



D2600V2, Serial No. 1061 Extended Dipole Calibrations

Referring to KDB 865664 D01 v01r02, if dipoles are verified in return loss ($< -20\text{dB}$, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

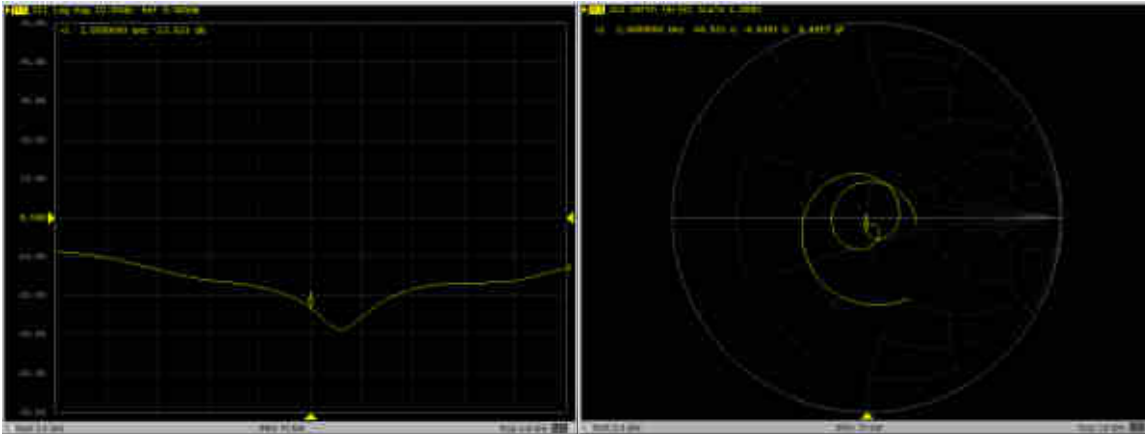
2600V2 – serial no. 1061												
	2600 Head						2600 Body					
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2018.12.07	-23.1		49.8		-7		-22.8		45.6		-5.41	
2019.11.27	-23.0	0.00	48.9	0.90	-6.83	0.17	-22.6	0.01	44.6	1	-5.29	0.12

<Justification of the extended calibration>

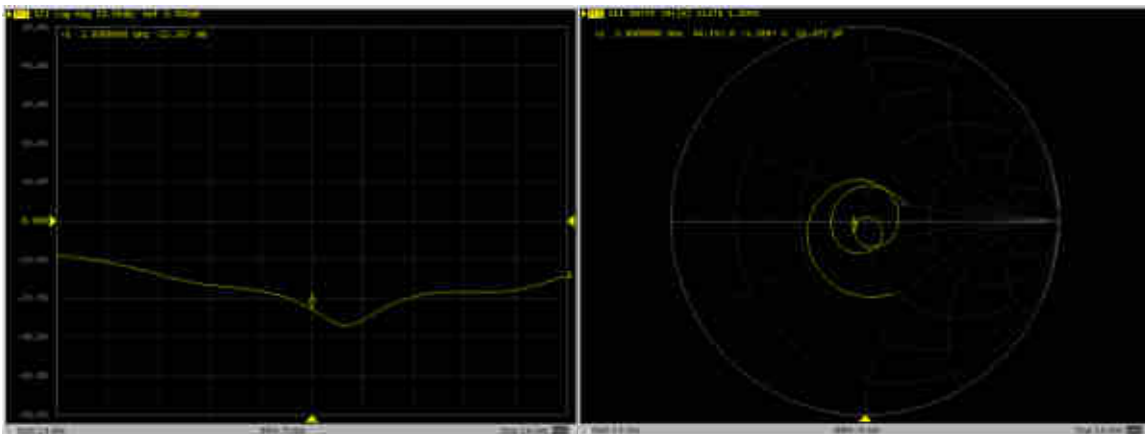
The return loss is $< -20\text{dB}$, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Dipole Verification Data> D2600V2, serial no. 1061

2600MHz – Head



2600MHz – Body





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **Sporton**

Certificate No: **D5GHzV2-1113_Sep19**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN:1113**

Calibration procedure(s) **QA CAL-22.v4
Calibration Procedure for SAR Validation Sources between 3-6 GHz**

Calibration date: **September 24, 2019**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
Reference Probe EX3DV4	SN: 3503	25-Mar-19 (No. EX3-3503_Mar19)	Mar-20
DAE4	SN: 601	30-Apr-19 (No. DAE4-601_Apr19)	Apr-20

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

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

Issued: September 25, 2019

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

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:

- 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
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- 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	V52.10.2
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	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.1 ± 6 %	4.53 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.09 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 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	34.6 ± 6 %	4.88 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	8.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.8 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	5.03 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.06 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.8 W/kg ± 19.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	51.7 Ω - 6.2 $j\Omega$
Return Loss	- 24.0 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	56.0 Ω - 2.7 $j\Omega$
Return Loss	- 24.1 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	56.7 Ω - 1.0 $j\Omega$
Return Loss	- 23.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.195 ns
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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
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Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1113

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz,
Frequency: 5750 MHz

Medium parameters used: $f = 5250$ MHz; $\sigma = 4.53$ S/m; $\epsilon_r = 35.1$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5600$ MHz; $\sigma = 4.88$ S/m; $\epsilon_r = 34.6$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5750$ MHz; $\sigma = 5.03$ S/m; $\epsilon_r = 34.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.4, 5.4, 5.4) @ 5250 MHz, ConvF(4.95, 4.95, 4.95) @ 5600 MHz, ConvF(4.98, 4.98, 4.98) @ 5750 MHz; Calibrated: 25.03.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 78.54 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 27.9 W/kg

SAR(1 g) = 8.09 W/kg; SAR(10 g) = 2.33 W/kg

Maximum value of SAR (measured) = 18.1 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 = 78.00 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 31.1 W/kg

SAR(1 g) = 8.40 W/kg; SAR(10 g) = 2.40 W/kg

Maximum value of SAR (measured) = 19.4 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan,

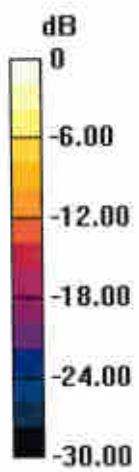
dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 75.13 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 31.8 W/kg

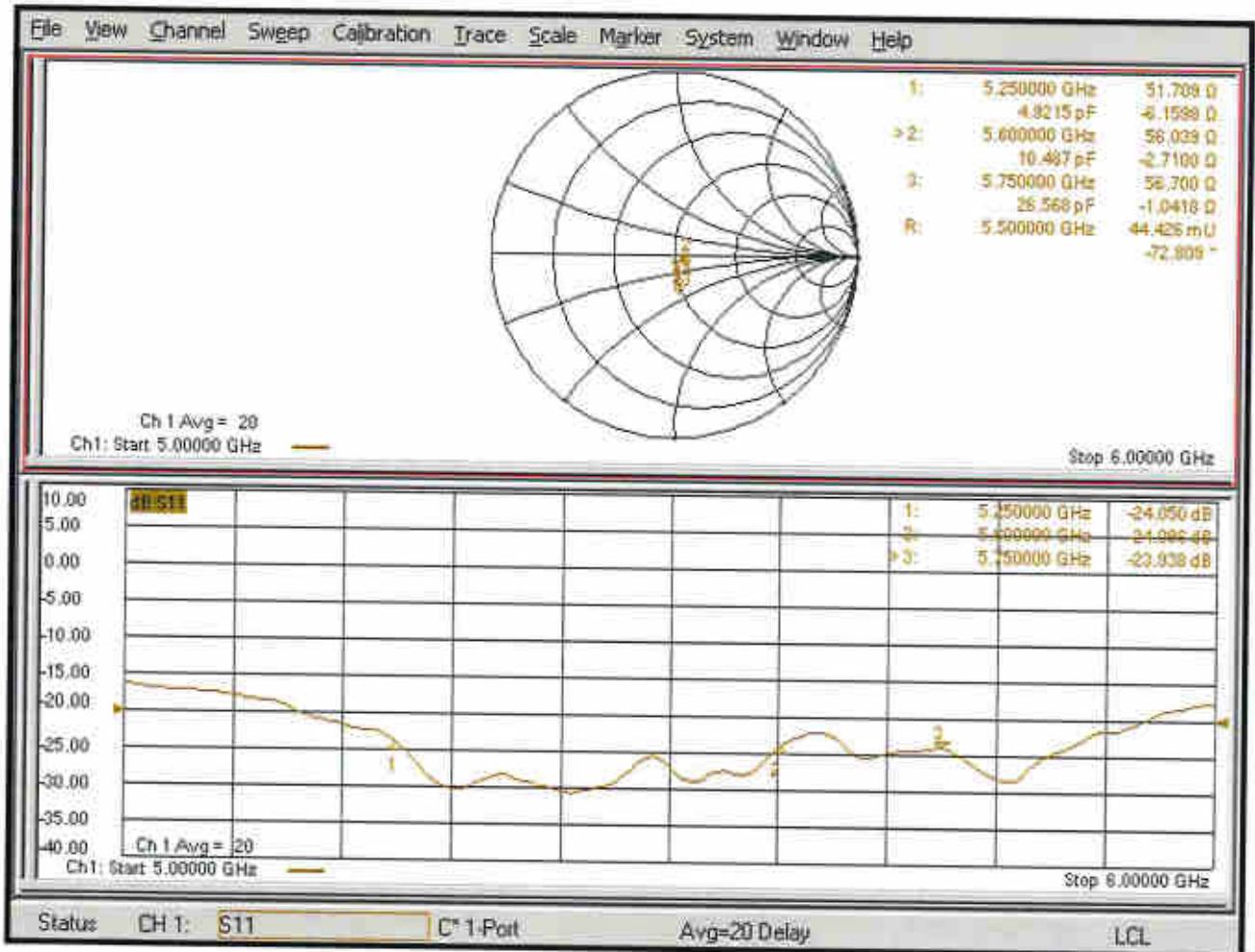
SAR(1 g) = 8.06 W/kg; SAR(10 g) = 2.30 W/kg

Maximum value of SAR (measured) = 19.0 W/kg



0 dB = 18.1 W/kg = 12.58 dBW/kg

Impedance Measurement Plot for Head TSL





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Accreditation No.: **SCS 0108**

Client **Sporton**

Certificate No: **DAE4-690_Mar20**

CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BM - SN: 690**

Calibration procedure(s) **QA CAL-06.v30
Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **March 26, 2020**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	03-Sep-19 (No:25949)	Sep-20
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 053 AA 1001	09-Jan-20 (in house check)	In house check: Jan-21
Calibrator Box V2.1	SE UMS 006 AA 1002	09-Jan-20 (in house check)	In house check: Jan-21

Calibrated by:	Name Eric Hainfeld	Function Laboratory Technician	Signature
Approved by:	Name Sven Kühn	Function Deputy Manager	Signature

Issued: March 26, 2020

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Accreditation No.: **SCS 0108**

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 = 6.1 μ V, 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	404.708 \pm 0.02% (k=2)	404.320 \pm 0.02% (k=2)	405.284 \pm 0.02% (k=2)
Low Range	3.98091 \pm 1.50% (k=2)	3.99691 \pm 1.50% (k=2)	3.93809 \pm 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	34.0 $^{\circ}$ \pm 1 $^{\circ}$
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Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	200033.46	0.84	0.00
Channel X + Input	20008.04	2.81	0.01
Channel X - Input	-20004.44	1.63	-0.01
Channel Y + Input	200033.01	0.28	0.00
Channel Y + Input	20004.74	-0.31	-0.00
Channel Y - Input	-20006.65	-0.48	0.00
Channel Z + Input	200032.64	-2.81	-0.00
Channel Z + Input	20006.13	1.16	0.01
Channel Z - Input	-20004.98	1.17	-0.01

Low Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	2000.43	-0.43	-0.02
Channel X + Input	200.02	-0.96	-0.48
Channel X - Input	-198.74	0.19	-0.09
Channel Y + Input	2001.49	0.62	0.03
Channel Y + Input	200.61	-0.27	-0.13
Channel Y - Input	-200.64	-1.61	0.81
Channel Z + Input	2001.03	0.27	0.01
Channel Z + Input	200.69	-0.18	-0.09
Channel Z - Input	-199.00	0.18	-0.09

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	14.15	12.87
	- 200	-12.83	-14.22
Channel Y	200	2.88	2.89
	- 200	-4.30	-4.61
Channel Z	200	0.04	0.39
	- 200	-0.98	-1.01

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	-	-2.69	-2.68
Channel Y	200	7.95	-	-0.72
Channel Z	200	6.90	5.66	-

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	16115	16314
Channel Y	16039	16490
Channel Z	16004	15469

5. Input Offset Measurement

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

Input 10M Ω

	Average (μ V)	min. Offset (μ V)	max. Offset (μ V)	Std. Deviation (μ V)
Channel X	0.25	-1.26	1.64	0.55
Channel Y	-0.70	-1.97	1.10	0.51
Channel Z	1.51	-0.80	2.84	0.58

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



Accreditation No.: **SCS 0108**

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Client **Sporton**

Certificate No: **EX3-3843_Sep19**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3843**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-14.v5, QA CAL-23.v5, QA CAL-25.v7
Calibration procedure for dosimetric E-field probes**

Calibration date: **September 26, 2019**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-19 (No. 217-02894)	Apr-20
DAE4	SN: 660	19-Dec-18 (No. DAE4-660_Dec18)	Dec-19
Reference Probe ES3DV2	SN: 3013	31-Dec-18 (No. ES3-3013_Dec18)	Dec-19
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-16)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-18)	In house check: Jun-20
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

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

Issued: October 1, 2019

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Accreditation No.: **SCS 0108**

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Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,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., $\vartheta = 0$ 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:

- 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
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z} = NORM_{x,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.
- DCP_{x,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
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,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 $f \leq 800$ 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 NORM_{x,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 NORM_x (no uncertainty required).

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3843

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.34	0.35	0.25	± 10.1 %
DCP (mV) ^B	110.9	96.1	101.1	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Max dev.	Unc ^C (k=2)
0	CW	X	0.0	0.0	1.0	0.00	134.1	±3.8 %	± 4.7 %
		Y	0.0	0.0	1.0		146.5		
		Z	0.0	0.0	1.0		132.2		

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 Norm X,Y,Z do not affect the E²-field uncertainty inside TSL (see Page 5).

^B Numerical linearization parameter; uncertainty not required.

^C 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:3843**Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	-34.3
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	1.4 mm

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3843

Calibration Parameter Determined in Head Tissue Simulating Media

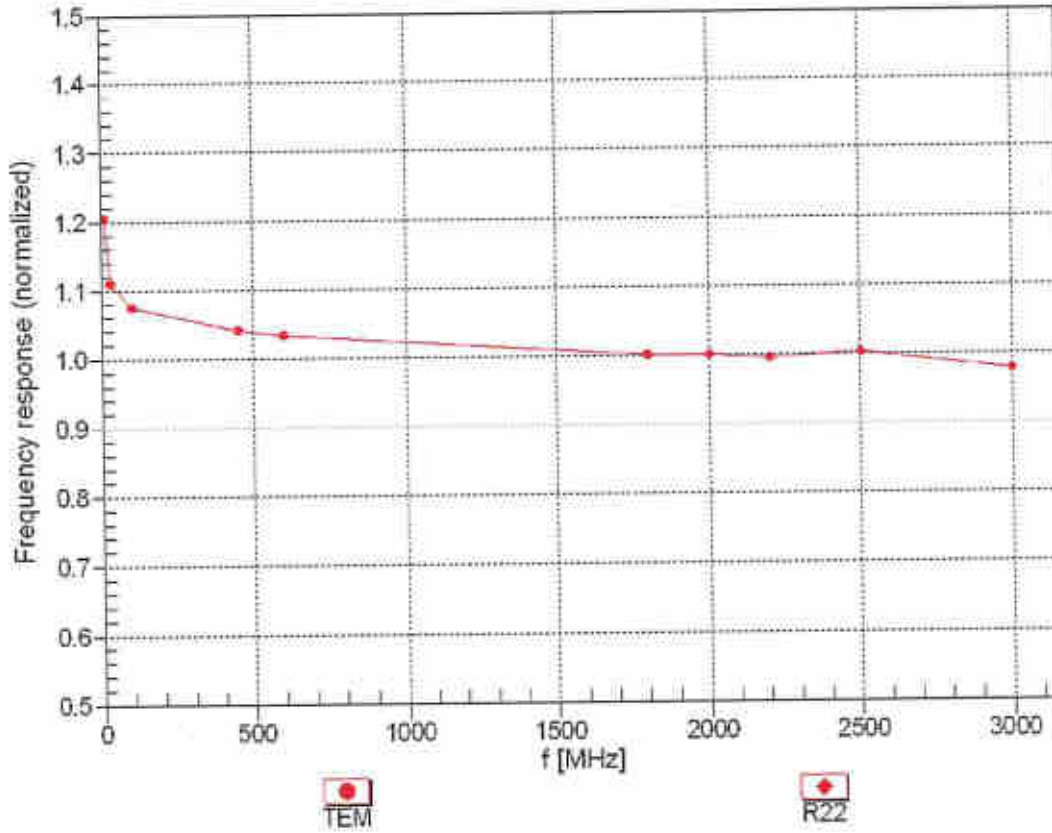
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
750	41.9	0.89	9.37	9.37	9.37	0.50	0.87	± 12.0 %
835	41.5	0.90	9.07	9.07	9.07	0.43	0.80	± 12.0 %
900	41.5	0.97	8.92	8.92	8.92	0.41	0.90	± 12.0 %
1450	40.5	1.20	8.17	8.17	8.17	0.32	0.80	± 12.0 %
1750	40.1	1.37	7.95	7.95	7.95	0.34	0.87	± 12.0 %
1900	40.0	1.40	7.67	7.67	7.67	0.32	0.87	± 12.0 %
2000	40.0	1.40	7.66	7.66	7.66	0.34	0.87	± 12.0 %
2300	39.5	1.67	7.30	7.30	7.30	0.26	0.90	± 12.0 %
2450	39.2	1.80	7.06	7.06	7.06	0.35	0.90	± 12.0 %
2600	39.0	1.96	6.90	6.90	6.90	0.43	0.80	± 12.0 %
5250	35.9	4.71	4.74	4.74	4.74	0.40	1.80	± 14.0 %
5600	35.5	5.07	4.47	4.47	4.47	0.40	1.80	± 14.0 %
5750	35.4	5.22	4.44	4.44	4.44	0.40	1.80	± 14.0 %

^C Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^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.

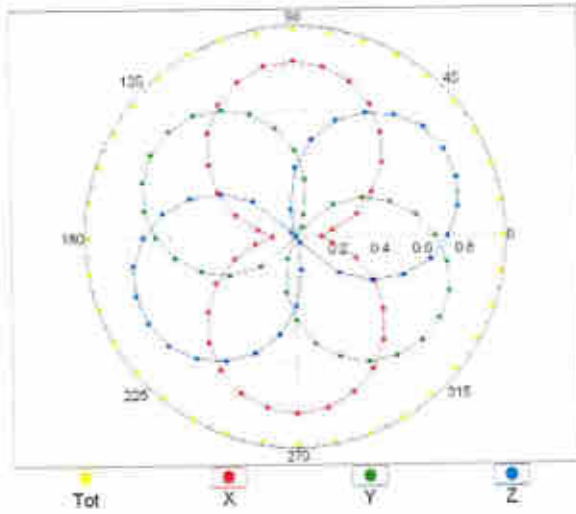
Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



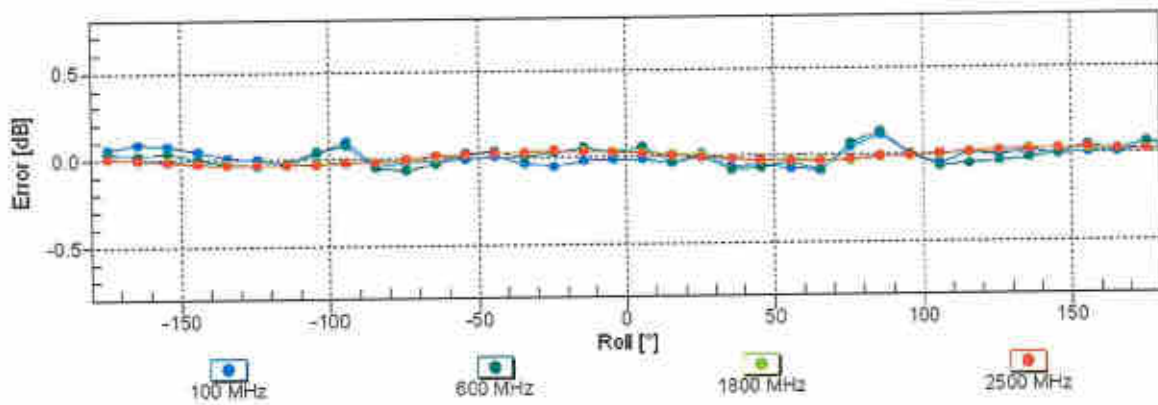
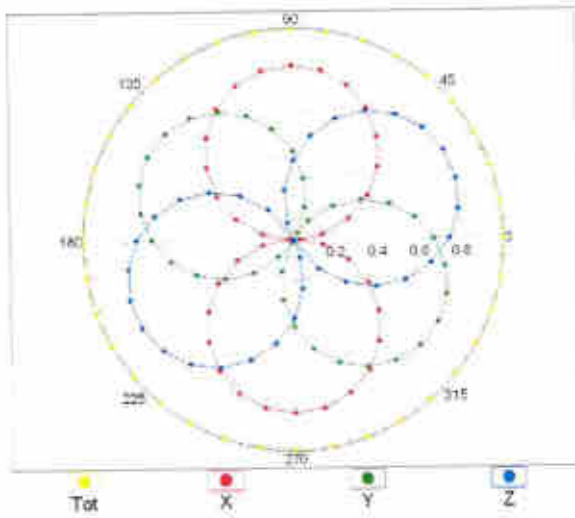
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz,TEM

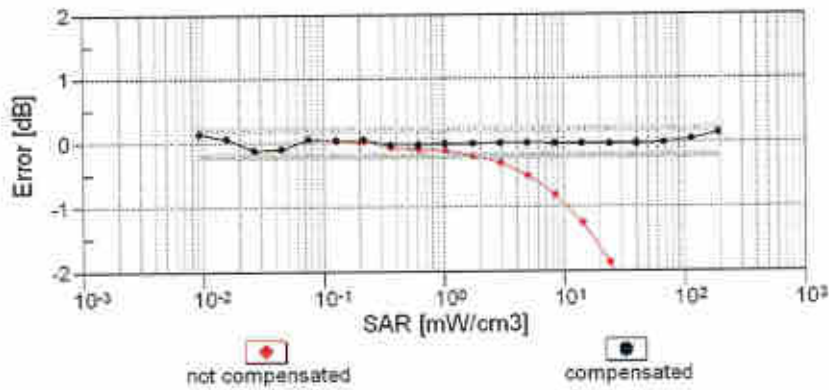
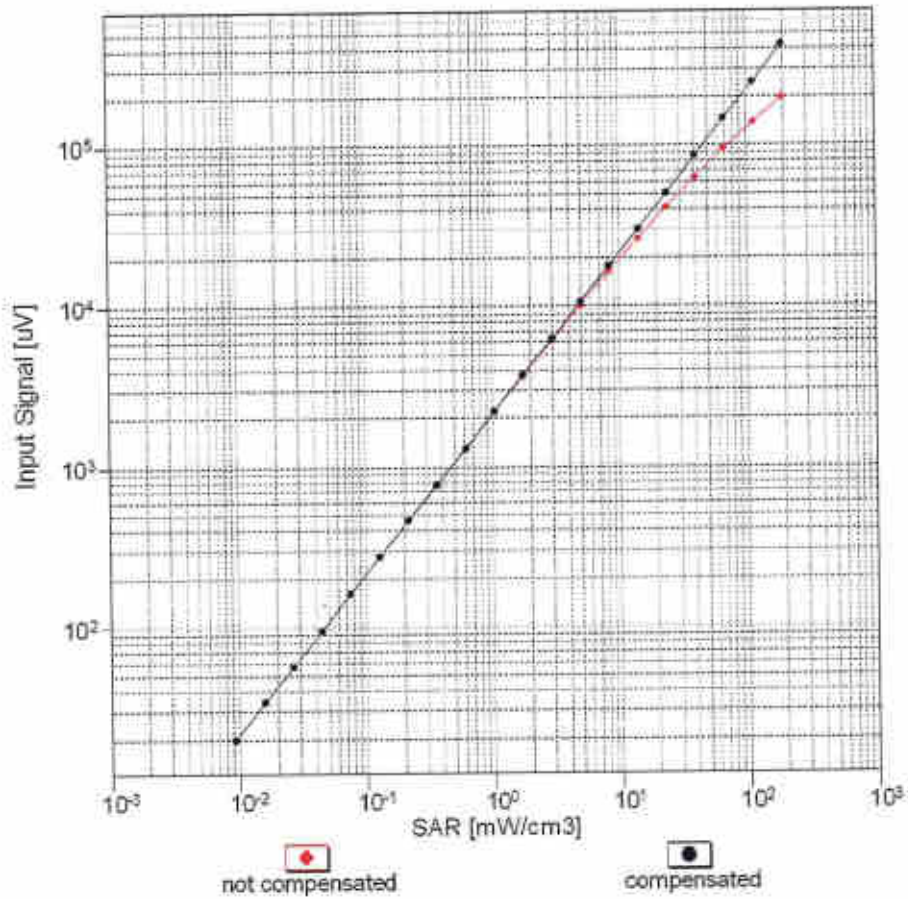


f=1800 MHz,R22



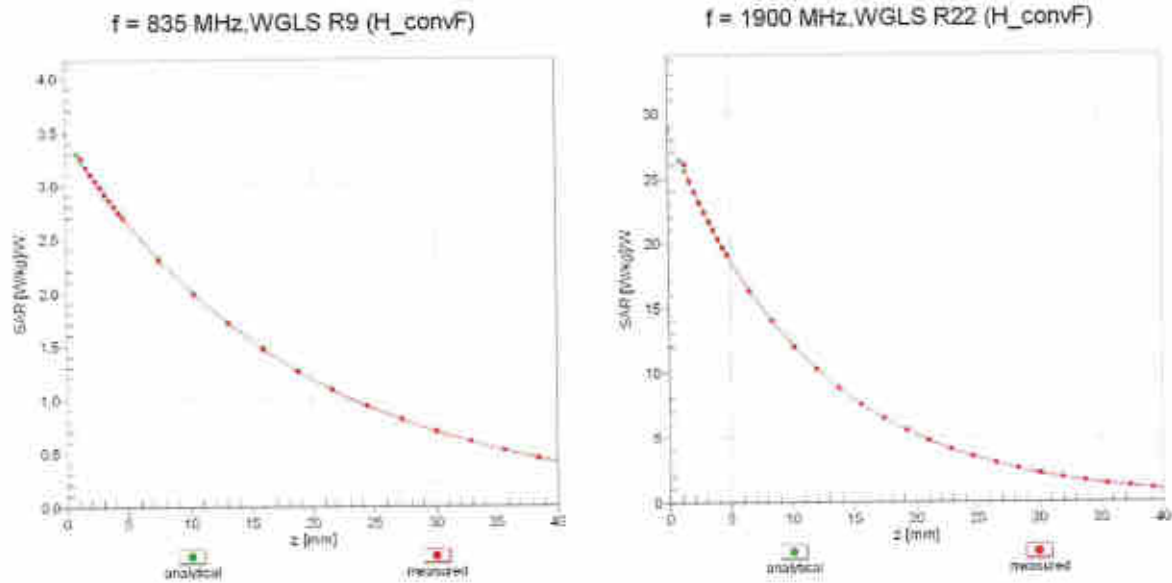
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range f(SAR_{head}) (TEM cell , f_{eval}= 1900 MHz)

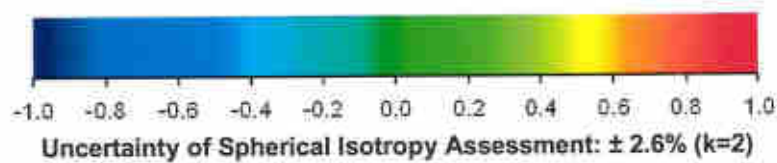
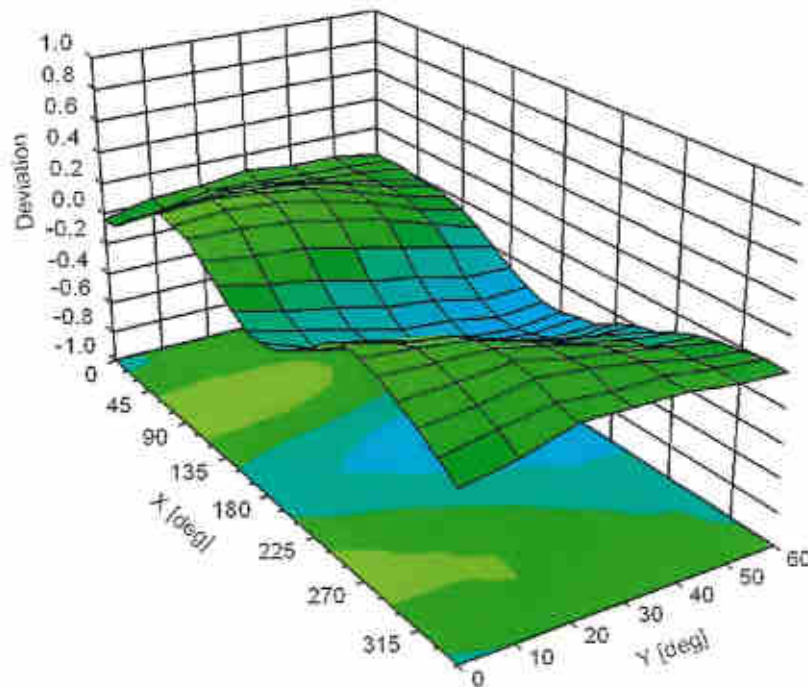


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid Error (ϕ, θ), f = 900 MHz





Appendix E. Conducted RF Output Power Table

The detailed power tables are shown as follows.



Full Power

GSM900 TX Channel	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
	126	169	251		126	169	251	
Frequency (MHz)	824.2	836.4	848.8	33.50	24.43	24.37	24.34	24.50
GPRS 1 Tx slots	33.43	33.37	33.34	30.50	24.33	24.27	24.26	24.50
GPRS 2 Tx slots	28.22	28.21	28.18	28.50	23.96	23.95	23.92	24.24
GPRS 4 Tx slots	26.87	26.93	26.83	27.00	23.87	23.93	23.83	24.00
EDGE 1 Tx slot	27.84	27.62	27.57	26.50	18.84	18.62	18.57	19.50
EDGE 2 Tx slots	24.63	24.39	24.37	25.50	18.63	18.39	18.37	19.50
EDGE 3 Tx slots	22.73	22.49	22.53	23.50	18.47	18.23	18.27	19.24
EDGE 4 Tx slots	21.37	21.19	21.13	22.00	18.37	18.19	18.13	19.00

GSM1900 TX Channel	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
	512	661	810		512	661	810	
Frequency (MHz)	1850.2	1860	1870.8	30.50	21.33	20.94	20.88	21.50
GPRS 1 Tx slot	30.35	29.94	29.88	28.50	21.53	21.13	21.10	22.50
GPRS 2 Tx slots	25.33	24.98	24.90	25.50	21.07	20.72	20.64	21.24
GPRS 4 Tx slots	24.11	23.67	23.88	24.50	21.11	20.67	20.88	21.50
EDGE 1 Tx slot	26.43	26.41	26.33	27.50	17.43	17.41	17.33	18.50
EDGE 2 Tx slots	23.31	23.29	23.25	24.50	17.31	17.29	17.25	18.50
EDGE 3 Tx slots	21.47	21.45	21.40	22.50	17.21	17.19	17.14	18.24
EDGE 4 Tx slots	20.15	20.13	20.08	21.00	17.15	17.13	17.08	18.00

Band TX Channel	WCDMA II			Tune-up Limit (dBm)	WCDMA IV			Tune-up Limit (dBm)	WCDMA V			Tune-up Limit (dBm)
	9262	9400	9638		1312	1413	1513		4132	4182	4233	
Rx Channel	9662	9800	9938	1537	1638	1738	4357	4407	4458			
Frequency (MHz)	1852.4	1880	1907.6	1712.4	1732.6	1752.6	826.4	836.4	846.6			
3GPP Rel 99 R1C 12.2Kbps	23.98	23.79	23.85	24.00	23.80	23.94	23.97	24.00	24.46	24.27	24.21	24.50
3GPP Rel 6 HSDPA Subtest-1	22.99	22.90	22.84	23.00	22.91	22.98	22.85	23.00	23.49	23.34	23.35	23.50
3GPP Rel 6 HSDPA Subtest-2	22.99	22.90	22.89	23.00	22.90	23.00	22.89	23.00	23.45	23.43	23.41	23.50
3GPP Rel 6 HSDPA Subtest-3	22.44	22.43	22.42	22.50	22.38	22.42	22.35	22.50	22.93	22.91	22.95	23.00
3GPP Rel 6 HSDPA Subtest-4	22.44	22.45	22.34	22.50	22.45	22.49	22.36	22.50	22.93	22.92	22.92	23.00
3GPP Rel 6 DC-HSDPA Subtest-1	22.68	22.53	22.50	23.00	22.61	22.53	22.41	23.00	23.18	23.00	23.11	23.50
3GPP Rel 6 DC-HSDPA Subtest-2	22.64	22.50	22.47	23.00	22.49	22.50	22.41	23.00	23.11	23.10	23.01	23.50
3GPP Rel 6 DC-HSDPA Subtest-3	22.10	22.04	22.01	22.50	22.01	22.01	22.06	22.50	22.59	22.54	22.61	23.00
3GPP Rel 6 DC-HSDPA Subtest-4	22.95	22.01	22.03	22.50	22.06	22.04	22.01	22.50	22.52	22.60	22.54	23.00
3GPP Rel 6 HSUPA Subtest-1	22.98	22.95	22.87	23.00	22.92	22.89	22.84	23.00	23.36	23.40	23.43	23.50
3GPP Rel 6 HSUPA Subtest-2	20.97	20.90	20.93	21.00	20.96	20.98	20.84	21.00	21.43	21.42	21.43	21.50
3GPP Rel 6 HSUPA Subtest-3	21.99	21.91	21.93	22.00	21.97	21.92	21.88	22.00	22.49	22.40	22.39	22.50
3GPP Rel 6 HSUPA Subtest-4	20.92	20.95	20.91	21.00	20.92	20.98	20.89	21.00	21.42	21.39	21.39	21.50
3GPP Rel 6 HSUPA Subtest-5	23.00	22.90	22.90	23.00	22.95	22.95	22.75	23.00	23.46	23.50	23.50	23.50

Band TX Channel	CDMA BC0			Tune-up Limit (dBm)	CDMA BC1			Tune-up Limit (dBm)	CDMA BC10			Tune-up Limit (dBm)
	824.7	836.52	848.31		25	500	1175		476	580	684	
Frequency (MHz)	824.7	836.52	848.31	1861.25	1880	1908.75	817.9	820.5	823.1			
RTAP 153.6Kbps	24.45	24.46	24.28	25.00	23.25	23.28	23.19	24.00	23.91	23.92	23.86	24.50
RETAP 4096Bb/s	24.46	24.47	24.27	25.00	23.23	23.25	23.20	24.00	23.90	23.89	23.85	24.50



Reduced Power Mode

GSM850	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
	128	169	251		128	169	251	
TX Channel	128	169	251	Limit	128	169	251	Limit
Frequency (MHz)	924.2	935.4	946.3		924.2	935.4	946.3	
GPRS 1 Tx slot	29.90	29.92	29.82	31.00	20.90	20.92	20.82	22.00
GPRS 2 Tx slots	27.34	27.33	27.32	28.00	21.34	21.33	21.32	22.00
GPRS 3 Tx slots	25.53	25.72	25.99	26.00	21.27	21.46	21.73	21.74
GPRS 4 Tx slots	23.87	23.94	23.99	24.50	20.87	20.94	20.99	21.50
EDGE 1 Tx slot	27.26	27.02	26.82	28.50	18.26	18.02	17.82	19.50
EDGE 2 Tx slots	24.01	23.78	23.58	25.50	18.01	17.78	17.58	19.50
EDGE 3 Tx slots	22.05	21.97	21.89	23.50	17.79	17.71	17.43	19.24
EDGE 4 Tx slots	20.75	20.55	20.35	22.00	17.75	17.55	17.35	19.00

Band	WCDMA II			Tune-up Limit (dBm)	WCDMA V			Tune-up Limit (dBm)	
	9262	9400	9538		4132	4182	4233		
TX Channel	9262	9400	9538	Limit	4132	4182	4233	Limit	
Rx Channel	9662	9800	9938	(dBm)	4357	4407	4458	(dBm)	
Frequency (MHz)	1852.4	1850	1907.6		826.4	836.4	846.6		
3GPP Rel 6	RMC 1/2/3Kbps	20.55	20.43	20.52	21.50	21.96	21.83	21.88	22.50
3GPP Rel 6	HSDPA Subtest-1	19.42	19.32	19.41	20.50	20.91	20.91	20.95	21.50
3GPP Rel 6	HSDPA Subtest-2	19.39	19.29	19.37	20.50	20.83	20.96	20.98	21.50
3GPP Rel 6	HSDPA Subtest-3	18.92	18.85	18.87	20.00	20.42	20.43	20.46	21.00
3GPP Rel 6	HSDPA Subtest-4	18.96	18.81	18.91	20.00	20.48	20.45	20.39	21.00
3GPP Rel 6	DC-HSDPA Subtest-1	19.23	18.98	19.20	20.50	20.50	20.44	20.41	21.50
3GPP Rel 6	DC-HSDPA Subtest-2	19.15	18.84	19.11	20.50	20.44	20.48	20.37	21.50
3GPP Rel 6	DC-HSDPA Subtest-3	18.58	18.39	18.61	20.00	20.00	19.89	19.91	21.00
3GPP Rel 6	DC-HSDPA Subtest-4	18.55	18.31	18.49	20.00	20.02	19.88	19.87	21.00
3GPP Rel 6	HSUPA Subtest-1	19.39	19.47	19.59	20.50	20.89	20.88	20.86	21.50
3GPP Rel 6	HSUPA Subtest-2	17.41	17.43	17.54	18.50	18.89	18.86	18.86	19.50
3GPP Rel 6	HSUPA Subtest-3	18.39	18.49	18.62	19.50	19.87	19.93	19.86	20.50
3GPP Rel 6	HSUPA Subtest-4	17.44	17.48	17.56	18.50	18.85	18.90	18.84	19.50
3GPP Rel 6	HSUPA Subtest-5	19.57	19.46	19.54	20.50	20.90	20.80	20.90	21.50

Band	CDMA BC0			Tune-up Limit (dBm)	CDMA BC1			CDMA BC10			Tune-up Limit (dBm)	
	1013	384	777		25	600	1175	476	580	684		
TX Channel	1013	384	777	Limit	25	600	1175	Limit	476	580	684	Limit
Frequency (MHz)	824.7	836.52	848.31	(dBm)	1851.25	1880	1908.75	(dBm)	817.9	820.5	823.1	(dBm)
RTAP 153.6Kbps	21.08	21.11	20.99	22.00	20.46	20.52	20.45	21.00	21.18	21.20	21.14	22.00
RETAP 4096Bits	21.09	21.08	21.02	22.00	20.44	20.51	20.46	21.50	21.15	21.18	21.12	22.00



2CA DL

Configure	CA List	PCC							SCC				Power			
		LTE	BW	UL	UL	Mod.	UL#	UL	LTE	BW	DL	DL	With CA	Without CA		
		Band	(MHz)	Freq. (MHz)	Channel		RB	RB Offset	Band	(MHz)	Freq. (MHz)	Channel	Tx. Power (dBm)	Tx. Power (dBm)		
Inter-Band	CA_2A-4A	Band 2	20M	1880	18900	QPSK	1	0	Band 4	20M	2132.5	2175	23.10	23.13		
	CA_2A-4A	Band 4	20M	1732.5	20175	QPSK	1	0	Band 2	20M	1960	900	23.67	23.98		
	CA_2A-5A	Band 2	20M	1880	18900	QPSK	1	0	Band 5	10M	881.5	2525	23.01	23.13		
	CA_2A-5A	Band 5	10M	836.5	20525	QPSK	1	0	Band 2	20M	1960	900	23.10	23.32		
	CA_2A-12A	Band 2	20M	1880	18900	QPSK	1	0	Band 12	10M	707.5	5095	23.09	23.13		
	CA_2A-12A	Band 12	10M	707.5	23095	QPSK	1	0	Band 2	20M	1960	900	23.32	23.40		
	CA_2A-13A	Band 2	20M	1880	18900	QPSK	1	0	Band 13	10M	751	5230	23.03	23.13		
	CA_2A-13A	Band 13	10M	782	23230	QPSK	1	0	Band 2	20M	1960	900	23.22	23.42		
	CA_2A-29A	Band 2	20M	1880	18900	QPSK	1	0	Band 29	10M	722.5	9715	23.10	23.13		
	CA_4A-5A	Band 4	20M	1732.5	20175	QPSK	1	0	Band 5	10M	881.5	2525	23.78	23.98		
	CA_4A-5A	Band 5	10M	836.5	20525	QPSK	1	0	Band 4	20M	2132.5	2175	23.11	23.32		
	CA_4A-12A	Band 4	20M	1732.5	20175	QPSK	1	0	Band 12	10M	737.5	5095	23.91	23.98		
	CA_4A-12A	Band 12	10M	707.5	23095	QPSK	1	0	Band 4	20M	2132.5	2175	23.22	23.40		
	CA_4A-13A	Band 4	20M	1732.5	20175	QPSK	1	0	Band 13	10M	751	5230	23.90	23.98		
	CA_4A-13A	Band 13	10M	782	23230	QPSK	1	0	Band 4	20M	2132.5	2175	23.22	23.42		
	CA_4A-29A	Band 4	20M	1732.5	20175	QPSK	1	0	Band 29	10M	722.5	9715	23.91	23.98		
	CA_4A-29A	Band 5	10M	836.5	20525	QPSK	1	0	Band 7	20M	2655	3100	23.22	23.32		
	CA_5A-7A	Band 7	20M	2535	21100	QPSK	1	0	Band 5	10M	881.5	2525	22.89	23.04		
	Intra-Band	Contiguous	CA_2C	Band 2	20M	1880	18900	QPSK	1	0	Band 2	20M	1979.8	1098	23.23	23.13
			CA_7B	Band 7	15M	2535	21100	QPSK	1	0	Band 7	5M	2664.3	3193	22.67	22.79
CA_7C			Band 7	20M	2535	21100	QPSK	1	0	Band 7	20M	2674.8	3298	23.00	23.04	
CA_41C			Band 41	20M	2593	40620	QPSK	1	0	Band 41	20M	2612.8	40818	23.01	23.24	
Non-Contiguous		CA_2A-2A	Band 2	20M	1880	18900	QPSK	1	0	Band 2	5M	1987.5	1175	23.20	23.13	
		CA_4A-4A	Band 4	20M	1732.5	20175	QPSK	1	0	Band 4	5M	2152.5	2375	23.80	23.98	
		CA_7A-7A	Band 7	20M	2535	21100	QPSK	1	0	Band 7	5M	2687.5	3425	23.01	23.04	
		CA_41A-41A	Band 41	20M	2593	40620	QPSK	1	0	Band 41	5M	2687.5	41565	23.32	23.24	

