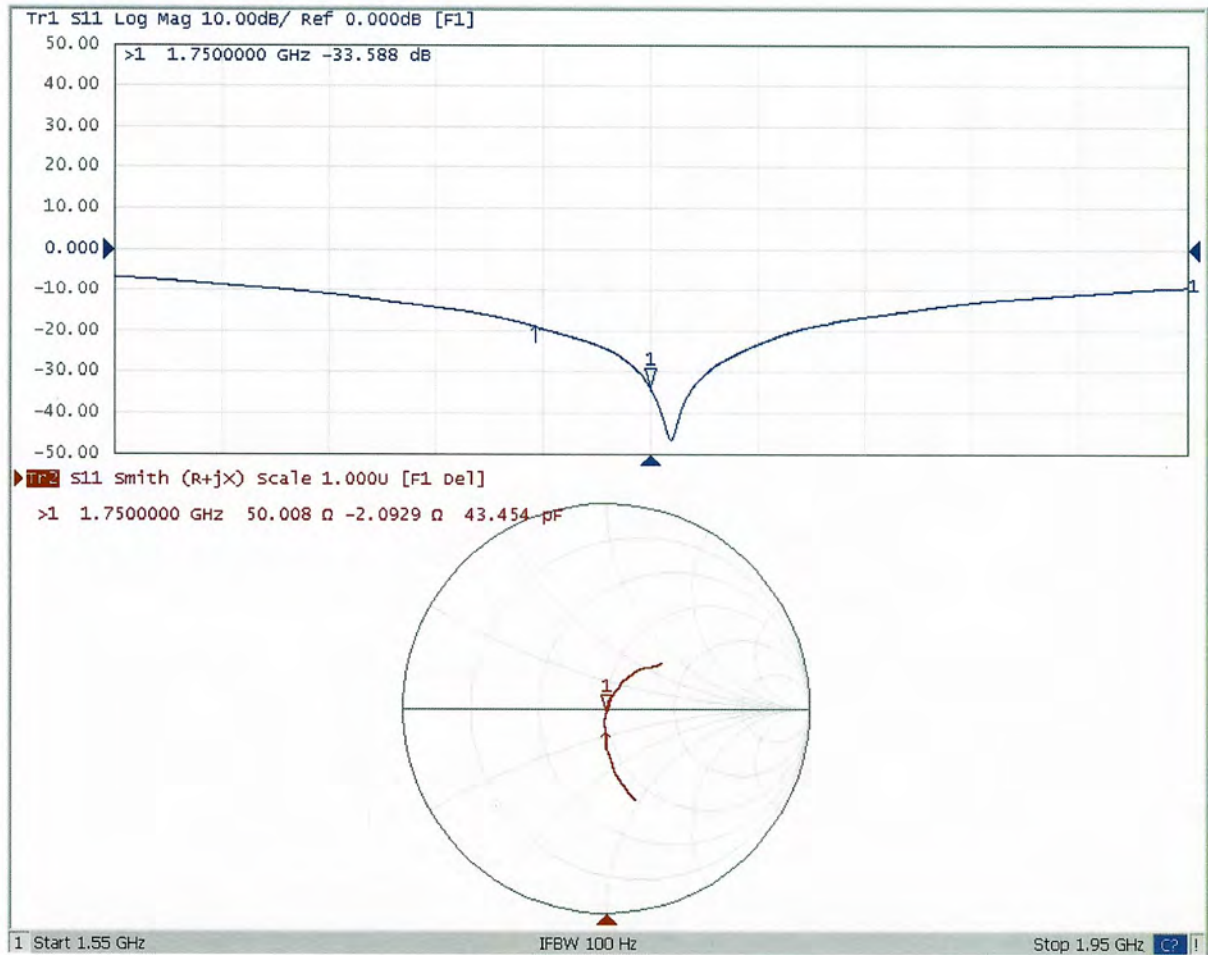




In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Head TSL



D1750V2 - SN: 1176 Extended Dipole Calibrations

Referring to KDB 865664 D01, 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.

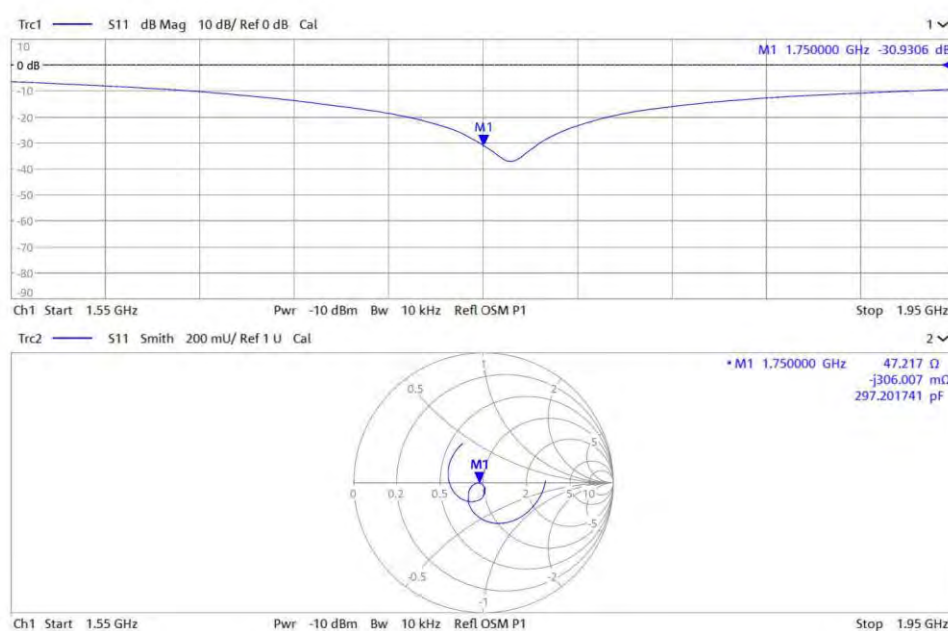
D1750V2 - SN: 1176						
1750MHz Head						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
10.19.2021	-33.6		50		-2.09	
10.18.2022	-30.9	-7.94	47.2	-2.78	-0.3	1.78

<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>

Head 1750MHz _2022.10.18





In Collaboration with
s p e a g
CALIBRATION LABORATORY



中国认可
国际互认
校准
CALIBRATION
CNAS L0570

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, Chi
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Client

B.V.ADT

Certificate No: **Z21-60336**

CALIBRATION CERTIFICATE

Object

D1900V2 - SN: 5d159

Calibration Procedure(s)

FF-Z11-003-01

Calibration Procedures for dipole validation kits

Calibration date:

September 16, 2021

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	23-Sep-20 (CTTL, No.J20X08336)	Sep-21
Power sensor NRP8S	104291	23-Sep-20 (CTTL, No.J20X08336)	Sep-21
Reference Probe EX3DV4	SN 7517	03-Feb-21(CTTL-SPEAG,No.Z21-60001)	Feb-22
DAE4	SN 1556	15-Jan-21(SPEAG,No.DAE4-1556_Jan21)	Jan-22
Secondary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	01-Feb-21 (CTTL, No.J21X00593)	Jan-22
NetworkAnalyzer E5071C	MY46110673	14-Jan-21 (CTTL, No.J21X00232)	Jan-22

	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: September 21, 2021

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



In Collaboration with

s p e a g
CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

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	V52.10.4
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 $\pm$ 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 $\pm$ 0.2) °C	40.2 $\pm$ 6 %	1.42 mho/m $\pm$ 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.97 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.7 W/kg $\pm$ 18.8 % (k=2)
SAR averaged over 10 cm³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.08 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.3 W/kg $\pm$ 18.7 % (k=2)



In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.2Ω+ 7.76jΩ
Return Loss	- 21.4dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.106 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
-----------------	-------



Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Head TSL

Date: 09.16.2021

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d159

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.416$ S/m; $\epsilon_r = 40.23$; $\rho = 1000$ kg/m³

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7517; ConvF(7.81, 7.81, 7.81) @ 1900 MHz; Calibrated: 2021-02-03
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2021-01-15
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

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

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

Reference Value = 99.85 V/m; Power Drift = 0.00 dB

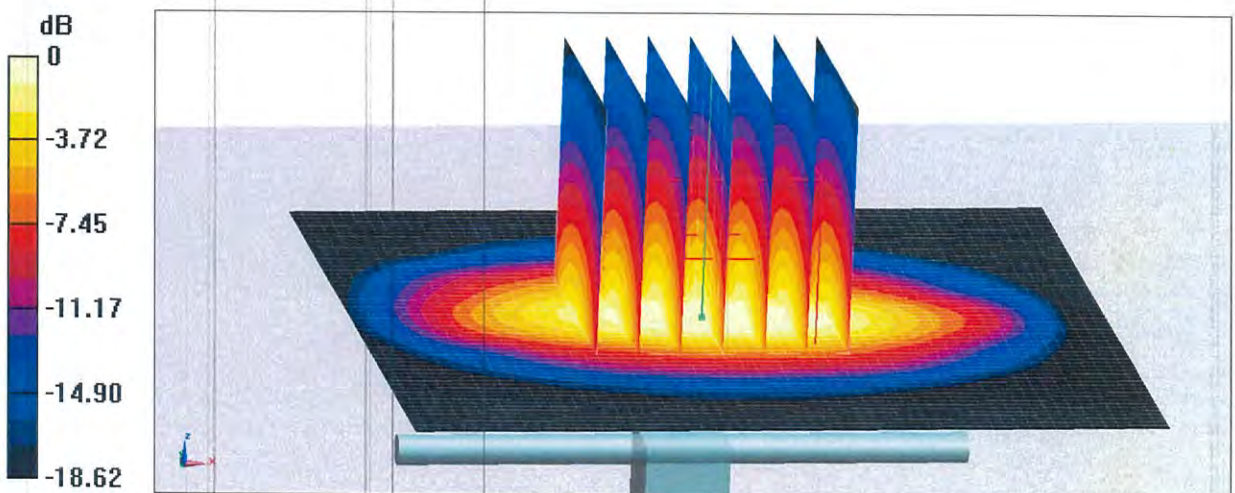
Peak SAR (extrapolated) = 19.4 W/kg

SAR(1 g) = 9.97 W/kg; SAR(10 g) = 5.08 W/kg

Smallest distance from peaks to all points 3 dB below = 10 mm

Ratio of SAR at M2 to SAR at M1 = 51.3%

Maximum value of SAR (measured) = 15.9 W/kg



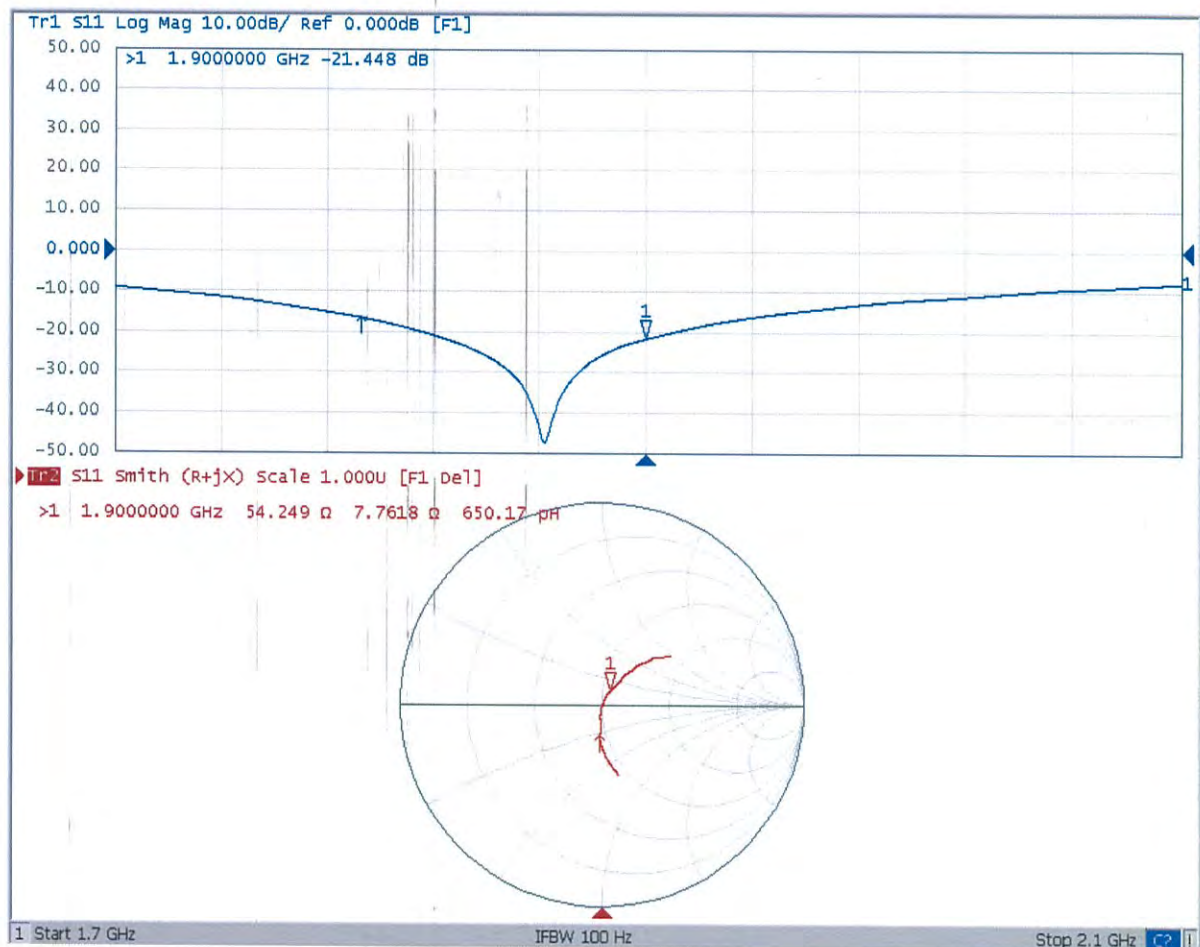
0 dB = 15.9 W/kg = 12.01 dBW/kg



In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Head TSL



D1900V2 - SN: 5d159 Extended Dipole Calibrations

Referring to KDB 865664 D01, 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.

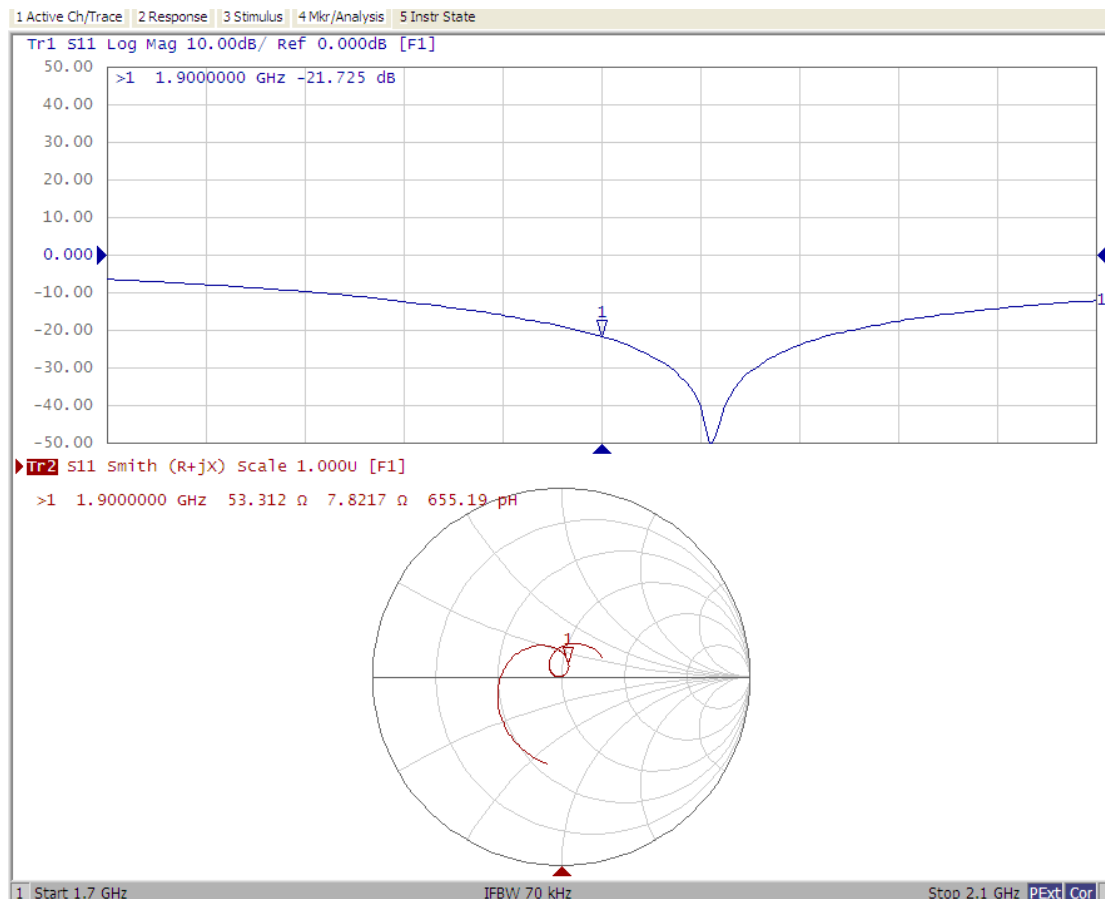
D1900V2 - SN: 5d159						
1900 Head						
Date of Measurement	Return-loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2021.09.16	-21.4		54.2		7.8	
2022.09.16	-21.7	-1.4	53.3	-0.9	7.8	0

<Justification of the extended calibration>

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

<Dipole Verification Data>

Head 1900MHz _2022.09.16





In Collaboration with
s p e a g
CALIBRATION LABORATORY



中国认可
国际互认
校准
CALIBRATION
CNAS L0570

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, Chi
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Client

7layers

Certificate No: Z21-60425

CALIBRATION CERTIFICATE

Object D2450V2 - SN: 1048

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

Calibration date: October 21, 2021

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 $(22\pm3)^{\circ}\text{C}$ 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	24-Sep-21 (CTTL, No.J21X08326)	Sep-22
Power sensor NRP8S	104291	24-Sep-21 (CTTL, No.J21X08326)	Sep-22
Reference Probe EX3DV4	SN 7517	03-Feb-21(CTTL-SPEAG,No.Z21-60001)	Feb-22
DAE4	SN 1556	15-Jan-21(SPEAG,No.DAE4-1556_Jan21)	Jan-22
Secondary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	01-Feb-21 (CTTL, No.J21X00593)	Jan-22
NetworkAnalyzer E5071C	MY46110673	14-Jan-21 (CTTL, No.J21X00232)	Jan-22

	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: October 27, 2021

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



In Collaboration with

s p e a g

CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China

Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

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%.



In Collaboration with

s p e a g

CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Measurement Conditions

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

DASY Version	DASY52	V52.10.4
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 $\pm$ 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 $\pm$ 0.2) °C	39.5 $\pm$ 6 %	1.81 mho/m $\pm$ 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.8 W/kg $\pm$ 18.8 % (k=2)
SAR averaged over 10 cm³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.05 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.2 W/kg $\pm$ 18.7 % (k=2)



In Collaboration with

s p e a g

CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.6Ω+ 8.39jΩ
Return Loss	- 21.6dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.057 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
-----------------	-------



In Collaboration with

s p e a g

CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China

Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

DASY5 Validation Report for Head TSL

Date: 10.21.2021

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 1048

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.809$ S/m; $\epsilon_r = 39.51$; $\rho = 1000$ kg/m³

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7517; ConvF(7.34, 7.34, 7.34) @ 2450 MHz; Calibrated: 2021-02-03
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2021-01-15
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7501)

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

Reference Value = 108.6 V/m; Power Drift = -0.02 dB

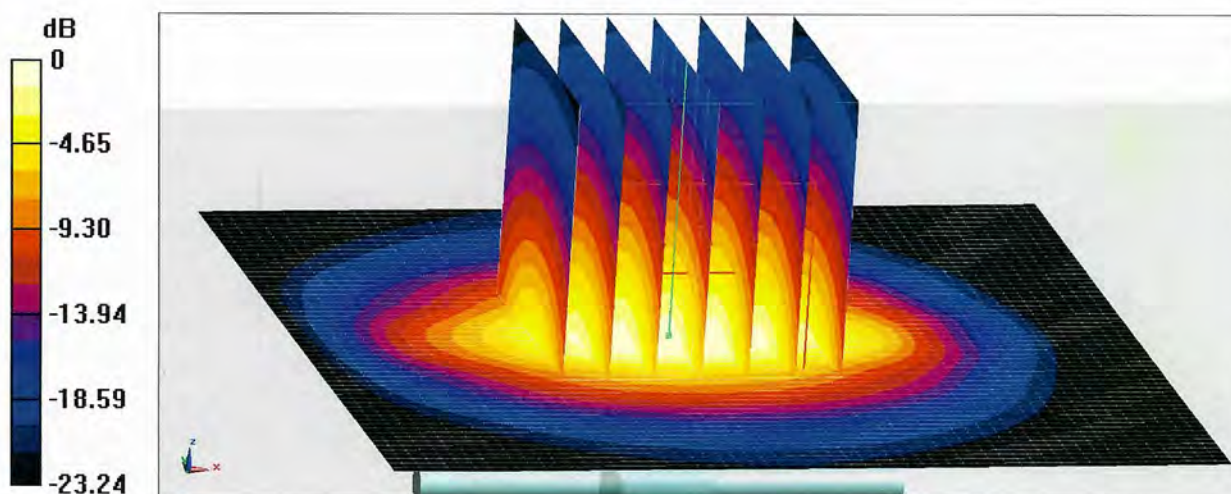
Peak SAR (extrapolated) = 28.0 W/kg

SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.05 W/kg

Smallest distance from peaks to all points 3 dB below = 9 mm

Ratio of SAR at M2 to SAR at M1 = 47.1%

Maximum value of SAR (measured) = 22.5 W/kg



0 dB = 22.5 W/kg = 13.52 dBW/kg



In Collaboration with

s p e a g

CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China

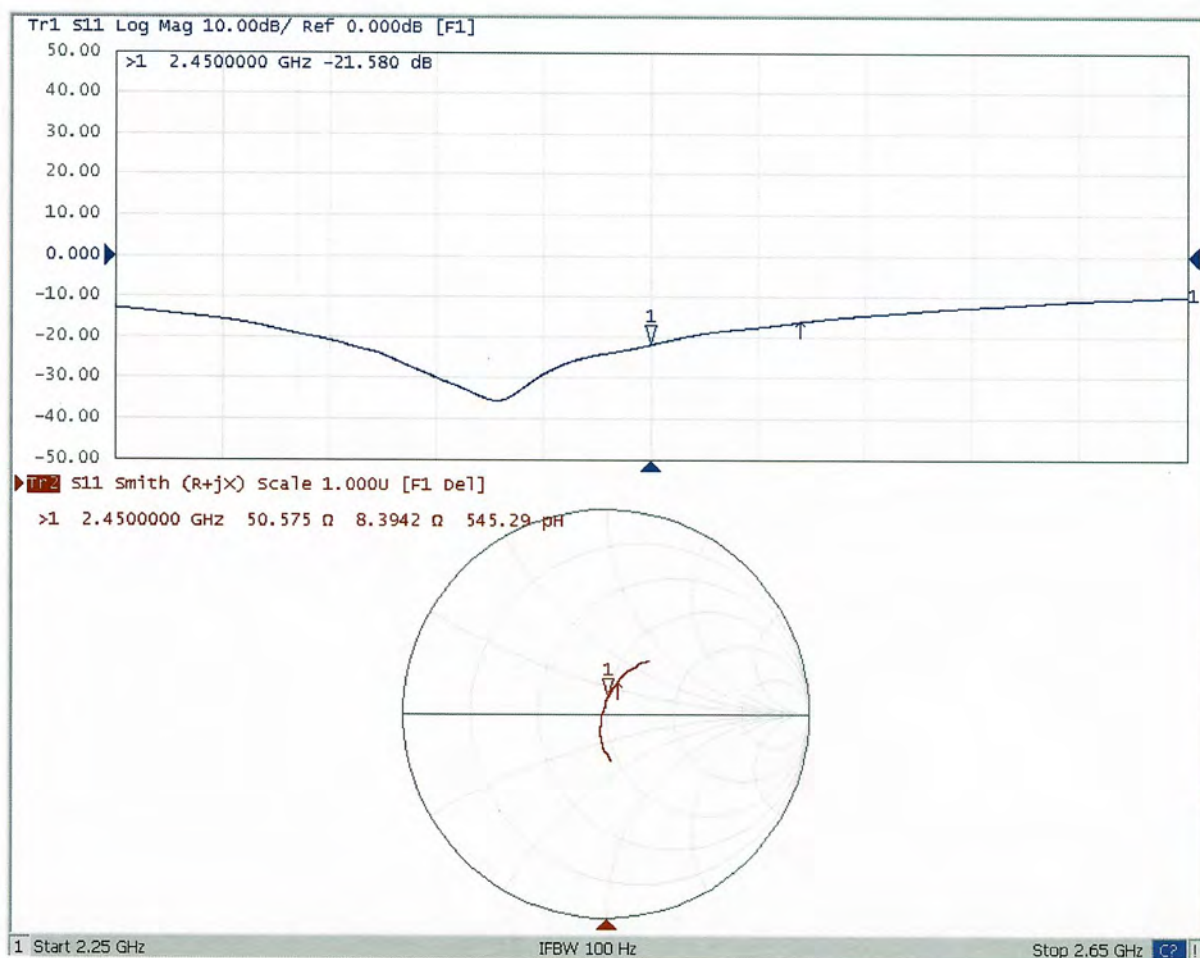
Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

Impedance Measurement Plot for Head TSL



D2450V2 - SN: 1048 Extended Dipole Calibrations

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

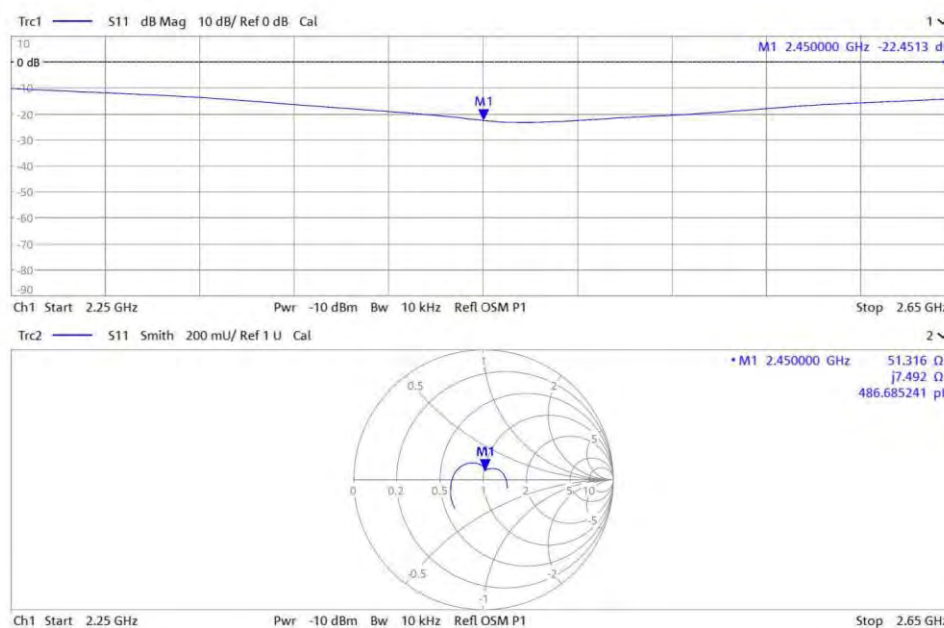
D2450V2 - SN: 1048						
2450MHz Head						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
10.21.2021	-21.6		50.6		8.39	
10.20.2022	-22.5	3.94	51.3	0.72	7.5	-0.90

<Justification of the extended calibration>

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

<Dipole Verification Data>

Head 2450MHz _2022.10.20





In Collaboration with
s p e a g
CALIBRATION LABORATORY



中国认可
国际互认
校准
CALIBRATION
CNAS L0570

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, Chi
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Client

B.V.ADT

Certificate No: **Z21-60339**

CALIBRATION CERTIFICATE

Object

D2600V2 - SN: 1110

Calibration Procedure(s)

FF-Z11-003-01

Calibration Procedures for dipole validation kits

Calibration date:

September 16, 2021

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 $(22\pm3)^{\circ}\text{C}$ 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	23-Sep-20 (CTTL, No.J20X08336)	Sep-21
Power sensor NRP8S	104291	23-Sep-20 (CTTL, No.J20X08336)	Sep-21
Reference Probe EX3DV4	SN 7517	03-Feb-21(CTTL-SPEAG,No.Z21-60001)	Feb-22
DAE4	SN 1556	15-Jan-21(SPEAG,No.DAE4-1556_Jan21)	Jan-22
Secondary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	01-Feb-21 (CTTL, No.J21X00593)	Jan-22
Network Analyzer E5071C	MY46110673	14-Jan-21 (CTTL, No.J21X00232)	Jan-22

	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: September 21, 2021

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



In Collaboration with

s p e a g
CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

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%.



In Collaboration with
s p e a g
 CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
 Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
 E-mail: cttl@chinattl.com http://www.chinattl.cn

Measurement Conditions

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

DASY Version	DASY52	V52.10.4
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	39.0 $\pm$ 6 %	1.95 mho/m $\pm$ 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.9 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	55.8 W/kg $\pm$ 18.8 % (k=2)
SAR averaged over 10 cm³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.13 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.6 W/kg $\pm$ 18.7 % (k=2)



In Collaboration with

s p e a g
CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China

Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

Appendix(Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.1Ω- 5.12jΩ
Return Loss	- 25.7dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.058 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
-----------------	--	-------



In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Head TSL

Date: 09.16.2021

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1110

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

Medium parameters used: $f = 2600$ MHz; $\sigma = 1.949$ S/m; $\epsilon_r = 39.04$; $\rho = 1000$ kg/m³

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7517; ConvF(7.1, 7.1, 7.1) @ 2600 MHz; Calibrated: 2021-02-03
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2021-01-15
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

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

Reference Value = 105.3 V/m; Power Drift = 0.01 dB

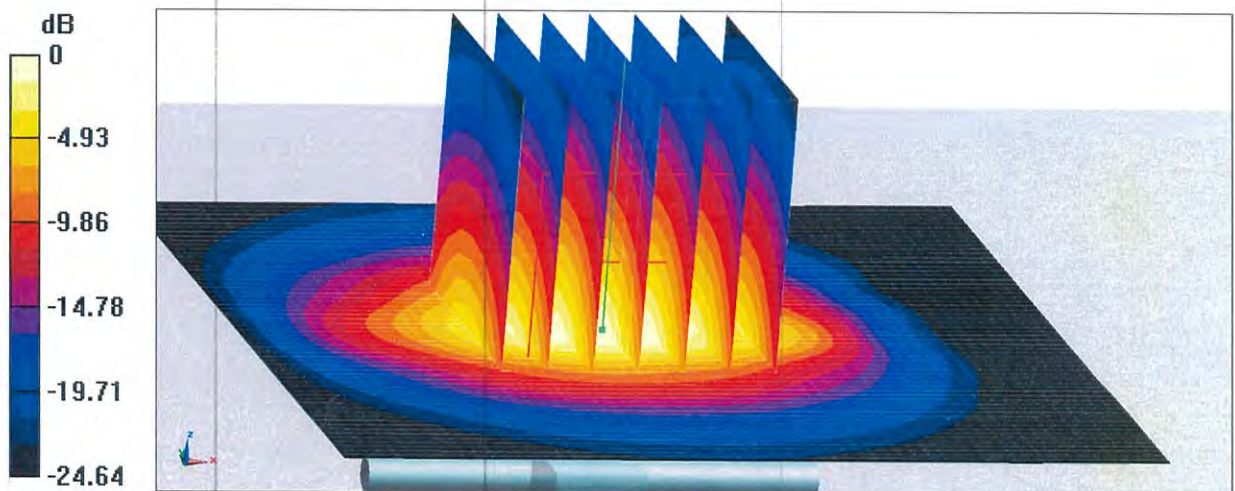
Peak SAR (extrapolated) = 30.6 W/kg

SAR(1 g) = 13.9 W/kg; SAR(10 g) = 6.13 W/kg

Smallest distance from peaks to all points 3 dB below = 9 mm

Ratio of SAR at M2 to SAR at M1 = 45.2%

Maximum value of SAR (measured) = 24.1 W/kg



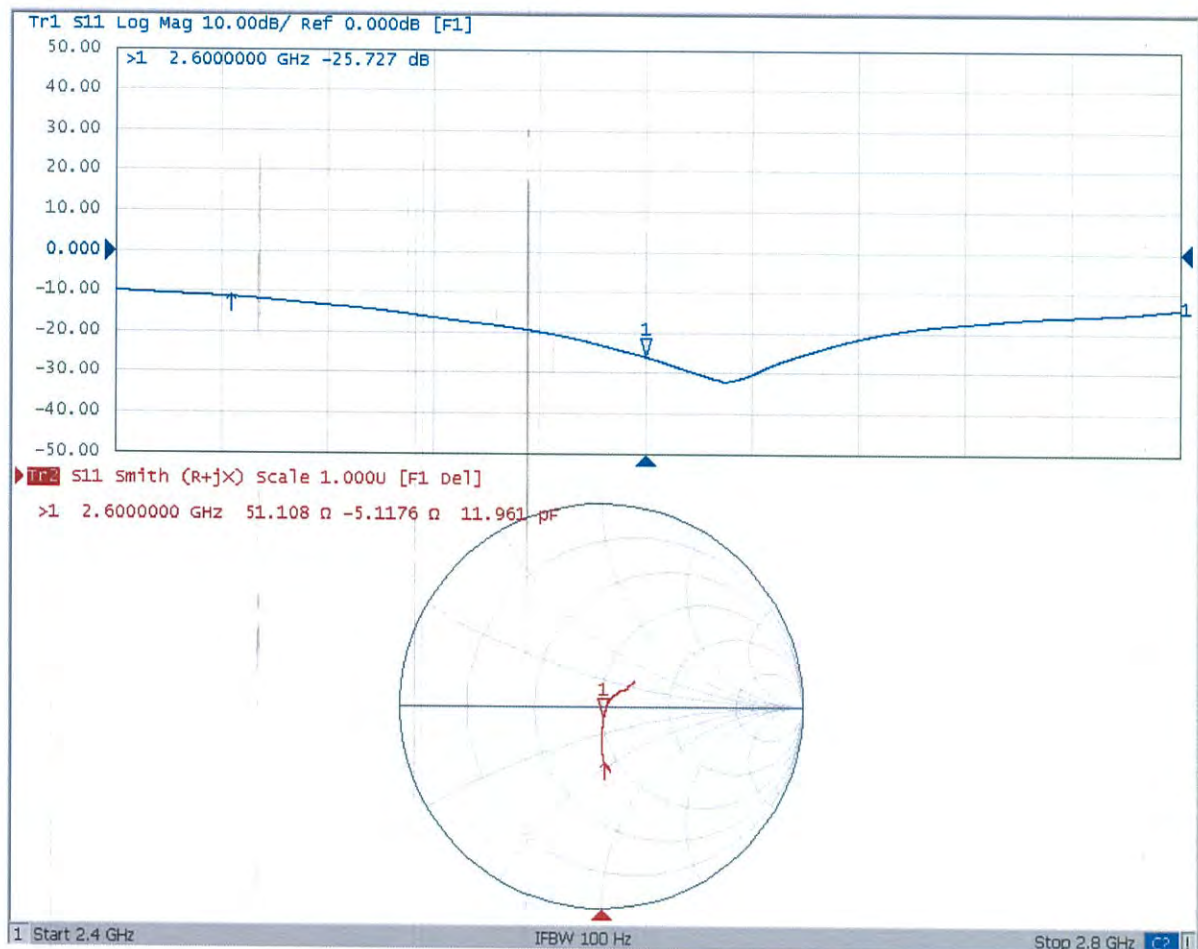
0 dB = 24.1 W/kg = 13.82 dBW/kg



In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Head TSL



D2600V2 - SN: 1110 Extended Dipole Calibrations

Referring to KDB 865664 D01, 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.

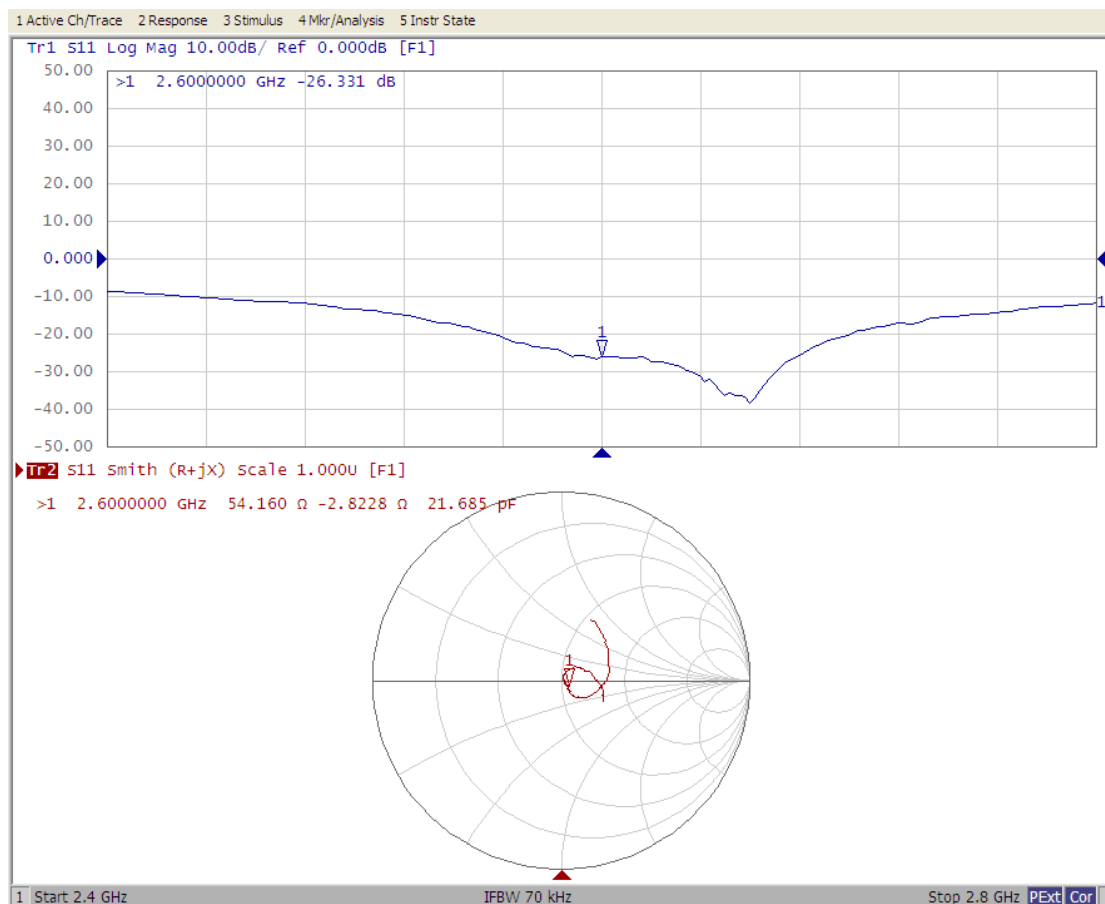
D2600V2 - SN: 1110						
2600 Head						
Date of Measurement	Return-loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2021.09.16	-25.7		51.1		-5.1	
2022.09.16	-26.3	2.7	54.2	3.1	-2.8	2.3

<Justification of the extended calibration>

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

<Dipole Verification Data>

Head 2600MHz _2022.09.16





BUREAU
VERITAS



Appendix D. Conducted Power Result

Band	GSM850				GSM1900			
Channel	128	189	251	Max. Tune-up Power	512	661	810	Max. Tune-up Power
Frequency	824.2	836.4	848.8		1850.2	1880	1909.8	
GSM	31.60	31.58	31.53	32.50	29.17	29.26	29.15	30.00
GPRS 1Tx Slot	31.47	31.42	31.37	32.50	29.19	29.11	29.08	30.00
GPRS 2Tx Slot	29.82	29.75	29.66	30.50	26.82	26.73	26.68	27.50
GPRS 3Tx Slot	28.18	28.08	27.95	29.00	25.21	25.19	25.04	26.00
GPRS 4Tx Slot	26.17	26.06	25.90	27.00	23.05	23.01	22.96	23.50
EDGE 1Tx Slot	24.39	24.16	24.01	25.50	25.39	25.28	24.81	26.00
EDGE 2Tx Slot	22.92	22.69	22.51	23.50	23.36	23.59	23.45	24.50
EDGE 3Tx Slot	19.74	19.64	19.10	20.50	20.95	20.91	20.56	21.50
EDGE 4Tx Slot	16.41	16.52	16.34	17.50	17.78	17.82	17.27	18.50

Source-Based Time-Averaged Power								
Band	GSM850			Max. Tune-up Power	GSM1900			Max. Tune-up Power
Channel	128	189	251		512	661	810	
GSM	22.60	22.58	22.53	23.50	20.17	20.26	20.15	21.00
GPRS 1Tx Slot	22.47	22.42	22.37	23.50	20.19	20.11	20.08	21.00
GPRS 2Tx Slot	23.82	23.75	23.66	24.50	20.82	20.73	20.68	21.50
GPRS 3Tx Slot	23.92	23.82	23.69	24.74	20.95	20.93	20.78	21.74
GPRS 4Tx Slot	23.17	23.06	22.90	24.00	20.05	20.01	19.96	20.50
EDGE 1Tx Slot	15.39	15.16	15.01	16.50	16.39	16.28	15.81	17.00
EDGE 2Tx Slot	16.92	16.69	16.51	17.50	17.36	17.59	17.45	18.50
EDGE 3Tx Slot	15.48	15.38	14.84	16.24	16.69	16.65	16.30	17.24
EDGE 4Tx Slot	13.41	13.52	13.34	14.50	14.78	14.82	14.27	15.50

Band	WCDMA II			WCDMA II	WCDMA V			WCDMA V	WCDMA IV			WCDMA V
TX Channel	9262	9400	9538	Max. Tune-up Power	4132	4182	4233	Max. Tune-up Power	1312	1413	1513	Max. Tune-up Power
Rx Channel	9662	9800	9938		4357	4407	4458		4357	4407	4458	
Frequency	1852.4	1880	1907.6		826.4	836.4	846.6		1712.4	1732.6	1752.6	
RMC 12.2K	21.70	21.68	21.66	22.50	23.73	23.70	23.74	24.50	20.88	20.89	20.86	21.50
HSDPA Subtest-1	21.12	21.10	21.08	22.00	23.15	23.16	23.12	24.00	20.30	20.31	20.28	21.00
HSDPA Subtest-2	21.11	21.09	21.07	22.00	23.14	23.15	23.11	24.00	20.29	20.30	20.27	21.00
HSDPA Subtest-3	20.60	20.58	20.56	21.50	22.63	22.64	22.60	23.50	19.78	19.79	19.76	20.50
HSDPA Subtest-4	20.59	20.57	20.55	21.50	22.62	22.63	22.59	23.50	19.77	19.78	19.75	20.50
DC-HSDPA Subtest-1	21.04	21.04	21.00	22.00	22.87	22.90	22.84	24.00	20.22	20.25	20.20	21.00
DC-HSDPA Subtest-2	21.03	21.03	20.99	22.00	22.86	22.89	22.83	24.00	20.21	20.24	20.19	21.00
DC-HSDPA Subtest-3	20.61	20.52	20.50	21.50	22.44	22.38	22.34	23.50	19.79	19.73	19.70	20.50
DC-HSDPA Subtest-4	20.60	20.51	20.49	21.50	22.43	22.37	22.33	23.50	19.78	19.72	19.69	20.50
HSUPA Subtest-1	21.08	21.06	21.04	22.00	23.11	23.12	23.08	24.00	20.26	20.27	20.24	21.00
HSUPA Subtest-2	20.07	20.05	20.03	21.00	22.10	22.11	22.07	22.50	19.25	19.26	19.23	20.00
HSUPA Subtest-3	20.55	20.54	20.52	21.50	22.58	22.60	22.56	23.50	19.73	19.75	19.72	20.50
HSUPA Subtest-4	20.04	20.03	20.01	21.00	22.07	22.09	22.05	22.50	19.22	19.24	19.21	21.00
HSUPA Subtest-5	21.03	21.02	21.00	22.00	23.06	23.08	23.04	24.00	20.21	20.23	20.20	21.00
HSPA+ Subtest-1	19.79	19.79	19.77	20.50	21.62	21.65	21.61	22.50	18.97	19.00	18.97	19.50

LTE Band 2										
BW	MCS Index	RB Size Channel	RB Offset				12GPP MPR (dB)	Max. Time-up (MHz)		
			Low	Mid	High	1800				
20M	QPSK	15QAM	Frequency (MHz)				1800	1800	1800	1800
			1	50	22.15	22.23				
			1	50	22.13	22.17				
			50	5	21.07	21.17				
			50	25	21.03	21.15				
			50	50	21.04	21.08				
			100	0	21.12	21.13				
			100	0	20.98	20.95				
			1	50	20.96	20.93				
			1	50	20.98	20.74				
20M	16QAM	16QAM	50	5	20.92	20.92				
			50	25	20.93	20.99				
			50	50	20.94	20.62				
			100	0	20.99	20.18				
			100	0	20.93	20.56				
			1	50	20.41	20.61				
			1	50	20.51	20.85				
			50	5	19.39	19.43				
			50	25	19.38	19.37				
			50	50	19.44	19.77				
20M	64QAM	64QAM	100	0	19.32	19.38				
			100	0	19.23	19.26				
			1	50	18.75	18.80				
			1	50	18.75	18.80				
			1	50	22.11	22.06				
			1	37	22.11	22.20				
			1	74	22.11	22.16				
			36	0	21.01	21.12				
			36	19	21.02	21.13				
			36	39	20.96	21.01				
10M	QPSK	16QAM	75	0	21.11	21.09				
			1	0	20.96	20.61				
			1	37	20.92	20.48				
			1	74	20.92	20.72				
			36	0	20.99	20.14				
			36	19	20.97	20.22				
			36	39	20.11	20.56				
			75	0	20.18	20.13				
			1	0	20.27	20.53				
			1	37	20.39	20.54				
10M	16QAM	16QAM	1	74	20.45	20.77				
			36	0	19.39	19.41				
			36	19	19.31	19.29				
			36	39	19.42	19.76				
			75	0	19.32	19.30				
10M	64QAM	64QAM	1	0	19.32	19.30				
			1	37	19.30	19.50				
			1	74	19.45	19.85				
			36	0	17.80	18.00				
			36	19	18.09	18.55				
			36	39	18.42	18.96				
			75	0	18.42	18.96				
			1	0	18.42	18.96				
			1	37	18.30	19.50				
			1	74	18.45	19.85				
5M	QPSK	16QAM	36	0	19.39	19.38				
			36	19	19.31	19.29				
			36	39	19.42	19.76				
			75	0	19.32	19.30				
			1	0	19.32	19.30				
			1	37	19.30	19.50				
			1	74	19.45	19.85				
			36	0	17.80	18.00				
			36	19	18.09	18.55				
			36	39	18.42	18.96				
5M	16QAM	16QAM	1	0	19.32	19.30				
			1	37	19.30	19.50				
			1	74	19.45	19.85				
			36	0	17.80	18.00				
			36	19	18.09	18.55				
			36	39	18.42	18.96				
			75	0	18.42	18.96				
			1	0	18.42	18.96				
			1	37	18.30	19.50				
			1	74	18.45	19.85				
5M	64QAM	64QAM	36	0	17.80	18.00				
			36	19	18.09	18.55				
			36	39	18.42	18.96				
			75	0	18.42	18.96				
			1	0	18.42	18.96				
			1	37	18.30	19.50				
			1	74	18.45	19.85				
			36	0	17.80	18.00				
			36	19	18.09	18.55				
			36	39	18.42	18.96				
1.4M	QPSK	16QAM	1	0	22.06	22.08				
			1	7	22.08	22.18				
			1	14	22.07	22.10				
			8	0	21.00	21.12				
			8	3	20.95	21.13				
			8	7	20.96	21.07				
			16	0	21.08	21.08				
			1	0	20.81	20.61				
			1	7	20.91	20.48				
			1	14	20.98	20.66				
1.4M	16QAM	16QAM	8	0	20.14	20.18				
			8	3	20.12	20.20				
			8	7	20.12	20.56				
			16	0	20.13	20.10				
			1	0	20.32	20.54				
			1	7	20.36	20.53				
			1	14	20.90	20.79				
			8	0	19.34	19.41				
			8	3	19.36	19.29				
			8	7	19.36	19.73				
1.4M	64QAM	64QAM	16	0	19.30	19.30				
			1	0	19.32	19.30				
			1	37	19.30	19.50				
			1	74	19.45	19.85				
			36	0	17.80	18.00				
			36	19	18.09	18.55				
			36	39	18.42	18.96				
			75	0	18.42	18.96				
			1	0	18.42	18.96				
			1	37	18.30	19.50				

LTE Band 4										
BW	MCS Index	RB Size Channel	RB Offset				12GPP MPR (dB)	Max. Time-up (MHz)		
			Low	Mid	High	2050				
20M	QPSK	15QAM	Frequency (MHz)				1800	1800	1800	1800

LTE Band 7									
BW	MCS Index	RB Size	RB Offset	Low	Mid	High	3GPP MPR (dB)	Max. Time- up (dB)	
		Channel		2080	2100	2180			
		Frequency (MHz)		2510	2535	2565			
20M	QPSK	1	0	19.71	19.67	19.51	0	20.50	
		1	50	19.51	19.64	19.27	0	20.50	
		1	99	19.49	19.32	19.33	0	20.50	
		50	0	18.73	18.69	18.54	1	19.50	
		50	25	18.60	18.66	18.51	1	19.50	
	16QAM	50	50	18.67	18.53	18.46	1	19.50	
		100	0	18.71	18.58	18.42	1	19.50	
		1	0	18.88	18.62	18.53	1	19.50	
		1	50	18.71	18.59	18.62	1	19.50	
		50	99	18.83	18.45	18.47	1	19.50	
	64QAM	50	25	17.81	17.45	17.46	3	18.50	
		50	25	18.84	18.47	18.51	2	19.50	
		50	50	19.88	18.53	18.91	2	19.50	
		100	0	18.91	18.64	18.72	2	19.50	
		1	0	18.82	19.43	19.15	2	20.00	
10M	QPSK	1	0	18.89	18.55	18.55	2	20.00	
		1	99	19.53	18.96	19.44	2	20.00	
		50	0	17.52	17.71	17.49	3	18.50	
		50	50	18.33	17.49	17.81	3	19.00	
		100	0	17.91	17.59	17.64	3	18.50	
5M	QPSK	1	0	19.63	19.43	19.43	0	20.50	
		1	37	19.47	19.61	19.21	0	20.50	
		1	74	19.47	19.31	19.29	0	20.50	
		36	0	18.67	18.64	18.53	1	19.50	
		36	19	18.59	18.64	18.46	1	19.50	
	16QAM	36	36	18.59	18.46	18.44	1	19.50	
		75	0	18.70	18.54	18.39	1	19.50	
		1	0	18.85	18.61	18.47	1	19.50	
		1	37	18.67	18.54	18.60	1	19.50	
		1	74	18.77	18.43	18.44	1	19.50	
	64QAM	36	0	18.51	18.71	18.58	2	19.50	
		36	19	18.76	18.43	18.46	2	19.50	
		36	39	19.05	18.47	18.89	2	19.50	
		75	0	18.90	18.59	18.54	2	19.50	
		1	0	18.78	19.40	19.09	2	20.00	
20M	QPSK	1	0	18.87	18.48	18.50	2	20.00	
		1	74	19.47	18.88	19.42	2	20.00	
		36	0	17.51	17.69	17.41	3	18.50	
		36	19	17.74	17.37	17.40	3	18.50	
		36	39	18.31	17.48	17.77	3	19.00	
	16QAM	75	0	17.89	17.51	17.63	3	18.50	
		1	0	19.63	19.63	19.46	0	20.50	
		1	24	19.49	19.56	19.26	0	20.50	
		1	49	19.41	19.28	19.28	0	20.50	
		25	0	18.70	18.63	18.52	1	19.50	
10M	QPSK	25	12	18.58	18.60	18.46	1	19.50	
		25	25	18.61	18.45	18.44	1	19.50	
		50	0	18.70	18.56	18.34	1	19.50	
		1	0	18.81	18.54	18.47	1	19.50	
		1	24	18.68	18.53	18.60	1	19.50	
	16QAM	1	49	18.81	18.38	18.42	1	19.50	
		25	0	18.47	18.71	18.57	2	19.50	
		25	12	18.82	18.39	18.50	2	19.50	
		25	25	19.00	18.49	18.86	2	19.50	
		50	0	18.89	18.56	18.71	2	19.50	
5M	QPSK	1	0	18.74	19.39	19.08	2	20.00	
		1	24	18.86	18.49	18.53	2	20.00	
		1	49	18.51	18.89	19.39	2	20.00	
		25	0	17.46	17.63	17.47	3	18.50	
		25	12	17.80	17.43	17.38	3	18.50	
	16QAM	25	25	18.28	17.41	17.75	3	19.00	
		50	0	17.86	17.53	17.62	3	18.50	
		1	0	19.65	19.60	19.46	0	20.50	
		1	12	19.49	19.56	19.25	0	20.50	
		1	24	19.44	19.24	19.32	0	20.50	
10M	QPSK	12	0	18.69	18.64	18.49	1	19.50	
		12	6	18.52	18.65	18.46	1	19.50	
		12	13	18.63	18.48	18.45	1	19.50	
		25	0	18.65	18.56	18.37	1	19.50	
		1	0	18.81	18.57	18.51	1	19.50	
	16QAM	1	12	18.63	18.57	18.57	1	19.50	
		1	24	18.81	18.37	18.45	1	19.50	
		12	0	18.45	18.73	18.51	2	19.50	
		12	6	18.78	18.45	18.45	2	19.50	
		12	13	19.01	18.48	18.89	2	19.50	
5M	QPSK	25	0	18.85	18.57	18.67	2	19.50	
		1	0	18.75	19.38	19.11	2	20.00	
		1	12	18.81	18.53	18.49	2	20.00	
		1	24	19.45	18.95	19.42	2	20.00	
		12	0	17.48	17.66	17.41	3	18.50	
	16QAM	12	6	17.73	17.44	17.44	3	18.50	
		12	13	18.29	17.44	17.73	3	19.00	
		25	0	17.86	17.57	17.61	3	18.50	

LTE Band 12									
BW	MCS Index	RB Size	RB Offset	Low	Mid	High	3GPP MPR (dB)	Max. Time-up (dB)	
		Channel		2080	2095	2138			
		Frequency (MHz)		784	797.5	711			
20M	QPSK	1	0	23.12	23.14	23.34	0	24.00	
		1	24	23.02	23.11	23.25	0	24.00	
		1	49	23.06	23.06	23.31	0	24.00	
		25	0	22.06	22.08	22.05	1	23.00	
		25	12	22.03	22.05	21.95	1	23.00	
	16QAM	25	25	22.08	22.11	22.17	1	23.00	
		50	0	22.05	22.03	22.16	1	23.00	
		1	0	22.27	22.34	22.35	1	23.00	
		1	24	22.02	22.25	22.25	1	23.00	
		1	49	22.14	22.28	22.24	1	23.00	
	64QAM	25	12	20.98	20.92	21.08	2	22.00	
		25	25	20.91	20.91	21.16	2	22.00	
		50	0	20.97	20.61	20.70	2	22.00	
		1	0	20.91	20.78	20.90	2	22.00	
		1	24	20.89	20.81	21.37	2	22.00	
10M	QPSK	1	0	23.07	23.07	23.29	0	24.00	
		1	12	23.05	23.03	23.23	0	24.00	
		1	24	23.01	22.98	23.30	0	24.00	
		12	0	22.02	22.03	22.00	1	23.00	
		12	6	21.95	22.04	21.90	1	23.00	
	16QAM	12	13	22.04	22.06	22.16	1	23.00	
		25	0	21.99	22.01	22.10	1	23.00	
		1	0	22.20	22.29	22.33	1	23.00	
		1	12	21.94	22.23	22.27	1	23.00	
		1	24	22.12	22.20	22.22	1	23.00	
5M	QPSK	12	0	20.76	20.80	20.97	2	22.00	
		12	6	20.92	20.90	21.02	2	22.00	
		12	13	20.84	20.86	21.14	2	22.00	
		25	0	20.91	20.54	20.65	2	22.00	
		1	0	20.84	20.73	20.88	2	22.00	
	16QAM	1	12	20.81	20.79	21.31	2	22.00	
		1	24	20.49	20.69	21.34	2	22.00	
		12	0	19.89	20.24	19.69	3	21.00	
		12	6	20.27	19.81	20.21	3	21.00	
		12	13	20.33	19.87	19.81	3	21.00	
20M	QPSK	25	0	20.25	19.81	19.99	3	21.00	
		1	0	23.05	23.12	23.28	0	24.00	
		1	7	22.95	23.06	23.23	0	24.00	
		1	14	23.00	22.99	23.26	0	24.00	
		8	0	21.99	22.03	22.03	1	23.00	
10M	QPSK	8	3	21.85	22.03	21.88	1	23.00	
		8	8	22.00	22.00	22.00	1	23.00	
		15	0	22.01	21.98	22.07	1	23.00	
		1	0	22.19	22.33	22.37	1	23.00	
		1	7	21.97	22.20	22.21	1	23.00	
	16QAM	1	14	22.12	22.20	22.23	1	23.00	
		8	3	20.76	20.82	21.02	2	22.00	
		8	3	20.95	20.86	21.06	2	22.00	
		8	7	20.89	20.84	21.11	2	22.00	
		15	0	20.91	20.53	20.66	2	22.00	
	64QAM	8	8	20.90	20.78	21.02	2	22.00	
		1	7	20.84	20.73	21.31	2	22.00	
		1	14	20.56	20.64	21.34	2	22.00	
		8	0	19.88	20.27	19.75	3	21.00	
		8	3	20.33	19.74	20.22	3	21.00	
20M	QPSK	8	3	20.20	19.86	19.86	3	21.00	
		15	0	20.29	19.75	20.01	3	21.00	
		1	0	23.05	23.12	23.28	0	24.00	
		1	7	22.95	23.06	23.23	0	24.00	
		1	14	23.00	22.99	23.26	0	24.00	
5M	QPSK	8	0	21.99	22.03	22.03	1	23.00	
		3	1	21.82	22.00	22.27	0	24.00	
		3	1	21.80	21.91	22.23	0	24.00	
		6	0	22.04	21.97	22.13	1	23.00	
		1	0	22.22	22.27	22.30	1	23.00	
	16QAM	1	2	22.00	22.17	22.23	1	23.00	
		5	5	22.09	22.20	22.23	1	23.00	
		3	1	21.80	21.91	22.23	1	23.00	
		3	1	21.90	21.91	22.03	1	23.00	
		3	3	21.87	21.86	22.16	1	23.00	
	64QAM	6	0	20.91	20.59	20.65	2	22.00	
		3	20.84	20.73	21.31	2	22.00		
		1	2	20.81	20.79	21.32	2	22.00	
		1	5	20.55	20.62	21.34	2	22.00	
		3	0	20.85	21.23	20.69	2	22.00	
20M	QPSK	3	1	21.26	20.80	21.17	2	22.00	
		3	1	21.32	20.84	21.17	2	22.00	
		6	0	20.27	19.76	19.97	3	21.00	
		3	1	20.85	20.84	21.17	2	22.00	
		3	1	20.85	20.84	21.17	2	22.00	

LTE Band 17										
BW	MCS Index	RB Size	RB Offset	Low	Mid	High	3GPP	Max.		
		Channel		2376	2379	2380	MPR	Tune-up	(dBm)	
		Frequency (MHz)		709	710	711	(dB)			
10M	QPSK	1	0	22.96	23.17	22.92	0	24.00		
		1	24	22.94	23.12	22.89	0	24.00		
		1	49	22.91	23.09	22.84	0	24.00		
		25	0	21.89	21.83	21.85	1	23.00		
		25	12	21.90	21.88	21.78	1	23.00		
		25	25	21.93	21.97	21.95	1	23.00		
		50	0	21.83	21.91	21.87	1	23.00		
		1	0	22.08	22.14	22.11	1	23.00		
		1	24	22.06	22.09	21.95	1	23.00		
		1	49	22.02	22.08	22.09	1	23.00		
10M	16QAM	25	0	20.93	21.14	20.82	2	22.00		
		25	12	20.83	21.18	20.95	2	22.00		
		25	25	20.98	21.27	20.90	2	22.00		
		50	0	20.84	20.95	20.98	2	22.00		
		64QAM	1	0	21.04	21.22	20.91	2	22.00	
			1	24	21.25	21.45	20.85	2	22.00	
			1	49	20.86	21.27	21.25	2	22.00	
			25	0	20.31	19.81	19.92	3	21.00	
			25	12	19.82	19.97	19.93	3	21.00	
			25	25	20.20	19.96	19.95	3	21.00	
50	0		19.98	20.14	20.05	3	21.00			
5M	MCS Index		Channel		2376	2379	2382	3GPP <th colspan="2">Max.</th>	Max.	
			Frequency (MHz)		708.5	710	713.5	MPR <th>Tune-up</th> <th>(dBm)</th>	Tune-up	(dBm)
			1	0	22.91	23.10	22.87	0	24.00	
		1	12	22.92	23.04	22.87	0	24.00		
		1	24	22.86	23.01	22.83	0	24.00		
		12	0	21.85	21.78	21.80	1	23.00		
		12	6	21.82	21.87	21.73	1	23.00		
		12	13	21.80	21.92	21.94	1	23.00		
		25	0	21.77	21.89	21.82	1	23.00		
		1	0	22.01	22.09	22.09	1	23.00		
		1	12	21.98	22.07	21.90	1	23.00		
		1	24	22.00	22.00	22.07	1	23.00		
		12	0	20.85	21.08	20.74	2	22.00		
		12	6	20.77	21.16	20.89	2	22.00		
		12	13	20.91	21.22	20.88	2	22.00		
		25	0	20.78	20.88	20.93	2	22.00		
		64QAM	1	0	20.97	21.17	20.89	2	22.00	
			1	12	21.17	21.43	20.79	2	22.00	
			1	24	20.78	21.26	21.23	2	22.00	
			12	0	20.27	19.75	19.84	3	21.00	
			12	6	19.74	19.95	19.91	3	21.00	
			12	13	20.16	19.92	19.87	3	21.00	
			25	0	19.92	20.12	20.02	3	21.00	

LTE Band 66											
BW	MCS Index	RB Size	RB Offset	Low	Mid	High	3GPP	Max.			
		Channel		13267.2	13232	13257.2	MPR (dB)	Tune-up (dBm)			
		Frequency (MHz)		1728	1745	1778					
20M	QPSK	1	0	20.84	20.85	20.78	0	21.50			
		1	50	20.87	20.94	20.95	0	21.50			
		1	99	20.79	20.92	20.83	0	21.50			
		50	0	19.82	19.83	19.91	1	20.50			
		50	25	19.86	19.90	19.94	1	20.50			
		50	50	19.82	19.87	19.81	1	20.50			
	16QAM	100	0	19.85	19.83	19.86	1	20.50			
		1	50	19.77	19.91	20.08	1	21.00			
		1	99	19.75	20.16	19.77	1	21.00			
		50	0	19.87	19.31	19.57	2	20.50			
		50	25	19.42	19.43	19.65	2	20.50			
		50	50	19.71	19.77	19.82	2	20.50			
	64QAM	100	0	19.35	19.56	19.75	2	20.50			
		1	0	19.97	19.54	19.63	2	20.50			
		1	50	19.49	19.52	19.67	2	20.50			
		1	99	20.08	20.33	20.29	2	21.00			
		50	0	17.85	18.28	18.41	3	19.50			
		50	25	18.29	18.45	18.51	3	19.50			
15M	QPSK	50	50	18.62	18.75	18.77	3	19.50			
		100	0	18.23	18.51	18.56	3	19.50			
		16QAM	1	0	20.83	20.81	20.70	0	21.50		
			1	37	20.83	20.91	20.89	0	21.50		
			1	74	20.77	20.91	20.79	0	21.50		
			36	0	19.76	19.78	19.90	1	20.50		
	36		19	19.85	19.86	19.89	1	20.50			
	36		39	19.74	19.80	19.79	1	20.50			
	64QAM	75	0	19.87	19.92	19.83	1	20.50			
		1	0	19.74	19.90	20.02	1	21.00			
		1	37	19.71	20.11	19.75	1	21.00			
		1	74	19.86	20.09	19.66	1	21.00			
		36	0	18.95	19.23	19.56	2	20.50			
		36	19	19.34	19.39	19.60	2	20.50			
	10M	16QAM	36	39	19.68	19.71	19.80	2	20.50		
			75	0	19.34	19.51	19.67	2	20.50		
			1	0	18.91	19.51	19.59	2	20.50		
			1	37	19.47	19.45	18.62	2	20.50		
1			74	20.02	20.25	20.27	2	21.00			
36			0	17.84	18.26	18.33	3	19.50			
64QAM		36	19	18.22	18.37	18.45	3	19.50			
		36	39	18.60	18.74	18.73	3	19.50			
		75	0	18.21	18.43	18.55	3	19.50			
		5M	QPSK	Channel		13198.7	13232	13267.2	3GPP	Max.	
				Frequency (MHz)		1718	1745	1778	MPR	Tune-up	
				1	0	20.78	20.81	20.73			0
1	24			20.85	20.86	20.94	0	21.50			
1	49			20.71	20.88	20.78	0	21.50			
25	0			19.79	19.77	19.89	1	20.50			
16QAM	25		12	19.84	19.83	19.89	1	20.50			
	25		25	19.76	19.79	19.79	1	20.50			
	50		0	19.87	19.94	19.78	1	20.50			
	1		0	19.70	19.83	20.02	1	21.00			
	1		24	19.72	20.10	19.75	1	21.00			
	1		49	19.90	20.04	19.64	1	21.00			
64QAM	25		0	18.91	19.23	19.55	2	20.50			
	25		12	19.40	19.35	19.64	2	20.50			
	25		25	19.63	19.73	19.77	2	20.50			
	50		0	19.33	19.48	19.74	2	20.50			
	1		0	18.89	19.50	19.58	2	20.50			
	1		24	19.46	19.46	19.65	2	20.50			
3M	QPSK	1	49	20.06	20.26	20.24	2	21.00			
		25	0	17.79	18.20	18.39	3	19.50			
		25	12	18.28	18.43	18.43	3	19.50			
		25	25	18.57	18.67	18.71	3	19.50			
		50	0	18.22	18.45	18.54	3	19.50			
		16QAM	1	0	20.79	20.78	20.73	0	21.50		
	1		12	20.85	20.86	20.93	0	21.50			
	1		24	20.74	20.94	20.82	0	21.50			
	12		0	19.78	19.78	19.86	1	20.50			
	12		6	19.78	19.89	19.89	1	20.50			
	12		13	19.78	19.82	19.80	1	20.50			
	64QAM	25	0	19.82	19.94	19.81	1	20.50			
		1	0	19.70	19.86	20.06	1	21.00			
		1	12	19.67	20.14	19.72	1	21.00			
		1	24	19.90	20.03	19.67	1	21.00			
		12	0	18.89	19.25	19.49	2	20.50			
		12	6	19.36	19.41	19.59	2	20.50			
	1.4M	QPSK	12	13	19.64	19.72	19.80	2	20.50		
25			0	19.29	19.49	19.70	2	20.50			
1			0	18.90	19.49	19.61	2	20.50			
1			12	19.41	19.50	19.61	2	20.50			
1			24	20.00	20.32	20.27	2	21.00			
12			0	17.81	18.23	18.33	3	19.50			
16QAM		12	6	18.21	18.44	18.44	3	19.50			
		12	13	18.58	18.69	18.69	3	19.50			
		25	0	18.17	18.48	18.53	3	19.50			
		BW	MCS Index	Channel		13198.7	13232	13267.2	3GPP	Max.	
				Frequency (MHz)		1712.5	1745	1778.5	MPR	Tune-up	
			1	0	20.78	20.83	20.72	0			21.50
1	7		20.80	20.89	20.93	0	21.50				
1	14		20.73	20.85	20.78	0	21.50				
QPSK	8		0	19.75	19.78	19.89	1	20.50			
	8		3	19.78	19.88	19.88	1	20.50			
	8		7	19.74	19.86	19.79	1	20.50			
	15		0	19.84	19.91	19.78	1	20.50			
	1		0	19.69	19.90	20.06	1	21.00			
	1		7	19.70	20.11	19.73	1	21.00			
16QAM	1		14	19.90	20.03	19.68	1	21.00			
	8	0	18.89	19.27	19.52	2	20.50				
	8	3	19.39	19.37	19.63	2	20.50				
	8	7	19.69	19.70	19.77	2	20.50				
	15	0	19.29	19.48	19.73	2	20.50				
	1	0	18.96	19.52	19.55	2	20.50				
64QAM	1	7	19.44	19.41	18.61	2	20.50				
	1	14	20.07	20.27	20.27	2	21.00				
	8	0	17.80	18.26	18.34	3	19.50				
	8	3	18.27	18.37	18.50	3	19.50				
	8	7	18.54	18.71	18.72	3	19.50				
	15	0	18.21	18.43	18.55	3	19.50				
1.4M	MCS Index	Channel		13197.9	13222	13266.7	3GPP	Max.			
		Frequency (MHz)		1716.7	1745	1778.3	MPR	Tune-up			
	1	0	20.76	20.81	20.73	0			21.50		
	1	2	20.84	20.88	20.93	0	21.50				
	QPSK	1	5	20.77	20.85	20.78	0	21.50			
		3	0	20.76	20.75	20.89	1	21.50			
		3	1	20.85	20.88	20.86	1	21.50			
		3	3	20.77	20.79	20.75	1	21.50			
		6	0	19.87	19.89	19.84	1	20.50			
		1	0	19.72	19.84	20.03	1	21.00			
	16QAM	1	2	19.73	20.08	19.75	1	21.00			
		1	5	19.87	20.03	19.68	1	21.00			
		3	0	19.93	19.76	20.02	2	21.00			
		3	1	19.84	19.92	20.10	2	21.00			
		3	3	20.17	20.32	20.31	2	21.00			
		6	0	19.26	19.54	19.70	2	20.50			
	64QAM	1	0	18.90	19.49	19.61	2	20.50			
		1	2	19.41	19.50	19.62	2	20.50			
1		5	19.56	19.75	19.77	2	20.50				
3		0	19.27	19.22	19.33	3	20.50				
3		1	19.43	19.43	19.45	3	20.50				
3		3	19.57	19.17	19.26	3	20.50				
BW	MCS Index	6	0	18.19	18.46	18.51	3	19.50			

2.4GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit
	802.11b 1Mbps	1	2412	15.24	16.00
		6	2437	14.22	15.00
		11	2462	16.11	17.00
	802.11g 6Mbps	1	2412	14.10	15.00
		6	2437	14.05	14.50
		11	2462	14.97	15.50
	802.11n-HT20 MCS0	1	2412	14.54	15.00
		6	2437	14.16	15.00
		11	2462	15.71	16.50

Mode	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit
BR / EDR	GFSK	CH 0	2402	8.48	9.00
		CH 39	2441	8.34	7.00
		CH 78	2480	7.73	7.00
	DQPSK	CH 0	2402	7.24	8.00
		CH 39	2441	6.32	7.00
		CH 78	2480	5.72	7.00
	8DPSK	CH 0	2402	7.17	8.00
		CH 39	2441	6.27	7.00
		CH 78	2480	5.65	7.00
BLE	1M	CH 0	2402	-0.41	1.00
		CH 19	2440	-0.14	1.00
		CH 39	2480	-0.91	1.00