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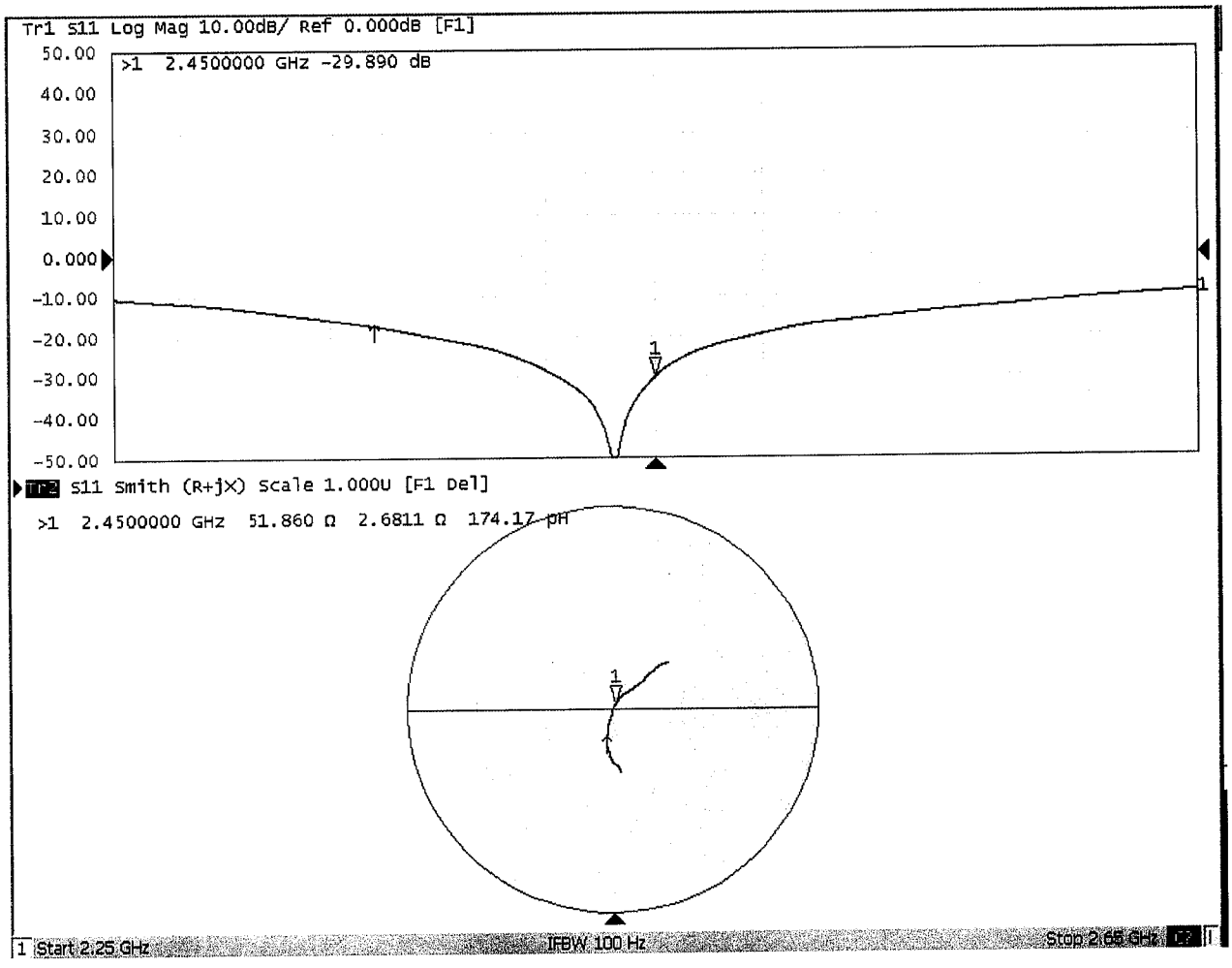
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Date: 04.15.2019

Test Laboratory: CTTL, Beijing, China

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

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: f = 2450 MHz; σ = 2.005 S/m; ε_r = 54.25; ρ = 1000 kg/m3

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.79, 7.79, 7.79) @ 2450 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

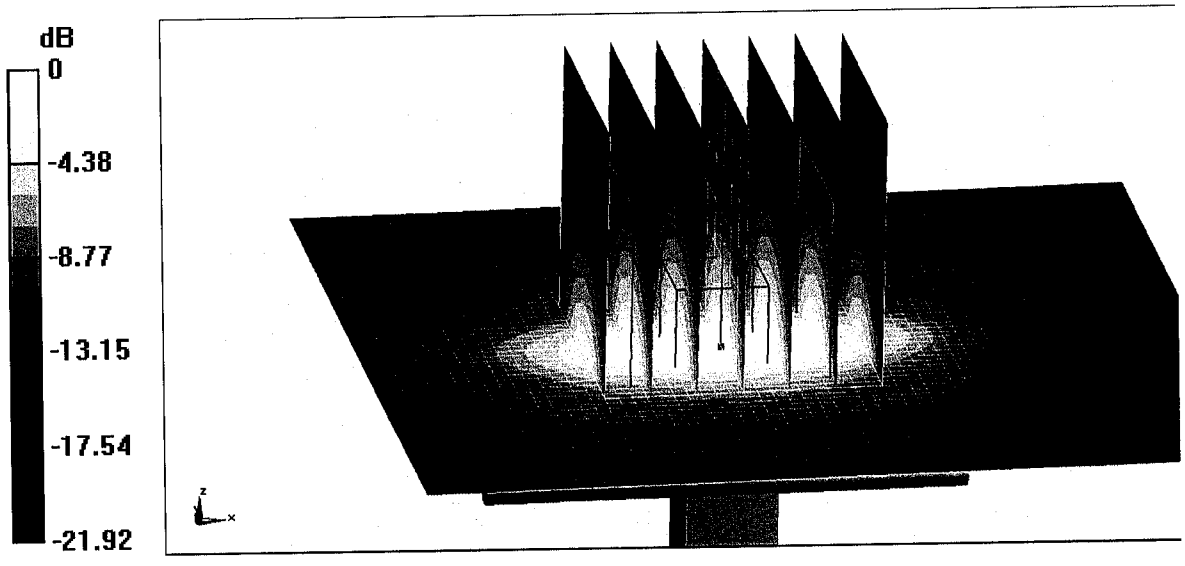
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.46 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 26.3 W/kg

SAR(1 g) = 12.6 W/kg; SAR(10 g) = 5.83 W/kg

Maximum value of SAR (measured) = 20.9 W/kg



0 dB = 20.9 W/kg = 13.20 dBW/kg

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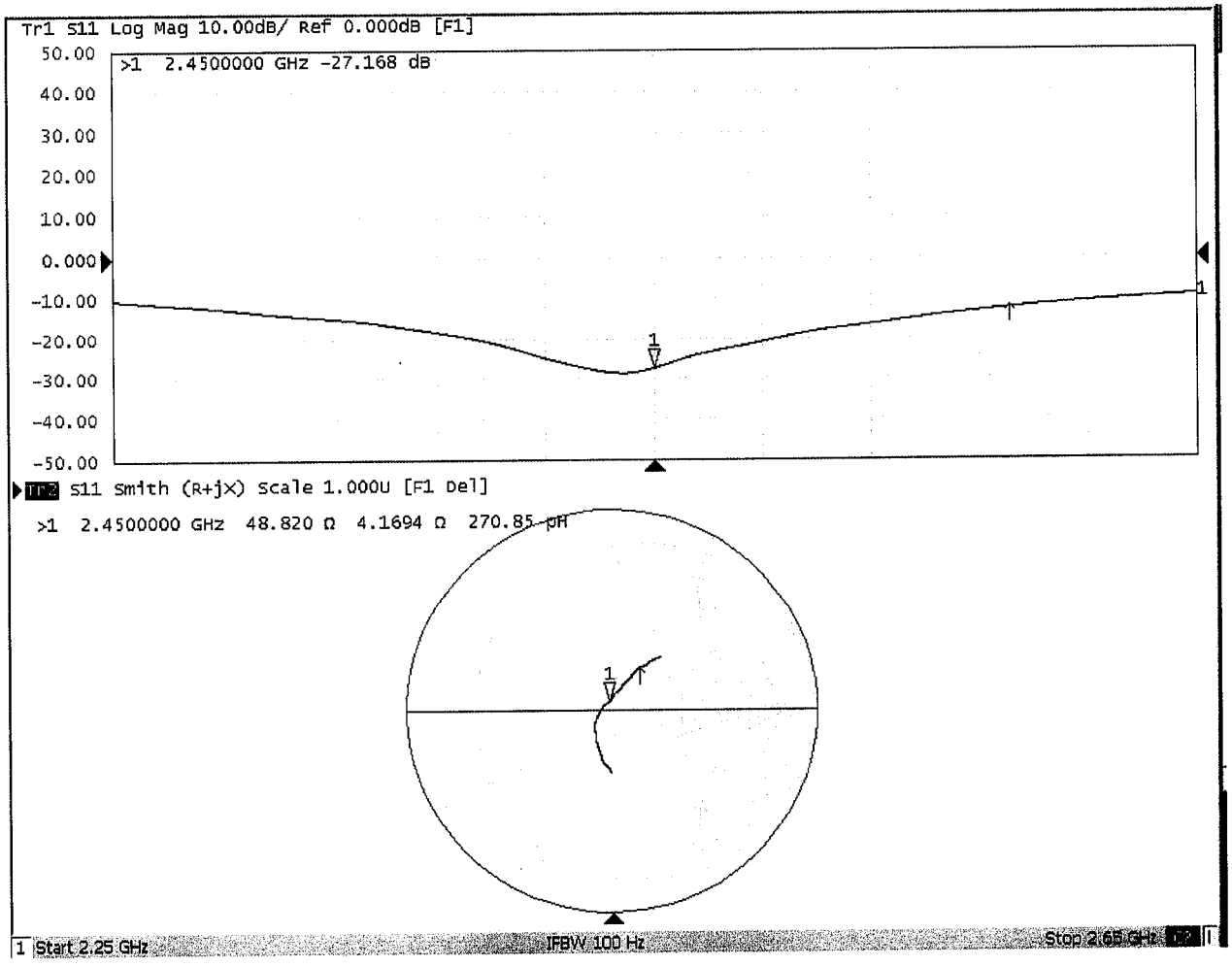
Impedance Measurement Plot for Body TSL



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CNAS L0570

Client **Sporton** **Certificate No: Z18-60537**

CALIBRATION CERTIFICATE

Object: D2600V2 - SN: 1070

Calibration Procedure(s): FF-Z11-003-01
Calibration Procedures for dipole validation kits

Calibration date: December 7, 2018

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)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102196	07-Mar-18 (CTTL, No.J18X01510)	Mar-19
Power sensor NRV-Z5	100596	07-Mar-18 (CTTL, No.J18X01510)	Mar-19
Reference Probe EX3DV4	SN 7514	27-Aug-18(SPEAG,No.EX3-7514_Aug18)	Aug-19
DAE4	SN 1555	20-Aug-18(SPEAG,No.DAE4-1555_Aug18)	Aug-19
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	23-Jan-18 (CTTL, No.J18X00560)	Jan-19
Network Analyzer E5071C	MY46110673	24-Jan-18 (CTTL, No.J18X00561)	Jan-19

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: December 10, 2018

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

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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,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, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016

c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010

d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) 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%.

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Measurement Conditions

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

DASY Version	DASY52	52.10.2.1495
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2600 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.1 ± 6 %	1.93 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.4 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**58.1 mW /g ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.50 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**26.1 mW /g ± 18.7 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.5	2.16 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.0 ± 6 %	2.18 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.8 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**54.6 mW /g ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	6.18 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**24.6 mW /g ± 18.7 % (k=2)**

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Appendix(Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.6Ω- 6.33jΩ
Return Loss	- 23.7dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	44.8Ω- 5.36jΩ
Return Loss	- 22.1dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.015 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

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DASY5 Validation Report for Head TSL Date: 12.06.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1070

Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium parameters used: f = 2600 MHz; σ = 1.926 S/m; ε_r = 39.1; ρ = 1000 kg/m3

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7514; ConvF(6.92, 6.92, 6.92) @ 2600 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/20/2018
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

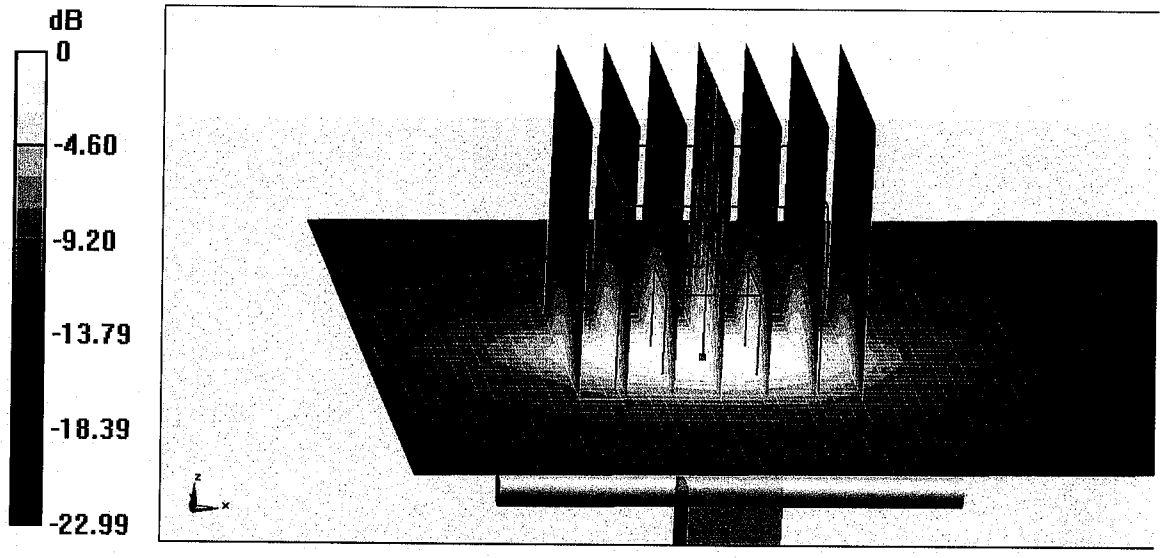
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.07 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 31.1 W/kg

SAR(1 g) = 14.4 W/kg; SAR(10 g) = 6.5 W/kg

Maximum value of SAR (measured) = 24.7 W/kg



0 dB = 24.7 W/kg = 13.93 dBW/kg

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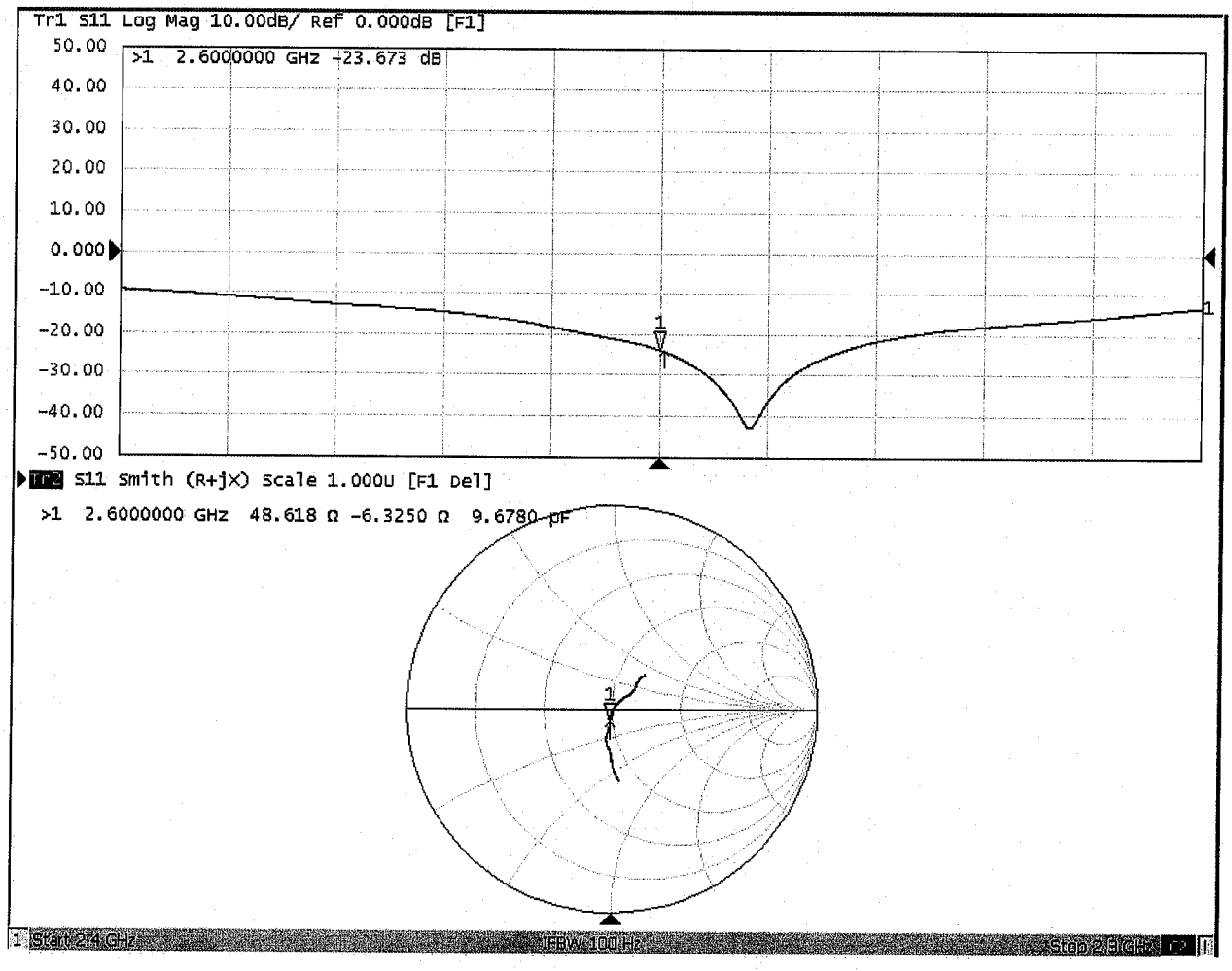
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Date: 12.06.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1070

Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium parameters used: f = 2600 MHz; σ = 2.181 S/m; ε_r = 51.03; ρ = 1000 kg/m3

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7514; ConvF(7.06, 7.06, 7.06) @ 2600 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/20/2018
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

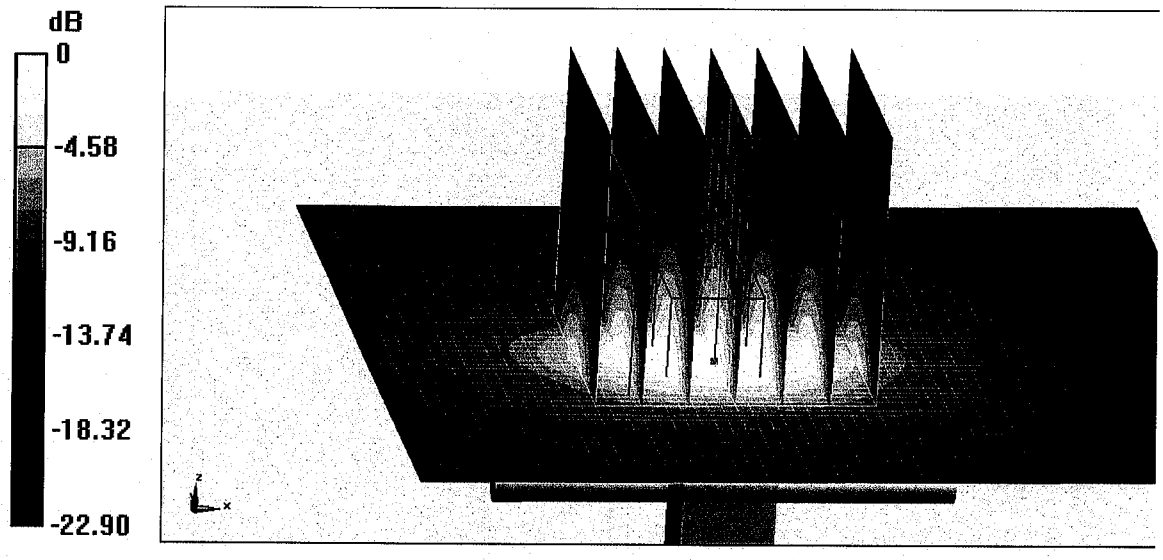
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 87.90 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 29.5 W/kg

SAR(1 g) = 13.8 W/kg; SAR(10 g) = 6.18 W/kg

Maximum value of SAR (measured) = 23.6 W/kg



0 dB = 23.6 W/kg = 13.73 dBW/kg

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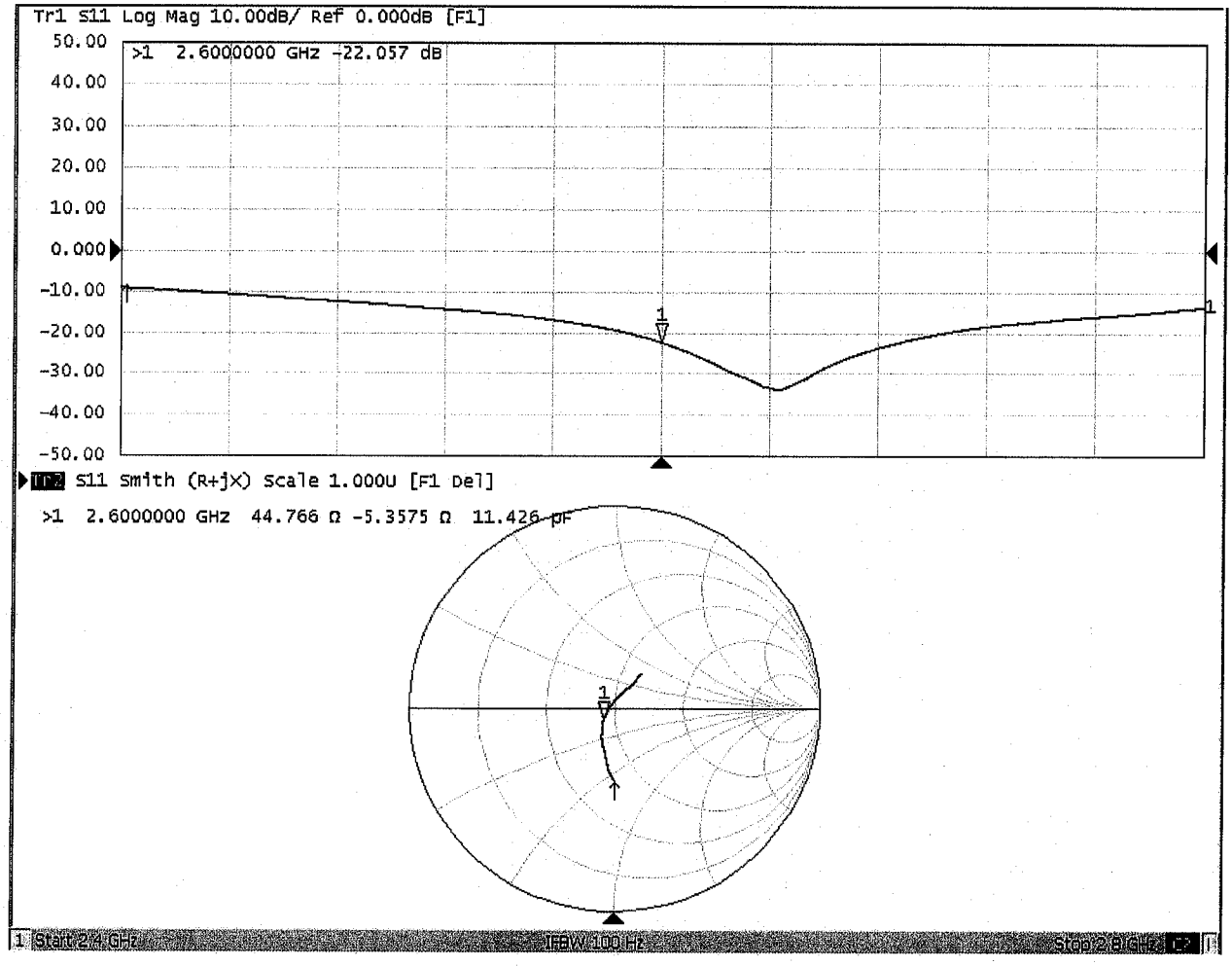
Impedance Measurement Plot for Body TSL



D2600V2, Serial No. 1070 Extended Dipole Calibrations

Referring to KDB 865664 D01 v01r02, if dipoles are verified in return loss (<-20dB, 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.

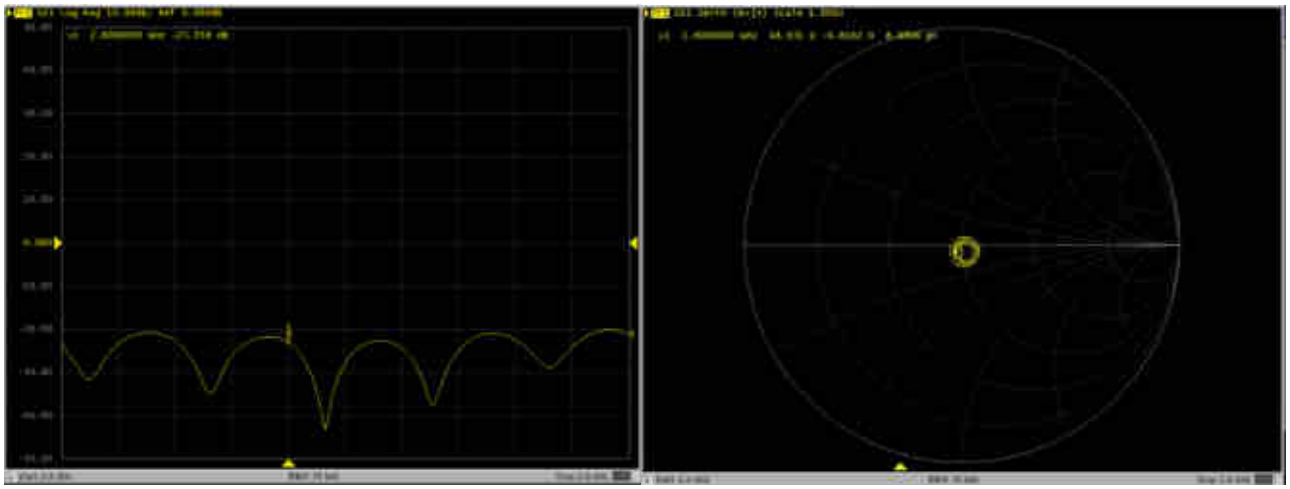
D2600V2 – serial no. 1070												
	2600 Head						2600 Body					
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2018.12.7	-23.7		48.6		-6.33		-22.1		44.8		-5.36	
2019.11.25	-23.1	2.5	48.6	0	-6.82	-0.49	-22.0	0.5	45.3	0.5	-4.65	0.71

<Justification of the extended calibration>

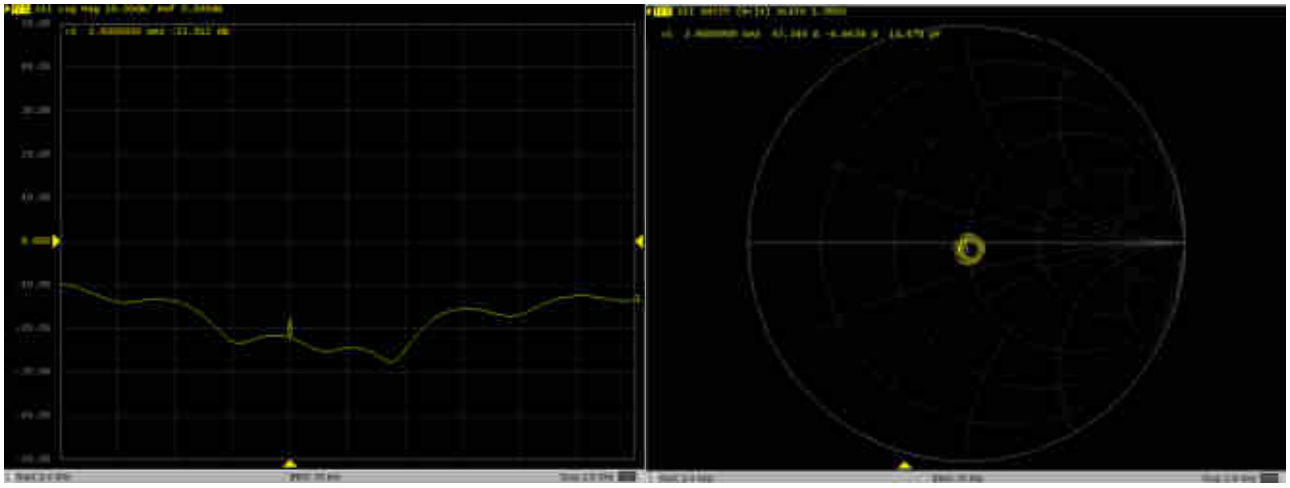
The return loss is < -20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Dipole Verification Data> D2600V2, serial no. 1070

2600MHz - Head



2600MHz – Body



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CNAS L0570

Client **Sporton** **Certificate No: Z18-60259**

CALIBRATION CERTIFICATE

Object D5GHzV2 - SN: 1167

Calibration Procedure(s) FF-Z11-003-01
Calibration Procedures for dipole validation kits

Calibration date: August 03, 2018

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)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	102083	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Power sensor NRP-Z91	100542	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
ReferenceProbe EX3DV4	SN 7464	12-Sep-17(SPEAG,No.EX3-7464_Sep17)	Sep-18
DAE4	SN 1524	13-Sep-17(SPEAG,No.DAE4-1524_Sep17)	Sep-18
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	23-Jan-18 (CTTL, No.J18X00560)	Jan-19
NetworkAnalyzerE5071C	MY46110673	24-Jan-18 (CTTL, No.J18X00561)	Jan-19

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: August 6, 2018

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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,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, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016

c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010

d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) 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%.

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Measurement Conditions

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

DASY Version	DASY52	52.10.1.1476
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4 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	35.9 ± 6 %	4.82 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °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	7.69 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**77.0 mW /g ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.20 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**22.0 mW /g ± 24.2 % (k=2)**

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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	35.1 ± 6 %	5.18 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °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	8.09 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**80.8 mW /g ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.32 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**23.2 mW /g ± 24.2 % (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	34.9 ± 6 %	5.37 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °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	7.70 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**76.9 mW /g ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.17 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**21.6 mW /g ± 24.2 % (k=2)**

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Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.4 ± 6 %	5.32 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.46 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**74.4 mW /g ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.10 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**20.9 mW /g ± 24.2 % (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	47.7 ± 6 %	5.79 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °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	7.73 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**77.1 mW /g ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.16 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**21.5 mW /g ± 24.2 % (k=2)**

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Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.5 ± 6 %	5.93 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.43 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**74.3 mW /g ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.08 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**20.8 mW /g ± 24.2 % (k=2)**

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	50.3Ω - 9.42jΩ
Return Loss	- 20.6dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	58.1Ω - 7.15jΩ
Return Loss	- 20.0dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	53.5Ω - 7.66jΩ
Return Loss	- 21.8dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	49.5Ω - 7.40jΩ
Return Loss	- 22.6dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	58.0Ω - 6.37jΩ
Return Loss	- 20.5dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	54.5Ω - 7.07jΩ
Return Loss	- 21.9dB

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General Antenna Parameters and Design

Electrical Delay (one direction)	1.065 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

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DASY5 Validation Report for Head TSL Date: 07.27.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1167

Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz,

Medium parameters used: f = 5250 MHz; σ = 4.822 S/m; εr = 35.92; ρ = 1000 kg/m3, Medium parameters used: f = 5600 MHz; σ = 5.184 S/m; εr = 35.14; ρ = 1000 kg/m3, Medium parameters used: f = 5750 MHz; σ = 5.365 S/m; εr = 34.88; ρ = 1000 kg/m3,

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(5.68, 5.68, 5.68) @ 5250 MHz; Calibrated: 9/12/2017, ConvF(4.98, 4.98, 4.98) @ 5600 MHz; Calibrated: 9/12/2017, ConvF(5.04, 5.04, 5.04) @ 5750 MHz; Calibrated: 9/12/2017,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 65.09 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 32.4 W/kg
SAR(1 g) = 7.69 W/kg; SAR(10 g) = 2.2 W/kg
Maximum value of SAR (measured) = 18.0 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.53 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 36.2 W/kg
SAR(1 g) = 8.09 W/kg; SAR(10 g) = 2.32 W/kg
Maximum value of SAR (measured) = 19.7 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.79 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 36.2 W/kg
SAR(1 g) = 7.7 W/kg; SAR(10 g) = 2.17 W/kg
Maximum value of SAR (measured) = 19.0 W/kg

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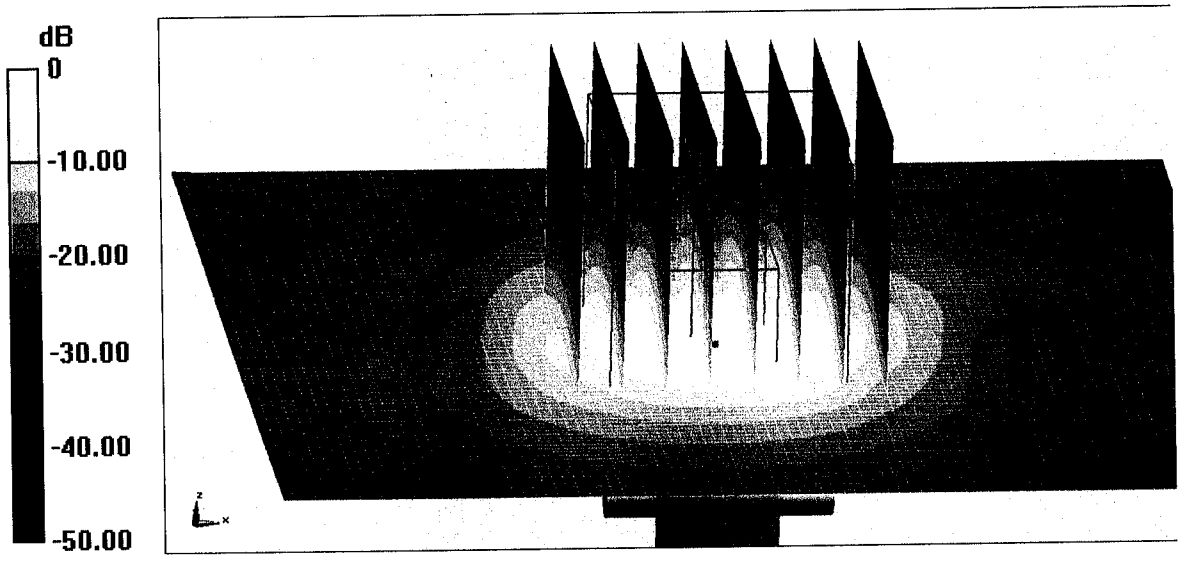

0 dB = 19.0 W/kg = 12.79 dBW/kg

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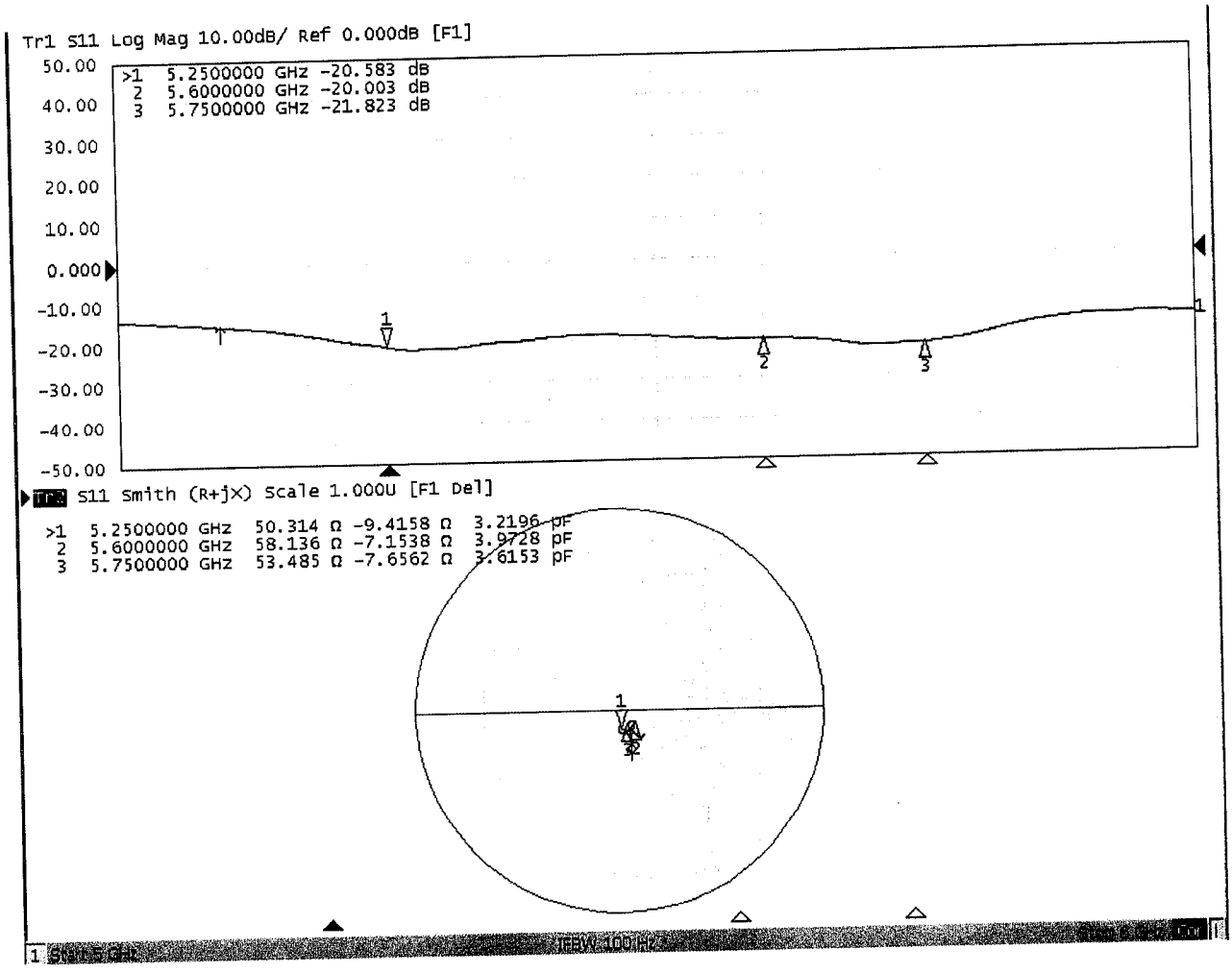
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Date: 08.02.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1167

Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz,

Medium parameters used: f = 5250 MHz; σ = 5.316 S/m; εr = 48.42; ρ = 1000 kg/m3, Medium parameters used: f = 5600 MHz; σ = 5.789 S/m; εr = 47.7; ρ = 1000 kg/m3, Medium parameters used: f = 5750 MHz; σ = 5.926 S/m; εr = 48.45; ρ = 1000 kg/m3,

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(5.29, 5.29, 5.29) @ 5250 MHz; Calibrated: 9/12/2017, ConvF(4.5, 4.5, 4.5) @ 5600 MHz; Calibrated: 9/12/2017, ConvF(4.59, 4.59, 4.59) @ 5750 MHz; Calibrated: 9/12/2017,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 64.14 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 31.9 W/kg
SAR(1 g) = 7.46 W/kg; SAR(10 g) = 2.1 W/kg
Maximum value of SAR (measured) = 17.6 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 62.32 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 36.3 W/kg
SAR(1 g) = 7.73 W/kg; SAR(10 g) = 2.16 W/kg
Maximum value of SAR (measured) = 19.1 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.99 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 35.2 W/kg
SAR(1 g) = 7.43 W/kg; SAR(10 g) = 2.08 W/kg
Maximum value of SAR (measured) = 18.0 W/kg

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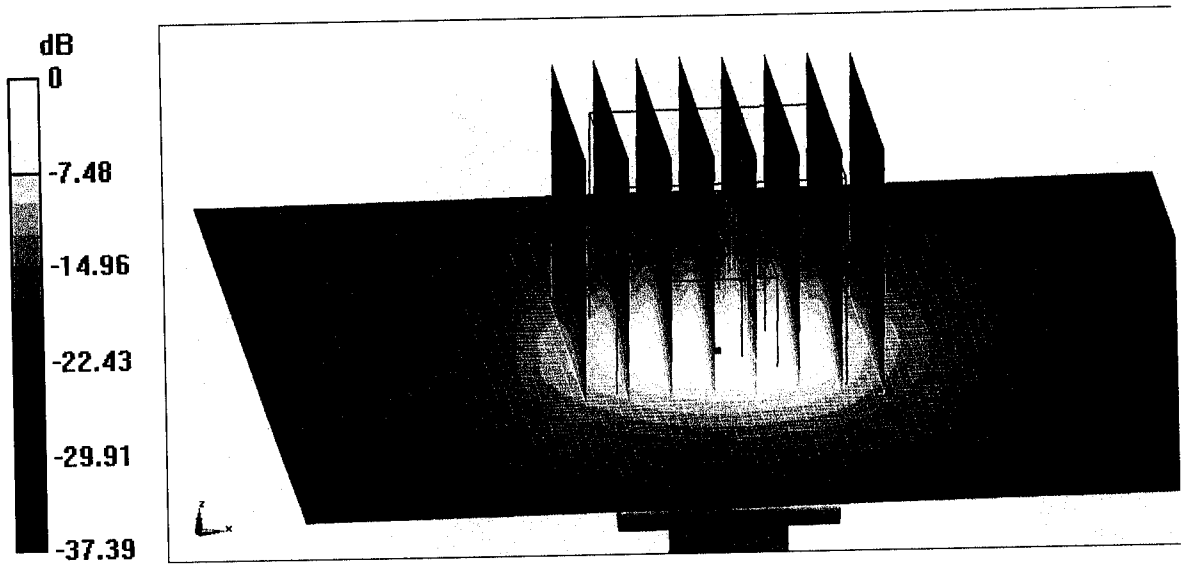

0 dB = 18.0 W/kg = 12.55 dBW/kg

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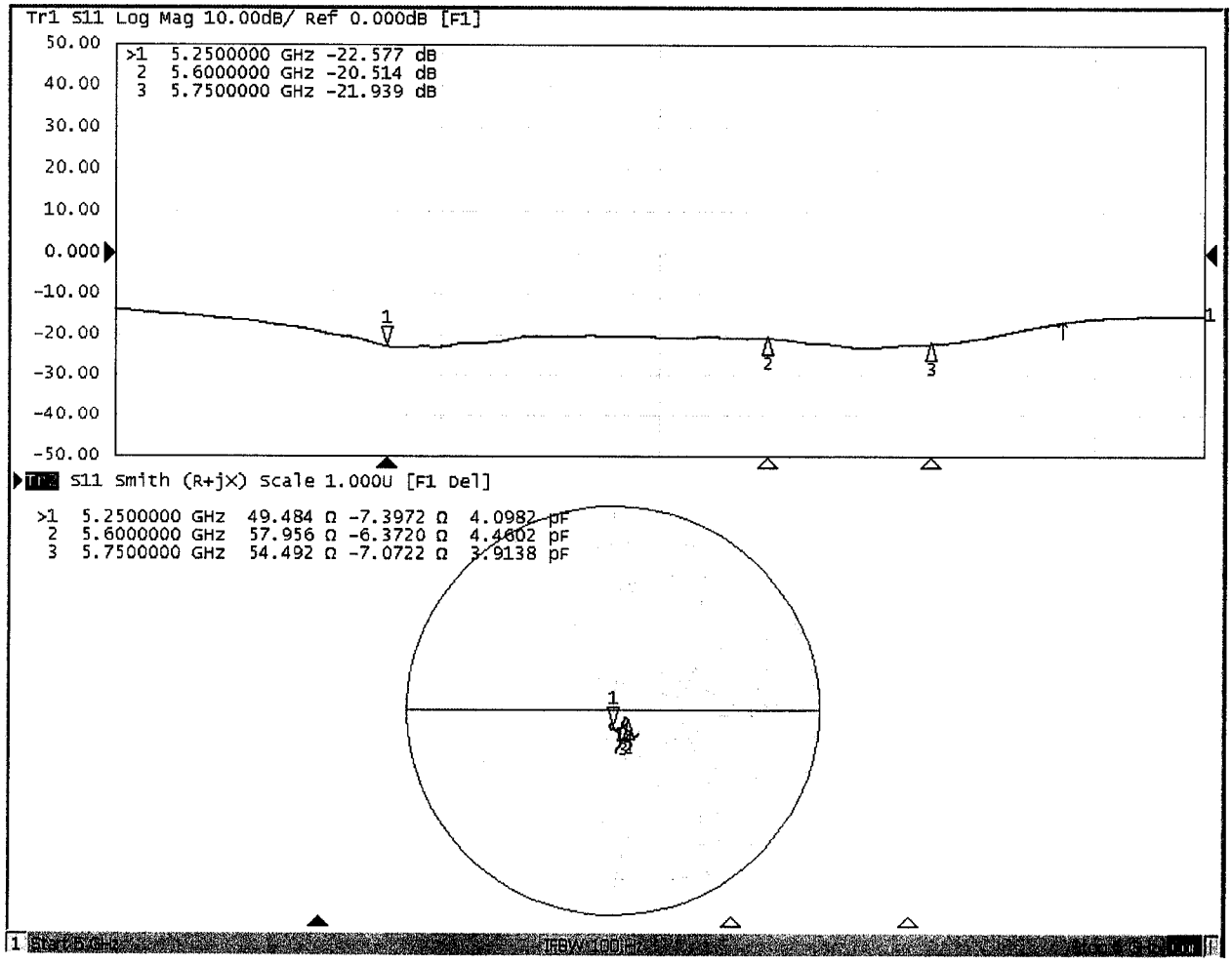
Impedance Measurement Plot for Body TSL



D5GHzV3, Serial No. 1167 Extended Dipole Calibrations

Referring to KDB 865664 D01 v01r02, if dipoles are verified in return loss (<-20dB, 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.

5250MHz

D5GHzV3 – serial no. 1167												
	5250 Head						5250 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)
2018.08.03	-20.6		50.3		-9.42		-22.6		49.5		-7.40	
2019.10.30	-20.3	1.5	50.9	0.6	-9.72	-0.3	-22.4	0.9	48.2	-1.3	-7.25	0.15

5600MHz

D5GHzV3 – serial no. 1167												
	5600 Head						5600 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)
2018.08.03	-20.0		58.1		-7.15		-20.5		58.0		-6.37	
2019.10.30	-20.1	-0.5	57.4	-0.7	-7.63	-0.48	-20.4	0.5	57.7	-0.3	-6.87	-0.5

5750MHz

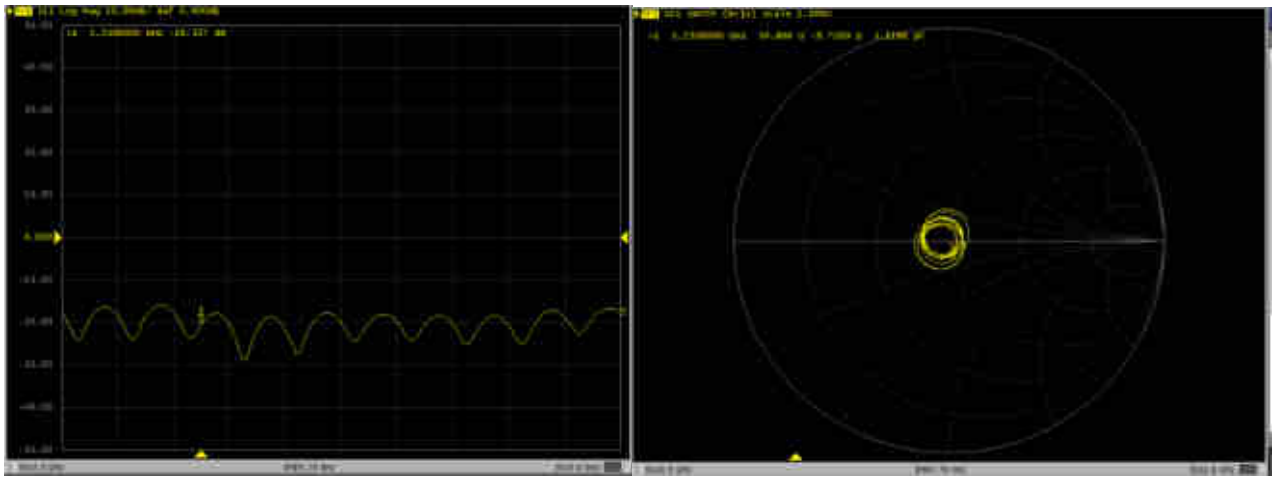
D5GHzV3 – serial no. 1167												
	5750 Head						5750 Body					
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2018.08.03	-21.8		53.5		-7.66		-21.9		54.5		-7.07	
2019.10.30	-21.1	3.2	53.0	-0.5	-8.58	-0.92	-21.6	1.4	55.2	0.7	-7.04	0.03

<Justification of the extended calibration>

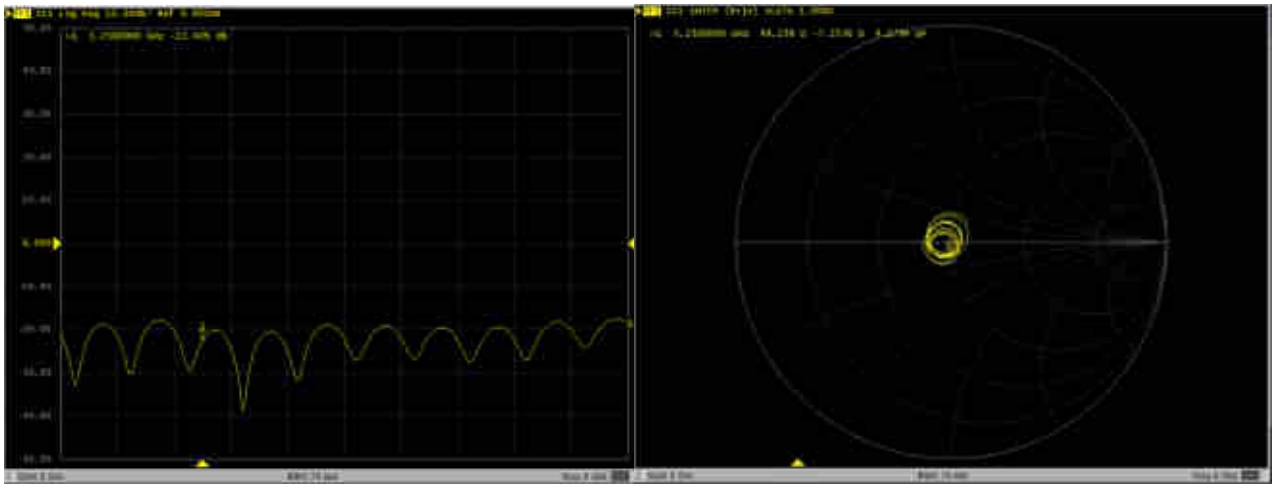
The return loss is < -20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Dipole Verification Data> D5GHzV3, serial no. 1167

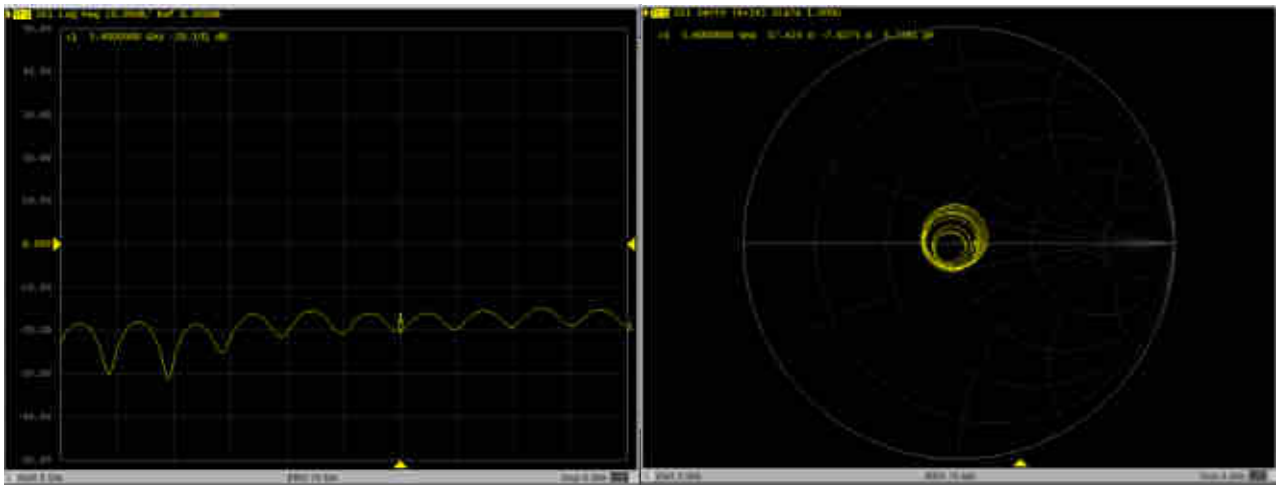
5250MHz - Head



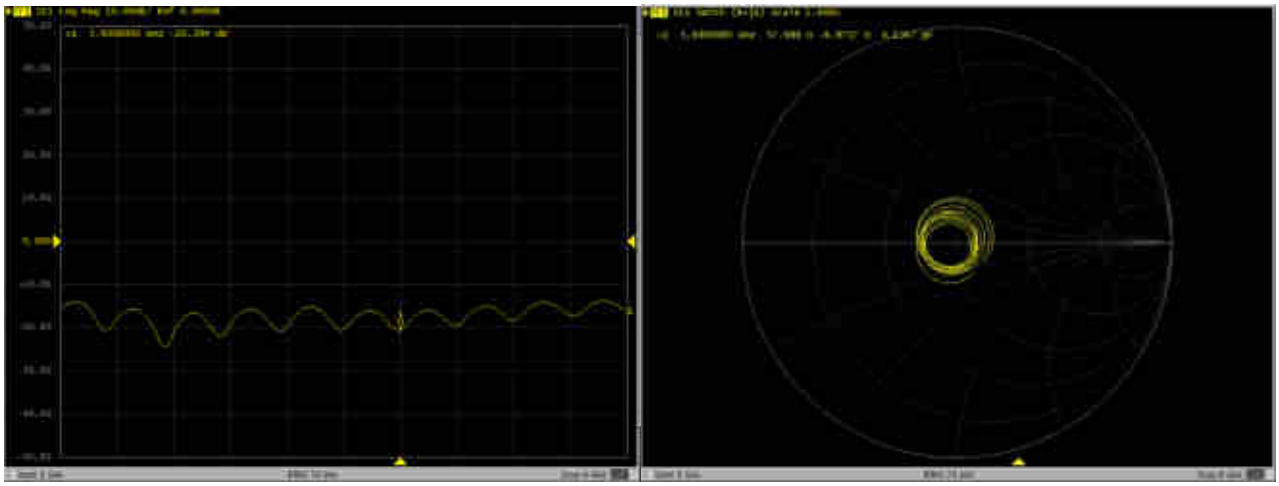
5250MHz – Body



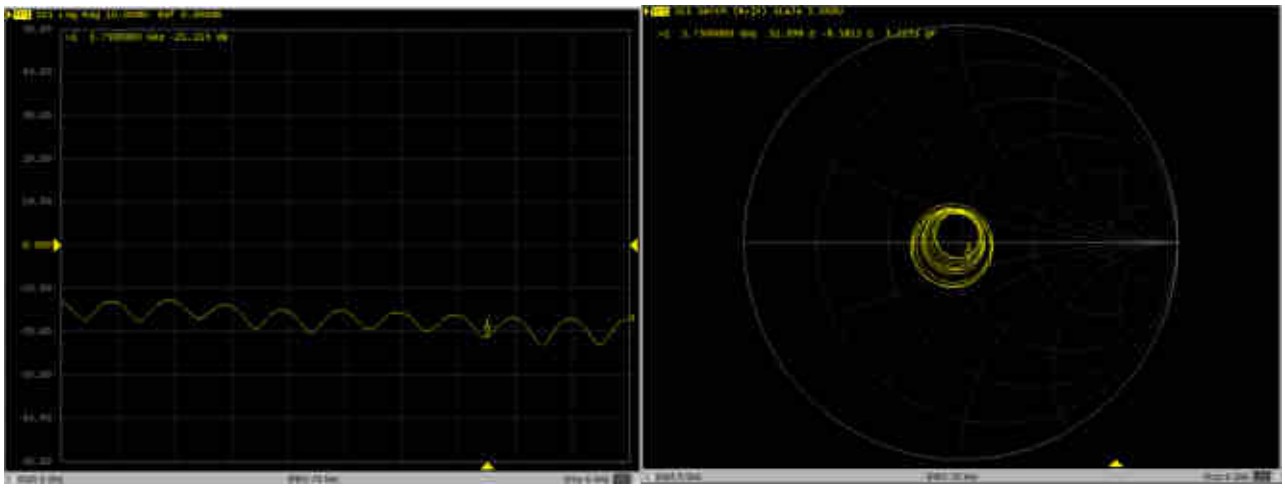
5600MHz – Head



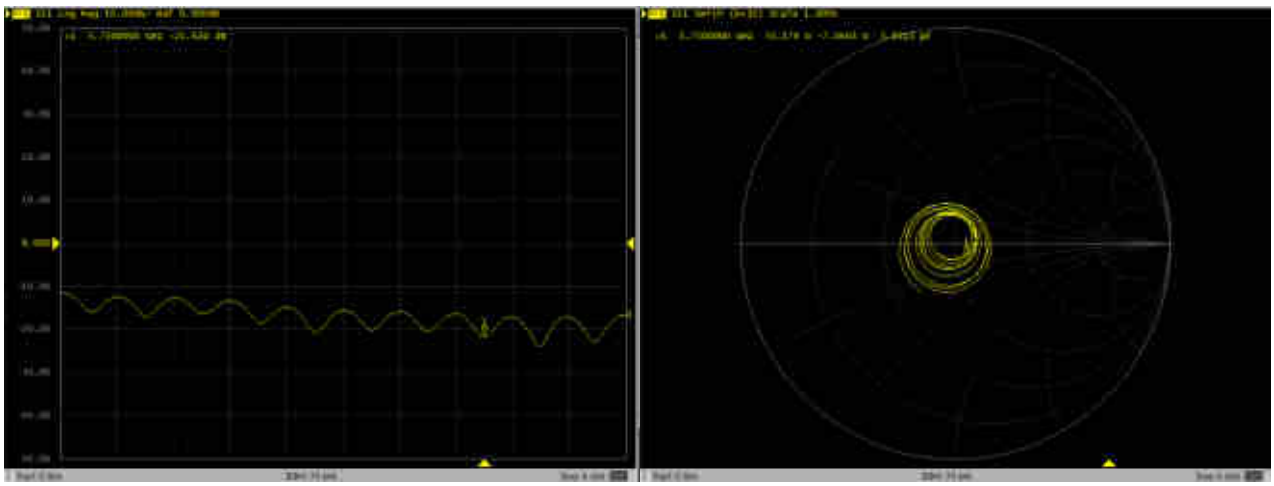
5600MHz – Body



5750MHz – Head



5750MHz – Body



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Client : **Sporton** **Certificate No: Z19-60436**

CALIBRATION CERTIFICATE

Object	DAE4 - SN: 1437
Calibration Procedure(s)	FF-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx)
Calibration date:	November 19, 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±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Process Calibrator 753	1971018	24-Jun-19 (CTTL, No.J19X05126)	Jun-20

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Zhao Jing	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: November 21, 2019

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

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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 report provide only calibration results for DAE, it does not contain other performance test results.

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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	404.110 ± 0.15% (k=2)	403.634 ± 0.15% (k=2)	404.056 ± 0.15% (k=2)
Low Range	3.95185 ± 0.7% (k=2)	3.93955 ± 0.7% (k=2)	3.90561 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	65° ± 1 °

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CNAS L0570

Client **Auden** **Certificate No: Z19-60119**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3975
Calibration Procedure(s)	FF-Z11-004-01 Calibration Procedures for Dosimetric E-field Probes
Calibration date:	April 30, 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±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Power sensor NRP-Z91	101547	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Power sensor NRP-Z91	101548	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Reference10dBAttenuator	18N50W-10dB	09-Feb-18(CTTL, No.J18X01133)	Feb-20
Reference20dBAttenuator	18N50W-20dB	09-Feb-18(CTTL, No.J18X01132)	Feb-20
Reference Probe EX3DV4	SN 7514	27-Aug-18(SPEAG,No.EX3-7514_Aug18/2)	Aug-19
DAE4	SN 1555	20-Aug-18(SPEAG, No.DAE4-1555_Aug18)	Aug -19
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
SignalGeneratorMG3700A	6201052605	21-Jun-18 (CTTL, No.J18X05033)	Jun-19
Network Analyzer E5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan -20

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

Issued: May 01, 2019

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Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

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 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, "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

c) 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

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization θ=0 (f≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect 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 (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;VRx,y,z:*A,B,C 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≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued 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±50MHz to±100MHz.
- *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).

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E-mail: cttl@chinattl.com Http://www.chinattl.cn

Probe EX3DV4

SN: 3975

Calibrated: April 30, 2019

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3975

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(μV/(V/m)²)[A]	0.41	0.45	0.51	±10.0%
DCP(mV)[B]	103.9	101.7	102.6	

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	150.5	±2.5%
		Y	0.0	0.0	1.0		159.5	
		Z	0.0	0.0	1.0		168.4	

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

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3975

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)
750	41.9	0.89	9.94	9.94	9.94	0.14	1.23	±12.1%
835	41.5	0.90	9.57	9.57	9.57	0.14	1.32	±12.1%
900	41.5	0.97	9.57	9.57	9.57	0.17	1.31	±12.1%
1750	40.1	1.37	8.34	8.34	8.34	0.22	1.14	±12.1%
1900	40.0	1.40	7.88	7.88	7.88	0.28	0.95	±12.1%
2000	40.0	1.40	7.90	7.90	7.90	0.26	0.97	±12.1%
2300	39.5	1.67	7.70	7.70	7.70	0.65	0.69	±12.1%
2450	39.2	1.80	7.40	7.40	7.40	0.63	0.70	±12.1%
2600	39.0	1.96	7.25	7.25	7.25	0.82	0.62	±12.1%
3500	37.9	2.91	6.69	6.69	6.69	0.73	0.85	±13.3%
5250	35.9	4.71	5.27	5.27	5.27	0.40	1.60	±13.3%
5600	35.5	5.07	4.70	4.70	4.70	0.45	1.45	±13.3%
5750	35.4	5.22	4.75	4.75	4.75	0.45	1.75	±13.3%

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

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

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3975

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)
750	55.5	0.96	9.96	9.96	9.96	0.40	0.80	±12.1%
835	55.2	0.97	9.65	9.65	9.65	0.16	1.45	±12.1%
900	55.0	1.05	9.66	9.66	9.66	0.23	1.22	±12.1%
1750	53.4	1.49	7.96	7.96	7.96	0.21	1.13	±12.1%
1900	53.3	1.52	7.72	7.72	7.72	0.23	1.12	±12.1%
2000	53.3	1.52	7.74	7.74	7.74	0.18	1.25	±12.1%
2300	52.9	1.81	7.62	7.62	7.62	0.55	0.81	±12.1%
2450	52.7	1.95	7.53	7.53	7.53	0.71	0.71	±12.1%
2600	52.5	2.16	7.30	7.30	7.30	0.69	0.69	±12.1%
3500	51.3	3.31	6.59	6.59	6.59	0.50	1.08	±13.3%
5250	48.9	5.36	4.80	4.80	4.80	0.45	1.65	±13.3%
5600	48.5	5.77	4.21	4.21	4.21	0.50	1.65	±13.3%
5750	48.3	5.94	4.27	4.27	4.27	0.50	1.52	±13.3%

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

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

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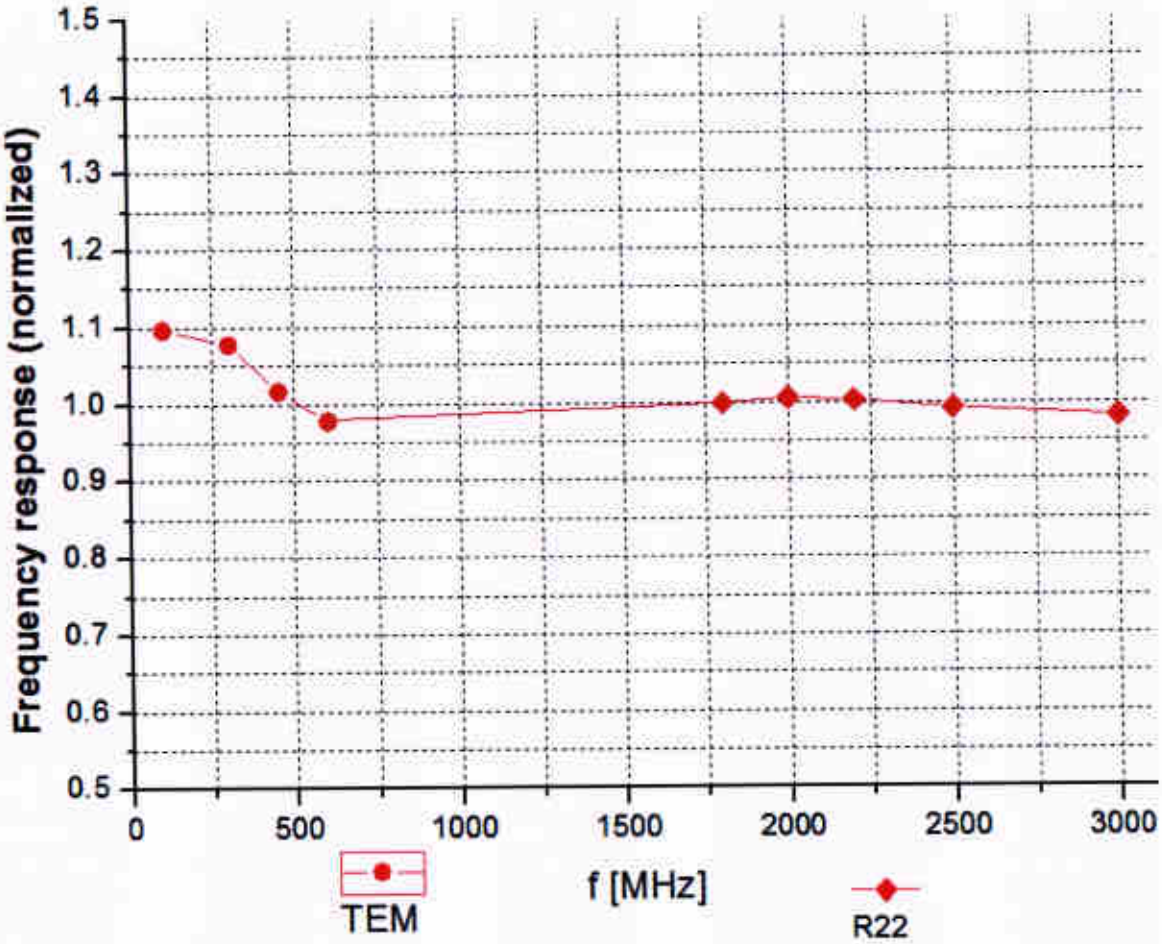
Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.4% (k=2)

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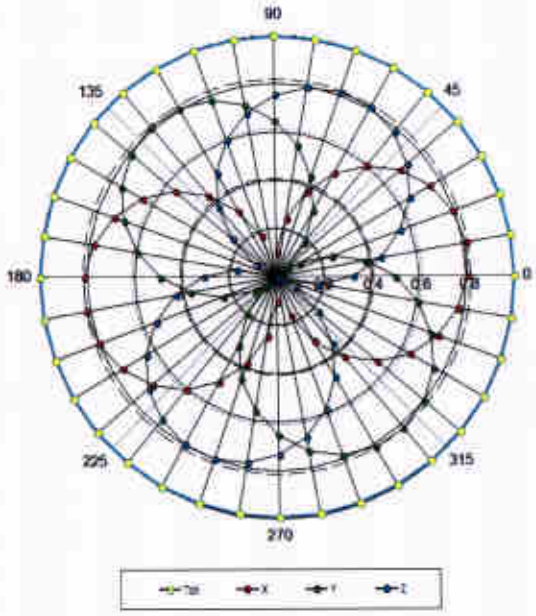
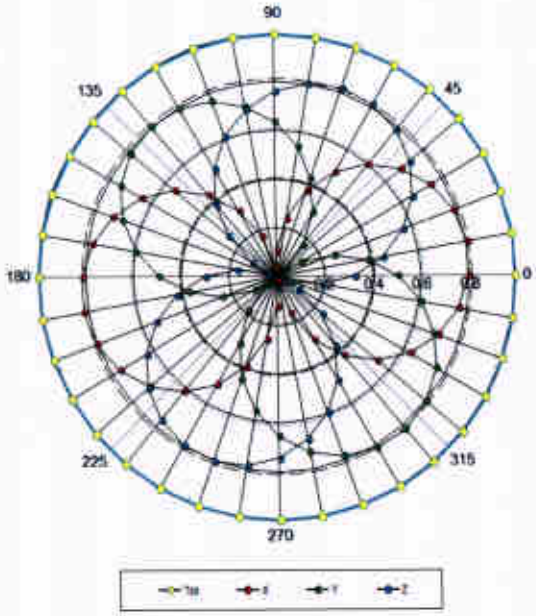
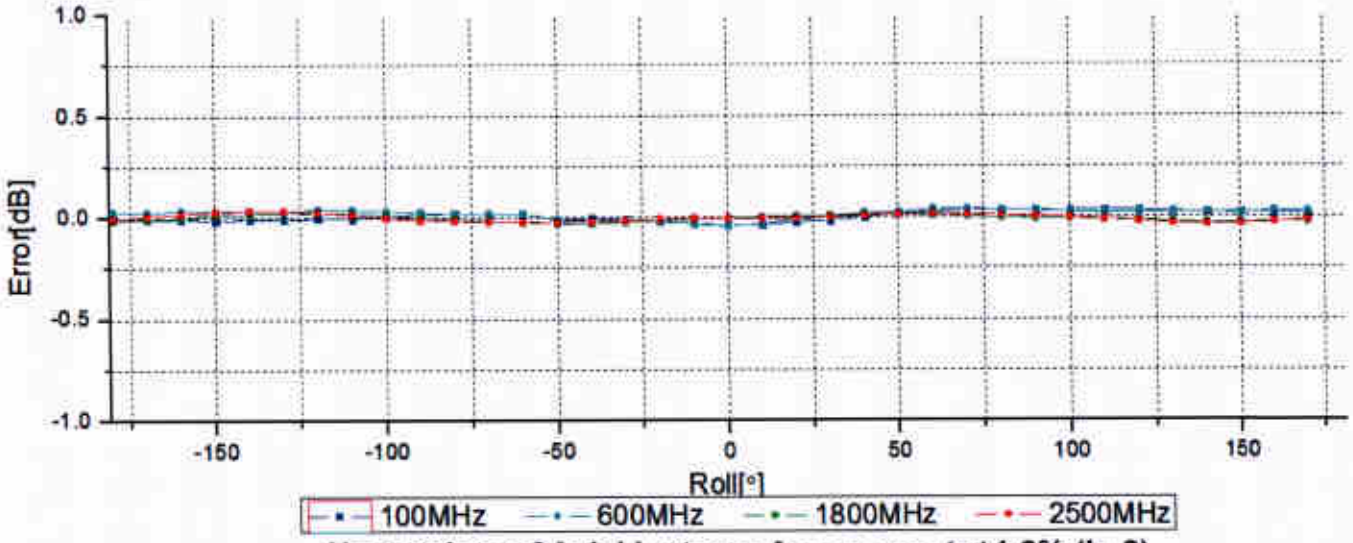
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM



f=1800 MHz, R22





Uncertainty of Axial Isotropy Assessment: ±1.2% (k=2)

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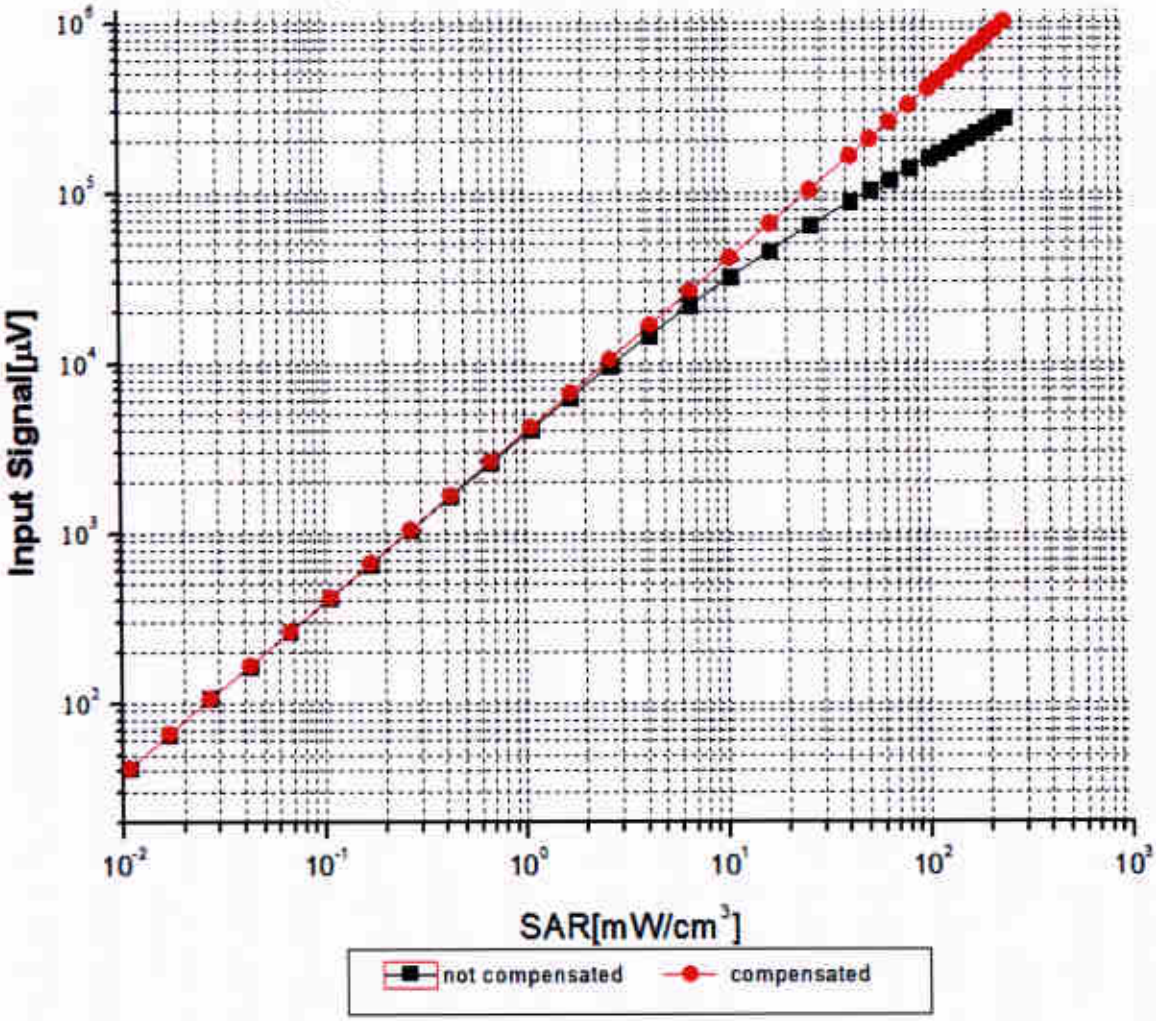
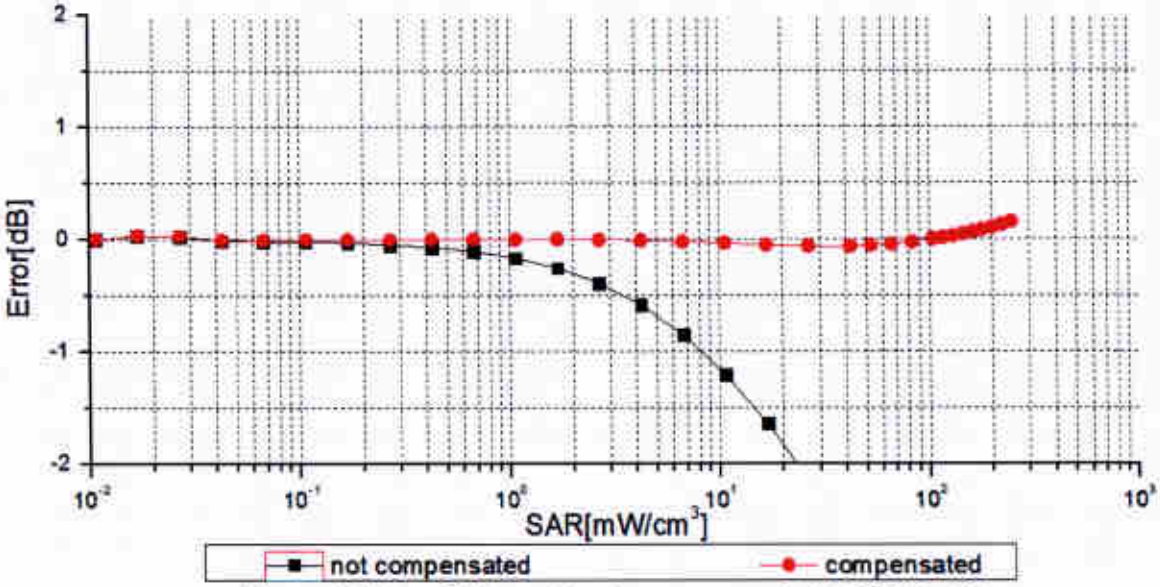
Dynamic Range f(SAR$_{head}$)
(TEM cell, f = 900 MHz)





Uncertainty of Linearity Assessment: ±0.9% (k=2)

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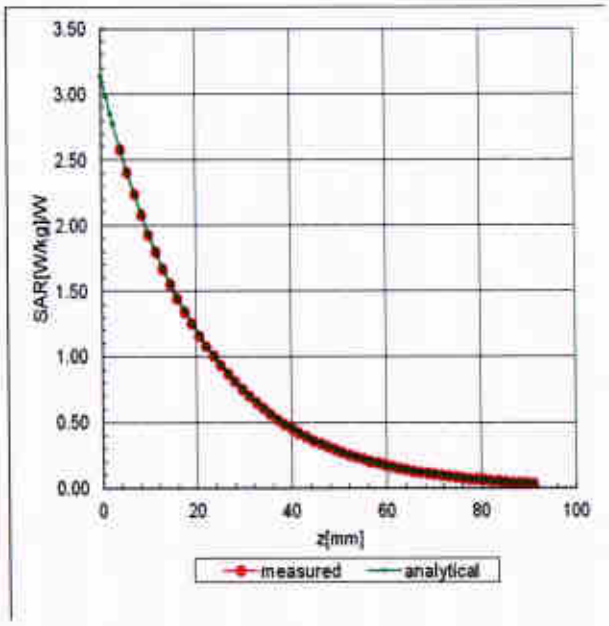
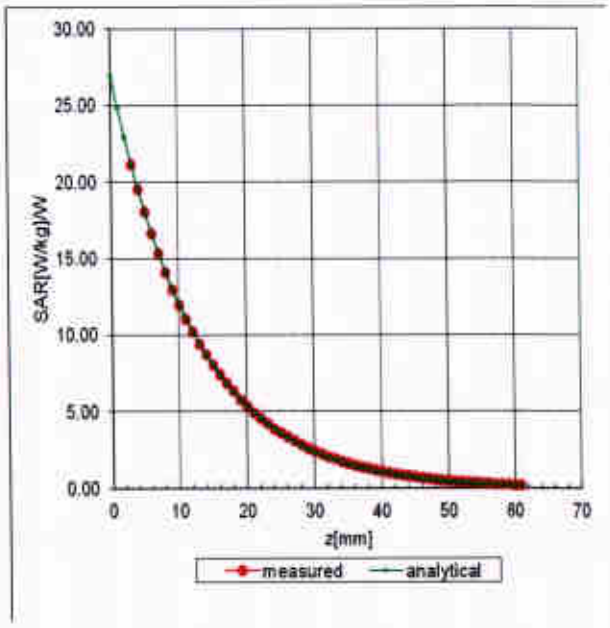
Conversion Factor Assessment

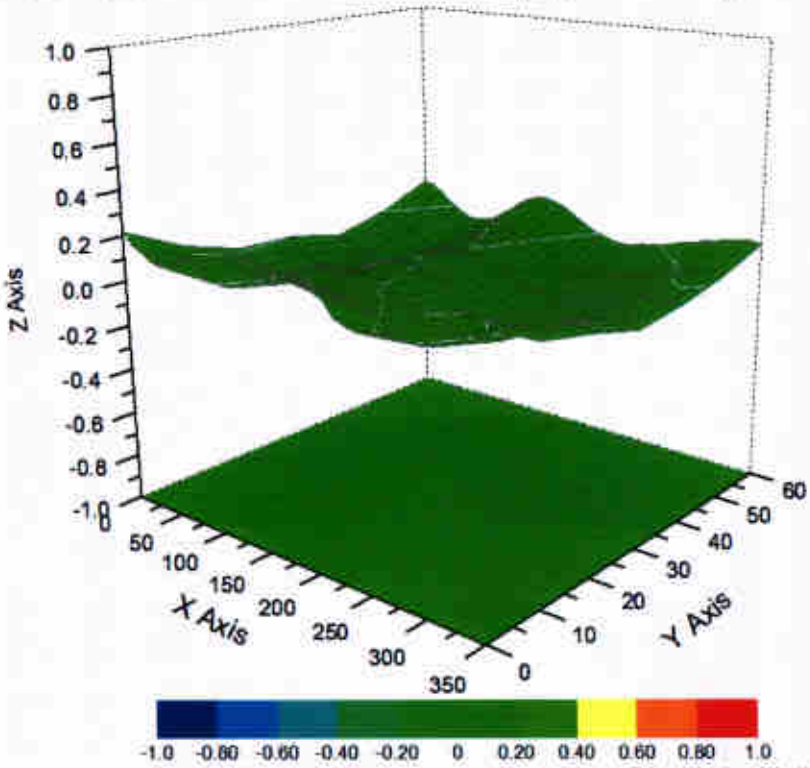
f=750 MHz, WGLS R9(H_convF)



f=1750 MHz, WGLS R22(H_convF)



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±3.2% (K=2)

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3975

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	83.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

Appendix E. Conducted RF Output Power Table

The detailed power table are shown as follows.

WWAN Power

GSM850	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
TX Channel	128	189	251		128	189	251	
Frequency (MHz)	824.2	836.4	848.8		824.2	836.4	848.8	
GPRS 1 Tx slot	32.84	32.91	32.91	33.50	23.84	23.91	23.91	24.50
GPRS 2 Tx slots	30.79	30.93	30.89	31.50	24.79	24.93	24.89	25.50
GPRS 3 Tx slots	28.15	28.22	28.11	29.00	23.89	23.96	23.85	24.74
GPRS 4 Tx slots	26.88	26.89	26.81	27.50	23.88	23.89	23.81	24.50
EDGE 1 Tx slot	27.04	26.88	27.03	27.50	18.04	17.88	18.03	18.50
EDGE 2 Tx slots	25.18	25.03	25.06	25.50	19.18	19.03	19.06	19.50
EDGE 3 Tx slots	22.63	22.73	22.73	24.00	18.37	18.47	18.47	19.74
EDGE 4 Tx slots	21.65	21.79	21.44	22.50	18.65	18.79	18.44	19.50

GSM1900	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
TX Channel	512	661	810		512	661	810	
Frequency (MHz)	1850.2	1880	1909.8		1850.2	1880	1909.8	
GPRS 1 Tx slot	30.17	30.01	29.90	31.00	21.17	21.01	20.90	22.00
GPRS 2 Tx slots	28.94	29.15	28.94	30.00	22.94	23.15	22.94	24.00
GPRS 3 Tx slots	26.66	26.75	26.93	28.00	22.40	22.49	22.67	23.74
GPRS 4 Tx slots	25.57	25.61	25.71	26.50	22.57	22.61	22.71	23.50
EDGE 1 Tx slot	25.86	25.93	25.85	27.00	16.86	16.93	16.85	18.00
EDGE 2 Tx slots	24.51	24.65	24.72	25.50	18.51	18.65	18.72	19.50
EDGE 3 Tx slots	22.91	22.93	22.96	24.00	18.65	18.67	18.70	19.74
EDGE 4 Tx slots	21.64	21.71	21.68	22.50	18.64	18.71	18.68	19.50

Band		WCDMA II			Tune-up Limit (dBm)	WCDMA IV			Tune-up Limit (dBm)
TX Channel		9262	9400	9538		1312	1413	1513	
Rx Channel		9662	9800	9938		1537	1638	1738	
Frequency (MHz)		1852.4	1880	1907.6		1712.4	1732.6	1752.6	
3GPP Rel 99	RMC 12.2Kbps	23.31	23.32	23.17	24.50	23.21	23.25	23.09	24.50
3GPP Rel 6	HSDPA Subtest-1	22.99	23.02	23.04	24.00	23.04	22.96	23.00	24.00
3GPP Rel 6	HSDPA Subtest-2	23.16	23.17	23.09	24.00	23.09	22.97	22.98	24.00
3GPP Rel 6	HSDPA Subtest-3	22.66	22.68	22.63	23.50	22.63	22.60	22.51	23.50
3GPP Rel 6	HSDPA Subtest-4	22.66	22.69	22.61	23.50	22.61	22.60	22.50	23.50
3GPP Rel 8	DC-HSDPA Subtest-1	22.87	22.95	22.92	24.00	23.01	22.92	22.95	24.00
3GPP Rel 8	DC-HSDPA Subtest-2	23.12	23.21	23.12	24.00	23.02	22.89	22.93	24.00
3GPP Rel 8	DC-HSDPA Subtest-3	22.53	22.61	22.58	23.50	22.51	22.53	22.49	23.50
3GPP Rel 8	DC-HSDPA Subtest-4	22.51	22.62	22.56	23.50	22.50	22.54	22.47	23.50
3GPP Rel 6	HSUPA Subtest-1	22.57	22.68	22.67	24.00	22.42	22.67	22.61	24.00
3GPP Rel 6	HSUPA Subtest-2	21.04	21.04	21.08	22.00	20.76	20.89	20.84	22.00
3GPP Rel 6	HSUPA Subtest-3	22.00	22.01	21.88	23.00	21.77	21.87	21.72	23.00
3GPP Rel 6	HSUPA Subtest-4	21.65	21.61	21.58	22.00	21.39	21.47	21.34	22.00
3GPP Rel 6	HSUPA Subtest-5	23.00	22.90	22.90	24.00	22.70	22.90	22.80	24.00

Band		WCDMA V			Tune-up Limit (dBm)
TX Channel		4132	4182	4233	
Rx Channel		4357	4407	4458	
Frequency (MHz)		826.4	836.4	846.6	
3GPP Rel 99	RMC 12.2Kbps	23.16	23.34	23.21	24.50
3GPP Rel 6	HSDPA Subtest-1	22.93	23.00	23.14	24.00
3GPP Rel 6	HSDPA Subtest-2	23.05	23.05	23.16	24.00
3GPP Rel 6	HSDPA Subtest-3	22.58	22.57	22.69	23.50
3GPP Rel 6	HSDPA Subtest-4	22.58	22.56	22.69	23.50
3GPP Rel 8	DC-HSDPA Subtest-1	22.89	22.93	23.01	24.00
3GPP Rel 8	DC-HSDPA Subtest-2	22.85	22.91	22.99	24.00
3GPP Rel 8	DC-HSDPA Subtest-3	22.51	22.48	22.56	23.50
3GPP Rel 8	DC-HSDPA Subtest-4	22.49	22.47	22.58	23.50
3GPP Rel 6	HSUPA Subtest-1	22.49	22.67	22.83	24.00
3GPP Rel 6	HSUPA Subtest-2	20.87	20.94	21.07	22.00
3GPP Rel 6	HSUPA Subtest-3	21.91	21.98	22.04	23.00
3GPP Rel 6	HSUPA Subtest-4	21.43	21.49	21.55	22.00
3GPP Rel 6	HSUPA Subtest-5	22.80	22.80	23.00	24.00

Band 2 (1900MHz Band)
Part 24E

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)	MPR (dB)
Channel				18700	18900	19100		
Frequency (MHz)				1860	1880	1900		
20	QPSK	1	0	23.70	23.74	23.68		
20	QPSK	1	49	23.58	23.46	23.56	25	0
20	QPSK	1	99	23.62	23.61	23.57		
20	QPSK	50	0	22.58	22.71	22.50		
20	QPSK	50	24	22.53	22.65	22.59	24	1
20	QPSK	50	50	22.56	22.56	22.58		
20	QPSK	100	0	22.49	22.71	22.63		
20	16QAM	1	0	22.97	22.97	22.98		
20	16QAM	1	49	22.66	22.89	22.75	24	1
20	16QAM	1	99	22.60	22.92	22.71		
20	16QAM	50	0	21.57	21.70	21.59		
20	16QAM	50	24	21.62	21.66	21.67	23	2
20	16QAM	50	50	21.51	21.58	21.57		
20	16QAM	100	0	21.47	21.67	21.52		
Channel				18675	18900	19125	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1857.5	1880	1902.5		
15	QPSK	1	0	23.52	23.71	23.72		
15	QPSK	1	37	23.45	23.51	23.26	25	0
15	QPSK	1	74	23.59	23.58	23.45		
15	QPSK	36	0	22.43	22.59	22.50		
15	QPSK	36	20	22.29	22.43	22.36	24	1
15	QPSK	36	39	22.34	22.52	22.46		
15	QPSK	75	0	22.36	22.63	22.49		
15	16QAM	1	0	22.85	22.71	22.64		
15	16QAM	1	37	22.43	22.46	22.51	24	1
15	16QAM	1	74	22.49	22.66	22.74		
15	16QAM	36	0	21.41	21.65	21.40		
15	16QAM	36	20	21.35	21.52	21.25	23	2
15	16QAM	36	39	21.34	21.62	21.37		
15	16QAM	75	0	21.41	21.56	21.43		
Channel				18650	18900	19150	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1855	1880	1905		
10	QPSK	1	0	23.58	23.68	23.49		
10	QPSK	1	25	23.49	23.55	23.41	25	0
10	QPSK	1	49	23.50	23.47	23.45		
10	QPSK	25	0	22.37	22.61	22.45		
10	QPSK	25	12	22.50	22.61	22.42	24	1
10	QPSK	25	25	22.40	22.58	22.46		
10	QPSK	50	0	22.48	22.60	22.47		
10	16QAM	1	0	22.60	22.75	22.88		
10	16QAM	1	25	22.89	22.72	22.84	24	1
10	16QAM	1	49	22.69	22.55	22.85		
10	16QAM	25	0	21.35	21.80	21.43		
10	16QAM	25	12	21.38	21.72	21.41	23	2
10	16QAM	25	25	21.39	21.59	21.35		
10	16QAM	50	0	21.34	21.69	21.46		
Channel				18625	18900	19175	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1852.5	1880	1907.5		
5	QPSK	1	0	23.42	23.59	23.61		
5	QPSK	1	12	23.61	23.71	23.59	25	0
5	QPSK	1	24	23.70	23.72	23.50		
5	QPSK	12	0	22.45	22.56	22.45		
5	QPSK	12	7	22.41	22.52	22.38	24	1
5	QPSK	12	13	22.39	22.68	22.36		
5	QPSK	25	0	22.40	22.61	22.47		
5	16QAM	1	0	22.69	22.76	22.37		
5	16QAM	1	12	22.34	22.71	22.34	24	1
5	16QAM	1	24	22.39	22.46	22.38		
5	16QAM	12	0	21.32	21.45	21.43		
5	16QAM	12	7	21.22	21.60	21.35	23	2
5	16QAM	12	13	21.36	21.67	21.44		
5	16QAM	25	0	21.35	21.60	21.36		
Channel				18615	18900	19185	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1851.5	1880	1908.5		
3	QPSK	1	0	23.49	23.62	23.55		
3	QPSK	1	8	23.55	23.57	23.32	25	0
3	QPSK	1	14	23.62	23.68	23.37		
3	QPSK	8	0	22.42	22.56	22.48		
3	QPSK	8	4	22.47	22.51	22.38	24	1
3	QPSK	8	7	22.49	22.56	22.33		
3	QPSK	15	0	22.45	22.61	22.41		
3	16QAM	1	0	23.01	22.88	23.18		
3	16QAM	1	8	22.80	22.94	22.84	24	1
3	16QAM	1	14	23.06	23.26	22.84		
3	16QAM	8	0	21.50	21.62	21.30		
3	16QAM	8	4	21.41	21.57	21.23	23	2
3	16QAM	8	7	21.46	21.69	21.26		
3	16QAM	15	0	21.43	21.84	21.37		
Channel				18607	18900	19193	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1850.7	1880	1909.3		
1.4	QPSK	1	0	23.26	23.36	23.32		
1.4	QPSK	1	3	23.38	23.50	23.34		
1.4	QPSK	1	5	23.28	23.38	23.34	25	0
1.4	QPSK	3	0	23.30	23.52	23.50		
1.4	QPSK	3	1	23.34	23.55	23.62		
1.4	QPSK	3	3	23.31	23.51	23.39		
1.4	QPSK	6	0	22.29	22.57	22.39	24	1
1.4	16QAM	1	0	22.45	22.66	22.43		
1.4	16QAM	1	3	22.34	22.80	22.70		
1.4	16QAM	1	5	22.53	22.76	22.36	24	1
1.4	16QAM	3	0	22.41	22.65	22.53		
1.4	16QAM	3	1	22.64	22.58	22.44		
1.4	16QAM	3	3	22.61	22.55	22.16		
1.4	16QAM	6	0	21.38	21.53	21.29	23	2

Band 4 (AWS Band)
Part 27L (only on channel required)

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)	MPR (dB)
Channel				20050	20175	20300		
Frequency (MHz)				1720	1732.5	1745		
20	QPSK	1	0	23.83	23.94	23.83		
20	QPSK	1	49	23.63	23.93	23.60	25	0
20	QPSK	1	99	23.67	23.54	23.80		
20	QPSK	50	0	22.55	22.78	22.75		
20	QPSK	50	24	22.50	22.63	22.56	24	1
20	QPSK	50	50	22.51	22.63	22.55		
20	QPSK	100	0	22.55	22.73	22.69		
20	16QAM	1	0	23.05	22.90	22.84		
20	16QAM	1	49	22.79	22.93	22.61	24	1
20	16QAM	1	99	23.06	22.73	22.72		
20	16QAM	50	0	21.63	21.82	21.65		
20	16QAM	50	24	21.57	21.67	21.54	23	2
20	16QAM	50	50	21.57	21.69	21.52		
20	16QAM	100	0	21.62	21.67	21.65		
Channel				20025	20175	20325	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1717.5	1732.5	1747.5		
15	QPSK	1	0	23.73	23.82	23.82		
15	QPSK	1	37	23.51	23.58	23.52	25	0
15	QPSK	1	74	23.61	23.61	23.83		
15	QPSK	36	0	22.53	22.75	22.70		
15	QPSK	36	20	22.48	22.57	22.57	24	1
15	QPSK	36	39	22.38	22.55	22.58		
15	QPSK	75	0	22.50	22.65	22.61		
15	16QAM	1	0	22.84	22.96	22.84		
15	16QAM	1	37	22.68	22.75	22.60	24	1
15	16QAM	1	74	22.97	23.04	22.98		
15	16QAM	36	0	21.56	21.67	21.67		
15	16QAM	36	20	21.59	21.60	21.62	23	2
15	16QAM	36	39	21.40	21.49	21.61		
15	16QAM	75	0	21.53	21.68	21.55		
Channel				20000	20175	20350	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1715	1732.5	1750		
10	QPSK	1	0	23.62	23.86	23.59		
10	QPSK	1	25	23.41	23.50	23.54	25	0
10	QPSK	1	49	23.50	23.46	23.49		
10	QPSK	25	0	22.45	22.54	22.56		
10	QPSK	25	12	22.37	22.49	22.49	24	1
10	QPSK	25	25	22.47	22.50	22.57		
10	QPSK	50	0	22.53	22.52	22.60		
10	16QAM	1	0	22.64	22.98	22.59		
10	16QAM	1	25	22.64	22.87	22.58	24	1
10	16QAM	1	49	22.81	22.67	22.61		
10	16QAM	25	0	21.52	21.52	21.54		
10	16QAM	25	12	21.41	21.46	21.53	23	2
10	16QAM	25	25	21.31	21.43	21.76		
10	16QAM	50	0	21.37	21.53	21.54		
Channel				19975	20175	20375	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1712.5	1732.5	1752.5		
5	QPSK	1	0	23.45	23.84	23.60		
5	QPSK	1	12	23.39	23.79	23.82	25	0
5	QPSK	1	24	23.48	23.82	23.76		
5	QPSK	12	0	22.45	22.60	22.52		
5	QPSK	12	7	22.26	22.54	22.42	24	1
5	QPSK	12	13	22.27	22.60	22.42		
5	QPSK	25	0	22.48	22.64	22.56		
5	16QAM	1	0	22.50	22.99	22.82		
5	16QAM	1	12	22.53	22.59	22.60	24	1
5	16QAM	1	24	22.64	22.93	22.92		
5	16QAM	12	0	21.52	21.62	21.37		
5	16QAM	12	7	21.42	21.53	21.32	23	2
5	16QAM	12	13	21.44	21.54	21.57		
5	16QAM	25	0	21.76	21.73	21.67		
Channel				19965	20175	20385	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1711.5	1732.5	1753.5		
3	QPSK	1	0	23.53	23.83	23.53		
3	QPSK	1	8	23.36	23.59	23.46	25	0
3	QPSK	1	14	23.36	23.67	23.62		
3	QPSK	8	0	22.51	22.63	22.46		
3	QPSK	8	4	22.42	22.68	22.50	24	1
3	QPSK	8	7	22.37	22.58	22.65		
3	QPSK	15	0	22.40	22.55	22.59		
3	16QAM	1	0	22.69	22.70	22.64		
3	16QAM	1	8	22.75	23.08	23.05	24	1
3	16QAM	1	14	22.70	23.00	23.04		
3	16QAM	8	0	21.33	21.78	21.33		
3	16QAM	8	4	21.42	21.69	21.45	23	2
3	16QAM	8	7	21.35	21.73	21.41		
3	16QAM	15	0	21.51	21.51	21.38		
Channel				19957	20175	20393	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1710.7	1732.5	1754.3		
1.4	QPSK	1	0	23.38	23.47	23.46		
1.4	QPSK	1	3	23.47	23.49	23.60		
1.4	QPSK	1	5	23.45	23.43	23.58	25	0
1.4	QPSK	3	0	23.52	23.68	23.63		
1.4	QPSK	3	1	23.64	23.71	23.77		
1.4	QPSK	3	3	23.55	23.65	23.77		
1.4	QPSK	6	0	22.51	22.59	22.71	24	1
1.4	16QAM	1	0	22.67	22.63	22.50		
1.4	16QAM	1	3	22.92	22.86	22.48		
1.4	16QAM	1	5	22.58	22.60	22.53	24	1
1.4	16QAM	3	0	22.54	22.63	22.23		
1.4	16QAM	3	1	22.46	22.68	22.57		
1.4	16QAM	3	3	22.47	22.64	22.35		
1.4	16QAM	6	0	21.20	21.62	21.53	23	2

Band 5 (Celluar Band)
Part 22H(only on channel required)

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)	MPR (dB)
Channel				20450	20525	20600		
Frequency (MHz)				829	836.5	844		
10	QPSK	1	0	23.77	23.93	23.87	25	0
10	QPSK	1	25	23.59	23.58	23.76		
10	QPSK	1	49	23.50	23.73	23.47		
10	QPSK	25	0	22.75	22.84	22.79	24	1
10	QPSK	25	12	22.64	22.63	22.72		
10	QPSK	25	25	22.62	22.66	22.60		
10	QPSK	50	0	22.69	22.76	22.75		
10	16QAM	1	0	22.92	22.97	22.94	24	1
10	16QAM	1	25	22.65	22.91	22.82		
10	16QAM	1	49	22.51	22.73	22.50		
10	16QAM	25	0	21.70	21.74	21.71	23	2
10	16QAM	25	12	21.69	21.58	21.53		
10	16QAM	25	25	21.39	21.48	21.42		
10	16QAM	50	0	21.66	21.73	21.65		
Channel				20425	20525	20625	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				826.5	836.5	846.5		
5	QPSK	1	0	23.70	23.67	23.85	25	0
5	QPSK	1	12	23.83	23.55	23.88		
5	QPSK	1	24	23.47	23.72	23.60		
5	QPSK	12	0	22.60	22.69	22.74	24	1
5	QPSK	12	7	22.59	22.67	22.61		
5	QPSK	12	13	22.63	22.60	22.61		
5	QPSK	25	0	22.68	22.64	22.73		
5	16QAM	1	0	22.88	22.91	22.74	24	1
5	16QAM	1	12	22.82	22.70	22.71		
5	16QAM	1	24	23.03	22.84	23.01		
5	16QAM	12	0	21.46	21.67	21.83	23	2
5	16QAM	12	7	21.43	21.62	21.70		
5	16QAM	12	13	21.57	21.67	21.70		
5	16QAM	25	0	21.75	21.90	21.93		
Channel				20415	20525	20635	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				825.5	836.5	847.5		
3	QPSK	1	0	23.79	23.87	23.79	25	0
3	QPSK	1	8	23.52	23.69	23.66		
3	QPSK	1	14	23.55	23.84	23.58		
3	QPSK	8	0	22.60	22.79	22.78	24	1
3	QPSK	8	4	22.58	22.65	22.74		
3	QPSK	8	7	22.71	22.52	22.64		
3	QPSK	15	0	22.70	22.66	22.68		
3	16QAM	1	0	22.59	22.66	22.94	24	1
3	16QAM	1	8	22.66	22.94	23.03		
3	16QAM	1	14	22.53	22.66	22.63		
3	16QAM	8	0	21.63	22.05	21.96	23	2
3	16QAM	8	4	21.56	21.84	22.02		
3	16QAM	8	7	21.58	21.92	21.61		
3	16QAM	15	0	21.49	21.95	21.67		
Channel				20407	20525	20643	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				824.7	836.5	848.3		
1.4	QPSK	1	0	23.38	23.66	23.48	25	0
1.4	QPSK	1	3	23.40	23.71	23.63		
1.4	QPSK	1	5	23.58	23.41	23.42		
1.4	QPSK	3	0	23.64	23.52	23.59		
1.4	QPSK	3	1	23.71	23.49	23.58		
1.4	QPSK	3	3	23.63	23.50	23.53		
1.4	QPSK	6	0	22.63	22.63	22.61	24	1
1.4	16QAM	1	0	22.97	22.65	22.88	24	1
1.4	16QAM	1	3	22.73	22.78	22.77		
1.4	16QAM	1	5	22.91	22.88	22.61		
1.4	16QAM	3	0	22.88	22.64	22.46		
1.4	16QAM	3	1	22.87	22.52	22.78		
1.4	16QAM	3	3	22.66	22.47	22.43		
1.4	16QAM	6	0	21.39	21.30	21.54	23	2

Band 7 (2600MHz Band)
Part 27

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)	MPR (dB)
Channel				20850	21100	21350		
Frequency (MHz)				2510	2535	2560		
20	QPSK	1	0	19.72	19.79	19.78	20	0
20	QPSK	1	49	19.69	19.76	19.77		
20	QPSK	1	99	19.56	19.78	19.67		
20	QPSK	50	0	18.69	18.75	18.74	19	1
20	QPSK	50	24	18.65	18.65	18.71		
20	QPSK	50	50	18.68	18.69	18.73		
20	QPSK	100	0	18.67	18.69	18.62		
20	16QAM	1	0	18.73	18.74	18.71	19	1
20	16QAM	1	49	18.71	18.71	18.73		
20	16QAM	1	99	18.73	18.97	18.72		
20	16QAM	50	0	17.73	17.71	17.73	18	2
20	16QAM	50	24	17.54	17.83	17.72		
20	16QAM	50	50	17.61	17.85	17.76		
20	16QAM	100	0	17.65	17.86	17.79		
Channel				20825	21100	21375	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				2507.5	2535	2562.5		
15	QPSK	1	0	19.58	19.73	19.63	20	0
15	QPSK	1	37	19.59	19.62	19.63		
15	QPSK	1	74	19.61	19.68	19.67		
15	QPSK	36	0	18.62	18.59	18.78	19	1
15	QPSK	36	20	18.49	18.55	18.71		
15	QPSK	36	39	18.65	18.78	18.75		
15	QPSK	75	0	18.54	18.68	18.79		
15	16QAM	1	0	18.99	18.75	18.86	19	1
15	16QAM	1	37	18.56	18.70	18.75		
15	16QAM	1	74	18.62	18.90	19.00		
15	16QAM	36	0	17.73	17.66	17.69	18	2
15	16QAM	36	20	17.61	17.71	17.79		
15	16QAM	36	39	17.49	17.83	17.61		
15	16QAM	75	0	17.58	17.65	17.83		
Channel				20800	21100	21400	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				2505	2535	2565		
10	QPSK	1	0	19.46	19.60	19.59	20	0
10	QPSK	1	25	19.72	19.54	19.65		
10	QPSK	1	49	19.63	19.66	19.74		
10	QPSK	25	0	18.58	18.56	18.75	19	1
10	QPSK	25	12	18.56	18.51	18.65		
10	QPSK	25	25	18.56	18.66	18.78		
10	QPSK	50	0	18.60	18.58	18.71		
10	16QAM	1	0	18.91	18.85	18.99	19	1
10	16QAM	1	25	19.00	18.87	19.00		
10	16QAM	1	49	18.62	18.90	18.99		
10	16QAM	25	0	17.50	17.66	17.73	18	2
10	16QAM	25	12	17.48	17.58	17.63		
10	16QAM	25	25	17.49	17.71	17.81		
10	16QAM	50	0	17.53	17.65	17.70		
Channel				20775	21100	21425	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				2502.5	2535	2567.5		
5	QPSK	1	0	19.56	19.45	19.70	20	0
5	QPSK	1	12	19.39	19.59	19.54		
5	QPSK	1	24	19.26	19.61	19.74		
5	QPSK	12	0	18.51	18.53	18.67	19	1
5	QPSK	12	7	18.54	18.54	18.70		
5	QPSK	12	13	18.53	18.55	18.82		
5	QPSK	25	0	18.55	18.61	18.77		
5	16QAM	1	0	18.86	18.89	18.80	19	1
5	16QAM	1	12	18.78	18.44	18.86		
5	16QAM	1	24	18.87	18.52	18.80		
5	16QAM	12	0	17.53	17.60	17.94	18	2
5	16QAM	12	7	17.57	17.62	17.76		
5	16QAM	12	13	17.55	17.53	17.87		
5	16QAM	25	0	17.89	17.78	17.71		

Band 12 (700MHz Low Band)
Part 27F(only on channel required)

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)	MPR (dB)
Channel				23060	23095	23130		
Frequency (MHz)				704	707.5	711		
10	QPSK	1	0	23.65	23.71	23.89	25	0
10	QPSK	1	25	23.80	24.09	24.00		
10	QPSK	1	49	23.63	23.86	23.92		
10	QPSK	25	0	22.66	22.75	22.83	24	1
10	QPSK	25	12	22.75	22.89	22.83		
10	QPSK	25	25	22.71	22.73	22.77		
10	QPSK	50	0	22.70	22.92	22.91		
10	16QAM	1	0	22.65	22.40	22.59	24	1
10	16QAM	1	25	22.83	22.56	22.69		
10	16QAM	1	49	22.73	22.53	22.34		
10	16QAM	25	0	21.52	21.96	21.95	23	2
10	16QAM	25	12	21.92	22.01	21.94		
10	16QAM	25	25	21.60	21.95	21.90		
10	16QAM	50	0	21.74	21.95	21.87		
Channel				23035	23095	23155	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				701.5	707.5	713.5		
5	QPSK	1	0	23.63	23.68	23.54	25	0
5	QPSK	1	12	23.87	23.83	23.47		
5	QPSK	1	24	23.57	23.71	23.52		
5	QPSK	12	0	22.70	22.66	22.83	24	1
5	QPSK	12	7	22.65	22.73	22.69		
5	QPSK	12	13	22.63	22.76	22.59		
5	QPSK	25	0	22.71	22.71	22.68		
5	16QAM	1	0	22.66	22.76	22.93	24	1
5	16QAM	1	12	22.61	22.79	22.52		
5	16QAM	1	24	22.48	22.84	22.47		
5	16QAM	12	0	21.78	21.56	21.69	23	2
5	16QAM	12	7	21.73	21.52	21.61		
5	16QAM	12	13	21.54	21.66	21.61		
5	16QAM	25	0	21.64	21.64	21.91		
Channel				23025	23095	23165	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				700.5	707.5	714.5		
3	QPSK	1	0	23.87	23.83	23.91	25	0
3	QPSK	1	8	23.82	23.58	23.64		
3	QPSK	1	14	23.61	24.02	23.73		
3	QPSK	8	0	22.79	22.76	22.72	24	1
3	QPSK	8	4	22.71	22.68	22.77		
3	QPSK	8	7	22.66	22.84	22.80		
3	QPSK	15	0	22.77	22.78	22.73		
3	16QAM	1	0	22.64	22.71	22.51	24	1
3	16QAM	1	8	22.56	22.82	22.63		
3	16QAM	1	14	22.68	22.90	22.49		
3	16QAM	8	0	21.90	21.77	21.63	23	2
3	16QAM	8	4	21.86	21.72	21.66		
3	16QAM	8	7	21.88	21.85	21.90		
3	16QAM	15	0	21.69	21.79	21.45		
Channel				23017	23095	23173	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				699.7	707.5	715.3		
1.4	QPSK	1	0	23.47	23.75	23.57	25	0
1.4	QPSK	1	3	23.42	23.87	23.89		
1.4	QPSK	1	5	23.49	23.82	23.82		
1.4	QPSK	3	0	23.67	23.73	23.63		
1.4	QPSK	3	1	23.76	23.80	23.77		
1.4	QPSK	3	3	23.60	23.73	23.73		
1.4	QPSK	6	0	22.69	22.84	22.74	24	1
1.4	16QAM	1	0	22.68	23.09	22.88	24	1
1.4	16QAM	1	3	22.81	22.88	22.94		
1.4	16QAM	1	5	22.63	22.91	22.92		
1.4	16QAM	3	0	22.74	22.98	22.79		
1.4	16QAM	3	1	22.73	23.07	22.92		
1.4	16QAM	3	3	22.72	22.77	22.82		
1.4	16QAM	6	0	21.86	21.47	21.76	23	2

Band 13(700MHz Band)
Part 27F

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)	MPR (dB)
Channel				23230				
Frequency (MHz)				782				
10	QPSK	1	0		23.19		24.5	0
10	QPSK	1	25		22.95			
10	QPSK	1	49		22.82			
10	QPSK	25	0		22.04		23.5	1
10	QPSK	25	12		22.01			
10	QPSK	25	25		21.94			
10	QPSK	50	0		21.88			
10	16QAM	1	0		22.13		23.5	1
10	16QAM	1	25		21.89			
10	16QAM	1	49		21.85			
10	16QAM	25	0		20.96		22.5	2
10	16QAM	25	12		21.00			
10	16QAM	25	25		20.97			
10	16QAM	50	0		20.86			
Channel				23205	23230	23255	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				779.5	782	784.5		
5	QPSK	1	0	23.03	22.95	22.88	24.5	0
5	QPSK	1	12	23.05	23.09	22.90		
5	QPSK	1	24	22.85	22.99	23.10		
5	QPSK	12	0	22.10	22.04	22.07	23.5	1
5	QPSK	12	7	22.05	22.00	21.91		
5	QPSK	12	13	21.91	21.94	21.95		
5	QPSK	25	0	22.00	22.03	22.08		
5	16QAM	1	0	21.77	21.82	22.05	23.5	1
5	16QAM	1	12	21.62	21.65	21.88		
5	16QAM	1	24	21.95	22.03	21.81		
5	16QAM	12	0	21.05	21.11	20.90	22.5	2
5	16QAM	12	7	21.09	20.99	20.87		
5	16QAM	12	13	20.95	20.97	21.07		
5	16QAM	25	0	20.96	21.03	20.88		

Band 25 (1900MHz Band)
Part 24E

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)	MPR (dB)
Channel				26140	26340	26590		
Frequency (MHz)				1860	1880	1905		
20	QPSK	1	0	23.15	23.23	23.06	24.5	0
20	QPSK	1	49	23.01	23.36	22.97		
20	QPSK	1	99	23.13	23.17	22.89		
20	QPSK	50	0	22.25	22.28	22.21	23.5	1
20	QPSK	50	24	22.19	22.16	22.12		
20	QPSK	50	50	22.15	22.11	22.00		
20	QPSK	100	0	22.18	22.27	22.14		
20	16QAM	1	0	22.44	22.25	22.29	23.5	1
20	16QAM	1	49	22.49	22.02	22.36		
20	16QAM	1	99	22.22	22.08	22.03		
20	16QAM	50	0	21.30	21.32	21.09	22.5	2
20	16QAM	50	24	21.29	21.26	20.99		
20	16QAM	50	50	21.18	21.20	20.98		
20	16QAM	100	0	21.16	21.17	21.07		
Channel				26115	26340	26615	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1857.5	1880	1907.5		
15	QPSK	1	0	23.12	23.25	23.22	24.5	0
15	QPSK	1	37	23.13	23.11	22.93		
15	QPSK	1	74	22.91	23.19	23.00		
15	QPSK	36	0	22.19	22.28	22.18	23.5	1
15	QPSK	36	20	22.13	22.18	22.10		
15	QPSK	36	39	22.09	22.13	22.01		
15	QPSK	75	0	22.13	22.20	22.15		
15	16QAM	1	0	22.06	21.97	22.35	23.5	1
15	16QAM	1	37	21.99	21.95	22.34		
15	16QAM	1	74	21.93	22.14	21.96		
15	16QAM	36	0	21.19	21.29	21.18	22.5	2
15	16QAM	36	20	21.14	21.22	21.01		
15	16QAM	36	39	21.10	21.15	21.05		
15	16QAM	75	0	21.10	21.12	20.97		
Channel				26090	26340	26640	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1855	1880	1910		
10	QPSK	1	0	23.31	23.17	22.91	24.5	0
10	QPSK	1	25	23.31	23.28	22.92		
10	QPSK	1	49	23.28	23.20	22.90		
10	QPSK	25	0	22.29	22.27	22.10	23.5	1
10	QPSK	25	12	22.21	22.23	22.05		
10	QPSK	25	25	22.20	22.14	22.06		
10	QPSK	50	0	22.19	22.26	22.06		
10	16QAM	1	0	22.28	22.27	22.48	23.5	1
10	16QAM	1	25	22.52	22.69	22.47		
10	16QAM	1	49	22.30	22.44	22.37		
10	16QAM	25	0	21.34	21.31	21.04	22.5	2
10	16QAM	25	12	21.47	21.12	21.10		
10	16QAM	25	25	21.33	21.18	21.25		
10	16QAM	50	0	21.33	21.10	21.15		
Channel				26065	26340	26665	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1852.5	1880	1912.5		
5	QPSK	1	0	23.11	22.94	23.03	24.5	0
5	QPSK	1	12	23.28	23.02	23.19		
5	QPSK	1	24	23.34	22.93	23.23		
5	QPSK	12	0	22.18	22.11	22.05	23.5	1
5	QPSK	12	7	22.08	22.17	22.07		
5	QPSK	12	13	22.13	22.19	22.18		
5	QPSK	25	0	22.12	22.24	22.06		
5	16QAM	1	0	22.59	22.69	22.59	23.5	1
5	16QAM	1	12	22.63	22.56	22.54		
5	16QAM	1	24	22.96	22.89	22.59		
5	16QAM	12	0	21.15	21.17	20.85	22.5	2
5	16QAM	12	7	21.15	21.07	20.94		
5	16QAM	12	13	21.11	21.10	20.95		
5	16QAM	25	0	21.38	21.30	21.02		
Channel				26055	26340	26675	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1851.5	1880	1913.5		
3	QPSK	1	0	23.03	23.21	22.99	24.5	0
3	QPSK	1	8	22.98	23.20	23.10		
3	QPSK	1	14	23.02	23.16	23.16		
3	QPSK	8	0	22.18	22.19	22.15	23.5	1
3	QPSK	8	4	22.22	22.14	22.14		
3	QPSK	8	7	22.26	22.27	22.23		
3	QPSK	15	0	22.09	22.18	22.15		
3	16QAM	1	0	22.13	22.20	21.99	23.5	1
3	16QAM	1	8	22.27	21.93	22.05		
3	16QAM	1	14	21.89	21.94	22.12		
3	16QAM	8	0	20.95	20.92	21.06	22.5	2
3	16QAM	8	4	21.00	20.96	21.27		
3	16QAM	8	7	21.04	21.27	21.35		
3	16QAM	15	0	20.87	21.20	21.08		
Channel				26047	26340	26683	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1850.7	1880	1914.3		
1.4	QPSK	1	0	23.03	23.14	22.94	24.5	0
1.4	QPSK	1	3	23.18	23.24	23.13		
1.4	QPSK	1	5	23.14	23.19	23.00		
1.4	QPSK	3	0	23.18	23.29	22.97		
1.4	QPSK	3	1	23.29	23.30	23.07		
1.4	QPSK	3	3	23.15	23.15	23.13		
1.4	QPSK	6	0	22.15	22.23	22.18	23.5	1
1.4	16QAM	1	0	22.15	22.13	22.46	23.5	1
1.4	16QAM	1	3	22.24	22.50	22.57		
1.4	16QAM	1	5	22.14	22.26	22.20		
1.4	16QAM	3	0	21.95	21.93	21.80		
1.4	16QAM	3	1	22.25	22.22	22.09		
1.4	16QAM	3	3	22.07	22.01	22.13		
1.4	16QAM	6	0	21.09	21.10	21.07	22.5	2

Band 26 for FCC
(only on channel required)

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)	MPR (dB)
Channel				26765	26865	26965		
Frequency (MHz)				821.5	831.5	841.5		
15	QPSK	1	0	23.11	23.24	23.41	24.5	0
15	QPSK	1	37	23.08	23.03	23.06		
15	QPSK	1	74	23.10	23.06	23.15		
15	QPSK	36	0	22.05	22.17	22.28	23.5	1
15	QPSK	36	20	21.97	22.11	22.16		
15	QPSK	36	39	22.01	22.07	22.16		
15	QPSK	75	0	22.08	22.16	22.20		
15	16QAM	1	0	22.89	22.94	22.92	23.5	1
15	16QAM	1	37	22.50	22.57	22.51		
15	16QAM	1	74	22.48	22.59	22.63		
15	16QAM	36	0	20.88	21.02	21.14	22.5	2
15	16QAM	36	20	20.92	21.17	21.01		
15	16QAM	36	39	21.05	20.92	21.11		
15	16QAM	75	0	21.16	21.13	21.26		
Channel				26740	26865	26990	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				819	831.5	844		
10	QPSK	1	0	22.98	23.26	23.03	24.5	0
10	QPSK	1	25	22.83	23.10	23.27		
10	QPSK	1	49	22.83	23.06	23.15		
10	QPSK	25	0	22.00	22.06	22.23	23.5	1
10	QPSK	25	12	21.91	22.19	22.17		
10	QPSK	25	25	21.84	22.05	22.10		
10	QPSK	50	0	21.92	22.15	22.22		
10	16QAM	1	0	22.02	22.46	22.27	23.5	1
10	16QAM	1	25	22.07	22.02	22.30		
10	16QAM	1	49	22.11	22.23	22.30		
10	16QAM	25	0	20.83	20.97	21.26	22.5	2
10	16QAM	25	12	20.82	21.20	21.08		
10	16QAM	25	25	20.84	20.96	21.03		
10	16QAM	50	0	20.88	21.02	21.11		
Channel				26715	26865	27015	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				816.5	831.5	846.5		
5	QPSK	1	0	23.10	23.36	23.38	24.5	0
5	QPSK	1	12	23.07	23.27	23.40		
5	QPSK	1	24	22.97	23.36	23.02		
5	QPSK	12	0	21.99	22.02	22.27	23.5	1
5	QPSK	12	7	21.86	22.07	22.07		
5	QPSK	12	13	21.83	22.05	22.02		
5	QPSK	25	0	21.93	22.06	22.24		
5	16QAM	1	0	22.48	22.45	22.23	23.5	1
5	16QAM	1	12	22.13	22.19	22.26		
5	16QAM	1	24	22.40	22.19	22.47		
5	16QAM	12	0	20.98	21.06	21.11	22.5	2
5	16QAM	12	7	20.91	20.99	21.00		
5	16QAM	12	13	20.82	21.17	20.99		
5	16QAM	25	0	21.07	21.26	21.23		
Channel				26705	26865	27025	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				815.5	831.5	847.5		
3	QPSK	1	0	23.12	23.33	23.37	24.5	0
3	QPSK	1	8	22.93	23.19	23.03		
3	QPSK	1	14	22.98	23.31	23.02		
3	QPSK	8	0	22.10	22.19	22.33	23.5	1
3	QPSK	8	4	21.95	22.02	22.18		
3	QPSK	8	7	21.97	22.07	22.12		
3	QPSK	15	0	21.93	22.23	22.21		
3	16QAM	1	0	22.30	22.22	22.33	23.5	1
3	16QAM	1	8	22.03	22.11	22.09		
3	16QAM	1	14	22.48	22.45	22.07		
3	16QAM	8	0	21.06	21.28	21.27	22.5	2
3	16QAM	8	4	20.93	21.35	21.24		
3	16QAM	8	7	20.94	21.21	20.98		
3	16QAM	15	0	20.66	20.94	20.88		
Channel				26697	26865	27033	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				814.7	831.5	848.3		
1.4	QPSK	1	0	22.90	23.13	23.05	24.5	0
1.4	QPSK	1	3	22.93	23.05	23.10		
1.4	QPSK	1	5	22.76	22.95	22.89		
1.4	QPSK	3	0	22.96	23.05	23.14		
1.4	QPSK	3	1	22.98	23.13	23.20		
1.4	QPSK	3	3	22.95	23.10	23.07		
1.4	QPSK	6	0	21.98	22.21	22.28	23.5	1
1.4	16QAM	1	0	21.85	21.99	21.86	23.5	1
1.4	16QAM	1	3	21.89	21.96	21.92		
1.4	16QAM	1	5	22.00	21.86	21.70		
1.4	16QAM	3	0	22.23	22.28	21.98		
1.4	16QAM	3	1	22.10	22.31	22.09		
1.4	16QAM	3	3	22.01	22.33	21.87		
1.4	16QAM	6	0	20.85	21.08	20.79	22.5	2

WLAN/Bluetooth Power

2.4GHz WLAN						
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	15.20	16.00	97.60
		6	2437	15.30	16.00	
		11	2462	15.00	16.00	
	802.11g 6Mbps	1	2412	14.10	15.00	87.30
		6	2437	14.20	15.00	
		11	2462	13.80	15.00	
	802.11n-HT20 MCS0	1	2412	12.40	13.00	86.60
		6	2437	12.30	13.00	
		11	2462	12.00	13.00	
	802.11n-HT40 MCS0	3	2422	11.90	13.00	76.30
		6	2437	11.80	13.00	
		9	2452	12.40	13.00	

5GHz WLAN						
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	12.14	13.50	87.44
		40	5200	12.49	13.50	
		44	5220	12.71	13.50	
		48	5240	12.66	13.50	
	802.11n-HT20 MCS0	36	5180	11.85	13.50	86.63
		40	5200	12.16	13.50	
		44	5220	12.42	13.50	
		48	5240	12.34	13.50	
	802.11n-HT40 MCS0	38	5190	12.21	13.00	70.95
		46	5230	12.79	13.00	

5GHz WLAN						
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	12.35	13.50	87.44
		56	5280	12.44	13.50	
		60	5300	12.53	13.50	
		64	5320	12.21	13.50	
	802.11n-HT20 MCS0	52	5260	12.42	13.50	86.63
		56	5280	12.51	13.50	
		60	5300	12.61	13.50	
		64	5320	12.29	13.50	
	802.11n-HT40 MCS0	54	5270	12.83	13.00	70.95
		62	5310	12.58	13.00	

5GHz WLAN						
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	12.74	14.00	87.44
		116	5580	13.54	14.00	
		132	5660	12.95	14.00	
		140	5700	12.96	14.00	
	802.11n-HT20 MCS0	100	5500	12.81	14.00	86.63
		116	5580	13.64	14.00	
		132	5660	12.99	14.00	
		140	5700	13.05	14.00	
	802.11n-HT40 MCS0	102	5510	13.17	13.50	70.95
		110	5550	13.26	13.50	
		134	5670	13.41	13.50	
		142	5710	13.36	13.50	

5GHz WLAN						
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a 6Mbps	149	5745	12.70	13.50	87.44
		157	5785	12.36	13.50	
		165	5825	12.46	13.50	
	802.11n-HT20 MCS0	149	5745	12.77	13.50	86.63
		157	5785	12.40	13.50	
		165	5825	12.54	13.50	
	802.11n-HT40 MCS0	151	5755	12.17	13.00	70.95
		159	5795	12.68	13.00	

Mode	Channel	Frequency (MHz)	Average power (dBm)									Tune-up Limit
			Packet Type									
			DH1	DH3	DH5	2DH1	2DH3	2DH5	3DH1	3DH3	3DH5	
BR/EDR	CH 0	2402	**5.70**	5.60	5.60	**3.80**	3.70	3.70	**3.80**	3.70	3.60	6
	CH 39	2441	5.10	5.00	5.00	3.20	3.10	3.00	3.20	3.10	3.10	
	CH 78	2480	5.00	4.90	4.90	3.10	3.00	3.00	3.10	3.00	3.00	

Mode	Channel	Frequency (MHz)	Average power (dBm)
			GFSK
LE	CH 00	2402	1.20
	CH 19	2440	0.70
	CH 39	2480	0.30
Tune-up Limit			2