MOTOROLA SOLUTIONS

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TESTING CERT # 2518.05

DECLARATION OF COMPLIANCE SAR ASSESSMENT Part 1 of 2

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Date of Report: 4/17/2016
Report Revision: C

Responsible Engineer:	Tiong Nguk Ing
Report Author:	Tiong Nguk Ing
Date/s Tested:	1/18/2016 – 2/6/2016
Manufacturer:	Motorola Solutions Inc.
DUT Description:	Handheld Portable – APX6000 and APX6000XE Refresh UHF1 380-472 MHz 5W
Test TX mode(s):	CW (PTT) , Bluetooth, WLAN 802.11 b/g/n
Max. Power output:	5.7 W (LMR 380-472 MHz band), 10 mW (Bluetooth), 1.98 mW (Bluetooth Low Energy), 63.1 mW (WLAN 802.11 b), 25.1 mW (WLAN 802.11g), 15.5 mW (WLAN 802.11n)
Nominal Power:	5.0 W (LMR 380-472 MHz band), 8 mW (Bluetooth), 1.5 mW (Bluetooth Low Energy), 31.6 mW (WLAN 802.11 b), 12.5 mW (WLAN 802.11g), 12.5 mW (WLAN 802.11n)
Tx Frequency Bands:	LMR 380-472 MHz; Bluetooth 2.402-2.480 GHz; WLAN 802.11 b/g/n 2.412-2.462 GHz
Signaling type:	FM (LMR), FHSS (Bluetooth), 802.11 b/g/n (WLAN)
Model(s) Tested:	H98QDD9PW5BN (PMUE4957A), H98QDH9PW7BN (PMUE4971A)
Model(s) Certified:	H98QDD9PW5BN (PMUE4957A), H98QDD9PW5BN (PMUE4969A), H98QDH9PW7BN (PMUE4959A), H98QDH9PW7BN (PMUE4971A)
Serial Number(s):	756TRV0821, 756TRV0823 and 756TRV0905
Classification:	Occupational/Controlled
FCC ID:	AZ489FT7077; LMR 406.125-472 MHz, Bluetooth 2.402-2.480 GHz, WLAN 802.11 b/g/n 2.412-2.462 GHz This report contains results that are immaterial for FCC equipment approval, which are clearly identified.
IC:	109U-89FT7077; This report contains results that are immaterial for IC equipment approval, which are clearly identified.

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 OET Bulletin 65. 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 4.0 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.

Tiong

Tiong Nguk Ing
Deputy Technical Manager
Approval Date: 4/17/2016

Tiong Nguk Ing

Digitally signed by Tiong Nguk Ing
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Certification Date: 2/23/2016

Certification No.:
L1160221P, L1160222P, L1160223P & L1160224P

Part 1 of 2

APPENDICES

Part 2 of 2

APPENDICES

Report Revision History

Date	Revision	Comments
2/29/2016	A	Initial release
4/01/2016	B	Update BT and WLAN power
4/17/2016	C	Includes RSS-102 exemption requirement

Table 0.0.└ .┘ .│ .─ .● .◘ 萤唛 ɻ鵙$ꭓ 啀 **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 H98QDD9PW5BN (PMUE4957A) and H98QDH9PW7BN (PMUE4971A). These devices are 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)	
		1g-SAR	10g-SAR	1g-SAR	10g-SAR
TNF	406.125 -472 MHz (LMR)	3.57	2.26	4.83	3.60
*DSS	2402-2480 MHz (Bluetooth)	NA	NA	NA	NA
DTS	2412-2462 MHz (WLAN 802.11 b/g/n)	0.06	0.04	0.22	0.12
**Simultaneous Results		3.63	2.30	5.05	3.72

*Results not required per KDB (refer to sections 13.6 and 14.0)

3.0 Abbreviations / Definitions

BT: Bluetooth
CNR: Calibration Not Required
CW: Continuous Wave
DSSS: Direct Sequence Spread Spectrum
DTS: Digital Transmission System
DUT: Device Under Test
EME: Electromagnetic Energy
FHSS: Frequency Hopping Spread Spectrum
Li-ion: Lithium-Ion
LMR: Land Mobile Radio
NA: Not Applicable
NiMH: Nickel Metal Hydride
OFDM: Orthogonal Frequency Division Multiplexing
PTT: Push to Talk
RF: Radio Frequency
SAR: Specific Absorption Rate
TNF: Licensed Non-Broadcast Transmitter Held to Face
WLAN: Wireless Local Area Network

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 (2013), 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 (2015), Limits of Human Exposure to Radio frequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz
- RSS-102 (Issue 5) – Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
- Australian Communications Authority Radio communications (Electromagnetic Radiation – Human Exposure) Standard (2014)
- 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).

- FCC KDB – 643646 D01 SAR Test for PTT Radios v01r03
- FCC KDB – 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB – 865664 D02 RF Exposure Reporting v01r02
- FCC KDB – 447498 D01 General RF Exposure Guidance v06
- FCC KDB – 248227 D01 802.11 Wi-Fi SAR v02r02

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 Devices Under Test (DUT)

These portable devices operate in the LMR bands using frequency modulation (FM). These devices also contain WLAN technology for data capabilities over 802.11 b/g/n wireless networks and Bluetooth technology for short range wireless devices.

The LMR bands in these devices operate in a half duplex system. A half duplex system only allows the user to transmit or receive. These devices cannot transmit and receive simultaneously. The user must stop transmitting in order to receive a signal or listen for a response, regardless of PTT button or use of voice activated audio accessories. This type of operation, along with the RF safety booklet, which instructs the user to transmit no more than 50% of the time, justifies the use of 50% duty factor for this device.

These devices also incorporate Class 1 Bluetooth Low energy (LE) device which is a Frequency Hopping Spread Spectrum (FHSS) technology and LE intended to reduce power consumption. The Bluetooth radio modem is used to wireless link audio accessories.
The maximum actual transmission duty cycle is imposing by Bluetooth standard. Packet types varying duty cycles: 1-slot, 3-slots and 5-slots packets. A 5-slot packet type receives on 1-slot and transmits on 5-slots, and thus maximum duty cycle = 76.1%.

WLAN 802.11 b/g/n operate using Direct Sequence Spread Spectrum (DSSS) and Orthogonal Frequency-Division Multiplexing (OFDM) accordance with the IEEE 802.11 b/g/n. With WiFi access, the radio can receive new code plug, firmware and software feature while allow users keep talking without interruption.

Table 3 below summarizes the technologies, bands, maximum duty cycles and maximum output powers. Maximum output powers are defined as upper limit of the production line final test station.

Table 3

Technologies	Band (MHz)	Transmission	Duty Cycle (%)	Max Power (W)
LMR	380-472	FM	*50	5.7
BT	2402-2480	FHSS	76.1	0.0100
BT LE	2402-2480	DSSS	76.1	0.00198
WLAN	2412-2462	802.11b	100	0.0631
WLAN	2412-2462	802.11g	100	0.0251
WLAN	2412-2462	802.11n	100	0.0155

Note - * includes 50% PTT operation

The intended operating positions are “at the face” with the DUT at least 2.5 cm from the mouth, and “at the body” by means of the offered body worn 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 to assess compliance of the devices. 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 optional removable antennas and one internal BT/WLAN antenna offered for these products. The Table below lists their descriptions.

Table 4

Antenna Models	Description	Selected for test	Tested
FAF5259A	Stubby, 380-472 MHz and 1575 MHz, ¼ Wave, -2 dBd	Yes	Yes
PMAE4065A	Whip, 380-472 MHz, 450-520 MHz and 1575 MHz , ¼ Wave, -2 dBd	Yes	Yes
NAG4000A	APX GPS Stubby Antenna. 1575 MHz, ¼ Wave, -2dBd	No	No; for GPS received only
84009370002	Internal BT/WLAN, 2.4 – 2.4835 GHz, ¼ Wave, 2.58 dBi	Yes	Yes; for WLAN only

7.2 Batteries

There are optional batteries offered for these products. These batteries categorized to long batteries and short batteries. The Table below lists their descriptions.

Table 5

Battery Models	Description	Selected for test	Tested	Comments
Long Batteries				
PMNN4494A	Battery Impress standard Delta-T rugged Li-ion 5000 mAh	Yes	Yes	Default battery for face
NNTN7034B	Battery Delta-T 4200 mAh	Yes	Yes	
NNTN8921A	Battery Impress Li-ion TIA4950 IP67 4100 mAh	Yes	Yes	
PMNN4487A	APX Gen 2 Impress High capacity Delta-T -30 Temperature 4400 mAh	Yes	Yes	
NNTN7573A	Battery Impress standard NiMH 2100 mAh minimum and 2300 mAh typical	Yes	Yes	
NNTN7037A	Battery Impress standard IP67 NiMH 2100 mAh minimum and 2300 mAh typical	Yes	Yes	
PMNN4439A	APX Clamshell battery pack (12xAA Alkaline batteries)	No	No	Low power, only up to 2W.

Table 5 Continued

Battery Models	Description	Selected for test	Tested	Comments
Short Batteries				
PMNN4403B	Battery standard Li-ion 2050 mAh	Yes	Yes	Default battery for Body
NNTN7038B	Battery Impress standard IP67 Li-ion 2900 mAh minimum and 3100 mAh typical	Yes	Yes	
NNTN8930A	Battery Impress Li-ion TIA950 standard battery 2700 mAh	Yes	Yes	
PMNN4485A	APX Gen 2 Impress slim Delta-T 2400 mAh	Yes	Yes	
PMNN4486A	APX Gen 2 Impress standard Delta-T 3400 mAh	Yes	Yes	
NNTN8182B	Battery Impress standard IP67 Li-ion 2900 mAh minimum and 3100 mAh typical (brown color)	No	No	By similarity to NNTN7038B, only color different

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 6

Body worn Models	Description	Selected for test	Tested	Comments
HLN6875A	3” belt clip	Yes	Yes	
PMLN5709A	Basic carry holder	No	No	This holder must used together with HLN6875A belt clip. Already cover with worst case configuration HLN6875A belt clip alone.
PMLN6802A	Molded Nylon Carry Case with quick disconnect swivel	Yes	Yes	
PMLN6712A	Carry Case for APX radio with Clamshell battery	No	No	Only compatible for PMNN4439A battery which transmit low power.
**PMLN5659B	Leather carry case with D-Ring and 2.75” swivel belt loop	Yes	Yes	For APX6000 only. Tested with RLN6487A & RLN6488A, AY000223A01, and NTN5243A without belt loop.
**PMLN5877A	Leather carry case with D-Ring and 2.75” swivel belt loop	Yes	Yes	For APX6000XE only, similar to PMLN5659B.
**PMLN5660B	Leather Carry Case with 3" Fixed Belt Loop	Yes	Yes	For APX6000 only. Tested with RLN6487A & RLN6488A
**PMLN5879A	Leather Carry Case with 3" Fixed Belt Loop	Yes	Yes	For APX6000XE only, similar to PMLN5660B
#PMLN5657B	Leather Carry case with D-Ring and 2.75” swivel belt loop	Yes	Yes	For APX6000 only. Tested with RLN6487A & RLN6488A without belt loop.
#PMLN5875A	Leather Carry case with D-Ring and 2.75” swivel belt loop	Yes	No	For APX6000XE only, by similarity to PMLN5657B
#PMLN5658B	Leather Carry case with 3” fixed belt loop	Yes	Yes	For APX6000 only. Tested with RLN6487A & RLN6488A without belt loop.

Table 6 Continued

Body worn Models	Description	Selected for test	Tested	Comments
#PMLN5876A	Leather Carry case with 3" fixed belt loop	Yes	No	For APX6000XE only, by similarity to PMLN5658B
AY000223A01	Boston leather fireman's radio strap with button back holder	Yes	Yes	Tested with PMLN5659B
AY000229A01	Boston leather fireman's radio strap with button back holder -XL	No	No	By similarity to AY000223A01
NTN5243A	Adjustable Nylon Carry Strap	Yes	Yes	Tested with PMLN5659B
RLN6487A	Boston Leather Fireman's radio strap -XL	Yes	Yes	Tested with PMLN5659B, PMLN5660B, PMLN5657B and PMLN5658B.
RLN6486A	Boston Leather Fireman's radio strap	No	No	By similarity to RLN6487A
RLN6488A	Boston leather anti-strap for Boston leather fireman's radio strap	Yes	Yes	Tested with PMLN5659B, PMLN5660B, PMLN5657B and PMLN5658B.
NNTN8749A	Carry accessory -Belt clip stud (pack of 5)	No	No	Secure access to RSM
4200865599	Belt	No	No	Already cover with worst case configuration "carry case & strap"

Note:
** Body worn compatible for long batteries only.
# Body worn compatible for short batteries only.

7.4 Audio Accessories

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

Table 7

Audio Acc. Models	Description	Selected for test	Tested	Comments
HMN4104B	Impress display remote speaker	Yes	*No	Tested with RMN5116A
RMN5116A	Receive and transmit boomless temple transducer	Yes	*No	Tested with HMN4104B
HMN4101B	Impress RSM no display with audio jack	No	No	By similarity to HMN4104B
HMN4103B	Impress RSM display with audio jack	No	No	By similarity to HMN4104B
NNTN8203A	Impress XE remote speaker microphone	Yes	Yes	Default audio
NNTN8203ABLK	Impress XE remote speaker microphone (black color)	No	No	By similarity to NNTN8203A
NNTN8203AYLW	Impress XE remote speaker microphone (yellow color)	No	No	By similarity to NNTN8203A
NNTN8575A	XE RSM with Xtream temperature cable high impact	No	No	By similarity to NNTN8203A
NNTN8575ABLK	XE RSM with Xtream temperature cable high impact (black color)	No	No	By similarity to NNTN8203A
NNTN8575AYLW	XE RSM with Xtream temperature cable high impact (yellow color)	No	No	By similarity to NNTN8203A
NMN6274A	Impress XP RSM for APX with dual microphone noise suppression, 3.5mm threaded jack	Yes	*No	
NMN6271A	Impress XP RSM with dual microphone noise suppression	No	No	By similarity to NMN6274A
PMMN4062A	Impress remote speaker microphone, noise cancelling	Yes	*No	

Table 7 Continued

Audio Acc. Models	Description	Selected for test	Tested	Comments
PMMN4065A	Impress RSM, IP57	No	No	By similarity to PMNN4062A
PMMN4069A	Impress RSM, 3.5 mm jack, IP55	No	No	By similarity to PMNN4062A
PMMN4083A	Impress RSM Delta-T	No	No	By similarity to PMNN4062A
PMMN4099A	Remote speaker microphone	No	No	By similarity to PMNN4062A
PMMN4084A	Impress RSM with 3.5mm threaded and non-threaded audio jack	Yes	*No	
PMLN5653A	Impress ear microphone with bone conduction and programmable button	Yes	*No	
PMLN5101A	Impress temple transducer	Yes	*No	
RMN5058A	Lightweight headset	No	No	By similarity to PMLN5101A
RMN5137A	Peltor MT series over-the-head headset, direct radio connect	Yes	*No	
RMN5138A	Peltor MT series neckband headset, direct radio connect	No	No	By similarity to RMLN5137A
RMN5139A	Peltor MT series hard hat attached headset, direct radio connect	No	No	By similarity to RMLN5137A
PMLN5275C	Heavy duty headset	Yes	*No	
RLN6484A	Integrated ear microphone/ receiver system with body PTT (include Adapter BDN6783)	Yes	*No	Tested with NTN8819B
NTN8819B	Integrated ear microphone / receiver	Yes	*No	Tested with RLN6484A
RLN6480A	Integrated ear microphone/ receiver system with Palm PTT (include Adapter BDN6783)	No	No	By similarity to RLN6484A
RLN6481A	Integrated ear microphone/ receiver system with PTT on adaptor (include Adapter BDN6783)	No	No	By similarity to RLN6484A
RLN6482A	Integrated ear microphone/ receiver system with ring PTT (include Adapter BDN6783)	No	No	By similarity to RLN6484A
RLN6483A	Integrated ear microphone/ receiver system with snap-on-side PTT (include Adapter BDN6783)	No	No	By similarity to RLN6484A
PMLN6088A	Peltor MT series over-the-head headset with Nexus connector	Yes	*No	Tested with PMLN6095A
PMLN6095A	Peltor PTT Nexus adaptor	Yes	*No	Tested with PMLN6088A
RLN6477A	Peltor MT series Neckband headset with Nexus connector	No	No	By similarity to PMLN6088A
RMN4051B	Peltor MT series hard hat attached with Nexus connector	No	No	By similarity to PMLN6088A
RMN4052B	Peltor TacticalPro series Over-The-Head Headset with Nexus connector	No	No	By similarity to PMLN6088A
RMN4053B	Peltor TacticalPro series hard hat attached with Nexus connector	No	No	By similarity to PMLN6088A
RMN5135A	Peltor TacticalPro series Neckband headset with Nexus connector	No	No	By similarity to PMLN6088A
PMLN6129A	Impress 2 Wire surveillance kit with translucent tube, black	Yes	*No	
PMLN6130A	Impress 2 Wire surveillance kit with translucent tube, beige	No	No	By similarity to PMLN6129A
PMLN6127A	Impress 2 wire surveillance kit, black	No	No	By similarity to PMLN6129A
PMLN6128A	Impress 2 wire surveillance kit, beige	No	No	By similarity to PMLN6129A
RLN5312B	2-wire surveillance kit with translucent tube	Yes	*No	Tested with BDN6783B
BDN6783B	3.5mm Threaded Audio Adapter	Yes	*No	Tested with RLN5312B
ZMN6038A	2-wire surveillance kit, black, Hirose connector	Yes	*No	Tested with NNTN7869A

Table 7 Continued

Audio Acc. Models	Description	Selected for test	Tested	Comments
NNTN7869A	Surveillance key loader accessory adaptor	Yes	*No	Tested with ZMN6038A and ZMN6031A
ZMN6032A	2-wire surveillance kit, beige, Hirose connector	No	No	By similarity to ZMN6038A
ZMN6031A	3-wire surveillance kit, beige, Hirose connector	Yes	*No	Tested with NNTN7869A
ZMN6039A	3-wire surveillance kit, with extra loud earpiece, beige, Hirose connector	No	No	By similarity to ZMN6031A
PMLN6123A	Impress 3 wire surveillance kit with translucent tube, black	Yes	*No	
PMLN6124A	Impress 3 wire surveillance kit with translucent tube, beige	No	No	By similarity to PMLN6123A
PMLN6766A	Tactical boomless temple transducer	Yes	*No	Tested with PMLN6827A
PMLN6827A	Tactical PTT only interface module	Yes	*No	Tested with PMLN6766A
PMLN6767A	Tactical remote body PTT	No	No	By similarity to PMLN6766A
PMLN6829A	Tactical ear microphone	No	No	By similarity to PMLN6766A
PMLN6830A	Tactical remote ring PTT	No	No	By similarity to PMLN6766A
AARLN4885B	Receive Only Ear bud	No	No	Receive only
BDN6664A	1-Wire Receive-Only Surveillance Kit With Earpiece, Beige, and 3.5mm Threaded.	No	No	Receive only
BDN6666A	1-Wire Receive-Only surveillance kit with volume control and earpiece, Beige, 3.5 mm Threaded	No	No	Receive only
BDN6667A	2-Wire Receive-Only Surveillance Kit With Earpiece, Beige, and 3.5mm Threaded.	No	No	Receive only
BDN6668A	3-Wire Receive-Only Surveillance Kit With Earpiece, Beige, and 3.5mm Threaded.	No	No	Receive only
BDN6669A	2-Wire Receive-Only Surveillance Kit With Extra-Loud Earpiece, Beige, and 3.5 mm Threaded.	No	No	Receive only
BDN6670A	3-Wire Receive-Only Surveillance Kit With Extra-Loud Earpiece, Beige, and 3.5 mm Threaded.	No	No	Receive only
BDN6726A	1-Wire Receive-Only Surveillance Kit With Earpiece, Black, and 3.5mm Threaded.	No	No	Receive only
BDN6727A	1-Wire Receive-Only Surveillance Kit With Extra-Loud Earpiece, Black, and 3.5mm Threaded.	No	No	Receive only
BDN6728A	1-Wire Receive-Only Surveillance Kit With Volume Control And Earpiece, Black, 3.5mm Threaded.	No	No	Receive only
BDN6729A	2-Wire Receive-Only Surveillance Kit With Earpiece, Black, and 3.5mm Threaded.	No	No	Receive only
BDN6730A	3-Wire Receive-Only Surveillance Kit With Earpiece, Black, 3.5mm Threaded..	No	No	Receive only
BDN6731A	2-Wire Receive-Only Surveillance Kit With Extra-Loud Earpiece, Black, and 3.5mm Threaded.	No	No	Receive only
BDN6732A	3-Wire Receive-Only Surveillance Kit With Extra-Loud Earpiece, Black, and 3.5mm Threaded.	No	No	Receive only
PMLN6125A	Receive Only Surveillance Kit, Black	No	No	Receive only
PMLN6126A	Receive Only Surveillance Kit, Beige	No	No	Receive only
RLN4941A	Receive Only Earpiece With Translucent Tube	No	No	Receive only
RLN5313B	1-Wire Receive-Only Surveillance Kit With Translucent Tube, Black, and 3.5mm Threaded.	No	No	Receive only
RLN5314B	1-Wire Receive-Only Surveillance Kit With Translucent Tube, Beige, 3.5mm Threaded.	No	No	Receive only
RLN6424B	Receive-Only Earpiece With Translucent Tube And Rubber Ear tip.	No	No	Receive only
RMN4055B	Peltor Ht Series Listen Only Over-The-Head Headset With 3.5mm Threaded connector.	No	No	Receive only
RMN4056B	Peltor Ht Series Listen Only Over-The-Head Headset With 3.5mm Threaded.	No	No	Receive only
RMN4057B	Peltor Ht Series Listen Only Hard Hat Attached Headset With 3.5mm Threaded Connector	No	No	Receive only
RMN5132A	Peltor Ht Series Listen Only Neckband Headset With 3.5mm Non Threaded Connector	No	No	Receive only

Table 7 Continued

Audio Acc. Models	Description	Selected for test	Tested	Comments
RMN5133A	Peltor Ht Series Listen Only Hard Hat Attached Headset With 3.5mm Non Threaded Connector	No	No	Receive only
WADN4190B	Receive Only Over The Ear Flexible Earpiece	No	No	Receive only

Note:
*No - SAR ≤ 4.0 W/kg, test not require as per KDB 643646 D01

8.0 Description of Test System

8.1 Descriptions of Robotics/Probes/Readout Electronics

Table 8

Dosimetric System type	System version	DAE type	Probe Type
Schmid & Partner Engineering AG SPEAG DASY 5	52.8.8.1222	DAE4	ES3DV3 EX3DV4 (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 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 9

Phantom Type	Phantom(s) Used	Material Parameters	Phantom Dimensions LxWxD (mm)	Material Thickness (mm)	Support Structure Material	Loss Tangent (wood)
Triple Flat	NA	200MHz -6GHz; Er = 3-5, Loss Tangent = ≤0.05	280x175x175	2mm +/- 0.2mm	Wood	< 0.05
SAM	NA	300MHz -6GHz; Er = < 5, Loss Tangent = ≤0.05	Human Model			
Oval Flat	√	300MHz -6GHz; Er = 4+/- 1, Loss Tangent = ≤0.05	600x400x190			

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 10. 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 (percent by mass)

Table 10

Ingredients	450 MHz		2450 MHz	
	Head	Body	Head	Body
Sugar	56.00	46.50	0	0
Diacetin	0	0	51.00	34.50
De ionized –Water	39.10	50.53	48.75	65.20
Salt	3.80	1.87	0.15	0.20
HEC	1.00	1.00	0	0
Bact.	0.10	0.10	0.10	0.10

9.0 Additional Test Equipment

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

Table 11

Equipment Type	Model Number	Serial Number	Calibration Date	Calibration Due Date
Speag Probe	ES3DV3	3122	6/19/2015	6/19/2016
Speag Probe	ES3DV3	3196	11/17/2015	11/17/2016
Speag Probe	EX3DV4	7364	6/23/2015	6/23/2016
Speag DAE	DAE4	1488	7/14/2015	7/14/2016
Speag DAE	DAE4	1294	1/6/2016	1/6/2017
Speag DAE	DAE4	1483	6/16/2015	6/16/2016
Signal Generator	E4438C	MY47272101	8/12/2014	8/12/2016
Signal Generator	E4438C	MY45091270	7/9/2014	7/9/2016
Power Meter	E4419B	MY40330364	5/29/2015	5/29/2017
Power Sensor	8482B	3318A07392	6/3/2015	6/3/2016
Power Meter	E4418B	MY45100739	5/29/2015	5/29/2017
Power Sensor	8481B	MY41091243	3/6/2015	3/6/2016
Power Meter	E4416A	MY50001037	2/16/2015	2/16/2016
Power Sensor	N8481B	MY51450002	2/23/2015	2/23/2016
Power Meter	E4418B	MY45100911	5/29/2015	5/29/2017
Power Meter	E4418B	MY45101014	11/4/2015	11/4/2017
Power Sensor	8482B	3318A07546	6/3/2015	6/3/2016
Power Sensor	8481B	SG41090258	6/3/2015	6/3/2016
Broadband Power Sensor	NRP-Z11	120907	2/11/2015	2/11/2017
Power Amplifier	5S1G4	313326	CNR	CNR
Power Amplifier	10W1000C	312859	CNR	CNR
Bi-directional Coupler	3020A	41935	8/27/2015	8/27/2016
Bi-directional Coupler	3022	81640	8/26/2015	8/26/2016
Dickson Temperature Recorder	TM320	06153216	7/20/2015	7/20/2016
Temperature Probe	DTM3000	3257	8/28/2015	8/28/2016
Dielectric Assessment Kit	DAK-12	1069	5/12/2015	5/12/2016
Network Analyzer	E5071B	MY42403218	8/4/2015	8/4/2016
Speag Dipole	D450V3	1053	3/17/2015	3/17/2017
Speag Dipole	D2450V2	781	3/20/2015	3/20/2017

10.0 SAR Measurement System Validation and Verification

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

10.1 System Validation

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

Table 12

Dates	Probe Calibration Point		Probe SN	Measured Tissue Parameters		Validation		
				σ	ϵ_r	Sensitivity	Linearity	Isotropy
CW								
8/25/2015	Body	450	3122	0.91	54.8	Pass	Pass	Pass
8/26/2015	Head	450		0.91	43.9	Pass	Pass	Pass
27/9/2015	Body	450	7364	0.92	55.3	Pass	Pass	Pass
7/24/2015	Head	450		0.87	44.3	Pass	Pass	Pass
CW								
1/13/2016	Body	2450	3196	2.01	47.6	Pass	Pass	Pass
1/12/2016	Head	2450		1.86	35.8	Pass	Pass	Pass

10.2 System Verification

System verification 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 13

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
3122	FCC Body	SPEAG D450V3 / 1053	4.41 +/- 10%	1.20	4.80	1/18/2016
				1.18	4.72	1/19/2016
				1.20	4.80	1/21/2016
				1.17	4.68	1/22/2016
				1.21	4.84	1/24/2016
				1.19	4.76	1/26/2016
	IEEE/IEC Head		4.45 +/- 10%	1.17	4.68	1/29/2016 *
				1.17	4.68	1/31/2016
				1.16	4.64	2/1/2016
				1.15	4.60	2/2/2016
7364	FCC Body	SPEAG D450V3 / 1053	4.41 +/- 10%	1.14	4.56	2/4/2016
3196	FCC Body	SPEAG D2450V2 / 781	51.90 +/- 10%	12.60	50.40	2/4/2016
				12.90	51.60	2/5/2016
	IEEE/IEC Head		52.30 +/- 10%	13.10	52.40	2/3/2016*
				13.20	52.80	2/6/2016

Note: * System performance check cover next testing day (within 24 hours).

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 14

Frequency (MHz)	Tissue Type	Conductivity Target (S/m)	Dielectric Constant Target	Conductivity Meas. (S/m)	Dielectric Constant Meas.	Tested Date
380	FCC Body	0.93 (0.88-0.98)	57.4 (54.5-60.3)	0.89	55.9	1/29/2016
	IEEE/ IEC Head	0.87 (0.83-0.91)	44.2 (42.1-46.6)	0.83	45.8	2/2/2016
393	FCC Body	0.93 (0.89-0.98)	57.3 (54.4-60.1)	0.90	55.6	1/29/2016
	IEEE/ IEC Head	0.87 (0.83-0.91)	44.2 (42.0-46.4)	0.84	45.5	2/2/2016
422	IEEE/ IEC Head	0.87 (0.83-0.91)	43.8 (41.6-46.0)	0.87	44.6	1/29/2016*
				0.85	45.4	1/31/2016
				0.85	45.1	2/1/2016
450	FCC Body	0.94 (0.89-0.99)	56.7 (53.9-59.5)	0.94	55.5	1/18/2016
				0.94	54.8	1/19/2016
				0.95	56.1	1/21/2016
				0.97	55.5	1/22/2016
				0.96	55.7	1/24/2016
				0.95	55.6	1/26/2016
				0.92	54.8	2/4/2016
450	IEEE/ IEC Head	0.87 (0.83-0.91)	43.5 (41.3-45.7)	0.89	44.0	1/29/2016*
				0.87	44.9	1/31/2016
				0.87	44.5	2/1/2016
				0.89	43.8	2/2/2016
455	FCC Body	0.94 (0.89-0.99)	56.7 (53.8-59.5)	0.95	55.4	1/18/2016
				0.95	55.4	1/19/2016
				0.95	56.0	1/21/2016
				0.97	55.4	1/22/2016
				0.96	55.6	1/24/2016
				0.95	55.5	1/26/2016
				0.93	54.7	2/4/2016
2412	FCC Body	1.91 (1.82-2.01)	52.8 (47.5-58.0)	1.99	49.2	2/4/2016
				2.00	48.1	2/5/2016
2412	IEEE/ IEC Head	1.77 (1.68-1.86)	39.3 (35.3-43.2)	1.85	35.6	2/3/2016*
				1.85	35.7	2/6/2016
2450	FCC Body	1.95 (1.85-2.05)	52.7 (47.4-58.0)	2.04	49.0	2/4/2016
				2.05	48.0	2/5/2016
2450	IEEE/ IEC Head	1.80 (1.71-1.89)	39.2 (35.3-43.1)	1.89	35.5	2/3/2016*
				1.88	35.5	2/6/2016

Note: * Tissue cover next testing day (within 24 hours).

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^{o}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 15

	Target	Measured
Ambient Temperature	18 – 25 ˚C	Range: 19.2 – 24.2˚C Avg. 21.6 ˚C
Tissue Temperature	NA	Range: 18.9 – 22.0˚C Avg. 20.0˚C

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. Oval flat phantoms filled with applicable simulated tissue were used for body and face testing.

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

Table 16

Description		≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface		5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location		30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: ΔxArea, ΔyArea		≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
		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.	
Maximum zoom scan spatial resolution: ΔxZoom, ΔyZoom		≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: ΔzZoom(n)	≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
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.			

12.2 DUT Configuration(s)

The DUT is a portable device operational at the 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.

12.3 DUT Positioning Procedures

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

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

Not applicable.

12.3.3 Face

The DUT was positioned with its’ front and back sides 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 drift. Appendix F includes a shortened scan to justify SAR scaling for drift. For this device the “Max Calc. 1g-SAR” and “Max Calc.10g-SAR” are scaled using the following formula:

$$Max\_Calc = SAR\_meas \cdot 10^{\frac{-Drift}{10}} \cdot \frac{P\_\max}{P\_\text{int}} \cdot DC$$

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 drift

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 CW and 50% duty cycle was applied to PTT configurations in the final results.

Standalone and simultaneous BT testing were assessed in sections 13.6 and 14.0 per the guidelines of KDB 447498.

WLAN tests were performed in 802.11b mode using a duty cycle of 99.87% with results scaled to 100% as per guidelines of KDB 248227.

13.0 DUT Test Data

13.1 LMR assessments at the Body for 406.125 – 472 MHz band

Battery PMNN4403B was selected as the default battery for assessments at the Body because it is the thinnest battery (refer to Exhibit 7B for battery illustration). The default battery was used during conducted power measurements for all test channels within FCC allocated frequency range (406.125 -472 MHz) which are listed in Table 17. The channel with the highest conducted power will be identified as the default channel per KDB 643646 (SAR Test for PTT Radios). SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 17

Test Freq (MHz)	Power (W)
406.125	5.64
422.125	5.66
438.500	5.55
454.500	5.67
470.000	5.66
472.000	5.66

Assessments at the Body with Body worn HLN6875A

DUT assessment with offered antennas, default battery and, default body worn accessory per KDB 643646. Optional batteries were tested per the requirements of KDB 643646. Refer to Table 17 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

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#
FAF5259A	PMNN4403B	HLN6875A	NNTN8203A	406.125							
				422.125							
				438.500							
				454.500	5.70	-0.29	4.85	3.57	2.59	1.91	FIE-AB-160118-03
				470.000							
				472.000							
PMAE4065A	PMNN4403B	HLN6875A	NNTN8203A	406.125							
				422.125							
				438.500							
				454.500	5.70	-0.23	4.46	3.30	2.35	1.74	FIE-AB-160118-04
				470.000							
				472.000							
Assessment of Additional Batteries											
FAF5259A	NNTN7038B	HLN6875A	NNTN8203A	454.500	5.70	-0.19	4.76	3.51	2.49	1.83	FIE-AB-160118-05
FAF5259A	NNTN8930A	HLN6875A	NNTN8203A	454.500	5.60	-0.29	5.17	3.82	2.81	2.08	FIE-AB-160118-06
FAF5259A	PMNN4485A	HLN6875A	NNTN8203A	454.500	5.70	-0.31	5.16	3.82	2.77	2.05	FIE-AB-160118-07
FAF5259A	PMNN4486A	HLN6875A	NNTN8203A	454.500	5.70	-0.23	4.82	3.56	2.54	1.88	FIE-AB-160118-08
FAF5259A	PMNN4494A	HLN6875A	NNTN8203A	454.500	5.70	-0.31	3.88	2.78	2.08	1.49	FIE-AB-160118-09
FAF5259A	NNTN7034B	HLN6875A	NNTN8203A	454.500	5.70	-0.34	4.56	3.38	2.47	1.83	AZ-AB-160118-10
FAF5259A	NNTN8921A	HLN6875A	NNTN8203A	454.500	5.65	-0.37	4.46	2.00	2.45	1.10	AZ-AB-160118-11
FAF5259A	PMNN4487A	HLN6875A	NNTN8203A	454.500	5.68	-0.46	4.10	2.97	2.29	1.66	AZ-AB-160118-12
FAF5259A	NNTN7573A	HLN6875A	NNTN8203A	454.500	5.70	-0.36	5.77	2.73	**3.13**	**1.48**	AZ-AB-160118-13
FAF5259A	NNTN7037A	HLN6875A	NNTN8203A	454.500	5.70	-0.24	4.97	2.54	2.63	1.34	AZ-AB-160119-01

Assessments at the Body with Body worn PMLN6802A

DUT assessment with offered antennas, default battery and, optional body worn accessory per KDB 643646. Optional batteries were tested per the requirements of KDB 643646. Refer to Table 17 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

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#
FAF5259A	PMNN4403B	PMLN6802A	NNTN8203A	406.125							
				422.125							
				438.500							
				454.500	5.70	-0.23	3.23	2.42	1.70	1.28	FIE-AB-160121-11
				470.000							
				472.000							

Table 19 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#
PMAE4065A	PMNN4403B	PMLN6802A	NNTN8203A	406.125							
				422.125							
				438.500							
				454.500	5.70	-0.21	3.14	2.35	1.65	1.23	FIE-AB-160121-12
				470.000							
				472.000							
Assessment of Additional Batteries											
FAF5259A	NNTN7038B	PMLN6802A	NNTN8203A	454.500	5.70	-0.24	3.52	2.64	1.86	1.39	FIE-AB-160121-13
FAF5259A	NNTN8930A	PMLN6802A	NNTN8203A	454.500	5.64	-0.31	3.70	2.76	**2.01**	**1.50**	FIE-AB-160121-14
FAF5259A	PMNN4485A	PMLN6802A	NNTN8203A	454.500	5.70	-0.25	3.41	2.55	1.81	1.35	FIE-AB-160121-15
FAF5259A	PMNN4486A	PMLN6802A	NNTN8203A	454.500	5.70	-0.24	3.44	2.56	1.82	1.35	FIE-AB-160121-16
FAF5259A	PMNN4494A	PMLN6802A	NNTN8203A	454.500	5.70	-0.13	2.02	1.51	1.04	0.78	TLC-AB-160122-02
FAF5259A	NNTN7034B	PMLN6802A	NNTN8203A	454.500	5.63	-0.26	2.72	2.04	1.46	1.10	TLC-AB-160122-03
FAF5259A	NNTN8921A	PMLN6802A	NNTN8203A	454.500	5.63	-0.34	2.33	1.74	1.28	0.95	TLC-AB-160122-04
FAF5259A	PMNN4487A	PMLN6802A	NNTN8203A	454.500	5.70	-0.21	2.07	1.54	1.09	0.81	TLC-AB-160122-05
FAF5259A	NNTN7573A	PMLN6802A	NNTN8203A	454.500	5.70	-0.21	2.85	2.15	1.50	1.13	TLC-AB-160122-06
FAF5259A	NNTN7037A	PMLN6802A	NNTN8203A	454.500	5.70	-0.15	3.24	2.43	1.68	1.26	TLC-AB-160122-07

Assessments at the Body with Body worn PMLN5657B w/ RLN6487A & RLN6488A

DUT assessment with offered antennas, default battery and, optional body worn accessory per KDB 643646. This body worn only compatible for short batteries. Optional short batteries were tested per the requirements of KDB 643646. Refer to Table 17 for highest output power channel. 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#
FAF5259A	PMNN4403B	PMLN5657B w/ RLN6487A & RLN6488A	NNTN8203A	406.125							
				422.125							
				438.500							
				454.500	5.70	-0.15	5.00	3.61	2.59	1.87	FIE-AB-160119-12
				470.000							
				472.000							
PMAE4065A	PMNN4403B	PMLN5657B w/ RLN6487A & RLN6488A	NNTN8203A	406.125							
				422.125							
				438.500							
				454.500	5.70	-0.19	5.04	3.64	2.63	1.90	FIE-AB-160119-13
				470.000							
				472.000							
Assessment of Additional Batteries											
PMAE4065A	NNTN7038B	PMLN5657B w/ RLN6487A & RLN6488A	NNTN8203A	454.500	5.70	-0.56	4.08	2.97	2.32	1.69	FIE-AB-160119-14
PMAE4065A	NNTN8930A	PMLN5657B w/ RLN6487A & RLN6488A	NNTN8203A	454.500	5.67	-0.56	3.87	2.88	2.21	1.65	FIE-AB-160119-15
PMAE4065A	PMNN4485A	PMLN5657B w/ RLN6487A & RLN6488A	NNTN8203A	454.500	5.70	-0.21	5.49	4.00	**2.88**	**2.10**	FIE-AB-160119-16
PMAE4065A	PMNN4486A	PMLN5657B w/ RLN6487A & RLN6488A	NNTN8203A	454.500	5.68	-0.22	4.91	3.50	2.59	1.85	TLC-AB-160121-04

Assessments at the Body with Body worn PMLN5658B w/ RLN6487A & RLN6488A

DUT assessment with offered antennas, default battery and, optional body worn accessory per KDB 643646. This body worn only compatible for short batteries. Optional short batteries were tested per the requirements of KDB 643646. Refer to Table 17 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 21

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#
FAF5259A	PMNN4403B	PMLN5658B w/ RLN6487A & RLN6488A	NNTN8203A	406.125							
				422.125							
				438.500							
				454.500	5.68	-0.22	4.03	3.01	2.13	1.59	TLC-AB-160121-05
				470.000							
				472.000							
PMAE4065A	PMNN4403B	PMLN5658B w/ RLN6487A & RLN6488A	NNTN8203A	406.125							
				422.125							
				438.500							
				454.500	5.67	-0.20	3.53	2.64	1.86	1.39	TLC-AB-160121-06
				470.000							
				472.000							
Assessment of Additional Batteries											
FAF5259A	NNTN7038B	PMLN5658B w/ RLN6487A & RLN6488A	NNTN8203A	454.500	5.65	-0.23	4.67	3.47	**2.48**	**1.85**	TLC-AB-160121-07
FAF5259A	NNTN8930A	PMLN5658B w/ RLN6487A & RLN6488A	NNTN8203A	454.500	5.60	-0.19	4.63	3.46	2.46	1.84	FIE-AB-160121-08
FAF5259A	PMNN4485A	PMLN5658B w/ RLN6487A & RLN6488A	NNTN8203A	454.500	5.70	-0.17	3.71	2.78	1.93	1.45	FIE-AB-160121-09
FAF5259A	PMNN4486A	PMLN5658B w/ RLN6487A & RLN6488A	NNTN8203A	454.500	5.70	-0.22	3.64	2.72	1.91	1.43	FIE-AB-160121-10

Assessments at the Body with Body worn PMLN5659B w/ RLN6487A & RLN6488A

DUT assessment with offered antennas, default battery and, optional body worn accessory per KDB 643646. This body worn only compatible for long batteries. Optional long batteries were tested per the requirements of KDB 643646. Refer to Table 17 for highest output power channel. 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#
FAF5259A	NNTN7573A	PMLN5659B w/ RLN6487A & RLN6488A	NNTN8203A	406.125							
				422.125							
				438.500							
				454.500	5.70	-0.40	5.51	4.06	3.02	2.23	FIE-AB-160122-08
				470.000							
				472.000							
PMAE4065A	NNTN7573A	PMLN5659B w/ RLN6487A & RLN6488A	NNTN8203A	406.125							
				422.125							
				438.500							
				454.500	5.70	-0.49	5.67	4.11	3.17	2.30	FIE-AB-160122-09
				470.000							
				472.000							
Assessment of Additional Batteries											
PMAE4065A	PMNN4494A	PMLN5659B w/ RLN6487A & RLN6488A	NNTN8203A	454.500	5.70	-0.15	5.78	4.14	2.99	2.14	FIE-AB-160122-12
PMAE4065A	NNTN7034B	PMLN5659B w/ RLN6487A & RLN6488A	NNTN8203A	454.500	5.70	-0.24	5.62	4.03	2.97	2.13	FIE-AB-160122-11
PMAE4065A	NNTN8921A	PMLN5659B w/ RLN6487A & RLN6488A	NNTN8203A	454.500	5.70	-0.30	5.58	3.91	2.99	2.09	FIE-AB-160122-13
PMAE4065A	PMNN4487A	PMLN5659B w/ RLN6487A & RLN6488A	NNTN8203A	454.500	5.70	-0.94	5.35	3.82	**3.32**	**2.37**	FIE-AB-160122-14
PMAE4065A	NNTN7037A	PMLN5659B w/ RLN6487A & RLN6488A	NNTN8203A	454.500	5.70	-0.34	6.06	4.29	3.28	2.32	FIE-AB-160122-15

Assessments at the Body with Body worn PMLN5660B w/ RLN6487A & RLN6488A

DUT assessment with offered antennas, default battery and, optional body worn accessory per KDB 643646. This body worn only compatible for long batteries. Optional long batteries were tested per the requirements of KDB 643646. Refer to Table 17 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

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#
FAF5259A	NNTN7573A	PMLN5660B w/ RLN6487A & RLN6488A	NNTN8203A	406.125							
				422.125							
				438.500							
				454.500	5.70	-0.26	4.06	3.01	2.16	1.60	FIE-AB-160124-02
				470.000							
				472.000							
PMAE4065A	NNTN7573A	PMLN5660B w/ RLN6487A & RLN6488A	NNTN8203A	406.125							
				422.125							
				438.500							
				454.500	5.70	-0.29	4.06	3.01	2.17	1.61	FIE-AB-160124-03
				470.000							
				472.000							
Assessment of Additional Batteries											
PMAE4065A	PMNN4494A	PMLN5660B w/ RLN6487A & RLN6488A	NNTN8203A	454.500	5.70	-0.32	2.50	1.85	1.35	1.00	FIE-AB-160124-05
PMAE4065A	NNTN7034B	PMLN5660B w/ RLN6487A & RLN6488A	NNTN8203A	454.500	5.70	-0.24	4.02	2.99	2.12	1.58	FIE-AB-160124-06
PMAE4065A	NNTN8921A	PMLN5660B w/ RLN6487A & RLN6488A	NNTN8203A	454.500	5.70	-0.21	3.44	2.56	1.81	1.34	FIE-AB-160124-07
PMAE4065A	PMNN4487A	PMLN5660B w/ RLN6487A & RLN6488A	NNTN8203A	454.500	5.70	-0.21	3.67	2.74	1.93	1.44	FIE-AB-160124-08
PMAE4065A	NNTN7037A	PMLN5660B w/ RLN6487A & RLN6488A	NNTN8203A	454.500	5.70	-0.33	4.04	3.02	**2.18**	**1.63**	FIE-AB-160124-09

Assessments at the Body with Body worn PMLN5659B w/ AY000223A01

DUT assessment with offered antennas, default battery and, optional body worn accessory per KDB 643646. This body worn only compatible for long batteries. Optional long batteries were tested per the requirements of KDB 643646. Refer to Table 17 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

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#
FAF5259A	NNTN7573A	PMLN5659B w/AY000223A01	NNTN8203A	406.125							
				422.125							
				438.500							
				454.500	5.70	-0.27	5.71	3.97	3.04	2.11	FIE-AB-160126-02
				470.000							
				472.000							
PMAE4065A	NNTN7573A	PMLN5659B w/AY000223A01	NNTN8203A	406.125							
				422.125							
				438.500							
				454.500	5.70	-0.32	5.50	3.85	2.96	2.07	FIE-AB-160126-03
				470.000							
				472.000							
Assessment of Additional Batteries											
FAF5259A	PMNN4494A	PMLN5659B w/AY000223A01	NNTN8203A	454.500	5.70	-0.28	5.94	3.43	3.17	1.83	FIE-AB-160126-06
FAF5259A	NNTN7034B	PMLN5659B w/AY000223A01	NNTN8203A	454.500	5.70	-0.30	6.06	4.33	**3.25**	**2.32**	FIE-AB-160126-05
FAF5259A	NNTN8921A	PMLN5659B w/AY000223A01	NNTN8203A	454.500	5.70	-0.36	5.86	3.99	3.18	2.17	FIE-AB-160126-07
FAF5259A	PMNN4487A	PMLN5659B w/AY000223A01	NNTN8203A	454.500	5.70	-0.35	5.85	4.16	3.17	2.25	FIE-AB-160126-08
FAF5259A	NNTN7037A	PMLN5659B w/AY000223A01	NNTN8203A	454.500	5.70	-0.25	5.72	3.95	3.03	2.09	FIE-AB-160126-09

Assessments at the Body with Body worn PMLN5659B w/NTN5243A

DUT assessment with offered antennas, default battery and, optional body worn accessory per KDB 643646. This body worn only compatible for long batteries. Optional long batteries were tested per the requirements of KDB 643646. Refer to Table 17 for highest output power channel. 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#
FAF5259A	NNTN7573A	PMLN5659B w/NTN5243A	NNTN8203A	406.125							
				422.125							
				438.500							
				454.500	5.70	-0.24	5.27	3.50	2.78	1.85	FIE-AB-160126-10
				470.000							
				472.000							
PMAE4065A	NNTN7573A	PMLN5659B w/NTN5243A	NNTN8203A	406.125							
				422.125							
				438.500							
				454.500	5.70	-0.38	4.78	3.19	2.61	1.74	FIE-AB-160126-11
				470.000							
				472.000							
Assessment of Additional Batteries											
FAF5259A	PMNN4494A	PMLN5659B w/NTN5243A	NNTN8203A	454.500	5.70	-0.27	6.00	3.44	**3.19**	**1.83**	FIE-AB-160126-12
FAF5259A	NNTN7034B	PMLN5659B w/NTN5243A	NNTN8203A	454.500	5.70	-0.34	5.36	3.78	2.90	2.04	AZ-AB-160126-13
FAF5259A	NNTN8921A	PMLN5659B w/NTN5243A	NNTN8203A	454.500	5.70	-0.37	5.47	3.61	2.98	1.97	AZ-AB-160126-14
FAF5259A	PMNN4487A	PMLN5659B w/NTN5243A	NNTN8203A	454.500	5.70	-0.29	5.79	3.56	3.09	1.90	AZ-AB-160126-15
FAF5259A	NNTN7037A	PMLN5659B w/NTN5243A	NNTN8203A	454.500	5.70	-0.21	5.26	3.52	2.76	1.85	AZ-AB-160126-16

Assessment at the Body with other audio accessories

Assessment per "KDB 643646 Body SAR Test Consideration for Audio Accessories without Built-in Antenna; Sec 1, A. when overall ≤ 4.0 W/kg, SAR tested for that audio accessory is not necessary." This was applicable to all remaining accessories.

Assessment of wireless BT configuration
Assessment using the overall highest SAR configuration at the body from above without an audio accessory attached. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 26

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#
PMAE4065A	PMNN4487A	PMLN5877A w/ RLN6487A & RLN6488A	None	406.125							
				422.125							
				438.500							
				454.500	5.68	-0.09	6.97	4.42	**3.57**	**2.26**	AZ-AB-160204-09
				470.000							
				472.000							

13.2 WLAN assessment at the Body for 802.11 b/g/n

The tables below represent the output power measurements for WLAN 2.4 GHz 802.11b/g/n for assessments at the Body using battery PMNN4403B because it is the thinnest battery (refer to Exhibit 7B for battery illustration). These power measurements were used to determine the necessary modes for SAR testing according to KDB 248227 D01 SAR Measurement Procedures for 802.11a/b/g/ Transmitters.

The battery was used during conducted power measurements for all test channels within FCC allocated frequency range (2.412-2.462 GHz) which are listed in Table 27. The channel with the highest conducted power will be identified as the default channel per KDB 643646 (SAR Test for PTT Radios). SAR plots of the highest results per Table (bolded) are presented in Appendix E.

SAR is not required for 802.11 g/n when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2W/kg.

Table 27

Mode	Channel #	Channel Frequency	Modulation	Battery: PMNN4403B Antenna port[mW]	Antenna Max Power [mW]
802.11b (1Mbps)	1	2412	DSSS	51.10	63.10
	6	2437		50.60	
	11	2462		47.60	
802.11g (6Mbps)	1	2412	OFDM	23.00	25.1
	6	2437		22.60	
	11	2462		21.10	
802.11n (MCS0)	1	2412	OFDM	14.10	15.5
	6	2437		14.40	
	11	2462		14.70	

802.11b was chosen over 802.11 g & n for testing because it has the highest max power

Assessments at the Body with all offered Body worn

DUT assessment with WLAN internal antenna, all offered batteries without any cable accessory attachment against phantom with all offered body worn. Refer to Table 27 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 28

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#
840093700002 WiFi Ant	PMNN4403B	HLN6875A	None	2412.000	0.051	-0.25	0.00	0.00	0.00	0.00	TLC-AB-160204-09
840093700002 WiFi Ant	PMNN4403B	PMLN5657B w/ RLN6487A & RLN6488A	None	2412.000	0.051	-1.10	0.02	0.01	0.02	0.01	ZR-AB-160204-10
840093700002 WiFi Ant	PMNN4403B	PMLN5658B w/ RLN6487A & RLN6488A	None	2412.000	0.051	-1.00	0.01	0.01	0.02	0.01	ZR-AB-160204-11
840093700002 WiFi Ant	PMNN4403B	PMLN6802A	None	2412.000	0.051	0.23	0.02	0.01	0.02	0.02	ZR-AB-160204-13
840093700002 WiFi Ant	NNTN7573A	PMLN5659B w/ RLN6487A & RLN6488A	None	2412.000	0.049	-0.03	0.01	0.00	0.01	0.01	FIE(ZWS)-AB-160204-16
840093700002 WiFi Ant	NNTN7573A	PMLN5660B w/ RLN6487A & RLN6488A	None	2412.000	0.049	0.04	0.05	0.03	**0.06**	**0.04**	FIE(ZWS)-AB-160204-17
840093700002 WiFi Ant	NNTN7573A	PMLN5659B w/AY000223A01	None	2412.000	0.049	-0.19	0.02	0.01	0.02	0.01	FIE(ZWS)-AB-160204-20
840093700002 WiFi Ant	NNTN7573A	PMLN5659B w/NTN5243A	None	2412.000	0.049	0.16	0.01	0.01	0.01	0.01	TLC(ZWS)-AB-160204-21

Table 28 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#
Assessment of Additional Batteries											
84009370002 WiFi Ant	NNTN7034B	PMLN5660B w/ RLN6487A & RLN6488A	None	2412.000	0.050	-0.28	0.01	0.00	0.01	0.00	ZR-AB-160205-03
84009370002 WiFi Ant	NNTN8921A	PMLN5660B w/ RLN6487A & RLN6488A	None	2412.000	0.049	-0.26	0.01	0.01	0.02	0.01	ZR-AB-160205-04
84009370002 WiFi Ant	PMNN4487A	PMLN5660B w/ RLN6487A & RLN6488A	None	2412.000	0.049	0.19	0.02	0.01	0.03	0.02	ZR-AB-160205-05
84009370002 WiFi Ant	NNTN7037A	PMLN5660B w/ RLN6487A & RLN6488A	None	2412.000	0.050	-0.86	0.01	0.00	0.01	0.01	ZR-AB-160205-06
84009370002 WiFi Ant	PMNN4494A	PMLN5660B w/ RLN6487A & RLN6488A	None	2412.000	0.051	-0.54	0.02	0.01	0.02	0.02	KKL(ZWS)-AB-160205-07

13.3 LMR assessments at the Face for 406.125-472 MHz band

Battery PMNN4494A was selected as the default battery for assessments at the Face because it has the highest capacity (refer to Exhibit 7B for battery illustration). The default battery was used during conducted power measurements for all test channels within FCC allocated frequency range (406.125 – 472 MHz) which are listed in Table 29. The channel with the highest conducted power will be identified as the default channel per KDB 643646 (SAR Test for PTT Radios). SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 29

Test Freq (MHz)	Power (W)
406.125	5.68
422.125	5.70
438.500	5.59
454.500	5.69
470.000	5.69
472.000	5.69

Assessments with front of radio facing the Face

DUT assessment with offered antennas, default battery with front of DUT positioned 2.5cm facing phantom per KDB 643646. Optional batteries were tested per the requirements of KDB 643646. Refer to Table 29 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 30

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#
FAF5259A	PMNN4494A	None, radio at front	None	406.125							
				422.125	5.70	-0.29	4.80	3.56	2.57	1.90	MO-FACE-160129-21
				438.500							
				454.500							
				470.000							
				472.000							
PMAE4065A	PMNN4494A	None, radio at front	None	406.125							
				422.125	5.70	-0.20	3.86	2.87	2.02	1.50	MO-FACE-160129-22
				438.500							
				454.500							
				470.000							
				472.000							
Assessment of Additional Batteries											
FAF5259A	NNTN7034B	None, radio at front	None	422.125	5.70	-0.39	6.77	5.05	3.70	2.76	MO-FACE-160129-23
FAF5259A	NNTN8921A	None, radio at front	None	422.125	5.70	-0.40	5.16	3.84	2.83	2.11	MO-FACE-160130-01
FAF5259A	PMNN4487A	None, radio at front	None	422.125	5.70	-0.21	4.02	3.00	2.11	1.57	MO-FACE-160130-02
FAF5259A	NNTN7573A	None, radio at front	None	422.125	5.70	-0.44	6.78	5.10	3.75	2.82	MO-FACE-160130-03
FAF5259A	NNTN7037A	None, radio at front	None	422.125	5.70	-0.36	6.57	4.94	3.57	2.68	MO-FACE-160130-04
FAF5259A	PMNN4403B	None, radio at front	None	422.125	5.70	-0.55	7.94	5.84	4.51	3.31	MO-FACE-160130-05
FAF5259A	NNTN7038B	None, radio at front	None	422.125	5.70	-0.45	7.71	5.74	4.28	3.18	MO-FACE-160130-06
FAF5259A	NNTN8930A	None, radio at front	None	422.125	5.64	-0.58	6.16	4.58	3.56	2.65	MO-FACE-160130-07
FAF5259A	PMNN4485A	None, radio at front	None	422.125	5.70	-0.30	8.82	6.49	**4.73**	**3.48**	FIE-FACE-160131-06
FAF5259A	PMNN4486A	None, radio at front	None	422.125	5.70	-0.34	8.02	5.97	4.34	3.23	FIE-FACE-160131-07

Assessments with back of radio facing the Face

DUT assessment with offered antennas, default battery with back of DUT positioned 2.5cm facing phantom per KDB 643646. Optional batteries were tested per the requirements of KDB 643646. Refer to Table 29 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 31

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#
FAF5259A	PMNN4494A	None, radio at back	None	406.125							
				422.125	5.70	-0.25	3.17	2.37	1.68	1.26	FIE-FACE-160131-09
				438.500							
				454.500							
				470.000							
				472.000							
PMAE4065A	PMNN4494A	None, radio at back	None	406.125							
				422.125	5.70	-0.24	2.76	2.06	1.46	1.09	FIE-FACE-160131-10
				438.500							
				454.500							
				470.000							
				472.000							
Assessment of Additional Batteries											
FAF5259A	NNTN7034B	None, radio at back	None	422.125	5.70	-0.40	7.84	5.86	4.30	3.21	FIE-FACE-160201-05
FAF5259A	NNTN8921A	None, radio at back	None	422.125	5.70	-0.34	5.88	4.37	3.18	2.36	FIE-FACE-160201-02
FAF5259A	PMNN4487A	None, radio at back	None	422.125	5.70	-0.30	3.15	2.35	1.69	1.26	FIE-FACE-160201-03
FAF5259A	NNTN7573A	None, radio at back	None	422.125	5.70	-0.32	7.06	5.27	3.80	2.84	FIE-FACE-160201-04
FAF5259A	NNTN7037A	None, radio at back	None	422.125	5.70	-0.31	7.24	5.41	3.89	2.91	FIE-FACE-160201-07
FAF5259A	PMNN4403B	None, radio at back	None	422.125	5.70	-0.61	7.47	5.54	4.30	3.19	FIE-FACE-160201-08
FAF5259A	NNTN7038B	None, radio at back	None	422.125	5.70	-0.49	8.04	6.00	4.50	3.36	FIE-FACE-160201-09
FAF5259A	NNTN8930A	None, radio at back	None	422.125	5.70	-0.72	6.52	4.85	3.85	2.86	FIE-FACE-160201-10
FAF5259A	PMNN4485A	None, radio at back	None	422.125	5.70	-0.36	7.94	5.91	4.31	3.21	FIE-FACE-160201-11
FAF5259A	PMNN4486A	None, radio at back	None	422.125	5.70	-0.44	8.73	6.50	**4.83**	**3.60**	FIE-FACE-160201-12

13.4 WLAN assessment at the Face for 802.11 b/g/n

The tables below represent the output power measurements for WLAN 2.4 GHz 802.11b/g/n for assessments at the Face using battery PMNN4494A because it is has the highest capacity (refer to Exhibit 7B for battery illustration). These power measurements were used to determine the necessary modes for SAR testing according to KDB 248227 D01 SAR Measurement Procedures for 802.11a/b/g/ Transmitters.

The battery was used during conducted power measurements for all test channels within FCC allocated frequency range (2.412-2.462GHz) which are listed in Table 32. The channel with the highest conducted power will be identified as the default channel per KDB 643646 (SAR Test for PTT Radios). SAR plots of the highest results per Table (bolded) are presented in Appendix E.

SAR is not required for 802.11 g/n when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2W/kg.

Table 32

Mode	Channel #	Channel Frequency	Modulation	Battery: PMNN4494A Antenna port[mW]	Antenna Max Power [mW]
802.11b (1Mbps)	1	2412	DSSS	51.80	63.10
	6	2437		51.40	
	11	2462		49.50	
802.11g (6Mbps)	1	2412	OFDM	22.20	25.1
	6	2437		22.10	
	11	2462		22.60	
802.11n (MCS0)	1	2412	OFDM	14.30	15.5
	6	2437		13.60	
	11	2462		13.80	

802.11b was chosen over 802.11 g & n for testing because it has the highest max power

DUT assessment with WLAN internal antenna with front and back of the DUT 2.5 cm from phantom with all offered batteries. Refer to Table 32 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 33

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#
84009370002 WiFi Ant	PMNN4494A	2.5cm @ Front	None	2412.000	0.0517	0.24	0.13	0.08	0.16	0.09	TLC-FACE-160206-04
84009370002 WiFi Ant	PMNN4494A	2.5cm @ Back	None	2412.000	0.0517	0.47	0.01	0.01	0.01	0.01	FIE(ZWS)-FACE-160203-07
Assessment of Additional Batteries											
84009370002 WiFi Ant	NNTN7034B	2.5cm @ Front	None	2412.000	0.0501	0.06	0.12	0.07	0.15	0.09	FIE(ZWS)-FACE-160203-08
84009370002 WiFi Ant	NNTN8921A	2.5cm @ Front	None	2412.000	0.0494	0.95	0.13	0.07	0.17	0.09	FIE(ZWS)-FACE-160203-09
84009370002 WiFi Ant	PMNN4487A	2.5cm @ Front	None	2412.000	0.0491	0.38	0.13	0.08	0.17	0.10	TLC(ZWS)-FACE-160203-10
84009370002 WiFi Ant	NNTN7573A	2.5cm @ Front	None	2412.000	0.0487	-0.29	0.12	0.07	0.17	0.09	TLC(ZWS)-FACE-160203-11
84009370002 WiFi Ant	NNTN7037A	2.5cm @ Front	None	2412.000	0.0501	0.51	0.12	0.07	0.15	0.09	TLC(ZWS)-FACE-160203-12
84009370002 WiFi Ant	PMNN4403B	2.5cm @ Front	None	2412.000	0.0505	0.66	0.17	0.10	**0.22**	**0.12**	TLC-FACE-160204-04
84009370002 WiFi Ant	NNTN7038B	2.5cm @ Front	None	2412.000	0.0502	0.30	0.11	0.06	0.14	0.08	TLC-FACE-160203-14
84009370002 WiFi Ant	NNTN8930A	2.5cm @ Front	None	2412.000	0.0495	-0.02	0.12	0.07	0.15	0.09	TLC-FACE-160204-01
84009370002 WiFi Ant	PMNN4485A	2.5cm @ Front	None	2412.000	0.0493	0.42	0.15	0.08	0.19	0.11	TLC-FACE-160204-02
84009370002 WiFi Ant	PMNN4486A	2.5cm @ Front	None	2412.000	0.0497	0.02	0.12	0.07	0.15	0.09	TLC-FACE-160204-03

13.5 Assessment for Industry Canada

Based on the assessment results for body and face per KDB643646, additional tests were not required for Industry Canada frequency range (406.125-430 MHz) and (450-470 MHz) as testing performed is in compliance with Industry Canada frequency range.

13.6 Assessment at the Bluetooth band

13.6.1 FCC Requirement

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)] *[$\sqrt{F_{(GHz)}}$] = 2.4 W/kg, which is ≤ 3 W/kg (1g)

Where:

Max. Power = 7.61mW (10mW*76.1% 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.

13.6.2 Industry Canada Requirement

Based on RSS-102 Issue 5, exemption limits for SAR evaluation for controlled devices at Bluetooth frequency band with separation distance ≤ 5mm was 20 mW.

Standalone Bluetooth transmitter operates at

Maximum conducted power:
= 10 mW * 76.1%
= 7.61 mW or 8.81 dBm

Equivalent isotropically radiated power (EIRP):
= Maximum conducted power, dBm + Antenna gain, dBi
= 8.81 dBm + 2.58 dBi
=11.39 dBm or 13.77 mW

Higher output power level, EIRP 13.77 mW was below the threshold power level 20 mW. Hence SAR test was not required for Bluetooth band.

13.7 Assessment outside FCC Part 90

Assessment of outside FCC Part 90 using highest SAR configuration from above. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 34

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#
Body											
FAF5259A	PMNN4487A	PMLN5659B w/ RLN6487A & RLN6488A	None	380.000	5.70	-0.71	3.40	2.53	2.00	1.49	FIE(FD)-AB-160129-13
				393.000	5.70	-0.77	4.28	2.70	**2.56**	**1.61**	FIE(FD)-AB-160129-14
PMAE4065A	PMNN4487A	PMLN5659B w/ RLN6487A & RLN6488A	None	380.000	5.70	-0.69	4.24	2.85	2.49	1.67	FIE(FD)-AB-160129-15
				393.000	5.65	-0.69	4.22	2.79	2.50	1.65	FIE(FD)-AB-160129-16
Face											
FAF5259A	PMNN4486A	None, radio at back	None	380.000	5.70	-0.36	2.73	2.01	1.48	1.09	MO-FACE-160202-17
				393.000	5.70	-0.14	4.37	3.23	2.26	1.67	MO-FACE-160202-18
PMAE4065A	PMNN4486A	None, radio at back	None	380.000	5.70	-0.27	4.51	3.33	2.40	1.77	MO-FACE-160202-19
				393.000	5.70	-0.15	6.25	4.62	**3.23**	**2.39**	MO-FACE-160202-20

13.8 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 F.

Table 35

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#
FAF5259A	PMNN4486A	None ,radio at back	None	422.125	5.70	-0.21	9.13	6.80	4.79	3.57	FIE-FACE-160201-13

14.0 Simultaneous Transmission Exclusion for BT

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] = 0.32 W/kg, which is ≤ 0.4 W/kg (1g)

Where:

X = 7.5 for 1g-SAR; 18.75 for 10g
Max. Power = 7.61mW (10mW*76.1% duty cycle)
Min. test separation distance = 5mm for actual test separation < 5mm
F(GHz) = 2.48 GHz

Per the result from the calculation above, simultaneous exclusion is applied and therefore SAR results are not reported herein.

15.0 Simultaneous Transmission between LMR, WLAN and BT

These devices use a single transmitter module and antenna for both WLAN and BT. WLAN and BT cannot transmit simultaneously. Simultaneous transmission for BT had been excluded as mentioned in section 14.0. The maximum sourced-based-time-averaged output power for 802.11 b is 63.1mW while BT is 7.61mW. Therefore the measured SAR from 802.11b is used in conjunction with LMR for simultaneous results.

The Table below summarizes the simultaneous transmissions between LMR and WLAN bands.

Table 36

		LMR Bands
	Freq. (MHz)	UHF (406.125-472 MHz)
WLAN Band	2412 - 2462	√

16.0 Results Summary

Based on the test guidelines from section 4.0 and satisfying frequencies within FCC bands and Industry Canada Frequency bands, the highest Operational Maximum Calculated 1-gram and 10-gram average SAR values found for this filing:

Table 37

Technologies	Frequency band (MHz)	Max Calc at Body (W/kg)		Max Calc at Face (W/kg)	
		1g-SAR	10g-SAR	1g-SAR	10g-SAR
FCC					
LMR	406.125-472	3.57	2.26	4.83	3.60
WLAN	2412-2462	0.06	0.04	0.22	0.12
Industry Canada					
LMR	406.125-430; 450-470	3.57	2.26	4.83	3.60
WLAN	2412-2462	0.06	0.04	0.22	0.12
Overall					
LMR	380-472	3.57	2.26	4.83	3.60
WLAN	2412-2462	0.06	0.04	0.22	0.12

All results are scaled to the maximum output power.

The highest combined 1g-SAR results for simultaneous is indicated in the following Table:

Table 38

Designator	Frequency bands	Combined 1g-SAR (W/kg)	Combined 10g-SAR (W/kg)
Body			
FCC	LMR (406.125-472 MHz) and WLAN band	3.63	2.30
Industry Canada	LMR (406.125-430 MHz; 450-470 MHz) and WLAN band	3.63	2.30
Overall	LMR (380-472 MHz) and WLAN band	3.63	2.30
Face			
FCC	LMR (406.125-472 MHz) and WLAN band	5.05	3.72
Industry Canada	LMR (406.125-430 MHz; 450-470 MHz) and WLAN band	5.05	3.72
Overall	LMR (380-472 MHz) and WLAN band	5.05	3.72

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 OET Bulletin 65. The 10 grams result is not applicable to FCC filing.

17.0 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 39

Run#	Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq. (MHz)	Adj Calc. 1g-SAR (W/kg)	Ratio	Comments
FIE-FACE-160201-12	FAF5259A	PMNN4486A	None, radio at back	None	422.125	4.83	1.01	No additional repeated scans is required due to the Ratio (SAR_{high}/SAR_{low}) < 1.20 and SAR not greater than 7.25W/kg.
FIE-FACE-160201-13						4.79		

18.0 System Uncertainty

A system uncertainty analysis is not required for this report per KDB 865664 because the highest report SAR value Occupational exposure 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

Table A.1: Uncertainty Budget for Device Under Test, for 450 MHz

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	6.7	N	1.00	1	1	6.7	6.7	∞
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	477
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				23	22	

Notes for uncertainty budget Tables:
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

Table A.2: Uncertainty Budget for Device Under Test, for 2450 MHz

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.**	**ci (1 g)**	**ci (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 Tables:
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

Table A.3: Uncertainty Budget for System Validation (dipole & flat phantom) for 450 MHz

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	6.7	N	1.00	1	1	6.7	6.7	∞
Axial Isotropy	E.2.2	4.7	R	1.73	1	1	2.7	2.7	∞
Spherical Isotropy	E.2.2	9.6	R	1.73	0	0	0.0	0.0	∞
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	0.0	R	1.73	1	1	0.0	0.0	∞
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 Mechanical 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	∞
Dipole									
Dipole Axis to Liquid Distance	8, E.4.2	2.0	R	1.73	1	1	1.2	1.2	∞
Input Power and SAR Drift Measurement	8, 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	R	1.73	0.64	0.43	1.2	0.8	∞
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	R	1.73	0.6	0.49	0.6	0.5	∞
Combined Standard Uncertainty			RSS				10	9	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				19	18	

Notes for uncertainty budget Tables:
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

Table A.4: Uncertainty Budget for System Validation (dipole & flat phantom) for 2450 MHz

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	1	1	2.7	2.7	∞
Spherical Isotropy	E.2.2	9.6	R	1.73	0	0	0.0	0.0	∞
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	0.0	R	1.73	1	1	0.0	0.0	∞
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 Mechanical 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	∞
Dipole									
Dipole Axis to Liquid Distance	8, E.4.2	2.0	R	1.73	1	1	1.2	1.2	∞
Input Power and SAR Drift Measurement	8, 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	R	1.73	0.64	0.43	1.2	0.8	∞
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	R	1.73	0.6	0.49	0.6	0.5	∞
Combined Standard Uncertainty			RSS				9	9	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				18	17	

Notes for uncertainty budget Tables:
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
C Service suisse d'étalonnage
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 0108

Client **Motorola Solutions MY**

Certificate No: **ES3-3122_Jun15**

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3122
Calibration procedure(s)	QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	June 19, 2015

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	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
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-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: June 20, 2015

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

Certificate No: ES3-3122_Jun15 Page 1 of 12

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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 0108**

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 E²-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:3122

Manufactured: July 11, 2006
Calibrated: June 19, 2015

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3122

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.34	1.22	1.42	± 10.1 %
DCP (mV)[B]	102.6	103.7	101.0	

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	209.7	±3.0 %
		Y	0.0	0.0	1.0		202.5	
		Z	0.0	0.0	1.0		200.4	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	27.38	99.6	27.9	9.39	147.3	±2.5 %
		Y	27.71	99.5	27.9		147.9	
		Z	26.04	99.6	28.1		137.2	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	27.85	100.0	28.2	9.57	143.3	±2.5 %
		Y	26.86	99.4	28.1		145.7	
		Z	25.67	99.3	28.0		131.5	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	38.46	99.1	25.1	6.56	119.9	±1.9 %
		Y	41.64	99.6	25.1		149.5	
		Z	29.41	94.8	23.6		137.4	
10025-DAB	EDGE-FDD (TDMA, 8PSK, TN 0)	X	13.71	94.1	35.6	12.62	94.9	±2.7 %
		Y	15.75	99.6	38.3		92.3	
		Z	12.29	91.8	34.9		87.0	
10026-DAB	EDGE-FDD (TDMA, 8PSK, TN 0-1)	X	15.93	94.8	32.6	9.55	121.3	±2.5 %
		Y	19.12	99.6	34.3		147.2	
		Z	19.09	99.8	34.3		135.4	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	57.39	99.7	23.3	4.80	132.9	±1.9 %
		Y	54.04	99.8	23.6		131.2	
		Z	59.21	99.7	23.1		122.7	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	62.80	99.8	22.5	3.55	139.9	±2.2 %
		Y	62.85	99.6	22.4		138.5	
		Z	84.57	99.8	21.6		129.1	
10029-DAB	EDGE-FDD (TDMA, 8PSK, TN 0-1-2)	X	18.17	94.0	30.7	7.78	137.1	±2.7 %
		Y	19.76	99.6	33.0		134.5	
		Z	15.07	93.3	30.5		125.4	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	4.90	66.8	18.9	4.57	144.7	±1.2 %
		Y	4.88	67.3	19.3		145.2	
		Z	4.65	66.0	18.3		136.8	
10056-DAB	EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3)	X	14.14	91.7	29.2	6.52	142.1	±1.9 %
		Y	18.63	98.5	31.7		141.2	
		Z	11.43	87.2	27.3		131.6	
10081-CAB	CDMA2000 (1xRTT, RC3)	X	3.96	65.9	18.2	3.97	138.0	±0.7 %
		Y	3.99	66.5	18.8		138.7	
		Z	3.77	65.0	17.6		131.9	

10090-DAB	GPRS-FDD (TDMA, GMSK, TN 0-4)	X	42.71	99.9	25.1	6.56	147.2	±1.9 %
		Y	39.29	99.6	25.2		119.4	
		Z	40.45	99.7	25.0		135.9	
10099-DAB	EDGE-FDD (TDMA, 8PSK, TN 0-4)	X	10.62	86.0	29.5	9.55	98.1	±3.0 %
		Y	15.63	97.2	34.3		96.6	
		Z	10.00	85.3	29.3		91.4	
10290-AAB	CDMA2000, RC1, SO55, Full Rate	X	4.46	67.1	18.8	3.91	143.1	±0.9 %
		Y	4.40	67.5	19.0		143.6	
		Z	4.15	66.0	17.9		134.7	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.63	66.2	18.1	3.46	137.6	±0.7 %
		Y	3.65	66.8	18.7		138.2	
		Z	3.40	65.0	17.3		130.5	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.58	66.3	18.2	3.39	137.5	±0.7 %
		Y	3.63	67.1	18.8		137.8	
		Z	3.39	65.3	17.5		130.2	
10293-AAB	CDMA2000, RC3, SO3, Full Rate	X	3.68	66.4	18.3	3.50	137.4	±0.7 %
		Y	3.67	66.8	18.7		138.4	
		Z	3.43	65.0	17.3		130.3	
10295-AAB	CDMA2000, RC1, SO3, 1/8th Rate 25 fr.	X	14.16	89.1	34.0	12.49	103.9	±2.2 %
		Y	19.23	99.8	38.9		102.8	
		Z	14.30	90.8	35.0		94.2	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.62	66.7	17.9	3.76	127.8	±0.7 %
		Y	4.64	67.4	18.4		127.7	
		Z	4.57	66.9	17.8		142.5	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.75	67.7	18.4	3.77	149.9	±0.7 %
		Y	4.74	68.3	18.9		149.9	
		Z	4.41	66.6	17.7		140.6	
10406-AAA	CDMA2000, RC3, SO32, SCH0, Full Rate	X	6.18	67.6	19.1	5.22	132.8	±1.2 %
		Y	6.23	68.4	19.6		132.7	
		Z	6.19	68.1	19.1		148.3	

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 7)
[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:3122

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)
150	52.3	0.76	7.00	7.00	7.00	0.08	1.20	± 13.3 %
300	45.3	0.87	6.79	6.79	6.79	0.15	1.20	± 13.3 %
450	43.5	0.87	6.79	6.79	6.79	0.21	1.30	± 13.3 %
750	41.9	0.89	6.39	6.39	6.39	0.33	1.76	± 12.0 %
900	41.5	0.97	6.02	6.02	6.02	0.46	1.51	± 12.0 %
1810	40.0	1.40	5.07	5.07	5.07	0.59	1.40	± 12.0 %
1900	40.0	1.40	5.02	5.02	5.02	0.80	1.16	± 12.0 %
2450	39.2	1.80	4.46	4.46	4.46	0.80	1.31	± 12.0 %

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

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

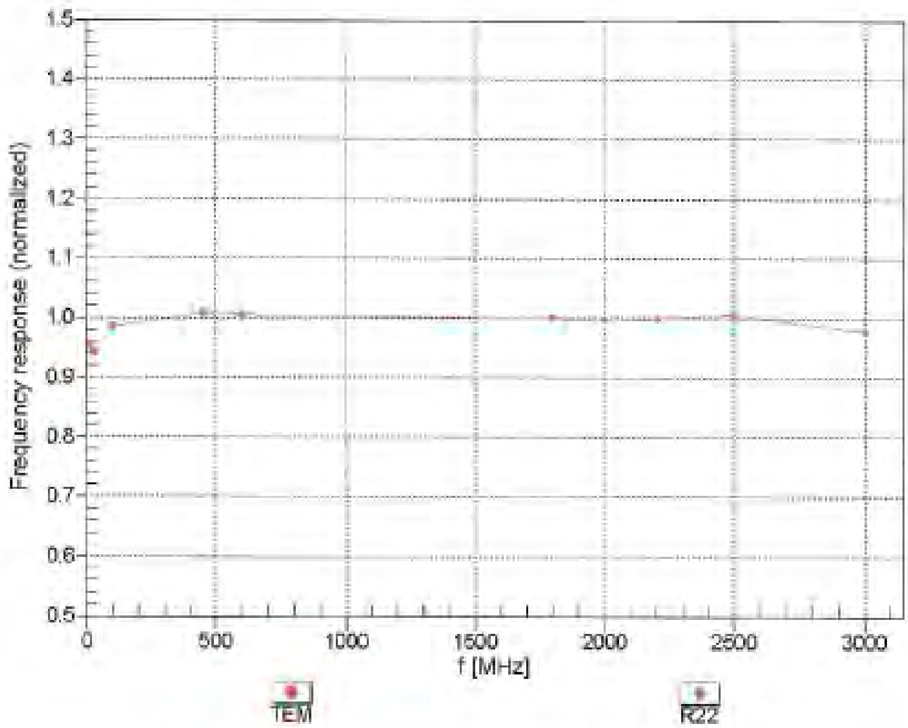
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3122

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)
150	61.9	0.80	6.58	6.58	6.58	0.06	1.20	± 13.3 %
300	58.2	0.92	6.71	6.71	6.71	0.12	1.30	± 13.3 %
450	56.7	0.94	6.78	6.78	6.78	0.15	1.30	± 13.3 %
750	55.5	0.96	6.06	6.06	6.06	0.55	1.38	± 12.0 %
900	55.0	1.05	5.88	5.88	5.88	0.46	1.45	± 12.0 %
1810	53.3	1.52	4.74	4.74	4.74	0.38	1.85	± 12.0 %
1900	53.3	1.52	4.63	4.63	4.63	0.43	1.76	± 12.0 %
2450	52.7	1.95	4.28	4.28	4.28	0.80	1.20	± 12.0 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

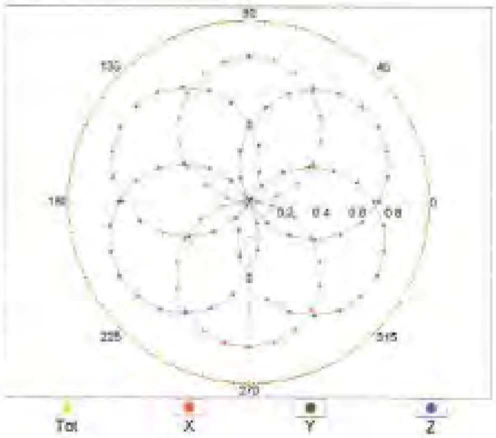
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



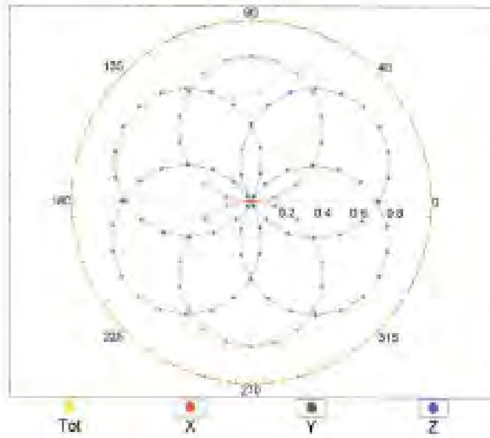
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

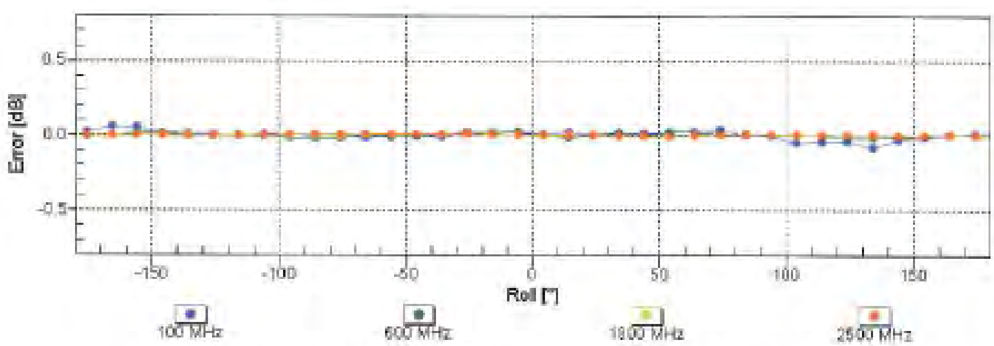
Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM



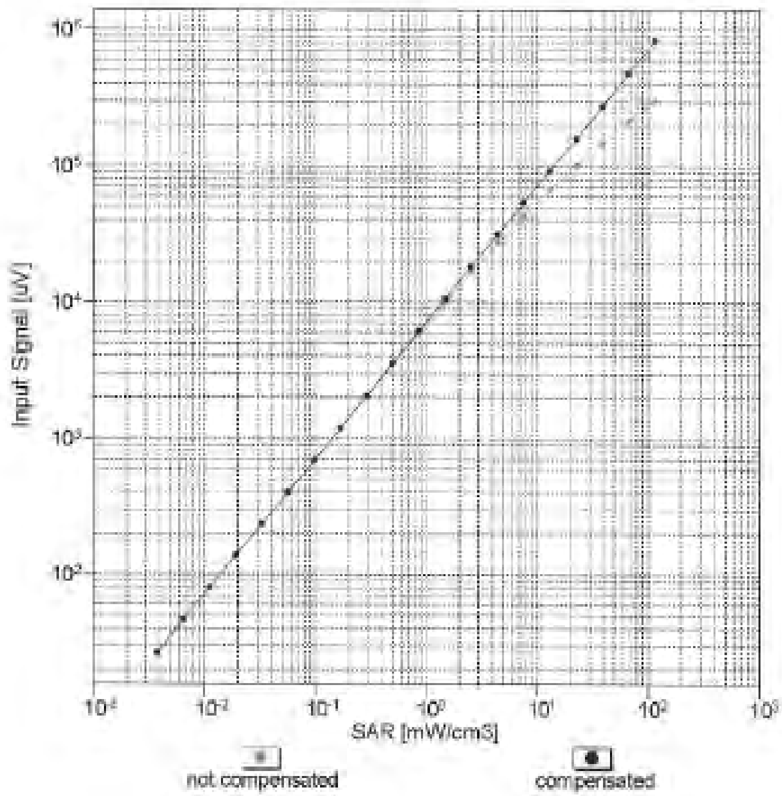
f=1800 MHz,R22

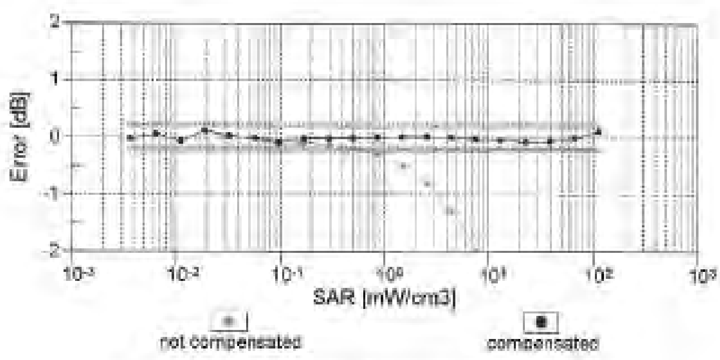




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

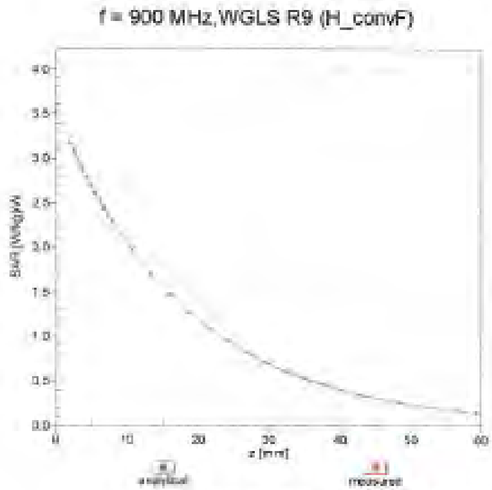


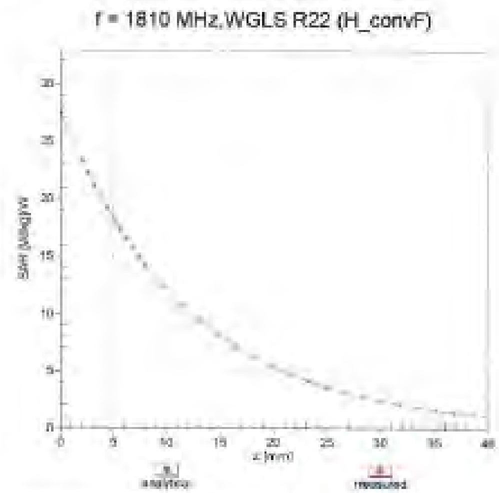


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

ES3DV3– SN:3122 June 19, 2015

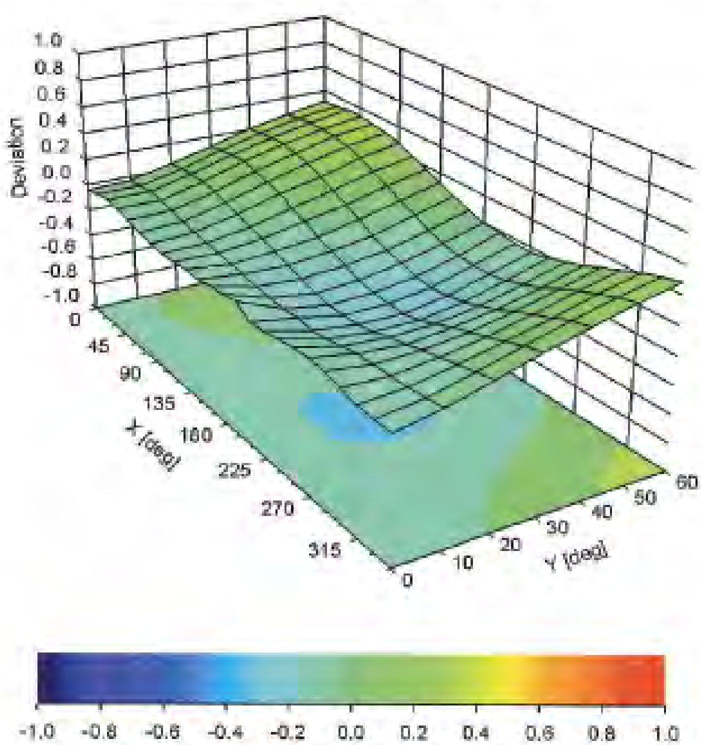
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (φ, θ), f = 900 MHz



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

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DASY/EASY - Parameters of Probe: ES3DV3 - SN:3122

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	24.1
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

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

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Accreditation No.: **SCS 0108**

Client **Motorola Solutions MY**

Certificate No: **EX3-7364_Jun15**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:7364

Calibration procedure(s): QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: June 23, 2015

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	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
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-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: June 24, 2015

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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 EX3DV4

SN:7364

Manufactured: February 5, 2015
Calibrated: June 23, 2015

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7364

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.48	0.46	0.59	± 10.1 %
DCP (mV)[B]	97.7	96.3	97.3	

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	115.0	±3.5 %
		Y	0.0	0.0	1.0		110.5	
		Z	0.0	0.0	1.0		124.6	
10011-CAB	UMTS-FDD (WCDMA)	X	3.42	67.2	18.6	2.91	122.6	±0.5 %
		Y	3.14	64.8	16.9		117.5	
		Z	3.46	67.3	18.5		135.3	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.86	68.1	18.5	1.87	122.4	±0.5 %
		Y	2.39	63.9	15.8		117.3	
		Z	3.01	69.0	18.8		135.0	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	10.47	68.7	22.2	9.46	115.4	±2.7 %
		Y	10.30	68.1	21.6		107.3	
		Z	10.58	69.3	22.6		126.2	
10059-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)	X	3.03	69.0	19.0	2.12	120.5	±0.5 %
		Y	2.58	65.1	16.6		115.0	
		Z	2.93	68.2	18.4		133.3	
10060-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps)	X	3.74	77.3	22.8	2.83	148.9	±0.5 %
		Y	2.75	70.3	19.2		141.7	
		Z	3.40	75.1	21.8		118.6	
10061-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	X	3.83	73.4	21.4	3.60	145.6	±0.7 %
		Y	3.06	68.2	18.5		139.1	
		Z	3.96	74.0	21.7		117.9	
10062-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	10.17	66.5	21.5	8.68	116.8	±2.5 %
		Y	9.91	67.6	20.8		107.4	
		Z	10.39	69.3	22.0		132.5	
10063-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps)	X	10.01	66.4	21.4	8.63	116.3	±2.5 %
		Y	9.85	67.7	20.9		108.8	
		Z	10.24	69.2	22.0		131.7	
10064-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps)	X	10.46	68.7	21.9	9.09	117.4	±2.7 %
		Y	10.34	68.2	21.3		110.7	
		Z	10.69	69.6	22.5		132.1	
10065-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps)	X	10.10	68.4	21.7	9.00	113.5	±2.5 %
		Y	10.01	68.0	21.2		107.5	
		Z	10.29	69.2	22.2		127.6	
10066-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps)	X	10.32	68.7	22.1	9.38	113.2	±2.5 %
		Y	10.20	68.1	21.6		106.0	
		Z	10.49	69.4	22.6		125.8	

10067-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps)	X	10.93	69.1	22.8	10.12	111.9	±3.0 %
		Y	10.70	68.6	22.3		105.5	
		Z	11.04	70.0	23.5		126.5	
10068-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps)	X	10.64	69.0	22.9	10.24	108.5	±3.3 %
		Y	11.07	70.0	23.2		145.3	
		Z	10.83	69.9	23.5		121.7	
10069-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps)	X	10.95	69.2	23.2	10.56	109.6	±3.5 %
		Y	11.38	70.3	23.6		148.1	
		Z	11.13	70.1	23.8		122.0	
10071-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 9 Mbps)	X	10.46	68.7	22.4	9.83	110.6	±2.5 %
		Y	10.36	68.2	21.9		105.8	
		Z	10.71	69.8	23.1		124.2	
10072-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps)	X	10.01	68.4	22.2	9.62	106.7	±3.0 %
		Y	10.38	69.2	22.4		144.1	
		Z	10.18	69.1	22.7		119.4	
10073-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 18 Mbps)	X	10.78	70.9	23.8	9.94	149.7	±3.0 %
		Y	10.27	69.1	22.6		139.1	
		Z	10.17	69.3	23.1		115.9	
10074-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps)	X	10.82	71.0	24.2	10.30	144.0	±3.3 %
		Y	10.30	69.2	22.9		133.6	
		Z	10.22	69.5	23.4		111.6	
10075-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps)	X	10.91	71.3	24.8	10.77	138.9	±3.3 %
		Y	10.34	69.2	23.3		129.4	
		Z	10.31	69.7	23.9		108.0	
10076-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps)	X	10.84	71.1	24.9	10.94	134.9	±3.3 %
		Y	10.25	69.0	23.3		125.9	
		Z	10.28	69.7	24.1		106.3	
10077-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)	X	10.81	71.1	24.9	11.00	133.2	±3.5 %
		Y	10.23	69.1	23.4		124.7	
		Z	11.06	72.3	25.8		148.3	
10097-CAB	UMTS-FDD (HSDPA)	X	4.64	66.4	18.3	3.98	129.4	±0.7 %
		Y	4.47	65.1	17.4		126.4	
		Z	4.82	67.2	18.8		144.7	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.66	66.5	18.4	3.98	130.1	±0.7 %
		Y	4.50	65.3	17.5		126.7	
		Z	4.78	67.0	18.7		145.5	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.59	67.6	19.7	5.67	136.1	±1.4 %
		Y	6.37	66.4	18.8		131.7	
		Z	6.14	66.0	18.9		107.5	
10101-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	X	7.69	67.9	20.1	6.42	146.1	±1.7 %
		Y	7.50	67.0	19.4		140.3	
		Z	7.24	66.6	19.5		115.2	
10102-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)	X	8.00	68.2	20.4	6.60	148.5	±1.7 %
		Y	7.78	67.2	19.6		141.8	
		Z	7.54	66.9	19.7		117.4	

10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.41	67.0	19.5	5.80	133.0	±1.2 %
		Y	6.24	66.1	18.8		128.4	
		Z	6.04	65.7	18.9		106.2	
10109-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	X	7.40	67.6	20.0	6.43	141.0	±1.7 %
		Y	7.23	66.7	19.3		135.5	
		Z	6.98	66.3	19.4		111.0	
10110-CAC	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.05	66.5	19.2	5.75	129.1	±1.4 %
		Y	5.89	65.5	18.5		124.3	
		Z	6.26	67.4	19.8		145.9	
10111-CAC	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	X	7.12	67.4	20.0	6.44	136.5	±1.4 %
		Y	6.94	66.5	19.2		130.6	
		Z	6.69	66.0	19.3		107.3	
10112-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)	X	7.64	67.8	20.2	6.59	142.4	±1.7 %
		Y	7.46	66.9	19.5		136.7	
		Z	7.21	66.5	19.6		111.3	
10113-CAC	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)	X	7.32	67.5	20.1	6.62	137.7	±1.7 %
		Y	7.15	66.6	19.4		131.4	
		Z	6.92	66.2	19.4		108.9	
10114-CAB	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.23	68.5	21.0	8.10	124.2	±2.5 %
		Y	10.04	67.9	20.5		117.0	
		Z	10.56	69.5	21.7		142.7	
10115-CAB	IEEE 802.11n (HT Greenfield, 81 Mbps, 16-QAM)	X	10.80	69.1	21.5	8.46	128.6	±2.5 %
		Y	10.61	68.5	21.0		120.9	
		Z	11.08	70.0	22.1		145.6	
10116-CAB	IEEE 802.11n (HT Greenfield, 135 Mbps, 64-QAM)	X	10.31	68.7	21.1	8.15	125.0	±2.5 %
		Y	10.13	68.1	20.6		118.2	
		Z	10.59	69.6	21.7		142.4	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.27	68.6	21.1	8.07	125.9	±2.5 %
		Y	10.08	68.0	20.5		119.0	
		Z	10.52	69.4	21.6		142.8	
10118-CAB	IEEE 802.11n (HT Mixed, 81 Mbps, 16-QAM)	X	10.91	69.2	21.7	8.59	128.3	±2.5 %
		Y	10.70	68.6	21.1		121.2	
		Z	11.21	70.2	22.3		146.3	
10119-CAB	IEEE 802.11n (HT Mixed, 135 Mbps, 64-QAM)	X	10.27	68.6	21.1	8.13	125.1	±2.5 %
		Y	10.10	68.0	20.6		118.1	
		Z	10.57	69.6	21.7		142.8	
10140-CAB	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)	X	7.93	68.3	20.4	6.49	147.7	±1.7 %
		Y	7.73	67.4	19.6		142.6	
		Z	7.42	66.8	19.6		116.6	
10141-CAB	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM)	X	8.04	68.2	20.3	6.53	149.1	±1.7 %
		Y	7.84	67.4	19.6		143.2	
		Z	7.56	66.9	19.7		117.6	
10142-CAC	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	X	5.83	66.2	19.1	5.73	125.7	±1.2 %
		Y	5.69	65.2	18.4		121.2	
		Z	6.04	67.0	19.6		142.9	

10143-CAC	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	X	6.82	67.3	19.9	6.35	131.4	±1.4 %
		Y	6.65	66.3	19.1		126.5	
		Z	7.04	68.1	20.4		148.1	
10144-CAC	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM)	X	7.15	67.5	20.1	6.65	132.6	±1.4 %
		Y	6.96	66.6	19.4		127.2	
		Z	7.36	68.4	20.7		149.1	
10145-CAC	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	X	5.54	65.9	19.0	5.76	120.5	±1.2 %
		Y	5.42	65.1	18.3		116.1	
		Z	5.76	66.9	19.6		135.7	
10146-CAC	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	X	6.48	67.3	19.9	6.41	124.0	±1.4 %
		Y	6.28	66.2	19.1		119.2	
		Z	6.70	68.1	20.4		140.0	
10147-CAC	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM)	X	6.74	67.4	20.1	6.72	124.3	±1.7 %
		Y	6.55	66.4	19.4		119.3	
		Z	6.97	68.3	20.7		140.2	
10149-CAB	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)	X	7.35	67.4	19.9	6.42	138.2	±1.4 %
		Y	7.17	66.5	19.2		133.3	
		Z	6.97	66.3	19.4		109.6	
10150-CAB	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)	X	7.61	67.7	20.1	6.60	140.5	±1.4 %
		Y	7.45	66.9	19.5		135.0	
		Z	7.22	66.5	19.6		112.4	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.03	66.4	19.2	5.75	127.0	±1.4 %
		Y	5.85	65.3	18.4		122.3	
		Z	6.24	67.3	19.8		145.2	
10155-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	X	7.06	67.2	19.8	6.43	134.1	±1.4 %
		Y	6.91	66.4	19.2		128.7	
		Z	6.69	66.1	19.3		107.1	
10156-CAC	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	5.76	66.0	19.1	5.79	123.3	±1.2 %
		Y	5.63	65.1	18.3		118.7	
		Z	5.97	67.0	19.7		139.3	
10157-CAC	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	X	6.80	67.2	19.9	6.49	128.7	±1.4 %
		Y	6.62	66.3	19.2		123.2	
		Z	6.99	68.0	20.4		144.9	
10158-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	X	7.30	67.4	20.0	6.62	134.5	±1.4 %
		Y	7.12	66.5	19.3		129.0	
		Z	6.91	66.3	19.5		107.5	
10159-CAC	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)	X	6.91	67.4	20.0	6.56	129.3	±1.4 %
		Y	6.69	66.3	19.2		123.1	
		Z	7.12	68.2	20.5		145.9	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.54	67.1	19.6	5.82	132.9	±1.4 %
		Y	6.29	65.9	18.7		126.6	
		Z	6.71	67.9	20.0		149.3	
10161-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)	X	7.41	67.6	20.0	6.43	139.7	±1.7 %
		Y	7.22	66.6	19.3		133.2	
		Z	6.97	66.2	19.3		110.0	

10162-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM)	X	7.66	67.9	20.2	6.58	141.5	±1.7 %
		Y	7.48	67.0	19.5		134.6	
		Z	7.18	66.4	19.5		112.1	
10166-CAC	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	X	4.96	65.8	18.8	5.46	115.4	±0.9 %
		Y	4.76	64.5	17.9		110.2	
		Z	5.13	66.5	19.3		130.4	
10167-CAC	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	X	5.82	66.9	19.6	6.21	117.4	±1.2 %
		Y	5.60	65.7	18.8		109.9	
		Z	6.07	67.9	20.3		132.7	
10168-CAC	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM)	X	6.28	67.1	20.0	6.79	117.2	±1.4 %
		Y	6.06	66.0	19.2		111.0	
		Z	6.49	67.9	20.6		132.0	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.78	65.8	19.1	5.73	109.6	±1.2 %
		Y	4.92	66.1	19.0		145.5	
		Z	4.94	66.5	19.6		123.2	
10170-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	5.36	66.3	19.7	6.52	107.4	±1.4 %
		Y	5.59	67.0	19.8		142.7	
		Z	5.61	67.4	20.4		121.7	
10171-AAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)	X	5.38	66.5	19.7	6.49	107.3	±1.4 %
		Y	5.59	67.1	19.8		144.6	
		Z	5.64	67.6	20.4		121.5	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.71	65.4	18.8	5.72	107.7	±1.2 %
		Y	4.91	66.0	18.9		144.8	
		Z	4.91	66.3	19.4		122.3	
10176-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	5.78	68.1	20.8	6.52	149.6	±1.4 %
		Y	5.57	66.9	19.7		142.9	
		Z	5.66	67.6	20.5		121.7	
10177-CAE	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	5.05	67.1	19.7	5.73	150.0	±1.2 %
		Y	4.91	66.0	18.9		144.6	
		Z	4.93	66.5	19.5		122.4	
10178-CAC	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	5.80	68.2	20.7	6.52	149.3	±1.4 %
		Y	5.59	67.0	19.8		142.5	
		Z	5.63	67.5	20.4		121.7	
10179-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	X	5.80	68.3	20.7	6.50	149.2	±1.4 %
		Y	5.62	67.2	19.9		144.9	
		Z	5.61	67.5	20.4		121.4	
10180-CAC	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	X	5.80	68.3	20.7	6.50	148.6	±1.4 %
		Y	5.60	67.1	19.8		144.4	
		Z	5.63	67.5	20.4		121.6	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.04	67.0	19.7	5.72	149.4	±1.2 %
		Y	4.94	66.2	19.1		145.6	
		Z	4.92	66.4	19.5		122.1	
10182-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	5.79	68.2	20.7	6.52	148.9	±1.4 %
		Y	5.57	66.9	19.7		142.2	
		Z	5.63	67.5	20.5		121.0	

10183-AAA	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)	X	5.81	68.4	20.8	6.50	148.4	±1.4 %
		Y	5.62	67.2	19.9		144.3	
		Z	5.62	67.5	20.4		121.1	
10184-CAC	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	X	5.06	67.1	19.8	5.73	149.2	±1.2 %
		Y	4.91	66.0	18.9		144.9	
		Z	4.94	66.5	19.5		122.0	
10185-CAC	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	X	5.77	68.1	20.6	6.51	148.4	±1.4 %
		Y	5.57	66.9	19.8		142.5	
		Z	5.62	67.5	20.4		121.5	
10186-AAC	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)	X	5.81	68.4	20.8	6.50	148.0	±1.7 %
		Y	5.63	67.3	19.9		144.7	
		Z	5.60	67.5	20.3		121.0	
10187-CAC	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	X	5.07	67.1	19.8	5.73	149.3	±1.2 %
		Y	4.94	66.2	19.0		145.6	
		Z	4.91	66.3	19.4		122.3	
10188-CAC	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	X	5.79	68.2	20.7	6.52	148.1	±1.7 %
		Y	5.57	66.9	19.7		142.5	
		Z	5.61	67.4	20.4		121.2	
10189-AAC	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)	X	5.83	68.5	20.8	6.50	148.1	±1.4 %
		Y	5.60	67.1	19.8		144.5	
		Z	5.64	67.6	20.4		121.5	
10193-CAB	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.64	67.7	20.6	8.09	112.5	±2.2 %
		Y	9.63	67.5	20.3		109.6	
		Z	10.04	68.9	21.4		132.4	
10194-CAB	IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM)	X	9.78	68.0	20.9	8.12	116.1	±2.2 %
		Y	9.67	67.5	20.4		110.9	
		Z	10.06	68.9	21.5		131.8	
10195-CAB	IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)	X	9.93	68.3	21.0	8.21	117.1	±2.5 %
		Y	9.81	67.7	20.5		112.3	
		Z	10.19	69.1	21.5		134.2	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.73	68.0	20.8	8.10	116.3	±2.2 %
		Y	9.62	67.5	20.3		111.7	
		Z	10.01	68.9	21.4		132.6	
10197-CAB	IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)	X	9.77	68.0	20.8	8.13	116.4	±2.2 %
		Y	9.75	67.7	20.5		111.4	
		Z	10.10	69.0	21.5		132.9	
10198-CAB	IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)	X	9.96	68.2	21.0	8.27	117.4	±2.5 %
		Y	9.88	67.8	20.6		112.8	
		Z	10.29	69.3	21.7		135.1	
10219-CAB	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.62	67.9	20.8	8.03	116.5	±2.2 %
		Y	9.53	67.4	20.3		111.0	
		Z	9.94	68.9	21.4		132.9	
10220-CAB	IEEE 802.11n (HT Mixed, 43.3 Mbps, 16-QAM)	X	9.81	68.1	20.9	8.13	117.2	±2.2 %
		Y	9.70	67.6	20.4		111.6	
		Z	10.10	69.0	21.5		134.0	

10221-CAB	IEEE 802.11n (HT Mixed, 72.2 Mbps, 64-QAM)	X	9.97	68.2	21.0	8.27	118.3	±2.5 %
		Y	9.89	67.8	20.6		112.7	
		Z	10.29	69.2	21.7		135.4	
10222-CAB	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.14	68.4	20.9	8.06	122.8	±2.5 %
		Y	10.02	67.9	20.5		116.9	
		Z	10.48	69.4	21.6		140.6	
10223-CAB	IEEE 802.11n (HT Mixed, 90 Mbps, 16-QAM)	X	10.72	69.0	21.4	8.48	126.2	±2.5 %
		Y	10.54	68.3	20.9		119.3	
		Z	11.04	69.9	22.1		143.9	
10224-CAB	IEEE 802.11n (HT Mixed, 150 Mbps, 64-QAM)	X	10.13	68.4	20.9	8.08	123.4	±2.5 %
		Y	10.01	68.0	20.5		115.7	
		Z	10.44	69.3	21.5		140.3	
10225-CAB	UMTS-FDD (HSPA+)	X	7.19	67.5	19.6	5.97	143.8	±1.4 %
		Y	7.05	66.7	19.0		138.4	
		Z	6.78	66.2	19.0		112.5	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	6.03	66.9	18.8	4.87	136.9	±1.2 %
		Y	5.89	66.1	18.1		131.5	
		Z	5.76	66.1	18.5		109.1	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.32	65.7	18.0	3.96	119.3	±0.9 %
		Y	4.16	64.5	17.1		112.7	
		Z	4.57	66.9	18.7		136.2	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.29	66.6	19.2	5.81	126.9	±1.4 %
		Y	6.12	65.6	18.5		120.7	
		Z	6.52	67.5	19.8		142.9	
10298-AAB	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	X	5.62	66.1	19.1	5.72	120.8	±1.2 %
		Y	5.44	65.0	18.3		115.1	
		Z	5.80	66.9	19.6		136.0	
10299-AAB	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)	X	6.55	67.1	19.8	6.39	125.4	±1.4 %
		Y	6.35	66.1	19.0		119.2	
		Z	6.82	68.2	20.5		140.5	
10300-AAB	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM)	X	6.73	67.3	20.0	6.60	125.1	±1.4 %
		Y	6.53	66.3	19.2		118.8	
		Z	6.99	68.2	20.6		140.9	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.94	67.4	19.7	6.06	135.3	±1.4 %
		Y	6.75	66.4	19.0		129.1	
		Z	6.55	66.2	19.2		106.3	
10315-AAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.71	67.3	17.7	1.71	120.4	±0.5 %
		Y	2.36	64.0	15.7		114.8	
		Z	2.97	68.9	18.7		133.5	
10316-AAB	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	9.89	68.1	21.1	8.36	116.2	±2.5 %
		Y	9.75	67.5	20.5		108.9	
		Z	10.15	69.0	21.6		131.4	
10317-AAB	IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)	X	9.89	68.1	21.1	8.36	116.7	±2.5 %
		Y	9.76	67.6	20.6		110.0	
		Z	10.16	69.0	21.7		132.3	

10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.58	66.6	17.4	1.54	122.6	±0.5 %
		Y	2.36	64.2	15.8		117.2	
		Z	2.79	68.0	18.2		136.1	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.83	68.1	21.0	8.23	117.6	±2.2 %
		Y	9.72	67.6	20.5		110.8	
		Z	10.12	69.0	21.6		132.8	
10417-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle)	X	9.82	68.1	20.9	8.23	117.7	±2.2 %
		Y	9.76	67.7	20.5		111.5	
		Z	10.11	69.0	21.6		133.6	
10418-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Long preambule)	X	9.69	68.0	20.9	8.14	116.8	±2.2 %
		Y	9.59	67.5	20.4		110.3	
		Z	9.95	68.8	21.4		131.4	
10419-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Short preambule)	X	9.78	68.1	20.9	8.19	117.3	±2.2 %
		Y	9.70	67.6	20.5		111.1	
		Z	10.04	68.9	21.5		132.4	
10422-AAA	IEEE 802.11n (HT Greenfield, 7.2 Mbps, BPSK)	X	10.03	68.4	21.1	8.32	119.6	±2.5 %
		Y	9.90	67.7	20.6		112.6	
		Z	10.29	69.2	21.7		133.6	
10423-AAA	IEEE 802.11n (HT Greenfield, 43.3 Mbps, 16-QAM)	X	10.19	68.5	21.3	8.47	120.0	±2.5 %
		Y	10.08	68.0	20.8		112.9	
		Z	10.43	69.3	21.8		134.2	
10424-AAA	IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM)	X	10.08	68.4	21.2	8.40	119.6	±2.5 %
		Y	9.96	67.8	20.7		112.6	
		Z	10.33	69.2	21.8		133.7	
10425-AAA	IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK)	X	10.62	68.9	21.4	8.41	126.1	±2.7 %
		Y	10.42	68.2	20.8		117.7	
		Z	10.92	69.6	22.0		142.2	
10426-AAA	IEEE 802.11n (HT Greenfield, 90 Mbps, 16-QAM)	X	10.66	69.0	21.5	8.45	126.5	±2.7 %
		Y	10.43	68.2	20.8		118.2	
		Z	10.95	69.8	22.0		142.5	
10427-AAA	IEEE 802.11n (HT Greenfield, 150 Mbps, 64-QAM)	X	10.65	69.0	21.4	8.41	126.9	±2.7 %
		Y	10.40	68.2	20.8		118.2	
		Z	10.92	69.8	22.0		142.7	
10434-AAA	W-CDMA (BS Test Model 1, 64 DPCH)	X	9.04	67.7	21.1	8.60	103.3	±2.7 %
		Y	9.68	69.3	21.7		143.5	
		Z	9.37	68.8	21.8		116.7	

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 12 and 16).

[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: EX3DV4 - SN:7364

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)
150	52.3	0.76	12.95	12.95	12.95	0.00	1.00	± 13.3 %
300	45.3	0.87	11.95	11.95	11.95	0.10	1.10	± 13.3 %
450	43.5	0.87	10.72	10.72	10.72	0.15	1.10	± 13.3 %
750	41.9	0.89	10.01	10.01	10.01	0.29	1.08	± 12.0 %
900	41.5	0.97	9.26	9.26	9.26	0.24	1.23	± 12.0 %
1810	40.0	1.40	7.93	7.93	7.93	0.33	0.80	± 12.0 %
1900	40.0	1.40	7.93	7.93	7.93	0.35	0.80	± 12.0 %
2450	39.2	1.80	7.18	7.18	7.18	0.27	0.98	± 12.0 %
2600	39.0	1.96	6.93	6.93	6.93	0.34	0.93	± 12.0 %
5200	36.0	4.66	5.22	5.22	5.22	0.35	1.80	± 13.1 %
5300	35.9	4.76	5.00	5.00	5.00	0.35	1.80	± 13.1 %
5500	35.6	4.96	4.75	4.75	4.75	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.64	4.64	4.64	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.52	4.52	4.52	0.40	1.80	± 13.1 %

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

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7364

Calibration Parameter Determined in Body Tissue Simulating Media

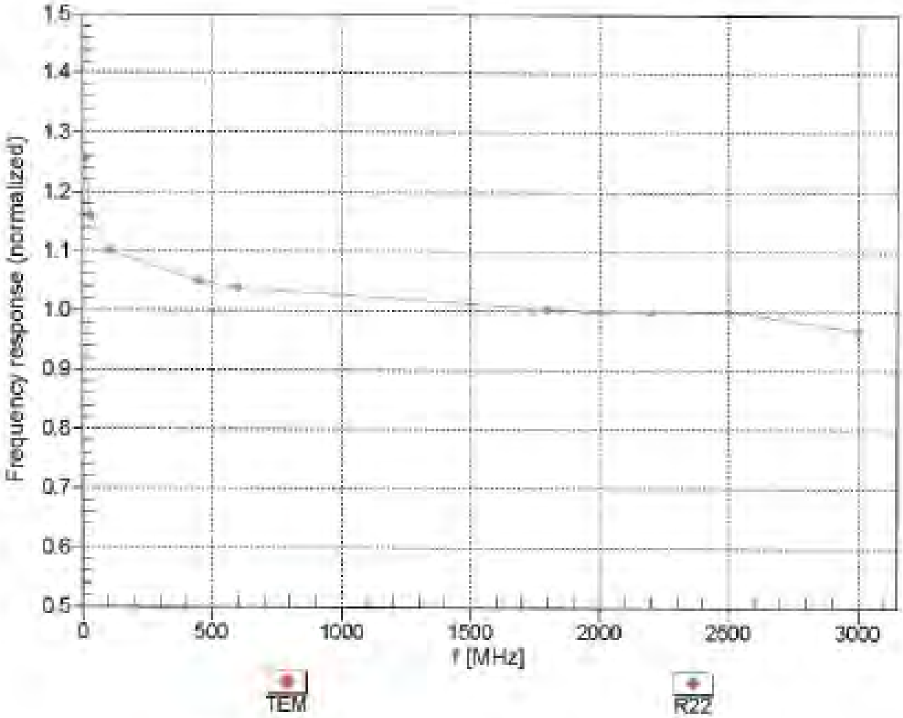
f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
150	61.9	0.80	12.28	12.28	12.28	0.00	1.00	± 13.3 %
300	58.2	0.92	11.24	11.24	11.24	0.08	1.10	± 13.3 %
450	56.7	0.94	11.02	11.02	11.02	0.09	1.10	± 13.3 %
750	55.5	0.96	9.42	9.42	9.42	0.27	1.06	± 12.0 %
900	55.0	1.05	9.20	9.20	9.20	0.27	1.22	± 12.0 %
1810	53.3	1.52	7.75	7.75	7.75	0.43	0.85	± 12.0 %
1900	53.3	1.52	7.57	7.57	7.57	0.47	0.80	± 12.0 %
2450	52.7	1.95	7.33	7.33	7.33	0.35	0.90	± 12.0 %
2600	52.5	2.16	7.17	7.17	7.17	0.31	0.95	± 12.0 %
5200	49.0	5.30	4.52	4.52	4.52	0.45	1.90	± 13.1 %
5300	48.9	5.42	4.29	4.29	4.29	0.45	1.90	± 13.1 %
5500	48.6	5.65	3.92	3.92	3.92	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.74	3.74	3.74	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.06	4.08	4.06	0.50	1.90	± 13.1 %

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

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

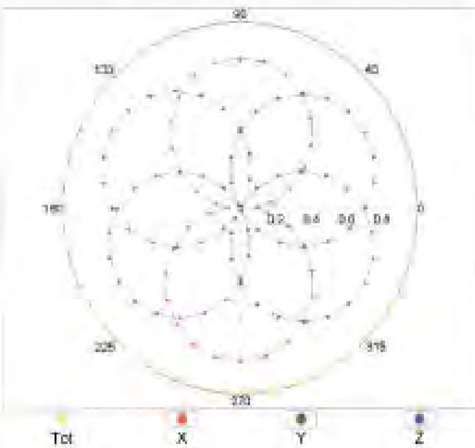
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



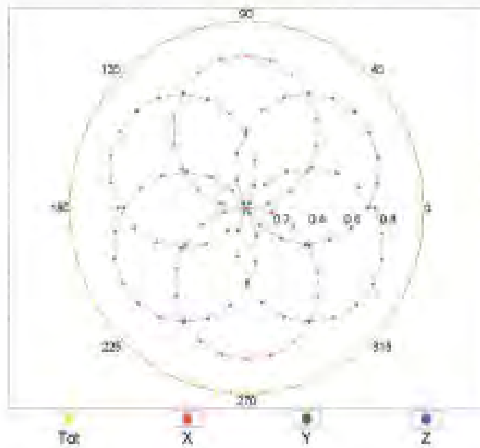
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

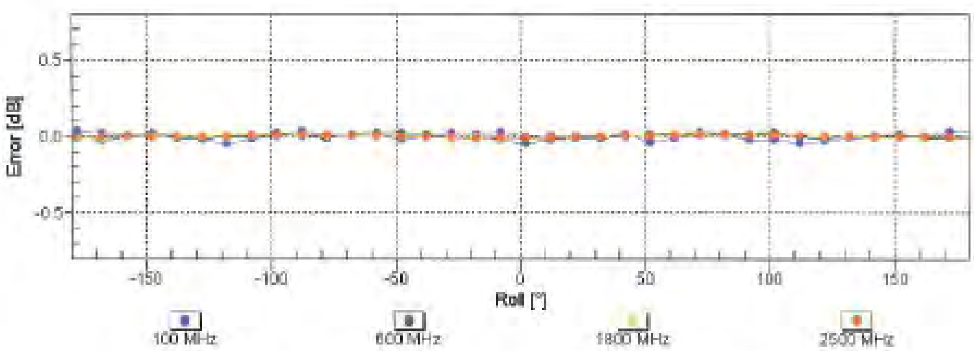
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



f=1800 MHz,R22

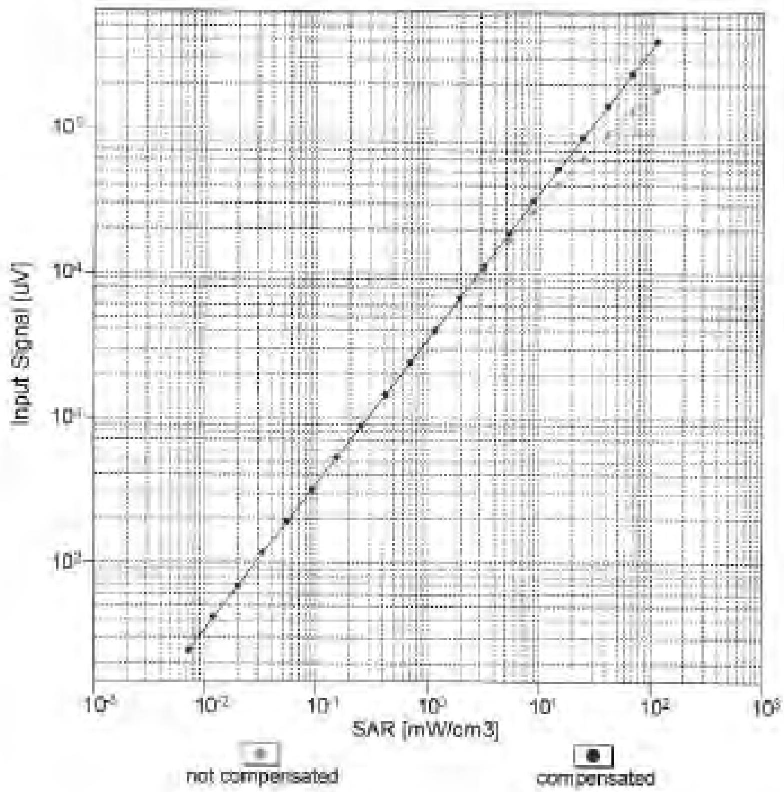


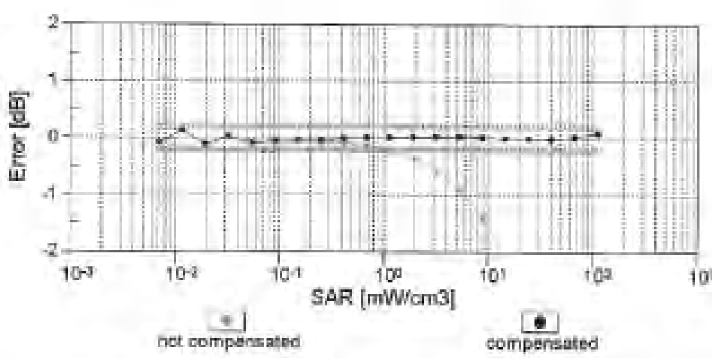


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

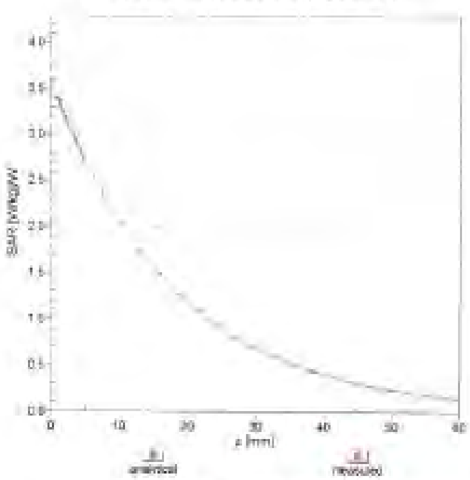
(TEM cell , f_{eval}= 1900 MHz)

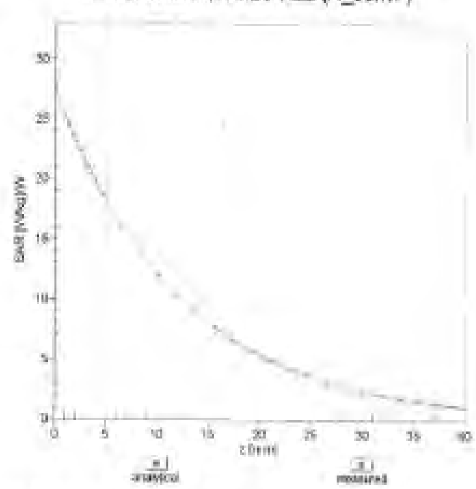




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

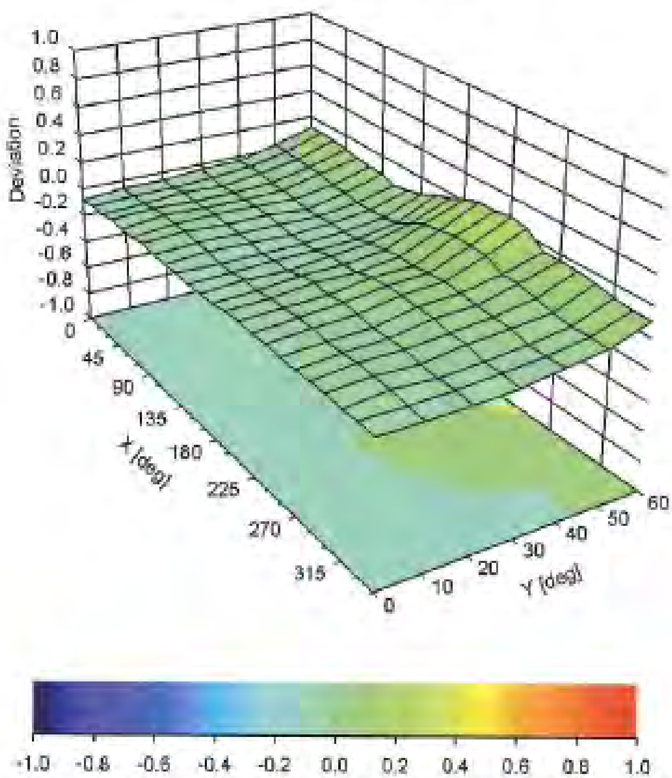
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7364

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	132.1
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

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Accreditation No.: **SCS 0108**

Client **Motorola Solutions MY**

Certificate No: **ES3-3196_Nov15**

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3196
Calibration procedure(s)	QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	November 17, 2015

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	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
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-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 17, 2015

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

Certificate No: ES3-3196_Nov15 Page 1 of 12

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Accreditation No.: **SCS 0108**

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
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 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:3196

Manufactured: June 16, 2008
Calibrated: November 17, 2015

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 (µV/(V/m)^2)[A]	1.27	1.29	1.33	± 10.1 %
DCP (mV)[B]	104.9	104.0	102.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√µV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	213.4	±3.3 %
		Y	0.0	0.0	1.0		214.3	
		Z	0.0	0.0	1.0		218.9	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.95	69.6	19.1	1.87	148.8	±0.7 %
		Y	3.00	69.4	18.9		147.7	
		Z	2.76	68.0	18.4		132.0	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.06	71.2	23.8	9.46	143.4	±3.3 %
		Y	10.95	70.6	23.3		145.2	
		Z	10.86	70.5	23.4		124.5	
10059-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)	X	3.25	70.7	19.7	2.12	147.8	±0.7 %
		Y	3.55	72.1	20.2		147.4	
		Z	3.08	69.5	19.2		131.0	
10071-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 9 Mbps)	X	11.24	71.6	24.3	9.83	140.4	±2.7 %
		Y	11.13	70.9	23.7		141.2	
		Z	11.61	72.5	24.9		149.5	
10114-CAB	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.05	68.9	21.4	8.10	127.0	±2.2 %
		Y	9.87	68.3	21.0		126.0	
		Z	10.23	69.4	21.7		134.0	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.01	68.8	21.3	8.07	127.5	±2.2 %
		Y	9.87	68.3	20.9		127.2	
		Z	10.21	69.3	21.7		134.9	
10193-CAB	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	10.02	69.6	21.9	8.09	147.9	±2.5 %
		Y	9.96	69.2	21.5		149.5	
		Z	9.84	69.0	21.6		129.1	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	10.00	69.6	21.9	8.10	147.4	±2.2 %
		Y	9.92	69.1	21.5		147.7	
		Z	9.82	69.0	21.6		126.8	
10219-CAB	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.88	69.5	21.8	8.03	146.9	±2.5 %
		Y	9.78	68.9	21.4		146.3	
		Z	9.73	69.0	21.6		127.8	
10222-CAB	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.00	68.8	21.3	8.06	127.3	±2.2 %
		Y	9.80	69.2	20.9		126.3	
		Z	10.17	69.2	21.6		134.7	

10422-AAA	IEEE 802.11n (HT Greenfield, 7.2 Mbps, BPSK)	X	10.28	69.9	22.2	8.32	149.2	±2.5 %
		Y	10.19	69.4	21.8		149.0	
		Z	10.09	69.3	21.9		129.5	
10425-AAA	IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK)	X	10.45	69.3	21.8	8.41	129.4	±2.5 %
		Y	10.27	68.7	21.3		128.2	
		Z	10.65	69.8	22.1		135.7	

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] The uncertainties of Norm X,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 6 and 7).
[B] Numerical linearization parameter: uncertainty not required.
[C] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: 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 [G]	Depth [G] (mm)	Unc (k=2)
150	52.3	0.76	7.31	7.31	7.31	0.06	1.25	± 13.3 %
300	45.3	0.87	7.34	7.34	7.34	0.14	1.60	± 13.3 %
450	43.5	0.87	6.83	6.83	6.83	0.22	1.80	± 13.3 %
750	41.9	0.89	6.46	6.46	6.46	0.40	1.64	± 12.0 %
900	41.5	0.97	6.13	6.13	6.13	0.56	1.38	± 12.0 %
2450	39.2	1.80	4.54	4.54	4.54	0.58	1.36	± 12.0 %

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

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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 [G]	Depth [G] (mm)	Unc (k=2)
150	61.9	0.80	6.94	6.94	6.94	0.06	1.25	± 13.3 %
300	58.2	0.92	6.94	6.94	6.94	0.10	1.60	± 13.3 %
450	56.7	0.94	7.06	7.06	7.06	0.13	1.60	± 13.3 %
750	55.5	0.96	6.36	6.36	6.36	0.42	1.59	± 12.0 %
900	55.0	1.05	6.10	6.10	6.10	0.39	1.80	± 12.0 %
2450	52.7	1.95	4.43	4.43	4.43	0.71	1.28	± 12.0 %

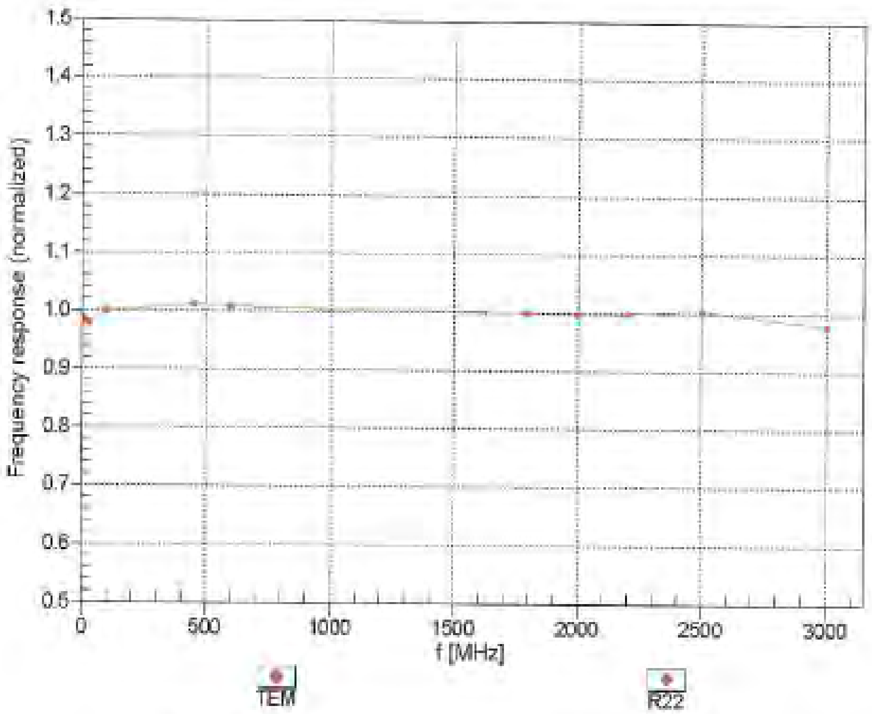
[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz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

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

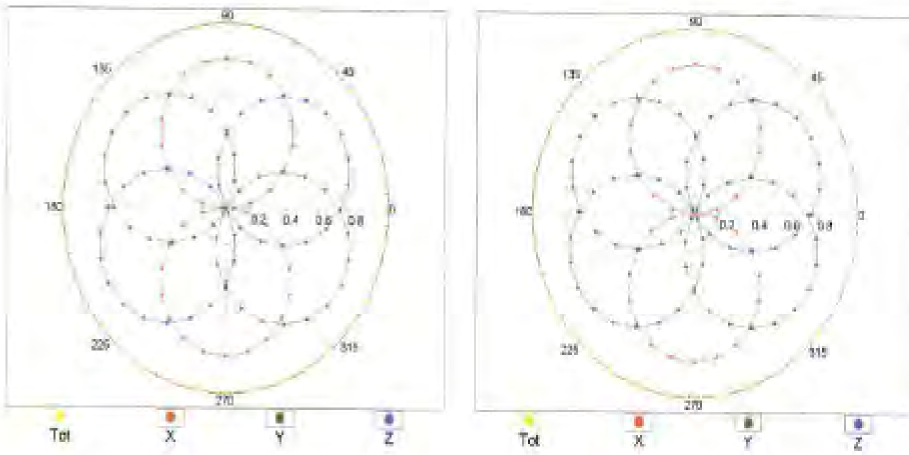
(TEM-Cell:ifi110 EXX, Waveguide: R22)

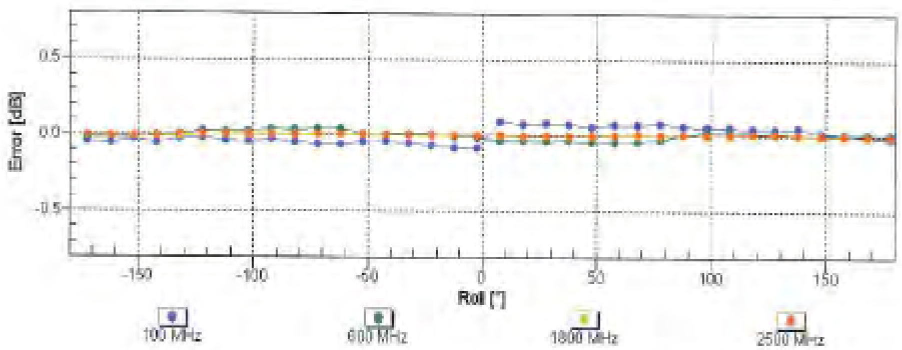


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°

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

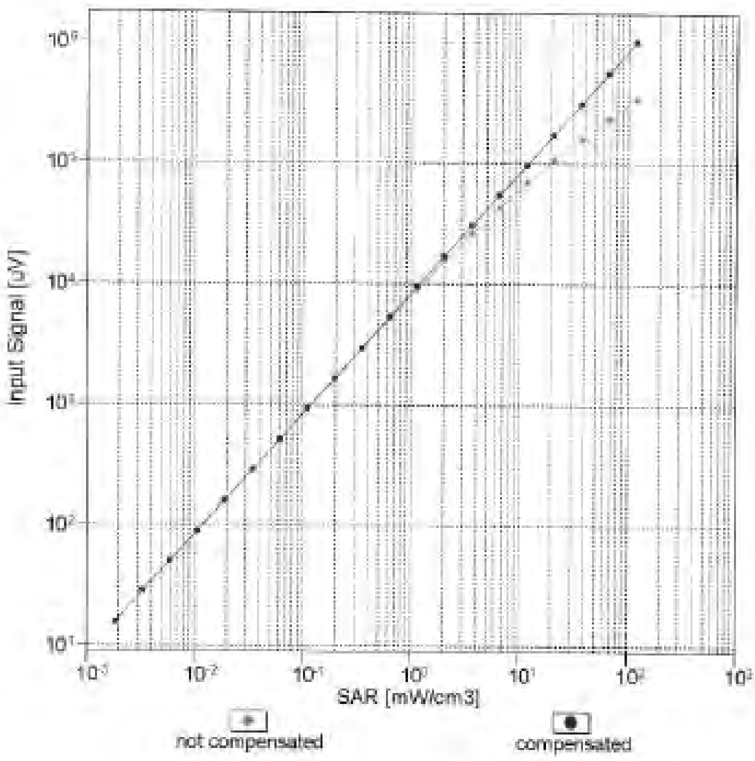


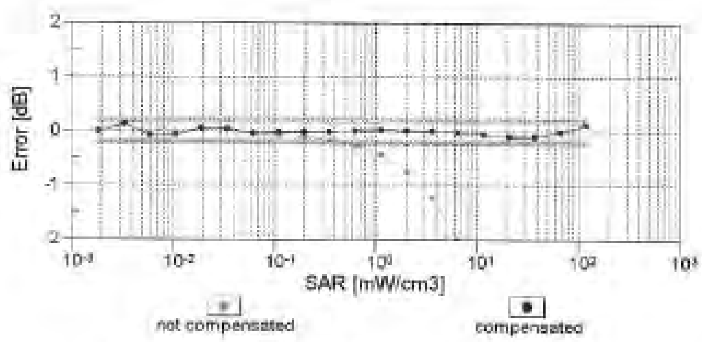


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

(TEM cell , f_{eval}= 1900 MHz)

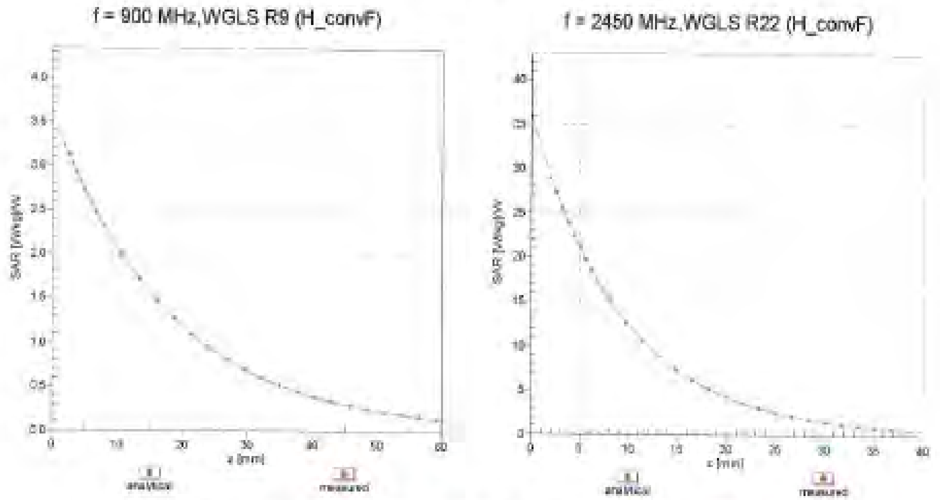




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

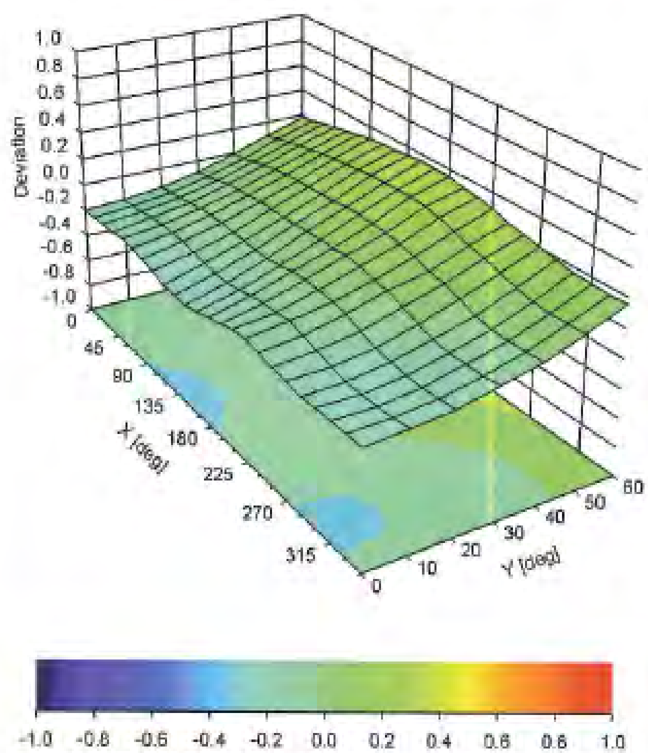
ES3DV3– SN:3196 November 17, 2015

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

Certificate No: ES3-3196_Nov15 Page 11 of 12

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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	7.9
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

Appendix C
Dipole Calibration Certificates

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Accreditation No.: **SCS 0108**

Client **Motorola Solutions MY**

Certificate No: **D450V3-1053_Mar15**

CALIBRATION CERTIFICATE

Object	D450V3 - SN:1053
Calibration procedure(s)	QA CAL-15.v8 Calibration procedure for dipole validation kits below 700 MHz
Calibration date:	March 17, 2015

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	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ET3DV6	SN: 1507	30-Dec-14 (No. ET3-1507_Dec14)	Dec-15
DAE4	SN: 654	30-Jun-14 (No. DAE4-654_Jun14)	Jun-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	04-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: March 17, 2015

Certificate No: D450V3-1053_Mar15 Page 1 of 8

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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 0108

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

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	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	43.5	0.87 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	43.9 ± 6 %	0.88 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 W input power	1.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**4.45 W/kg ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 W input power	0.747 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**2.97 W/kg ± 17.6 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	56.7	0.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	56.7 ± 6 %	0.97 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 W input power	1.13 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**4.41 W/kg ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 W input power	0.746 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**2.92 W/kg ± 17.6 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	57.2 Ω - 2.2 jΩ
Return Loss	- 23.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	55.2 Ω - 5.3 jΩ
Return Loss	- 23.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.350 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 16, 2005

DASY5 Validation Report for Head TSL

Date: 17.03.2015

Test Laboratory: SPEAG, Zurich, Switzerland

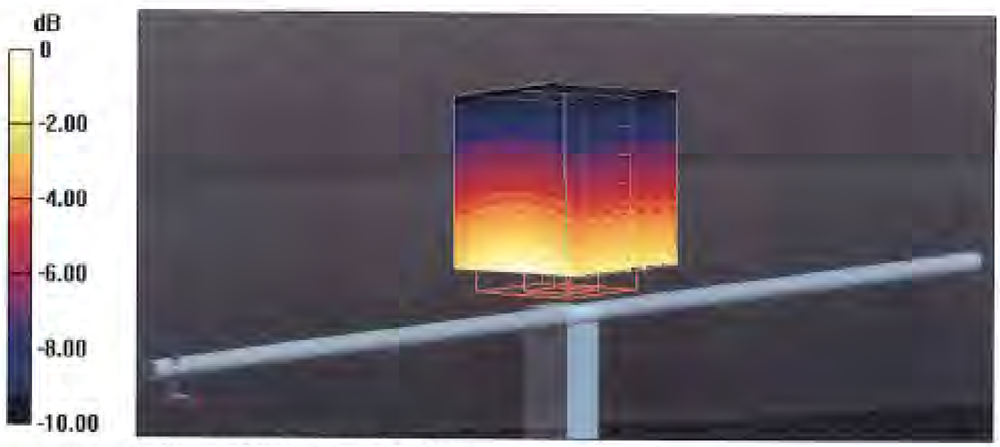
DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN:1053

Communication System: UID 0 - CW; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; σ = 0.88 S/m; ε_r = 43.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.58, 6.58, 6.58); Calibrated: 30.12.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 30.06.2014
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

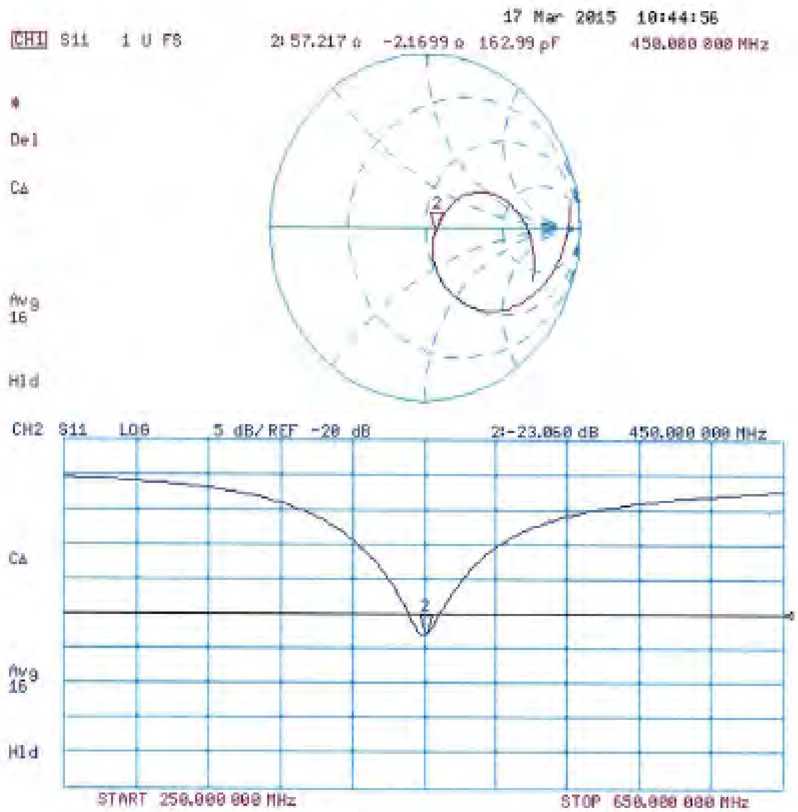
Dipole Calibration for Head Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 38.88 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 1.61 W/kg
SAR(1 g) = 1.12 W/kg; SAR(10 g) = 0.747 W/kg
Maximum value of SAR (measured) = 1.20 W/kg



0 dB = 1.20 W/kg = 0.79 dBW/kg

Certificate No: D450V3-1053_Mar15 Page 5 of 8

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 17.03.2015

Test Laboratory: SPEAG, Zurich, Switzerland

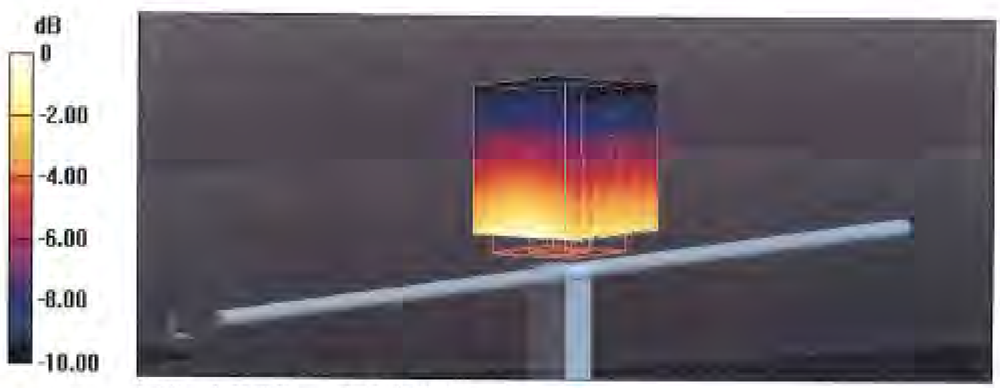
DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN:1053

Communication System: UID 0 - CW; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; σ = 0.97 S/m; ε_r = 56.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

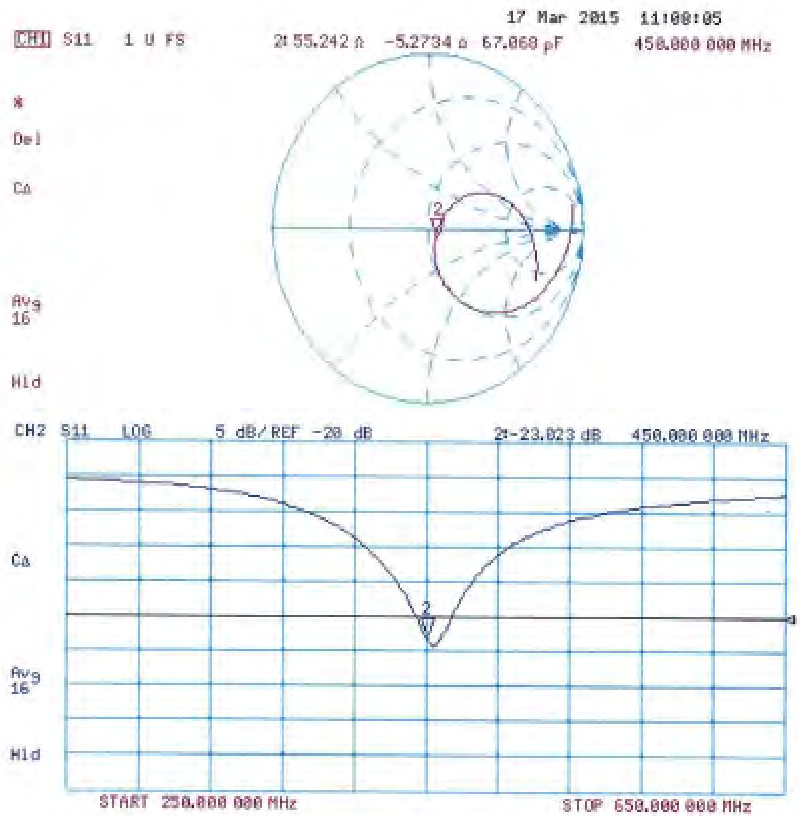
- Probe: ET3DV6 - SN1507; ConvF(7.05, 7.05, 7.05); Calibrated: 30.12.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 30.06.2014
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Body Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 36.35 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 1.81 W/kg
SAR(1 g) = 1.13 W/kg; SAR(10 g) = 0.746 W/kg
Maximum value of SAR (measured) = 1.21 W/kg



0 dB = 1.21 W/kg = 0.83 dBW/kg

Impedance Measurement Plot for Body TSL



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

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Accreditation No.: **SCS 0108**

Client **Motorola Solutions MY** Certificate No: **D2450V2-781_Mar15**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN:781
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	March 20, 2015

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	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

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-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: March 20, 2015

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

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Calibration Laboratory of
Schmid & Partner
Engineering AG
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

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	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.8 ± 6 %	1.83 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	13.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**52.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.4 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	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.8 ± 6 %	2.02 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	13.3 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**51.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**24.2 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.8 Ω + 1.2 jΩ
Return Loss	- 28.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.9 Ω + 3.2 jΩ
Return Loss	- 30.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.155 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	May 06, 2005

DASY5 Validation Report for Head TSL

Date: 20.03.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:781

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.83 S/m; ε_r = 37.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

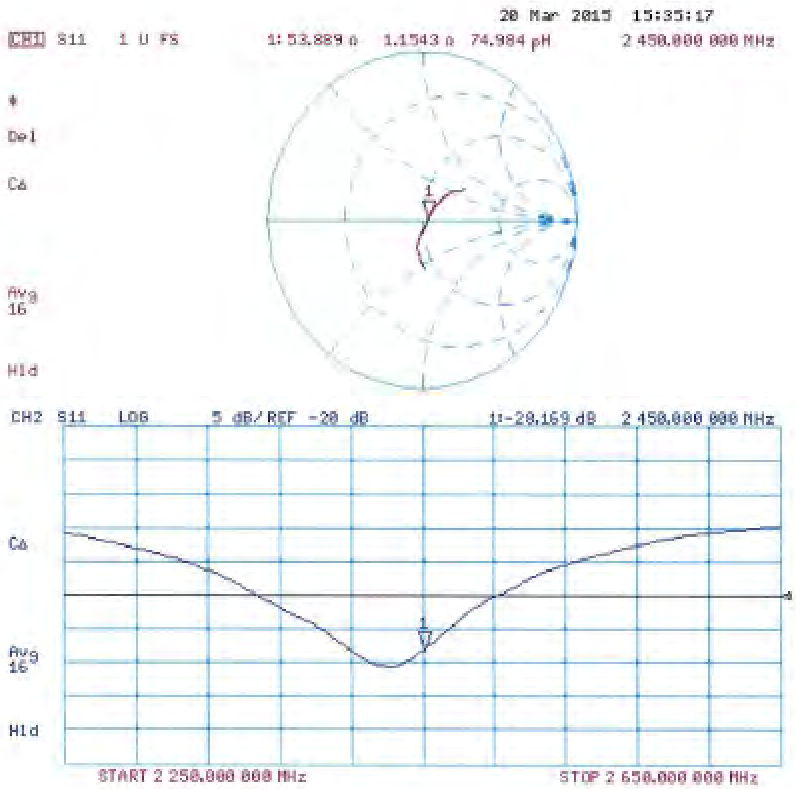
DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.54, 4.54, 4.54); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 101.2 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 27.9 W/kg
SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.16 W/kg
Maximum value of SAR (measured) = 17.4 W/kg

0 dB = 17.4 W/kg = 12.41 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 19.03.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:781

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.02 S/m; ε_r = 50.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

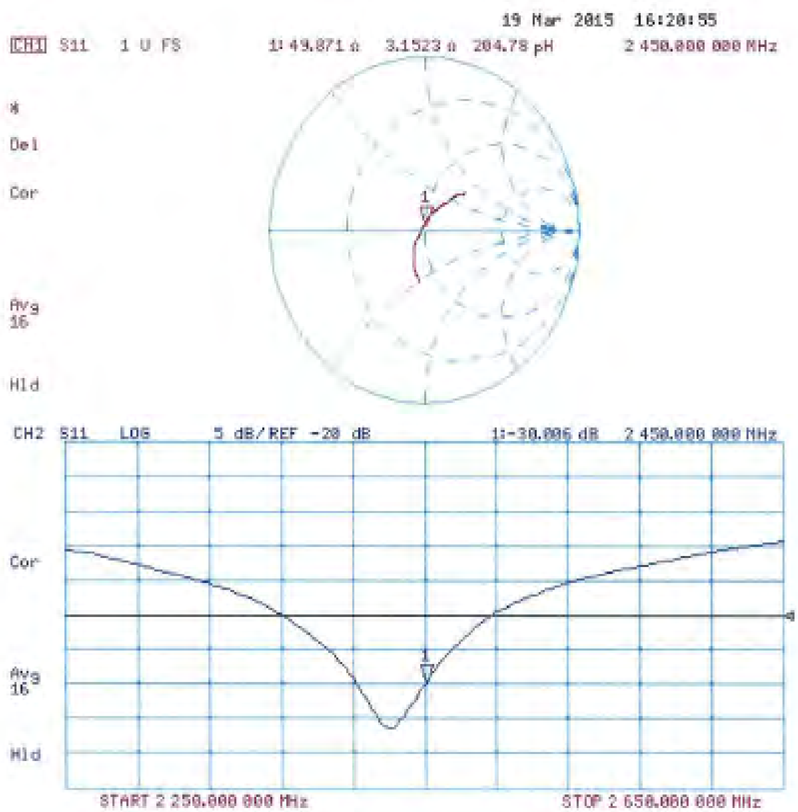
- Probe: ES3DV3 - SN3205; ConvF(4.32, 4.32, 4.32); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.66 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 28.0 W/kg
SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.15 W/kg
Maximum value of SAR (measured) = 17.4 W/kg

0 dB = 17.4 W/kg = 12.41 dBW/kg

Impedance Measurement Plot for Body TSL



Dipole Data

As stated in KDB 865664, only dipoles used for longer calibration intervals required to provide supporting information and measurement to qualify for extended calibration interval.

Dipole D450V3 (serial number 1053) and D2450V2 (serial number 781) not exceed annual calibration date, hence no further justification required.