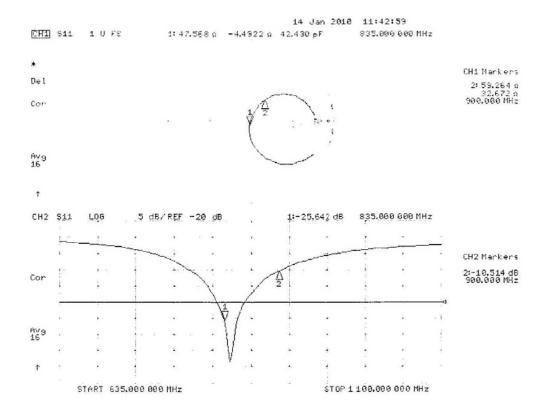
# Impedance Measurement Plot for Body TSL



# **ANNEX F: D1900V2 Dipole Calibration Certificate**

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





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

Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates Accreditation No.: SCS 108

Certificate No: D1900V2-5d018\_Jun10

CALIBRATION C	ERTIFICATE		
Object	D1900V2 - SN: 5	d018	
Calibration procedure(s)	QA CAL-05.v7 Calibration proce	dure for dipole validation kits	
Calibration date:	June 15, 2010		
The measurements and the unce	rtainties with confidence p	onal standards, which realize the physical unrobability are given on the following pages a ry facility: environment temperature (22 $\pm$ 3) <sup>4</sup>	nd are part of the certificate.
Primary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-09 (No. 217-01086)	Oct-10
Power sensor HP 8481A	U\$37292783	06-Oct-09 (No. 217-01086)	Oct-10
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES3DV3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11
Secondary Standards	ID#	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	U\$37390585 \$4206	18-Oct-01 (in house check Oct-09)	In house check: Oct-10
		- 0.00 pt 0.00	
Calibrated by:	Name Dimos Illev	Function Laboratory Technician	Signature  D. Killer
Approved by:	Katja Pokovic	Technical Manager	All.
		2	Issued: June 17, 2010
This calibration certificate shall n	ot be reproduced except in	full without written approval of the laborator	у.

Certificate No: D1900V2-5d018\_Jun10

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#### Calibration Laboratory of

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





S Schweizerischer Kalibrierdienst

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S Swiss Calibration Service

Accreditation No.: SCS 108

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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:

- a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

#### **Additional Documentation:**

d) DASY4/5 System Handbook

# Methods Applied and Interpretation of Parameters:

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

10 pc 2

#### **Measurement Conditions**

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

DASY Version	DASY5	V52.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	201
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	39.6 ± 6 %	1.44 mho/m ± 6 %
Head TSL temperature during test	(22.5 ± 0.2) °C	****	

#### SAR result with Head TSL

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.0 mW / g
SAR normalized	normalized to 1W	40.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	39.2 mW /g ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	3400 9
SAR measured	250 mW input power	5.22 mW / g
SAR normalized	normalized to 1W	20.9 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.7 mW /g ± 16.5 % (k=2)

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# **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	53.4 ± 6 %	1.54 mho/m ± 6 %
Body TSL temperature during test	(21.7 ± 0.2) °C		

# SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	2000 CT - 4 - 2 - 2 - 1 - 2 - 2 - 2 - 2 - 2 - 2 - 2
SAR measured	250 mW input power	10.3 mW / g
SAR normalized	normalized to 1W	41.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	40.9 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.52 mW / g
SAR normalized	normalized to 1W	22.1 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	22.0 mW / g ± 16.5 % (k=2)

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# **Appendix**

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.1 $\Omega$ + 2.6 j $\Omega$	
Return Loss	- 29.7 dB	

# **Antenna Parameters with Body TSL**

Impedance, transformed to feed point	$47.4 \Omega + 3.2 j\Omega$
Return Loss	- 27.6 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.194 ns
Liberious Boiley (one direction)	11.011.0

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.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

#### **Additional EUT Data**

Manufactured by	SPEAG	
Manufactured on	June 04, 2002	

Certificate No: D1900V2-5d018\_Jun10

#### **DASY5 Validation Report for Head TSL**

Date/Time: 15.06.2010 10:40:45

Test Laboratory: SPEAG, Zurich, Switzerland

### DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d018

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: HSL U11 BB

Medium parameters used: f = 1900 MHz;  $\sigma = 1.44 \text{ mho/m}$ ;  $\varepsilon_r = 39.5$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

#### DASY5 Configuration:

Probe: ES3DV3 - SN3205; ConvF(5.09, 5.09, 5.09); Calibrated: 30.04.2010

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 10.06.2010

Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001

Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)

Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

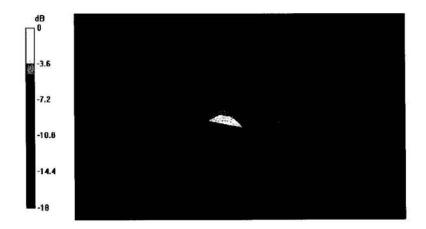
# Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement

grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.7 V/m; Power Drift = 0.022 dB

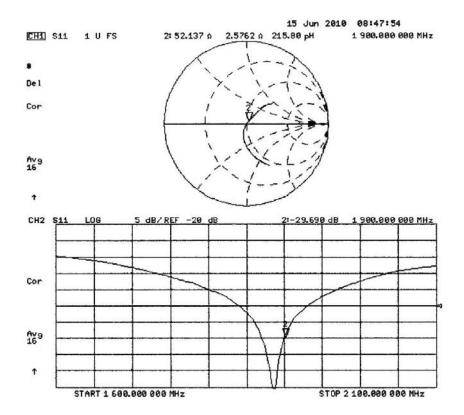
Peak SAR (extrapolated) = 18.4 W/kg

SAR(1 g) = 10 mW/g; SAR(10 g) = 5.22 mW/gMaximum value of SAR (measured) = 12.6 mW/g



0 dB = 12.6 mW/g

# Impedance Measurement Plot for Head TSL



#### **DASY5 Validation Report for Body**

Date/Time: 15.06.2010 14:14:27

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d018

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: MSL U11 BB

Medium parameters used: f = 1900 MHz;  $\sigma = 1.54 \text{ mho/m}$ ;  $\varepsilon_r = 53.5$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

#### DASY5 Configuration:

Probe: ES3DV3 - SN3205; ConvF(4.59, 4.59, 4.59); Calibrated: 30.04.2010

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 10.06.2010

Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002

Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)

Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

# Pin250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement

grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.1 V/m; Power Drift = 0.055 dB

Peak SAR (extrapolated) = 17.3 W/kg

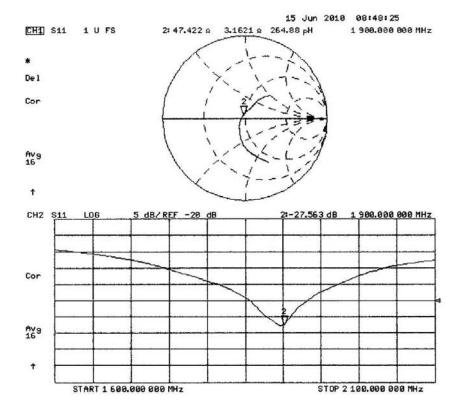
SAR(1 g) = 10.3 mW/g; SAR(10 g) = 5.52 mW/g

Maximum value of SAR (measured) = 12.8 mW/g



0 dB = 12.8 mW/g

# Impedance Measurement Plot for Body TSL



# **ANNEX G: DAE4 Calibration Certificate**

#### **Calibration Laboratory of**

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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	n)	Certificate	e No: DAE4-871_Nov09
CALIBRATION C	CERTIFICATE		
Object	DAE4 - SD 000 D	04 BJ - SN: 871	
Calibration procedure(s)	QA CAL-06.v12 Calibration proced	lure for the data acquisition e	electronics (DAE)
Calibration date:	November 11, 200	9	
The measurements and the unce	ertainties with confidence pro	nal standards, which realize the physical bability are given on the following page facility: environment temperature (22 ±	s and are part of the certificate.
Primary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
Primary Standards		Cal Date (Certificate No.) 1-Oct-09 (No: 9055)	Scheduled Calibration Oct-10
Primary Standards Keithley Multimeter Type 2001 Secondary Standards	ID # SN: 0810278		
	ID # SN: 0810278	1-Oct-09 (No: 9055) Check Date (in house)	Oct-10 Scheduled Check
Primary Standards Keithley Multimeter Type 2001 Secondary Standards	ID # SN: 0810278  ID # SE UMS 006 AB 1004  Name	1-Oct-09 (No: 9055) Check Date (in house)	Oct-10  Scheduled Check In house check: Jun-10
Primary Standards Keithley Multimeter Type 2001 Secondary Standards	ID # SN: 0810278  ID # SE UMS 006 AB 1004	1-Oct-09 (No: 9055)  Check Date (in house)  05-Jun-09 (in house check)	Oct-10  Scheduled Check In house check: Jun-10
Primary Standards Keithley Multimeter Type 2001 Secondary Standards Calibrator Box V1.1	ID # SN: 0810278  ID # SE UMS 006 AB 1004  Name	1-Oct-09 (No: 9055)  Check Date (in house)  05-Jun-09 (in house check)	Oct-10 Scheduled Check

Certificate No: DAE4-871\_Nov09

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### **Calibration Laboratory of**

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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Glossary

DAE data :
Connector angle inform

data acquisition electronics

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: 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.

Certificate No: DAE4-871\_Nov09

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# **DC Voltage Measurement**

A/D - Converter Resolution nominal

High Range:  $1LSB = 6.1\mu V$ , full range = -100...+300 mVLow Range: 1LSB = 61nV, full range = -1......+3mV

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

Calibration Factors	х	Y	Z
High Range	404.813 ± 0.1% (k=2)	404.794 ± 0.1% (k=2)	405.237 ± 0.1% (k=2)
Low Range	3.98191 ± 0.7% (k=2)	3.98417 ± 0.7% (k=2)	3.98912 ± 0.7% (k=2)

# **Connector Angle**

Connector Angle to be used in DASY system	90.0 ° ± 1 °

# **Appendix**

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199994.0	1.84	0.00
Channel X	+ Input	19999.85	0.05	0.00
Channel X	- Input	-19997.97	1.83	-0.01
Channel Y	+ Input	200010.3	-3.71	-0.00
Channel Y	+ Input	19999.12	-0.48	-0.00
Channel Y	- Input	-20000.18	-0.78	0.00
Channel Z	+ Input	200010.2	-2.80	-0.00
Channel Z	+ Input	19998.54	-0.86	-0.00
Channel Z	- Input	-19999.82	0.00	0.00

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2000.3	0.22	0.01
Channel X	+ Input	200.20	0.30	0.15
Channel X	- Input	-199.89	0.21	-0.10
Channel Y	+ Input	1999.8	-0.13	-0.01
Channel Y	+ Input	200.06	-0.04	-0.02
Channel Y	- Input	-200.43	-0.73	0.36
Channel Z	+ Input	1999.5	-0.57	-0.03
Channel Z	+ Input	199.58	-0.72	-0.36
Channel Z	- Input	-201.11	-1.01	0.51

# 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	13.79	12.75
	- 200	-12.26	-13.72
Channel Y	200	-11.82	-11.47
	- 200	10.67	10.68
Channel Z	200	-1.08	-1.35
	- 200	0.32	0.12

#### 3. Channel separation

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

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	3.36	1.06
Channel Y	200	1.52		3.59
Channel Z	200	2.55	1.41	-

# 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	15928	16288
Channel Y	16188	15745
Channel Z	15790	16219

#### 5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec Input  $10 \mathrm{M}\Omega$ 

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.06	-3.43	1.18	0.52
Channel Y	-0.71	-2.66	0.96	0.57
Channel Z	-0.95	-1.94	0.04	0.41

#### 6. Input Offset Current

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

7. Input Resistance

	Zeroing (MOhm)	Measuring (MOhm)
Channel X	0.1999	204.4
Channel Y	0.1999	203.6
Channel Z	0.1999	203.8

8. Low Battery Alarm Voltage (verified during pre test)

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

9. Power Consumption (verified during pre test)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.0	+6	+14
Supply (- Vcc)	-0.01	-8	-9

# **ANNEX H: The EUT Appearances and Test Configuration**



a: EUT



b: back view





c: Battery

Picture 6: Constituents of EUT



Picture 7: Left Hand Touch Cheek Position



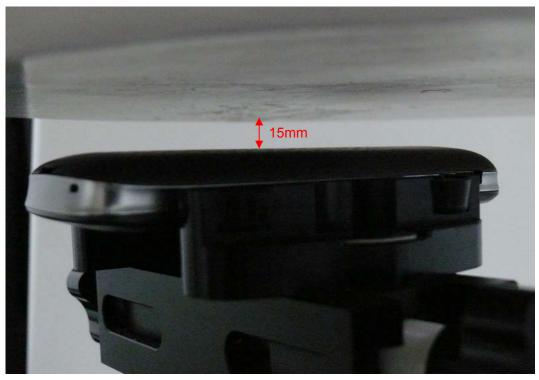
Picture 8: Left Hand Tilt 15 Degree Position



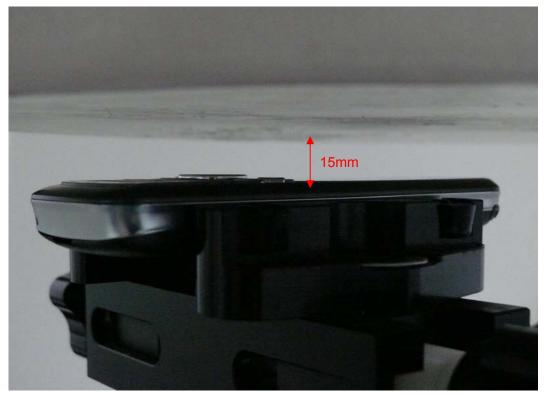
Picture 9: Right Hand Touch Cheek Position



Picture 10: Right Hand Tilt 15 Degree Position



Picture 11: Body, The EUT display towards ground, the distance from handset to the bottom of the Phantom is 15mm



Picture 12: Body, The EUT display towards phantom, the distance from handset to the bottom of the Phantom is 15mm



Picture 13: Body with earphone, The EUT display towards ground, the distance from handset to the bottom of the Phantom is 15mm