MOTOROLA SOLUTIONS

ACCREDITED
TESTING CERT # 2518.05

DECLARATION OF COMPLIANCE SAR ASSESSMENT Part 1 of 2

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Date of Report: 03/24/2015
Report Revision: C

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Report Author:	Tan CheeChin (EME Section Manager)
Date/s Tested:	01/03/14-03/26/14
Manufacturer/Location:	Motorola Solutions Inc., Penang
Sector/Group/Div.:	EMS
Date submitted for test:	12/05/13
DUT Description:	Handheld Portable MTP3100 800MHz LKP CLR ROM MTP3250 800MHz FKP GPS/BT CLR ROM
Test TX mode(s):	TDMA (PTT); CW (Bluetooth)
Max. Power output:	2.0W (800 band), 4.62 mW (Bluetooth)
Nominal Power:	1.8W (800 band), 2.0 mW (Bluetooth)
Tx Frequency Bands:	806 -870 MHz, 2.402 - 2.48GHz Bluetooth
Signaling type:	TDMA & PI/4DQPSK ; FHSS (Bluetooth)
Model(s) Tested:	PMUF1620A, PMUF1619A
Model(s) Certified:	PMUF1620A(H61UCF6TZ1AN), PMUF1619A(H63UCH6TZ7AN)
Serial Number(s):	409TNZ0019
Classification:	Occupational/Controlled
FCC ID:	AZ489FT5868; 809-824MHz, 854-869MHz; 2402-2480MHz
IC :	109U-89FT5868; 806-824MHz, 851-869MHz; 2402-2480MHz

The test results clearly demonstrate compliance with FCC Occupational/Controlled RF Exposure limits of 8 W/kg averaged over 1 gram per the requirements of 47 CFR 2.1093(d). The 10 grams result is not applicable to FCC filing. The test results clearly demonstrate compliance with ICNIRP (1998) Guidelines for limiting exposure in time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz), Health Physics 74, 494-522 RF Exposure limits of 10 W/kg averaged over 10grams of contiguous tissue.

Based on the information and the testing results provided herein, the undersigned certifies that when used as stated in the operating instructions supplied, said product complies with the national and international reference standards and guidelines listed in section 3.0 of this report. This report shall not be reproduced without written approval from an officially designated representative of the Motorola Solutions Inc EME Laboratory.
I attest to the accuracy of the data and assume full responsibility for the completeness of these measurements. This reporting format is consistent with the suggested guidelines of the TIA TSB-150 December 2004. The results and statements contained in this report pertain only to the device(s) evaluated.

Deanna Zakharia
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Approval Date: 3/24/2015

Part 1 of 2

APPENDICES

Part 2 of 2

APPENDICES

Report Revision History

Date	Revision	Comments
04/23/2014	O	Initial release
01/08/2015	A	Added sales model numbers to report
03/10/2015	B	Update BT power level
03/24/2015	C	Update KDB revision date and the equipments cal dues in sec 9.

1.0 Introduction

This report details the utilization, test setup, test equipment, and test results of the Specific Absorption Rate (SAR) measurements performed at the Motorola Solutions Inc. EME Test Laboratory for handheld portable model number PMUF1620A. This device is classified as Occupational/Controlled.

2.0 FCC SAR Summary

TABLE 1

Equipment Class	Frequency band (MHz)	Max Calc at Body (W/Kg)		Max Calc at Face (W/Kg)		Max Calc at Head (W/Kg)	
		1g-SAR	10g-SAR	1g-SAR	10g-SAR	1g-SAR	10g-SAR
TNF	809-824MHz	6.07	4.50	0.25	0.18	1.77	1.27
	854-869MHz	6.37	4.65	0.28	0.21	1.49	1.08
*DSS	2402-2480	NA	NA	NA	NA	NA	NA
*Simultaneous Results		NA	NA	NA	NA	NA	NA

*Results not required per KDB

3.0 Abbreviations / Definitions

CNR: Calibration Not Required
EME: Electromagnetic Energy
CW: Continuous Wave
DUT: Device Under Test
BT: Bluetooth
FHSS: Frequency Hopping Spread Spectrum
FM: Frequency Modulation
NA: Not Applicable
PTT: Push to Talk
TDMA: Time Division Multiple Access
SAR: Specific Absorption Rate
MSPD: Multi Slot Packed Data
SSPD: Single Slot Packet Data
DPSK: Differential Phase-Shift Keying
DSP: Digital Signal Processor
PI/4DQPSK: Π/4 Differential Quadrature Phase Shift Keying
LKP: Limited Keypad
FKP: Full Keypad
TNF: Licensed Non-Broadcast Transmitter Held to Face
DSS: Spread Spectrum Transmitter

Audio accessories: These accessories allow communication while the DUT is worn on the body.
Body worn accessories: These accessories allow the DUT to be worn on the body of the user.
Maximum Power: Defined as the upper limit of the production line final test station.

4.0 Referenced Standards and Guidelines

This product is designed to comply with the following applicable national and international standards and guidelines.

- IEC62209-1*(2005) Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)
- Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields", OET Bulletin 65, FCC, Washington, D.C.: 1997.
- IEEE 1528*(2003), Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
- American National Standards Institute (ANSI) / Institute of Electrical and Electronics Engineers (IEEE) C95. 1-1992
- Institute of Electrical and Electronics Engineers (IEEE) C95.1-2005
- International Commission on Non-Ionizing Radiation Protection (ICNIRP) 1998
- Ministry of Health (Canada) Safety Code 6 (2009), Limits of Human Exposure to Radio frequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz
- Australian Communications Authority Radio communications (Electromagnetic Radiation - Human Exposure) Standard (2003)
- ANATEL, Brazil Regulatory Authority, Resolution No. 303 of July 2, 2002 "Regulation of the limitation of exposure to electrical, magnetic, and electromagnetic fields in the radio frequency range between 9 kHz and 300 GHz." and "Attachment to resolution # 303 from July 2, 2002"
- IEC62209-2 Edition 1.0 2010-03, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures – Part 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).

(*) The IEC62209-1 and IEEE 1528 are applicable for hand-held devices used in close proximity to the ear only.

- FCC KDB – 648474 D04 SAR Evaluation Consideration For wireless Handset v01r02 (12/04/2013)
- FCC KDB – 643646 D01 SAR Test for PTT Radios v01r01 (04/04/2011)
- FCC KDB – 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03 (02/07/2014)
  D02 RF Exposure Reporting v01r01 (02/07/2014)
- FCC KDB – 447498 D01 General RF Exposure Guidance v05r02 (02/07/2014)

5.0 SAR Limits

TABLE 2

EXPOSURE LIMITS	SAR (W/Kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / Controlled Exposure Environment)
Spatial Average - ANSI - (averaged over the whole body)	0.08	0.4
Spatial Peak - ANSI - (averaged over any 1-g of tissue)	1.6	8.0
Spatial Peak – ICNIRP/ANSI - (hands/wrists/feet/ankles averaged over 10-g)	4.0	20.0
Spatial Peak - ICNIRP - (Head and Trunk 10-g)	2.0	10.0

6.0 Description of Device Under Test (DUT)

These portable devices model PMUF1620A & PMUF1619A operate in dispatch and phone modes. It uses two digital technologies: PI/4DQPSK and Time Division Multiple Access (TDMA).

PI/4DQPSK is a modulation technique that transmits information by altering the phase of the radio frequency (RF) signal. Data is converted into complex symbols, which alter the RF signal and transmit the information. When the signal is received, the change in phase is converted back into symbols and then into the original data. The system can accommodate 4-voice channels in the standard 25 kHz channel as used in the two-way radio. Time Division Multiple Access (TDMA) is used to allocate portions of the RF signal by dividing time into four slots, one for each unit. Time allocation enables each unit to transmit its voice information without interference from other transmitting units. Transmission from a unit or base station is accommodated in time-slot lengths of 15 milliseconds and frame lengths of 60 milliseconds.

The TDMA technique requires sophisticated algorithms and a digital signal processor (DSP) to perform voice compressions/decompressions and RF modulation/demodulation. The radios can be used by transmitting Multi Slot Packed Data (MSPD) with 6:9 (66.67%) duty cycle and Single Slot Packed Data (SSPD) with 1:4.55 (22%) duty cycle at maximum transmit power. The radios can operate in data mode with and without the data cable attached.

The device of model PMUF1619A also incorporates a Class 1 Bluetooth device which is a Frequency Hopping Spread Spectrum (FHSS) technology. The Bluetooth radio modem is used to wireless link audio accessories. The maximum actual transmission duty cycle is imposed by the Bluetooth standard. The maximum duty cycle for BT is 77%. Simultaneous transmission can occur between the BT and primary transmitter. Refer to section 14.0 Simultaneous Transmission Exclusion.

These models represented under this filing utilizes removeable antennas and an internal fixed antenna (Bluetooth) capable of transmitting in the 809-824MHz & 854-869MHz and 2.402-2.480 GHz (Bluetooth) bands respectively. The nominal output powers are 1.8 W with maximum output powers of 2.0 W (800 band). The nominal BT output power is 2.0mW and maximum output power is 4.62 mW as defined by upper limit of the production line final test station.

The intended operating positions are "against the head" in phone mode, "in front of the face" in PTT mode with the DUT at least 1 inch from the mouth, and "against the body" in data, phone or PTT mode by means of the offered bodyworn accessories. Body worn audio and PTT operation is accomplished by means of optional remote accessories that are connected to the radio. Operation at the body without an audio accessory attached is possible by means of BT accessories.

7.0 Optional Accessories and Test Criteria

These devices are offered with optional accessories. All accessories were individually evaluated during the test plan creation to determine if testing was required per the guidelines outlined in "SAR Test Reduction Considerations for Occupational PTT Radios" FCC KDB 643646 and KDB 447498 General RF Exposure Guidances to assess compliance of this device. The following sections identify the test criteria and details for each accessory category. Refer to Exhibit 7B for antenna separation distances.

7.1 Antennas

There are two removable antennas and one BT internal antenna offered for this product. The table below lists their descriptions.

TABLE 3

Antenna Models	Description	Selected for test	Tested
85012070001	Whip, Tetra, GPS 806-870MHz GPS (1575.42 MHz) 1/2 wave, 7cm, +1dBd	Yes	Yes
85012069001	Stubby, Tetra, GPS 806-870MHz GPS (1575.42 MHz) 1/2 wave, 3.7cm, +0.5dBd	Yes	Yes
0104042J37	PIFA Antenna 2.4 - 2.5GHz 1/4 wave, 3cm, 0dBd	*No	*No

* Refer to sections 13.8 and 14.0 for low power exclusion and simulataneous Tx for antennas not tested.

7.2 Batteries

There are two batteries offered for this product. The table below lists its description.

TABLE 4

Battery Models	Description	Selected for test	Tested	Comments
NNTN8020A	Battery STD Li-ion capacity 1650mAh Min 1700mAh Typical	Yes	Yes	
NNTN8023B	Battery STD Li-ion capacity 2150mAh Min 2200mAh Typical	Yes	Yes	

7.3 Body worn Accessories

All body worn accessories were considered. The table below lists the body worn accessories, and body worn accessory descriptions.

TABLE 5

Body worn Models	Description	Selected for test	Tested	Comments
PMLN5885B	Hard Leather Case with 3 inch Swivel Belt Loop - full keypad and limited keypad	Yes	Yes	
PMLN5887B	Soft Leather Case 3 SWL Belt Loop	Yes	Yes	
PMLN5890B	Soft Leather Pouch use w/ P.J. STUD	Yes	Yes	Tested with PMLN5004B and GMDN0386A
HLN9714A	Large Belt clip 2.5 inch	Yes	Yes	
PMLN5616B	Short Belt clip 2 inch	Yes	Yes	
PMLN5004B	Modified Shoulder wearing device Long lever	Yes	Yes	Tested with Peter Jones docks
HLN6602A	Universal Chest Pack	Yes	Yes	
RLN4570A	Break-a-Way Chest Pack with Radio Holder	Yes	Yes	
RLN4815A	RadioPak Radio Utility Case	Yes	Yes	
NTN5243A	Shoulder strap for carry case	Yes	Yes	Tested with PMLN5885B and PMLN5887B w/o belt loop
GMDN0386A	Peter Jones Klick Fast Sew on Dock, Dock 06	Yes	Yes	Tested with PMLN5004B
GMDN0445AA	Peter Jones RSM Tag	Yes	Yes	Tested with PMLN5004B
GMDN0547A	Double Tongue Tag Dock	Yes	Yes	Tested with PMLN5004B
WALN4307A	Replacement Dock for FTN6355A	Yes	Yes	Tested with PMLN5004B
GMDN0566AC	Belt Loop Dock	Yes	Yes	Tested with PMLN5004B
GMDN0445AC	Peter Jones Loop w/ Dock	Yes	Yes	Tested with PMLN5004B
PMLN5888B	Soft Leather Case 2.5 SWLBL FKP/LKP	No	No	By similarity to PMLN5887B
JMZN4020A	Wrist Strap	No	No	Test no required
GMLN4488A	Peter Jones Click Fast 50 mm Dock Belt	No	No	By similarity to GMDN0386A
PMLN5610A	2.5 inch Leather Swivel Belt Loop	No	No	Part of PMLN5888B that attached with leather case. No test on belt loop alone.
PMLN5611A	3.0 inch Leather Swivel Belt Loop	No	No	Part of PMLN5888B that attached with leather case. No test on belt loop alone.
GMDN0497A	Dock 02 for 38mm Belt	No	No	By similarity to GMDN0386A

7.4 Audio/ Data cable Accessories

All offered audio and data cable accessories were considered. The table below lists the audio/data cable accessories and their descriptions. Exhibit 7B illustrates photos of the tested audio accessories.

TABLE 6

Audio Acc. Models	Description	Selected for test	Tested	Comments
Audio Cables				
PMMN4072A	IMPRES Large RSM, noise cancelling, 3.5mm Jack, emergency button	Yes	Yes	
PMMN4074A	IMPRES RSM with 3.5mm earjack, Windporting, Emergency button. Small. IP55	Yes	No	Intended for test. Per KDB provisions test not required.
PMLN5726A	2-wire earbud style surveillance kit (beige) (in ear solution); removable earbud	No	No	By similarity to PMLN5727A
PMLN5727A	Swivel Earpiece with in-line mic and PTT	Yes	No	Intended for test. Per KDB provisions test not required.
PMLN5729A	GCAI Ear Microphone System w/ Option Button	Yes	No	Intended for test. Per KDB provisions test not required.
PMLN5733A	Earbud with in-line mic and PTT; Includes foam cushion. Without vox switch	Yes	No	Intended for test. Per KDB provisions test not required.
PMMN4075A	RSM small IP57, no Emerg	Yes	No	Intended for test. Per KDB provisions test not required.
PMMN4078A	RSM small 3.5 jack, Emerg	No	No	By Similarity to PMLN5731A
PMLN5724A	2 Wire Surveillance Kit, Black	Yes	No	Intended for test. Per KDB provisions test not required.
PMLN5728A	Earpiece, RX Only, Swivel, Mag One	Yes	No	Intended for test. Per KDB provisions test not required.
PMLN5731A	Heavy Duty Headset, NC, Inline PTT	Yes	No	Intended for test. Per KDB provisions test not required.
PMLN5732A	Earset w/ Boom Mic, Mag One	Yes	No	Intended for test. Per KDB provisions test not required.
WADN4190B	Earbud Reveiver w/ Coil Cable & 3.5mm Plug	Yes	No	Intended for test. Per KDB provisions test not required.
PMLN4620B	D-Shell RX-Only Earpiece 3.5mm Plug	No	No	Receive only
MDRLN4885B	Earbud w/ 3.5mm Plug	Yes	No	Intended for test. Per KDB provisions test not required.
MDRLN4941A	Receive-Only Earpiece w/ Transc. Tube	No	No	Receive only
Data Cables				
PMKN4129A	Tetra USB data cable	No	No	For radio programming purpose
PMKN4127A	Bottom connector serial data cable	No	No	For radio programming purpose

8.0 Description of Test System

8.1 Descriptions of Robotics/Probes/Readout Electronics

TABLE 7

Dosimetric System type	System version	DAE type	Probe Type
Schmid & Partner Engineering AG SPEAG DASY 5	52.8.2.969	DAE4	ES3DV3 (E-Field)

The DASY5™ system is operated per the instructions in the DASY5™ Users Manual. The complete manual is available directly from SPEAG™. All measurement equipment used to assess EME SAR compliance was calibrated according to ISO/IEC 17025 A2LA guidelines. Section 9.0 presents additional test equipment information. Appendices B and C present the applicable calibration certificates. The E-field probe first scans a coarse grid over a large area inside the phantom in order to locate the interpolated maximum SAR distribution. After the coarse scan measurement, the probe is automatically moved to a position at the interpolated maximum. The subsequent scan can directly use this position as reference for the cube evaluations.

8.2 Description of Phantom(s)

TABLE 8

Phantom type	Phantom ID (s)	Material Parameters	Phantom Dimensions LxWxD (mm)	Material Thickness (mm)	Support Structure Material	Loss Tangent (Wood)
Dual Flat	NA	300MHz -6GHz; Er = 4+/- 1, Loss Tangent = ≤0.05	600x400x190	2mm +/- 0.2mm	Wood	< 0.05
SAM	SAMTP1384					
Elliptical	ELI4 1050 ELI5 1150					

8.3 Description of Simulated Tissue

The sugar based simulate tissue is produced by placing the correct measured amount of De-ionized water into a large container. Each of the dried ingredients are weighed and added to the water carefully to avoid clumping. If the solution has a high sugar concentration the water is pre-heated to aid in dissolving the ingredients. For Diacetin and similar type simulates, sugar and HEC ingredients are not needed. The solution is mixed thoroughly, covered, and allowed to sit overnight prior to use.

The simulated tissue mixture was mixed based on the Simulated Tissue Composition indicated in Table 9. During the daily testing of this product, the applicable mixture was used to measure the Di-electric parameters at each of the tested frequencies to verify that the Di-electric parameters were within the tolerance of the tissue specifications.

Simulated Tissue Composition (by mass)
TABLE 9

Ingredients	835 MHz	
	Head	Body
Sugar	57.0	44.9
Diacetin	0	0
De ionized – Water	40.45	53.06
Salt	1.45	0.94
HEC	1.0	1.0
Bact.	0.1	0.1

9.0 Additional Test Equipment

The table below lists additional test equipment used during the SAR assessment.

TABLE 10

Equipment Type	Model Number	Serial Number	Calibration Date	Calibration Due Date
Power Meter	E4418B	MY45100911	5/24/2013	5/24/2014
Power Sensor	8481B	SG41090258	6/21/2013	6/21/2014
Power Meter	E4418B	MY45100739	5/24/2013	5/24/2014
Power Sensor	8481B	MY41091243	7/1/2013	7/1/2014
Power Meter	E4416A	MY50001037	2/27/2013	2/27/2014*
Power Sensor	N8481B	MY51450002	2/26/2013	2/26/2014*
Power Meter	E4418B	MY45100532	10/25/2013	10/25/2014
Power Sensor	8481B	MY41091170	10/24/2013	10/24/2014
Signal Generator	E4438C	MY45091270	6/28/2012	6/28/2014
Amplifier	10W1000C	312858	CNR	CNR
NARDA Bi-Directional Coupler	3020A	41931	7/14/2013	7/14/2014
Dickson Temperature Recorder	TM320	06153216	6/27/2013	6/27/2014
Thermometer	HH202A	35882	8/19/2013	8/19/2014
Therm. Probe	80PK-22	8766	6/27/2013	6/27/2014
Dielectric Probe Kit	DAK-12	1051	6/11/2013	6/11/2014
Network Analyzer	E5071B	MY42403147	10/25/2013	10/25/2014
Speag Dipole	D835V2	4d029	3/5/2013	3/5/2015
Speag Dipole	D835V2	4d030	10/15/2013	10/15/2015
Speag Probe	ES3DV3	3196	3/13/2013	3/13/2014**
Speag Probe	ES3DV3	3096	10/21/2013	10/21/2014
Speag DAE	DAE4	684	10/15/2013	10/15/2014

*Out for calibration; replaced with MY45100532 and MY41091170 for continued testing.
**Out for calibration; replaced with 3096 for continued testing.

10.0 SAR Measurement System Validation and Verification

DASY output files of the probe/dipole calibration certificates and system performance test results are included in appendices B, C and D respectively.

10.1 System Validation

The SAR measurement system was validated according to the procedures in KDB 865664. The validation status summary Table is below.

TABLE 11

Dates	Probe Calibration Point		Probe SN	Measured Tissue Parameters		Validation for TDMA		
				σ	ϵ_r	Sensitivity	Linearity	Isotropy
09/12/2013	Body	835	3196	0.99	53.1	Pass	Pass	Pass
09/12/2013	Head	835	3196	0.92	40.5	Pass	Pass	Pass
11/29/2013	Body	835	3096	1.02	56.2	Pass	Pass	Pass
12/02/2013	Head	835	3096	0.94	42.2	Pass	Pass	Pass

10.2 System Verification

System performance checks were conducted each day during the SAR assessment. The results are normalized to 1W. APPENDIX D includes DASY plots for each day during the SAR assessment. The table below summarizes the daily system check results used for the SAR assessment.

TABLE 12

Probe Serial #	Tissue Type	Dipole Kit / Serial #	Ref SAR @ 1W (W/kg)	System Check Results Measured (W/kg)	System Check Test Results when normalized to 1W (W/kg)	Tested Date
3196	FCC Body	SPEAG D835V2 / 4d029	*9.66 +/- 10%	2.26	9.04	1/7/14
				2.28	9.12	1/8/14
				2.28	9.12	1/9/14
				2.25	9.00	1/10/14
				2.29	9.16	1/13/14
				2.27	9.08	1/15/14
				2.27	9.08	1/20/14
	IEEE/IEC Head	SPEAG D835V2 / 4d029	*9.46 +/- 10%	2.21	8.84	1/3/14
				2.28	9.12	1/6/14
				2.17	8.68	1/7/14
3096	FCC Body	SPEAG D835V2 / 4d030	*9.52 +/- 10%	2.23	8.92	3/18/14
				2.31	9.24	3/26/14

*Dipole manufacture's reference target

10.3 Equivalent Tissue Test Results

Simulated tissue prepared for SAR measurements is measured daily and within 24 hours prior to actual SAR testing to verify that the tissue is within +/- 5% of target parameters at the center of the transmit band. This measurement is done using the applicable equipment indicated in section 9.0. The table below summarizes the measured tissue parameters used for the SAR assessment.

TABLE 13

Frequency (MHz)	Tissue Type	Conductivity Target (S/m)	Dielectric Constant Target	Conductivity Meas. (S/m)	Dielectric Constant Meas.	Tested Date
809	FCC Body	0.97 (0.92-1.02)	55.3 (52.5-58.1)	0.93	55.7	1/07/14
				0.94	56.9	1/08/14
				0.94	55.9	1/10/14
				0.92	55.5	3/18/14
817	IEEE/ IEC Head	0.90 (0.85-0.94)	41.6 (39.5-43.7)	0.88	41.5	1/03/14
				0.87	43.0	1/06/14
				0.86	40.5	1/06/14
	FCC Body	0.97 (0.92-1.02)	55.3 (52.5-58.0)	0.92	55.9	1/07/14
				0.97	56.1	1/09/14
				0.93	55.4	3/18/14
824	FCC Body	0.97 (0.92-1.02)	55.2 (52.5-58.0)	0.99	56.3	1/08/14
				0.99	55.2	1/10/14
				0.94	55.4	3/18/14
				0.95	55.2	3/26/14
854	FCC Body	0.99 (0.94-1.04)	55.1 (52.4-57.9)	1.00	52.9	1/13/14
				1.02	53.1	1/15/14
862	FCC Body	1.00 (0.95-1.05)	55.1 (52.4-57.9)	1.03	54.2	1/08/14
				1.03	53.7	1/09/14
				1.03	53.2	1/10/14
				0.98	52.7	1/13/14
				1.01	52.8	1/15/14
				1.02	53.7	1/20/14
	IEEE/ IEC Head	0.90 (0.85-0.94)	41.6 (39.5-43.7)	0.95	42.4	1/06/14
				0.94	39.9	1/06/14
				0.95	41.0	1/07/14
869	FCC Body	1.01 (0.96-1.06)	55.1 (52.3-57.9)	1.00	52.6	1/15/14
835	FCC Body	0.97 (0.92-1.02)	55.2 (52.4-58.0)	0.96	56.3	1/07/14
				1.02	55.6	1/08/14
				1.02	55.1	1/09/14
				1.02	54.6	1/10/14
				1.02	53.7	1/13/14
				1.01	53.9	1/15/14
				1.00	54.8	1/20/14
				0.95	55.3	3/18/14
				0.96	55.1	3/26/14
	IEEE/ IEC Head	0.90 (0.86-0.95)	41.5 (39.4-43.6)	0.92	40.7	1/03/14
				0.89	43.2	1/06/14
				0.90	41.7	1/07/14

11.0 Environmental Test Conditions

The EME Laboratory's ambient environment is well controlled resulting in very stable simulated tissue temperature and therefore stable dielectric properties. Simulated tissue temperature is measured prior to each scan to insure it is within +/ - 2°C of the temperature at which the dielectric properties were determined. The liquid depth within the phantom used for measurements was at least 15cm. Additional precautions are routinely taken to ensure the stability of the simulated tissue such as covering the phantoms when scans are not actively in process in order to minimize evaporation. The lab environment is continuously monitored. The table below presents the range and average environmental conditions during the SAR tests reported herein:

TABLE 14

	Target	Measured
Ambient Temperature	18 – 25 ˚C	Range: 21.3 – 24.4˚C Avg. 23.2 ˚C
Relative Humidity	30 – 70 %	Range: 39.9 – 52.0 % Avg. 45.1 %
Tissue Temperature	NA	Range: 19.9-21.5˚C Avg. 20.4˚C

Relative humidity target range is a recommended target

The EME Lab RF environment uses a Spectrum Analyzer to monitor for extraneous large signal RF contaminants that could possibly affect the test results. If such unwanted signals are discovered the SAR scans are repeated.

12.0 DUT Test Setup and Methodology

12.1 Measurements

SAR measurements were performed using the DASY system described in section 8.0 using zoom scans. Elliptical flat and SAM phantoms filled with applicable simulated tissue were used for body, face and head testing.

The table below includes the step sizes and resolution of area and zoom scans per KDB 865664 requirement.

TABLE 15

<table>
<tr><th colspan="2">Description</th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td colspan="2">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td colspan="2">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="2" rowspan="2">Maximum area scan spatial resolution: ΔxArea, ΔyArea</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="2">Maximum zoom scan spatial resolution: ΔxZoom, ΔyZoom</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td>Maximum zoom scan spatial resolution, normal to phantom surface</td><td>uniform grid: ΔzZoom(n)</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td colspan="4">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.
* When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

12.2 DUT Configuration(s)

The DUT is a portable device operational at the head, body and face as described in section 6.0 while using the applicable accessories listed in section 7.0. All accessories listed in section 7.0 of this report were considered when implementing the guidelines specified in KDB 643646 and KDB 447498.

12.3 DUT Positioning Procedures

The positioning of the device for each body location is described below and illustrated in APPENDIX H.

12.3.1 Body

The DUT was positioned in normal use configuration against the phantom with the offered body worn accessory as well as with and without the offered audio accessories as applicable.

12.3.2 Head

The DUT was placed against the right and left heads of the SAM phantom in the cheek touch and 15º tilt positions.

12.3.3 Face

The DUT was positioned with its' front side separated 2.5cm from the phantom.

12.4 DUT Test Channels

The number of test channels was determined by using the following IEEE 1528 equation. The use of this equation produces the same or more test channels compared to the FCC KDB 447498 number of test channels formula.

$$N_c = 2 * roundup[10 * (f_{high} - f_{low}) / f_c] + 1$$

Where
N_c = Number of channels
F_{high} = Upper channel
F_{low} = Lower channel
F_c = Center channel

12.5 SAR Result Scaling Methodology

The calculated 1-gram and 10-gram averaged SAR results indicated as "Max Calc. 1g-SAR" and "Max Calc.10g-SAR" in the data tables is determined by scaling the measured SAR to account for power leveling variations and power slump. A table and graph of output power versus time is provided in APPENDIX F. For this device the "Max Calc. 1g-SAR" and "Max Calc.10g-SAR" are scaled using the following formula:

$$Max\_Calc = SAR\_meas \cdot 10^{\frac{-Drift}{10}} \cdot \frac{P\_max}{P\_int} \cdot DC$$

P_max = Maximum Power (W)
P_int = Initial Power (W)
Drift = DASY drift results (dB)
SAR_meas = Measured 1-g or 10-g Avg. SAR (W/kg)
DC = Transmission mode duty cycle in % where applicable
50% duty cycle is applied for PTT operation

Note: for conservative results, the following are applied:
If P_int > P_max, then P_max/P_int = 1.
Drift = 1 for positive drif

Additional SAR scaling was applied using the methodologies outlined in FCC KDB 865664 using tissue sensitivity values. SAR was scaled for conditions where the tissue permittivity was measured above the nominal target and for tissue conductivity that was measured below the nominal target. Negative or reduced SAR scaling is not permitted.

12.6 DUT Test Plan

The guidelines and requirements outlined in Section 4.0 were used to assess compliance of this device. All modes of operation identified in section 6.0 were considered during the development of the test plan. All tests were performed in TDMA mode ie. Voice 1:4.55 (22%) and Data 6:9 (66.67%). A 50% duty cycle was applied for PTT applications to the final results.

Standalone and simultaneous BT testing were assessed in sections 13.8 and 14.0 per the guidelines of KDB 447498.

13.0 DUT Test Data

13.1 Assessments at the Body for 809-824 MHz band

Battery NNTN8020A was selected as the default battery per KDB 643646 for assessments at the Body because it is the thinnest battery (refer to Exhibit 7B for the illustration of the battery). The default battery was used during conducted power measurements for all test channels within Part 90 frequency range (809-824MHz) which are listed in Table 16. The middle channel will be identified as the default channel as the conducted output power variation across the required test channels is < ½ dB per KDB 447498 section 4.3.3 foot note 31. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

TABLE 16

Test Freq (MHz)	Power (W)	Duty Cycle (%)
809.000	1.94	66.67
816.500	1.95	
824.000	1.94	

Assessments at the Body with Antenna 85012070001 with Body-worn accessories:
DUT data assessment with offered body worn accessories, antenna and, default battery and default test channel with highest duty cycle and without an accessories cable per KDB 643646. Each configuration above 4.0 W/kg was tested with the remaining channels per KDB 447498.

TABLE 17

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
85012070001	NNTN8020A	HLN9714A	None	809.000	1.95	-0.45	4.030	2.930	4.58	3.33	PS-AB-140107-26
				816.500	1.96	-0.44	3.980	2.890	4.49	3.26	CcC-AB-140107-07
				824.000	1.96	-0.38	4.250	3.150	4.73	3.51	CcC-AB-140108-02
		PMLN5616B		809.000	1.96	-0.47	4.080	2.980	4.64	3.39	CcC-AB-140108-03
				816.500	1.97	-0.47	4.040	2.940	4.57	3.33	CcC-AB-140107-08
				824.000	1.97	-0.35	4.320	3.190	4.75	3.51	CcC-AB-140108-04
		PMLN5885B		809.000							
				816.500	1.97	-0.50	1.010	0.760	1.15	0.87	CcC-AB-140107-09
				824.000							
		PMLN5887B		809.000							
				816.500	1.96	-0.54	0.913	0.691	1.05	0.80	CcC-AB-140107-10
				824.000							
		PMLN5890B / PMLN5004B and GMDN0386A		809.000							
				816.500	1.96	-0.41	2.510	1.880	2.81	2.11	CcC-AB-140107-11
				824.000							
		HLN6602A		809.000	1.95	-0.76	4.460	3.290	5.45	4.02	CcC-AB-140108-05
				816.500	1.96	-0.54	4.120	3.040	4.76	3.51	Lee-AB-140107-12
				824.000	1.96	-0.67	4.450	3.290	5.30	3.92	CcC-AB-140108-06
		RLN4570A		809.000	1.96	-0.73	4.940	3.650	**5.96**	**4.41**	CcC-AB-140108-07
				816.500	1.97	-0.61	4.930	3.620	5.76	4.23	Lee-AB-140107-13
				824.000	1.96	-0.47	4.870	3.620	5.54	4.12	CcC-AB-140108-08
		RLN4815A		809.000							
				816.500	1.96	-0.59	2.220	1.650	2.59	1.93	Lee-AB-140107-14
				824.000							
		GMDN0386A / PMLN5004B		809.000							
				816.500	1.96	-0.36	2.390	1.760	2.65	1.95	Lee-AB-140107-15
				824.000							
		GMDN0445AC / PMLN5004B		809.000							
				816.500	1.97	-0.43	1.290	0.974	1.45	1.09	Lee-AB-140107-16
				824.000							
		GMDN0547A / PMLN5004B		809.000							
				816.500	1.97	-0.43	1.730	1.240	1.94	1.39	Lee-AB-140107-17
				824.000							
		GMDN0445AA / PMLN5004B		809.000							
				816.500	1.96	-0.42	1.770	1.270	1.99	1.43	Lee-AB-140107-18
				824.000							

TABLE 17 (Continued)

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
85012070001	NNTN8020A	GMDN0566AC / PMLN5004B	None	809.000							
				816.500	1.97	-0.38	1.340	1.010	1.48	1.12	Lee-AB-140107-19
				824.000							
		WALN4307A / PMLN5004B		809.000							
				816.500	1.97	-0.50	1.800	1.340	2.05	1.53	PS-AB-140107-20
				824.000							
		PMLN5885B / NTN5243A		809.000							
				816.500	1.96	-0.55	2.540	1.910	2.94	2.21	PS-AB-140109-15
				824.000							
		PMLN5887B / NTN5243A		809.000							
				816.500	1.97	-0.59	2.220	1.670	2.58	1.94	PS-AB-140109-16
				824.000							

Assessments at the Body with Antenna 85012069001with Body-worn accessories:

DUT data assessment with offered body worn accessories, optional antenna, default battery and default test channel with the highest duty cycle and without an accessories cable per KDB 643646. Each configuration above 4.0 W/kg was tested with the remaining channels per KDB 447498.

TABLE 18

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
85012069001	NNTN8020A	HLN9714A	None	809.000	1.96	-0.41	3.590	2.620	4.03	2.94	CcC-AB-140110-02
				816.500	1.97	-0.39	4.070	2.990	4.52	3.32	CcC-AB-140109-08
				824.000	1.96	-0.39	4.280	3.160	4.78	3.53	CcC-AB-140110-03
		PMLN5616B		809.000	1.95	-0.49	4.030	2.960	4.63	3.40	CcC-AB-140110-04
				816.500	1.97	-0.37	4.120	3.030	4.55	3.35	CcC-AB-140109-09
				824.000	1.95	-0.44	4.190	3.090	4.76	3.51	CcC-AB-140110-05
		PMLN5885B		809.000							
				816.500	1.97	-0.47	1.010	0.763	1.14	0.86	CcC-AB-140109-10
				824.000							
		PMLN5887B		809.000							
				816.500	1.97	-0.54	0.904	0.689	1.04	0.79	CcC-AB-140109-11
				824.000							
		PMLN5890B / PMLN5004B and GMDN0386A		809.000							
				816.500	1.97	-0.48	2.540	1.890	2.88	2.14	CcC-AB-140109-12
				824.000							
		HLN6602A		809.000	1.95	-0.54	4.380	3.240	5.09	3.76	CcC-AB-140110-06
				816.500	1.97	-0.64	4.530	3.330	5.33	3.92	CcC-AB-140109-13
				824.000	1.95	-0.62	4.780	3.550	**5.65**	**4.20**	CcC-AB-140110-07

TABLE 18 (Continued)

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
85012069001	NNTN8020A	RLN4570A	None	809.000	1.96	-0.60	4.790	3.530	5.61	4.14	CcC-AB-140108-09
				816.500	1.97	-0.59	4.850	3.590	5.64	4.18	Lee-AB-140109-14
				824.000	1.96	-0.50	4.790	3.540	5.48	4.05	CcC-AB-140108-10
		RLN4815A		809.000							
				816.500	1.97	-0.55	2.350	1.730	2.71	1.99	PS-AB-140109-17
				824.000							
		GMDN0386A / PMLN5004B		809.000							
				816.500	1.95	-0.40	2.410	1.790	2.71	2.01	PS-AB-140109-18
				824.000							
		GMDN0445AC / PMLN5004B		809.000							
				816.500	1.94	-0.43	1.330	1.010	1.51	1.15	PS-AB-140109-19
				824.000							
		GMDN0547A / PMLN5004B		809.000							
				816.500	1.96	-0.46	1.820	1.310	2.06	1.49	PS-AB-140109-20
				824.000							
		GMDN0445AA / PMLN5004B		809.000							
				816.500	1.95	-0.46	1.790	1.280	2.04	1.46	PS-AB-140109-21
				824.000							
		GMDN0566AC / PMLN5004B		809.000							
				816.500	1.95	-0.36	1.200	0.908	1.34	1.01	PS-AB-140109-22
				824.000							
		WALN4307A / PMLN5004B		809.000							
				816.500	1.96	-0.45	1.800	1.350	2.04	1.53	PS-AB-140109-23
				824.000							
		PMLN5885B / NTN5243A		809.000							
				816.500	1.97	-0.46	2.290	1.720	2.58	1.94	PS-AB-140109-24
				824.000							
		PMLN5887B / NTN5243A		809.000							
				816.500	1.97	-0.49	2.310	1.740	2.63	1.98	PS-AB-140109-25
				824.000							

DUT data assessment for optional battery using highest configuration from each antenna per KDB 643646.

TABLE 19

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
85012070001	NNTN8023B	RLN4570A	None	809.000	1.95	-0.58	4.760	3.530	5.58	4.14	CcC-AB-140108-11
				816.500	1.96	-0.54	4.800	3.520	5.55	4.07	PS-AB-140107-24
				824.000	1.96	-0.56	5.230	3.880	**6.07**	**4.50**	CcC-AB-140108-12
85012069001	NNTN8023B	HLN6602A	None	809.000	1.95	-0.54	4.570	3.360	5.31	3.90	CcC-AB-140318-03
				816.500	1.98	-0.51	4.660	3.440	5.29	3.91	CcC-AB-140318-02
				824.000	1.96	-0.54	4.720	3.480	5.45	4.02	CcC-AB-140318-04

Assessment at the Body with audio accessory

DUT voice assessment using the overall highest SAR configuration at the body from above with audio accessory attached. Additional testing in voice mode (SSPD) is not required per IEEE1528 because of lower “maximum sourced-based time averaged output power” as compared to data mode (MSPD). Where “maximum sourced-based time averaged output power” SSPD = 0.44W and MSPD = 1.33W. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

TABLE 20

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
85012070001	NNTN8023B	RLN4570A	PMMN4072A	809.000							
				816.500							
				824.000	1.98	0.01	1.540	1.110	**0.78**	0.56	PS-AB-140326-06

13.2 Assessments at the Body for 854-869 MHz band

Battery NNTN8020A was selected as the default battery per KDB 643646 for assessments at the Body because it is the thinnest battery (refer to Exhibit 7B for the illustration of the battery). The default battery was used during conducted power measurements for all test channels within Part 90 frequency range (854-869MHz) which are listed in Table 21. The middle channel will be identified as the default channel as the conducted output power variation across the required test channels is < ½ dB per KDB 447498 section 4.3.3 foot note 31. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

TABLE 21

Test Freq (MHz)	Power (W)	Duty Cycle (%)
854.000	1.93	66.67
861.500	1.93	
869.000	1.94	

Assessments at the Body with Antenna 85012070001 with Body-worn accessories:

DUT data assessment with offered body worn accessories, antenna and, default battery and default test channel with highest duty cycle and without an accessories cable per KDB 643646. Each configuration above 4.0 W/kg was tested with the remaining channels per KDB 447498. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

TABLE 22

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
85012070001	NNTN8020A	HLN9714A	None	854.000	1.94	-0.38	4.720	3.440	5.31	3.87	CcC-AB-140113-10
				861.500	1.95	-0.42	4.940	3.580	5.58	4.04	Lee-AB-140108-15
				869.000	1.97	-0.56	4.840	3.500	5.59	4.04	PS-AB-140115-02
		PMLN5616B		854.000	1.94	-0.47	5.100	3.700	5.86	4.25	CcC-AB-140113-11
				861.500	1.94	-0.65	5.300	3.860	6.35	4.62	Lee-AB-140108-16
				869.000	1.97	-0.53	5.030	3.660	5.77	4.20	PS-AB-140115-03
		PMLN5885B		854.000							
				861.500	1.93	-0.53	1.290	0.963	1.51	1.13	Lee-AB-140108-17
				869.000							
		PMLN5887B		854.000							
				861.500	1.93	-0.58	1.110	0.835	1.31	0.99	Lee-AB-140108-18
				869.000							
		PMLN5890B / PMLN5004B and GMDN0386A		854.000							
				861.500	1.94	-0.55	3.140	2.340	3.67	2.74	Lee-AB-140108-19
				869.000							
		HLN6602A		854.000	1.94	-0.62	5.060	3.690	6.02	4.39	CcC-AB-140113-12
				861.500	1.94	-0.77	5.130	3.740	6.31	4.60	PS-AB-140108-20
				869.000	1.96	-0.66	4.990	3.640	5.93	4.32	PS-AB-140115-04
		RLN4570A		854.000	1.95	-0.55	5.250	3.850	6.11	4.48	CcC-AB-140113-13
				861.500	1.93	-0.60	5.350	3.910	**6.37**	**4.65**	PS-AB-140108-21
				869.000	1.96	-0.67	5.120	3.730	6.10	4.44	PS-AB-140115-05
		RLN4815A		854.000							
				861.500	1.94	-0.52	3.010	2.170	3.50	2.52	PS-AB-140108-22
				869.000							
		GMDN0386A / PMLN5004B		854.000							
				861.500	1.94	-0.38	3.000	2.220	3.38	2.50	PS-AB-140108-23
				869.000							
		GMDN0445AC / PMLN5004B		854.000							
				861.500	1.94	-0.45	1.860	1.380	2.13	1.58	PS-AB-140108-24
				869.000							
		GMDN0547A / PMLN5004B		854.000							
				861.500	1.94	-0.47	2.230	1.580	2.56	1.82	PS-AB-140108-25
				869.000							
		GMDN0445AA / PMLN5004B		854.000							
				861.500	1.93	-0.48	2.160	1.540	2.50	1.78	PS-AB-140108-26
				869.000							
		GMDN0566AC / PMLN5004B		854.000							
				861.500	1.94	-0.45	1.680	1.250	1.92	1.43	PS-AB-140108-27
				869.000							

TABLE 22 (Continued)

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
85012070001	NNTN8020A	WALN4307A / PMLN5004B	None	854.000							
				861.500	1.94	-0.42	2.240	1.670	2.54	1.90	CcC-AB-140109-02
				869.000							
		PMLN5885B / NTN5243A		854.000							
				861.500	1.94	-0.56	2.980	2.190	3.49	2.57	CcC-AB-140109-03
				869.000							
		PMLN5887B / NTN5243A		854.000							
				861.500	1.94	-0.56	2.850	2.110	3.34	2.47	CcC-AB-140109-04
				869.000							

Assessments at the Body with Antenna 85012069001 with Body-worn accessories:

DUT data assessment with offered body worn accessories, optional antenna, default battery and default test channel with the highest duty cycle and without an accessories cable per KDB 643646. Each configuration above 4.0 W/kg was tested with the remaining channels per KDB 447498.

TABLE 23

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
85012069001	NNTN8020A	HLN9714A	None	854.000	1.95	-0.41	4.610	3.350	5.20	3.78	CcC-AB-140113-14
				861.500	1.93	-0.45	4.580	3.330	5.26	3.83	PS-AB-140109-26
				869.000	1.97	-0.41	4.410	3.190	4.92	3.56	PS-AB-140115-06
		PMLN5616B		854.000	1.95	-0.30	4.650	3.380	5.11	3.71	CcC-AB-140113-15
				861.500	1.95	-0.48	4.450	3.210	5.10	3.68	CcC-AB-140110-08
				869.000	1.97	-0.34	4.470	3.220	4.91	3.54	PS-AB-140115-07
		PMLN5885B		854.000							
				861.500	1.93	-0.39	1.220	0.913	1.38	1.04	Lee-AB-140110-09
				869.000							
		PMLN5887B		854.000							
				861.500	1.94	-0.52	1.070	0.803	1.24	0.93	Lee-AB-140110-10
				869.000							
		PMLN5890B / PMLN5004B and GMDN0386A		854.000							
				861.500	1.94	-0.43	3.050	2.250	3.47	2.56	Lee-AB-140110-11
				869.000							
		HLN6602A		854.000	1.95	-0.46	4.090	3.000	4.66	3.42	CcC-AB-140113-16
				861.500	1.94	-0.46	4.070	2.970	4.66	3.40	Lee-AB-140110-12
				869.000	1.97	-0.40	3.540	2.590	3.94	2.88	PS-AB-140115-08

TABLE 23 (Continued)

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
85012069001	NNTN8020A	RLN4570A	None	854.000	1.95	-0.59	4.840	3.540	**5.69**	**4.16**	PS-AB-140115-09
				861.500	1.93	-0.35	4.860	3.530	5.46	3.97	Lee-AB-140110-13
				869.000	1.98	-0.48	4.490	3.260	5.07	3.68	CcC-AB-140115-10
		RLN4815A		854.000							
				861.500	1.94	-0.73	2.540	1.850	3.10	2.26	Lee-AB-140110-14
				869.000							
		GMDN0386A / PMLN5004B		854.000							
				861.500	1.95	-0.46	2.910	2.150	3.32	2.45	Lee-AB-140110-15
				869.000							
		GMDN0445AC / PMLN5004B		854.000							
				861.500	1.94	-0.44	1.660	1.240	1.89	1.41	Lee-AB-140110-16
				869.000							
		GMDN0547A / PMLN5004B		854.000							
				861.500	1.95	-0.48	1.960	1.390	2.25	1.59	Lee-AB-140113-02
				869.000							
		GMDN0445AA / PMLN5004B		854.000							
				861.500	1.94	-0.49	2.010	1.430	2.32	1.65	Lee-AB-140113-03
				869.000							
		GMDN0566AC / PMLN5004B		854.000							
				861.500	1.94	-0.39	1.610	1.210	1.82	1.36	Lee-AB-140113-04
				869.000							
		WALN4307A / PMLN5004B		854.000							
				861.500	1.95	-0.41	2.060	1.530	2.32	1.72	CcC-AB-140113-05
				869.000							
		PMLN5885B / NTN5243A		854.000							
				861.500	1.95	-0.48	2.460	1.810	2.82	2.07	CcC-AB-140113-06
				869.000							
		PMLN5887B / NTN5243A		854.000							
				861.500	1.95	-0.47	2.420	1.780	2.77	2.03	CcC-AB-140113-07
				869.000							

DUT data assessment for optional battery using highest configuration from each antenna per KDB 643646.

TABLE 24

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
85012070001	NNTN8023B	RLN4570A	None	854.000	1.95	-0.43	4.820	3.560	5.46	4.03	CcC-AB-140115-11
				861.500	1.94	-0.54	4.860	3.610	**5.67**	**4.21**	CcC-AB-140109-06
				869.000	1.97	-0.48	4.800	3.520	5.44	3.99	CcC-AB-140115-12
85012069001	NNTN8023B	RLN4570A	None	854.000	1.96	-0.49	4.690	3.460	5.36	3.95	CcC-AB-140115-13
				861.500	1.94	-0.53	4.530	3.340	5.28	3.89	CcC-AB-140109-07
				869.000	1.97	-0.47	4.140	3.060	4.68	3.46	CcC-AB-140115-14

Assessment at the Body with audio accessory

DUT voice assessment using the overall highest SAR configuration at the body from above with audio accessory attached. Additional testing in voice mode (SSPD) is not required per IEEE1528 because of lower “maximum sourced-based time averaged output power” as compared to data mode (MSPD). Where “maximum sourced-based time averaged output power” SSPD = 0.44W and MSPD = 1.33W. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

TABLE 25

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
85012070001	NNTN8020B	RLN4570A	PMMN4072A	854.000							
				861.500	1.93	0.06	1.510	1.080	**0.78**	**0.56**	CcC-AB-140115-20
				869.000							

13.3 Assessments at the Face for 809-824MHz band

Battery NNTN8023B was selected as the default battery for assessments at the Face because it has the highest capacity (refer to Exhibit 7B for the illustration of the battery). The default battery was used during conducted power measurements for all test channels within Part 90 frequency range (809-824MHz) which are listed in Table 26. The middle channel will be identified as the default channel as the conducted output power variation across the required test channels is < ½ dB per KDB 447498 section 4.3.3 foot note 31. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

TABLE 26

Test Freq (MHz)	Power (W)	Duty Cycle (%)
809.000	1.96	22
816.500	1.96	
824.000	1.95	

DUT voice PTT assessment with offered antennas, default battery with front of DUT positioned 2.5cm facing phantom per KDB 643646. If the results are less than 3.5 W/kg per KDB 643646, the remaining test channels and optional battery are NOT required. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

TABLE 27

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
85012070001	NNTN8023B	None	None	809.000							
				816.500	1.94	0.02	0.478	0.350	**0.25**	**0.18**	PS-FACE-140106-22
				824.000							
85012069001	NNTN8023B	None	None	809.000							
				816.500	1.95	0.03	0.464	0.344	0.24	0.18	PS-FACE-140106-23
				824.000							

13.4 Assessments at the Face for 854-869MHz band

Battery NNTN8023B was selected as the default battery for assessments at the Face because it has the highest capacity (refer to Exhibit 7B for the illustration of the battery). The default battery was used during conducted power measurements for all test channels within Part 90 frequency range (854-869MHz) which are listed in Table 28. The middle channel will be identified as the default channel as the conducted output power variation across the required test channels is < ½ dB per KDB 447498 section 4.3.3 foot note 31. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

TABLE 28

Test Freq (MHz)	Power (W)	Duty Cycle (%)
854.000	1.94	22
861.500	1.94	
869.000	1.94	

DUT voice PTT assessment with offered antennas, default battery with front of DUT positioned 2.5cm facing phantom per KDB 643646. If the results are less than 3.5 W/kg per KDB 643646, the remaining test channels and optional battery are NOT required. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

TABLE 29

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
85012070001	NNTN8023B	None	None	854.000							
				861.500	1.93	-0.02	0.534	0.395	**0.28**	**0.21**	PS-FACE-140106-24
				869.000							
85012069001	NNTN8023B	None	None	854.000							
				861.500	1.93	0.03	0.529	0.386	0.27	0.20	CcC-FACE-140107-03
				869.000							

13.5 Assessments at the Head for 809-824MHz band

Battery NNTN8023B was selected as the default battery for assessments at the Head because it has the highest capacity (refer to Exhibit 7B for the illustration of the battery). The default battery was used during conducted power measurements for all test channels within the Part 90 frequency range (809-824MHz) which are listed in Table 30. The channel with the highest conducted power will be identified as the default channel per KDB 447498. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

TABLE 30

Test Freq (MHz)	Power (W)	Duty Cycle (%)
809.000	1.96	22
816.500	1.96	
824.000	1.95	

Left ear position assessment with offered antennas, default battery with the DUT in both the check touch and tilt positions per KDB 447498. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

TABLE 31

Antenna	Battery	Carry Accessory/ Test position	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
Assessments at Head - Left ear											
85012070001	NNTN8023B	None, Touch	None	809.000							
				816.500	1.95	0.09	1.730	1.240	**1.77**	**1.27**	CcC-LEAR-140103-02
				824.000							
		None, Tilt		809.000							
				816.500	1.95	-0.35	1.380	0.929	1.53	1.03	CcC-LEAR-140103-03
				824.000							
85012069001		None, Touch		809.000							
				816.500	1.95	0.05	1.680	1.220	1.72	1.25	CcC-LEAR-140103-04
				824.000							
		None, Tilt		809.000							
				816.500	1.95	-0.04	1.340	0.918	1.39	0.95	CcC-LEAR-140103-05
				824.000							
Assessments at Head with optional battery											
85012070001	NNTN8020A	None, Touch	None	809.000							
				816.500	1.95	0.16	1.690	1.220	1.73	1.25	CcC-LEAR-140103-06
				824.000							

Right ear position assessment with offered antennas, default battery with the DUT in both the check touch and tilt positions per KDB 447498. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

TABLE 32

Antenna	Battery	Carry Accessory/ Test position	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
Assessments at Head - Right ear											
85012070001	NNTN8023B	None, Touch	None	809.000							
				816.500	1.95	0.00	1.570	1.160	**1.61**	**1.19**	CcC-REAR-140103-07
				824.000							
		None, Tilt		809.000							
				816.500	1.95	0.25	1.200	0.833	1.23	0.85	CcC-REAR-140106-02
				824.000							
85012069001		None, Touch		809.000							
				816.500	1.95	0.01	1.570	1.160	1.61	1.19	CcC-REAR-140106-03
				824.000							
		None, Tilt		809.000							
				816.500	1.95	0.02	1.190	0.820	1.22	0.84	CcC-REAR-140106-04
				824.000							
Assessments at Head with optional battery											
85012070001	NNTN8020A	None, Touch	None	809.000							
				816.500	1.95	0.06	1.560	1.160	1.60	1.19	CcC-REAR-140106-05
				824.000							

13.6 Assessments at the Head for 854-869MHz band

Battery NNTN8023B was selected as the default battery for assessments at the Head because it has the highest capacity (refer to Exhibit 7B for the illustration of the battery). The default battery was used during conducted power measurements for all test channels within the Part 90 frequency range (854-869MHz) which are listed in Table 33. The channel with the highest conducted power will be identified as the default channel per KDB 447498. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

TABLE 33

Test Freq (MHz)	Power (W)	Duty Cycle (%)
854.000	1.94	22
816.500	1.94	
869.000	1.94	

Left ear position assessment with offered antennas, default battery with the DUT in both the check touch and tilt positions per KDB 447498. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

TABLE 34

Antenna	Battery	Carry Accessory/ Test position	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
Assessments at Head - Left ear											
85012070001	NNTN8023B	None, Touch	None	854.000							
				861.500	1.95	-0.06	1.420	1.030	1.48	1.07	CcC-LEAR-140106-06
				869.000							
		None, Tilt		854.000							
				861.500	1.93	-0.06	1.300	0.875	1.37	0.92	CcC-LEAR-140106-08
				869.000							
85012069001		None, Touch		854.000							
				861.500	1.93	-0.05	1.200	0.870	1.26	0.91	CcC-LEAR-140106-09
				869.000							
		None, Tilt		854.000							
				861.500	1.93	-0.11	1.120	0.743	1.19	0.79	CcC-LEAR-140106-10
				869.000							
Assessments at Head with optional battery											
85012070001	NNTN8020A	None, Touch	None	854.000							
				861.500	1.93	-0.02	1.430	1.040	**1.49**	**1.08**	CcC-LEAR-140106-11
				869.000							

Right ear position assessment with offered antennas, default battery with the DUT in both the check touch and tilt positions per KDB 447498. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

TABLE 35

Antenna	Battery	Carry Accessory/ Test position	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
Assessments at Head - Right ear											
85012070001	NNTN8023B	None, Touch	None	854.000							
				861.500	1.93	0.02	1.370	0.996	1.42	1.03	Lee-REAR-140106-13
				869.000							
		None, Tilt		854.000							
				861.500	1.93	0.41	1.130	0.763	1.17	0.79	Lee-REAR-140106-14
				869.000							
85012069001		None, Touch		854.000							
				861.500	1.92	0.14	1.170	0.839	1.22	0.87	Lee-REAR-140106-15
				869.000							
		None, Tilt		854.000							
				861.500	1.93	0.10	0.890	0.622	0.92	0.64	Lee-REAR-140106-16
				869.000							
Assessments at Head with optional battery											
85012070001	NNTN8020A	None, Touch	None	854.000							
				861.500	1.93	0.05	1.370	0.994	**1.42**	**1.03**	CcC-REAR-140106-12
				869.000							

13.7 Assessment for Industry Canada

Based on the assessment results for body, face and head, additional tests were not conducted for Industry Canada frequency range (806-824 MHz & 851-869 MHz).

13.8 Assessment at the Bluetooth band

Per guidelines in KDB 447498, the following formula was used to determine the test exclusion for standalone Bluetooth transmitter;

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] *[$\sqrt{F_{(GHz)}}$] = 1.1, which is ≤ 3 for 1-g SAR

Where:

Max. power = 3.56mW (4.62mW*77% duty cycle)
Min. test separation distance = 5mm for actual test separation < 5mm
F(GHz) = 2.48 GHz

Per the result from the calculation above, the standalone SAR assessment was not required for Bluetooth band. Therefore, SAR results for Bluetooth are not reported herein.

13.9 Shortened Scan Assessment

A "shortened" scan using the highest SAR configuration overall from above was performed to validate the SAR drift of the full DASY5™ coarse and zoom scans. Note that the shortened scan represents the zoom scan performance result; this is obtained by first running a coarse scan to find the peak area and then, using a newly charged battery, a zoom scan only was performed. The results of the shortened cube scan presented in Appendix D demonstrate that the scaling methodology used to determine the calculated SAR results presented herein are valid. The SAR result from the table below is provided in Appendix D.

TABLE 36

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
85012070001	NNTN8020A	RLN4570A	None	861.500	1.96	-0.15	5.640	4.110	**5.96**	**4.34**	PS-AB-140120-02

14.0 Simultaneous Transmission Exclusion

Per guidelines in KDB 447498, the following formula was used to determine the test exclusion to an antenna that transmits simultaneously with other antennas for test distances ≤ 50mm:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] *[√F(GHz)/X] = 0.15 W/kg & 0.06 W/kg (1g & 10g)

Where:
X = 7.5 for 1g-SAR; 18.75 for 10g
Max. power = 3.56mW (4.62mW*77% duty cycle)
Min. test separation distance = 5mm for actual test separation < 5mm
F(GHz) = 2.48 GHz

Simultananeous transmission exclusion is applied based on the calculated results.

15.0 Results Summary

Based on the test guidelines from KDB 643646 and satisfying frequencies with Part 90 FCC band to be in compliance with Industry Canada Frequency range, the highest Operational Maximum Calculated 1-gram and 10-gram average SAR values found for this filing:

TABLE 37

Designator	Frequency band (MHz)	Max Calc at Body (W/kg)		Max Calc at Face (W/kg)		Max Calc at Head (W/kg)	
		1g-SAR	10g-SAR	1g-SAR	10g-SAR	1g-SAR	10g-SAR
FCC	809-824	6.07	4.50	0.25	0.18	1.77	1.27
	854-869	6.37	4.65	0.28	0.21	1.49	1.08
Industry Canada	806-824	6.07	4.50	0.25	0.18	1.77	1.27
	851-869	6.37	4.65	0.28	0.21	1.49	1.08

All results are scaled to the maximum output power

The test results clearly demonstrate compliance with FCC Occupational/Controlled RF Exposure limits of 8 W/kg averaged over 1 gram per the requirements of 47 CFR 2.1093(d). The 10 grams result is not applicable to FCC filing.

16.0 Variability Assessment

Per the guidelines in KDB 865664 SAR variability assessment is required because SAR results are above 4.0W/kg (Occupational).

The Table below includes test results of the original measurement(s), the repeated measurement(s), and the ratio (SAR_{high}/SAR_{low}) for the applicable test configuration(s).

TABLE 38

Run#	Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq. (MHz)	Adj Calc. 1g-SAR (W/kg)	Ratio	Comments
PS-Ab-140108-21 (Table 22, full scan)	85012070001	NNTN8020A	RLN4570A	None	861.500	6.14	1.05	No additional repeated scans is required due to the Ratio (SAR_{high}/SAR_{low}) < 1.20
PS-Ab-140120-02 (Table 37, shorten scan)						5.84		

17.0 System Uncertainty

A system uncertainty analysis is not required for this report per KDB 865664 because the highest report SAR value for Occupation is less than 7.5W/kg.

Per the guidelines of ISO 17025 a reported system uncertainty is required and therefore measurement uncertainty budget is included in Appendix A.

Appendix A
Measurement Uncertainty Budget

Uncertainty Budget - Device Under Test for 750 MHz to 2.6 GHz

a	*b*	*c*	*d*	*e = f(d,k)*	*f*	*g*	*h = c x f / e*	*i = c x g / e*	*k*
Uncertainty Component	**IEEE 1528 section**	**Tol. (± %)**	**Prob Dist**	**Div.**	c_i **(1 g)**	c_i **(10 g)**	**1 g** u_i **(±%)**	**10 g** u_i **(±%)**	v_i
Measurement System									
Probe Calibration	E.2.1	6.0	N	1.00	1	1	6.0	6.0	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	1.1	R	1.73	1	1	0.6	0.6	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mech. Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.2	N	1.00	1	1	3.2	3.2	29
Device Holder Uncertainty	E.4.1	4.0	N	1.00	1	1	4.0	4.0	8
SAR drift	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				11	11	419
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				22	22	

Notes for uncertainty budget Table:
a) Column headings *a*-*k* are given for reference.
b) Tol. - tolerance in influence quantity.
c) Prob. Dist. – Probability distribution
d) N, R - normal, rectangular probability distributions
e) Div. - divisor used to translate tolerance into normally distributed standard uncertainty
f) *ci* - sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.
g) *ui* – SAR uncertainty
h) *vi* - degrees of freedom for standard uncertainty and effective degrees of freedom for the expanded uncertainty

Appendix B
Probe Calibration Certificates

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

S Schweizerischer Kalibrierdienst
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S Servizio svizzero di taratura
Swiss Calibration Service

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The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Motorola MY**

Certificate No: **ES3-3196_Mar13**

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3196
Calibration procedure(s)	QA CAL-01.v8, QA CAL-12.v7, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	March 13, 2013

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 (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

Issued: March 14, 2013

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

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S 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**

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep 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
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,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 ≤ 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 *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 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.

Probe ES3DV3

SN:3196

Manufactured: June 16, 2008
Calibrated: March 13, 2013

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3196

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.28	1.30	1.34	± 10.1 %
DCP (mV)[B]	104.7	101.7	98.9	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	156.3	±3.0 %
		Y	0.0	0.0	1.0		158.9	
		Z	0.0	0.0	1.0		164.2	

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 NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] 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: ES3DV3 - SN:3196

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	Depth (mm)	Unct. (k=2)
300	45.3	0.87	7.24	7.24	7.24	0.27	1.22	± 13.4 %
450	43.5	0.87	6.55	6.55	6.55	0.18	1.94	± 13.4 %
750	41.9	0.89	6.51	6.51	6.51	0.52	1.40	± 12.0 %
900	41.5	0.97	6.17	6.17	6.17	0.42	1.54	± 12.0 %
1810	40.0	1.40	5.07	5.07	5.07	0.54	1.42	± 12.0 %
1950	40.0	1.40	4.88	4.88	4.88	0.62	1.34	± 12.0 %
2300	39.5	1.67	4.72	4.72	4.72	0.74	1.30	± 12.0 %
2450	39.2	1.80	4.44	4.44	4.44	0.77	1.24	± 12.0 %
2600	39.0	1.96	4.30	4.30	4.30	0.80	1.28	± 12.0 %

[C] Frequency validity 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.
[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.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3196

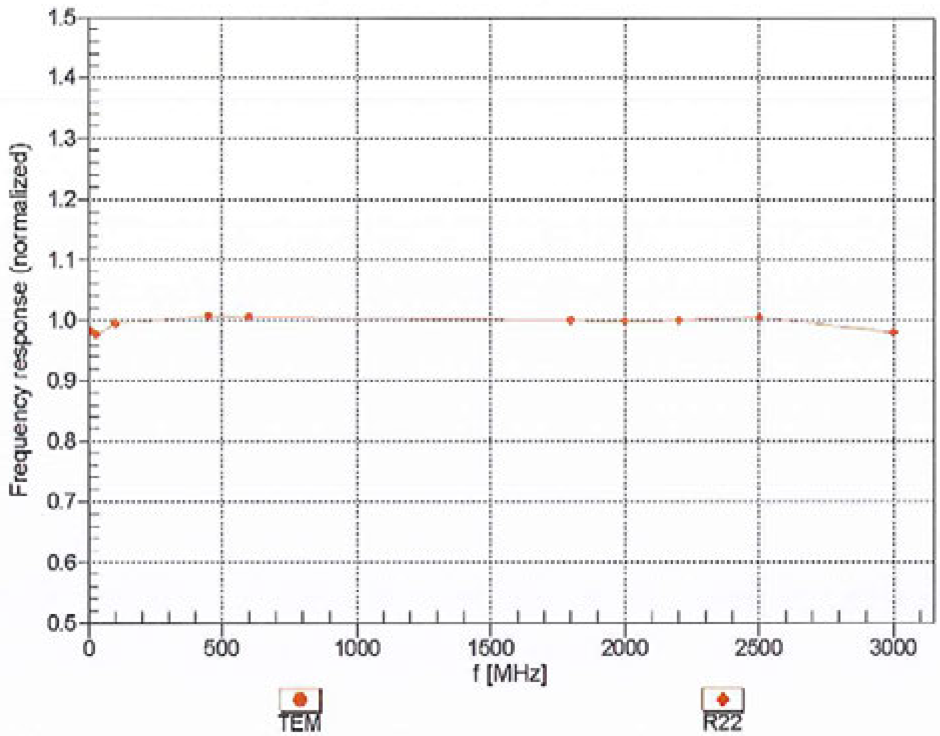
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
300	58.2	0.92	6.76	6.76	6.76	0.24	2.15	± 13.4 %
450	56.7	0.94	6.99	6.99	6.99	0.10	1.00	± 13.4 %
750	55.5	0.96	6.30	6.30	6.30	0.42	1.64	± 12.0 %
900	55.0	1.05	6.17	6.17	6.17	0.55	1.37	± 12.0 %
1810	53.3	1.52	4.83	4.83	4.83	0.51	1.61	± 12.0 %
1950	53.3	1.52	4.81	4.81	4.81	0.52	1.60	± 12.0 %
2300	52.9	1.81	4.45	4.45	4.45	0.71	1.35	± 12.0 %
2450	52.7	1.95	4.30	4.30	4.30	0.80	1.01	± 12.0 %
2600	52.5	2.16	4.05	4.05	4.05	0.69	1.02	± 12.0 %

[C] Frequency validity 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.
[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.

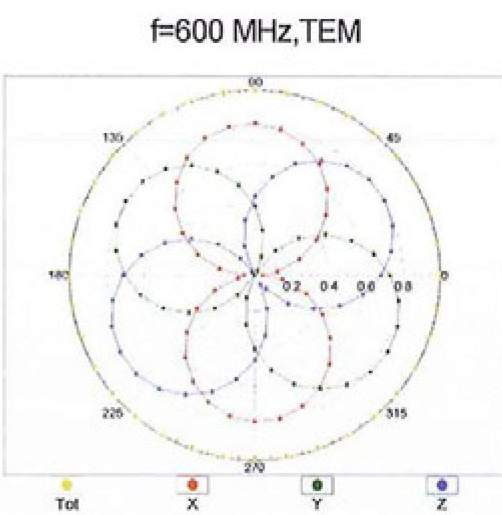
Frequency Response of E-Field

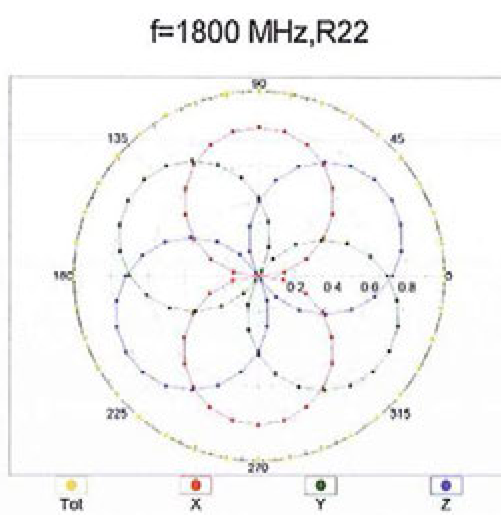
(TEM-Cell:ifi110 EXX, Waveguide: R22)

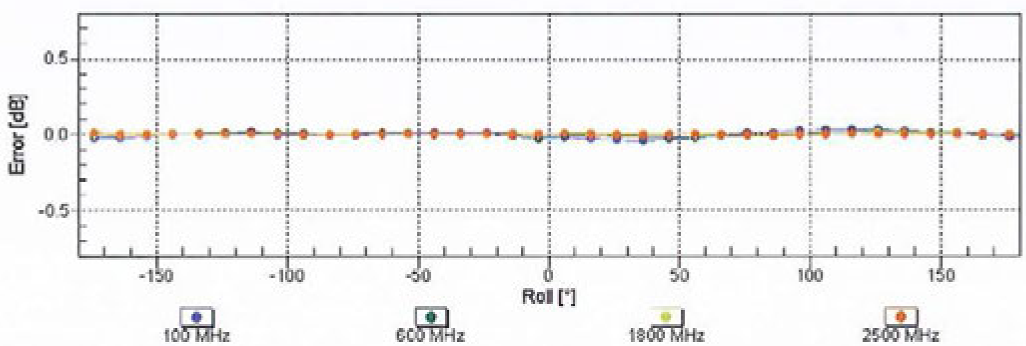


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°



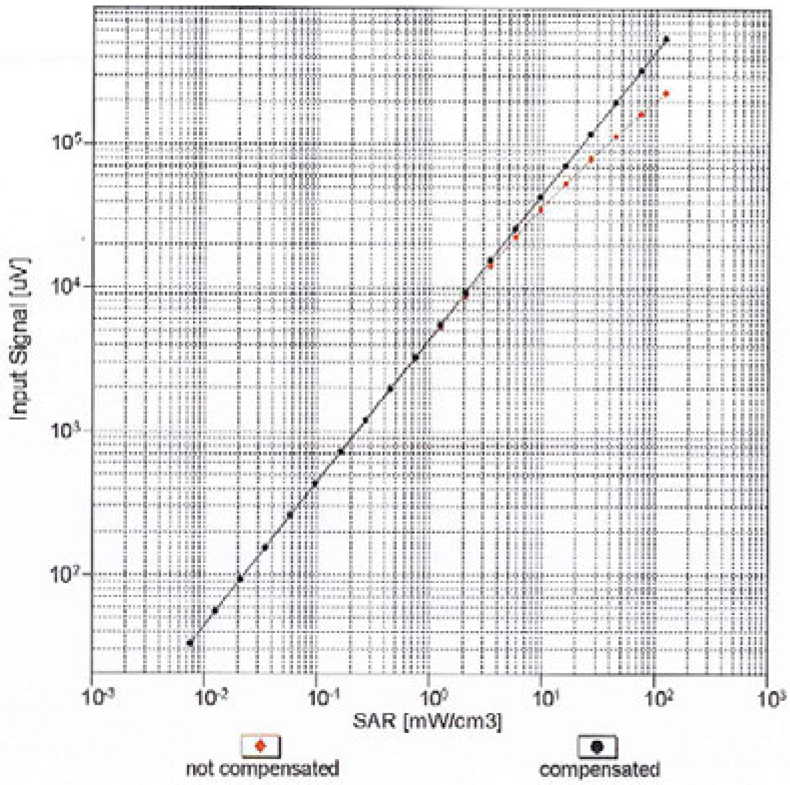


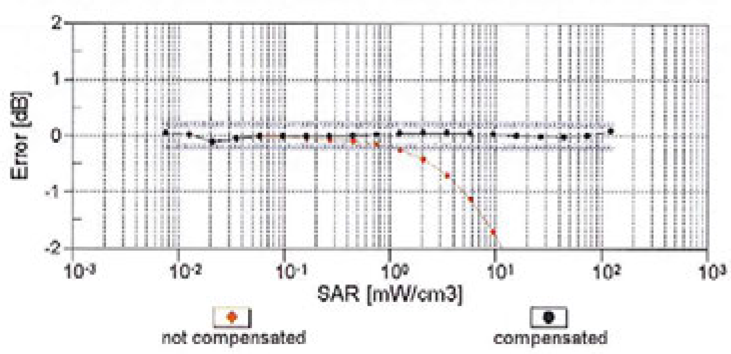


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

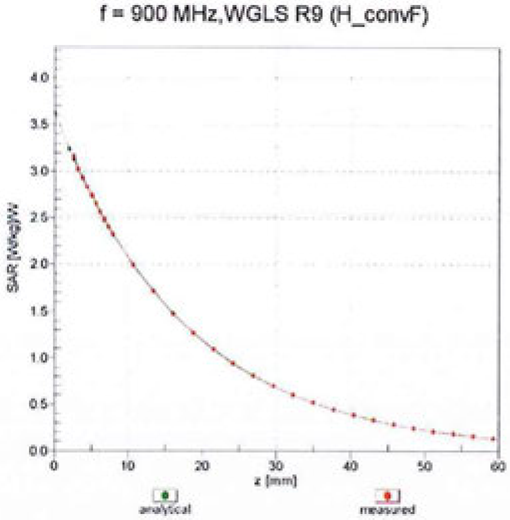
(TEM cell , f = 900 MHz)

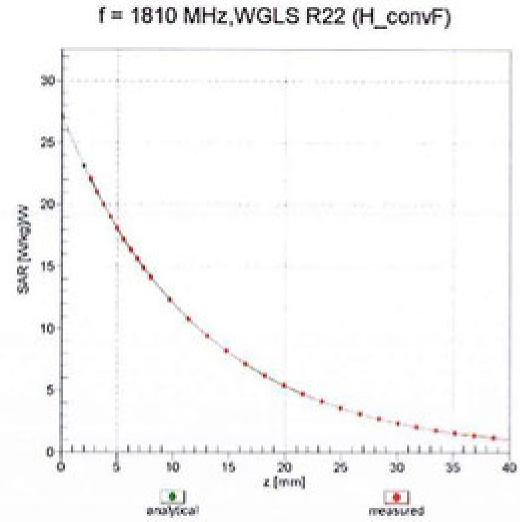




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

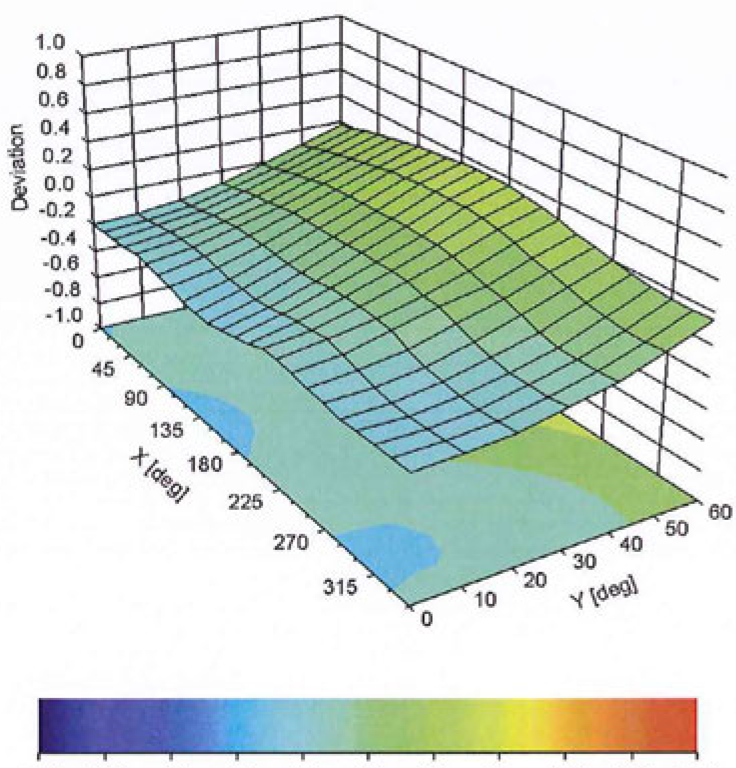
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3196

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	6.1
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ES3DV3**
Serial Number:	**3196**
Place of Assessment:	**Zurich**
Date of Assessment:	**March 15, 2013**
Probe Calibration Date:	**March 13, 2013**

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 450, 900 MHz or 1810 MHz.

Assessed by:

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info@speag.com, http://www.speag.com

Dosimetric E-Field Probe ES3DV3 SN:3196

Conversion factor (± standard deviation)

150 ± 50 MHz	*ConvF*	**8.4 ± 10%**	ε_r = 52.3 ± 5% σ = 0.76 ± 5% mho/m (head tissue)
150 ± 50 MHz	*ConvF*	**8.1 ± 10%**	ε_r = 61.9 ± 5% σ = 0.80 ± 5% mho/m (body tissue)

Important Note:

For numerically assessed probe conversion factors, parameters Alpha and Delta in the DASY software must have the following entries: Alpha = 0 and Delta = 1.

Please see also DASY Manual.

Calibration Laboratory of
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Accreditation No.: **SCS 108**

Client **Motorola MY**

Certificate No: **ES3-3096_Oct13**

CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3096

Calibration procedure(s): QA CAL-01.v9, QA CAL-12.v8, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: October 21, 2013

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 (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	4-Sep-13 (No. DAE4-660_Sep13)	Sep-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: October 24, 2013

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

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The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep 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
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,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 ≤ 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 *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 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 *NORMx* (no uncertainty required).

Probe ES3DV3

SN:3096

Manufactured: July 12, 2005
Calibrated: October 21, 2013

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3096

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.27	1.03	1.23	± 10.1 %
DCP (mV)[B]	101.2	98.2	99.0	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	156.1	±3.5 %
		Y	0.0	0.0	1.0		139.3	
		Z	0.0	0.0	1.0		151.5	

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 NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] 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: ES3DV3 - SN:3096

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
300	45.3	0.87	6.68	6.68	6.68	0.14	2.99	± 13.4 %
450	43.5	0.87	6.33	6.33	6.33	0.20	2.42	± 13.4 %
750	41.9	0.89	6.16	6.16	6.16	0.27	1.96	± 12.0 %
900	41.5	0.97	5.91	5.91	5.91	0.65	1.22	± 12.0 %
1810	40.0	1.40	4.95	4.95	4.95	0.77	1.26	± 12.0 %
1950	40.0	1.40	4.77	4.77	4.77	0.80	1.21	± 12.0 %
2300	39.5	1.67	4.61	4.61	4.61	0.80	1.25	± 12.0 %
2450	39.2	1.80	4.45	4.45	4.45	0.80	1.26	± 12.0 %
2600	39.0	1.96	4.25	4.25	4.25	0.80	1.27	± 12.0 %

[C] Frequency validity 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.
[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.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3096

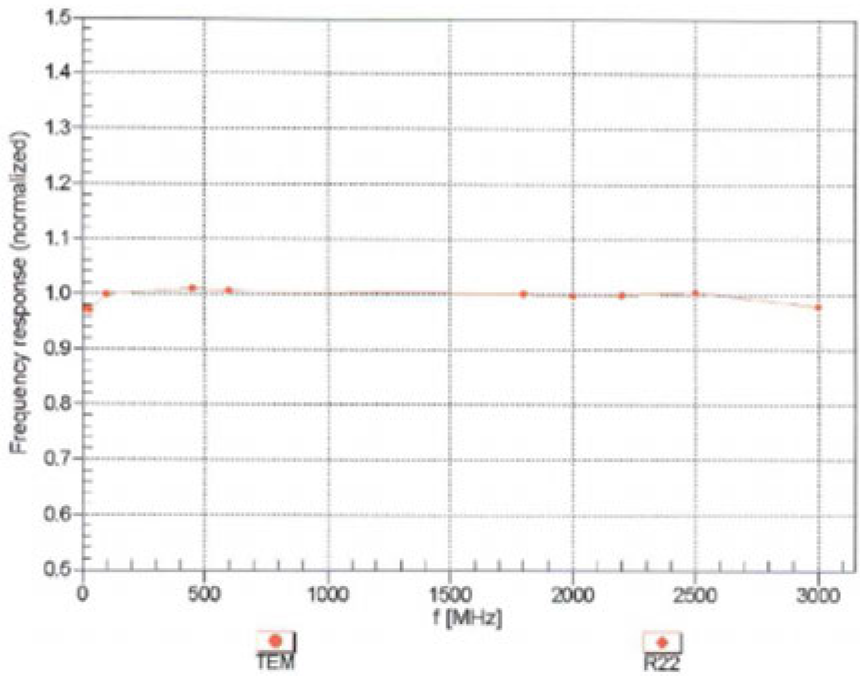
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
300	58.2	0.92	6.80	6.80	6.80	0.11	1.25	± 13.4 %
450	56.7	0.94	6.70	6.70	6.70	0.14	1.68	± 13.4 %
750	55.5	0.96	5.79	5.79	5.79	0.31	1.87	± 12.0 %
900	55.0	1.05	5.68	5.68	5.68	0.44	1.58	± 12.0 %
1810	53.3	1.52	4.77	4.77	4.77	0.57	1.57	± 12.0 %
1950	53.3	1.52	4.77	4.77	4.77	0.59	1.52	± 12.0 %
2300	52.9	1.81	4.39	4.39	4.39	0.80	1.22	± 12.0 %
2450	52.7	1.95	4.26	4.26	4.26	0.80	1.16	± 12.0 %
2600	52.5	2.16	4.12	4.12	4.12	0.63	0.93	± 12.0 %

[C] Frequency validity 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.
[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

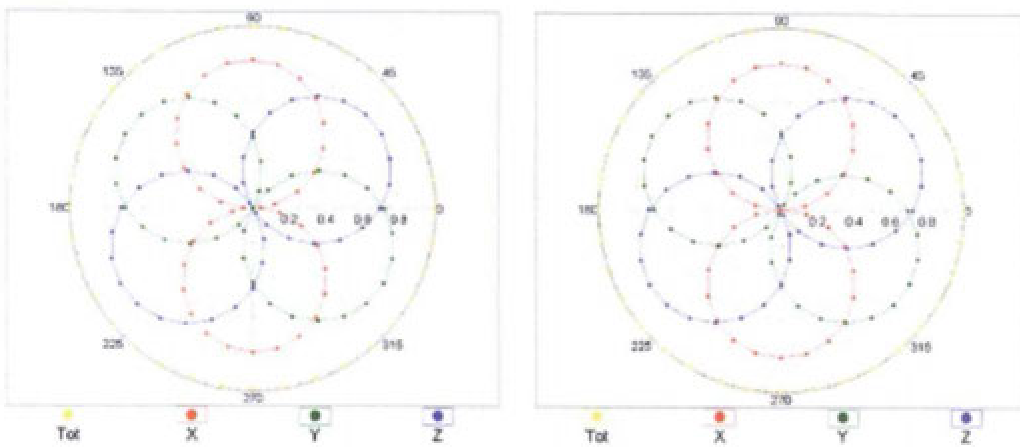
(TEM-Cell:ifi110 EXX, Waveguide: R22)

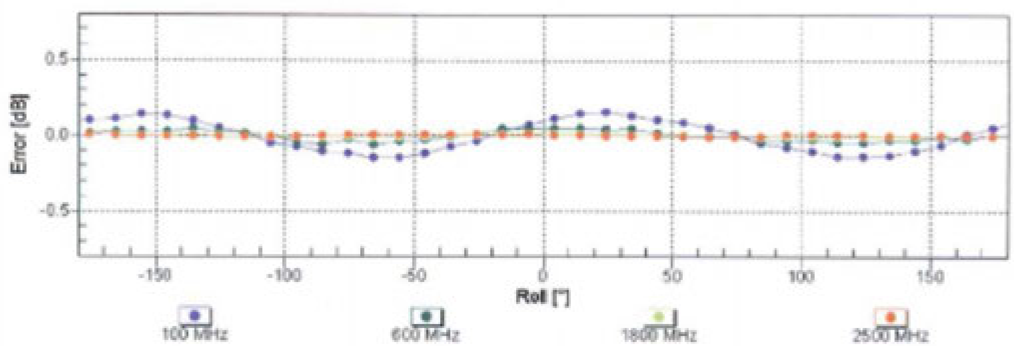


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°

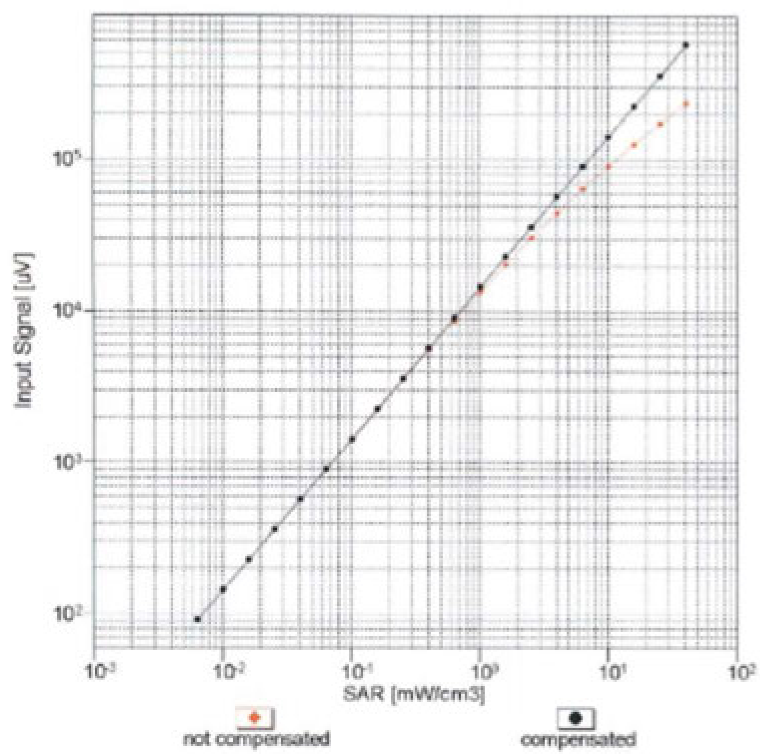
f=600 MHz,TEM f=1800 MHz,R22

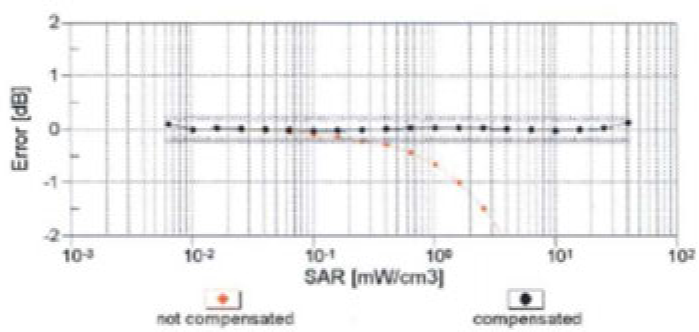




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

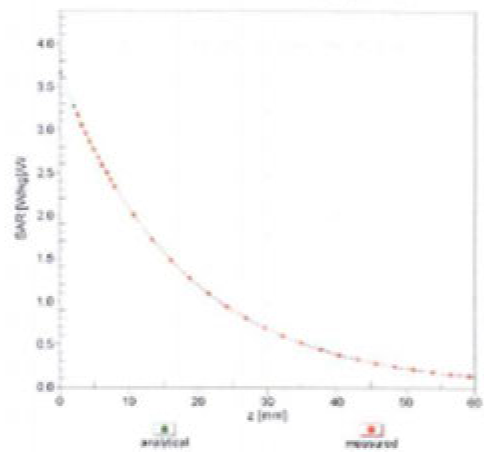
Dynamic Range f(SAR$_{head}$)
(TEM cell , f = 900 MHz)

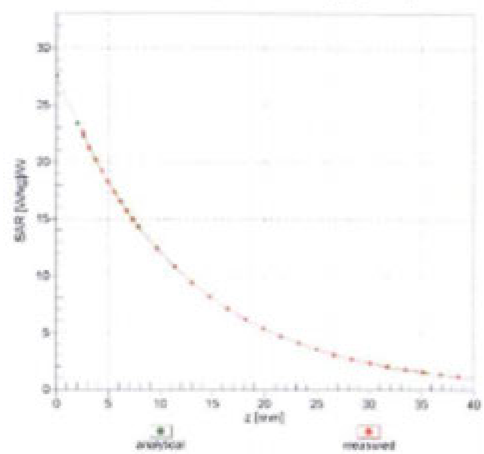




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

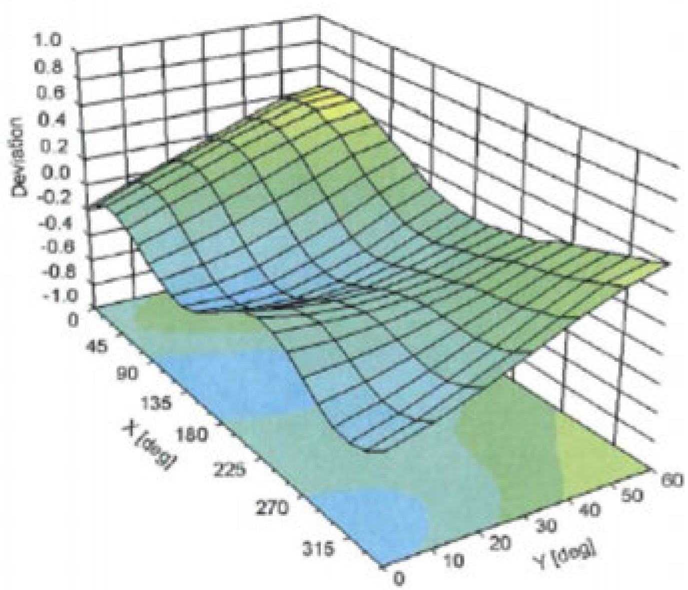
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3096

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-135.8
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ES3DV3**
Serial Number:	**3096**
Place of Assessment:	**Zurich**
Date of Assessment:	**October 24, 2013**
Probe Calibration Date:	**October 21, 2013**

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 450, 900 and at 1810 MHz.

Assessed by:

Schmid & Partner Engineering AG **s p e a g**

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Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

Dosimetric E-Field Probe ES3DV3 SN:3096

Conversion factor (± standard deviation)

150 ± 50 MHz	*ConvF*	**7.51 ± 10%**	**ε_r = 52.3 ± 5%** **σ = 0.76 ± 5% mho/m** (head tissue)
250 ± 50 MHz	*ConvF*	**7.31 ± 10%**	**ε_r = 47.6 ± 5%** **σ = 0.83 ± 5% mho/m** (head tissue)
150 ± 50 MHz	*ConvF*	**7.61 ± 10%**	**ε_r = 61.9 ± 5%** **σ = 0.80 ± 5% mho/m** (body tissue)
250 ± 50 MHz	*ConvF*	**7.35 ± 10%**	**ε_r = 59.4 ± 5%** **σ = 0.88 ± 5% mho/m** (body tissue)

Important Note:

For numerically assessed probe conversion factors, parameters Alpha and Delta in the DASY software must have the following entries: Alpha = 0 and Delta = 1.

Please see also DASY Manual.

Appendix C
Dipole Calibration Certificates

Calibration Laboratory of
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Motorola MY**

Certificate No: **D835V2-4d029_Mar13**

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d029
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	March 05, 2013

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 (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: March 5, 2013

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

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The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

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.

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	V52.8.5
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
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	40.9 ± 6 %	0.94 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.46 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.59 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.18 W/kg ± 16.5 % (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	54.1 ± 6 %	1.02 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.52 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.66 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.65 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.39 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.1 Ω - 4.4 jΩ
Return Loss	- 27.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.6 Ω - 6.7 jΩ
Return Loss	- 22.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.388 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
Manufactured on	December 17, 2004

DASY5 Validation Report for Head TSL

Date: 05.03.2013

Test Laboratory: SPEAG, Zurich, Switzerland

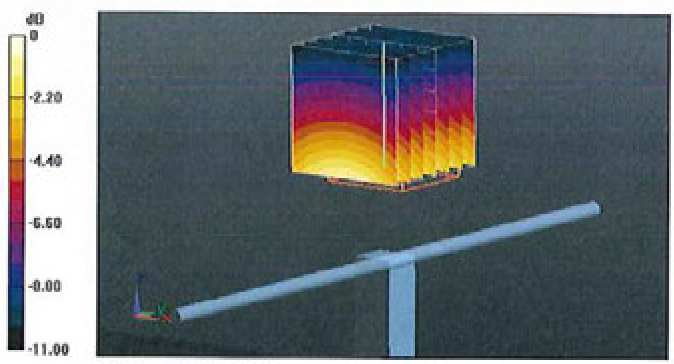
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d029

Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.94 S/m; ε_r = 40.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

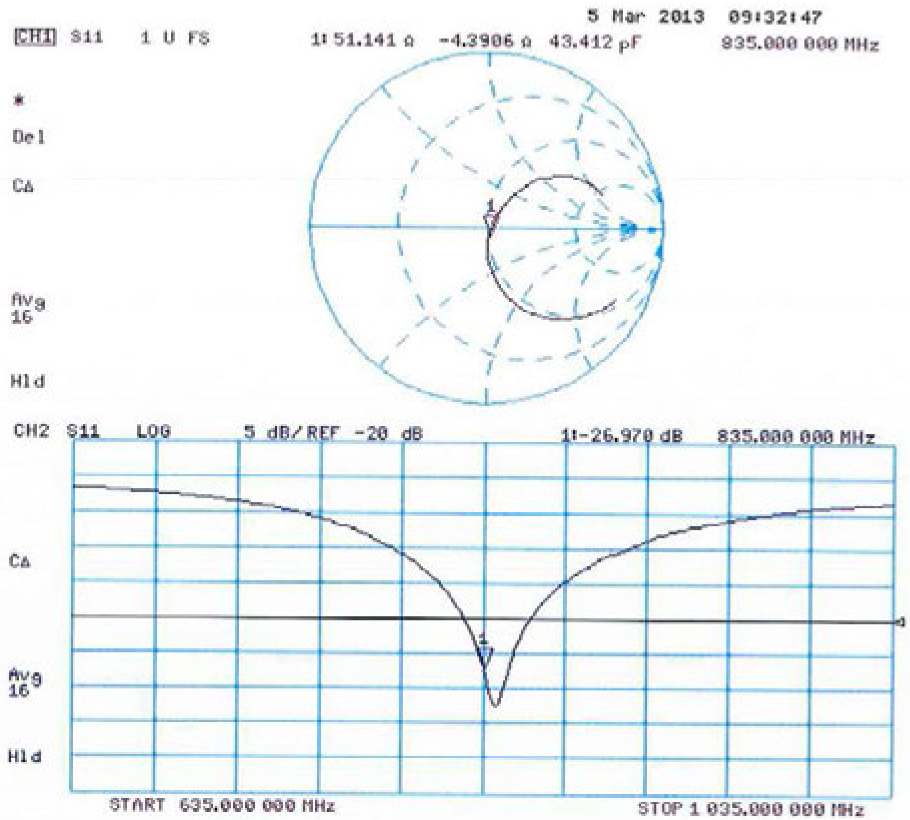
- Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.876 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.71 W/kg
SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.59 W/kg
Maximum value of SAR (measured) = 2.88 W/kg



0 dB = 2.88 W/kg = 4.59 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 04.03.2013

Test Laboratory: SPEAG, Zurich, Switzerland

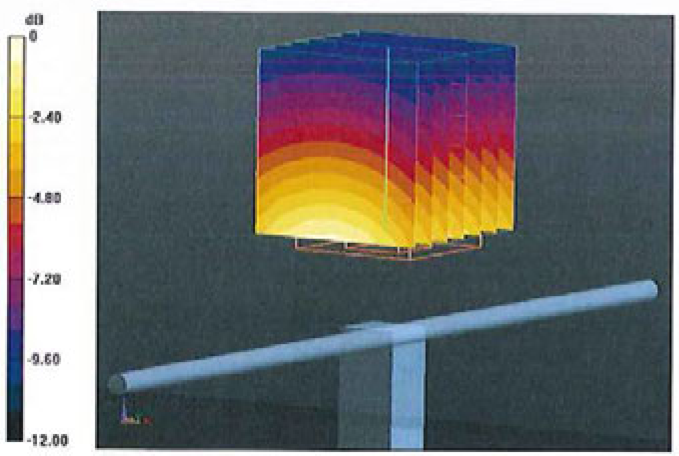
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d029

Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 1.02 S/m; ε_r = 54.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 6.04, 6.04); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

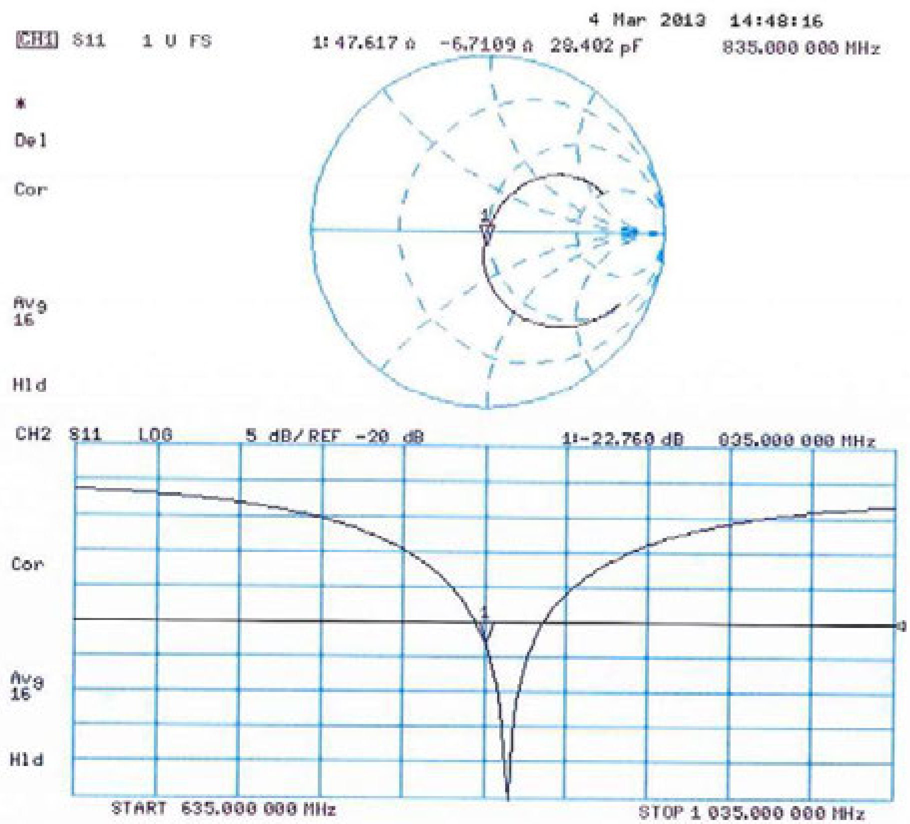
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.578 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.69 W/kg
SAR(1 g) = 2.52 W/kg; SAR(10 g) = 1.65 W/kg
Maximum value of SAR (measured) = 2.92 W/kg



0 dB = 2.92 W/kg = 4.65 dBW/kg

Certificate No: D835V2-4d029_Mar13 Page 7 of 8

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client Motorola MY

Certificate No: D835V2-4d030_Oct13

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d030
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	October 15, 2013

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 (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-15
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Laboratory Technician	D. Iliev
Approved by:	Katja Pokovic	Technical Manager	

Issued: October 15, 2013

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Accreditation No.: **SCS 108**

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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "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) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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.

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	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
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	41.2 ± 6 %	0.93 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.47 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.58 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.19 W/kg ± 16.5 % (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	54.5 ± 6 %	1.00 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.45 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.52 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.61 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.29 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.7 Ω - 1.6 jΩ
Return Loss	- 28.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.0 Ω - 4.6 jΩ
Return Loss	- 26.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.385 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
Manufactured on	December 17, 2004

DASY5 Validation Report for Head TSL

Date: 14.10.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d030

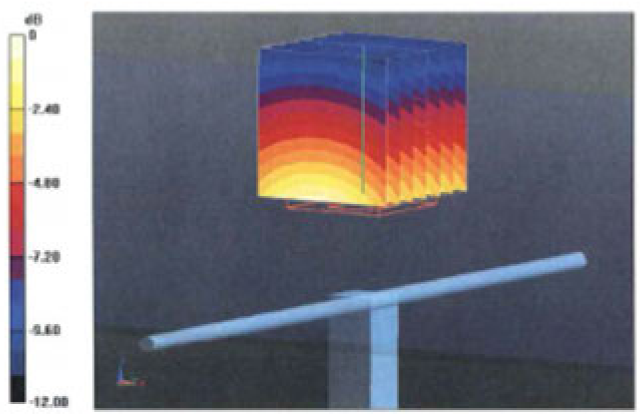
Communication System: UID 0 - CW ; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma = 0.93$ S/m; $\varepsilon_r = 41.2$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.730 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 3.68 W/kg
SAR(1 g) = 2.43 W/kg; SAR(10 g) = 1.58 W/kg
Maximum value of SAR (measured) = 2.83 W/kg



0 dB = 2.83 W/kg = 4.52 dBW/kg

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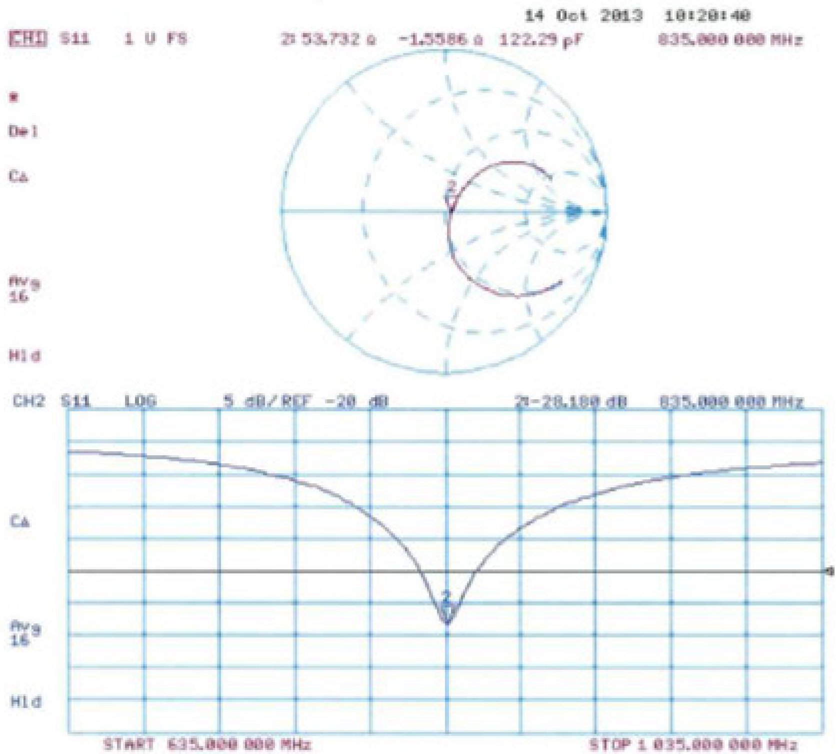
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 15.10.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d030

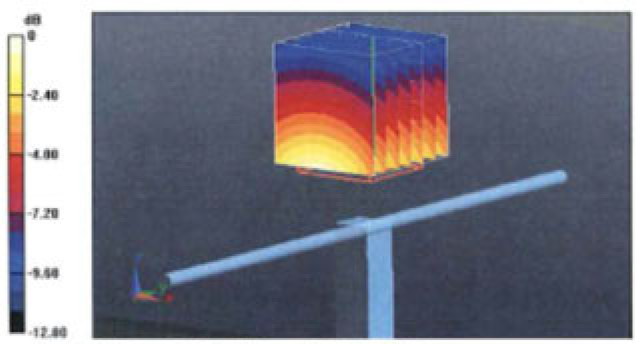
Communication System: UID 0 - CW ; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 1.005 S/m; ε_r = 54.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 6.04, 6.04); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.730 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.58 W/kg
SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.61 W/kg
Maximum value of SAR (measured) = 2.82 W/kg



0 dB = 2.82 W/kg = 4.50 dBW/kg

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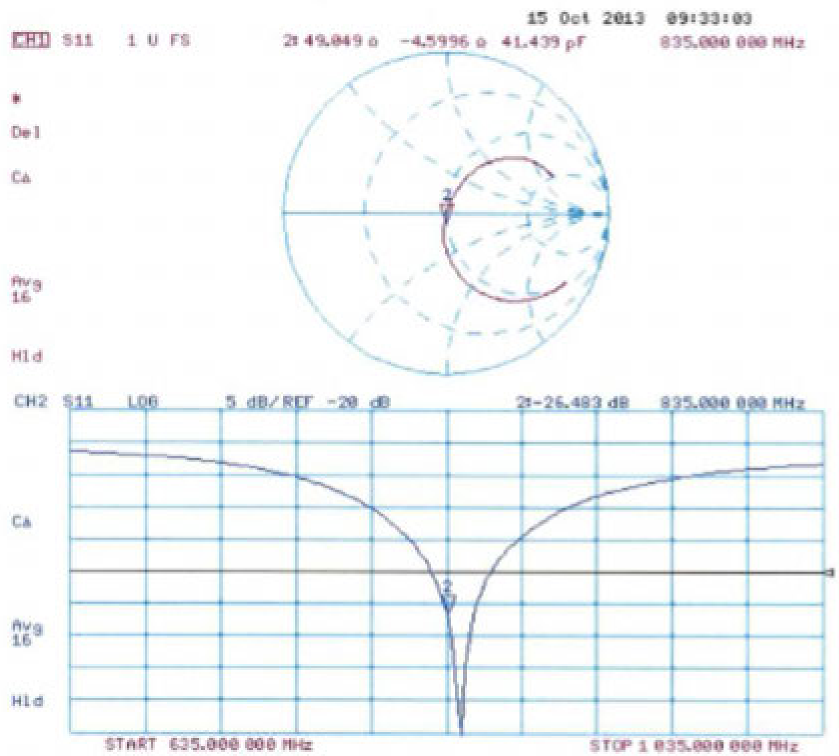
Impedance Measurement Plot for Body TSL



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