



D750V3, Serial No. 1087 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.

750V3 – serial no. 1087

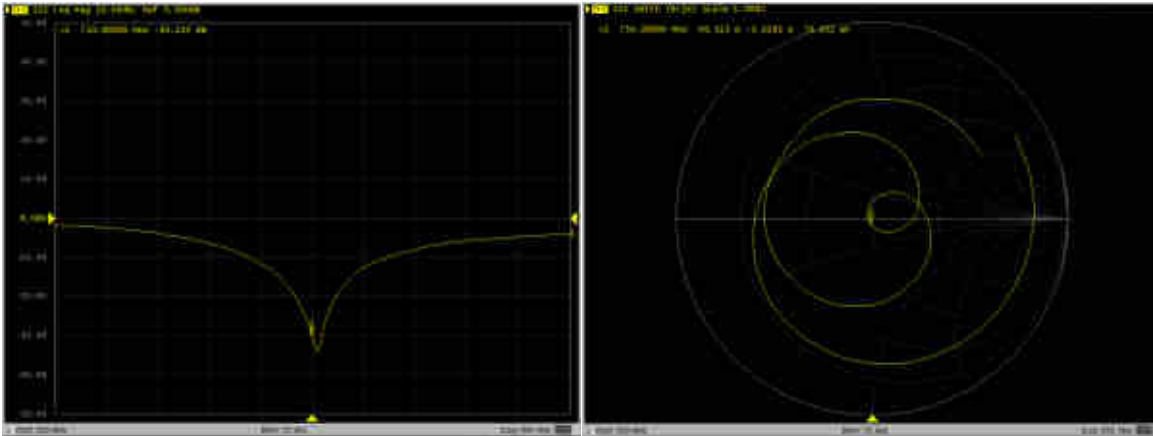
750V3 – serial no. 1087												
	750 Head						750 Body					
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2019.3.27	-29.3		52.4		-2.6		-27.7		51.6		-3.9	
2020.3.26	-30.2	-0.03	49.5	2.88	-3.0	0.44	26.6	1.96	54.896	-3.33	0.45	-4.31

<Justification of the extended calibration>

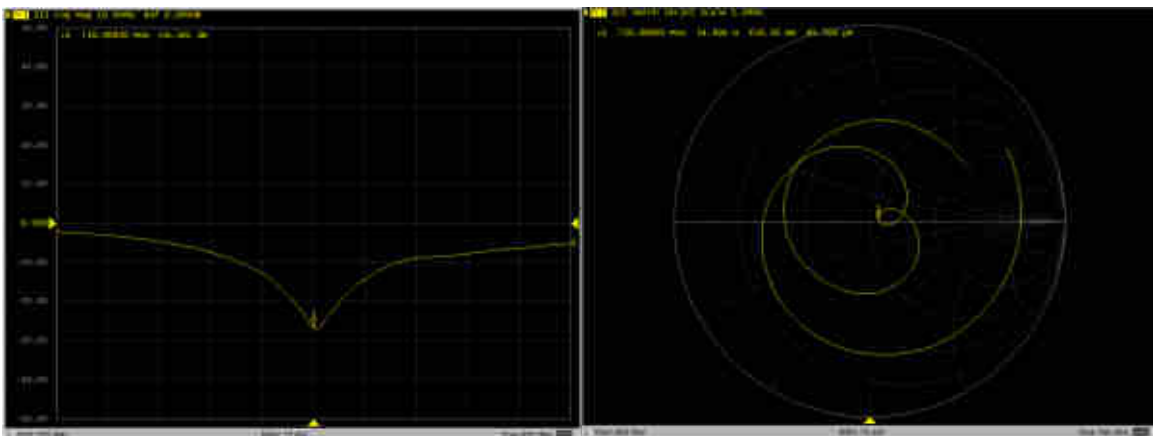
The return loss is $< -20\text{dB}$, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Dipole Verification Data> D750V3, serial no. 1087

750MHz – Head



750MHz – Body





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 CNAS L0570

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Client **Sporton**

Certificate No: **Z19-60082**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d151**

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

Calibration date: **March 27, 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)°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Power sensor NRP8S	104291	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Reference Probe EX3DV4	SN 3617	31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Jan-20
DAE4	SN 1331	06-Feb-19(SPEAG,No.DAE4-1331_Feb19)	Feb-20
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-19 (CTTL, No.J19X00336)	Jan-20
NetworkAnalyzer E5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan-20

	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: March 30, 2019

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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 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
- 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
- KDB865664, 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%.



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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	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.7 ± 6 %	0.93 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	2.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.30 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.56 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.16 W/kg ± 18.7 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	56.7 ± 6 %	0.94 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	2.32 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.53 W /kg ± 18.8 % (k=2)
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.52 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.20 W/kg ± 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	50.8Ω- 3.28jΩ
Return Loss	- 29.5dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.7Ω- 3.98jΩ
Return Loss	- 25.5dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.253 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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DASY5 Validation Report for Head TSL

Date: 03.26.2019

Test Laboratory: CCTL, Beijing, China

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d151

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 835$ MHz; $\sigma = 0.925$ S/m; $\epsilon_r = 42.68$; $\rho = 1000$ kg/m³

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(9.75, 9.75, 9.75) @ 835 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)

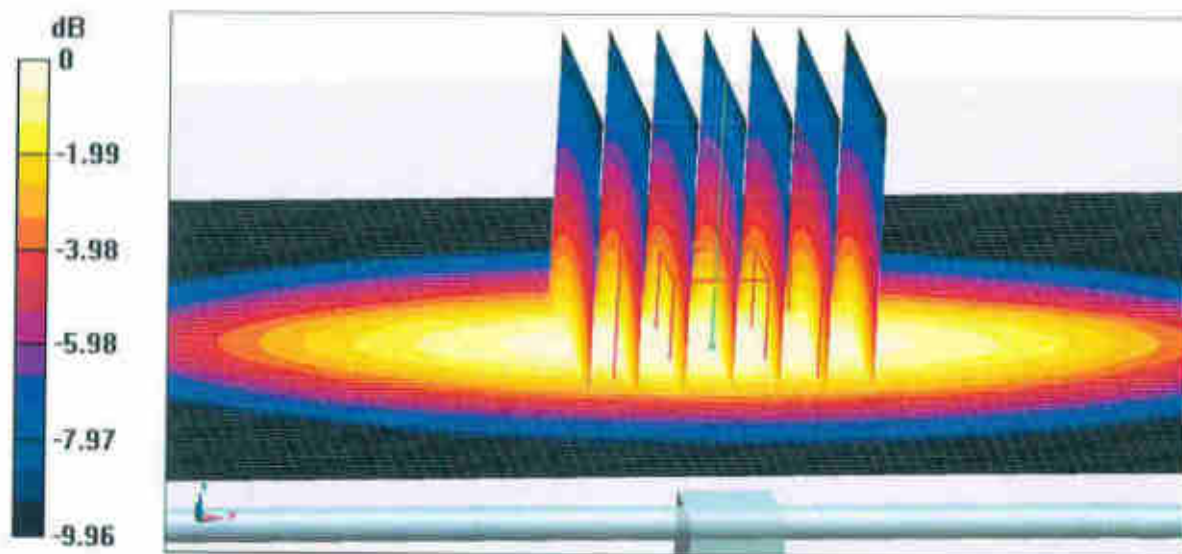
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.34 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 3.55 W/kg

SAR(1 g) = 2.36 W/kg; SAR(10 g) = 1.56 W/kg

Maximum value of SAR (measured) = 3.14 W/kg

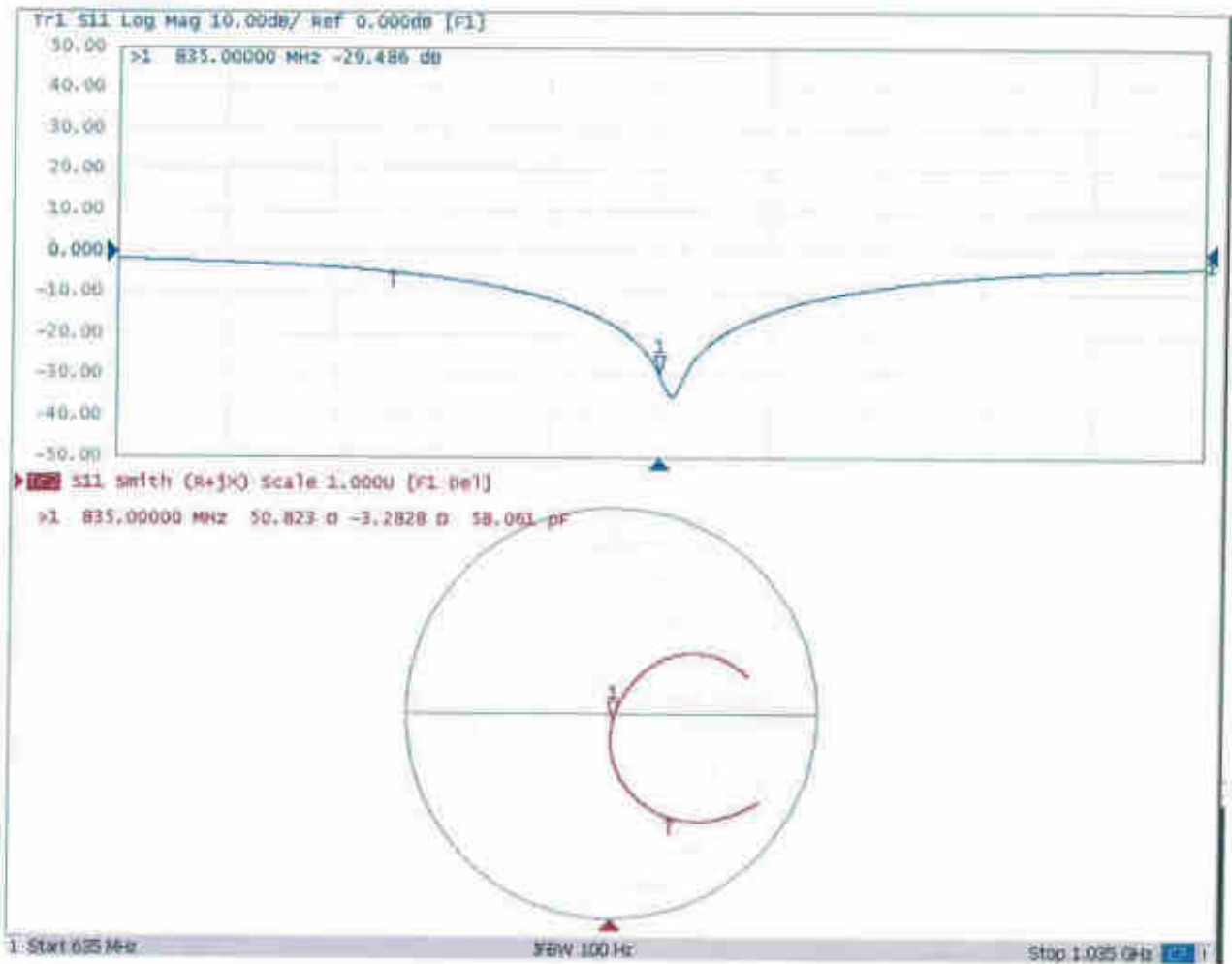


0 dB = 3.14 W/kg = 4.97 dBW/kg



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Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 03.26.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d151

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 835$ MHz; $\sigma = 0.944$ S/m; $\epsilon_r = 56.66$; $\rho = 1000$ kg/m³

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(9.61, 9.61, 9.61) @ 835 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)

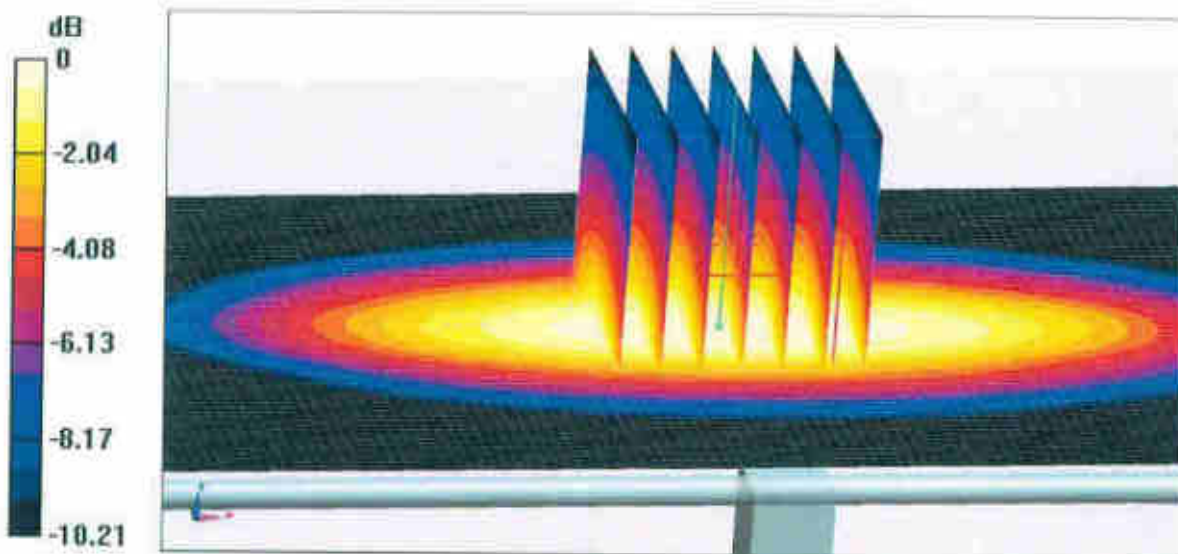
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.03 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 3.53 W/kg

SAR(1 g) = 2.32 W/kg; SAR(10 g) = 1.52 W/kg

Maximum value of SAR (measured) = 3.12 W/kg

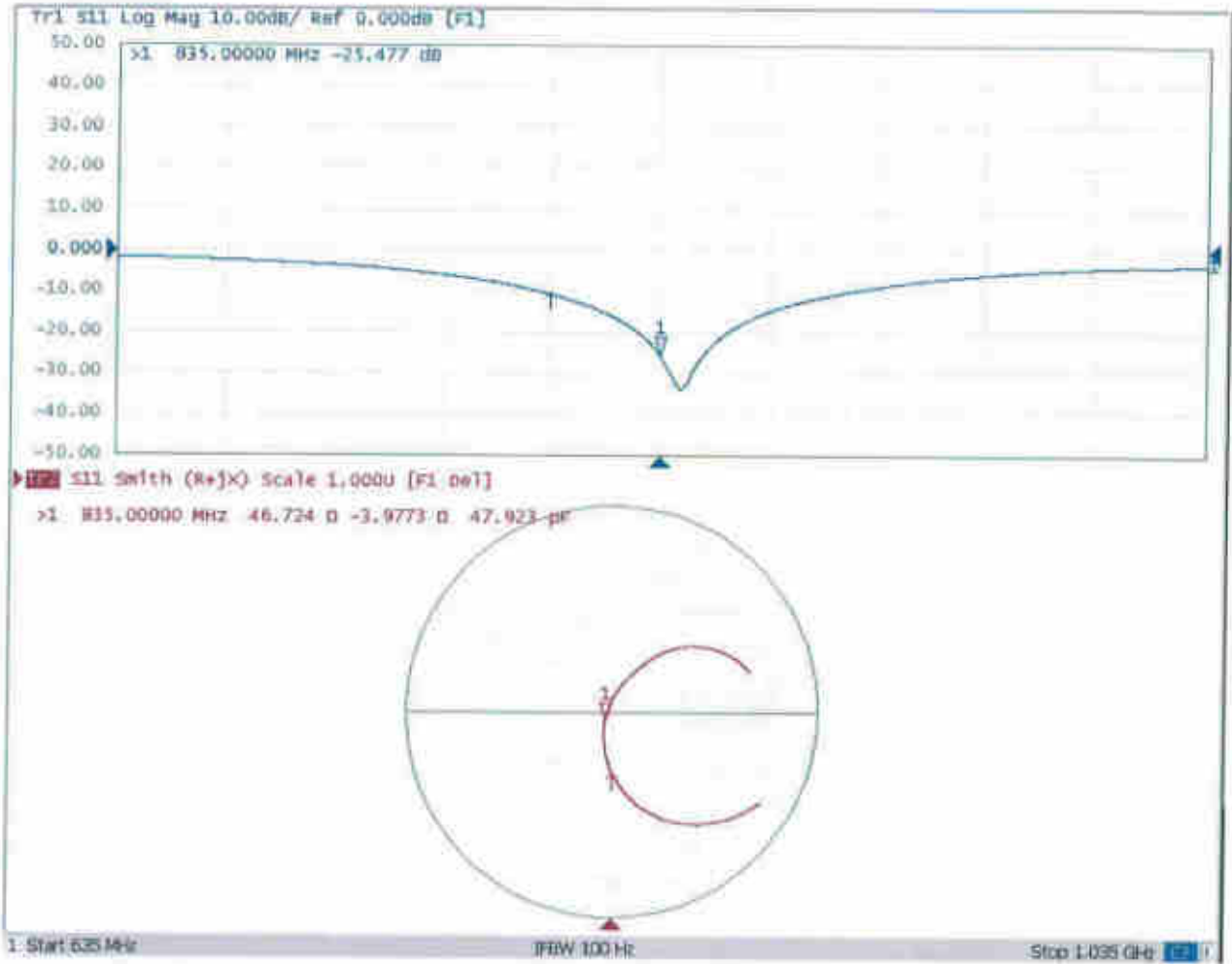


0 dB = 3.12 W/kg = 4.94 dBW/kg



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Impedance Measurement Plot for Body TSL





D835V2, Serial No. 4d151 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.

835V2 – serial no. 4d151

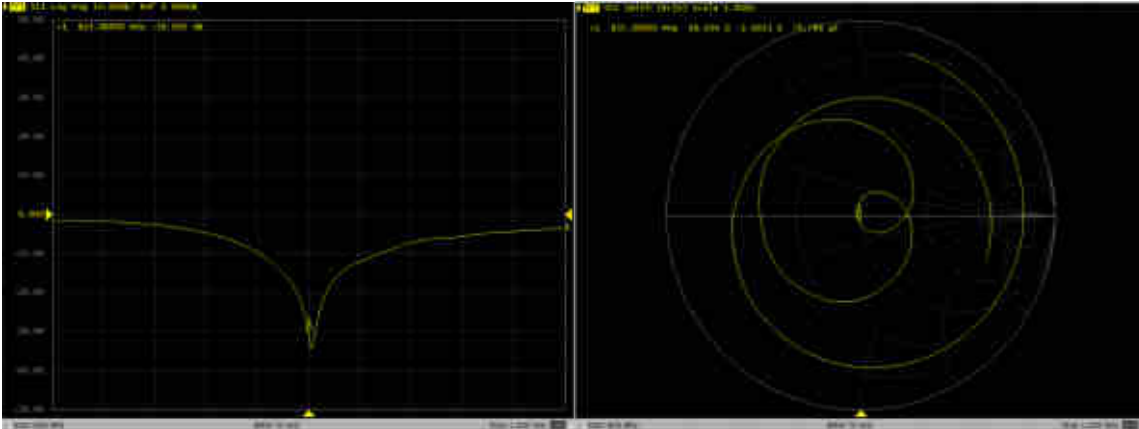
Date of Measurement	835 Head						835 Body					
	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2019.3.27	-29.3		52.4		-2.6		-27.7		51.6		-3.9	
2020.3.26	-30.7	-0.05	49.0	3.44	-2.7	0.10	-24.9	0.10	50.6	0.94	-5.7	1.84

<Justification of the extended calibration>

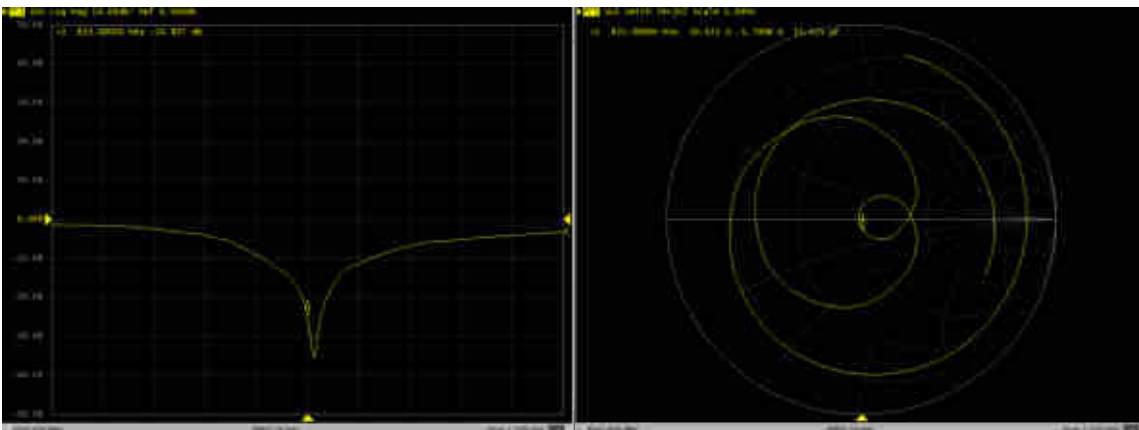
The return loss is $< -20\text{dB}$, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Dipole Verification Data> D835V2, serial no. 4d151

835MHz – Head



835MHz – Body





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Client **Sporton**

Certificate No: **Z19-60084**

CALIBRATION CERTIFICATE

Object **D1750V2 - SN: 1090**

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

Calibration date: **March 27, 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	106277	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Power sensor NRP8S	104291	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Reference Probe EX3DV4	SN 3617	31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Jan-20
DAE4	SN 1331	06-Feb-19(SPEAG,No.DAE4-1331_Feb19)	Feb-20
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-19 (CTTL, No.J19X00336)	Jan-20
NetworkAnalyzer E5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan-20

	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: March 29, 2019

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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 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
- 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
- KDB865664, 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%.



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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	1750 MHz \pm 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	41.3 \pm 6 %	1.37 mho/m \pm 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	9.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.4 W/kg \pm 18.8 % (k=2)
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	4.79 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.2 W/kg \pm 18.7 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 \pm 0.2) °C	55.0 \pm 6 %	1.45 mho/m \pm 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	9.21 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.7 W/kg \pm 18.8 % (k=2)
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	4.89 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.9 W/kg \pm 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	47.5Ω- 2.34 jΩ
Return Loss	- 29.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	43.9Ω- 2.19 jΩ
Return Loss	- 23.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.085 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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DASY5 Validation Report for Head TSL

Date: 03.26.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1090

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.37$ S/m; $\epsilon_r = 41.27$; $\rho = 1000$ kg/m³

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(8.38, 8.38, 8.38) @ 1750 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)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid:

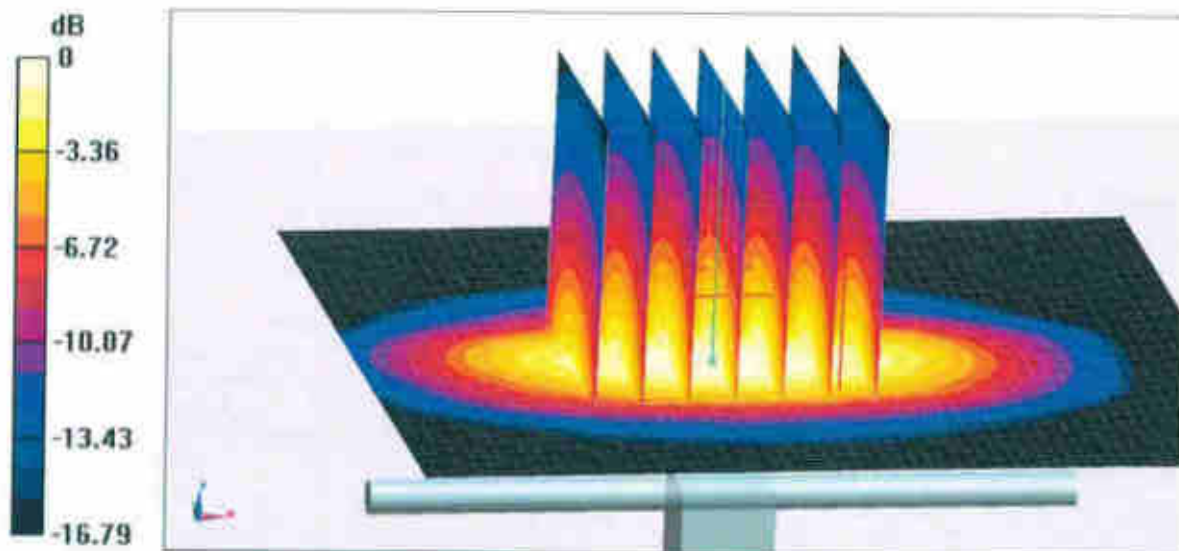
$dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 89.03 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 17.1 W/kg

SAR(1 g) = 9.04 W/kg; SAR(10 g) = 4.79 W/kg

Maximum value of SAR (measured) = 14.2 W/kg

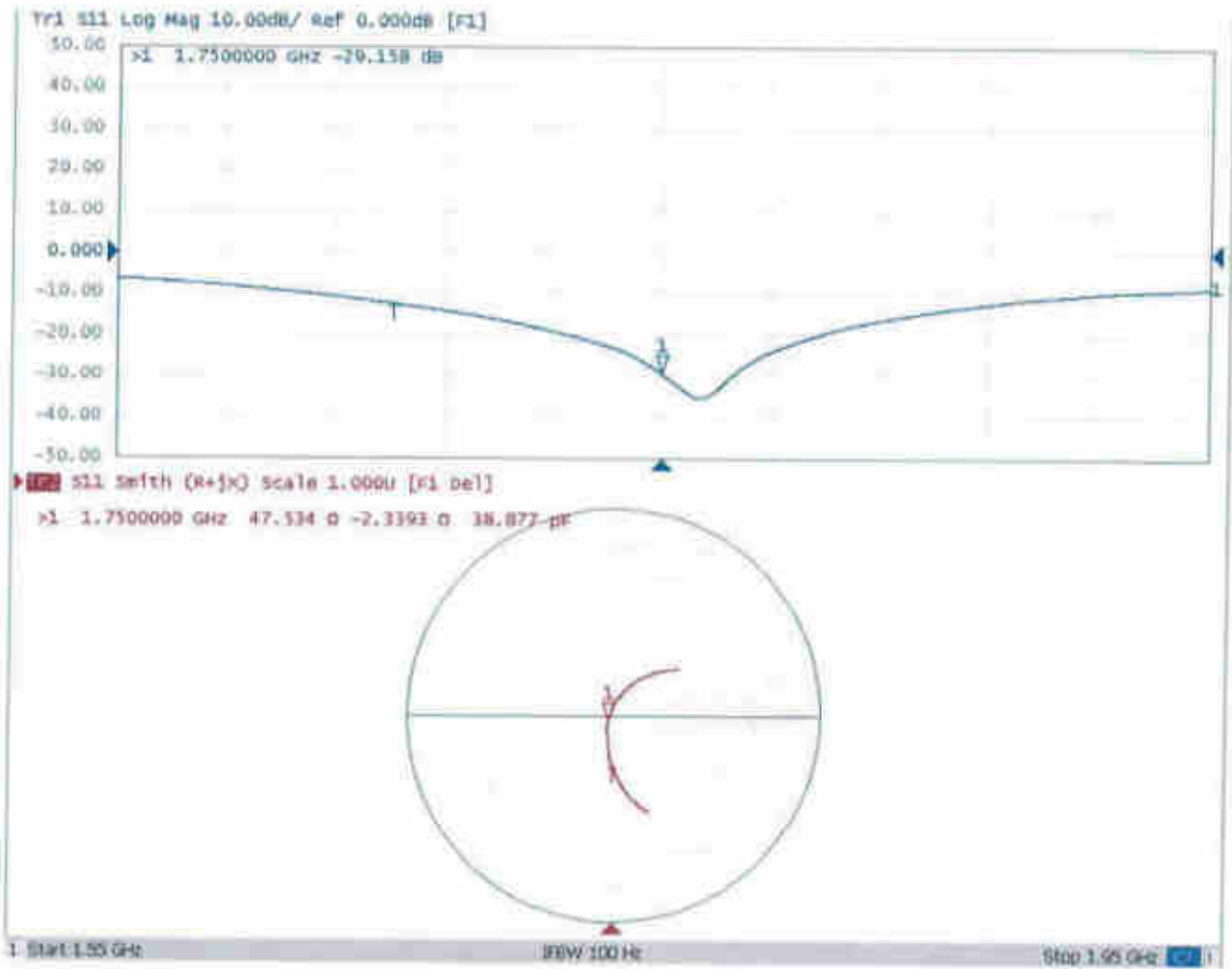


0 dB = 14.2 W/kg = 11.52 dBW/kg



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Impedance Measurement Plot for Head TSL





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DASY5 Validation Report for Body TSL

Date: 03.26.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1090

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.449$ S/m; $\epsilon_r = 54.97$; $\rho = 1000$ kg/m³

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(8.03, 8.03, 8.03) @ 1750 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)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid:

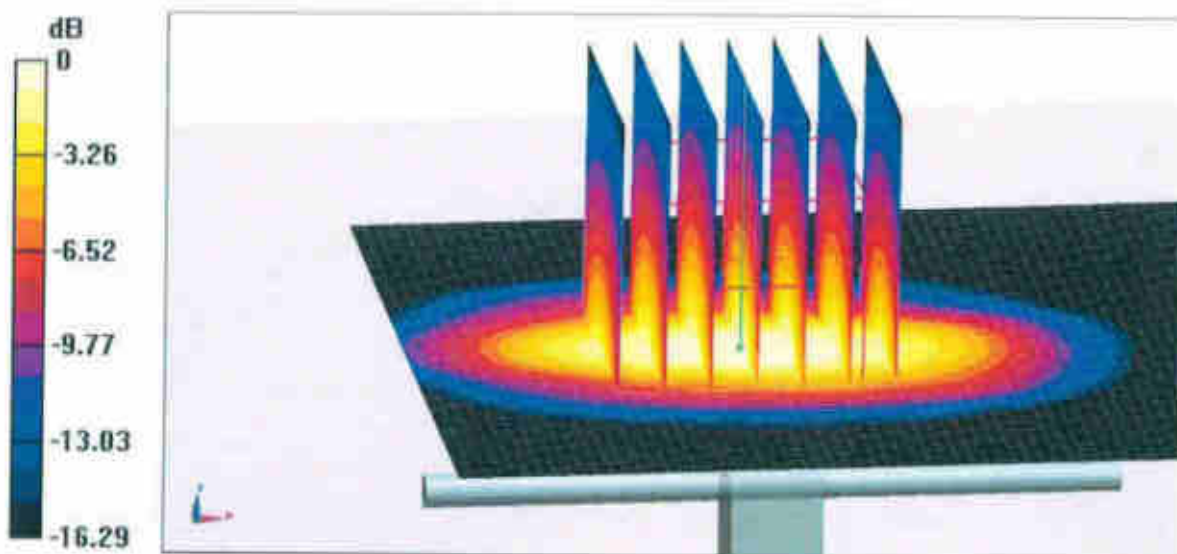
$dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 93.13 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 16.8 W/kg

SAR(1 g) = 9.21 W/kg; SAR(10 g) = 4.89 W/kg

Maximum value of SAR (measured) = 14.2 W/kg

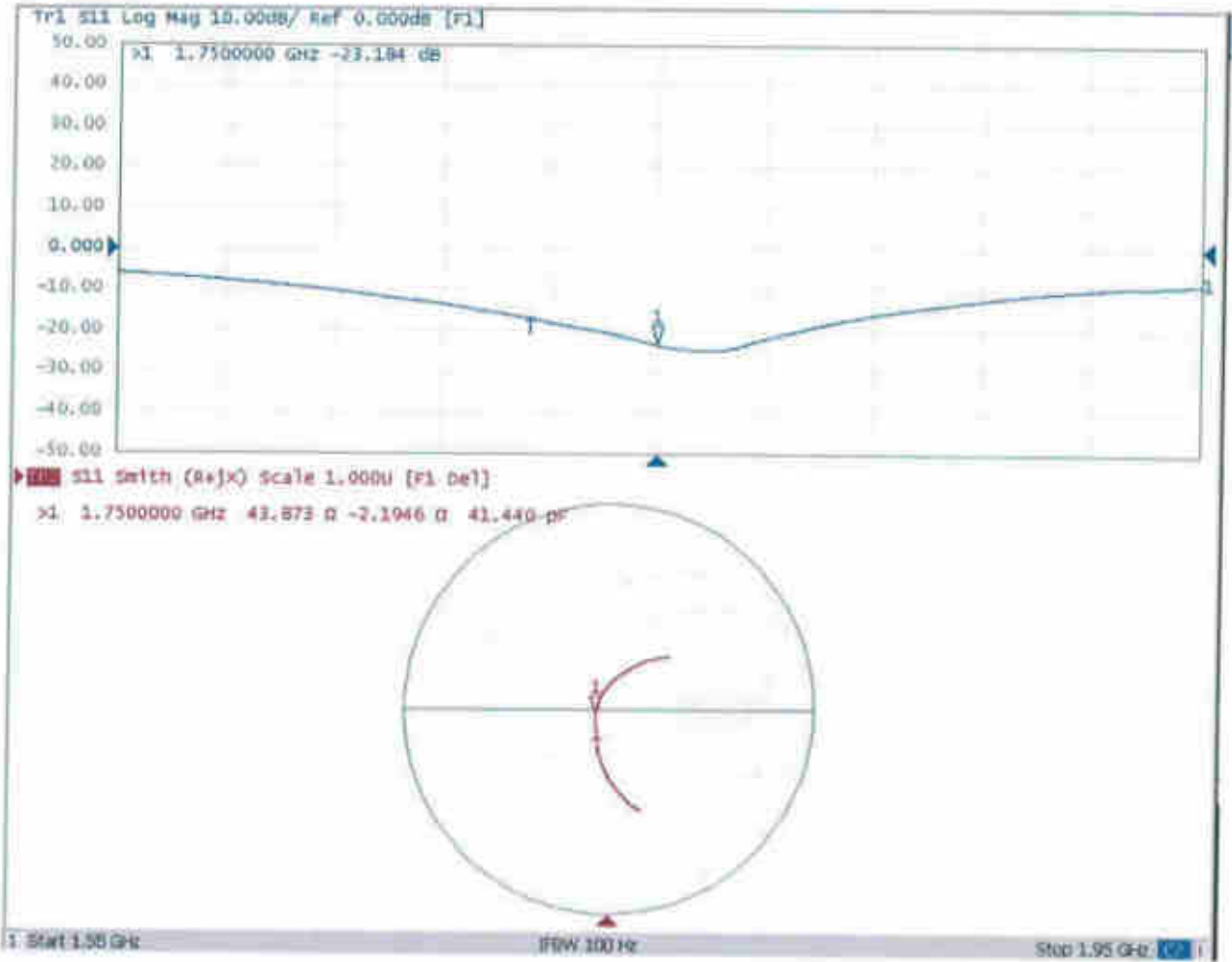


0 dB = 14.2 W/kg = 11.52 dBW/kg



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Impedance Measurement Plot for Body TSL





D1750V2, Serial No. 1090 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.

1750V2 – serial no. 1090

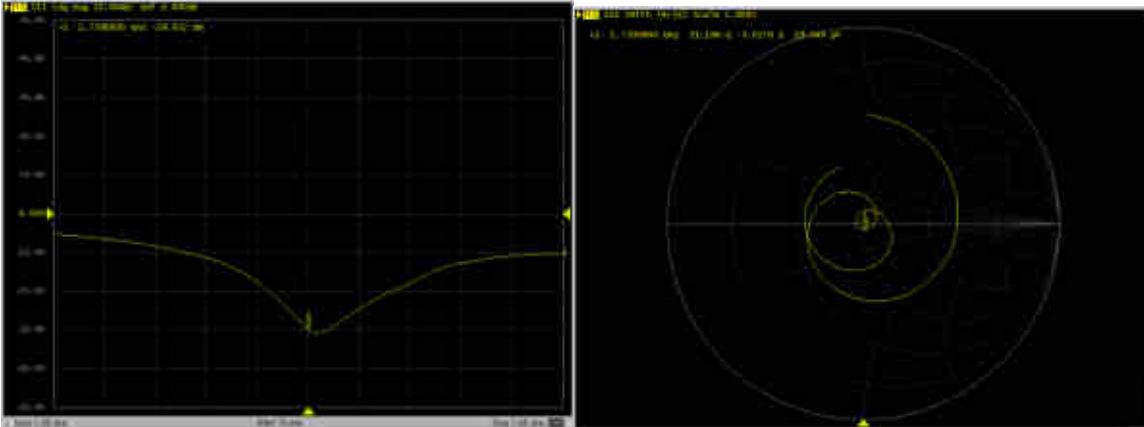
1750V2 – serial no. 1090												
	1750 Head						1750 Body					
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2019.3.27	-29.2		47.5		-2.3		-23.2		43.9		-2.2	
2020.3.26	-29.8	-0.02	51.2	-3.66	-3.0	0.70	-25.0	-0.08	45.1	-1.22	-2.17	-0.02

<Justification of the extended calibration>

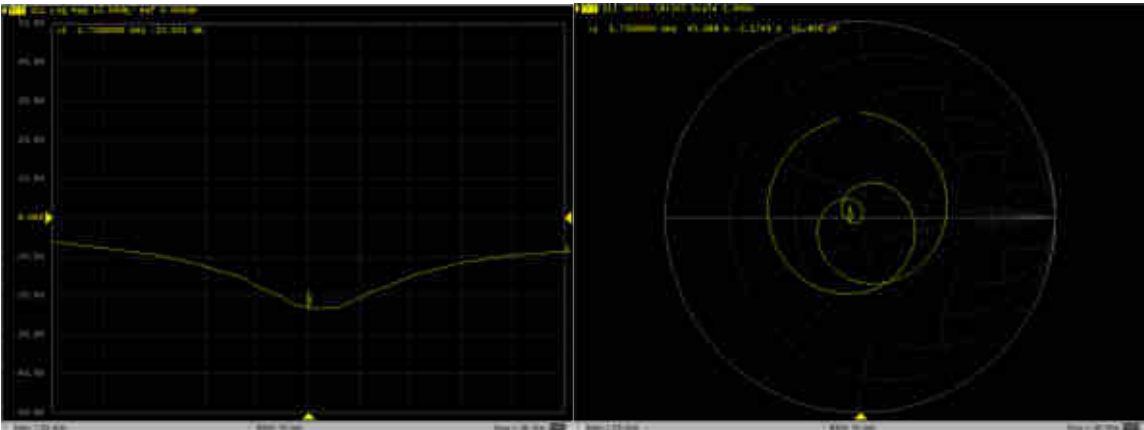
The return loss is $< -20\text{dB}$, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Dipole Verification Data> D1750V2, serial no. 1090

1750MHz – Head



1750MHz – Body





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Client

Sporton

Certificate No:

Z19-60085

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d170**

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

Calibration date: **March 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±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	106277	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Power sensor NRP8S	104291	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Reference Probe EX3DV4	SN 3617	31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Jan-20
DAE4	SN 1331	06-Feb-19(SPEAG,No.DAE4-1331_Feb19)	Feb-20
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-19 (CTTL, No.J19X00336)	Jan-20
NetworkAnalyzer E5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan-20

	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: March 29, 2019

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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 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
- 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
- KDB865664, 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%.



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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	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.5 ± 6 %	1.44 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	9.90 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.0 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.3 W/kg ± 18.7 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.5 ± 6 %	1.56 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	10.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.0 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.28 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.0 W/kg ± 18.7 % (k=2)



Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.7Ω+ 6.73jΩ
Return Loss	- 23.3dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.8Ω+ 6.72jΩ
Return Loss	- 22.8dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.066 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: 03.26.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d170

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.441$ S/m; $\epsilon_r = 40.48$; $\rho = 1000$ kg/m³

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(8.14, 8.14, 8.14) @ 1900 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)

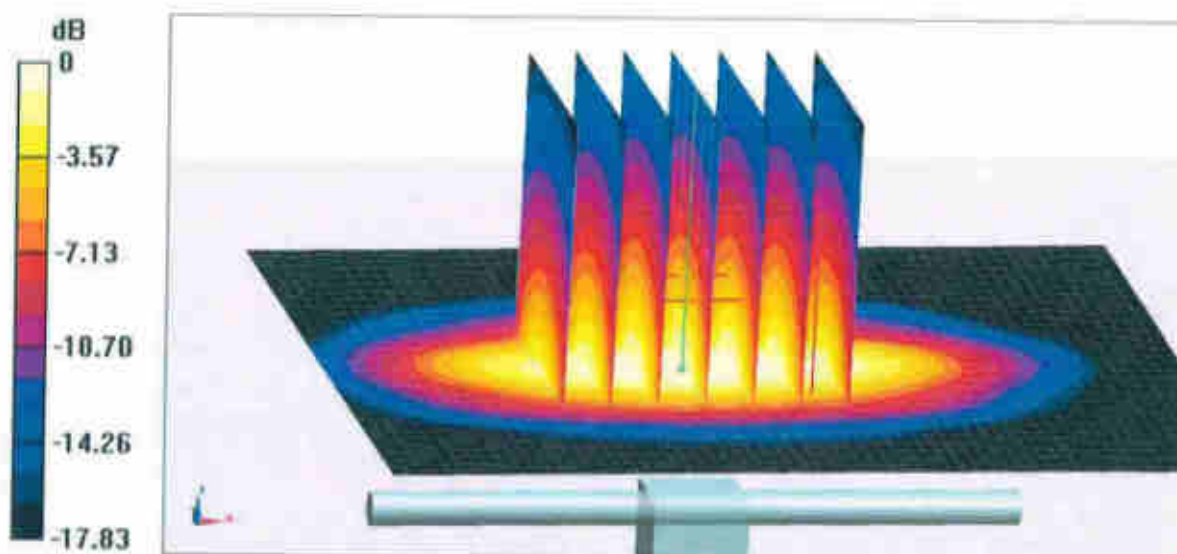
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid:
 $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 97.54 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 18.9 W/kg

SAR(1 g) = 9.9 W/kg; SAR(10 g) = 5.12 W/kg

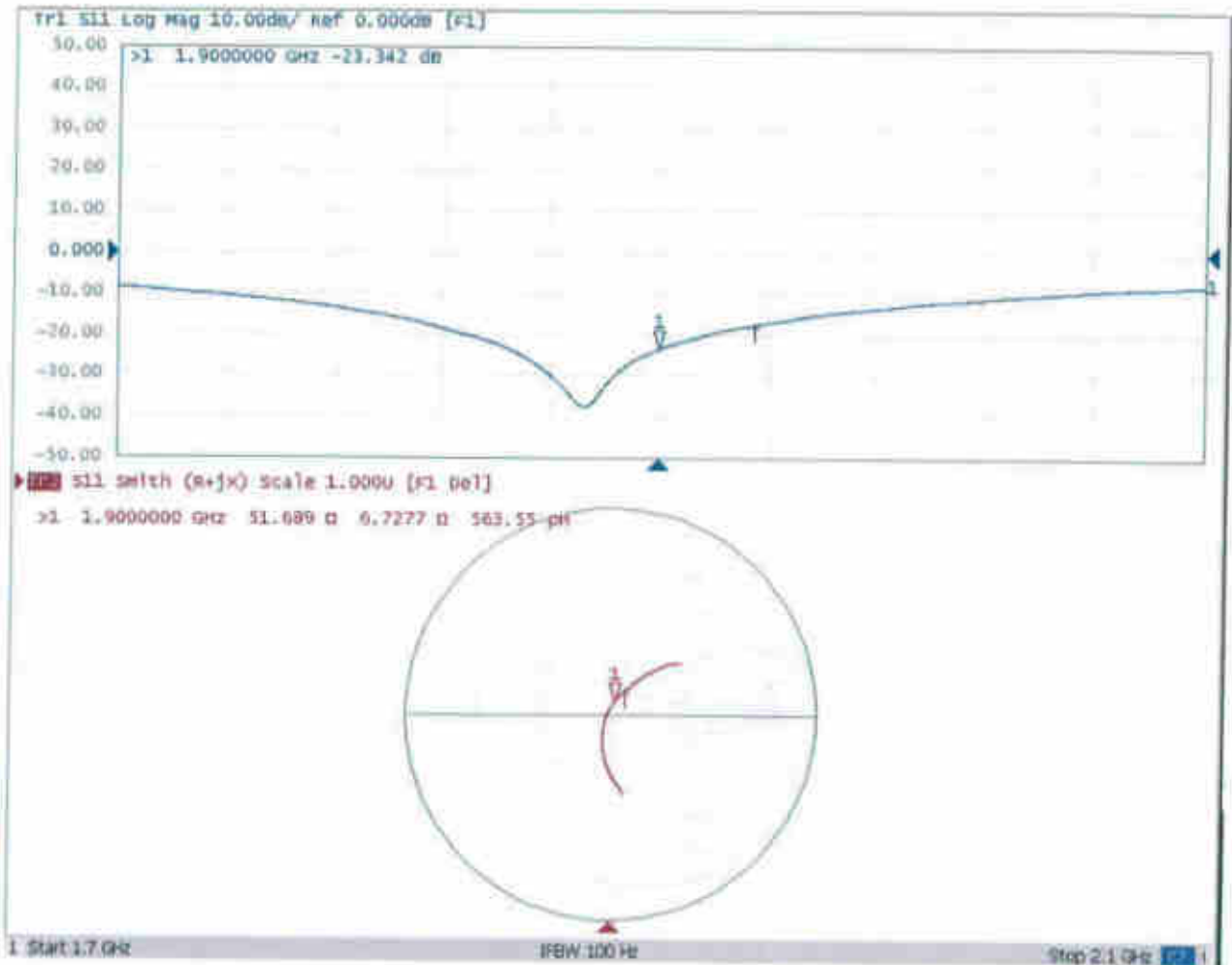
Maximum value of SAR (measured) = 15.6 W/kg





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Impedance Measurement Plot for Head TSL





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DASY5 Validation Report for Body TSL

Date: 03.26.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d170

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.56$ S/m; $\epsilon_r = 54.52$; $\rho = 1000$ kg/m³

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.78, 7.78, 7.78) @ 1900 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)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid:

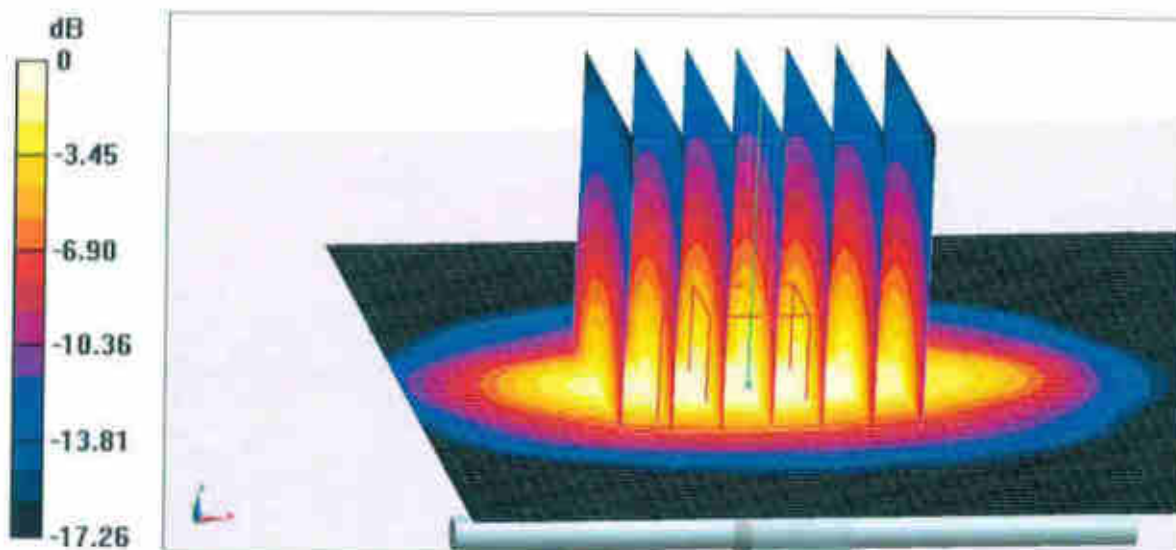
$dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 95.48 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 18.6 W/kg

SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.28 W/kg

Maximum value of SAR (measured) = 15.7 W/kg

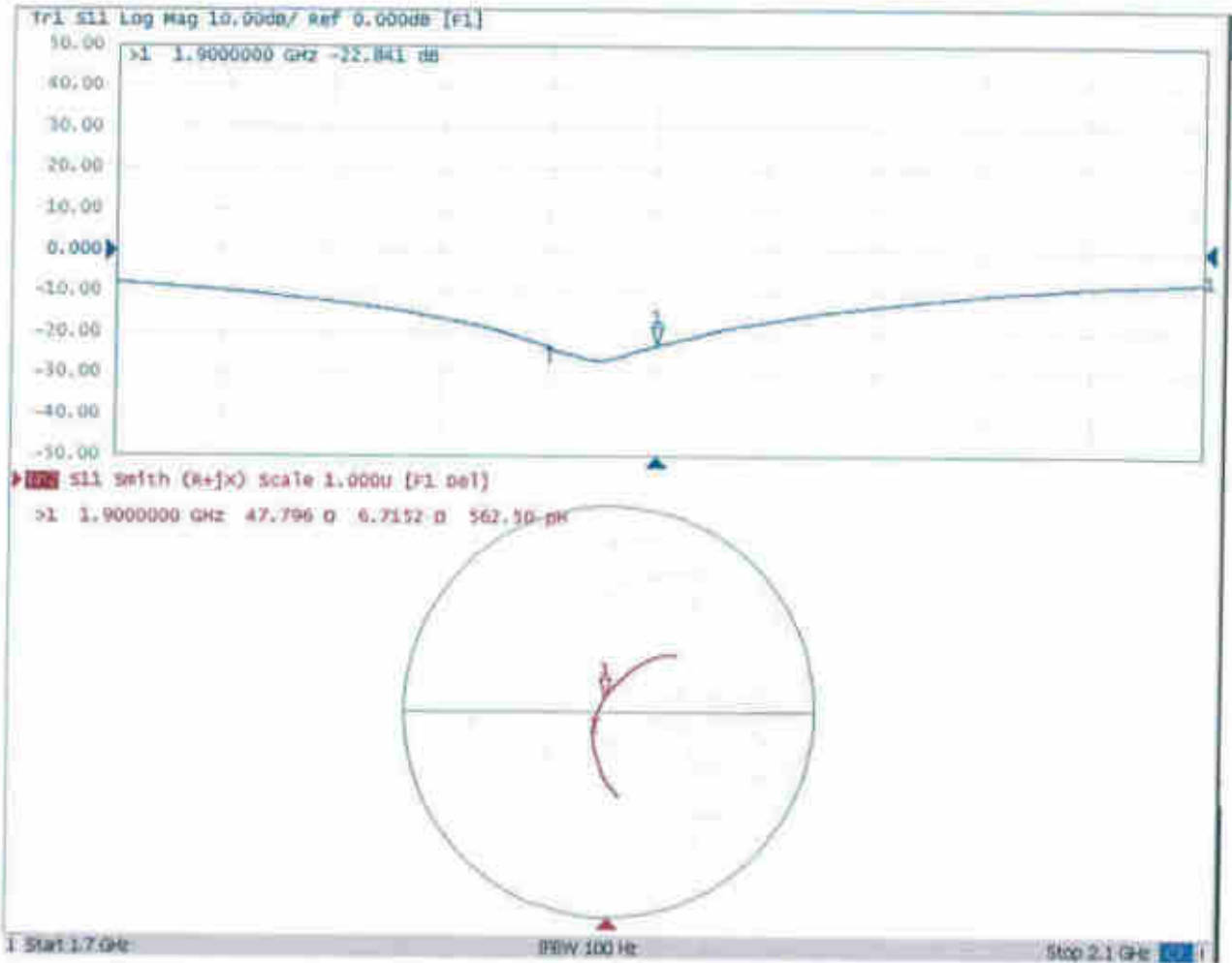


0 dB = 15.7 W/kg = 11.96 dBW/kg



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Impedance Measurement Plot for Body TSL





D1900V2, Serial No. 5d170 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.

1900V2 – serial no. 5d170

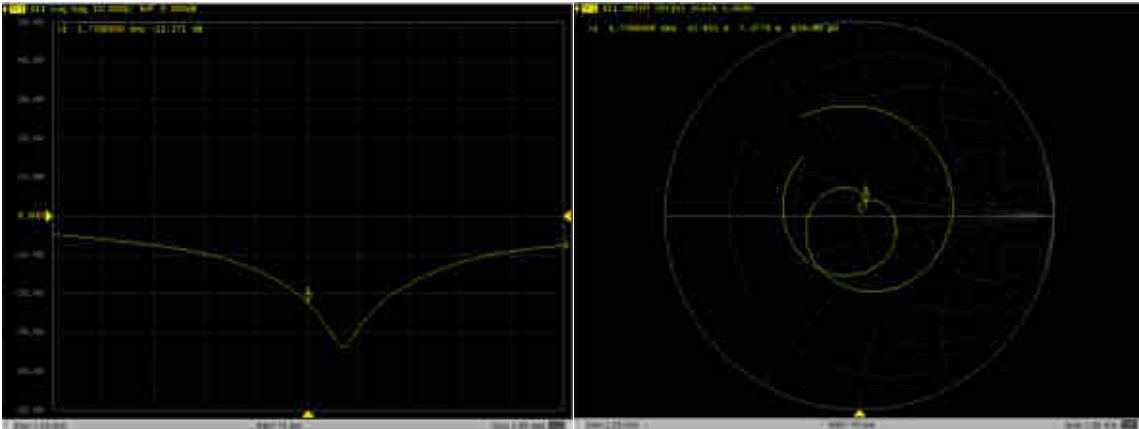
1900V2 – serial no. 5d170												
	1900 Head						1900 Body					
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2019.3.26	-23.3		51.7		6.7		-22.8		47.8		6.7	
2020.3.25	-22.3	0.05	53.0	-1.26	7.4	-0.64	-22.5	0.01	49.2	-1.37	7.41	-0.69

<Justification of the extended calibration>

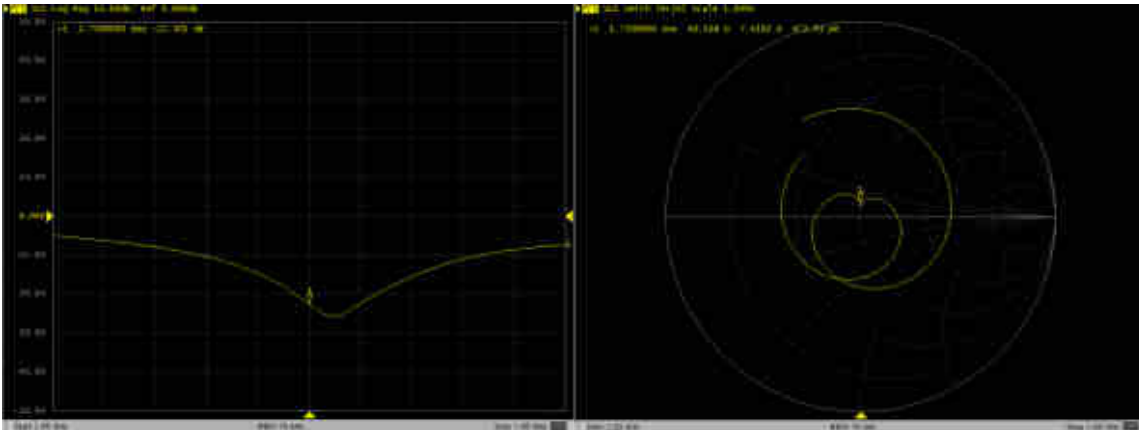
The return loss is $< -20\text{dB}$, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Dipole Verification Data> D1900V2, serial no. 5d170

1900MHz – Head



1900MHz – Body





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Client **Sporton**

Certificate No: **Z19-60087**

CALIBRATION CERTIFICATE

Object: **D2450V2 - SN: 908**

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

Calibration date: **March 25, 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)°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Power sensor NRP8S	104291	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Reference Probe EX3DV4	SN 3617	31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Jan-20
DAE4	SN 1331	06-Feb-19(SPEAG,No.DAE4-1331_Feb19)	Feb-20
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-19 (CTTL, No.J19X00336)	Jan-20
NetworkAnalyzer E5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan-20

	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: March 28, 2019

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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 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
- 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
- KDB865664, 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	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	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.6 ± 6 %	1.84 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	13.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.8 W/kg ± 18.6 % (k=2)
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.07 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.2 W/kg ± 18.7 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.8 ± 6 %	2.00 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	12.8 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	50.8 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.91 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.6 W/kg ± 18.7 % (k=2)



Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$57.3\Omega + 5.18 j\Omega$
Return Loss	- 21.6dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$52.6\Omega + 5.81 j\Omega$
Return Loss	- 24.1dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.020 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: 03.25.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 908

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.841$ S/m; $\epsilon_r = 39.63$; $\rho = 1000$ kg/m³

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.62, 7.62, 7.62) @ 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)

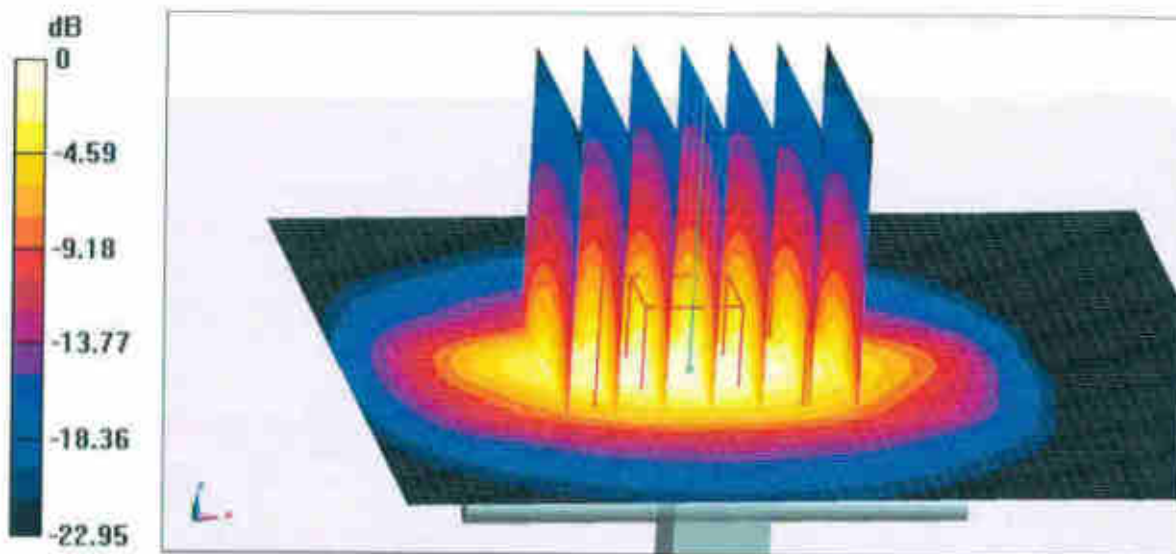
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.04 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 28.3 W/kg

SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.07 W/kg

Maximum value of SAR (measured) = 22.4 W/kg

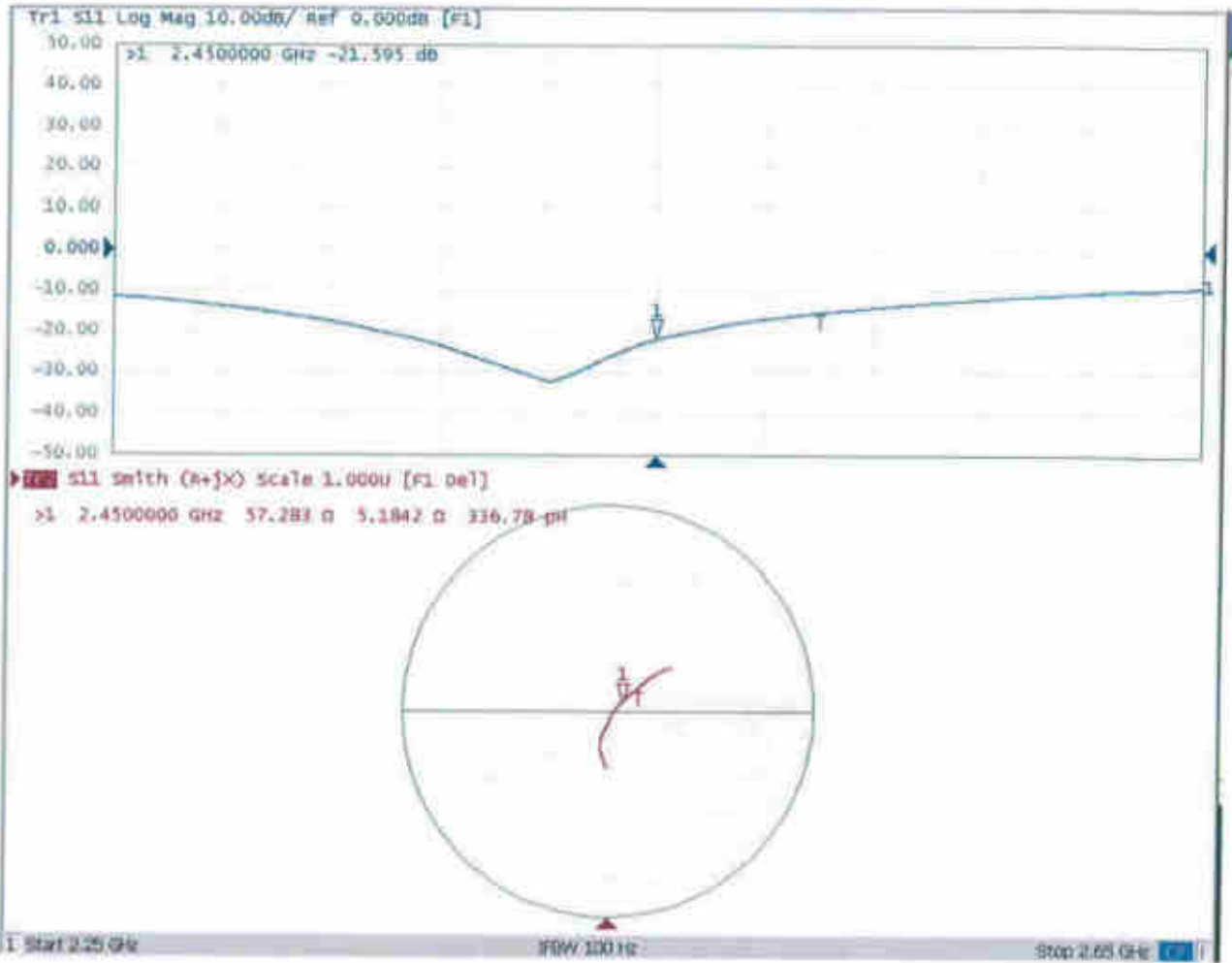


0 dB = 22.4 W/kg = 13.50 dBW/kg



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Impedance Measurement Plot for Head TSL





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DASY5 Validation Report for Body TSL

Date: 03.25.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 908

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.003$ S/m; $\epsilon_r = 53.78$; $\rho = 1000$ 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)

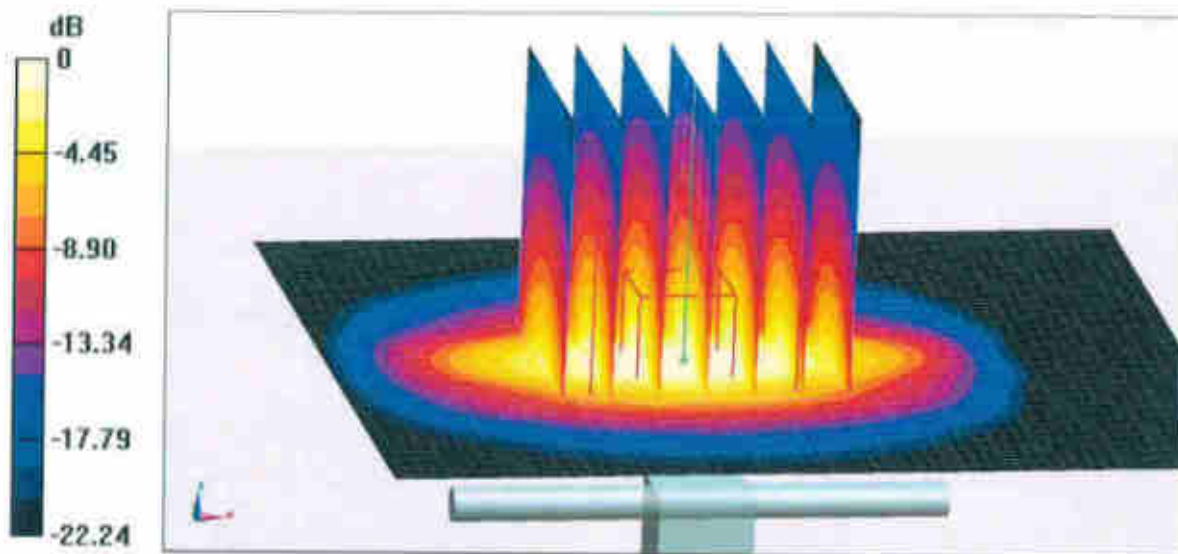
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.51 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 27.1 W/kg

SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.91 W/kg

Maximum value of SAR (measured) = 21.4 W/kg

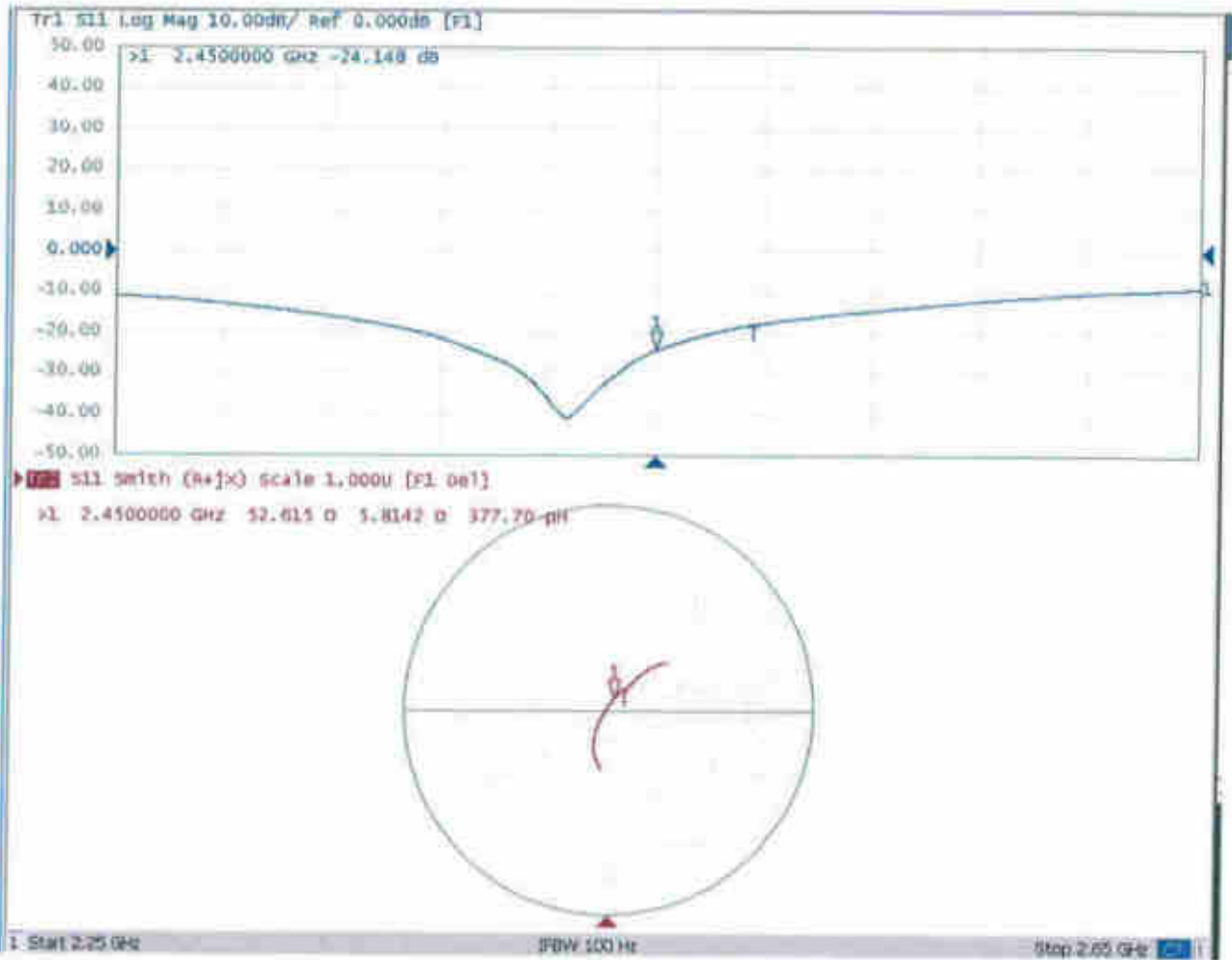


0 dB = 21.4 W/kg = 13.30 dBW/kg



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Impedance Measurement Plot for Body TSL





D2450V2, Serial No. 908 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.

2450V2 – serial no. 908

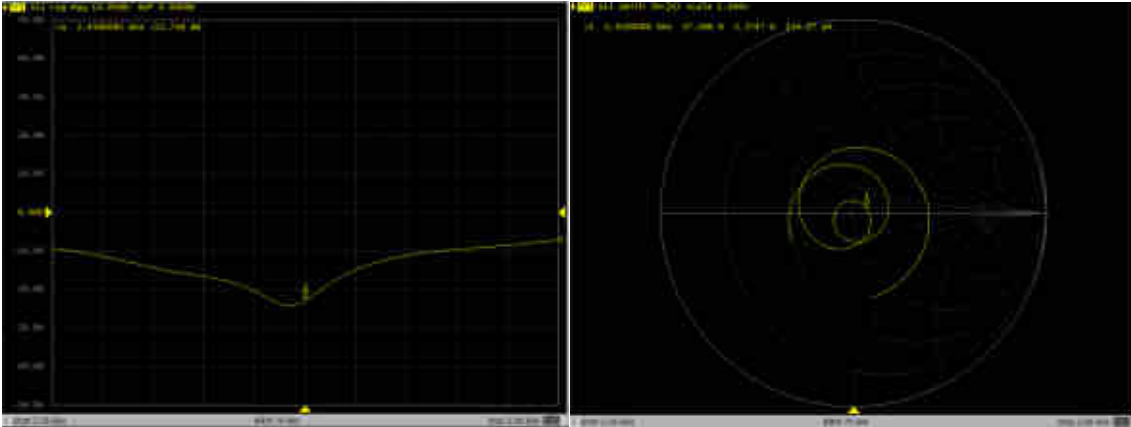
2450V2 – serial no. 908												
	2450 Head						2450 Body					
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2019.3.25	-21.6		57.3		5.2		-24.1		52.6		5.8	
2020.3.24	-22.7	-0.05	57.5	-0.18	2.4	2.81	-26.1	-0.08	55.01	-2.40	1.493	4.32

<Justification of the extended calibration>

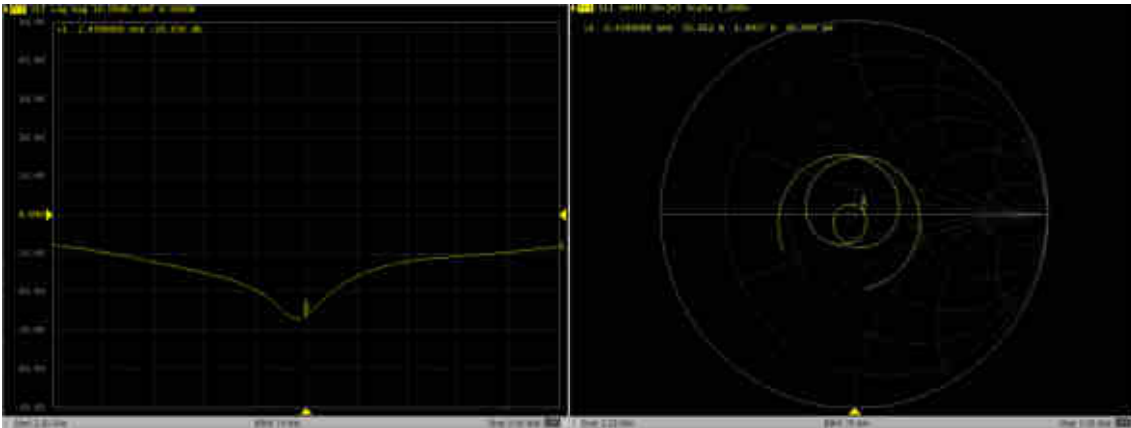
The return loss is $< -20\text{dB}$, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Dipole Verification Data> D2450V2, serial no. 908

2450MHz – Head



2450MHz – Body





Client **Sporton**

Certificate No: **Z18-60490**

CALIBRATION CERTIFICATE

Object **D2600V2 - SN: 1061**

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 / 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 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
- 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
- KDB865664, 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	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 \pm 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 \pm 0.2) °C	39.1 \pm 6 %	1.93 mho/m \pm 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	14.3 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	57.7 mW / g \pm 18.8 % (k=2)
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.45 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	25.9 mW / g \pm 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 \pm 0.2) °C	51.0 \pm 6 %	2.18 mho/m \pm 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	13.7 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	54.2 mW / g \pm 18.8 % (k=2)
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	6.11 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	24.3 mW / g \pm 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	49.8Ω- 7.00jΩ
Return Loss	- 23.1dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.6Ω- 5.41jΩ
Return Loss	- 22.8dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.012 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: 12.06.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1061

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

Medium parameters used: $f = 2600$ MHz; $\sigma = 1.926$ S/m; $\epsilon_r = 39.1$; $\rho = 1000$ 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)

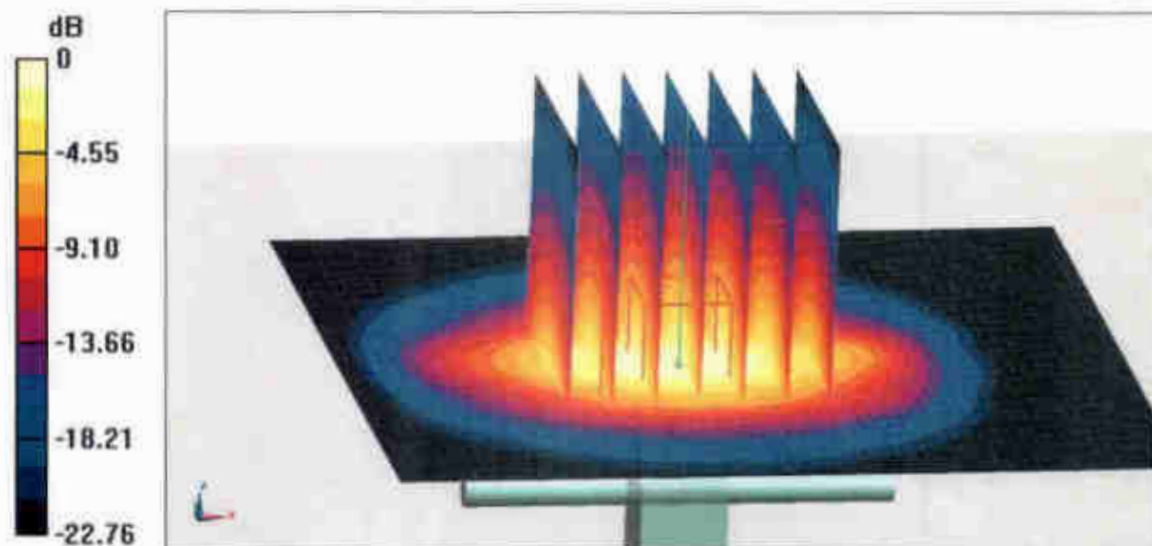
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.5 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 31.0 W/kg

SAR(1 g) = 14.3 W/kg; SAR(10 g) = 6.45 W/kg

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

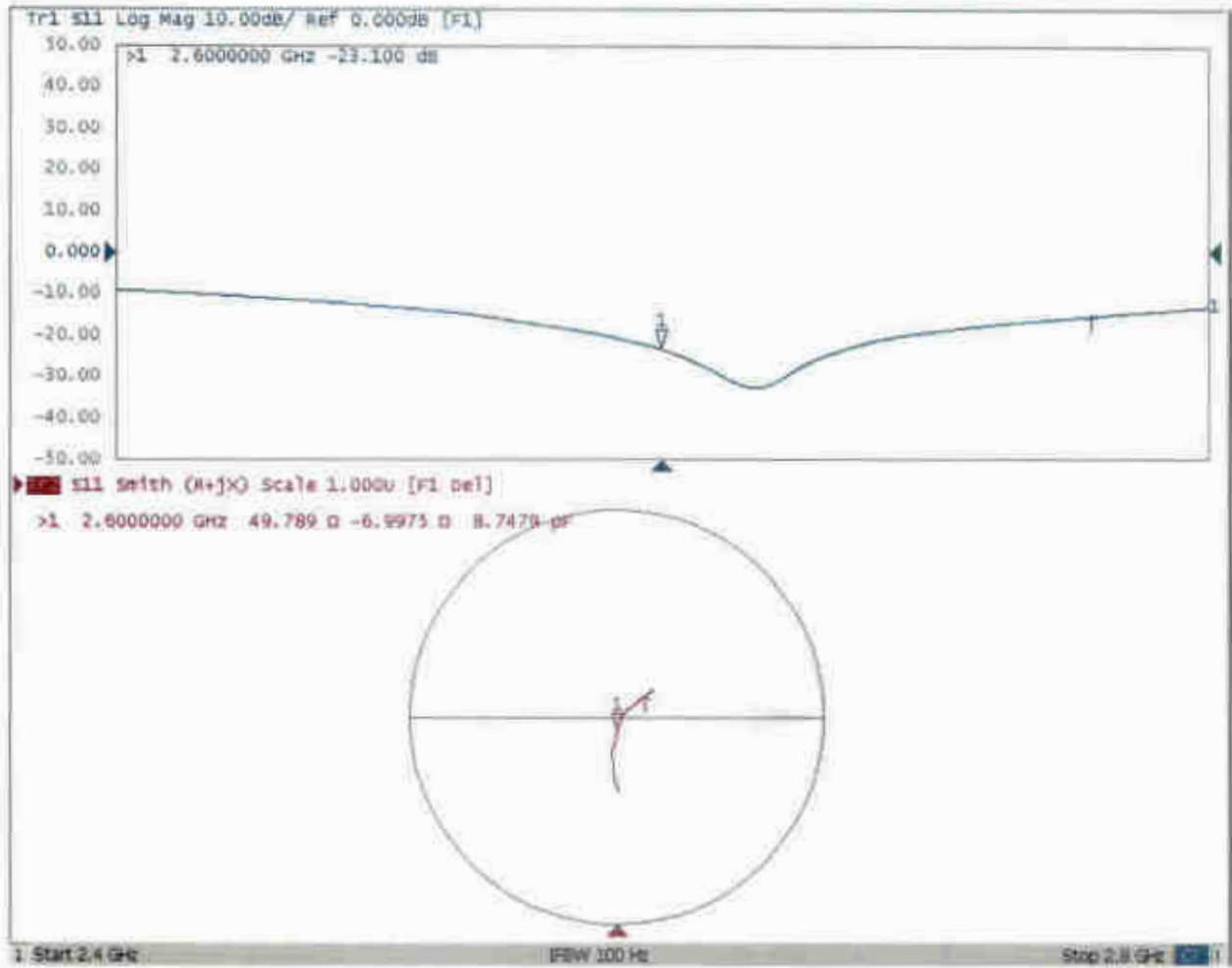


0 dB = 24.7 W/kg = 13.93 dBW/kg



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Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 12.06.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1061

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

Medium parameters used: $f = 2600$ MHz; $\sigma = 2.181$ S/m; $\epsilon_r = 51.03$; $\rho = 1000$ 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)

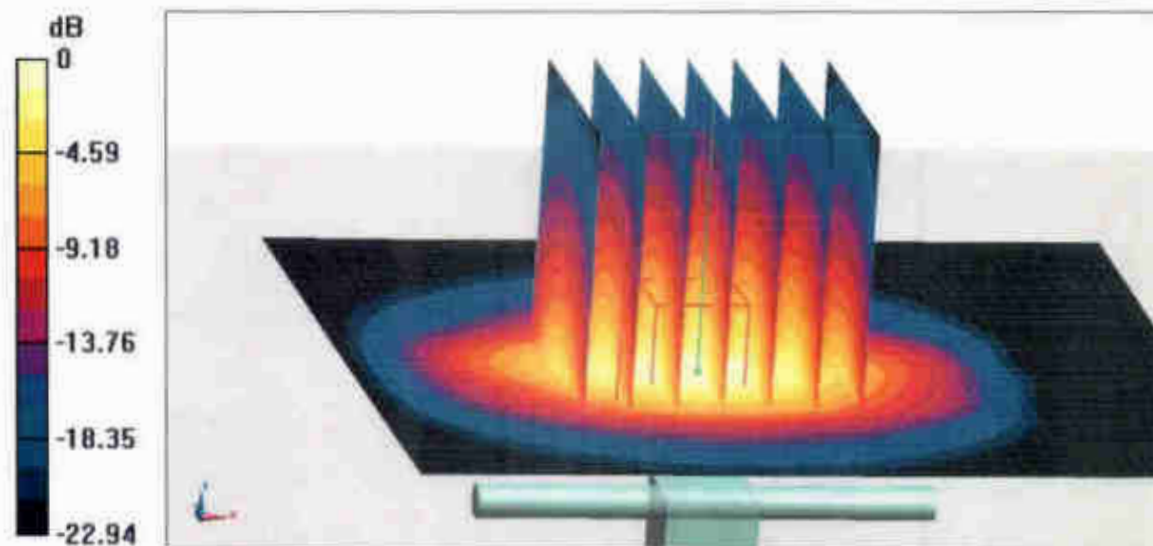
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 87.11 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 29.3 W/kg

SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.11 W/kg

Maximum value of SAR (measured) = 23.4 W/kg

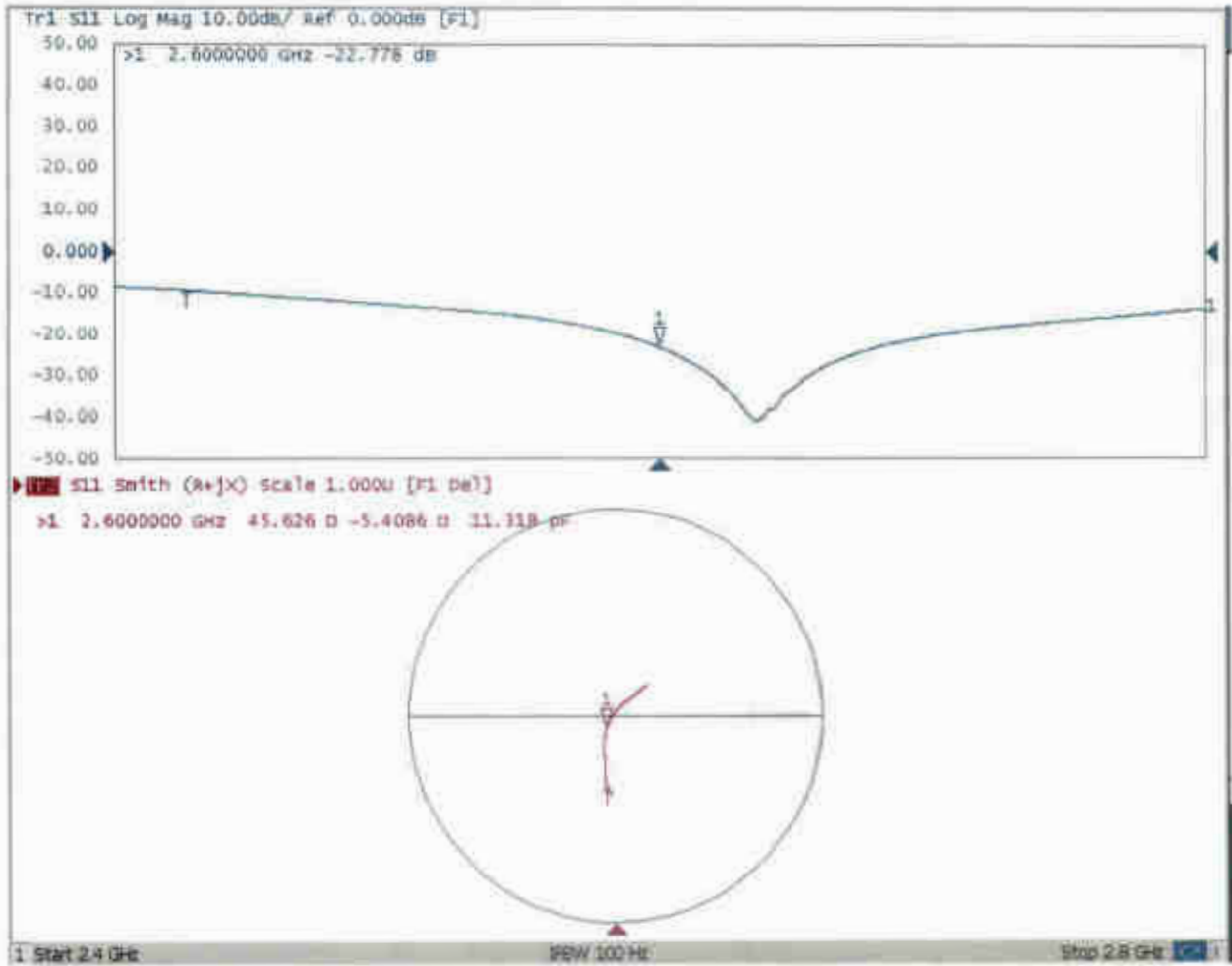


0 dB = 23.4 W/kg = 13.69 dBW/kg



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Impedance Measurement Plot for Body TSL





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.

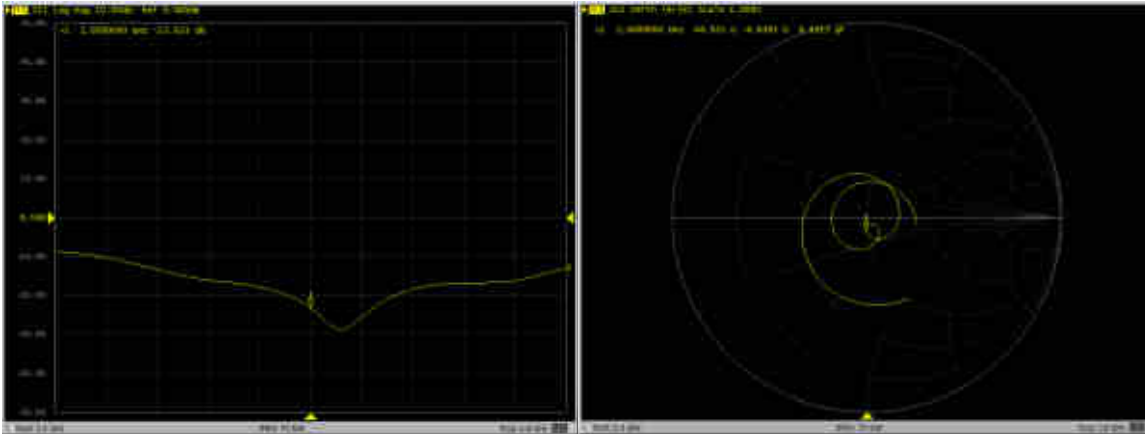
2600V2 – serial no. 1061												
	2600 Head						2600 Body					
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2018.12.07	-23.1		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>

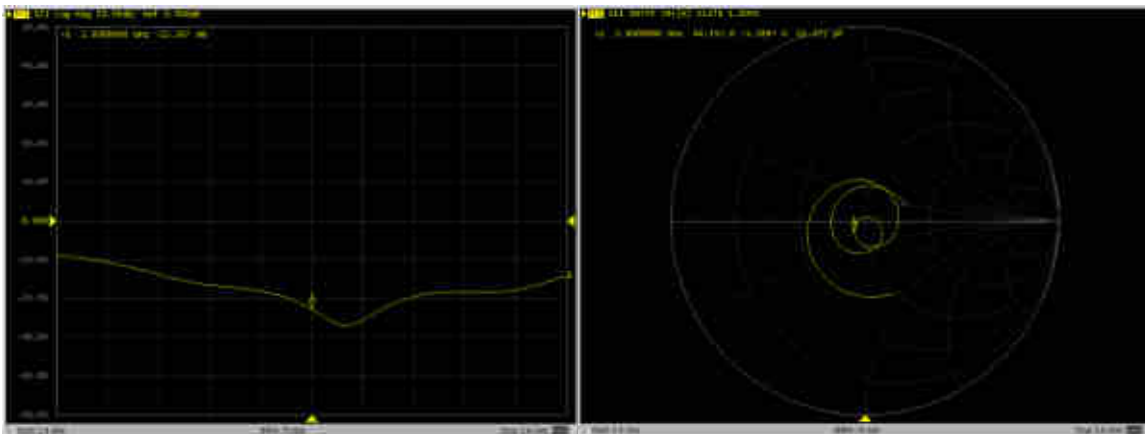
The return loss is $< -20\text{dB}$, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

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

Issued: September 25, 2019

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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
----------------------------------	----------

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,

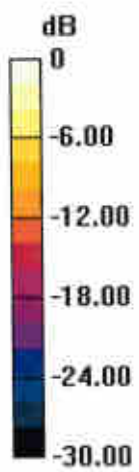
dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

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

Peak SAR (extrapolated) = 31.8 W/kg

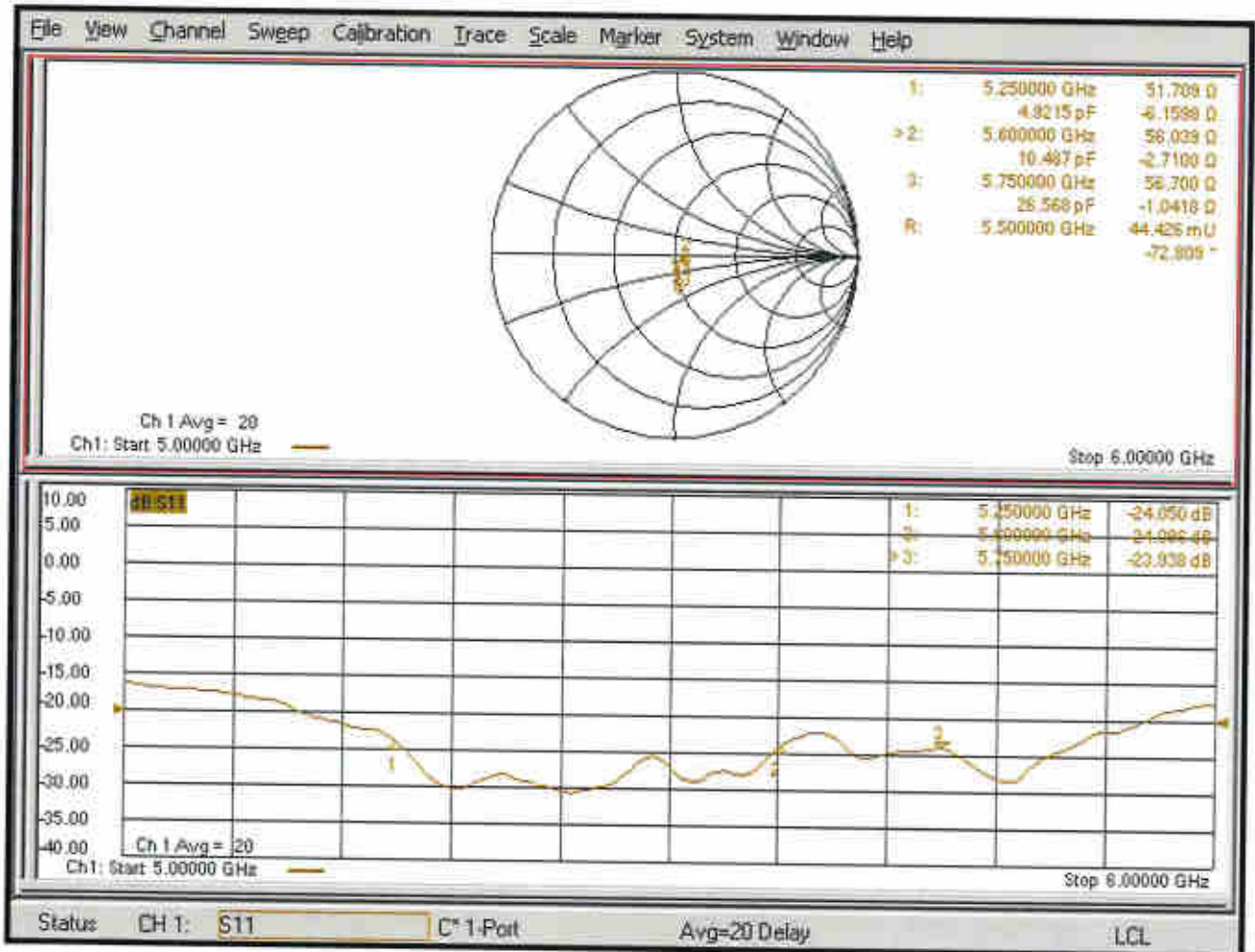
SAR(1 g) = 8.06 W/kg; SAR(10 g) = 2.30 W/kg

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 $^{\circ}$
---	------------------------------------

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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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

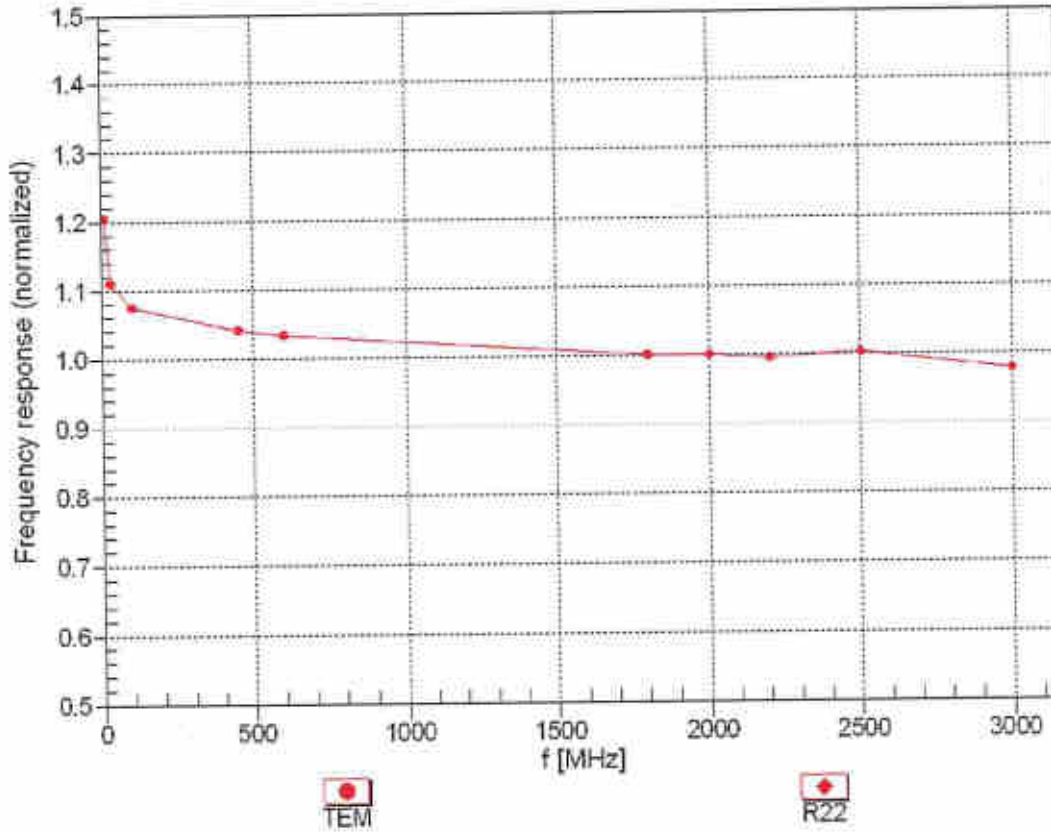
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
750	41.9	0.89	9.37	9.37	9.37	0.50	0.87	± 12.0 %
835	41.5	0.90	9.07	9.07	9.07	0.43	0.80	± 12.0 %
900	41.5	0.97	8.92	8.92	8.92	0.41	0.90	± 12.0 %
1450	40.5	1.20	8.17	8.17	8.17	0.32	0.80	± 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.

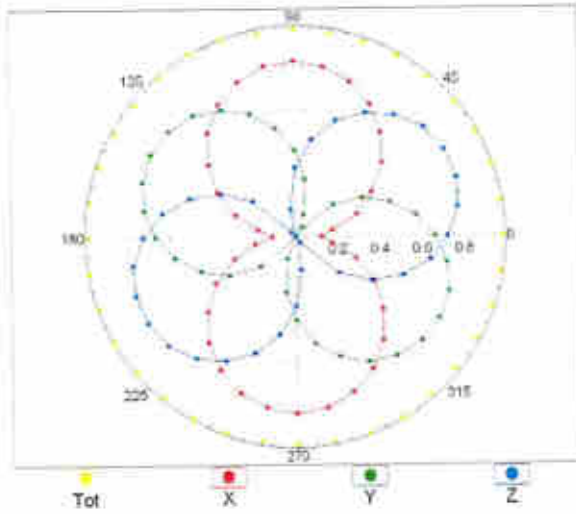
Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



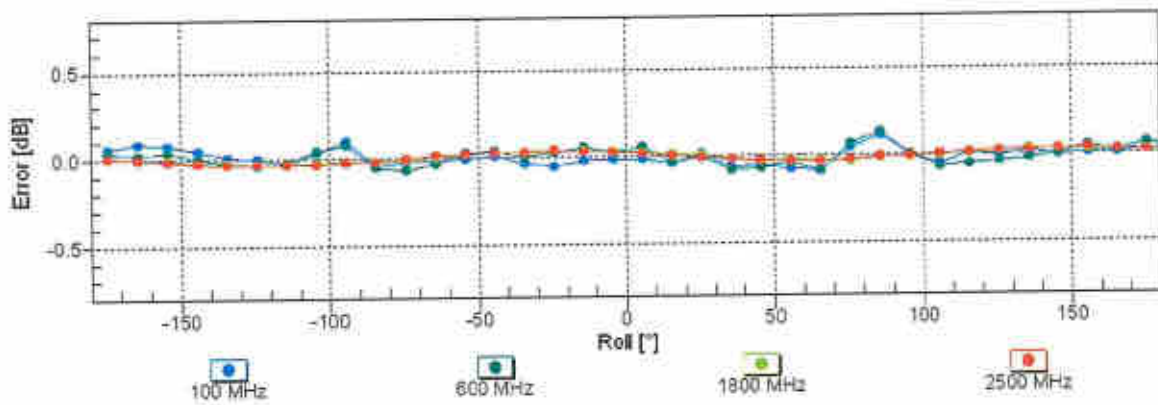
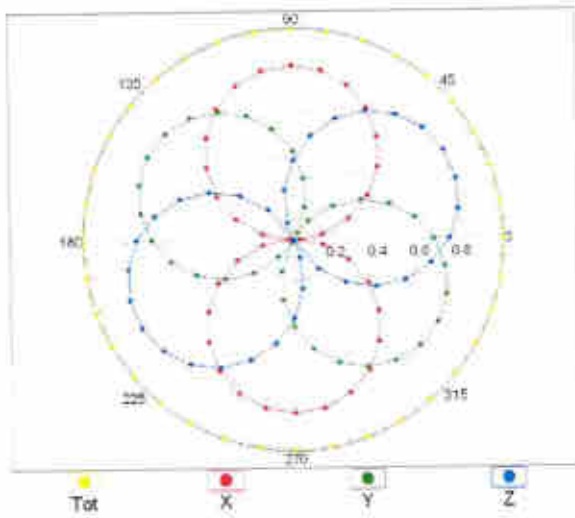
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz,TEM

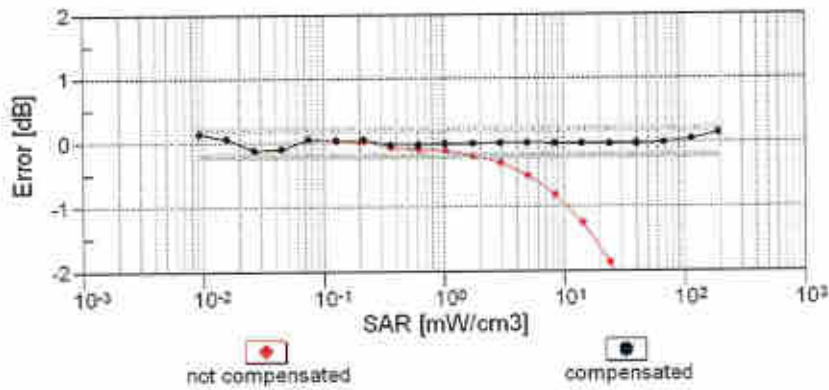
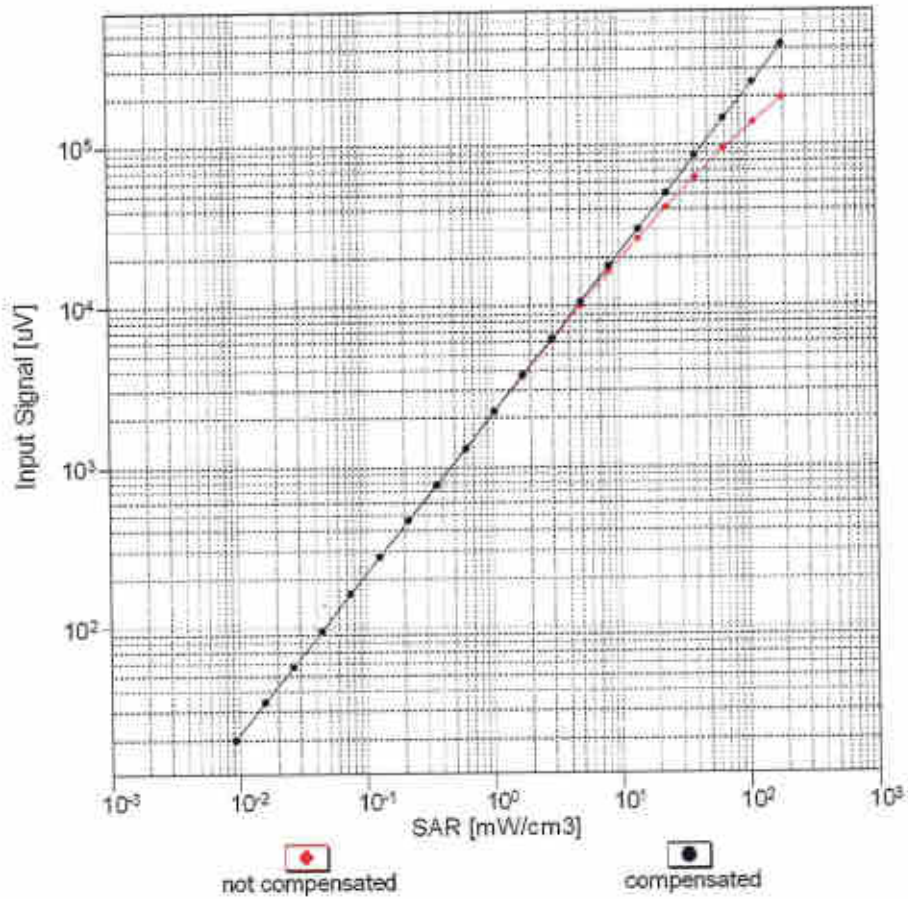


f=1800 MHz,R22



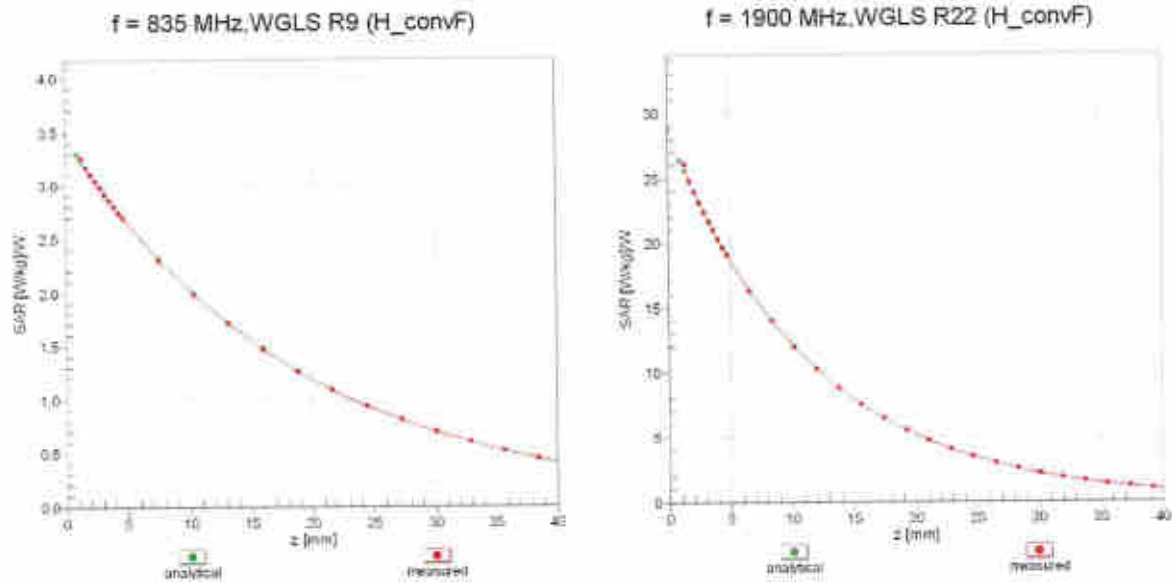
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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

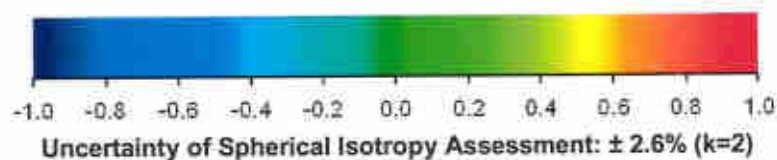
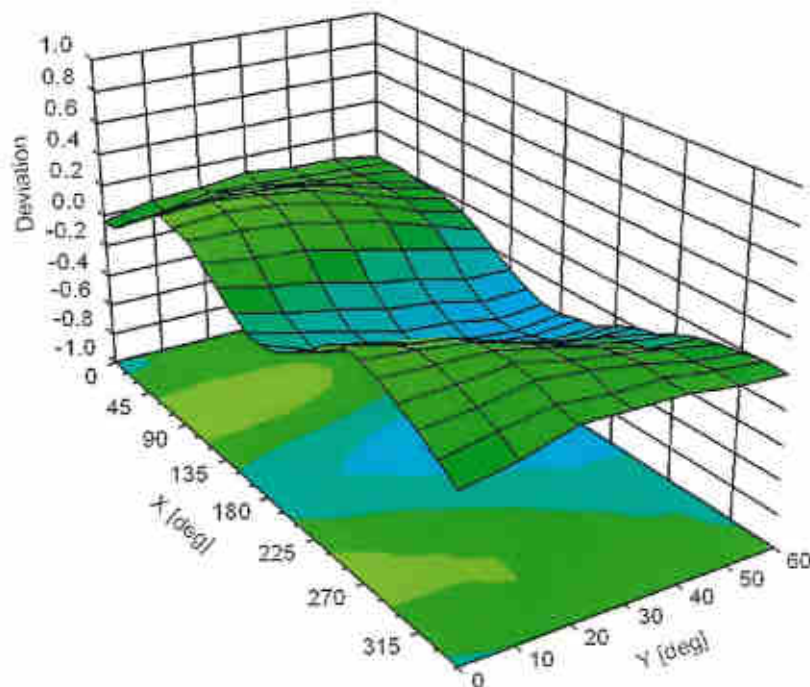


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



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





Appendix E. Conducted RF Output Power Table

The detailed power table are shown as follows.



Full Power Mode

GSM850	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
	152	159	251		152	159	251	
TX Channel	152	159	251	152	159	251	152	159
Frequency (MHz)	824.2	836.4	848.8	824.2	836.4	848.8	824.2	836.4
GSM 1 Tx slot	32.57	32.85	32.64	33.50	23.57	23.85	23.64	24.50
GPRS 1 Tx slot	32.56	32.84	32.62	33.50	23.56	23.84	23.62	24.50
GPRS 2 Tx slots	30.72	30.78	30.77	31.50	24.72	24.78	24.77	25.50
GPRS 3 Tx slots	29.86	30.03	30.02	31.00	25.60	25.77	25.76	26.74
GPRS 4 Tx slots	28.12	28.37	28.46	29.50	25.12	25.37	25.46	26.50
EDGE 1 Tx slot	26.63	26.62	26.63	27.50	17.63	17.62	17.63	18.50
EDGE 2 Tx slots	25.52	25.57	25.51	26.50	18.52	18.57	18.51	20.50
EDGE 3 Tx slots	23.62	23.94	23.91	24.50	18.66	18.88	18.85	20.24
EDGE 4 Tx slots	22.31	22.28	22.32	23.50	18.31	18.28	18.32	20.50

GSM1900	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
	512	661	810		512	661	810	
TX Channel	512	661	810	512	661	810	512	661
Frequency (MHz)	1850.2	1860	1909.6	1850.2	1860	1909.6	1850.2	1860
GSM 1 Tx slot	29.90	29.87	29.83	30.50	20.90	20.87	20.83	21.50
GPRS 1 Tx slot	29.89	29.85	29.81	30.50	20.89	20.85	20.81	21.50
GPRS 2 Tx slots	28.87	28.89	28.76	29.50	22.87	22.89	22.76	23.50
GPRS 3 Tx slots	27.26	27.28	27.21	28.00	23.00	23.02	22.95	23.74
GPRS 4 Tx slots	25.60	25.50	25.62	26.50	22.60	22.50	22.62	23.50
EDGE 1 Tx slot	26.43	26.28	26.37	27.50	17.43	17.28	17.37	18.50
EDGE 2 Tx slots	24.91	24.72	24.85	25.50	18.91	18.72	18.85	19.50
EDGE 3 Tx slots	23.79	23.61	23.73	24.50	18.53	18.35	18.47	20.24
EDGE 4 Tx slots	21.70	21.58	21.61	22.50	18.70	18.58	18.61	19.50

Band	WCDMA II			Tune-up Limit (dBm)	WCDMA IV			Tune-up Limit (dBm)	WCDMA V			Tune-up Limit (dBm)	
	9262	9400	9538		1312	1413	1513		4132	4182	4233		
TX Channel	9262	9400	9538	1312	1413	1513	4132	4182	4233	4132	4182	4233	
Rx Channel	9962	9800	9938	1537	1638	1738	4357	4407	4458	4357	4407	4458	
Frequency (MHz)	1852.4	1860	1907.6	1712.4	1732.6	1752.6	526.4	636.4	846.6	526.4	636.4	846.6	
3GPP Rel 99	AMR 12.2Kbps	23.10	23.17	23.06	24.00	22.90	23.12	23.12	24.00	23.00	23.02	22.89	24.00
3GPP Rel 99	RM C 12.2Kbps	23.11	23.19	23.09	24.00	22.91	23.15	23.13	24.00	23.01	23.04	22.92	24.00
3GPP Rel 6	HSDPA Subtest-1	22.13	22.24	22.14	23.00	21.94	22.17	22.17	23.00	22.05	22.03	22.04	23.00
3GPP Rel 6	HSDPA Subtest-2	22.16	22.25	22.16	23.00	21.92	22.19	22.19	23.00	22.07	22.09	21.75	23.00
3GPP Rel 6	HSDPA Subtest-3	21.70	21.81	21.67	22.50	21.43	21.71	21.70	22.50	21.96	21.80	21.23	22.50
3GPP Rel 6	HSDPA Subtest-4	21.63	21.78	21.68	22.50	21.45	21.71	21.67	22.50	21.55	21.59	21.58	22.50
3GPP Rel 8	DC-HSDPA Subtest-1	22.12	22.23	22.13	23.00	21.92	22.15	22.16	23.00	22.04	22.02	22.03	23.00
3GPP Rel 8	DC-HSDPA Subtest-2	22.15	22.23	22.15	23.00	21.91	22.18	22.18	23.00	21.55	21.59	21.74	23.00
3GPP Rel 8	DC-HSDPA Subtest-3	21.88	21.80	21.65	22.50	21.42	21.68	21.69	22.50	21.52	21.58	21.22	22.50
3GPP Rel 8	DC-HSDPA Subtest-4	21.61	21.77	21.67	22.50	21.44	21.70	21.65	22.50	22.03	22.01	21.54	22.50
3GPP Rel 6	HSUPA Subtest-1	22.09	22.23	22.14	23.00	21.87	22.13	22.15	23.00	22.01	22.03	22.05	23.00
3GPP Rel 6	HSUPA Subtest-2	20.15	20.24	20.09	21.00	19.89	20.13	20.15	21.00	20.09	20.08	20.05	21.00
3GPP Rel 6	HSUPA Subtest-3	21.08	21.18	21.10	22.00	20.89	21.14	21.15	22.00	21.00	21.05	21.01	22.00
3GPP Rel 6	HSUPA Subtest-4	20.11	20.19	20.09	21.00	19.87	20.13	20.15	21.00	20.00	20.07	20.08	21.00
3GPP Rel 6	HSUPA Subtest-5	22.20	22.20	22.20	23.00	21.90	22.10	22.10	23.00	22.10	22.10	22.00	23.00



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	Time-up limit (dBm)	MPR (dB)		
Channel										
Frequency (MHz)										
20	QPSK	1	0	23.05	23.10	23.01			24	0
20	QPSK	1	49	22.98	23.06	23.10				
20	QPSK	1	99	22.96	23.00	22.94				
20	QPSK	50	0	22.00	22.14	22.03				
20	QPSK	50	24	22.02	22.08	22.12				
20	QPSK	50	50	22.07	22.06	22.07				
20	QPSK	100	0	22.18	22.24	21.98				
20	16QAM	1	49	22.48	21.53	21.56				
20	16QAM	1	49	22.41	22.42	22.48				
20	16QAM	1	99	22.34	22.39	22.31				
20	16QAM	50	0	21.15	21.20	21.19				
20	16QAM	50	24	21.16	21.21	21.25				
20	16QAM	50	50	21.17	21.17	21.16				
20	16QAM	100	0	21.19	21.19	21.11				
20	8QAM	1	0	21.56	21.57	21.52				
20	8QAM	1	49	21.48	21.53	21.56				
20	8QAM	1	99	21.45	21.47	21.37				
20	8QAM	50	0	20.36	20.39	20.35				
20	8QAM	50	24	20.38	20.41	20.44				
20	8QAM	50	50	20.36	20.39	20.36				
20	8QAM	100	0	20.41	20.41	20.32				
Channel										
Frequency (MHz)										
15	QPSK	1	0	22.99	23.05	23.13			24	0
15	QPSK	1	37	22.96	23.04	23.06				
15	QPSK	1	74	22.88	22.99	22.95				
15	QPSK	36	0	22.04	22.07	22.06				
15	QPSK	36	20	22.03	22.11	22.12				
15	QPSK	36	39	21.97	22.03	22.03				
15	QPSK	75	0	21.88	22.05	22.06				
15	16QAM	1	0	22.39	22.38	22.48				
15	16QAM	1	37	22.38	22.38	22.42				
15	16QAM	1	74	22.30	22.32	22.33				
15	16QAM	36	0	21.15	21.21	21.25				
15	16QAM	36	20	21.16	21.22	21.27				
15	16QAM	36	39	21.09	21.21	21.16				
15	16QAM	75	0	21.14	21.19	21.21				
15	8QAM	1	0	21.55	21.54	21.60				
15	8QAM	1	37	21.51	21.51	21.50				
15	8QAM	1	74	21.39	21.44	21.41				
15	8QAM	36	0	20.39	20.44	20.44				
15	8QAM	36	20	20.18	20.24	20.47				
15	8QAM	36	39	20.31	20.42	20.38				
15	8QAM	75	0	20.37	20.41	20.41				
Channel										
Frequency (MHz)										
10	QPSK	1	0	23.11	23.15	23.08			24	0
10	QPSK	1	25	22.99	23.04	23.05				
10	QPSK	1	49	22.96	23.06	22.95				
10	QPSK	25	0	22.02	22.10	22.11				
10	QPSK	25	12	22.02	22.10	22.07				
10	QPSK	25	12	21.96	22.06	22.05				
10	QPSK	50	0	21.99	22.07	22.07				
10	16QAM	1	0	22.47	22.48	22.44				
10	16QAM	1	25	22.37	22.42	22.41				
10	16QAM	1	49	22.41	22.45	22.31				
10	16QAM	25	0	21.17	21.23	21.22				
10	16QAM	25	12	21.16	21.21	21.21				
10	16QAM	25	12	21.10	21.18	21.15				
10	16QAM	50	0	21.11	21.26	21.18				
10	8QAM	1	0	21.59	21.59	21.57				
10	8QAM	1	25	21.47	21.51	21.51				
10	8QAM	1	49	21.47	21.53	21.40				
10	8QAM	25	0	20.38	20.43	20.43				
10	8QAM	25	12	20.39	20.44	20.42				
10	8QAM	25	25	20.30	20.39	20.36				
10	8QAM	50	0	20.33	20.40	20.39				
Channel										
Frequency (MHz)										
5	QPSK	1	0	22.97	23.02	23.00			24	0
5	QPSK	1	12	22.89	23.04	23.01				
5	QPSK	1	24	22.91	23.00	22.96				
5	QPSK	12	0	22.04	22.10	22.08				
5	QPSK	12	7	22.03	22.13	22.10				
5	QPSK	12	13	21.99	22.06	22.03				
5	QPSK	25	0	21.88	22.07	22.07				
5	16QAM	1	0	22.32	22.37	22.38				
5	16QAM	1	12	22.40	22.36	22.37				
5	16QAM	1	24	22.32	22.36	22.32				
5	16QAM	12	0	21.16	21.22	21.20				
5	16QAM	12	7	21.22	21.25	21.22				
5	16QAM	12	13	21.14	21.19	21.17				
5	16QAM	25	0	21.11	21.21	21.17				
5	8QAM	1	0	21.50	21.51	21.48				
5	8QAM	1	12	21.49	21.50	21.48				
5	8QAM	1	24	21.44	21.45	21.45				
5	8QAM	12	0	20.38	20.44	20.39				
5	8QAM	12	7	20.37	20.45	20.42				
5	8QAM	12	13	20.34	20.39	20.39				
5	8QAM	25	0	20.29	20.39	20.37				
Channel										
Frequency (MHz)										
3	QPSK	1	0	22.86	23.04	22.96			24	0
3	QPSK	1	8	22.95	23.05	22.95				
3	QPSK	1	14	22.92	23.00	22.92				
3	QPSK	8	0	22.00	22.06	22.00				
3	QPSK	8	4	22.05	22.09	22.05				
3	QPSK	8	7	21.88	22.01	21.98				
3	QPSK	15	0	21.97	22.05	21.97				
3	16QAM	1	0	22.36	22.40	22.36				
3	16QAM	1	8	22.39	22.44	22.39				
3	16QAM	1	14	22.30	22.37	22.30				
3	16QAM	8	0	21.21	21.24	21.21				
3	16QAM	8	4	21.23	21.30	21.23				
3	16QAM	8	7	21.18	21.24	21.18				
3	16QAM	15	0	21.13	21.18	21.13				
3	8QAM	1	0	21.45	21.49	21.45				
3	8QAM	1	8	21.49	21.54	21.49				
3	8QAM	1	14	21.44	21.48	21.44				
3	8QAM	8	0	20.37	20.44	20.37				
3	8QAM	8	4	20.41	20.46	20.41				
3	8QAM	8	7	20.34	20.39	20.34				
3	8QAM	15	0	20.33	20.38	20.33				
Channel										
Frequency (MHz)										
1.4	QPSK	1	0	22.90	22.96	22.92			24	0
1.4	QPSK	1	3	22.97	23.06	23.02				
1.4	QPSK	1	5	22.94	23.08	22.92				
1.4	QPSK	3	0	22.86	22.86	22.86				
1.4	QPSK	3	1	22.99	23.08	23.03				
1.4	QPSK	3	3	22.85	23.04	22.97				
1.4	QPSK	6	0	21.93	22.02	21.97				
1.4	16QAM	1	0	22.28	22.32	22.27				
1.4	16QAM	1	3	22.39	22.40	22.31				
1.4	16QAM	1	5	22.30	22.32	22.25				
1.4	16QAM	3	0	22.08	22.10	22.08				
1.4	16QAM	3	1	22.12	22.17	22.11				
1.4	16QAM	3	3	22.04	22.07	22.03				
1.4	16QAM	6	0	21.15	21.19	21.18				
1.4	8QAM	1	0	21.38	21.44	21.40				
1.4	8QAM	1	3	21.49	21.47	21.49				
1.4	8QAM	1	5	21.41	21.41	21.36				
1.4	8QAM	3	0	21.34	21.35	21.32				
1.4	8QAM	3	1	21.35	21.41	21.31				
1.4	8QAM	3	3	21.32	21.35	21.29				
1.4	8QAM	6	0	20.26	20.34	20.30				

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	Time-up limit (dBm)	MPR (dB)		
Channel										
Frequency (MHz)										
20	QPSK	1	0	23.02						



Band 7 (600MHz 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				2050	2100	2150			
Frequency (MHz)				230	235	250			
20	QPSK	1	0	22.53	22.59	22.54			
20	QPSK	1	49	22.50	22.44	22.58		24	0
20	QPSK	1	99	22.57	22.52	22.63			
20	QPSK	50	0	22.13	22.28	22.18			
20	QPSK	50	24	22.18	22.08	22.22		23	1
20	QPSK	50	50	22.19	22.13	22.27			
20	QPSK	100	0	22.15	22.25	22.24			
20	16QAM	1	0	22.47	22.47	22.50			
20	16QAM	1	49	22.45	22.42	22.54		23	1
20	16QAM	1	99	22.49	22.46	22.60			
20	16QAM	50	0	21.22	21.12	21.28			
20	16QAM	50	24	21.26	21.18	21.32		22	2
20	16QAM	50	50	21.24	21.20	21.34			
20	16QAM	100	0	21.23	21.14	21.30			
20	84QAM	1	0	21.38	21.35	21.83			
20	84QAM	1	49	21.53	21.54	21.66		22	2
20	84QAM	1	99	21.61	21.59	21.70			
20	84QAM	50	0	20.42	20.33	20.50			
20	84QAM	50	24	20.49	20.39	20.54		21	3
20	84QAM	50	50	20.45	20.43	20.56			
20	84QAM	100	0	20.46	20.38	20.52			
Channel				2065	2100	21375			
Frequency (MHz)				2507.5	2535	2562.5			
15	QPSK	1	0	22.60	22.44	22.58			
15	QPSK	1	37	22.60	22.44	22.59		24	0
15	QPSK	1	74	22.61	22.54	22.68			
15	QPSK	36	0	22.23	22.07	22.20			
15	QPSK	36	20	22.20	22.09	22.25		23	1
15	QPSK	36	39	22.20	22.13	22.28			
15	QPSK	75	0	22.17	22.06	22.22			
15	16QAM	1	0	22.49	22.39	22.55			
15	16QAM	1	37	22.49	22.42	22.57		23	1
15	16QAM	1	74	22.53	22.53	22.63			
15	16QAM	36	0	21.32	21.10	21.31			
15	16QAM	36	20	21.26	21.20	21.37		22	2
15	16QAM	36	39	21.25	21.19	21.32			
15	16QAM	75	0	21.24	21.18	21.33			
15	84QAM	1	0	21.84	21.50	21.65			
15	84QAM	1	37	21.68	21.50	21.64		22	2
15	84QAM	1	74	21.63	21.63	21.74			
15	84QAM	36	0	20.50	20.33	20.53			
15	84QAM	36	20	20.45	20.41	20.59		21	3
15	84QAM	36	39	20.44	20.42	20.54			
15	84QAM	75	0	20.47	20.40	20.56			
Channel				2080	2100	21400			
Frequency (MHz)				2505	2535	2565			
10	QPSK	1	0	22.58	22.44	22.56			
10	QPSK	1	25	22.62	22.46	22.60		24	0
10	QPSK	1	49	22.57	22.50	22.66			
10	QPSK	25	0	22.20	22.06	22.20			
10	QPSK	25	12	22.23	22.10	22.22		23	1
10	QPSK	25	25	22.19	22.08	22.25			
10	QPSK	50	0	22.14	22.06	22.22			
10	16QAM	1	0	22.45	22.42	22.51			
10	16QAM	1	25	22.52	22.43	22.52		23	1
10	16QAM	1	49	22.55	22.44	22.62			
10	16QAM	25	0	21.30	21.14	21.28			
10	16QAM	25	12	21.35	21.17	21.32		22	2
10	16QAM	25	25	21.22	21.21	21.34			
10	16QAM	50	0	21.23	21.18	21.31			
10	84QAM	1	0	21.61	21.47	21.58		22	2
10	84QAM	1	25	21.61	21.52	21.68			
10	84QAM	1	49	21.62	21.56	21.67			
10	84QAM	25	0	20.52	20.38	20.46			
10	84QAM	25	12	20.57	20.39	20.49		21	3
10	84QAM	25	25	20.45	20.40	20.51			
10	84QAM	50	0	20.44	20.40	20.52			
Channel				2075	2100	21425			
Frequency (MHz)				2522.5	2535	2537.5			
5	QPSK	1	0	22.57	22.41	22.54			
5	QPSK	1	12	22.60	22.43	22.59		24	0
5	QPSK	1	24	22.62	22.46	22.61			
5	QPSK	12	0	22.20	22.01	22.19			
5	QPSK	12	7	22.22	22.10	22.26		23	1
5	QPSK	12	13	22.26	22.07	22.25			
5	QPSK	25	0	22.22	22.02	22.22			
5	16QAM	1	0	22.47	22.41	22.49			
5	16QAM	1	12	22.47	22.43	22.53		23	1
5	16QAM	1	24	22.52	22.41	22.54			
5	16QAM	12	0	21.29	21.12	21.30			
5	16QAM	12	7	21.34	21.18	21.32		22	2
5	16QAM	12	13	21.30	21.15	21.31			
5	16QAM	25	0	21.29	21.13	21.27			
5	84QAM	1	0	21.59	21.45	21.61			
5	84QAM	1	12	21.64	21.53	21.65		22	2
5	84QAM	1	24	21.61	21.53	21.64			
5	84QAM	12	0	20.50	20.33	20.51			
5	84QAM	12	7	20.56	20.37	20.54		21	3
5	84QAM	12	13	20.50	20.36	20.53			
5	84QAM	25	0	20.52	20.34	20.48			

Band 12 (700MHz Low Band) Part 277(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				2300	2395	2435			
Frequency (MHz)				704	707.5	711			
10	QPSK	1	0	22.82	22.83	22.84			
10	QPSK	1	25	22.88	22.86	22.82		24	0
10	QPSK	1	49	22.86	22.84	22.81			
10	QPSK	25	0	21.95	21.96	21.86			
10	QPSK	25	12	21.94	21.94	21.92		23	1
10	QPSK	25	25	21.92	21.90	21.90			
10	QPSK	50	0	21.94	21.95	21.98			
10	16QAM	1	0	22.15	22.10	22.14			
10	16QAM	1	25	22.20	22.20	22.15		23	1
10	16QAM	1	49	22.19	22.14	22.12			
10	16QAM	25	0	21.02	20.98	20.96			
10	16QAM	25	12	21.05	20.99	21.02		22	2
10	16QAM	25	25	21.02	21.01	20.96			
10	16QAM	50	0	21.02	21.00	21.00			
10	84QAM	1	0	21.29	21.21	21.30			
10	84QAM	1	25	21.32	21.28	21.28		22	2
10	84QAM	1	49	21.31	21.28	21.24			
10	84QAM	25	0	20.23	20.20	20.18			
10	84QAM	25	12	20.27	20.22	20.23		21	3
10	84QAM	25	25	20.24	20.22	20.16			
10	84QAM	50	0	20.22	20.18	20.21			
Channel				23035	23095	23155			
Frequency (MHz)				701.5	707.5	713.5			
5	QPSK	1	0	22.84	22.83	22.81			
5	QPSK	1	12	22.82	22.83	22.79		24	0
5	QPSK	1	24	22.87	22.85	22.80			
5	QPSK	12	0	21.86	21.86	21.87			
5	QPSK	12	7	21.90	21.92	21.87		23	1
5	QPSK	12	13	21.97	21.89	21.82			
5	QPSK	25	0	21.96	21.91	21.83			
5	16QAM	1	0	22.14	22.17	22.11			
5	16QAM	1	12	22.18	22.15	22.15		23	1
5	16QAM	1	24	22.18	22.17	22.09			
5	16QAM	12	0	20.99	20.99	20.96			
5	16QAM	12	7	21.02	21.01	20.98		22	2
5	16QAM	12	13	21.08	21.00	20.93			
5	16QAM	25	0	21.06	20.98	20.95			
5	84QAM	1	0	21.27	21.30	21.29			
5	84QAM	1	12	21.25	21.29	21.22		22	2
5	84QAM	1	24	21.33	21.29	21.21			
5	84QAM	12	0	20.17	20.19	20.18			
5	84QAM	12	7	20.20	20.22	20.20		21	3
5	84QAM	12	13	20.29	20.20	20.14			
5	84QAM	25	0	20.28	20.20	20.17			



Band 66									
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				132072	132222	132572			
Frequency (MHz)				1723	1745	1773			
20	QPSK	1	0	22.97	23.09	23.01			
20	QPSK	1	49	22.93	22.96	23.08	24	0	
20	QPSK	1	99	22.83	22.84	22.85			
20	QPSK	50	0	22.21	22.27	22.25			
20	QPSK	50	24	22.21	22.22	22.23			
20	QPSK	50	50	22.13	22.17	22.20			
20	QPSK	100	0	22.15	22.22	22.20	23	1	
20	16QAM	1	0	22.49	22.66	22.66			
20	16QAM	1	49	22.53	22.54	22.63	23	1	
20	16QAM	1	99	22.41	22.46	22.48			
20	16QAM	50	0	21.31	21.37	21.35			
20	16QAM	50	24	21.32	21.36	21.31			
20	16QAM	50	50	21.27	21.26	21.35			
20	16QAM	100	0	21.27	21.30	21.26	22	2	
20	64QAM	1	0	21.64	21.75	21.74			
20	64QAM	1	49	21.62	21.66	21.78			
20	64QAM	1	99	21.58	21.64	21.62			
20	64QAM	50	0	20.53	20.56	20.55			
20	64QAM	50	24	20.51	20.53	20.51			
20	64QAM	50	50	20.46	20.45	20.55			
20	64QAM	100	0	20.48	20.51	20.52	21	3	
Channel				152047	152322	152597			
Frequency (MHz)				1717.5	1745	1772.5			
15	QPSK	1	0	22.96	23.04	23.00			
15	QPSK	1	37	22.95	22.96	23.07	24	0	
15	QPSK	1	74	22.91	22.89	22.90			
15	QPSK	36	0	22.17	22.27	22.21			
15	QPSK	36	20	22.20	22.28	22.35	23	1	
15	QPSK	36	39	22.15	22.21	22.21			
15	QPSK	75	0	22.20	22.24	22.17			
15	16QAM	1	0	22.53	22.63	22.68			
15	16QAM	1	37	22.55	22.58	22.57	23	1	
15	16QAM	1	74	22.60	22.45	22.50			
15	16QAM	36	0	21.33	21.36	21.36			
15	16QAM	36	20	21.33	21.40	21.43	22	2	
15	16QAM	36	39	21.30	21.30	21.35			
15	16QAM	75	0	21.31	21.36	21.33			
15	64QAM	1	0	21.68	21.74	21.76			
15	64QAM	1	37	21.65	21.68	21.68	22	2	
15	64QAM	1	74	21.63	21.53	21.62			
15	64QAM	36	0	20.55	20.60	20.55			
15	64QAM	36	20	20.57	20.59	20.62			
15	64QAM	36	39	20.55	20.50	20.58			
15	64QAM	75	0	20.53	20.55	20.51	21	3	
Channel				132022	132322	132622			
Frequency (MHz)				1715	1745	1775			
10	QPSK	1	0	22.97	23.02	23.04			
10	QPSK	1	25	22.98	22.99	23.01	24	0	
10	QPSK	1	49	22.93	22.90	22.90			
10	QPSK	25	0	22.19	22.27	22.24			
10	QPSK	25	12	22.18	22.23	22.24	23	1	
10	QPSK	25	25	22.16	22.22	22.21			
10	QPSK	50	0	22.20	22.24	22.25			
10	16QAM	1	0	22.48	22.63	22.67			
10	16QAM	1	25	22.53	22.55	22.59	23	1	
10	16QAM	1	49	22.46	22.46	22.50			
10	16QAM	25	0	21.33	21.38	21.39			
10	16QAM	25	12	21.32	21.36	21.39	22	2	
10	16QAM	25	25	21.28	21.27	21.32			
10	16QAM	50	0	21.29	21.36	21.36			
10	64QAM	1	0	21.62	21.75	21.79			
10	64QAM	1	25	21.64	21.70	21.72	22	2	
10	64QAM	1	49	21.58	21.58	21.60			
10	64QAM	25	0	20.54	20.60	20.63			
10	64QAM	25	12	20.55	20.57	20.59			
10	64QAM	25	25	20.52	20.48	20.52	21	3	
10	64QAM	50	0	20.52	20.57	20.54			
Channel				131997	132222	132447			
Frequency (MHz)				1712.5	1745	1777.5			
5	QPSK	1	0	23.00	23.04	23.04			
5	QPSK	1	12	22.98	23.04	23.03	24	0	
5	QPSK	1	24	22.98	22.94	22.96			
5	QPSK	12	0	22.27	22.33	22.29			
5	QPSK	12	7	22.30	22.32	22.32	23	1	
5	QPSK	12	13	22.27	22.26	22.25			
5	QPSK	25	0	22.26	22.31	22.29			
5	16QAM	1	0	22.53	22.64	22.65			
5	16QAM	1	12	22.57	22.63	22.60	23	1	
5	16QAM	1	24	22.53	22.57	22.59			
5	16QAM	12	0	21.42	21.43	21.46			
5	16QAM	12	7	21.43	21.44	21.45	22	2	
5	16QAM	12	13	21.38	21.40	21.39			
5	16QAM	25	0	21.34	21.38	21.39			
5	64QAM	1	0	21.65	21.71	21.77			
5	64QAM	1	12	21.71	21.75	21.69	22	2	
5	64QAM	1	24	21.66	21.67	21.66			
5	64QAM	12	0	20.62	20.62	20.64			
5	64QAM	12	7	20.61	20.64	20.66	21	3	
5	64QAM	12	13	20.55	20.60	20.57			
5	64QAM	25	0	20.57	20.61	20.61			
Channel				131987	132322	132657			
Frequency (MHz)				1711.5	1745	1778.5			
3	QPSK	1	0	23.04	23.01	22.97			
3	QPSK	1	8	23.04	23.05	22.98	24	0	
3	QPSK	1	14	22.94	22.96	22.93			
3	QPSK	8	0	22.19	22.27	22.24			
3	QPSK	8	4	22.18	22.23	22.24	23	1	
3	QPSK	8	7	22.16	22.22	22.21			
3	QPSK	15	0	22.31	22.23	22.20			
3	16QAM	1	0	22.64	22.55	22.49			
3	16QAM	1	8	22.63	22.66	22.53	23	1	
3	16QAM	1	14	22.57	22.52	22.48			
3	16QAM	8	0	21.42	21.43	21.46			
3	16QAM	8	4	21.43	21.44	21.45	22	2	
3	16QAM	8	7	21.38	21.40	21.39			
3	16QAM	15	0	21.38	21.42	21.29			
3	64QAM	1	0	21.71	21.69	21.62			
3	64QAM	1	8	21.75	21.73	21.64	22	2	
3	64QAM	1	14	21.67	21.61	21.59			
3	64QAM	8	0	20.71	20.76	20.79			
3	64QAM	8	4	20.73	20.83	20.83	21	3	
3	64QAM	8	7	20.72	20.79	20.80			
3	64QAM	15	0	20.61	20.56	20.52			
Channel				131979	132322	132685			
Frequency (MHz)				1710.7	1745	1779.3			
1.4	QPSK	1	0	22.86	22.96	23.01			
1.4	QPSK	1	3	22.98	23.04	23.05	24	0	
1.4	QPSK	1	5	22.88	22.95	22.96			
1.4	QPSK	3	0	22.96	23.02	23.00			
1.4	QPSK	3	1	22.99	23.06	23.04			
1.4	QPSK	3	3	22.95	23.01	23.03			
1.4	QPSK	8	0	22.19	22.23	22.23	23	1	
1.4	16QAM	1	0	22.47	22.53	22.55			
1.4	16QAM	1	3	22.53	22.65	22.66			
1.4	16QAM	1	5	22.45	22.52	22.52	23	1	
1.4	16QAM	3	0	22.26	22.33	22.34			
1.4	16QAM	3	1	22.28	22.37	22.35			
1.4	16QAM	3	3	22.24	22.31	22.32			
1.4	16QAM	6	0	21.35	21.43	21.42	22	2	
1.4	64QAM	1	0	21.59	21.59	21.69			
1.4	64QAM	1	3	21.66	21.75	21.73			
1.4	64QAM	1	5	21.54	21.61	21.61	22	2	
1.4	64QAM	3	0	21.49	21.54	21.57			
1.4	64QAM	3	1	21.51	21.61	21.61			
1.4	64QAM	3	3	21.50	21.57	21.58			
1.4	64QAM	6	0	20.50	20.57	20.56	21	3	



Reduced Power Mode for Sensor On/Hotspot on

GSM850	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
	153	159	251		153	150	251	
TX Channel	153	159	251	153	150	251	153	150
Frequency (MHz)	852.2	858.4	849.8	852.2	858.4	849.8	852.2	858.4
GSM 1 Tx slot	30.89	30.66	30.85	31.50	21.89	21.66	21.85	22.50
GPRS 1 Tx slot	30.88	30.60	30.84	31.50	21.88	21.60	21.84	22.50
GPRS 2 Tx slots	28.42	28.40	28.72	29.50	22.42	22.40	22.72	23.50
GPRS 3 Tx slots	27.80	27.81	27.80	29.00	23.54	23.55	23.54	24.74
GPRS 4 Tx slots	25.85	25.93	26.12	27.50	22.85	22.93	23.12	24.50
EDGE 1 Tx slot	25.28	25.14	25.21	25.50	16.28	16.14	16.21	16.50
EDGE 2 Tx slots	23.67	23.50	23.61	24.50	17.67	17.50	17.61	18.50
EDGE 3 Tx slots	22.49	22.33	22.35	22.50	16.23	16.07	16.09	16.24
EDGE 4 Tx slots	20.28	20.23	20.44	21.50	17.28	17.23	17.44	18.50

GSM1900	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
	512	661	810		512	661	810	
TX Channel	512 <td>661 <td>810 <td>512 <td>661 <td>810 <td>512 <td>661 </td></td></td></td></td></td></td>	661 <td>810 <td>512 <td>661 <td>810 <td>512 <td>661 </td></td></td></td></td></td>	810 <td>512 <td>661 <td>810 <td>512 <td>661 </td></td></td></td></td>	512 <td>661 <td>810 <td>512 <td>661 </td></td></td></td>	661 <td>810 <td>512 <td>661 </td></td></td>	810 <td>512 <td>661 </td></td>	512 <td>661 </td>	661
Frequency (MHz)	1850.2 <td>1880 <td>1909.6 <td>1850.2 <td>1880 <td>1909.6 <td>1850.2 <td>1880 </td></td></td></td></td></td></td>	1880 <td>1909.6 <td>1850.2 <td>1880 <td>1909.6 <td>1850.2 <td>1880 </td></td></td></td></td></td>	1909.6 <td>1850.2 <td>1880 <td>1909.6 <td>1850.2 <td>1880 </td></td></td></td></td>	1850.2 <td>1880 <td>1909.6 <td>1850.2 <td>1880 </td></td></td></td>	1880 <td>1909.6 <td>1850.2 <td>1880 </td></td></td>	1909.6 <td>1850.2 <td>1880 </td></td>	1850.2 <td>1880 </td>	1880
GSM 1 Tx slot	20.00	19.85	19.91	21.50	11.00	10.85	10.91	12.50
GPRS 1 Tx slot	19.99	19.81	19.89	21.50	10.99	10.81	10.89	12.50
GPRS 2 Tx slots	18.78	18.69	18.65	20.50	12.78	12.69	12.65	14.50
GPRS 3 Tx slots	17.51	17.52	17.34	19.00	13.25	13.26	13.08	14.74
GPRS 4 Tx slots	15.92	15.65	15.74	17.50	12.92	12.65	12.74	14.50
EDGE 1 Tx slot	16.73	16.54	16.74	18.50	7.73	7.54	7.74	9.50
EDGE 2 Tx slots	14.51	14.08	14.29	16.50	8.51	8.08	8.29	10.50
EDGE 3 Tx slots	14.19	13.75	14.00	15.50	9.93	9.49	9.74	11.24
EDGE 4 Tx slots	12.80	12.41	12.66	13.50	9.80	9.41	9.66	10.50

Band	WCDMA II			Tune-up Limit (dBm)	WCDMA IV			WCDMA V			Tune-up Limit (dBm)		
	9262	8400	9538		1312	1413	1513	4132	4182	4233			
TX Channel	9262	8400	9538	1312	1413	1513	4132	4182	4233	4132	4182	4233	
Rx Channel	9962	8800	9938	1537	1638	1738	4357	4407	4458	4357	4407	4458	
Frequency (MHz)	1852.4	1880	1907.6	1712.4	1732.6	1752.6	836.4	836.4	846.6	836.4	836.4	846.6	
3GPP Rel 99	AMR 12.2Kbps	12.50	12.53	12.25	13.50	12.15	12.25	12.26	13.50	20.82	20.90	20.90	22.00
3GPP Rel 99	RMC 12.2Kbps	12.54	12.55	12.30	13.50	12.17	12.29	12.28	13.50	20.85	20.94	20.93	22.00
3GPP Rel 6	HSDPA Subtest-1	12.03	12.01	11.93	12.50	11.23	11.27	11.24	12.50	19.66	19.66	19.67	21.00
3GPP Rel 6	HSDPA Subtest-2	12.03	12.06	11.88	12.50	11.28	11.30	11.27	12.50	19.73	19.65	19.72	21.00
3GPP Rel 6	HSDPA Subtest-3	11.58	11.56	11.40	12.00	10.75	10.81	10.73	12.00	18.14	18.95	19.04	20.50
3GPP Rel 6	HSDPA Subtest-4	11.51	11.55	11.43	12.00	10.74	10.80	10.76	12.00	19.21	19.24	19.03	20.50
3GPP Rel 8	DC-HSDPA Subtest-1	12.04	12.01	11.98	12.50	11.20	11.30	11.30	12.50	19.67	19.68	19.71	21.00
3GPP Rel 8	DC-HSDPA Subtest-2	12.04	12.00	11.99	12.50	11.22	11.26	11.20	12.50	19.74	19.68	19.70	21.00
3GPP Rel 8	DC-HSDPA Subtest-3	11.56	11.55	11.60	12.00	10.84	10.75	10.74	12.00	19.15	19.21	19.20	20.50
3GPP Rel 8	DC-HSDPA Subtest-4	11.55	11.53	11.57	12.00	10.74	10.77	10.74	12.00	19.20	19.20	19.22	20.50
3GPP Rel 6	HSUPA Subtest-1	11.45	11.06	11.53	12.50	11.16	11.15	11.04	12.50	19.73	19.70	19.79	21.00
3GPP Rel 6	HSUPA Subtest-2	9.45	9.09	9.54	10.50	9.13	9.22	9.05	10.50	17.66	17.70	17.81	19.00
3GPP Rel 6	HSUPA Subtest-3	10.48	10.65	10.49	11.50	10.16	10.16	10.04	11.50	18.74	18.74	18.74	20.00
3GPP Rel 6	HSUPA Subtest-4	9.49	9.91	9.55	10.50	9.14	9.17	8.99	10.50	17.61	17.68	17.73	19.00
3GPP Rel 6	HSUPA Subtest-5	11.50	11.90	11.50	12.50	11.15	11.15	11.05	12.50	19.70	19.70	19.70	21.00



Band 2 (1900MHz Band) Part 24E										
BW (MHz)	Modulation	RB Size	RB Offset	Power Low Ch / Freq	Power Mid Ch / Freq	Power High Ch / Freq	Tune-up limit (dBm)	MPR (dB)		
Channel										
Frequency (MHz)				18700	18900	19100				
Frequency (MHz)				1860	1880	1900				
20	QPSK	1	0	12.51	12.56	12.33	13.5	0		
20	QPSK	1	49	12.37	12.40	12.33				
20	QPSK	1	99	12.36	12.29	12.19				
20	QPSK	50	0	12.47	12.50	12.32				
20	QPSK	50	24	12.45	12.43	12.43				
20	QPSK	50	50	12.49	12.37	12.32				
20	QPSK	100	0	12.53	12.54	12.32				
20	16QAM	1	0	12.37	12.35	12.15				
20	16QAM	1	49	12.23	12.24	12.19	13.5	0		
20	16QAM	1	99	12.20	12.12	11.99				
20	16QAM	50	0	12.34	12.33	12.19				
20	16QAM	50	24	12.05	12.04	12.02				
20	16QAM	50	50	12.09	11.97	11.91	13.5	0		
20	16QAM	100	0	12.15	12.02	11.89				
20	64QAM	1	0	12.27	12.22	12.03				
20	64QAM	1	49	12.14	12.13	12.08	13.5	0		
20	64QAM	1	99	12.08	12.00	11.88				
20	64QAM	50	0	12.05	12.04	11.89				
20	64QAM	50	24	12.04	12.03	11.94				
20	64QAM	50	50	12.07	11.98	11.90	13.5	0		
20	64QAM	100	0	12.14	12.01	11.89				
Channel										
Frequency (MHz)				18975	18900	19125				
Frequency (MHz)				1867.5	1880	1902.5				
15	QPSK	1	0	12.47	12.36	12.38	13.5	0		
15	QPSK	1	37	12.36	12.32	12.27				
15	QPSK	1	74	12.23	12.27	12.14				
15	QPSK	36	0	12.46	12.44	12.33				
15	QPSK	36	20	12.43	12.43	12.37	13.5	0		
15	QPSK	36	38	12.36	12.37	12.30				
15	QPSK	75	0	12.40	12.40	12.34				
15	16QAM	1	0	12.33	12.24	12.18				
15	16QAM	1	37	12.19	12.20	12.11	13.5	0		
15	16QAM	1	74	12.09	12.09	11.95				
15	16QAM	36	0	12.04	12.04	11.99				
15	16QAM	36	20	12.03	12.02	11.94	13.5	0		
15	16QAM	36	38	11.96	11.93	11.88				
15	16QAM	75	0	12.05	11.97	11.90				
15	64QAM	1	0	12.21	12.14	12.07				
15	64QAM	1	37	12.07	12.08	12.02	13.5	0		
15	64QAM	1	74	11.96	11.96	11.85				
15	64QAM	36	0	12.03	12.03	11.98				
15	64QAM	36	20	12.03	12.01	11.94	13.5	0		
15	64QAM	36	38	11.94	11.92	11.87				
15	64QAM	75	0	12.03	11.97	11.92				
Channel										
Frequency (MHz)				18950	18900	19150				
Frequency (MHz)				18650	18800	19050				
10	QPSK	1	0	12.56	12.50	12.34	13.5	0		
10	QPSK	1	25	12.41	12.35	12.26				
10	QPSK	1	49	12.39	12.37	12.16				
10	QPSK	25	0	12.47	12.41	12.36				
10	QPSK	25	12	12.44	12.41	12.32	13.5	0		
10	QPSK	25	25	12.39	12.38	12.23				
10	QPSK	50	0	12.44	12.36	12.29				
10	16QAM	1	0	12.41	12.37	12.20	13.5	0		
10	16QAM	1	25	12.34	12.28	12.26				
10	16QAM	1	49	12.25	12.21	12.00				
10	16QAM	25	0	12.07	12.03	11.96				
10	16QAM	25	12	12.08	12.01	11.91	13.5	0		
10	16QAM	25	25	12.01	11.97	11.85				
10	16QAM	50	0	12.04	11.99	11.89				
10	64QAM	1	0	12.30	12.23	12.07				
10	64QAM	1	25	12.12	12.09	11.97	13.5	0		
10	64QAM	1	49	12.10	12.10	11.87				
10	64QAM	25	0	12.08	12.03	11.95				
10	64QAM	25	12	12.07	12.00	11.90	13.5	0		
10	64QAM	25	25	12.00	11.96	11.86				
10	64QAM	50	0	12.02	11.98	11.86				
Channel										
Frequency (MHz)				18825	18800	19175				
Frequency (MHz)				1852.5	1880	1907.5				
5	QPSK	1	0	12.38	12.38	12.17	13.5	0		
5	QPSK	1	12	12.39	12.39	12.17				
5	QPSK	1	24	12.31	12.31	12.17				
5	QPSK	12	0	12.43	12.43	12.30	13.5	0		
5	QPSK	12	7	12.43	12.43	12.31				
5	QPSK	12	13	12.38	12.38	12.21				
5	QPSK	25	0	12.37	12.37	12.23				
5	16QAM	1	0	12.21	12.21	12.09				
5	16QAM	1	12	12.22	12.22	12.07	13.5	0		
5	16QAM	1	24	12.16	12.16	11.97				
5	16QAM	12	0	12.05	12.05	11.86				
5	16QAM	12	7	12.02	12.02	11.88	13.5	0		
5	16QAM	12	13	11.98	11.98	11.86				
5	16QAM	25	0	11.98	11.98	11.86				
5	64QAM	1	0	12.14	12.14	11.99	13.5	0		
5	64QAM	1	12	12.13	12.13	11.97				
5	64QAM	1	24	12.08	12.06	11.86				
5	64QAM	12	0	12.01	12.01	11.84				
5	64QAM	12	7	11.99	11.99	11.81	13.5	0		
5	64QAM	12	13	11.98	11.98	11.84				
5	64QAM	25	0	11.98	11.98	11.86				
Channel										
Frequency (MHz)				1851.5	18900	19185				
3	QPSK	1	0	12.49	12.50	12.47	13.5	0		
3	QPSK	1	8	12.48	12.46	12.47				
3	QPSK	1	14	12.44	12.45	12.44				
3	QPSK	8	0	12.53	12.52	12.51	13.5	0		
3	QPSK	8	4	12.54	12.54	12.55				
3	QPSK	8	7	12.52	12.49	12.53				
3	QPSK	15	0	12.52	12.48	12.47				
3	16QAM	1	0	12.34	12.29	12.30	13.5	0		
3	16QAM	1	8	12.33	12.31	12.32				
3	16QAM	1	14	12.25	12.28	12.24				
3	16QAM	8	0	12.18	12.17	12.13	13.5	0		
3	16QAM	8	4	12.20	12.18	12.19				
3	16QAM	8	7	12.17	12.14	12.14				
3	16QAM	15	0	12.12	12.12	12.13				
3	64QAM	1	0	12.23	12.23	12.19	13.5	0		
3	64QAM	1	8	12.21	12.23	12.20				
3	64QAM	1	14	12.18	12.20	11.93				
3	64QAM	8	0	12.15	12.12	12.11	13.5	0		
3	64QAM	8	4	12.15	12.14	12.13				
3	64QAM	8	7	12.11	12.09	12.06				
3	64QAM	15	0	12.10	12.09	12.10				
Channel										
Frequency (MHz)				18607	18900	19193				
Frequency (MHz)				1850.7	1880	1909.3				
1.4	QPSK	1	0	12.43	12.42	12.44	13.5	0		
1.4	QPSK	1	3	12.49	12.48	12.47				
1.4	QPSK	1	5	12.38	12.38	12.36				
1.4	QPSK	3	0	12.44	12.44	12.44	13.5	0		
1.4	QPSK	3	1	12.48	12.48	12.49				
1.4	QPSK	3	3	12.46	12.47	12.45				
1.4	QPSK	6	0	12.45	12.43	12.45	13.5	0		
1.4	16QAM	1	0	12.33	12.24	12.23				
1.4	16QAM	1	3	12.36	12.38	12.35				
1.4	16QAM	1	5	12.27	12.26	12.26	13.5	0		
1.4	16QAM	3	0	12.21	12.16	12.16				
1.4	16QAM	3	1	12.16	12.09	12.09				
1.4	16QAM	3	3	12.08	12.07	12.01	13.5	0		
1.4	16QAM	6	0	12.12	12.12	12.14				
1.4	64QAM	1	0	12.						



Band 7 (200MHz 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	14.58	14.70	14.50	16	0	
20	QPSK	1	49	14.59	14.54	14.56			
20	QPSK	1	99	14.60	14.50	14.54			
20	QPSK	50	0	14.58	14.60	14.61			
20	QPSK	50	24	14.67	14.58	14.61			
20	QPSK	50	50	14.62	14.58	14.61			
20	QPSK	100	0	14.61	14.62	14.59			
20	16QAM	1	0	14.53	14.50	14.48			
20	16QAM	1	49	14.54	14.48	14.54	16	0	
20	16QAM	1	99	14.56	14.54	14.45			
20	16QAM	50	0	14.22	14.22	14.18			
20	16QAM	50	24	14.23	14.24	14.23			
20	16QAM	50	50	14.33	14.25	14.20			
20	16QAM	100	0	14.23	14.20	14.19			
20	64QAM	1	0	14.41	14.31	14.33			
20	64QAM	1	49	14.40	14.35	14.34	16	0	
20	64QAM	1	99	14.41	14.34	14.34			
20	64QAM	50	0	14.20	14.15	14.17			
20	64QAM	50	24	14.23	14.22	14.17			
20	64QAM	50	50	14.23	14.22	14.18	16	0	
20	64QAM	100	0	14.23	14.20	14.17			
Channel				20825	21100	21375			
Frequency (MHz)				2507.5	2535	2562.5			
15	QPSK	1	0	14.47	14.30	14.38	16	0	
15	QPSK	1	37	14.45	14.31	14.34			
15	QPSK	1	74	14.51	14.40	14.45			
15	QPSK	38	0	14.51	14.32	14.38			
15	QPSK	38	20	14.47	14.36	14.43	16	0	
15	QPSK	38	39	14.48	14.36	14.42			
15	QPSK	75	0	14.44	14.33	14.40			
15	16QAM	1	0	14.58	14.47	14.50			
15	16QAM	1	37	14.57	14.45	14.44	16	0	
15	16QAM	1	74	14.59	14.58	14.55			
15	16QAM	38	0	14.31	14.17	14.21			
15	16QAM	38	20	14.28	14.23	14.25	16	0	
15	16QAM	38	39	14.25	14.25	14.24			
15	16QAM	75	0	14.24	14.20	14.20			
15	64QAM	1	0	14.48	14.36	14.36	16	0	
15	64QAM	1	37	14.48	14.35	14.32			
15	64QAM	1	74	14.49	14.41	14.33			
15	64QAM	38	0	14.30	14.15	14.22			
15	64QAM	38	20	14.23	14.22	14.24	16	0	
15	64QAM	38	39	14.25	14.24	14.22			
15	64QAM	75	0	14.22	14.19	14.20			
Channel				20800	21100	21400			
Frequency (MHz)				2505	2535	2565			
10	QPSK	1	0	14.41	14.25	14.28	16	0	
10	QPSK	1	25	14.44	14.29	14.32			
10	QPSK	1	49	14.42	14.30	14.34			
10	QPSK	25	0	14.47	14.29	14.32			
10	QPSK	25	12	14.50	14.36	14.33	16	0	
10	QPSK	25	25	14.43	14.37	14.32			
10	QPSK	50	0	14.40	14.33	14.36			
10	16QAM	1	0	14.57	14.40	14.44			
10	16QAM	1	25	14.61	14.45	14.41	16	0	
10	16QAM	1	49	14.52	14.51	14.46			
10	16QAM	25	0	14.29	14.18	14.13			
10	16QAM	25	12	14.32	14.18	14.15	16	0	
10	16QAM	25	25	14.20	14.17	14.14			
10	16QAM	50	0	14.22	14.21	14.18			
10	64QAM	1	0	14.41	14.29	14.27			
10	64QAM	1	25	14.44	14.33	14.29	16	0	
10	64QAM	1	49	14.39	14.37	14.34			
10	64QAM	25	0	14.29	14.15	14.10			
10	64QAM	25	12	14.32	14.18	14.15	16	0	
10	64QAM	25	25	14.24	14.15	14.13			
10	64QAM	50	0	14.20	14.18	14.16			
Channel				20775	21100	21425			
Frequency (MHz)				2502.5	2535	2567.5			
5	QPSK	1	0	14.37	14.28	14.28	16	0	
5	QPSK	1	12	14.41	14.28	14.28			
5	QPSK	1	24	14.44	14.33	14.30			
5	QPSK	12	0	14.45	14.34	14.30			
5	QPSK	12	7	14.40	14.35	14.35	16	0	
5	QPSK	12	13	14.46	14.36	14.37			
5	QPSK	25	0	14.44	14.29	14.29			
5	16QAM	1	0	14.52	14.39	14.40			
5	16QAM	1	12	14.51	14.40	14.40	16	0	
5	16QAM	1	24	14.59	14.43	14.39			
5	16QAM	12	0	14.29	14.15	14.16			
5	16QAM	12	7	14.32	14.23	14.19	16	0	
5	16QAM	12	13	14.34	14.20	14.16			
5	16QAM	25	0	14.26	14.17	14.10			
5	64QAM	1	0	14.38	14.28	14.28			
5	64QAM	1	12	14.40	14.30	14.28	16	0	
5	64QAM	1	24	14.44	14.28	14.27			
5	64QAM	12	0	14.28	14.14	14.16			
5	64QAM	12	7	14.32	14.22	14.16	16	0	
5	64QAM	12	13	14.29	14.18	14.17			
5	64QAM	25	0	14.27	14.18	14.13			

Band 66									
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				132072	132322	132572			
Frequency (MHz)				1720	1745	1770			
20	QPSK	1	0	12.58	12.50	12.18			
20	QPSK	1	49	12.59	12.35	12.26	13.5	0	
20	QPSK	1	99	12.44	12.36	12.24			
20	QPSK	50	0	12.37	12.32	12.16			
20	QPSK	50	24	12.36	12.24	12.12			
20	QPSK	50	50	12.24	12.14	12.13	13.5	0	
20	QPSK	100	0	12.31	12.30	12.14			
20	16QAM	1	0	12.36	12.25	12.17			
20	16QAM	1	49	12.27	12.14	12.21	13.5	0	
20	16QAM	1	99	12.11	12.09	12.04			
20	16QAM	50	0	12.07	11.92	11.86			
20	16QAM	50	24	12.04	11.92	11.84			
20	16QAM	50	50	11.97	11.83	11.85	13.5	0	
20	16QAM	100	0	12.01	11.86	11.82			
20	64QAM	1	0	12.22	12.10	12.04			
20	64QAM	1	49	12.12	11.98	12.05	13.5	0	
20	64QAM	1	99	11.96	11.94	11.89			
20	64QAM	50	0	12.05	11.94	11.86			
20	64QAM	50	24	12.05	11.88	11.82			
20	64QAM	50	50	11.95	11.80	11.84	13.5	0	
20	64QAM	100	0	12.01	11.84	11.84			
Channel				132047	132322	132597			
Frequency (MHz)				1717.5	1745	1772.5			
15	QPSK	1	0	12.23	12.16	12.01			
15	QPSK	1	37	12.17	12.04	12.05	13.5	0	
15	QPSK	1	74	12.09	11.89	11.93			
15	QPSK	38	0	12.23	12.16	12.05			
15	QPSK	38	20	12.25	12.12	12.12	13.5	0	
15	QPSK	38	39	12.15	12.01	12.03			
15	QPSK	75	0	12.21	12.07	11.98			
15	16QAM	1	0	12.34	12.22	12.09			
15	16QAM	1	37	12.25	12.08	12.13	13.5	0	
15	16QAM	1	74	12.14	11.97	12.04			
15	16QAM	38	0	12.04	11.88	11.83			
15	16QAM	38	20	12.06	11.91	11.90	13.5	0	
15	16QAM	38	39	11.98	11.81	11.88			
15	16QAM	75	0	12.01	11.85	11.78			
15	64QAM	1	0	12.21	12.08	12.01			
15	64QAM	1	37	12.11	11.98	12.01	13.5	0	
15	64QAM	1	74	12.01	11.85	11.92			
15	64QAM	38	0	12.02	11.89	11.81			
15	64QAM	38	20	12.04	11.92	11.91	13.5	0	
15	64QAM	38	39	11.95	11.80	11.88			
15	64QAM	75</							



Reduced Power Mode for Handheld on

Band		WCDMA II			Tune-up Limit (dBm)	WCDMA IV			Tune-up Limit (dBm)
TX Channel		9262	9490	9538		1312	1413	1513	
Rx Channel		9902	9900	9939	1537	1638	1738		
Frequency (MHz)		1852.4	1880	1907.6	1712.4	1732.6	1752.6		
3GPP Rel 99	AMR 12.2Kbps	19.00	18.92	18.67	20.00	18.43	18.54	18.50	19.50
3GPP Rel 99	RMC 12.2Kbps	19.01	19.08	18.99	20.00	18.45	18.58	18.51	19.50
3GPP Rel 6	HSDPA Subtest-1	17.96	18.07	17.87	19.00	17.10	17.29	17.27	18.50
3GPP Rel 6	HSDPA Subtest-2	18.18	18.08	17.82	19.00	17.15	17.26	17.27	18.50
3GPP Rel 6	HSDPA Subtest-3	17.66	17.56	17.41	18.50	16.63	16.79	16.70	18.00
3GPP Rel 6	HSDPA Subtest-4	17.63	17.60	17.35	18.50	16.62	16.82	16.76	18.00
3GPP Rel 6	DC-HSDPA Subtest-1	17.99	18.00	18.01	19.00	17.12	17.20	17.21	18.50
3GPP Rel 6	DC-HSDPA Subtest-2	18.10	18.01	18.02	19.00	17.16	17.24	17.20	18.50
3GPP Rel 6	DC-HSDPA Subtest-3	17.65	17.56	17.56	18.50	16.71	16.74	16.84	18.00
3GPP Rel 6	DC-HSDPA Subtest-4	17.58	17.65	17.56	18.50	16.80	16.70	16.80	18.00
3GPP Rel 6	HSUPA Subtest-1	17.96	17.80	17.71	19.00	17.13	17.36	17.10	18.50
3GPP Rel 6	HSUPA Subtest-2	16.01	15.92	15.77	17.00	15.23	15.35	15.14	16.50
3GPP Rel 6	HSUPA Subtest-3	17.04	16.82	16.74	18.00	16.20	16.29	16.16	17.50
3GPP Rel 6	HSUPA Subtest-4	16.04	16.07	15.65	17.00	15.16	15.28	15.16	16.50
3GPP Rel 6	HSUPA Subtest-5	18.10	18.00	17.60	19.00	17.20	17.30	17.10	18.50



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										
Frequency (MHz)										
20	QPSK	1	0	19.07	19.20	19.09	20	0		
20	QPSK	1	49	18.99	19.12	19.19	20	0		
20	QPSK	1	99	19.00	19.06	19.05	20	0		
20	QPSK	50	0	19.03	19.19	19.06	20	0		
20	QPSK	50	24	19.05	19.15	19.18	20	0		
20	QPSK	50	50	19.05	19.13	19.12	20	0		
20	QPSK	100	0	19.09	19.13	19.06	20	0		
20	16QAM	1	0	19.02	19.12	19.09	20	0		
20	16QAM	1	49	18.96	19.10	19.14	20	0		
20	16QAM	1	99	18.96	19.03	19.01	20	0		
20	16QAM	50	0	18.86	18.75	18.74	20	0		
20	16QAM	50	24	18.67	18.82	18.84	20	0		
20	16QAM	50	50	18.78	18.75	18.75	20	0		
20	16QAM	100	0	18.73	18.76	18.75	20	0		
20	84QAM	1	0	18.95	19.01	18.97	20	0		
20	84QAM	1	49	18.90	18.97	19.03	20	0		
20	84QAM	1	99	18.94	18.87	18.87	20	0		
20	84QAM	50	0	18.67	18.79	18.72	20	0		
20	84QAM	50	24	18.66	18.80	18.83	20	0		
20	84QAM	50	50	18.72	18.70	18.75	20	0		
20	84QAM	100	0	18.81	18.75	18.72	20	0		
Channel										
Frequency (MHz)										
15	QPSK	1	0	18.81	18.89	18.96	20	0		
15	QPSK	1	37	18.77	18.90	18.92	20	0		
15	QPSK	1	74	18.70	18.92	18.95	20	0		
15	QPSK	36	0	18.84	18.93	18.95	20	0		
15	QPSK	36	20	18.87	18.95	18.98	20	0		
15	QPSK	36	39	18.79	18.89	18.91	20	0		
15	QPSK	75	0	18.78	18.89	18.95	20	0		
15	16QAM	1	0	18.88	19.06	19.12	20	0		
15	16QAM	1	37	18.94	19.05	19.08	20	0		
15	16QAM	1	74	18.88	18.99	18.97	20	0		
15	16QAM	36	0	18.74	18.90	18.95	20	0		
15	16QAM	36	20	18.72	18.93	18.95	20	0		
15	16QAM	36	39	18.68	18.76	18.77	20	0		
15	16QAM	75	0	18.69	18.76	18.84	20	0		
15	84QAM	1	0	18.86	18.94	19.00	20	0		
15	84QAM	1	37	18.83	18.92	18.96	20	0		
15	84QAM	1	74	18.78	18.82	18.85	20	0		
15	84QAM	36	0	18.71	18.76	18.84	20	0		
15	84QAM	36	20	18.70	18.81	18.92	20	0		
15	84QAM	36	39	18.63	18.71	18.76	20	0		
15	84QAM	75	0	18.70	18.75	18.75	20	0		
Channel										
Frequency (MHz)										
10	QPSK	1	0	18.90	18.98	18.94	20	0		
10	QPSK	1	25	18.81	18.86	18.91	20	0		
10	QPSK	1	49	18.78	18.88	18.84	20	0		
10	QPSK	25	0	18.81	18.90	18.92	20	0		
10	QPSK	25	12	18.80	18.91	18.92	20	0		
10	QPSK	25	25	18.77	18.84	18.85	20	0		
10	QPSK	50	0	18.78	18.88	18.92	20	0		
10	16QAM	1	0	19.07	19.17	19.10	20	0		
10	16QAM	1	25	18.97	19.04	19.07	20	0		
10	16QAM	1	49	18.95	19.09	19.03	20	0		
10	16QAM	25	0	18.70	18.75	18.78	20	0		
10	16QAM	25	12	18.66	18.79	18.78	20	0		
10	16QAM	25	25	18.66	18.72	18.75	20	0		
10	16QAM	50	0	18.64	18.75	18.76	20	0		
10	84QAM	1	0	18.96	19.06	19.08	20	0		
10	84QAM	1	25	18.86	18.98	19.07	20	0		
10	84QAM	1	49	18.82	18.93	18.89	20	0		
10	84QAM	25	0	18.68	18.76	18.78	20	0		
10	84QAM	25	12	18.67	18.76	18.77	20	0		
10	84QAM	25	25	18.60	18.72	18.74	20	0		
10	84QAM	50	0	18.66	18.76	18.73	20	0		
Channel										
Frequency (MHz)										
5	QPSK	1	0	18.78	18.84	18.90	20	0		
5	QPSK	1	12	18.78	18.94	18.79	20	0		
5	QPSK	1	24	18.72	18.84	18.79	20	0		
5	QPSK	12	0	18.82	18.92	18.96	20	0		
5	QPSK	12	7	18.87	18.92	18.96	20	0		
5	QPSK	12	13	18.80	18.89	18.90	20	0		
5	QPSK	25	0	18.78	18.82	18.86	20	0		
5	16QAM	1	0	18.99	19.10	19.08	20	0		
5	16QAM	1	12	18.95	19.07	19.06	20	0		
5	16QAM	1	24	18.96	19.06	19.06	20	0		
5	16QAM	12	0	18.72	18.82	18.81	20	0		
5	16QAM	12	7	18.73	18.82	18.82	20	0		
5	16QAM	12	13	18.75	18.77	18.80	20	0		
5	16QAM	25	0	18.62	18.74	18.76	20	0		
5	84QAM	1	0	18.84	18.94	18.94	20	0		
5	84QAM	1	12	18.83	18.95	18.93	20	0		
5	84QAM	1	24	18.77	18.92	18.90	20	0		
5	84QAM	12	0	18.71	18.80	18.79	20	0		
5	84QAM	12	7	18.68	18.84	18.82	20	0		
5	84QAM	12	13	18.68	18.76	18.76	20	0		
5	84QAM	25	0	18.62	18.74	18.76	20	0		
Channel										
Frequency (MHz)										
3	QPSK	1	0	18.81	18.86	18.89	20	0		
3	QPSK	1	8	18.80	18.82	18.87	20	0		
3	QPSK	1	14	18.82	18.85	18.83	20	0		
3	QPSK	8	0	18.84	18.93	18.92	20	0		
3	QPSK	8	4	18.86	18.96	18.93	20	0		
3	QPSK	8	7	18.85	18.88	18.91	20	0		
3	QPSK	15	0	18.88	18.88	18.88	20	0		
3	16QAM	1	0	18.90	19.02	19.04	20	0		
3	16QAM	1	8	18.94	19.04	19.08	20	0		
3	16QAM	1	14	18.92	19.03	18.97	20	0		
3	16QAM	8	0	18.76	18.85	18.85	20	0		
3	16QAM	8	4	18.83	18.86	18.89	20	0		
3	16QAM	8	7	18.78	18.97	18.95	20	0		
3	16QAM	15	0	18.67	18.78	18.74	20	0		
3	84QAM	1	0	18.81	18.87	18.92	20	0		
3	84QAM	1	8	18.85	18.98	18.95	20	0		
3	84QAM	1	14	18.79	18.89	18.86	20	0		
3	84QAM	8	0	18.70	18.80	18.79	20	0		
3	84QAM	8	4	18.73	18.86	18.85	20	0		
3	84QAM	8	7	18.70	18.80	18.77	20	0		
3	84QAM	15	0	18.61	18.72	18.76	20	0		
Channel										
Frequency (MHz)										
1.4	QPSK	1	0	18.72	18.84	18.82	20	0		
1.4	QPSK	1	3	18.78	18.86	18.88	20	0		
1.4	QPSK	1	5	18.75	18.79	18.80	20	0		
1.4	QPSK	3	0	18.79	18.85	18.82	20	0		
1.4	QPSK	3	1	18.81	18.91	18.89	20	0		
1.4	QPSK	3	3	18.79	18.84	18.82	20	0		
1.4	QPSK	6	0	18.76	18.82	18.83	20	0		
1.4	16QAM	1	0	18.93	19.09	19.06	20	0		
1.4	16QAM	1	3	18.99	19.06	19.05	20	0		
1.4	16QAM	1	5	18.88	18.98	18.93	20	0		
1.4	16QAM	3	0	18.69	18.76	18.71	20	0		
1.4	16QAM	3	1	18.68	18.77	18.77	20	0		
1.4	16QAM	3	3	18.64	18.70	18.72	20	0		
1.4	16QAM	6	0	18.73	18.73	18.75	20	0		
1.4	84QAM	1	0	18.83	18.94	18.89	20	0		
1.4	84QAM	1	3	18.87	19.00	18.95	20	0		
1.4	84QAM	1	5	18.78	18.92	18.86	20	0		
1.4	84QAM	3	0	18.75	18.79	1				



Band 66									
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				132072	132222	132572			
Frequency (MHz)				1723	1745	1773			
20	QPSK	1	0	18.19	18.96	19.01	20	0	
20	QPSK	1	49	18.93	18.96	19.03			
20	QPSK	1	89	18.86	18.88	18.86			
20	QPSK	50	0	18.95	19.01	19.00			
20	QPSK	50	24	18.98	18.99	18.95	20	0	
20	QPSK	50	50	18.92	18.91	18.94			
20	QPSK	100	0	18.00	18.98	18.91			
20	16QAM	1	0	18.96	18.98	19.03			
20	16QAM	1	49	19.00	18.99	19.04	20	0	
20	16QAM	1	89	18.93	18.91	18.85			
20	16QAM	50	0	18.75	18.76	18.70			
20	16QAM	50	24	18.78	18.74	18.69	20	0	
20	16QAM	50	50	18.74	18.67	18.68			
20	16QAM	100	0	18.72	18.69	18.64			
20	64QAM	1	0	18.93	19.01	18.92			
20	64QAM	1	49	18.90	18.83	18.84	20	0	
20	64QAM	1	89	18.82	18.81	18.78			
20	64QAM	50	0	18.75	18.74	18.71			
20	64QAM	50	24	18.72	18.71	18.69	20	0	
20	64QAM	50	50	18.66	18.65	18.68			
20	64QAM	100	0	18.75	18.68	18.66			
Channel				132047	132322	132597			
Frequency (MHz)				1717.5	1745	1772.5			
15	QPSK	1	0	18.89	18.94	18.90	20	0	
15	QPSK	1	37	18.86	18.89	18.93			
15	QPSK	1	74	18.78	18.77	18.75			
15	QPSK	36	0	18.93	18.97	18.87			
15	QPSK	36	20	18.94	18.94	18.89	20	0	
15	QPSK	36	39	18.85	18.89	18.89			
15	QPSK	75	0	18.90	18.90	18.82			
15	16QAM	1	0	18.11	18.07	18.01	20	0	
15	16QAM	1	37	19.00	18.98	19.02			
15	16QAM	1	74	18.96	18.86	18.88			
15	16QAM	36	0	18.77	18.77	18.68			
15	16QAM	36	20	18.80	18.78	18.78	20	0	
15	16QAM	36	39	18.74	18.67	18.70			
15	16QAM	75	0	18.73	18.73	18.66			
15	64QAM	1	0	18.95	18.94	18.89	20	0	
15	64QAM	1	37	18.87	18.83	18.90			
15	64QAM	1	74	18.84	18.74	18.75			
15	64QAM	36	0	18.75	18.75	18.71			
15	64QAM	36	20	18.77	18.74	18.80	20	0	
15	64QAM	36	39	18.74	18.68	18.71			
15	64QAM	75	0	18.72	18.72	18.65			
Channel				132022	132322	132622			
Frequency (MHz)				1715	1745	1775			
10	QPSK	1	0	18.92	18.94	18.95	20	0	
10	QPSK	1	25	18.89	18.91	18.89			
10	QPSK	1	49	18.81	18.78	18.80			
10	QPSK	25	0	18.90	18.94	18.92			
10	QPSK	25	12	18.93	18.93	18.93	20	0	
10	QPSK	25	25	18.86	18.88	18.88			
10	QPSK	50	0	18.90	18.87	18.92			
10	16QAM	1	0	18.10	18.01	18.05	20	0	
10	16QAM	1	25	19.02	19.00	18.99			
10	16QAM	1	49	18.95	18.89	18.89			
10	16QAM	25	0	18.78	18.74	18.77			
10	16QAM	25	12	18.75	18.74	18.74	20	0	
10	16QAM	25	25	18.68	18.65	18.69			
10	16QAM	50	0	18.72	18.73	18.73			
10	64QAM	1	0	18.97	18.91	18.96			
10	64QAM	1	25	18.90	18.89	18.85	20	0	
10	64QAM	1	49	18.88	18.79	18.80			
10	64QAM	25	0	18.74	18.73	18.78			
10	64QAM	25	12	18.75	18.73	18.75	20	0	
10	64QAM	25	25	18.73	18.65	18.67			
10	64QAM	50	0	18.74	18.70	18.68			
Channel				131997	132322	132647			
Frequency (MHz)				1712.5	1745	1777.5			
5	QPSK	1	0	18.86	18.88	18.86	20	0	
5	QPSK	1	12	18.86	18.89	18.87			
5	QPSK	1	24	18.82	18.82	18.81			
5	QPSK	12	0	18.90	18.92	18.88			
5	QPSK	12	7	18.91	18.95	18.90	20	0	
5	QPSK	12	13	18.87	18.87	18.85			
5	QPSK	25	0	18.87	18.90	18.88			
5	16QAM	1	0	18.98	18.97	18.97			
5	16QAM	1	12	19.03	18.94	18.97	20	0	
5	16QAM	1	24	18.95	18.96	18.96			
5	16QAM	12	0	18.75	18.77	18.74			
5	16QAM	12	7	18.79	18.76	18.77	20	0	
5	16QAM	12	13	18.75	18.69	18.68			
5	16QAM	25	0	18.72	18.68	18.69			
5	64QAM	1	0	18.87	18.88	18.85	20	0	
5	64QAM	1	12	18.86	18.85	18.86			
5	64QAM	1	24	18.83	18.77	18.78			
5	64QAM	12	0	18.73	18.74	18.70			
5	64QAM	12	7	18.73	18.74	18.72	20	0	
5	64QAM	12	13	18.70	18.68	18.67			
5	64QAM	25	0	18.70	18.69	18.67			
Channel				131987	132322	132657			
Frequency (MHz)				1711.5	1745	1778.5			
3	QPSK	1	0	18.89	18.93	18.90	20	0	
3	QPSK	1	8	18.87	18.92	18.85			
3	QPSK	1	14	18.82	18.87	18.81			
3	QPSK	8	0	18.92	18.98	18.91			
3	QPSK	8	4	18.96	19.00	18.94	20	0	
3	QPSK	8	7	18.93	18.94	18.89			
3	QPSK	15	0	18.95	18.96	18.87			
3	16QAM	1	0	19.01	19.00	18.97			
3	16QAM	1	8	19.04	19.01	19.00	20	0	
3	16QAM	1	14	19.02	18.95	18.92			
3	16QAM	8	0	18.87	18.84	18.81			
3	16QAM	8	4	18.86	18.86	18.82	20	0	
3	16QAM	8	7	18.81	18.78	18.76			
3	16QAM	15	0	18.77	18.79	18.72			
3	64QAM	1	0	18.90	18.90	18.85			
3	64QAM	1	8	18.95	18.94	18.87	20	0	
3	64QAM	1	14	18.90	18.86	18.80			
3	64QAM	8	0	18.80	18.79	18.72			
3	64QAM	8	4	18.87	18.83	18.76	20	0	
3	64QAM	8	7	18.82	18.79	18.76			
3	64QAM	15	0	18.78	18.73	18.69			
Channel				131979	132322	132665			
Frequency (MHz)				1710.7	1745	1779.3			
1.4	QPSK	1	0	18.00	18.03	18.01	20	0	
1.4	QPSK	1	3	18.06	18.12	18.10			
1.4	QPSK	1	5	18.01	18.04	18.08			
1.4	QPSK	3	0	18.07	18.10	18.06			
1.4	QPSK	3	1	18.09	18.12	18.08			
1.4	QPSK	3	3	18.04	18.08	18.04	20	0	
1.4	QPSK	6	0	18.07	18.08	18.06			
1.4	16QAM	1	0	18.96	18.92	18.93			
1.4	16QAM	1	3	18.04	18.00	18.01			
1.4	16QAM	1	5	18.93	18.92	18.89	20	0	
1.4	16QAM	3	0	18.73	18.73	18.71			
1.4	16QAM	3	1	18.80	18.75	18.74			
1.4	16QAM	3	3	18.75	18.70	18.72			
1.4	16QAM	6	0	18.78	18.76	18.76	20	0	
1.4	64QAM	1	0	18.88	18.81	18.82			
1.4	64QAM	1	3	18.94	18.89	18.87			
1.4	64QAM	1	5	18.82	18.80	18.76	20	0	
1.4	64QAM	3	0	18.80	18.76	18.75			
1.4	64QAM	3	1	18.81	18.78	18.81			
1.4	64QAM	3	3	18.77	18.77	18.72			
1.4	64QAM	6	0	18.70	18.66	18.67	20	0	



Full Power Mode
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.	Channel		RB	RB	Band	(Mhz)	Freq.	Channel	Tx. Power	Tx. Power	
				(Mhz)			Offset	(Mhz)			(dBm)		(dBm)		
Inter-Band	CA_2A-7A	Band 2	20M	1880	18900	QPSK	1	0	Band 7	20M	2655	3100	22.88	23.16	
		Band 7	20M	2535	21100	QPSK	1	0	Band 2	20M	1960	900	22.34	22.69	
	CA_4A-12A	Band 4	20M	1732.5	20175	QPSK	1	0	Band 12	10M	737.5	5095	22.85	23.06	
		Band 12	10M	707.5	23095	QPSK	1	0	Band 4	20M	2132.5	2175	22.63	22.89	
	CA_4A-17A	Band 4	10M	1732.5	20175	QPSK	1	0	Band 17	10M	740	5790	22.79	23.06	
		Band 17	10M	710	23790	QPSK	1	0	Band 4	10M	2132.5	2175	22.74	22.93	
	CA_5A-7A	Band 5	10M	836.5	20525	QPSK	1	0	Band 7	20M	2655	3100	22.74	22.99	
		Band 7	20M	2535	21100	QPSK	1	0	Band 5	10M	881.5	2525	22.58	22.69	
	CA_12A-66A	Band 12	10M	707.5	23095	QPSK	1	0	Band 66	20M	2155	6686	22.67	22.89	
		Band 66	20M	1745	132322	QPSK	1	0	Band 12	10M	737.5	5095	22.79	23.09	
Intra-Band	Contiguous	CA_7B	Band 7	15M	2535	21100	QPSK	1	0	Band 7	5M	2664.3	3193	22.39	22.44
		CA_66B	Band 66	15M	1745	132322	QPSK	1	0	Band 66	5M	2164.3	66979	22.93	23.04
		CA_66C	Band 66	20M	1745	132322	QPSK	1	0	Band 66	20M	2174.8	67084	22.90	23.09
	Non-Contiguous	CA_4A-4A	Band 4	20M	1732.5	20175	QPSK	1	0	Band 4	5M	2152.5	2375	22.78	23.06
		CA_7A-7A	Band 7	20M	2535	21100	QPSK	1	0	Band 7	5M	2687.5	3425	22.49	22.69



3CA DL

<Inter-Band for Three Carrier Combination> (three bands)

Configure		PCC							SCC1				SCC2				Power	
		LTE	BW	UL	UL	Mod.	UL	UL	LTE	BW	DL	DL	LTE	BW	DL	DL	With CA	Without CA
		Band	(MHz)	Freq. (MHz)	Channel		RB	RB Offset	Band	(MHz)	Freq. (MHz)	Channel	Band	(MHz)	Freq. (MHz)	Channel	Tx. Power (dBm)	Tx. Power (dBm)
Inter-Band	CA_2A-4A-5A	Band 2	20M	1880	18900	QPSK	1	0	Band 4	20M	2132.5	2175	Band 5	10M	881.5	2525	22.93	23.16
		Band 4	20M	1732.5	20175	QPSK	1	0	Band 5	10M	881.5	2525	Band 2	20M	1960	900	22.76	23.06
		Band 5	10M	836.5	20625	QPSK	1	0	Band 2	20M	1960	900	Band 4	20M	2132.5	2175	22.79	22.99
	CA_7A-66A-66A	Band 7	20M	2510	20850	QPSK	1	0	Band 66	20M	2155	66886	Band 66	5M	2197.5	67311	22.46	22.53
		Band 7	20M	2535	21100	QPSK	1	0	Band 66	20M	2155	66886	Band 66	5M	2197.5	67311	22.32	22.69
		Band 7	20M	2560	21350	QPSK	1	0	Band 66	20M	2155	66886	Band 66	5M	2197.5	67311	22.42	22.54
		Band 66	20M	1720	132072	QPSK	1	0	Band 66	5M	2197.5	67311	Band 7	20M	2655	3100	22.89	22.97
		Band 66	20M	1745	132322	QPSK	1	0	Band 66	5M	2197.5	67311	Band 7	20M	2655	3100	22.81	23.09
		Band 66	20M	1770	132572	QPSK	1	0	Band 66	5M	2197.5	67311	Band 7	20M	2655	3100	22.79	23.01
	CA_4A-7C	Band 4	20M	1720	20050	QPSK	1	0	Band 7	20M	2655	3100	Band 7	20M	2674.8	3298	22.83	23.02
		Band 4	20M	1732.5	20175	QPSK	1	0	Band 7	20M	2655	3100	Band 7	20M	2674.8	3298	22.83	23.06
		Band 4	20M	1745	20300	QPSK	1	0	Band 7	20M	2655	3100	Band 7	20M	2674.8	3298	22.78	23.02
		Band 7	20M	2510	20850	QPSK	1	0	Band 7	20M	2649.8	3048	Band 4	20M	2132.5	2175	22.43	22.53
		Band 7	20M	2535	21100	QPSK	1	0	Band 7	20M	2674.8	3298	Band 4	20M	2132.5	2175	22.38	22.69
		Band 7	20M	2560	21350	QPSK	1	0	Band 7	20M	2660.2	3152	Band 4	20M	2132.5	2175	22.41	22.54



**Reduced Power Mode for Sensor On/Hotspot on
2CA DL**

Configure	CA List	PCC							SCC				Power			
		LTE	BW	UL	UL	Mod.	UL	UL	LTE	BW	DL	DL	Tx. Power (dBm)	Tx. Power (dBm)		
		Band	(MHz)	Freq. (MHz)	Channel		RB	RB Offset	Band	(MHz)	Freq. (MHz)	Channel				
Inter-Band	CA_2A-7A	Band 2	20M	1880	18900	QPSK	1	0	Band 7	20M	2655	3100	12.33	12.56		
		Band 7	20M	2535	21100	QPSK	1	0	Band 2	20M	1960	900	14.56	14.70		
	CA_4A-12A	Band 4	20M	1732.5	20175	QPSK	1	0	Band 12	10M	737.5	5095	12.35	12.51		
		Band 12	10M	707.5	23095	QPSK	1	0	Band 4	20M	2132.5	2175	22.69	22.89		
	CA_4A-17A	Band 4	10M	1732.5	20175	QPSK	1	0	Band 17	10M	740	5790	12.37	12.51		
		Band 17	10M	710	23790	QPSK	1	0	Band 4	10M	2132.5	2175	22.69	22.93		
	CA_5A-7A	Band 5	10M	836.5	20525	QPSK	1	0	Band 7	20M	2655	3100	21.16	21.31		
		Band 7	20M	2535	21100	QPSK	1	0	Band 5	10M	881.5	2525	14.51	14.70		
	CA_12A-66A	Band 12	10M	707.5	23095	QPSK	1	0	Band 66	20M	2155	66866	22.74	22.89		
		Band 66	20M	1745	132322	QPSK	1	0	Band 12	10M	737.5	5095	12.36	12.50		
	Intra-Band	Contiguous	CA_7B	Band 7	15M	2535	21100	QPSK	1	0	Band 7	5M	2664.3	3193	14.05	14.30
			CA_66B	Band 66	15M	1745	132322	QPSK	1	0	Band 66	5M	2164.3	66979	12.03	12.16
CA_66C			Band 66	20M	1745	132322	QPSK	1	0	Band 66	20M	2174.8	67084	12.24	12.50	
Non-Contiguous		CA_4A-4A	Band 4	20M	1732.5	20175	QPSK	1	0	Band 4	5M	2152.5	2375	12.31	12.51	
		CA_7A-7A	Band 7	20M	2535	21100	QPSK	1	0	Band 7	5M	2687.5	3425	14.49	14.70	



3CA DL

<Inter-Band for Three Carrier Combination> (three bands)

Configure		PCC							SCC1				SCC2				Power	
		LTE	BW	UL	UL	Mod.	UL	UL	LTE	BW	DL	DL	LTE	BW	DL	DL	With CA	Without CA
		Band	(MHz)	Freq (MHz)	Channel		RB	RB	Band	(MHz)	Freq (MHz)	Channel	Band	(MHz)	Freq (MHz)	Channel	Tx. Power (dBm)	Tx. Power (dBm)
						Offset												
Inter-Band	CA_2A-4A-5A	Band 2	20M	1880	18900	QPSK	1	0	Band 4	20M	2132.5	2175	Band 5	10M	881.5	2525	12.82	12.56
		Band 4	20M	1732.5	20175	QPSK	1	0	Band 5	10M	881.5	2525	Band 2	20M	1960	900	12.34	12.51
		Band 5	10M	836.5	20525	QPSK	1	0	Band 2	20M	1960	900	Band 4	20M	2132.5	2175	21.22	21.31
	CA_7A-66A-66A	Band 7	20M	2510	20850	QPSK	1	0	Band 66	20M	2155	66886	Band 66	5M	2197.5	67311	14.25	14.58
		Band 7	20M	2535	21100	QPSK	1	0	Band 66	20M	2155	66886	Band 66	5M	2197.5	67311	14.31	14.7
		Band 7	20M	2560	21350	QPSK	1	0	Band 66	20M	2155	66886	Band 66	5M	2197.5	67311	14.28	14.5
		Band 66	20M	1720	132072	QPSK	1	0	Band 66	5M	2197.5	67311	Band 7	20M	2655	3100	12.47	12.58
	CA_4A-7C	Band 66	20M	1745	132322	QPSK	1	0	Band 66	5M	2197.5	67311	Band 7	20M	2655	3100	12.43	12.5
		Band 66	20M	1770	132572	QPSK	1	0	Band 66	5M	2197.5	67311	Band 7	20M	2655	3100	12.01	12.18
		Band 4	20M	1720	20050	QPSK	1	0	Band 7	20M	2655	3100	Band 7	20M	2674.8	3298	12.29	12.4
		Band 4	20M	1732.5	20175	QPSK	1	0	Band 7	20M	2655	3100	Band 7	20M	2674.8	3298	12.35	12.51
		Band 4	20M	1745	20300	QPSK	1	0	Band 7	20M	2655	3100	Band 7	20M	2674.8	3298	12.07	12.25
		Band 7	20M	2510	20850	QPSK	1	0	Band 7	20M	2649.8	3048	Band 4	20M	2132.5	2175	14.31	14.58
		Band 7	20M	2535	21100	QPSK	1	0	Band 7	20M	2674.8	3298	Band 4	20M	2132.5	2175	14.47	14.7
		Band 7	20M	2560	21350	QPSK	1	0	Band 7	20M	2660.2	3152	Band 4	20M	2132.5	2175	14.25	14.5



**Reduced Power Mode for Handheld on
2CA DL**

Configure	CA List	PCC							SCC				Power		
		LTE	BW	UL	UL	Mod.	UL	UL	LTE	BW	DL	DL	With CA Tx. Power (dBm)	Without CA Tx. Power (dBm)	
		Band	(MHz)	Freq. (MHz)	Channel		RB	RB Offset	Band	(MHz)	Freq. (MHz)	Channel			
Inter-Band	CA_2A-7A	Band 2	20M	1880	18900	QPSK	1	0	Band 7	20M	2655	3100	18.97	19.20	
		Band 7	20M	2535	21100	QPSK	1	0	Band 2	20M	1960	900	20.41	20.64	
	CA_4A-12A	Band 4	20M	1732.5	20175	QPSK	1	0	Band 12	10M	737.5	5095	18.86	19.18	
		Band 12	10M	707.5	23095	QPSK	1	0	Band 4	20M	2132.5	2175	22.61	22.89	
	CA_4A-17A	Band 4	10M	1732.5	20175	QPSK	1	0	Band 17	10M	740	5790	18.92	19.18	
		Band 17	10M	710	23790	QPSK	1	0	Band 4	10M	2132.5	2175	22.76	22.93	
	CA_5A-7A	Band 5	10M	836.5	20525	QPSK	1	0	Band 7	20M	2655	3100	22.78	22.99	
		Band 7	20M	2535	21100	QPSK	1	0	Band 5	10M	881.5	2525	20.41	20.64	
	CA_12A-66A	Band 12	10M	707.5	23095	QPSK	1	0	Band 66	20M	2155	66886	22.71	22.89	
		Band 66	20M	1745	132322	QPSK	1	0	Band 12	10M	737.5	5095	18.68	18.98	
Intra-Band	Contiguous	CA_7B	Band 7	15M	2535	21100	QPSK	1	0	Band 7	5M	2664.3	3193	20.14	20.32
		CA_66B	Band 66	15M	1745	132322	QPSK	1	0	Band 66	5M	2164.3	66979	18.68	18.94
		CA_66C	Band 66	20M	1745	132322	QPSK	1	0	Band 66	20M	2174.8	67084	18.75	18.98
	Non-Contiguous	CA_4A-4A	Band 4	20M	1732.5	20175	QPSK	1	0	Band 4	5M	2152.5	2375	19.03	19.18
		CA_7A-7A	Band 7	20M	2535	21100	QPSK	1	0	Band 7	5M	2687.5	3425	20.34	20.64



3CA DL

<Inter-Band for Three Carrier Combination> (three bands)

Configure		PCC							SCC1				SCC2				Power	
		LTE	BW	UL	UL	Mod.	UL	UL	LTE	BW	DL	DL	LTE	BW	DL	DL	Tx. Power (dBm)	Tx. Power (dBm)
		Band	(MHz)	Freq (MHz)	Channel		RB	RB Offset	Band	(MHz)	Freq (MHz)	Channel	Band	(MHz)	Freq (MHz)	Channel		
Inter-Band	CA_2A-4A-5A	Band 2	20M	1880	18900	QPSK	1	0	Band 4	20M	2132.5	2175	Band 5	10M	881.5	2525	18.76	18.97
		Band 4	20M	1732.5	20175	QPSK	1	0	Band 5	10M	881.5	2525	Band 2	20M	1960	900	18.67	18.86
		Band 5	10M	836.5	20525	QPSK	1	0	Band 2	20M	1960	900	Band 4	20M	2132.5	2175	21.78	22.78
	CA_7A-66A-66A	Band 7	20M	2510	20850	QPSK	1	0	Band 66	20M	2155	66886	Band 66	5M	2197.5	67311	20.26	20.44
		Band 7	20M	2535	21100	QPSK	1	0	Band 66	20M	2155	66886	Band 66	5M	2197.5	67311	20.29	20.64
		Band 7	20M	2560	21350	QPSK	1	0	Band 66	20M	2155	66886	Band 66	5M	2197.5	67311	20.18	20.51
		Band 66	20M	1720	132072	QPSK	1	0	Band 66	5M	2197.5	67311	Band 7	20M	2655	3100	19.11	19.19
		Band 66	20M	1745	132322	QPSK	1	0	Band 66	5M	2197.5	67311	Band 7	20M	2655	3100	18.76	18.98
		Band 66	20M	1770	132572	QPSK	1	0	Band 66	5M	2197.5	67311	Band 7	20M	2655	3100	18.88	19.01
	CA_4A-7C	Band 4	20M	1720	20050	QPSK	1	0	Band 7	20M	2655	3100	Band 7	20M	2674.8	3298	18.91	19.05
		Band 4	20M	1732.5	20175	QPSK	1	0	Band 7	20M	2655	3100	Band 7	20M	2674.8	3298	18.95	19.18
		Band 4	20M	1745	20300	QPSK	1	0	Band 7	20M	2655	3100	Band 7	20M	2674.8	3298	18.86	19.1
		Band 7	20M	2510	20850	QPSK	1	0	Band 7	20M	2649.8	3048	Band 4	20M	2132.5	2175	20.25	20.44
		Band 7	20M	2535	21100	QPSK	1	0	Band 7	20M	2674.8	3298	Band 4	20M	2132.5	2175	20.31	20.64
		Band 7	20M	2560	21350	QPSK	1	0	Band 7	20M	2660.2	3152	Band 4	20M	2132.5	2175	20.17	20.51



2.4GHz WLAN Full Power & Body Worn & Handheld						
Mode	Channel	Frequency (MHz)	Average power (dBm)	Time-Up Limit	Duty Cycle %	
2.4GHz WLAN	802.11b 1Mbps	1	2412	18.13	20.00	100.00
		6	2437	18.43	20.00	
		11	2462	18.34	20.00	
	802.11g 6Mbps	1	2412	17.84	19.00	
		6	2437	18.49	20.00	
		11	2462	18.01	17.50	
802.11n-HT20 MCS0	1	2412	17.01	19.00	98.50	
	6	2437	17.50	19.00		
	11	2462	16.22	18.00		

2.4GHz WLAN At Head						
Mode	Channel	Frequency (MHz)	Average power (dBm)	Time-Up Limit	Duty Cycle %	
2.4GHz WLAN	802.11b 1Mbps	1	2412	18.13	19.00	100.00
		6	2437	18.43	19.00	
		11	2462	18.34	19.00	
	802.11g 6Mbps	1	2412	17.84	19.00	
		6	2437	18.49	19.00	
		11	2462	18.01	17.50	
802.11n-HT20 MCS0	1	2412	17.01	19.00	98.50	
	6	2437	17.50	19.00		
	11	2462	16.22	18.00		

2.4GHz WLAN Reduced Power for Simultaneous & Hotspot						
Mode	Channel	Frequency (MHz)	Average power (dBm)	Time-Up Limit	Duty Cycle %	
2.4GHz WLAN	802.11b 1Mbps	1	2412	14.17	15.00	100.00
		6	2437	14.25	15.00	
		11	2462	14.23	15.00	
	802.11g 6Mbps	1	2412	15.50	98.50	
		6	2437	15.50		
		11	2462	15.50		
802.11n-HT20 MCS0	1	2412	Not Inquired	98.50		
	6	2437	15.50			
	11	2462	15.50			

5GHz WLAN Full Power & Head & Handheld						
Mode	Channel	Frequency (MHz)	Average power (dBm)	Time-Up Limit	Duty Cycle %	
5.2GHz WLAN	802.11a 6Mbps	36	5180	17.96	18.50	97.90
		40	5200	18.28	19.00	
		44	5220	18.35	19.00	
	802.11n-HT20 MCS0	48	5240	18.32	19.00	
		36	5180	17.02	18.50	
		40	5200	18.21	19.00	
802.11n-HT40 MCS0	44	5220	18.32	19.00	98.50	
	48	5240	18.29	19.00		
	38	5190	12.96	14.00		
	46	5230	18.36	19.00		
	36	5180	16.19	17.00		
	40	5200	16.20	17.00		
802.11ac-VHT20 MCS0	44	5220	15.94	17.00	97.40	
	48	5240	16.00	17.00		
	38	5190	16.06	17.00		
	46	5230	15.93	17.00		
	36	5180	15.93	17.00		
	42	5210	12.17	13.00		

5GHz WLAN Reduced Power for Simultaneous & Hotspot						
Mode	Channel	Frequency (MHz)	Average power (dBm)	Time-Up Limit	Duty Cycle %	
5.2GHz WLAN	802.11a 6Mbps	36	5180	7.15	7.50	97.90
		40	5200	7.23	7.50	
		44	5220	7.19	7.50	
	802.11n-HT20 MCS0	48	5240	7.17	7.50	
		36	5180	7.50	98.16	
		40	5200	7.50		
802.11n-HT40 MCS0	44	5220	7.50	98.60		
	48	5240	7.50			
	38	5190	7.00			
	46	5230	7.00			
	36	5180	7.50			
	40	5200	7.50			
802.11ac-VHT20 MCS0	44	5220	7.50	98.01		
	48	5240	7.50			
	38	5190	7.00			
	46	5230	7.00			
	36	5180	7.00			
	42	5210	7.00			

5GHz WLAN Reduced Power for P-Sensor Body Worn						
Mode	Channel	Frequency (MHz)	Average power (dBm)	Time-Up Limit	Duty Cycle %	
5.2GHz WLAN	802.11a 6Mbps	36	5180	11.49	12.00	97.90
		40	5200	11.51	12.00	
		44	5220	11.37	12.00	
	802.11n-HT20 MCS0	48	5240	11.23	12.00	
		36	5180	12.00	98.16	
		40	5200	12.00		
802.11n-HT40 MCS0	44	5220	12.00	98.60		
	48	5240	12.00			
	38	5190	11.50			
	46	5230	11.50			
	36	5180	12.00			
	40	5200	12.00			
802.11ac-VHT20 MCS0	44	5220	12.00	98.01		
	48	5240	12.00			
	38	5190	11.50			
	46	5230	11.50			
	36	5180	11.50			
	42	5210	11.50			

5GHz WLAN Full Power & Head & Handheld						
Mode	Channel	Frequency (MHz)	Average power (dBm)	Time-Up Limit	Duty Cycle %	
5.2GHz WLAN	802.11a 6Mbps	52	5280	18.20	19.00	97.90
		56	5300	18.30	19.00	
		60	5320	18.14	19.00	
	802.11n-HT20 MCS0	64	5340	17.75	19.00	
		52	5280	18.18	19.00	
		56	5300	18.19	19.00	
802.11n-HT40 MCS0	60	5300	18.46	19.00	98.50	
	64	5320	17.62	19.00		
	54	5270	15.14	19.00		
	62	5310	15.62	17.00		
	52	5280	15.73	17.00		
	56	5300	16.83	17.00		
802.11ac-VHT20 MCS0	60	5300	15.81	17.00	97.40	
	64	5320	15.87	17.00		
	54	5270	15.72	17.00		
	62	5310	15.77	17.00		
	52	5280	15.71	17.00		
	56	5300	15.81	17.00		
802.11ac-VHT40 MCS0	60	5300	15.81	17.00	96.27	
	64	5320	15.87	17.00		
	54	5270	15.72	17.00		
	62	5310	15.77	17.00		
	52	5280	15.71	17.00		
	56	5300	15.81	17.00		

5GHz WLAN Reduced Power for Simultaneous						
Mode	Channel	Frequency (MHz)	Average power (dBm)	Time-Up Limit	Duty Cycle %	
5.2GHz WLAN	802.11a 6Mbps	52	5280	8.26	7.50	97.90
		56	5300	8.34	7.50	
		60	5320	8.27	7.50	
	802.11n-HT20 MCS0	64	5340	7.50	98.16	
		52	5280	7.50		
		56	5300	7.50		
802.11n-HT40 MCS0	60	5300	7.50	98.60		
	64	5320	7.50			
	54	5270	7.00			
	62	5310	7.00			
	52	5280	7.50			
	56	5300	7.50			
802.11ac-VHT20 MCS0	60	5300	7.50	98.01		
	64	5320	7.50			
	54	5270	7.00			
	62	5310	7.00			
	52	5280	7.50			
	56	5300	7.50			

5GHz WLAN Reduced Power for P-Sensor Body Worn						
Mode	Channel	Frequency (MHz)	Average power (dBm)	Time-Up Limit	Duty Cycle %	
5.2GHz WLAN	802.11a 6Mbps	52	5280	11.15	12.00	97.90
		56	5300	11.26	12.00	
		60	5320	11.23	12.00	
	802.11n-HT20 MCS0	64	5340	11.15	12.00	
		52	5280	12.00	98.16	
		56	5300	12.00		
802.11n-HT40 MCS0	60	5300	12.00	98.60		
	64	5320	12.00			
	54	5270	11.50			
	62	5310	11.50			
	52	5280	12.00			
	56	5300	12.00			
802.11ac-VHT20 MCS0	60	5300	12.00	98.01		
	64	5320	12.00			
	54	5270	11.50			
	62	5310	11.50			
	52	5280	12.00			
	56	5300	12.00			

5GHz WLAN Full Power & Head & Handheld							
Mode	Channel	Frequency (MHz)	Average power (dBm)	Time-Up Limit	Duty Cycle %		
5.2GHz WLAN	802.11a 6Mbps	100	5500	18.83	19.00	97.90	
		116	5580	18.70	19.00		
		124	5620	18.68	19.00		
		132	5660	18.32	19.00		
		140	5700	18.35	19.00		
		144	5720	18.14	19.00		
	802.11n-HT20 MCS0	100	5500	18.72	19.00		98.50
		116	5580	18.62	19.00		
		124	5620	18.71	19.00		
		132	5660	18.13	19.00		
		140	5700	18.40	19.00		
		144	5720	18.15	19.00		
802.11n-HT40 MCS0	102	5510	16.34	18.00	96.24		
	110	5550	16.44	19.00			
	126	5630	18.93	19.00			
	134	5670	17.72	18.50			
	142	5710	18.08	19.00			
	100	5500	15.69	17.00			
802.11ac-VHT20 MCS0	116	5580	16.84	17.00		97.40	
	124	5620	16.24	17.00			
	132	5660	16.03	17.00			
	140	5700	16.83	17.00			
	144	5720	16.98	17.00			
	102	5510	15.88	17.00			
802.11ac-VHT40 MCS0	110	5550	16.06	17.00	96.27		
	126	5630	16.25	17.00			
	134	5670	16.27	17.00			
	142	5710	16.82	17.00			
	106	5530	15.04	14.00			
	122	5610	15.01	17.00			
802.11ac-VHT80 MCS0	138	5690	16.49	17.00		92.65	
	138	5690	16.49	17.00			

5GHz WLAN Reduced Power for Simultaneous						
Mode	Channel	Frequency (MHz)	Average power (dBm)	Time-Up Limit	Duty Cycle %	
5.2GHz WLAN	802.11a 6Mbps	100	5500	8.28	7.50	97.90
		116	5580	8.75	7.50	
		124	5620	8.65	7.50	
		132	5660	8.37	7.50	
		140	5700	8.73	7.50	
		144	5720	8.67	7.50	
	802.11n-HT20 MCS0	100	5500	7.50	98.16	
		116	5580	7.50		
		124	5620	7.50		
		132	5660	7.50		
		140	5700	7.50		
		144	5720	7.50		
802.11n-HT40 MCS0	102	5510	7.00	98.60		
	110	5550	7.00			
	126	5630	7.00			
	134	5670	7.00			
	142	5710	7.00			
	100	5500	7.50			
802.11ac-VHT20 MCS0	116	5580	7.50	98.01		
	124	5620	7.50			
	132	5660	7.50			
	140	5700	7.50			
	144	5720	7.50			
	102	5510	7.00			
802.11ac-VHT40 MCS0	110	5550	7.00	96.50		
	126	5630	7.00			
	134	5670	7.00			
	142	5710	7.00			
	106	5530	7.00			
	122	5610	7.00			
802.11ac-VHT80 MCS0	138	5690	7.00	91.00		
	138	5690	7.00			

5GHz WLAN Reduced Power for P-Sensor Body Worn						
Mode	Channel	Frequency (MHz)	Average power (dBm)	Time-Up Limit	Duty Cycle %	
5.2GHz WLAN	802.11a 6Mbps	100	5500	11.24	12.00	97.90
		116	5580	10.86	12.00	
		124	5620	10.96	12.00	
		132	5660	11.69	12.00	
		140	5700			