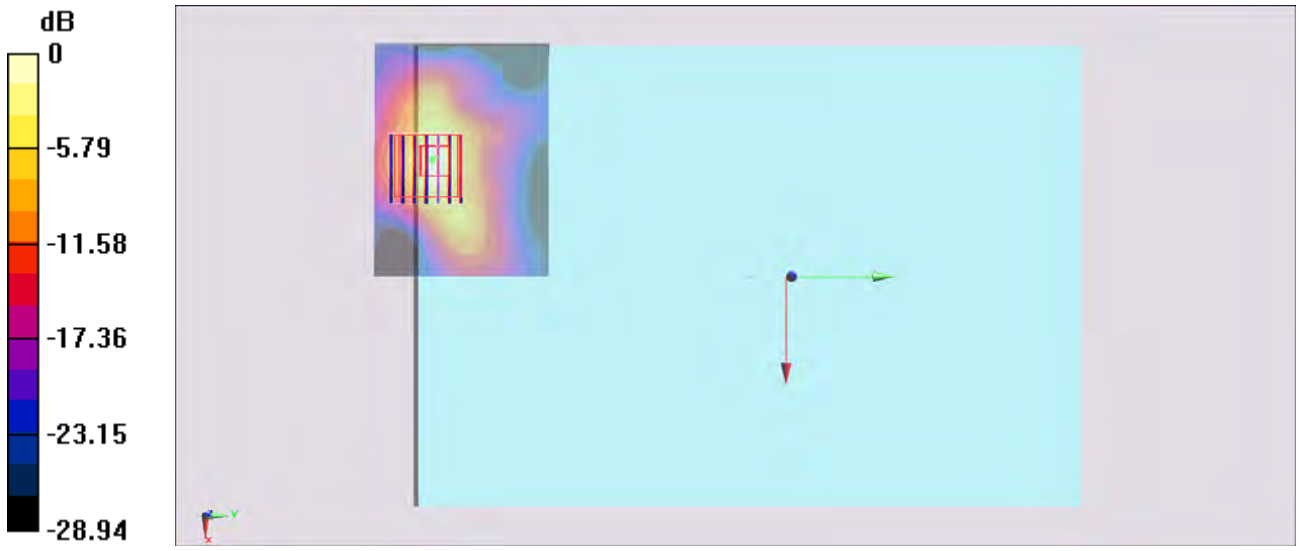
#03_WLAN5GHz_802.11a 6Mbps_Bottom Face - Slant of Edge4_0cm_Ch52;Ant 2

Communication System: 802.11a ; Frequency: 5260 MHz;Duty Cycle: 1:1.073
Medium: MSL_5G_140506 Medium parameters used : f = 5260 MHz; σ = 5.213 S/m; ε_r = 48.726; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃； Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3935; ConvF(4.18, 4.18, 4.18); Calibrated: 2013/11/4;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2013/11/5
- Phantom: ELI 4.0_Front; Type: QDOVA001BB; Serial: 1026
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Ch52/Area Scan (81x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 3.55 W/kg

Configuration/Ch52/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 29.266 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 4.97 W/kg
SAR(1 g) = 1.29 W/kg; SAR(10 g) = 0.335 W/kg
Maximum value of SAR (measured) = 3.23 W/kg



0 dB = 3.23 W/kg = 5.09 dBW/kg

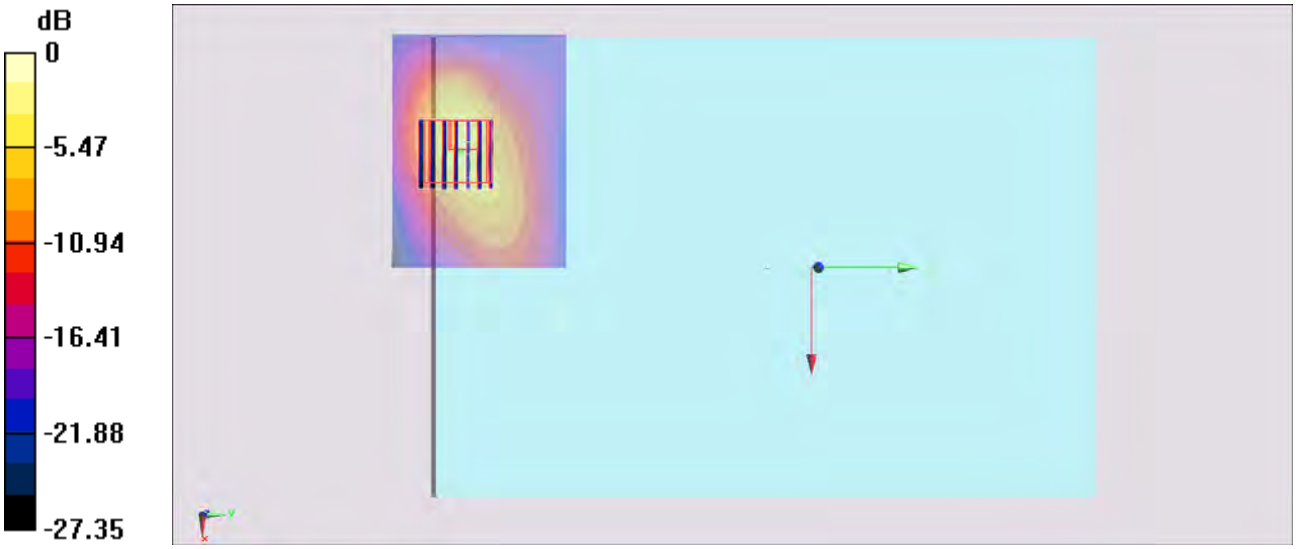
#04_WLAN5GHz_802.11n-HT40 MCS0_Bottom Face - Slant of Edge 4 _0cm_Ch142;Ant 2

Communication System: 802.11n ; Frequency: 5710 MHz;Duty Cycle: 1:1.153
Medium: MSL_5G_140507 Medium parameters used : f = 5710 MHz; σ = 6.008 S/m; ε_r = 47.424; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3954; ConvF(4.08, 4.08, 4.08); Calibrated: 2013/11/4;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2014/1/30
- Phantom: ELI 4.0_Front; Type: QDOVA001BB; Serial: 1026
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Ch142/Area Scan (81x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.58 W/kg

Configuration/Ch142/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 24.911 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 6.01 W/kg
SAR(1 g) = 1.25 W/kg; SAR(10 g) = 0.309 W/kg
Maximum value of SAR (measured) = 3.39 W/kg



0 dB = 3.39 W/kg = 5.30 dBW/kg

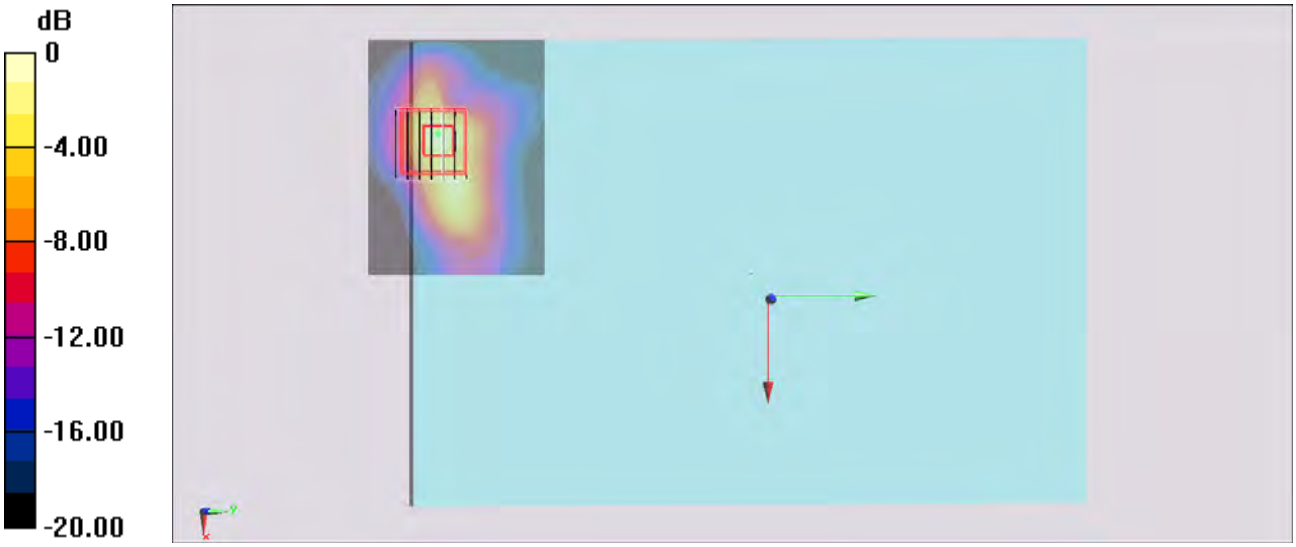
#05_WLAN5GHz_802.11a 6Mbps_Bottom Face - Slant of Edge4_0cm_Ch157;Ant 2

Communication System: 802.11a ; Frequency: 5785 MHz;Duty Cycle: 1:1.073
Medium: MSL_5G_140418 Medium parameters used : f = 5785 MHz; σ = 6.214 S/m; ε_r = 47.373; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3935; ConvF(4.09, 4.09, 4.09); Calibrated: 2013/11/4;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2013/11/5
- Phantom: ELI 4.0_Front; Type: QDOVA001BB; Serial: 1026
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Ch157/Area Scan (81x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.75 W/kg

Configuration/Ch157/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 26.380 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 6.02 W/kg
SAR(1 g) = 1.22 W/kg; SAR(10 g) = 0.340 W/kg
Maximum value of SAR (measured) = 3.56 W/kg



0 dB = 3.56 W/kg = 5.51 dBW/kg

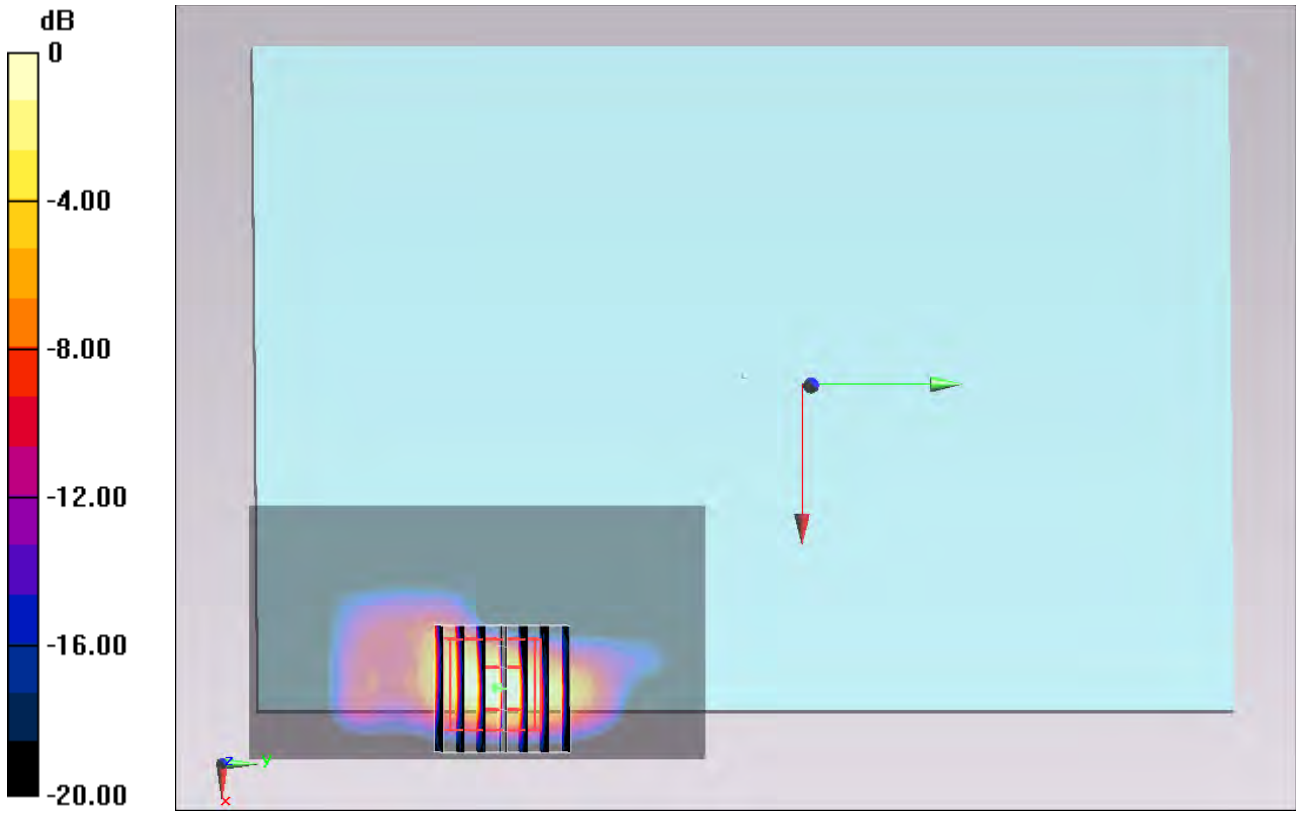
#06_Bluetooth_1Mbps_Bottom Face - Slant of Edge1_0cm_Ch0;Ant 1

Communication System: Bluetooth_DH5; Frequency: 2402 MHz;Duty Cycle: 1:1.2
Medium: MSL_2450_140724 Medium parameters used: f = 2402 MHz; σ = 1.927 S/m; ε_r = 53.891; ρ = 1000 kg/m^3
Ambient Temperature：23.6 ℃; Liquid Temperature：22.6 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3954; ConvF(7.34, 7.34, 7.34); Calibrated: 2013/11/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1425; Calibrated: 2014/3/3
- Phantom: ELI 4.0_Front; Type: QDOVA001BB; Serial: 1029
- Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Configuration/Ch0/Area Scan (51x91x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.132 W/kg

Configuration/Ch0/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.380 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.134 W/kg
SAR(1 g) = 0.064 W/kg; SAR(10 g) = 0.019 W/kg
Maximum value of SAR (measured) = 0.107 W/kg



0 dB = 0.107 W/kg = -9.71 dBW/kg

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **Sporton-TW (Auden)**

Certificate No: D2450V2-924_Nov13

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 924
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	November 13, 2013

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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-15
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 13, 2013

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

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

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%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.7 ± 6 %	1.84 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**52.4 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.08 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.2 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.1 ± 6 %	2.02 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.8 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**50.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.92 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.4 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.1 Ω + 2.6 jΩ
Return Loss	- 28.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.6 Ω + 4.3 jΩ
Return Loss	- 27.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.154 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 26, 2013

DASY5 Validation Report for Head TSL

Date: 13.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 924

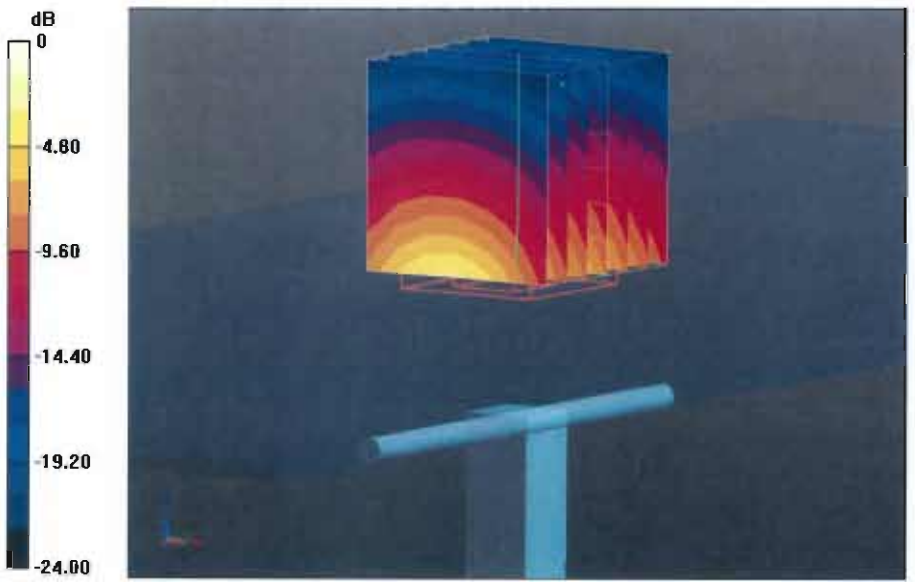
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.84 S/m; ε_r = 39.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

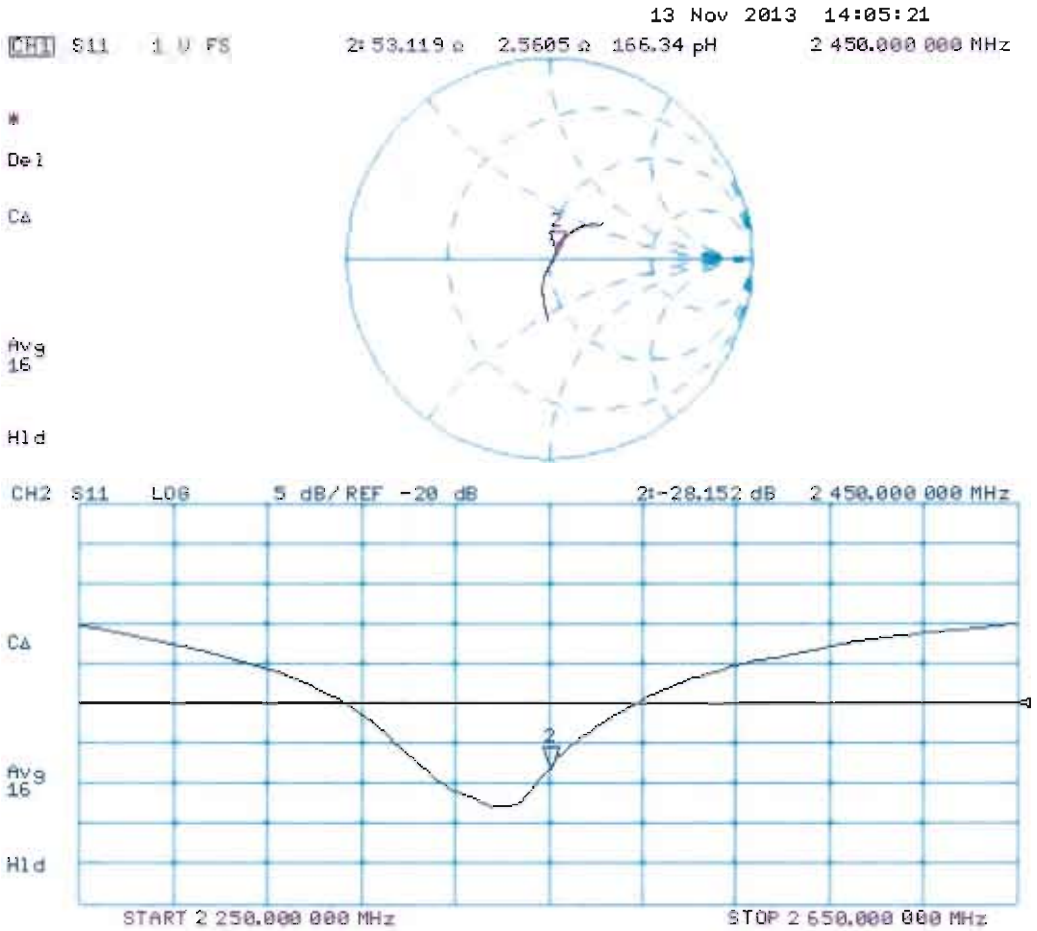
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 98.75 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 27.5 W/kg
SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.08 W/kg
Maximum value of SAR (measured) = 16.7 W/kg



0 dB = 16.7 W/kg = 12.23 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 13.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 924

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.02 S/m; ε_r = 52.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

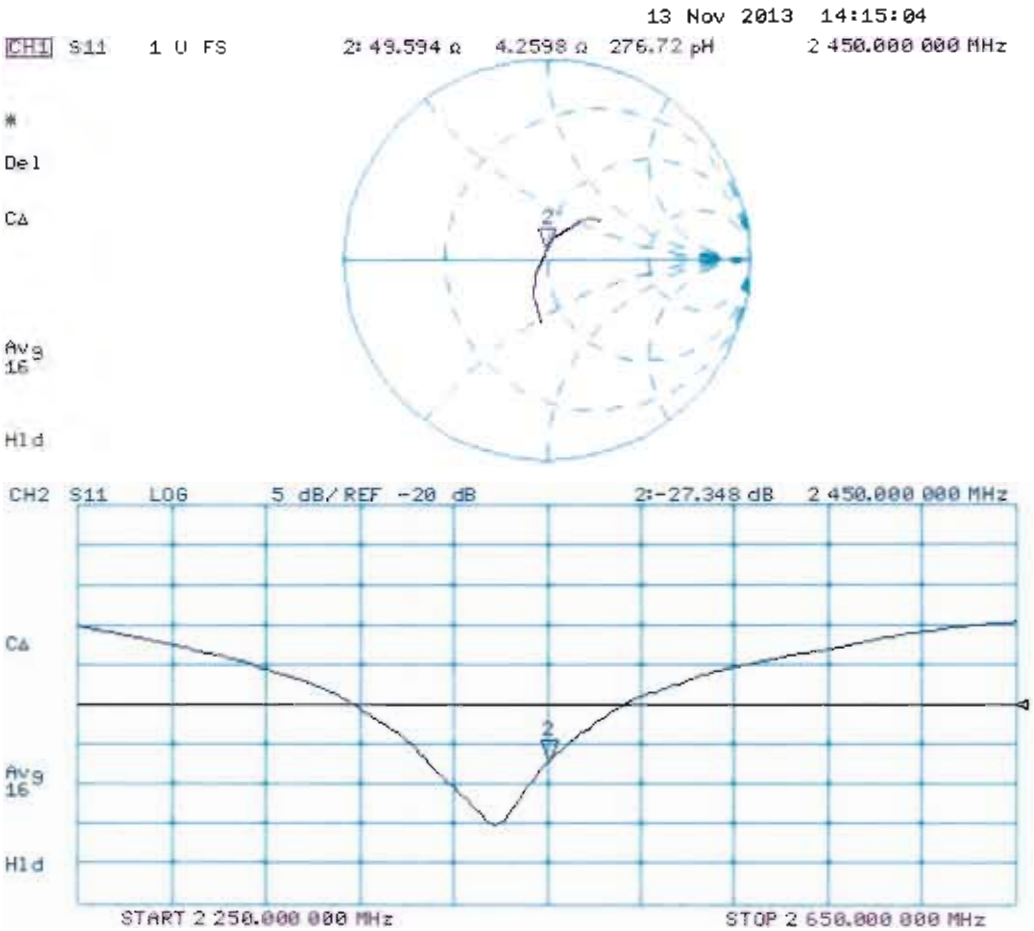
- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.726 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 26.8 W/kg
SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.92 W/kg
Maximum value of SAR (measured) = 16.8 W/kg

0 dB = 16.8 W/kg = 12.25 dBW/kg

Impedance Measurement Plot for Body TSL



Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
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S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **Sporton-TW (Auden)**

Certificate No: D5GHzV2-1128_Jul13

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN: 1128
Calibration procedure(s)	QA CAL-22.v2 Calibration procedure for dipole validation kits between 3-6 GHz
Calibration date:	July 24, 2013

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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe EX3DV4	SN: 3503	28-Dec-12 (No. EX3-3503_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 24, 2013

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

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010

b) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

c) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

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%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5300 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.2 ± 6 %	4.46 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.86 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**78.2 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.27 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.5 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.1 ± 6 %	4.55 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**80.6 W / kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.2 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.7 ± 6 %	4.85 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.10 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**80.5 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.1 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	5.05 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.78 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**77.2 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.1 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.9 ± 6 %	5.40 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.34 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**73.4 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.07 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.7 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.8 ± 6 %	5.55 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.49 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**74.3 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.11 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.9 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.2 ± 6 %	5.93 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.78 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**77.8 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.18 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.8 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.9 ± 6 %	6.21 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.22 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**72.2 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.02 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.2 W/kg ± 19.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	52.6 Ω - 5.0 jΩ
Return Loss	- 25.2 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	50.7 Ω - 1.6 jΩ
Return Loss	- 35.2 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	56.2 Ω + 1.6 jΩ
Return Loss	- 24.4 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	55.5 Ω + 1.2 jΩ
Return Loss	- 25.4 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	52.3 Ω - 2.5 jΩ
Return Loss	- 29.6 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	50.7 Ω + 0.0 jΩ
Return Loss	- 42.7 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	56.4 Ω + 4.1 jΩ
Return Loss	- 22.9 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	55.3 Ω + 2.8 jΩ
Return Loss	- 24.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.209 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 08, 2011

DASY5 Validation Report for Head TSL

Date: 23.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1128

Communication System: UID 0 - CW ; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 4.46 S/m; ε_r = 35.2; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 4.55 S/m; ε_r = 35.1; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 4.85 S/m; ε_r = 34.7; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 5.05 S/m; ε_r = 34.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

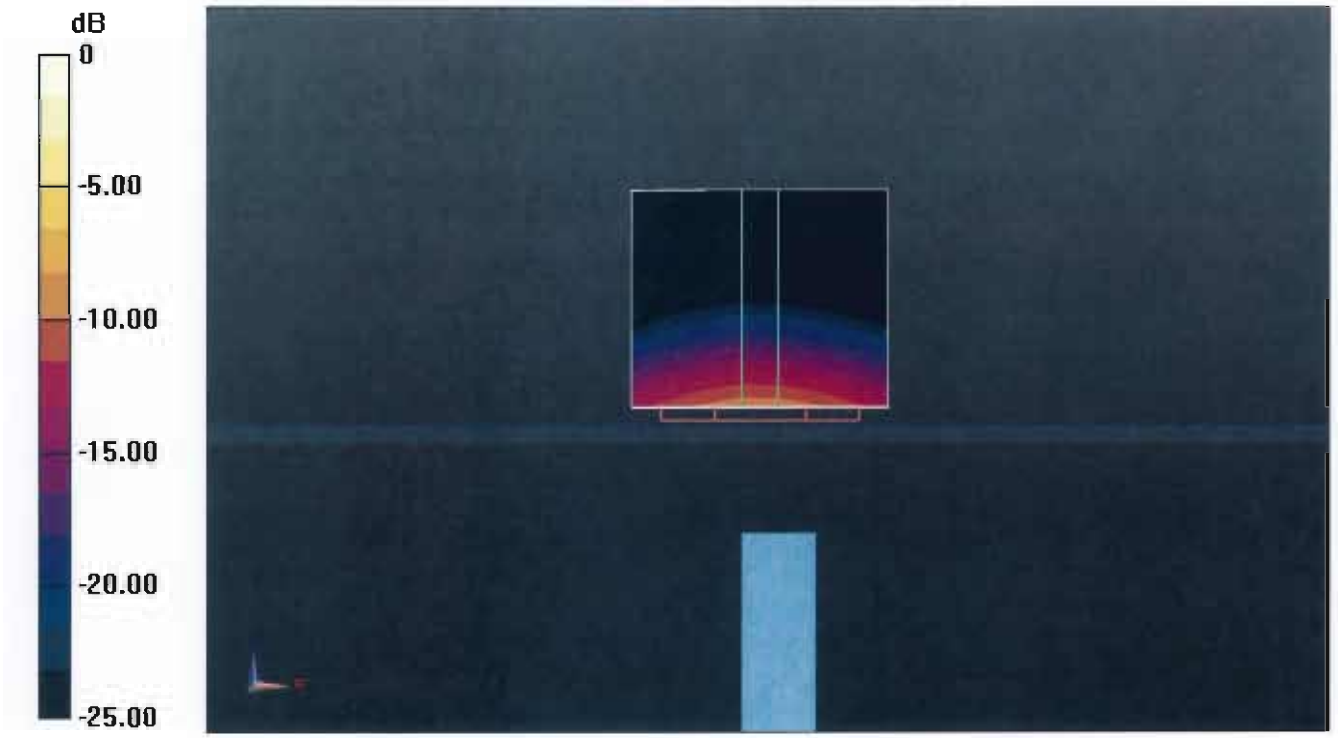
- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41); Calibrated: 28.12.2012, ConvF(5.1, 5.1, 5.1); Calibrated: 28.12.2012, ConvF(4.76, 4.76, 4.76); Calibrated: 28.12.2012, ConvF(4.81, 4.81, 4.81); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.593 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 28.2 W/kg
SAR(1 g) = 7.86 W/kg; SAR(10 g) = 2.27 W/kg
Maximum value of SAR (measured) = 17.6 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.984 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 29.9 W/kg
SAR(1 g) = 8.11 W/kg; SAR(10 g) = 2.34 W/kg
Maximum value of SAR (measured) = 18.2 W/kg

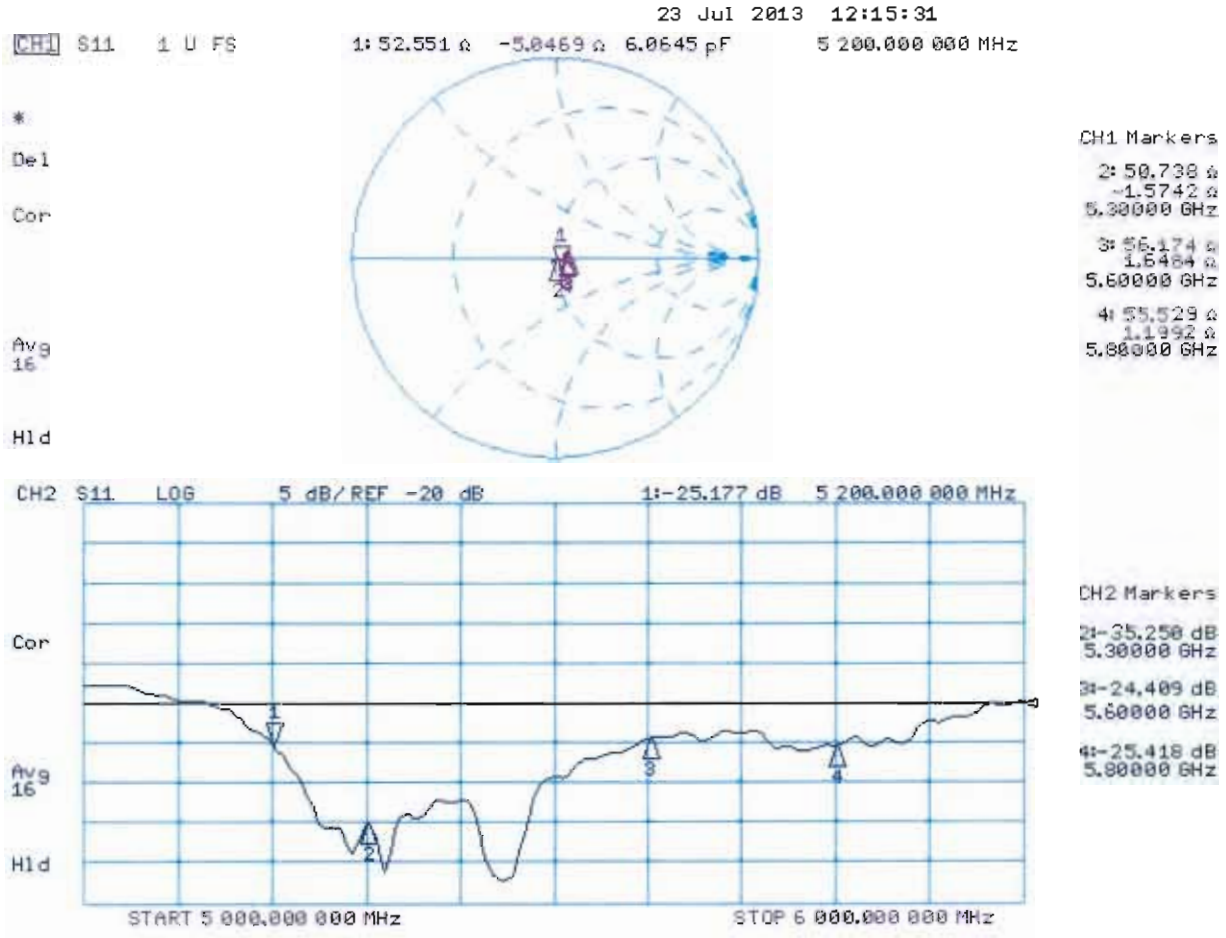
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 62.627 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 31.5 W/kg
SAR(1 g) = 8.1 W/kg; SAR(10 g) = 2.33 W/kg
Maximum value of SAR (measured) = 18.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 60.557 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 31.6 W/kg
SAR(1 g) = 7.78 W/kg; SAR(10 g) = 2.23 W/kg
Maximum value of SAR (measured) = 18.3 W/kg



0 dB = 18.3 W/kg = 12.62 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 24.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1128

Communication System: UID 0 - CW ; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 5.4 S/m; ε_r = 48.9; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 5.55 S/m; ε_r = 46.8; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 5.93 S/m; ε_r = 48.2; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 6.21 S/m; ε_r = 47.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

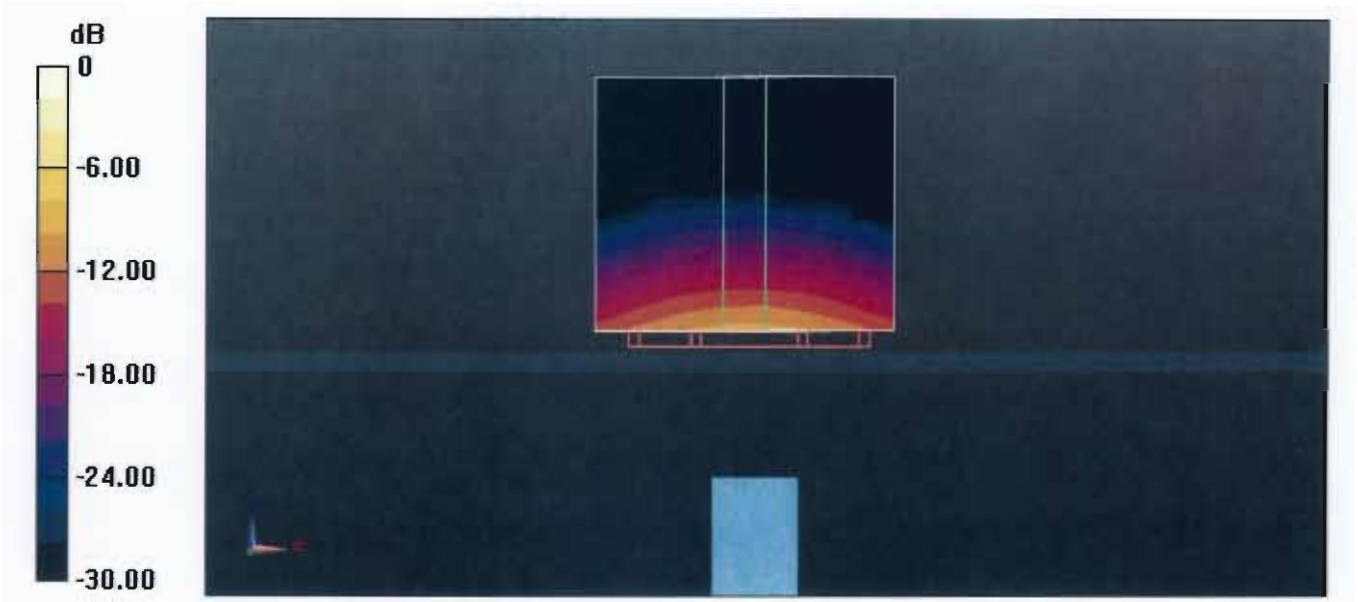
- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91); Calibrated: 28.12.2012, ConvF(4.67, 4.67, 4.67); Calibrated: 28.12.2012, ConvF(4.22, 4.22, 4.22); Calibrated: 28.12.2012, ConvF(4.38, 4.38, 4.38); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 57.643 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 28.4 W/kg
SAR(1 g) = 7.34 W/kg; SAR(10 g) = 2.07 W/kg
Maximum value of SAR (measured) = 16.6 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 57.535 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 29.9 W/kg
SAR(1 g) = 7.49 W/kg; SAR(10 g) = 2.11 W/kg
Maximum value of SAR (measured) = 17.2 W/kg

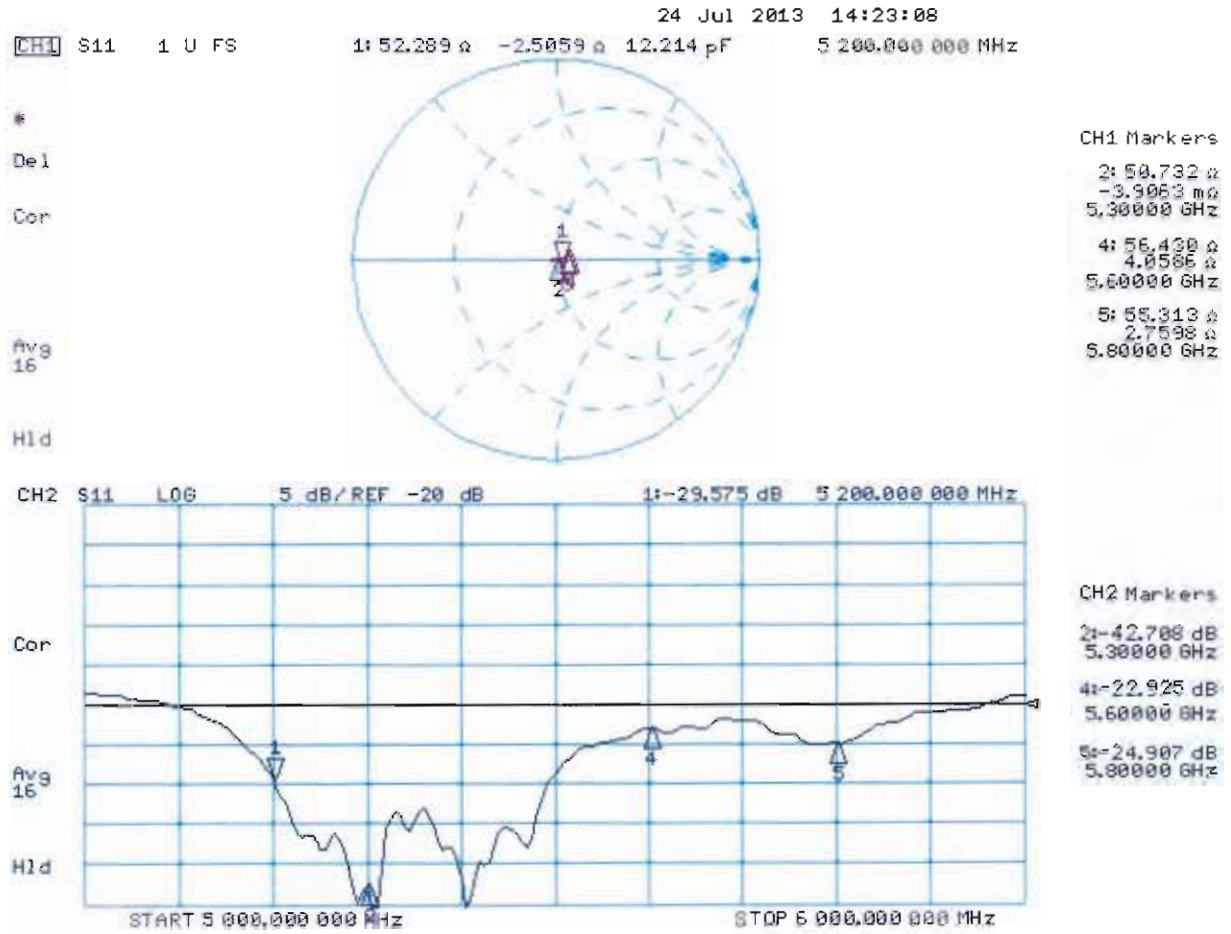
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 57.173 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 33.8 W/kg
SAR(1 g) = 7.78 W/kg; SAR(10 g) = 2.18 W/kg
Maximum value of SAR (measured) = 18.9 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 54.111 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 32.9 W/kg
SAR(1 g) = 7.22 W/kg; SAR(10 g) = 2.02 W/kg
Maximum value of SAR (measured) = 17.8 W/kg



0 dB = 17.8 W/kg = 12.50 dBW/kg

Impedance Measurement Plot for Body TSL



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IMPORTANT NOTICE

USAGE OF THE DAE 4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE4 unit is closed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:
Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:
Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:
To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **Sporton-TW (Auden)**

Certificate No: DAE4-778_Aug13

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BM - SN: 778
Calibration procedure(s)	QA CAL-06.v26 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	August 21, 2013

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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	02-Oct-12 (No:12728)	Oct-13
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-13 (in house check)	In house check: Jan-14
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-13 (in house check)	In house check: Jan-14

	Name	Function	Signature
Calibrated by:	R.Mayoraz	Technician	
Approved by:	Fin Bomholt	Deputy Technical Manager	

Issued: August 21, 2013

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

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range:	1LSB =	6.1μV ,	full range =	-100...+300 mV
Low Range:	1LSB =	61nV ,	full range =	-1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.656 ± 0.02% (k=2)	403.459 ± 0.02% (k=2)	405.006 ± 0.02% (k=2)
Low Range	3.98558 ± 1.50% (k=2)	3.96461 ± 1.50% (k=2)	3.99935 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	283.0 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199995.77	0.06	0.00
Channel X	+ Input	20002.53	2.55	0.01
Channel X	- Input	-19999.49	1.92	-0.01
Channel Y	+ Input	199997.44	1.64	0.00
Channel Y	+ Input	20001.15	1.28	0.01
Channel Y	- Input	-20001.01	0.48	-0.00
Channel Z	+ Input	199996.91	1.45	0.00
Channel Z	+ Input	19997.43	-2.47	-0.01
Channel Z	- Input	-20003.75	-2.20	0.01

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2000.81	0.69	0.03
Channel X	+ Input	201.01	0.45	0.23
Channel X	- Input	-198.36	0.93	-0.46
Channel Y	+ Input	2000.40	0.37	0.02
Channel Y	+ Input	199.54	-0.90	-0.45
Channel Y	- Input	-200.61	-1.22	0.61
Channel Z	+ Input	2000.36	0.26	0.01
Channel Z	+ Input	199.66	-0.86	-0.43
Channel Z	- Input	-200.42	-1.13	0.56

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-4.53	-5.58
	- 200	7.17	6.04
Channel Y	200	-1.81	-2.21
	- 200	-0.01	-0.08
Channel Z	200	-8.38	-9.43
	- 200	7.65	7.91

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	-1.57	-3.03
Channel Y	200	8.98	-	0.17
Channel Z	200	4.34	6.37	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	16059	17241
Channel Y	16174	15934
Channel Z	16438	15805

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.80	-0.20	1.81	0.38
Channel Y	-0.87	-2.38	0.78	0.61
Channel Z	-0.59	-1.80	0.66	0.51

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	–0.01	-8	-9

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IMPORTANT NOTICE

USAGE OF THE DAE 4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE4 unit is closed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:
Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:
Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:
To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **Sporton - TW (Auden)**

Certificate No: DAE4-1338_Nov13

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BM - SN: 1338
Calibration procedure(s)	QA CAL-06.v26 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	November 05, 2013

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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	01-Oct-13 (No:13976)	Oct-14
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-13 (in house check)	In house check: Jan-14
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-13 (in house check)	In house check: Jan-14

	Name	Function	Signature
Calibrated by:	Eric Hainfeld	Technician	
Approved by:	Fin Bomholt	Deputy Technical Manager	i.v.

Issued: November 5, 2013

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

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range:	1LSB =	6.1μV ,	full range =	-100...+300 mV
Low Range:	1LSB =	61nV ,	full range =	-1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	403.588 ± 0.02% (k=2)	404.163 ± 0.02% (k=2)	404.121 ± 0.02% (k=2)
Low Range	3.97535 ± 1.50% (k=2)	3.97840 ± 1.50% (k=2)	4.00168 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	61.5 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	199991.54	-2.49	-0.00
Channel X	+ Input	19998.72	-0.84	-0.00
Channel X	- Input	-20001.49	-0.25	0.00
Channel Y	+ Input	199992.13	-1.44	-0.00
Channel Y	+ Input	19998.12	-1.38	-0.01
Channel Y	- Input	-20002.84	-1.55	0.01
Channel Z	+ Input	199991.31	-2.03	-0.00
Channel Z	+ Input	19996.91	-2.55	-0.01
Channel Z	- Input	-20003.07	-1.77	0.01

Low Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	2001.08	1.13	0.06
Channel X	+ Input	200.79	0.33	0.16
Channel X	- Input	-199.30	0.27	-0.14
Channel Y	+ Input	2000.90	1.18	0.06
Channel Y	+ Input	199.73	-0.49	-0.25
Channel Y	- Input	-200.57	-0.83	0.41
Channel Z	+ Input	2000.53	0.81	0.04
Channel Z	+ Input	199.26	-1.03	-0.52
Channel Z	- Input	-201.38	-1.66	0.83

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (µV)	Low Range Average Reading (µV)
Channel X	200	7.85	6.28
	- 200	-4.77	-6.78
Channel Y	200	-21.63	-20.91
	- 200	19.72	19.81
Channel Z	200	-2.76	-2.99
	- 200	0.47	0.46

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (µV)	Channel Y (µV)	Channel Z (µV)
Channel X	200	-	3.56	-3.27
Channel Y	200	8.51	-	4.88
Channel Z	200	9.57	6.01	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	16248	15963
Channel Y	16289	16472
Channel Z	16098	16221

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	-0.93	-2.76	0.02	0.42
Channel Y	-1.27	-2.49	-0.40	0.43
Channel Z	-1.95	-3.07	-0.93	0.35

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	–0.01	-8	-9

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Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **Sporton-TW (Auden)**

Certificate No: DAE3-577_May14

CALIBRATION CERTIFICATE

Object	DAE3 - SD 000 D03 AA - SN: 577
Calibration procedure(s)	QA CAL-06.v26 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	May 15, 2014

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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	01-Oct-13 (No:13976)	Oct-14
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-14 (in house check)	In house check: Jan-15
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-14 (in house check)	In house check: Jan-15

	Name	Function	Signature
Calibrated by:	R.Mayoraz	Technician	
Approved by:	Fin Bomholt	Deputy Technical Manager	

Issued: May 15, 2014

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

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	403.502 ± 0.02% (k=2)	403.489 ± 0.02% (k=2)	403.794 ± 0.02% (k=2)
Low Range	3.91202 ± 1.50% (k=2)	3.94891 ± 1.50% (k=2)	3.96437 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	153.0 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	200035.63	-1.10	-0.00
Channel X	+ Input	20009.01	4.84	0.02
Channel X	- Input	-20000.99	4.76	-0.02
Channel Y	+ Input	200033.80	-2.27	-0.00
Channel Y	+ Input	20006.18	2.29	0.01
Channel Y	- Input	-20005.70	0.26	-0.00
Channel Z	+ Input	200034.44	-1.76	-0.00
Channel Z	+ Input	20005.23	1.27	0.01
Channel Z	- Input	-20006.26	-0.42	0.00

Low Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	2000.47	-0.05	-0.00
Channel X	+ Input	201.41	0.81	0.40
Channel X	- Input	-198.53	0.84	-0.42
Channel Y	+ Input	2000.24	0.05	0.00
Channel Y	+ Input	199.82	-0.43	-0.21
Channel Y	- Input	-200.38	-0.69	0.35
Channel Z	+ Input	2000.38	0.17	0.01
Channel Z	+ Input	199.82	-0.57	-0.28
Channel Z	- Input	-201.02	-1.42	0.71

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (µV)	Low Range Average Reading (µV)
Channel X	200	-2.31	-3.84
	- 200	5.81	3.87
Channel Y	200	-13.72	-14.00
	- 200	13.80	13.60
Channel Z	200	2.26	2.69
	- 200	-5.76	-5.45

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (µV)	Channel Y (µV)	Channel Z (µV)
Channel X	200	-	0.10	-2.92
Channel Y	200	9.53	-	1.00
Channel Z	200	6.85	6.81	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	16132	15549
Channel Y	16099	15687
Channel Z	16128	12672

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.10	-0.80	1.33	0.38
Channel Y	0.41	-0.69	1.64	0.51
Channel Z	0.49	-0.71	1.43	0.44

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	–0.01	-8	-9

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The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **Sporton (Auden)**

Certificate No: DAE4-1279_Jan14

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BM - SN: 1279
Calibration procedure(s)	QA CAL-06.v26 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	January 30, 2014

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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	01-Oct-13 (No:13976)	Oct-14
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-14 (in house check)	In house check: Jan-15
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-14 (in house check)	In house check: Jan-15

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Technician	
Approved by:	Fin Bomholt	Deputy Technical Manager	i.V. B. Blumer

Issued: January 30, 2014

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

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range:	1LSB =	6.1μV ,	full range =	-100...+300 mV
Low Range:	1LSB =	61nV ,	full range =	-1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	405.178 ± 0.02% (k=2)	404.973 ± 0.02% (k=2)	404.309 ± 0.02% (k=2)
Low Range	3.96880 ± 1.50% (k=2)	3.97235 ± 1.50% (k=2)	3.99752 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	334.0 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	200028.82	-4.52	-0.00
Channel X	+ Input	20005.82	2.76	0.01
Channel X	- Input	-20004.34	1.52	-0.01
Channel Y	+ Input	200032.35	-1.27	-0.00
Channel Y	+ Input	20004.35	1.40	0.01
Channel Y	- Input	-20006.83	-0.81	0.00
Channel Z	+ Input	200030.61	-3.01	-0.00
Channel Z	+ Input	20002.53	-0.55	-0.00
Channel Z	- Input	-20006.90	-0.91	0.00

Low Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	2000.24	0.47	0.02
Channel X	+ Input	200.68	0.67	0.33
Channel X	- Input	-198.71	1.35	-0.68
Channel Y	+ Input	2001.36	1.65	0.08
Channel Y	+ Input	198.60	-1.29	-0.65
Channel Y	- Input	-200.40	-0.15	0.08
Channel Z	+ Input	1999.81	0.15	0.01
Channel Z	+ Input	199.07	-0.84	-0.42
Channel Z	- Input	-201.20	-0.91	0.46

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (µV)	Low Range Average Reading (µV)
Channel X	200	18.49	17.11
	- 200	-15.07	-16.64
Channel Y	200	9.07	8.72
	- 200	-8.43	-9.57
Channel Z	200	-1.18	-1.55
	- 200	-1.04	-0.85

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (µV)	Channel Y (µV)	Channel Z (µV)
Channel X	200	-	2.78	-3.39
Channel Y	200	8.58	-	4.01
Channel Z	200	10.19	6.19	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15685	15484
Channel Y	16475	15992
Channel Z	15949	16054

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	2.95	0.79	4.24	0.59
Channel Y	-1.35	-3.08	0.56	0.73
Channel Z	1.85	0.28	3.67	0.61

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	–0.01	-8	-9

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IMPORTANT NOTICE

USAGE OF THE DAE 4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE4 unit is closed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:
Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:
Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:
To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Demen SH (Auden)**

Certificate No: **DAE4-1425_Mar14**

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BM - SN: 1425
Calibration procedure(s)	QA CAL-06.v26 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	March 03, 2014

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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	01-Oct-13 (No:13976)	Oct-14
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto OAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-14 (in house check)	In house check: Jan-15
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-14 (in house check)	In house check: Jan-15

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Technician	
Approved by:	Fin Bomholt	Deputy Technical Manager	i.V.

Issued: March 3, 2014

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

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	403.670 ± 0.02% (k=2)	404.488 ± 0.02% (k=2)	404.243 ± 0.02% (k=2)
Low Range	3.95785 ± 1.50% (k=2)	4.00029 ± 1.50% (k=2)	3.95364 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	263.5 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	200042.53	7.26	0.00
Channel X	+ Input	20003.35	0.38	0.00
Channel X	- Input	-20005.96	0.62	-0.00
Channel Y	+ Input	200038.34	3.10	0.00
Channel Y	+ Input	20003.01	0.12	0.00
Channel Y	- Input	-20008.09	-1.33	0.01
Channel Z	+ Input	200044.03	8.42	0.00
Channel Z	+ Input	20002.03	-0.98	-0.00
Channel Z	- Input	-20009.19	-2.51	0.01

Low Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	1999.88	-0.03	-0.00
Channel X	+ Input	200.42	0.52	0.26
Channel X	- Input	-199.41	0.53	-0.26
Channel Y	+ Input	2000.10	0.38	0.02
Channel Y	+ Input	199.46	-0.33	-0.16
Channel Y	- Input	-200.67	-0.51	0.25
Channel Z	+ Input	1999.76	-0.07	-0.00
Channel Z	+ Input	198.26	-1.61	-0.80
Channel Z	- Input	-201.78	-1.70	0.85

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (µV)	Low Range Average Reading (µV)
Channel X	200	-20.64	-22.11
	- 200	24.13	22.76
Channel Y	200	-6.41	-6.15
	- 200	4.65	5.03
Channel Z	200	-4.87	-5.20
	- 200	2.47	2.37

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (µV)	Channel Y (µV)	Channel Z (µV)
Channel X	200	-	0.20	-3.93
Channel Y	200	6.85	-	0.72
Channel Z	200	9.69	4.55	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	16258	16314
Channel Y	16164	16198
Channel Z	15935	15638

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.08	-1.51	1.02	0.38
Channel Y	0.20	-0.81	0.95	0.36
Channel Z	-0.54	-1.67	0.43	0.39

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	–0.01	-8	-9

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S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **Sporton-TW (Auden)**

Certificate No: ES3-3270_Sep13

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3270
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	September 24, 2013

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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	4-Sep-13 (No. DAE4-660_Sep13)	Apr-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	Israe El-Naouq
Approved by:	Katja Pokovic	Technical Manager	

Issued: September 26, 2013

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Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV3

SN:3270

Manufactured: February 25, 2010
Calibrated: September 24, 2013

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3270

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.11	1.20	1.22	± 10.1 %
DCP (mV)[B]	99.9	102.5	100.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	194.6	±2.7 %
		Y	0.0	0.0	1.0		153.1	
		Z	0.0	0.0	1.0		149.9	

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%.

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3270

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
835	41.5	0.90	6.18	6.18	6.18	0.40	1.59	± 12.0 %
900	41.5	0.97	6.06	6.06	6.06	0.80	1.10	± 12.0 %
1750	40.1	1.37	5.26	5.26	5.26	0.80	1.09	± 12.0 %
1900	40.0	1.40	5.08	5.08	5.08	0.58	1.37	± 12.0 %
2000	40.0	1.40	5.06	5.06	5.06	0.59	1.35	± 12.0 %
2450	39.2	1.80	4.53	4.53	4.53	0.80	1.26	± 12.0 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) 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 (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

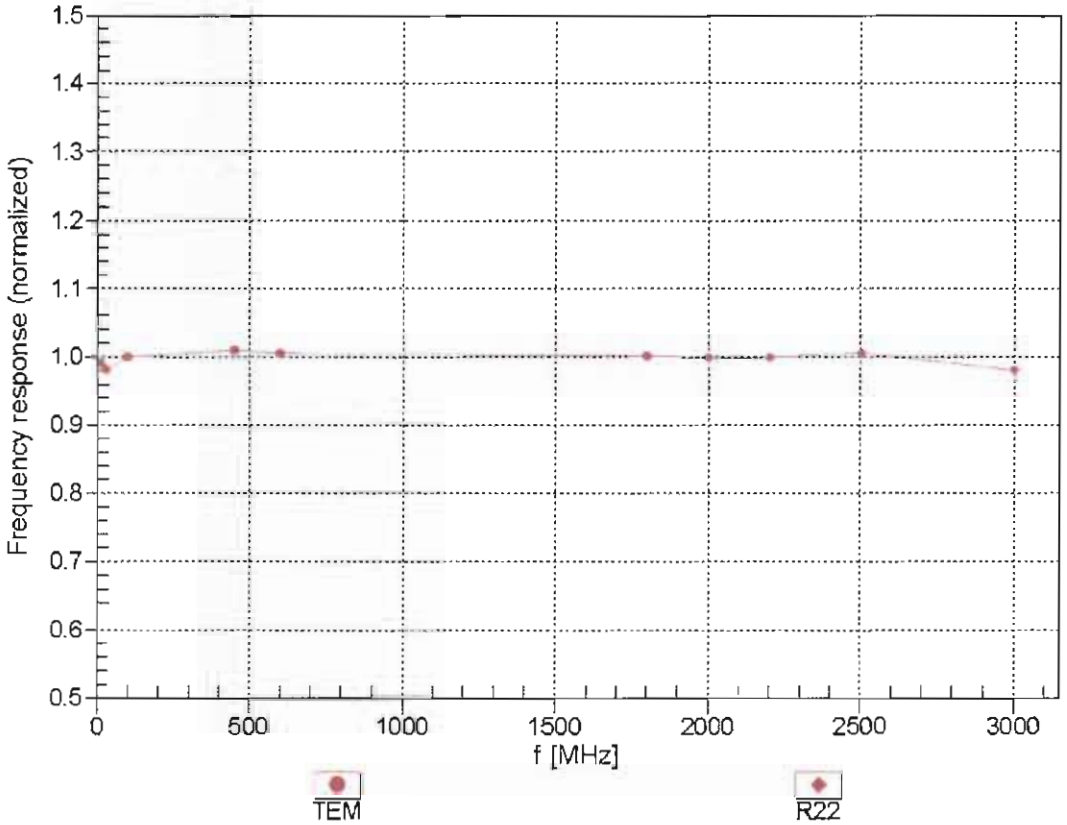
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3270

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
835	55.2	0.97	6.08	6.08	6.08	0.57	1.38	± 12.0 %
900	55.0	1.05	5.98	5.98	5.98	0.80	1.14	± 12.0 %
1750	53.4	1.49	4.91	4.91	4.91	0.55	1.50	± 12.0 %
1900	53.3	1.52	4.71	4.71	4.71	0.57	1.50	± 12.0 %
2000	53.3	1.52	4.78	4.78	4.78	0.60	1.46	± 12.0 %
2450	52.7	1.95	4.28	4.28	4.28	0.80	1.09	± 12.0 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) 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 (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

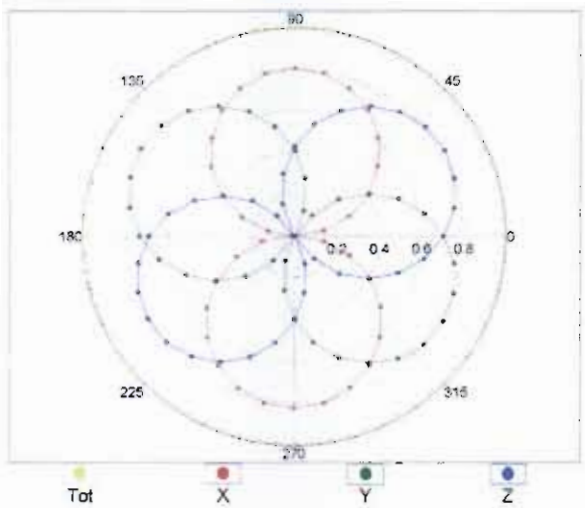
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



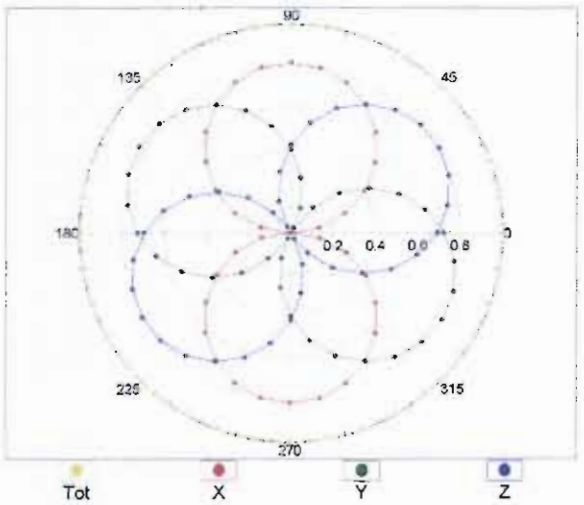
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

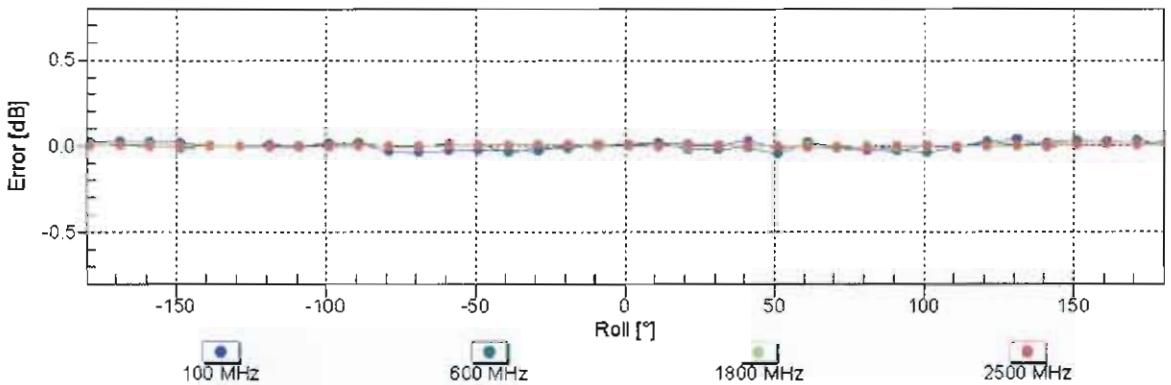
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



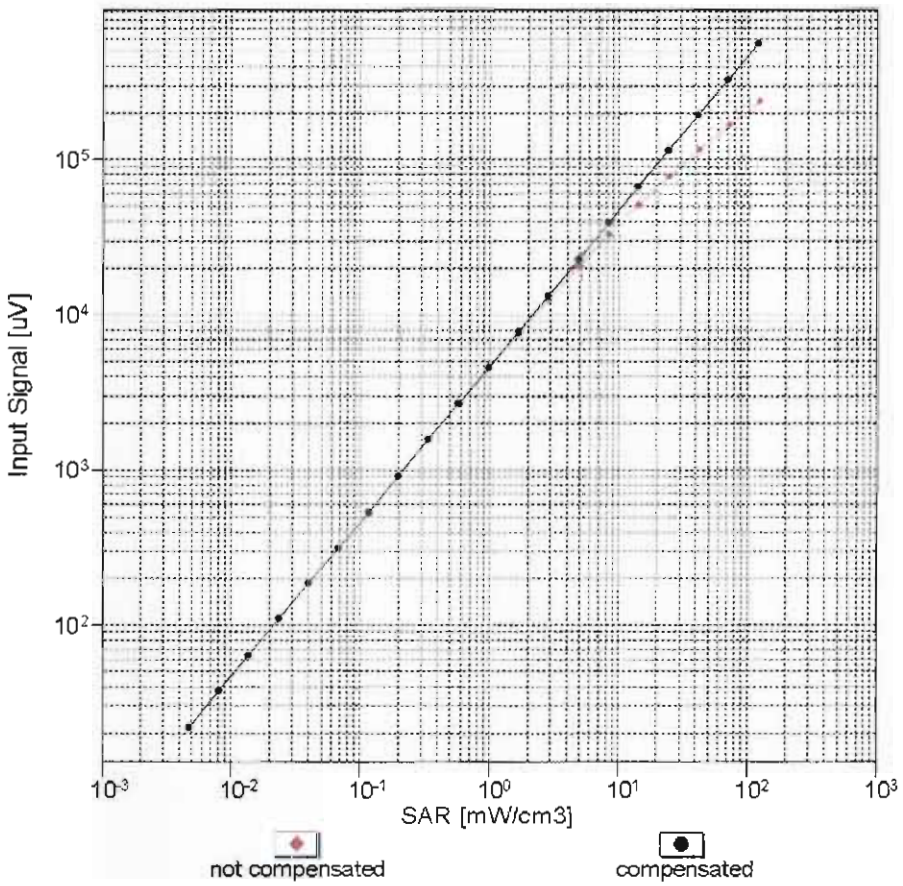
f=1800 MHz,R22

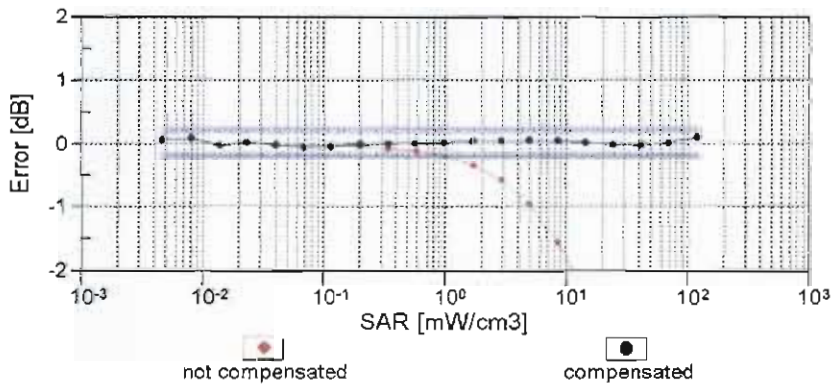




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR$_{head}$)
(TEM cell , f = 900 MHz)

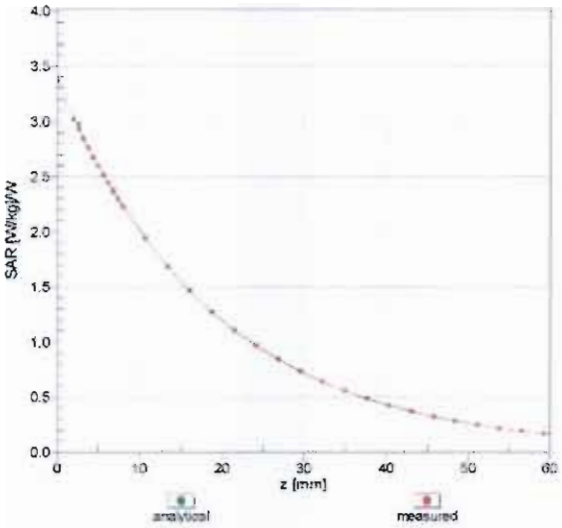




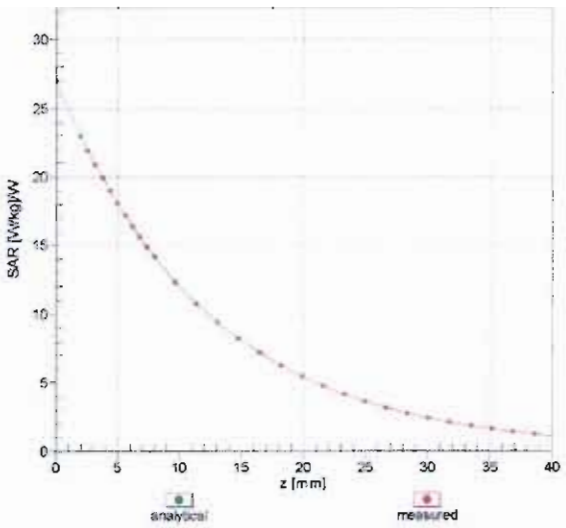
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

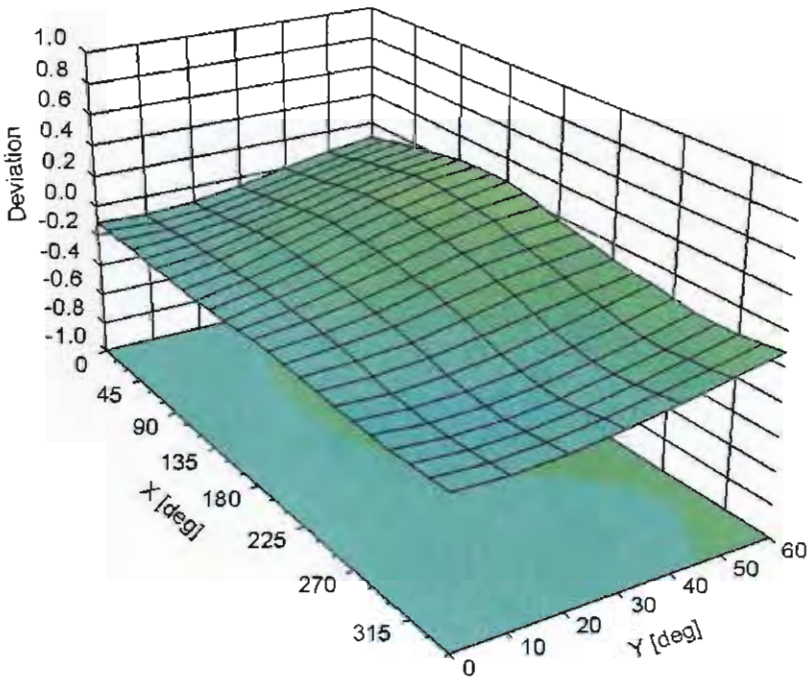


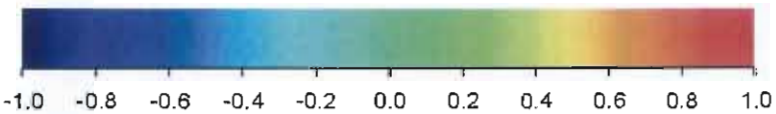
f = 1750 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3270

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-18.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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Accreditation No.: SCS 108

Client **Sporton-TW (Auden)**

Certificate No: EX3-3935_Nov13

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3935
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	November 4, 2013

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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	4-Sep-13 (No. DAE4-660_Sep13)	Sep-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 4, 2013

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

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe EX3DV4

SN:3935

Manufactured: July 24, 2013
Calibrated: November 4, 2013

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3935

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.50	0.54	0.49	± 10.1 %
DCP (mV)[B]	103.3	98.8	100.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	167.0	±2.7 %
		Y	0.0	0.0	1.0		172.1	
		Z	0.0	0.0	1.0		171.9	

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%.

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3935

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
835	41.5	0.90	10.11	10.11	10.11	0.34	0.96	± 12.0 %
900	41.5	0.97	9.98	9.98	9.98	0.39	0.85	± 12.0 %
1750	40.1	1.37	8.54	8.54	8.54	0.78	0.62	± 12.0 %
1900	40.0	1.40	8.27	8.27	8.27	0.62	0.72	± 12.0 %
2000	40.0	1.40	8.25	8.25	8.25	0.42	0.83	± 12.0 %
2300	39.5	1.67	7.81	7.81	7.81	0.40	0.81	± 12.0 %
2450	39.2	1.80	7.43	7.43	7.43	0.62	0.63	± 12.0 %
2600	39.0	1.96	7.27	7.27	7.27	0.37	0.85	± 12.0 %
3500	37.9	2.91	6.99	6.99	6.99	0.41	1.00	± 13.1 %
5200	36.0	4.66	5.29	5.29	5.29	0.30	1.80	± 13.1 %
5300	35.9	4.76	5.03	5.03	5.03	0.30	1.80	± 13.1 %
5500	35.6	4.96	4.90	4.90	4.90	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.62	4.62	4.62	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.52	4.52	4.52	0.40	1.80	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) 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 (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] 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 frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3935

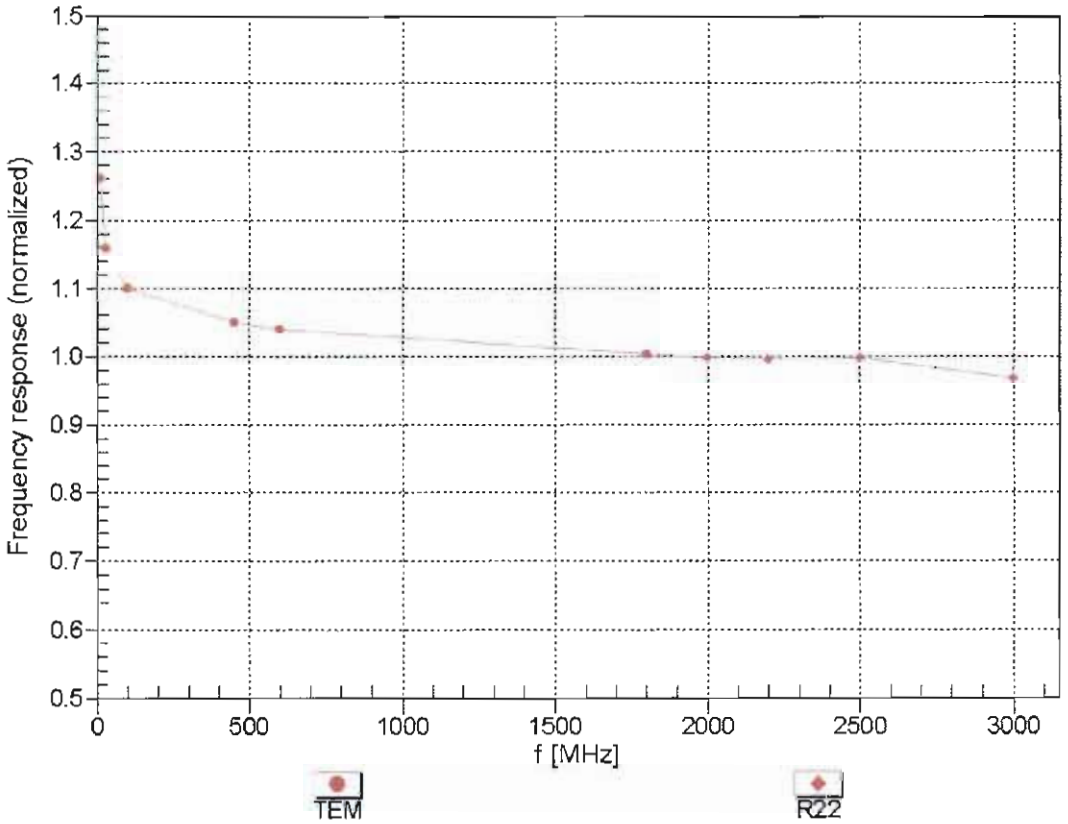
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
835	55.2	0.97	10.09	10.09	10.09	0.38	0.89	± 12.0 %
900	55.0	1.05	9.86	9.86	9.86	0.43	0.87	± 12.0 %
1750	53.4	1.49	8.30	8.30	8.30	0.76	0.62	± 12.0 %
1900	53.3	1.52	7.85	7.85	7.85	0.58	0.68	± 12.0 %
2000	53.3	1.52	7.95	7.95	7.95	0.51	0.71	± 12.0 %
2300	52.9	1.81	7.62	7.62	7.62	0.62	0.68	± 12.0 %
2450	52.7	1.95	7.32	7.32	7.32	0.78	0.59	± 12.0 %
2600	52.5	2.16	7.08	7.08	7.08	0.80	0.50	± 12.0 %
3500	51.3	3.31	6.78	6.78	6.78	0.30	1.35	± 13.1 %
5200	49.0	5.30	4.61	4.61	4.61	0.40	1.90	± 13.1 %
5300	48.9	5.42	4.18	4.18	4.18	0.50	1.90	± 13.1 %
5500	48.6	5.65	3.83	3.83	3.83	0.55	1.90	± 13.1 %
5600	48.5	5.77	3.69	3.69	3.69	0.55	1.90	± 13.1 %
5800	48.2	6.00	4.09	4.09	4.09	0.50	1.90	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) 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 (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] 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 frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

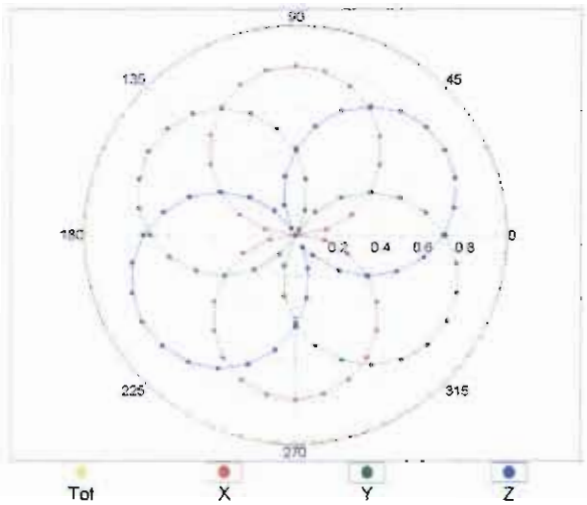
(TEM-Cell:ifi110 EXX, Waveguide: R22)



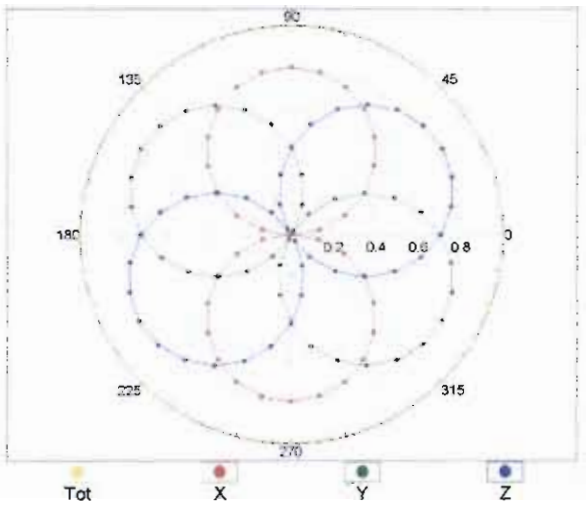
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

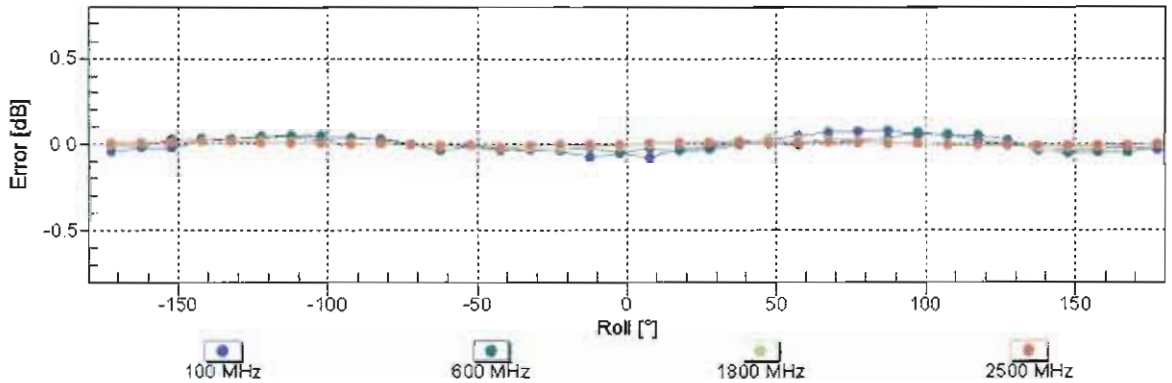
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



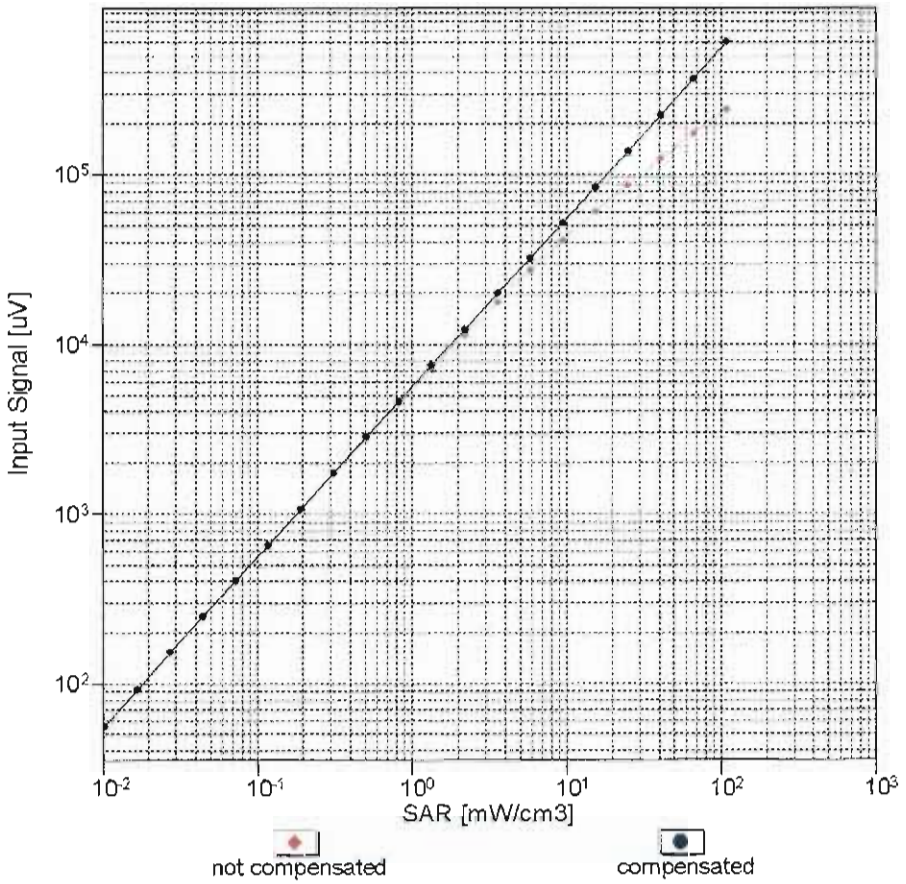
f=1800 MHz,R22

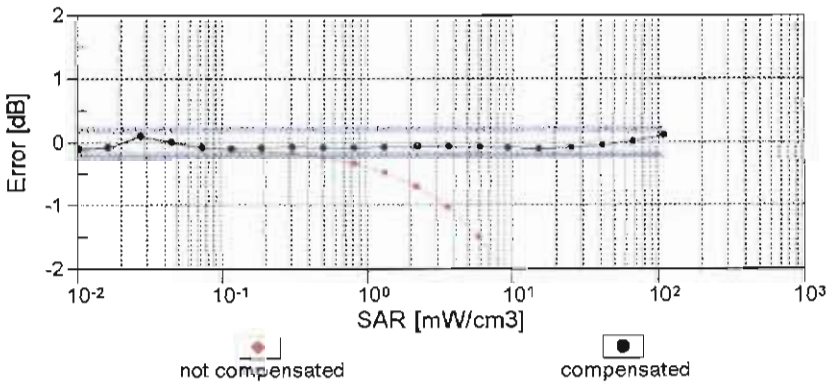




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

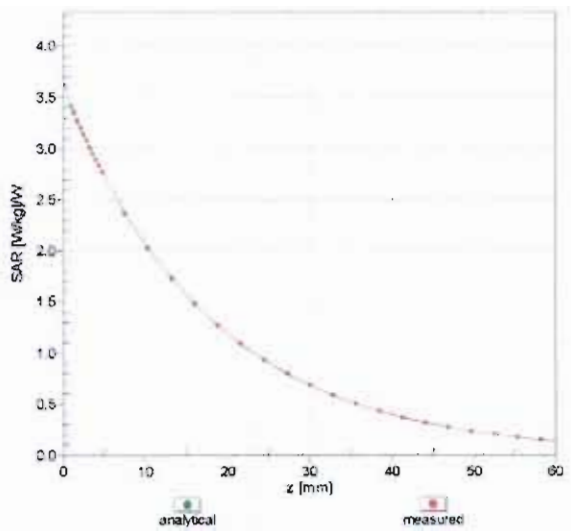




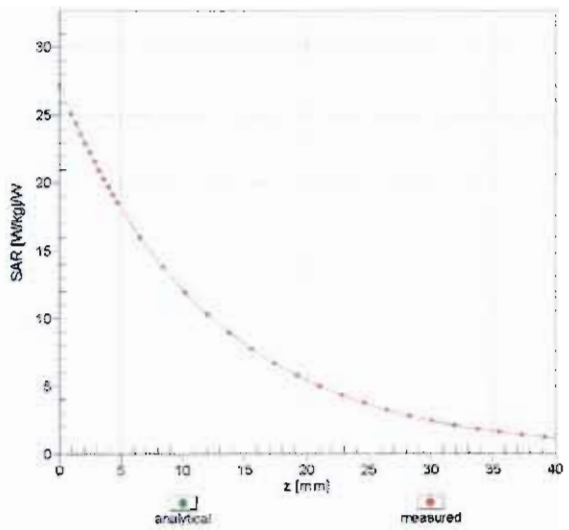
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

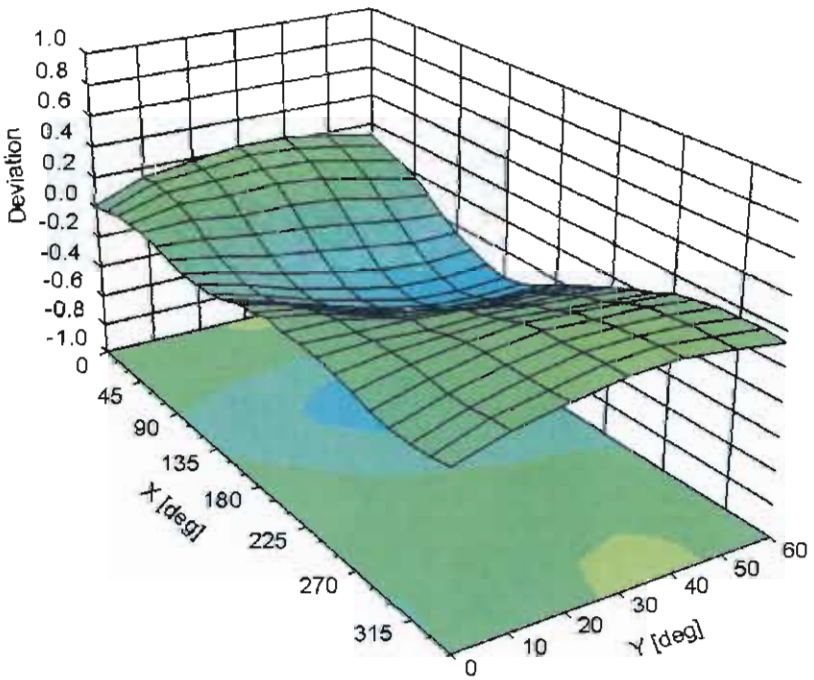


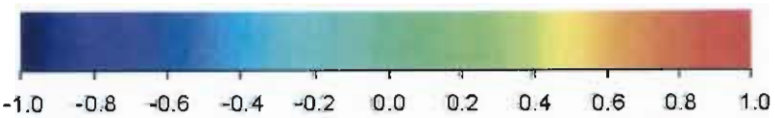
f = 1750 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3935

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-142.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Sporton-TW (Auden)**

Certificate No: **EX3-3931_Sep13**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3931
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	September 10, 2013

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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	4-Sep-13 (No. DAE4-660_Sep13)	Apr-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: September 10, 2013

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

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003

b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z*: Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z*: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR*: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters*: Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe EX3DV4

SN:3931

Manufactured: July 24, 2013
Calibrated: September 10, 2013

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3931

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.42	0.58	0.50	± 10.1 %
DCP (mV)[B]	102.4	97.7	100.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	146.7	±2.5 %
		Y	0.0	0.0	1.0		133.5	
		Z	0.0	0.0	1.0		120.4	

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%.

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3931

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
835	41.5	0.90	9.87	9.87	9.87	0.18	1.43	± 12.0 %
900	41.5	0.97	9.59	9.59	9.59	0.18	1.46	± 12.0 %
1750	40.1	1.37	8.82	8.82	8.82	0.30	0.99	± 12.0 %
1900	40.0	1.40	8.40	8.40	8.40	0.59	0.69	± 12.0 %
2000	40.0	1.40	8.41	8.41	8.41	0.46	0.78	± 12.0 %
2450	39.2	1.80	7.59	7.59	7.59	0.35	0.91	± 12.0 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) 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 (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

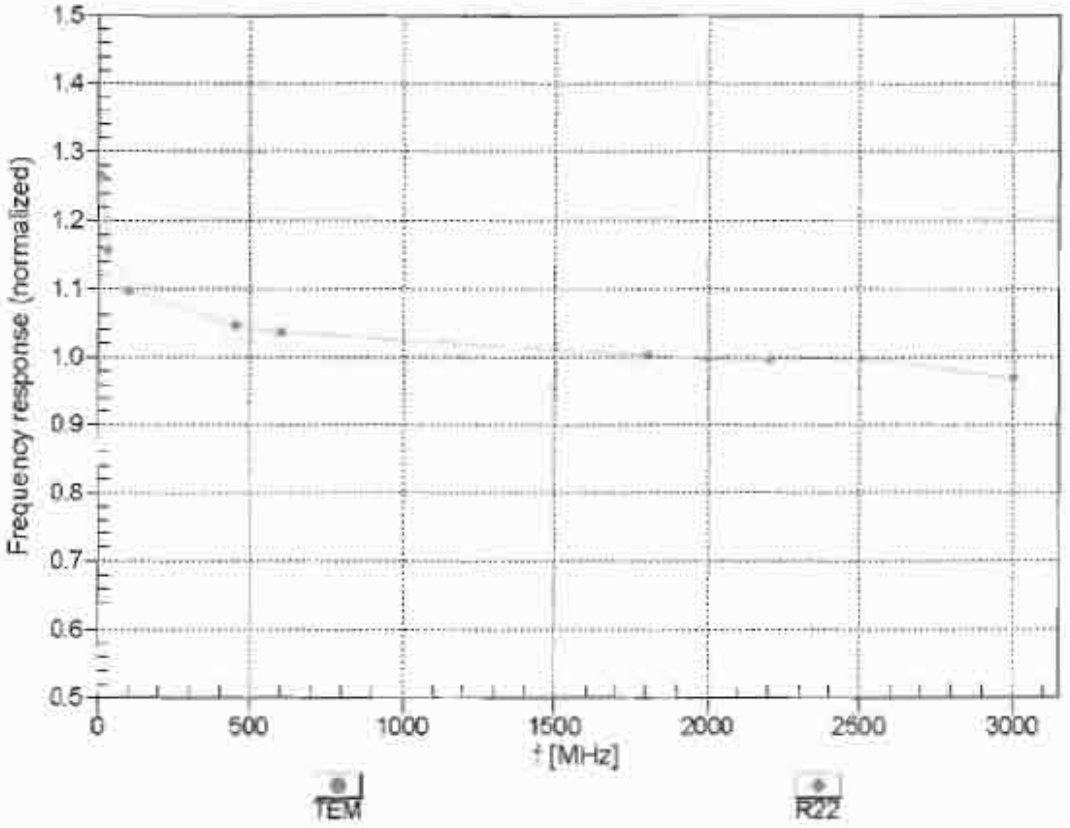
DASY/EASY - Parameters of Probe: EX3DV4 - SN:3931

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
835	55.2	0.97	9.66	9.66	9.66	0.32	0.99	± 12.0 %
900	55.0	1.05	9.35	9.35	9.35	0.22	1.40	± 12.0 %
1750	53.4	1.49	7.99	7.99	7.99	0.46	0.78	± 12.0 %
1900	53.3	1.52	7.61	7.61	7.61	0.44	0.84	± 12.0 %
2000	53.3	1.52	7.83	7.83	7.83	0.38	0.87	± 12.0 %
2450	52.7	1.95	7.24	7.24	7.24	0.75	0.57	± 12.0 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) 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 (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

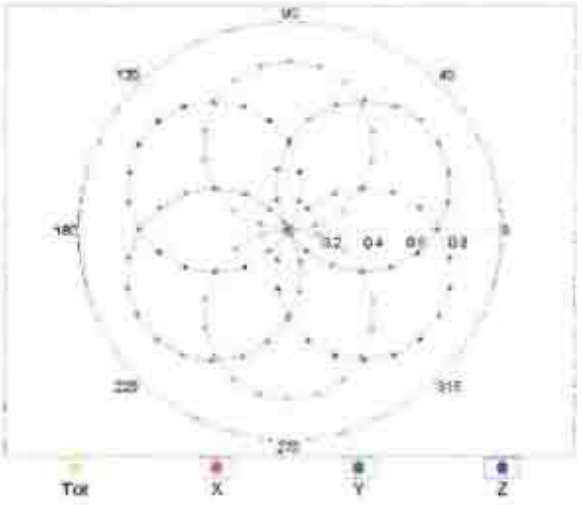


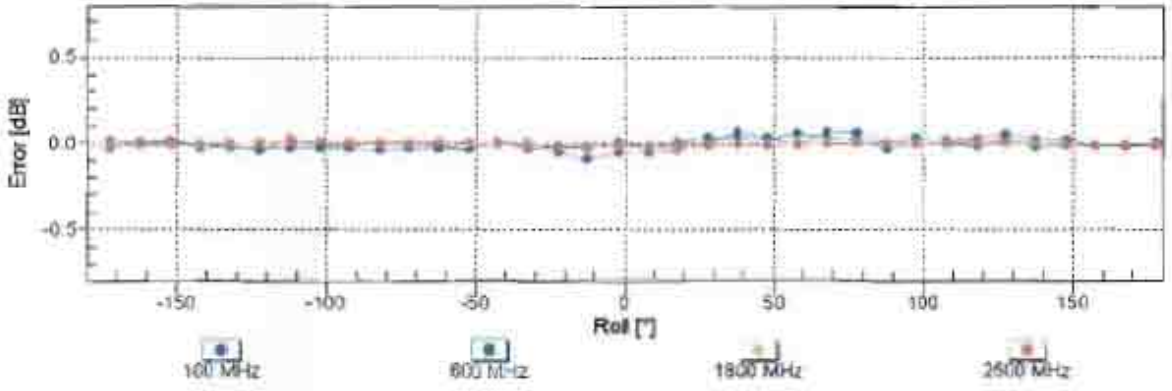
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM

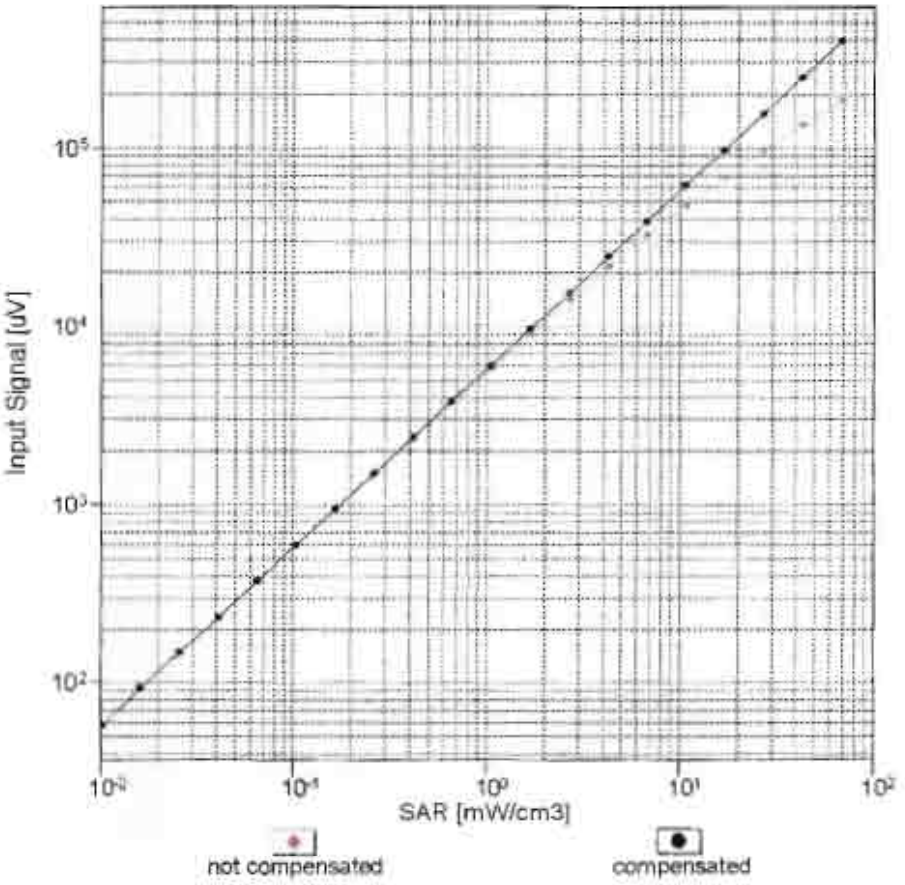
f=1800 MHz,R22

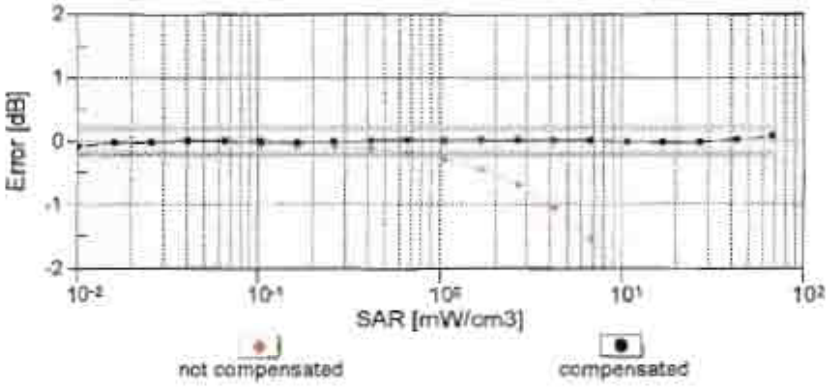




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

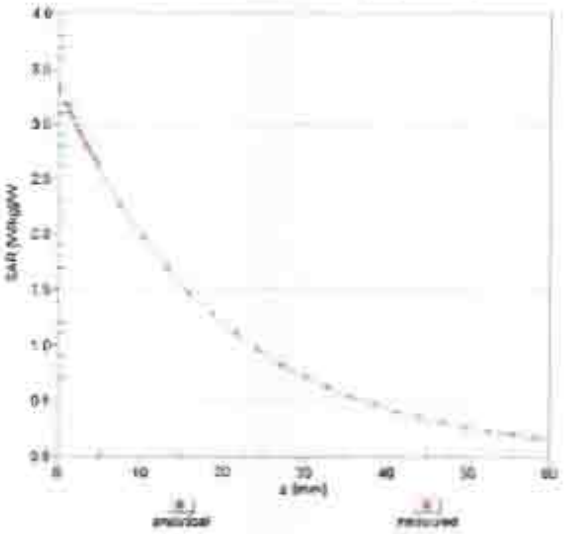




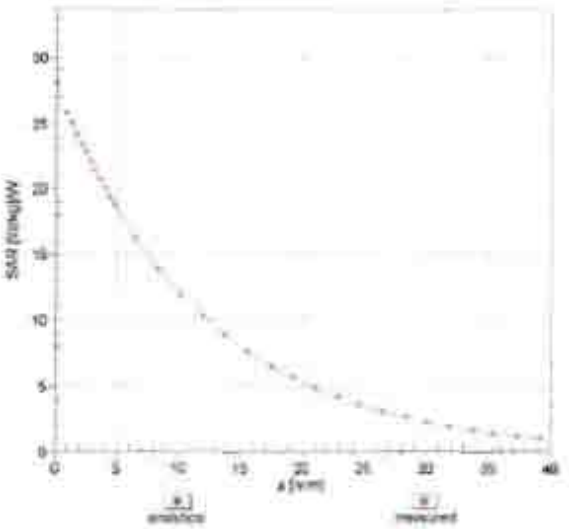
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

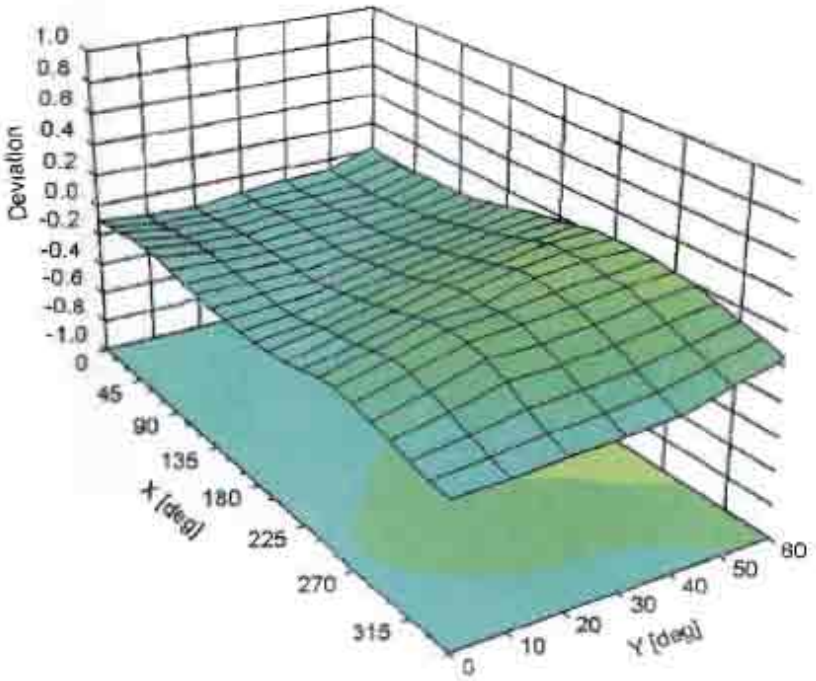


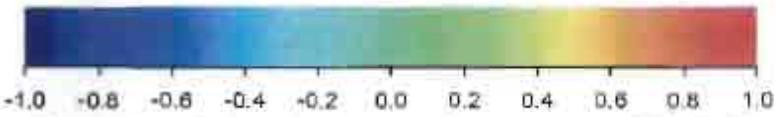
f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3931

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-12.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **Sporton-TW (Auden)**

Certificate No: EX3-3954_Nov13

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3954
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	November 4, 2013

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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	4-Sep-13 (No. DAE4-660_Sep13)	Sep-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 4, 2013

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

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe EX3DV4

SN:3954

Manufactured: August 6, 2013
Calibrated: November 4, 2013

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3954

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.56	0.45	0.54	± 10.1 %
DCP (mV)[B]	100.9	101.8	97.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	177.1	±3.0 %
		Y	0.0	0.0	1.0		153.7	
		Z	0.0	0.0	1.0		170.2	

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%.

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3954

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
850	41.5	0.92	9.76	9.76	9.76	0.17	1.56	± 12.0 %
1900	40.0	1.40	8.13	8.13	8.13	0.43	0.77	± 12.0 %
2450	39.2	1.80	7.26	7.26	7.26	0.44	0.75	± 12.0 %
5200	36.0	4.66	5.03	5.03	5.03	0.33	1.80	± 13.1 %
5300	35.9	4.76	4.89	4.89	4.89	0.34	1.80	± 13.1 %
5500	35.6	4.96	4.73	4.73	4.73	0.35	1.80	± 13.1 %
5600	35.5	5.07	4.69	4.69	4.69	0.32	1.80	± 13.1 %
5800	35.3	5.27	4.55	4.55	4.55	0.38	1.80	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) 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 (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] 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 frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3954

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
850	55.2	0.99	9.61	9.61	9.61	0.24	1.27	± 12.0 %
1900	53.3	1.52	7.95	7.95	7.95	0.42	0.84	± 12.0 %
2450	52.7	1.95	7.34	7.34	7.34	0.74	0.60	± 12.0 %
5200	49.0	5.30	4.52	4.52	4.52	0.38	1.90	± 13.1 %
5300	48.9	5.42	4.28	4.28	4.28	0.42	1.90	± 13.1 %
5500	48.6	5.65	4.04	4.04	4.04	0.45	1.90	± 13.1 %
5600	48.5	5.77	3.97	3.97	3.97	0.40	1.90	± 13.1 %
5800	48.2	6.00	4.08	4.08	4.08	0.46	1.90	± 13.1 %

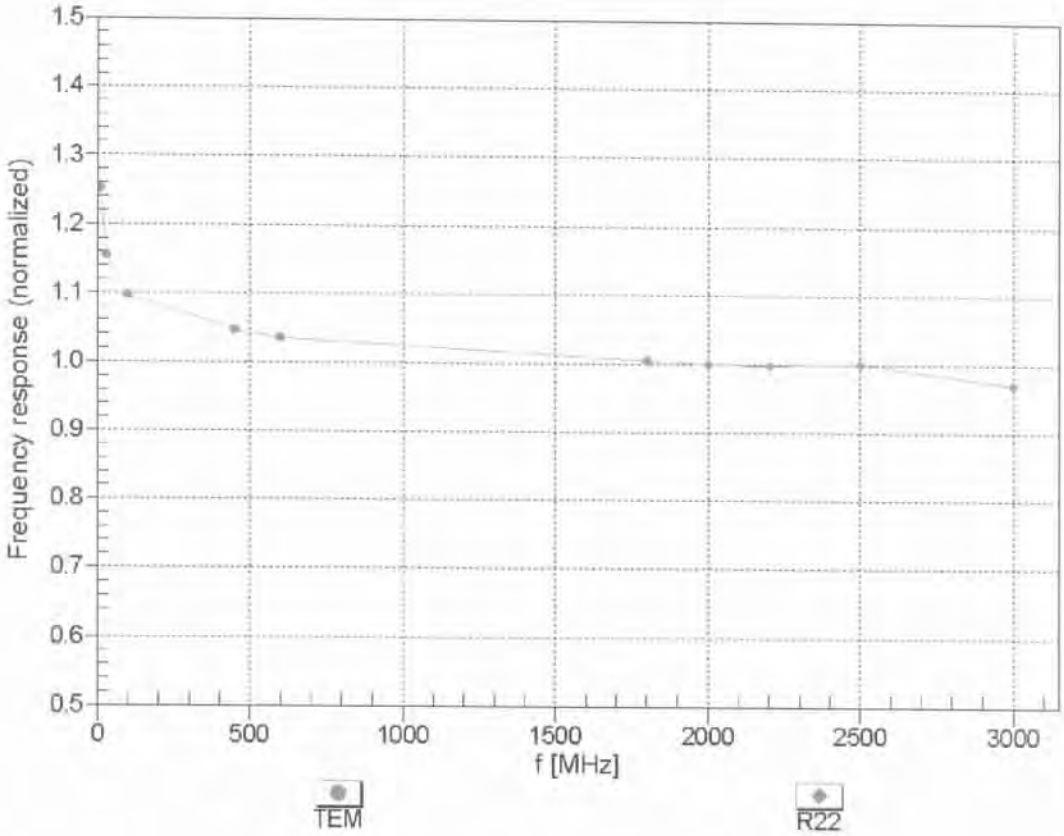
[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) 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 (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] 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 frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

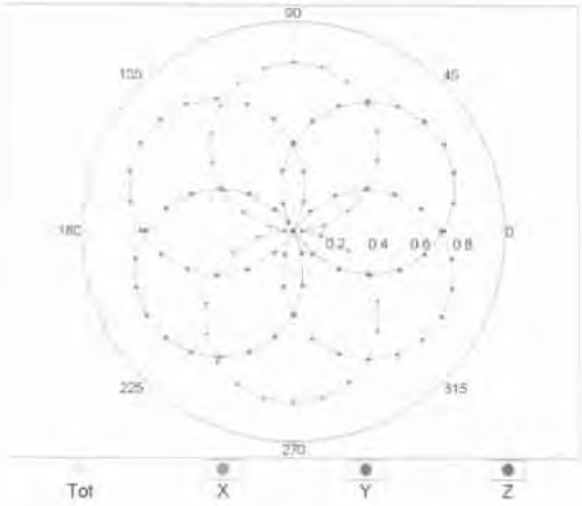
(TEM-Cell:ifi110 EXX, Waveguide: R22)



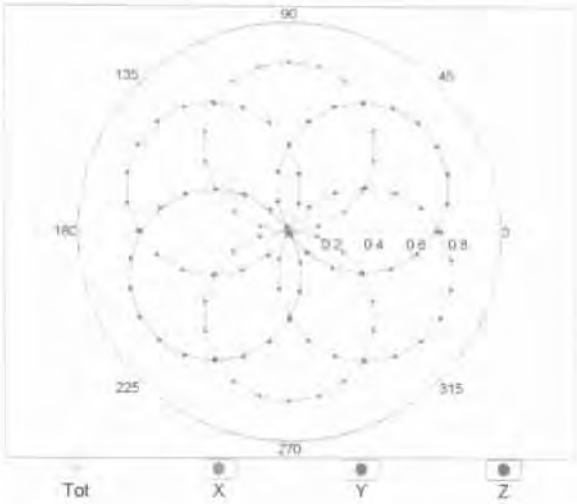
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

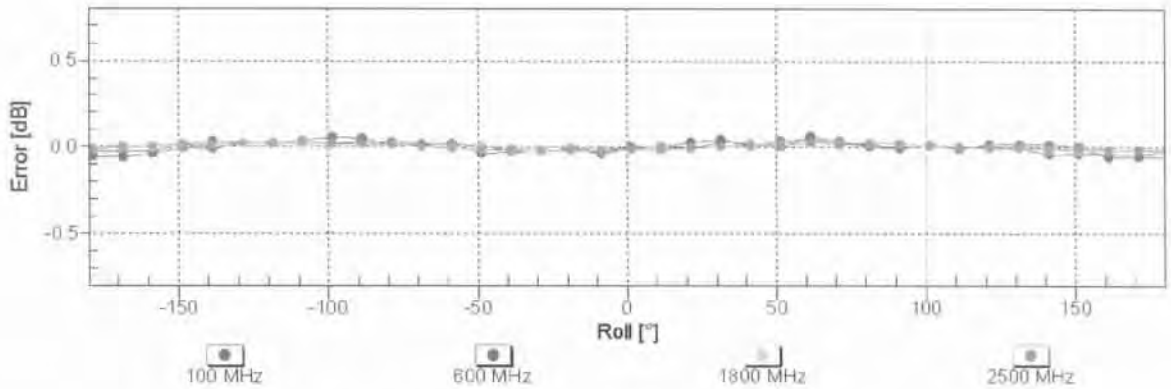
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



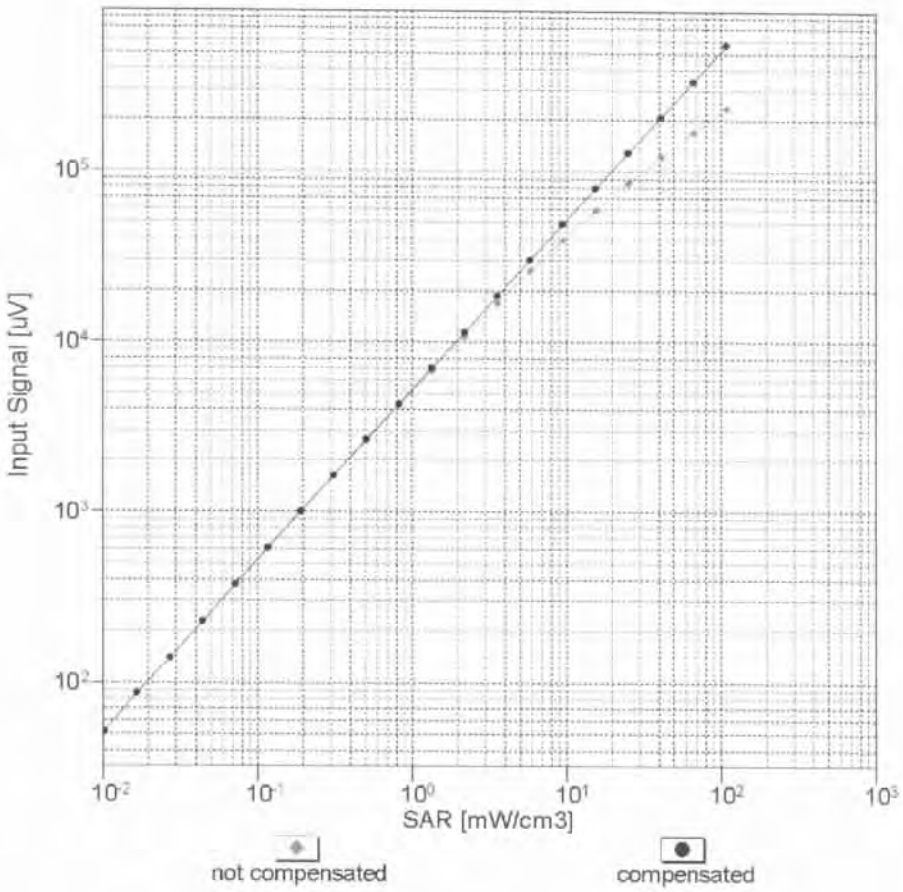
f=1800 MHz,R22

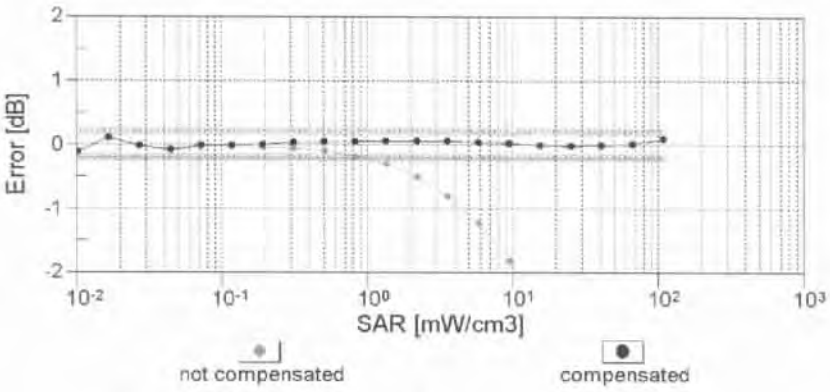




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

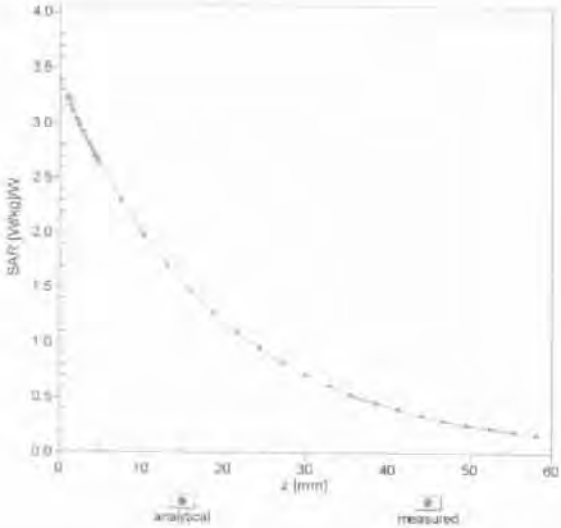




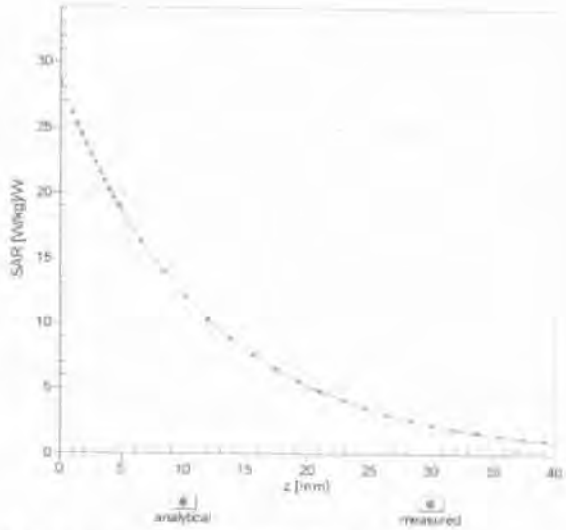
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 850 MHz,WGLS R9 (H_convF)

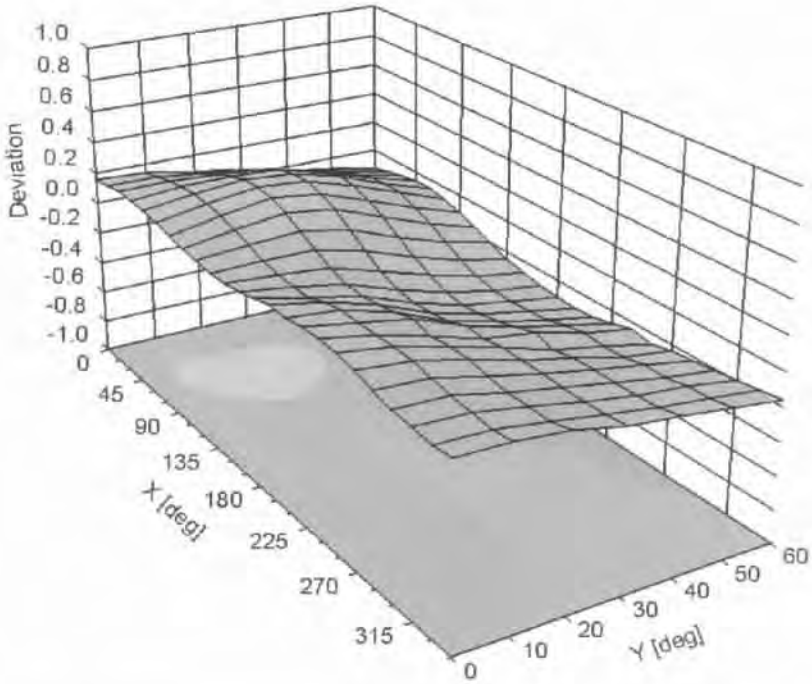


f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3954

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-118.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm