

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1113Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz,
Frequency: 5750 MHzMedium parameters used: $f = 5250$ MHz; $\sigma = 4.53$ S/m; $\epsilon_r = 35.1$; $\rho = 1000$ kg/m³,Medium parameters used: $f = 5600$ MHz; $\sigma = 4.88$ S/m; $\epsilon_r = 34.6$; $\rho = 1000$ kg/m³,Medium parameters used: $f = 5750$ MHz; $\sigma = 5.03$ S/m; $\epsilon_r = 34.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.4, 5.4, 5.4) @ 5250 MHz, ConvF(4.95, 4.95, 4.95) @ 5600 MHz, ConvF(4.98, 4.98, 4.98) @ 5750 MHz; Calibrated: 25.03.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan,**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 78.54 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 27.9 W/kg

SAR(1 g) = 8.09 W/kg; SAR(10 g) = 2.33 W/kg

Maximum value of SAR (measured) = 18.1 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan,**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 78.00 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 31.1 W/kg

SAR(1 g) = 8.40 W/kg; SAR(10 g) = 2.40 W/kg

Maximum value of SAR (measured) = 19.4 W/kg

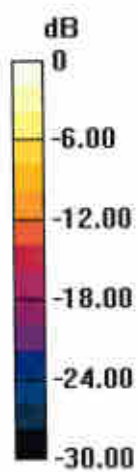
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan,**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

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

Peak SAR (extrapolated) = 31.8 W/kg

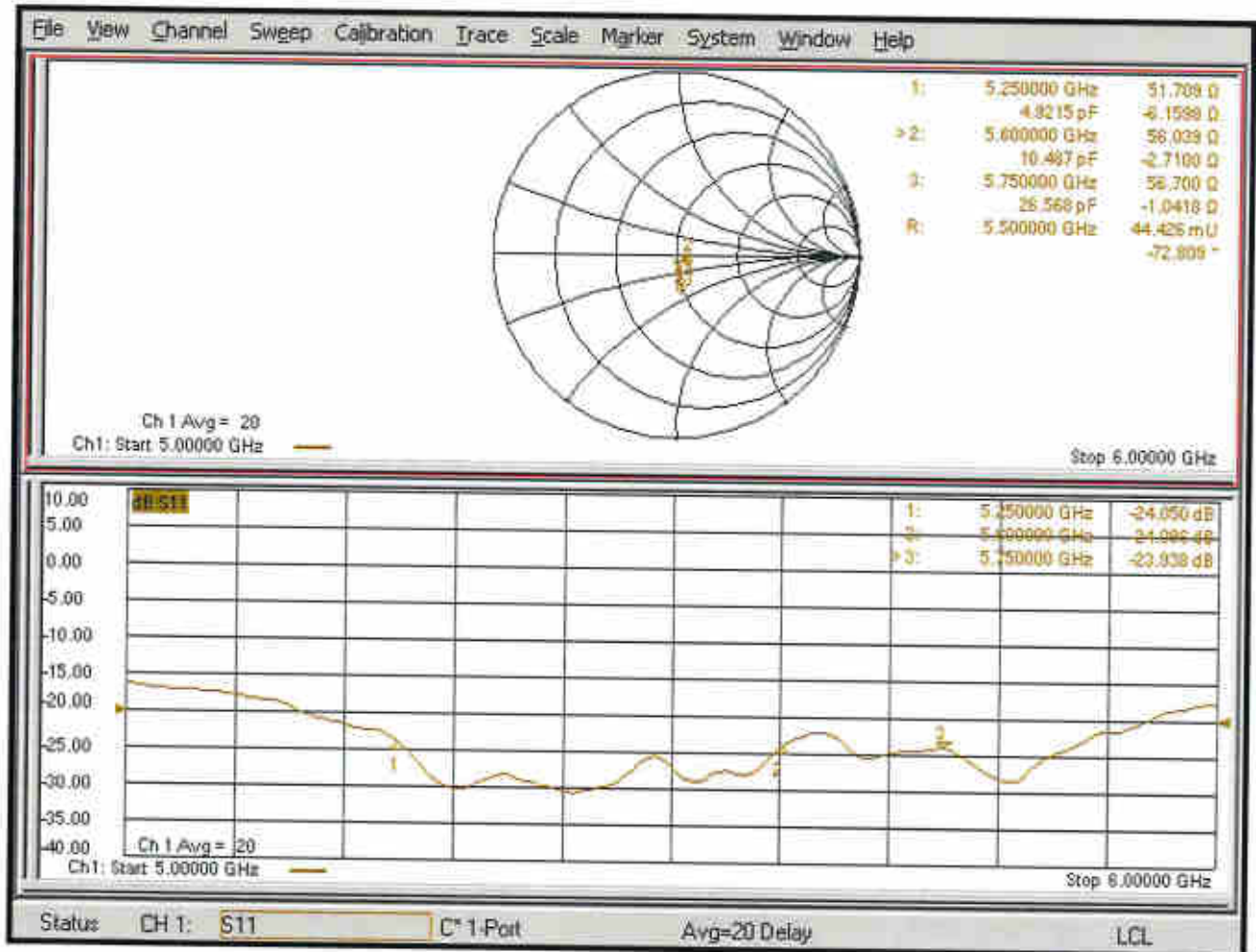
SAR(1 g) = 8.06 W/kg; SAR(10 g) = 2.30 W/kg

Maximum value of SAR (measured) = 19.0 W/kg



0 dB = 18.1 W/kg = 12.58 dBW/kg

Impedance Measurement Plot for Head TSL



D5GHzV2, Serial No. 1113 Extended Dipole Calibrations

Referring to KDB 865664 D01 v01r02, if dipoles are verified in return loss ($< -20\text{dB}$, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

D5GHzV2 – serial no. 1113						
5250 Head						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2019.9.24	-24.05		51.71		-6.16	
2020.9.23	-24.80	-0.03	50.56	1.15	-5.94	-0.22

D5GHzV2 – serial no. 1113						
5600 Head						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2019.9.24	-24.09		56.04		-2.71	
2020.9.23	-23.95	0.01	57.70	-1.66	-2.85	0.14

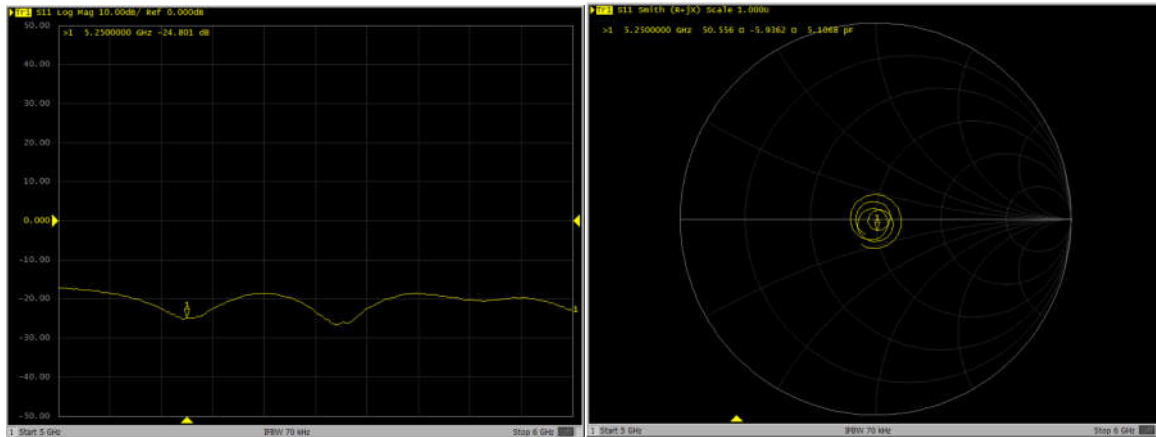
D5GHzV2 – serial no. 1113						
5750 Head						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2019.9.24	-23.94		56.70		-1.04	
2020.9.23	-21.92	0.08	58.56	-1.86	-1.58	0.54

<Justification of the extended calibration>

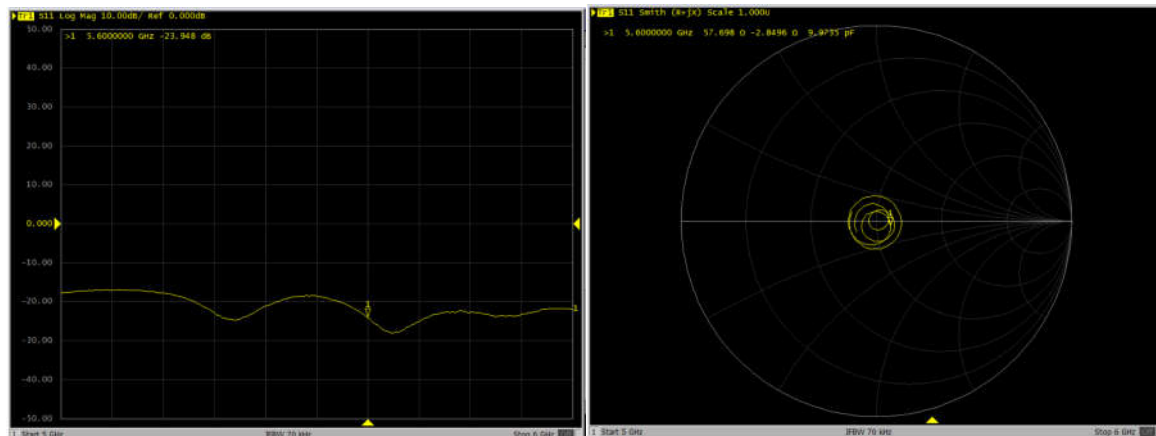
The return loss is $< -20\text{dB}$, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Dipole Verification Data> D3700V2, serial no. 1008

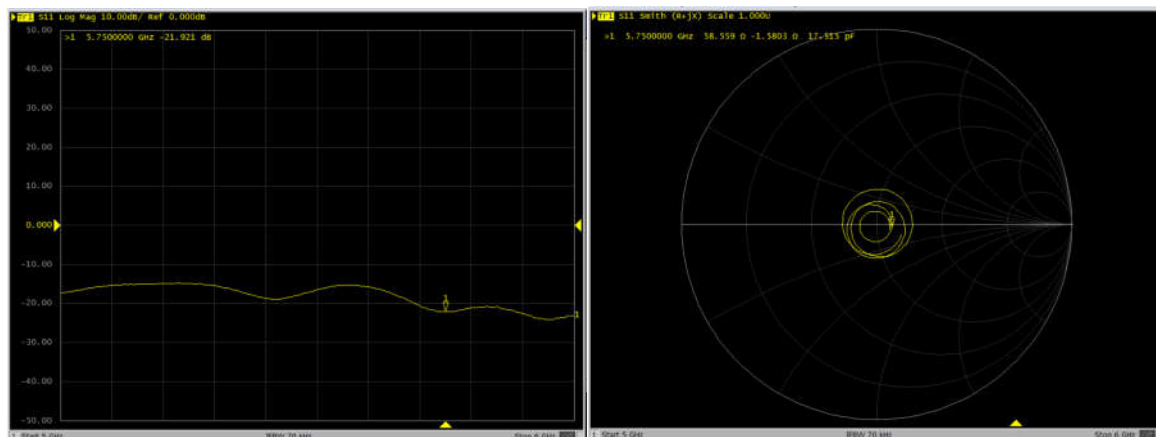
5250MHz – Head



5600MHz – Head



5750MHz – Head



IMPORTANT NOTICE

USAGE OF THE DAE4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE4 unit is fixed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:

Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:

Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:

To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client **Sporton**

Certificate No: DAE4-1279_Aug20

CALIBRATION CERTIFICATE

Object DAE4 - SD 000 D04 BM - SN: 1279

Calibration procedure(s) QA CAL-06.v30
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: August 25, 2020

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	03-Sep-19 (No:25949)	Sep-20
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit Calibrator Box V2.1	SE UWS 053 AA 1001	09-Jan-20 (in house check)	In house check: Jan-21
	SE UMS 006 AA 1002	09-Jan-20 (in house check)	In house check: Jan-21

Calibrated by: Name Dominique Steffen Function Laboratory Technician

Signature

Approved by: Sven Kühn Deputy Manager

Issued: August 25, 2020

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Accreditation No.: **SCS 0108**

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle:* The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
 - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
 - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
 - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
 - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
 - *Input Offset Measurement:* Output voltage and statistical results over a large number of zero voltage measurements.
 - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
 - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
 - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
 - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 μ V , full range = -100...+300 mV

Low Range: 1LSB = 61 nV , full range = -1.....+3mV

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

Calibration Factors	X	Y	Z
High Range	403.992 $\pm$ 0.02% (k=2)	403.936 $\pm$ 0.02% (k=2)	404.671 $\pm$ 0.02% (k=2)
Low Range	3.98386 $\pm$ 1.50% (k=2)	3.98923 $\pm$ 1.50% (k=2)	3.99029 $\pm$ 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	114.0 ° $\pm$ 1 °
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Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	199992.98	-3.60	-0.00
Channel X + Input	20004.41	2.27	0.01
Channel X - Input	-20000.14	1.42	-0.01
Channel Y + Input	199993.98	-2.71	-0.00
Channel Y + Input	20004.10	2.00	0.01
Channel Y - Input	-20002.55	-0.86	0.00
Channel Z + Input	199996.29	-0.02	-0.00
Channel Z + Input	20001.83	-0.15	-0.00
Channel Z - Input	-20002.45	-0.66	0.00

Low Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	2001.76	0.43	0.02
Channel X + Input	201.97	0.41	0.20
Channel X - Input	-197.75	0.55	-0.28
Channel Y + Input	2001.59	0.39	0.02
Channel Y + Input	201.77	0.37	0.18
Channel Y - Input	-198.61	-0.14	0.07
Channel Z + Input	2001.73	0.62	0.03
Channel Z + Input	202.53	1.20	0.60
Channel Z - Input	-198.78	-0.27	0.13

2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-18.13	-19.89
	- 200	20.83	19.81
Channel Y	200	5.56	5.45
	- 200	-5.67	-5.95
Channel Z	200	6.42	6.28
	- 200	-7.70	-7.94

3. Channel separation

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

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	3.63	-3.17
Channel Y	200	8.74	-	3.69
Channel Z	200	9.20	7.14	-

4. AD-Converter Values with inputs shorted

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

	High Range (LSB)	Low Range (LSB)
Channel X	15970	16495
Channel Y	15941	15166
Channel Z	15692	14666

5. Input Offset Measurement

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

Input 10M Ω

	Average (μ V)	min. Offset (μ V)	max. Offset (μ V)	Std. Deviation (μ V)
Channel X	0.79	-0.20	1.79	0.42
Channel Y	-0.22	-1.72	0.62	0.46
Channel Z	0.74	-0.45	2.00	0.50

6. Input Offset Current

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

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

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

9. Power Consumption (Typical values for information)

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



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Accreditation No.: **SCS 0108**

Client **Sporton**

Certificate No: **EX3-3935_May20**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3935**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-14.v5, QA CAL-23.v5, QA CAL-25.v7**
Calibration procedure for dosimetric E-field probes

Calibration date: **May 27, 2020**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: CC2552 (20x)	31-Mar-20 (No. 217-03106)	Apr-21
DAE4	SN: 660	27-Dec-19 (No. DAE4-660_Dec19)	Dec-20
Reference Probe ES3DV2	SN: 3013	31-Dec-19 (No. ES3-3013_Dec19)	Dec-20
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-18)	In house check: Jun-20
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
			Issued: June 1, 2020
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Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E^2 -field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3935

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.49	0.53	0.48	$\pm 10.1 \%$
DCP (mV) ^B	102.6	103.2	102.3	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Max dev.	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	137.0	$\pm 3.3 \%$	$\pm 4.7 \%$
		Y	0.0	0.0	1.0		150.1		
		Z	0.0	0.0	1.0		141.6		

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

^A The uncertainties of Norm X,Y,Z do not affect the E²-field uncertainty inside TSL (see Page 5).

^B Numerical linearization parameter: uncertainty not required.

^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:3935

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	44.5
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3935

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
750	41.9	0.89	10.58	10.58	10.58	0.57	0.80	± 12.0 %
835	41.5	0.90	10.31	10.31	10.31	0.38	0.93	± 12.0 %
900	41.5	0.97	10.16	10.16	10.16	0.40	0.88	± 12.0 %
1750	40.1	1.37	8.60	8.60	8.60	0.27	0.86	± 12.0 %
1900	40.0	1.40	8.35	8.35	8.35	0.24	0.86	± 12.0 %
2000	40.0	1.40	8.25	8.25	8.25	0.34	0.86	± 12.0 %
2300	39.5	1.67	7.86	7.86	7.86	0.35	0.90	± 12.0 %
2450	39.2	1.80	7.60	7.60	7.60	0.33	0.90	± 12.0 %
2600	39.0	1.96	7.43	7.43	7.43	0.37	0.90	± 12.0 %
5250	35.9	4.71	5.04	5.04	5.04	0.40	1.80	± 14.0 %
5600	35.5	5.07	4.76	4.76	4.76	0.40	1.80	± 14.0 %
5750	35.4	5.22	4.67	4.67	4.67	0.40	1.80	± 14.0 %

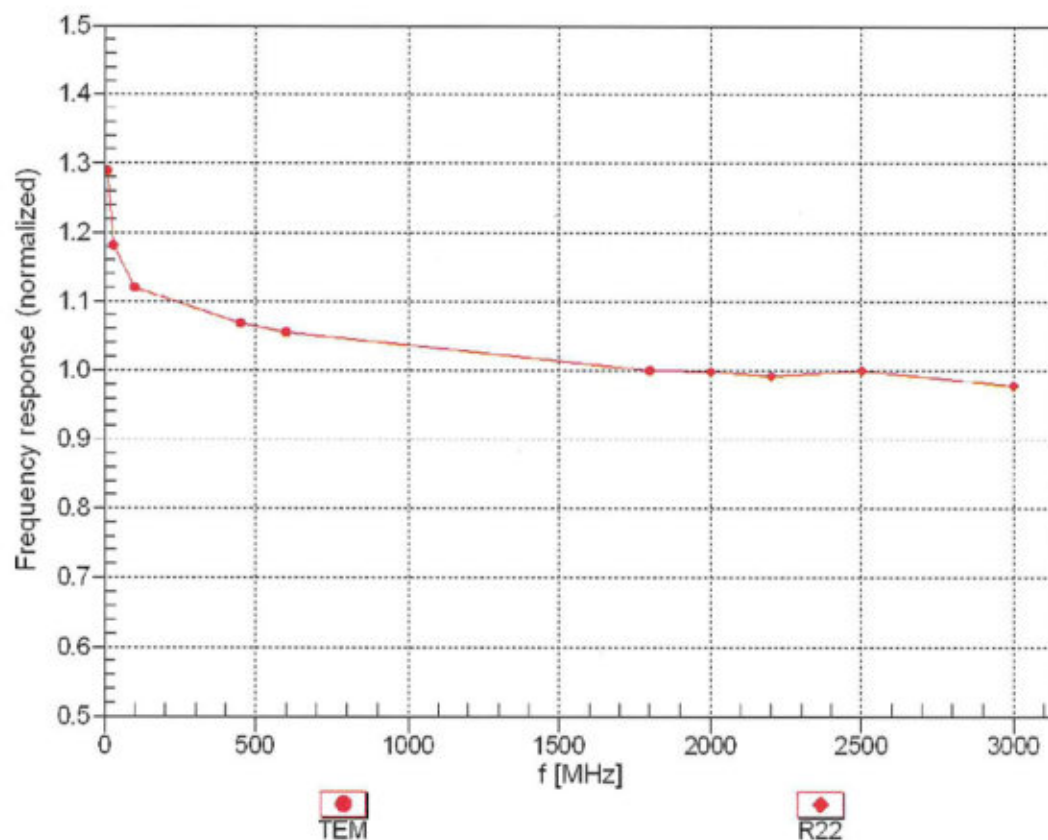
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F At frequencies up to 6 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

Frequency Response of E-Field

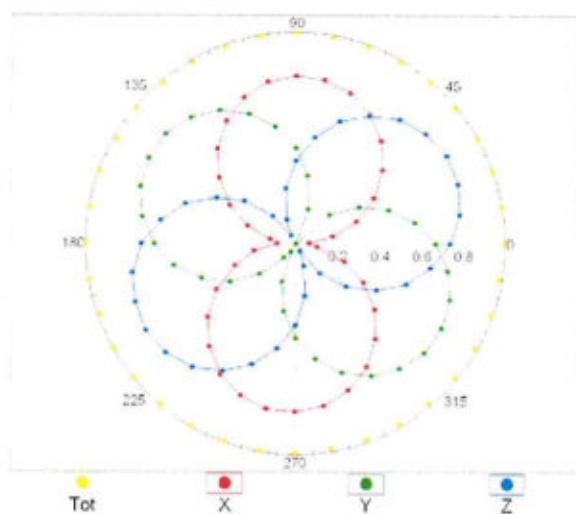
(TEM-Cell:ifi110 EXX, Waveguide: R22)



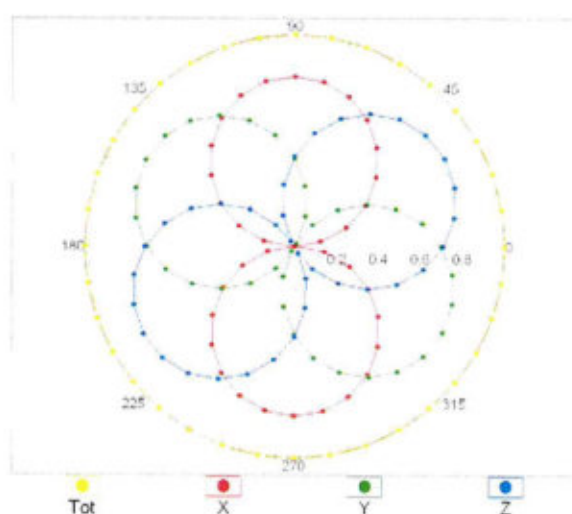
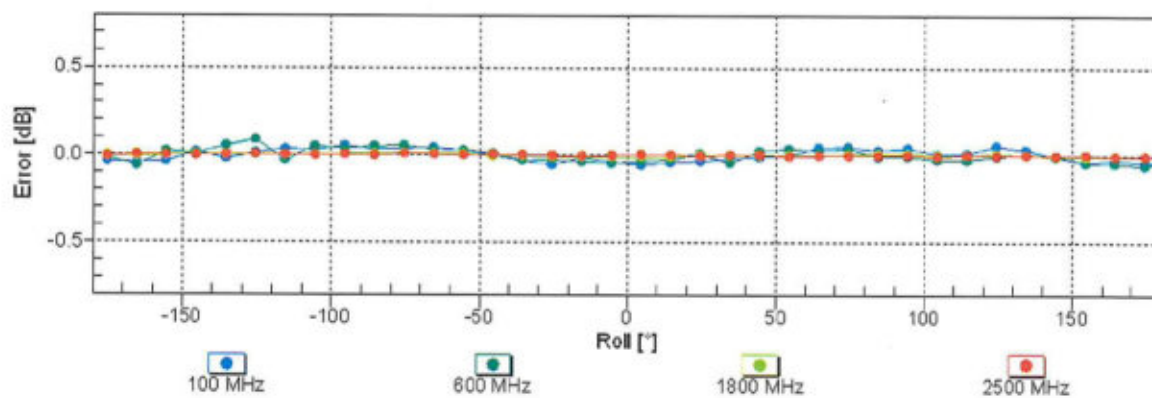
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz, TEM

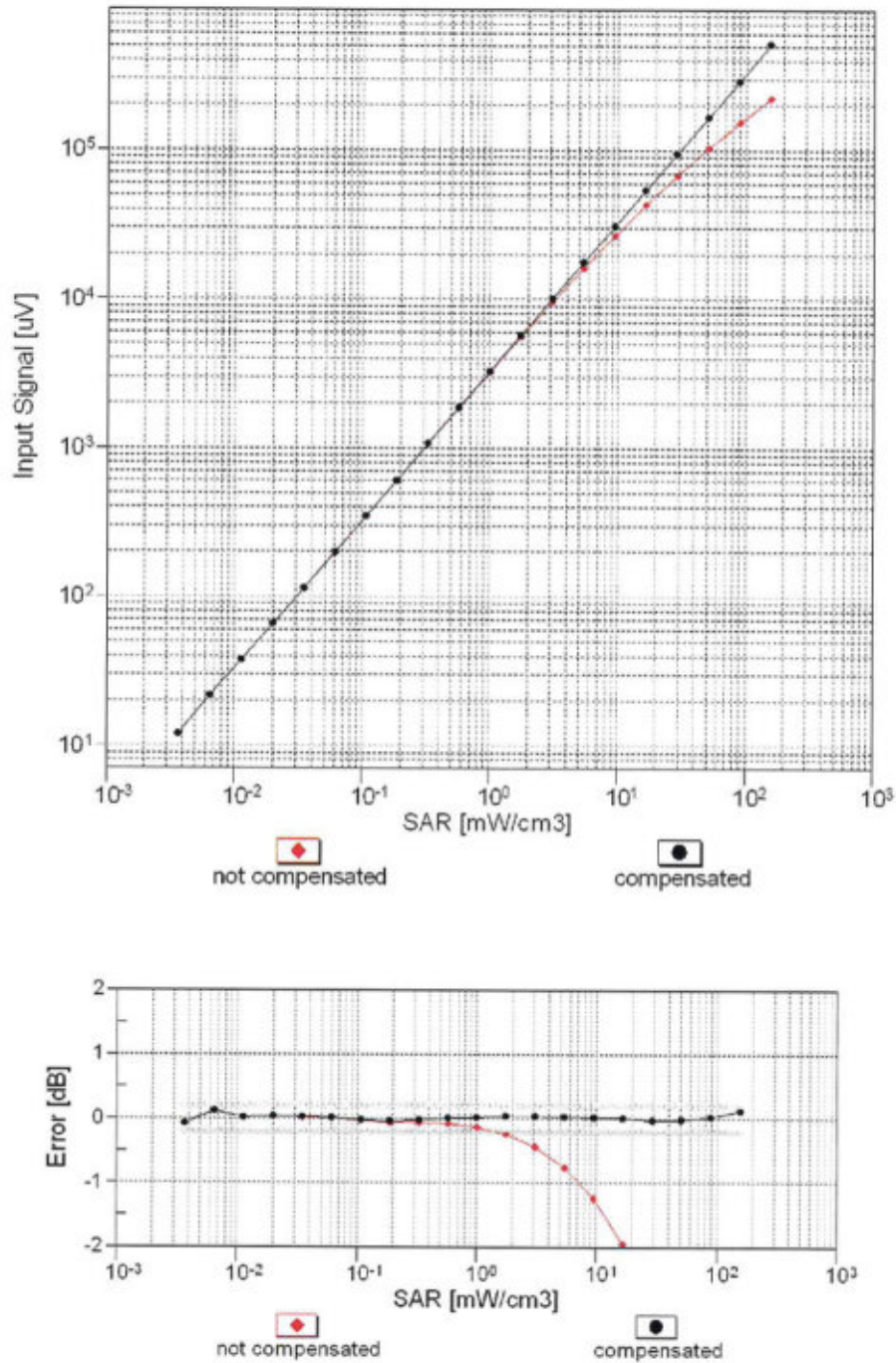


f=1800 MHz, R22



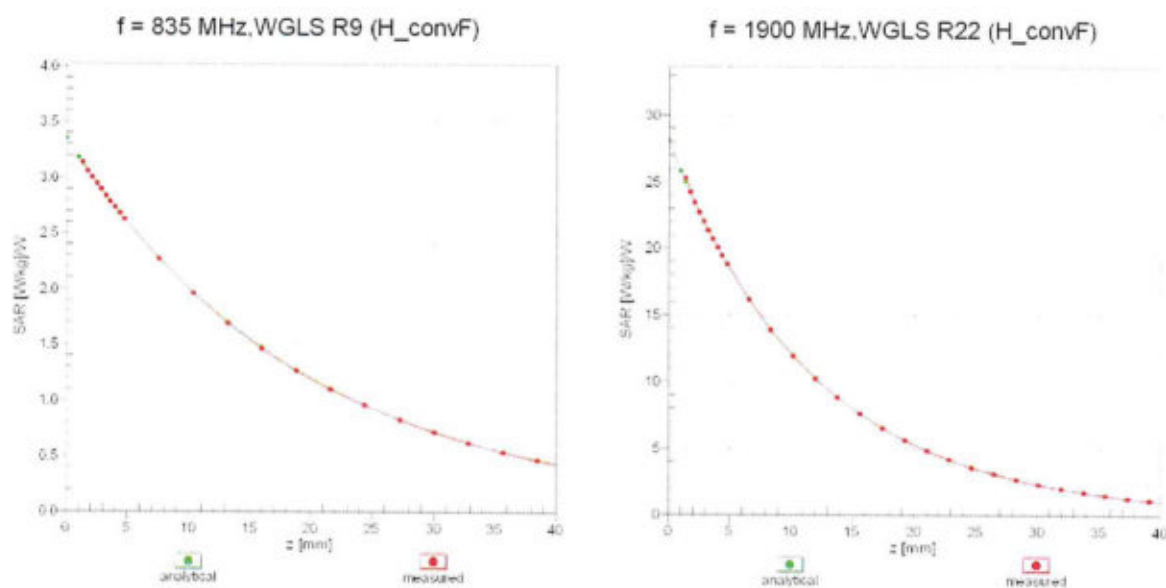
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f_{\text{eval}} = 1900 \text{ MHz}$)



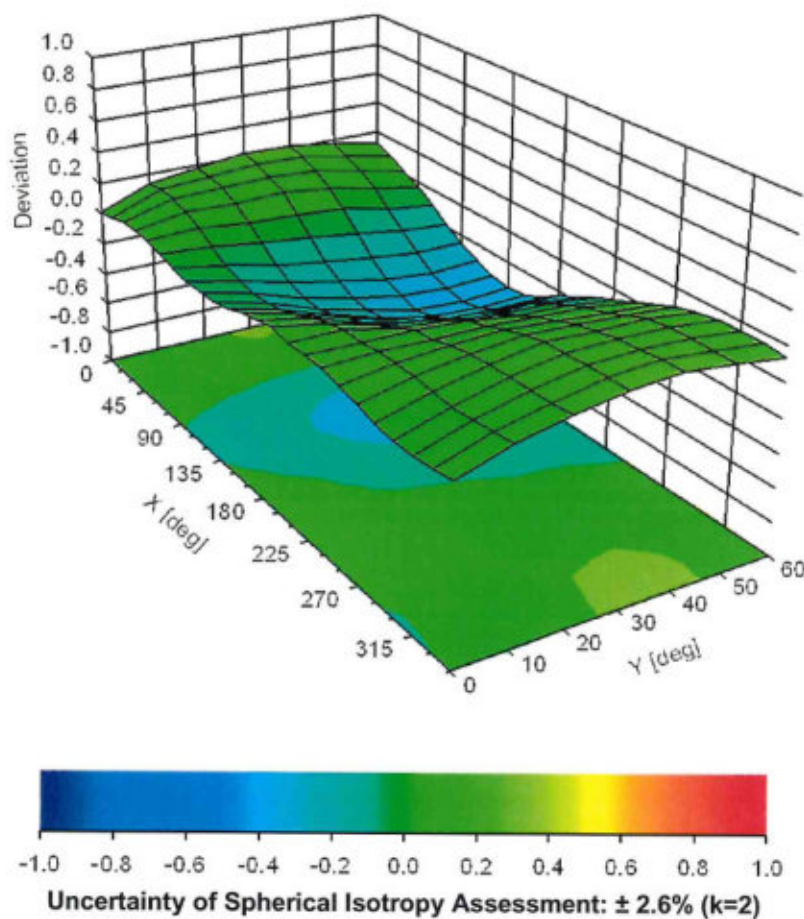
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), $f = 900 \text{ MHz}$





Appendix E. Conducted RF Output Power Table

The detailed power tables are shown as follows.

2.4GHz WLAN		Ant 1+2 Full Power					
2.4GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Time-Up Limit	Duty Cycle %	
	802.11n 1Mbps	1	2412	21.92	23.00	100.00	
		6	2437	22.17	23.00		
		11	2462	22.05	23.00		
	802.11g 9Mbps	1	2412	20.22	21.00	100.00	
		6	2437	20.33	21.00		
		11	2462	20.41	21.00		
	802.11n-HT20 MCS9	1	2412	20.07	21.00	100.00	
		6	2437	20.17	21.00		
		11	2462	20.33	21.00		
	802.11n-HT40 MCS9	1	2412	16.83	18.00	100.00	
		6	2437	17.05	18.00		
		9	2452	17.34	18.00		
	802.11n-HE20 MCS9	1	2412	20.19	21.50	100.00	
		6	2437	20.32	21.50		
		11	2462	20.32	21.50		
	802.11n-HE40 MCS9	3	2422	16.87	18.00	100.00	
		6	2437	16.89	18.00		
		9	2452	17.14	18.00		

5GHz WLAN		Ant 1+2 Full Power				
5.0GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Time-Up Limit	Duty Cycle %
	802.11n 6Mbps	36	5180	17.21	18.00	99.27
		40	5200	17.13	18.00	
		44	5220	17.25	18.00	
	802.11n-HT20 MCS9	48	5240	17.29	18.00	100.00
		36	5180	17.40	18.00	
		40	5200	17.45	18.00	
	802.11n-HT40 MCS9	44	5220	17.85	18.00	100.00
		48	5240	17.87	18.00	
		36	5180	17.59	18.00	
	802.11ac-VHT20 MCS9	46	5210	17.04	18.00	100.00
		36	5180	17.46	18.50	
		40	5200	17.39	18.50	
	802.11ac-VHT40 MCS9	44	5220	17.48	18.50	100.00
		48	5240	17.52	18.50	
		36	5180	17.01	18.00	
	802.11ac-HE20 MCS9	46	5230	16.36	18.00	100.00
		42	5210	16.08	17.00	
		36	5180	17.54	18.50	
	802.11ac-HE40 MCS9	40	5200	17.55	18.50	100.00
		44	5220	17.65	18.50	
		48	5240	17.68	18.50	
	802.11ac-HE80 MCS9	36	5180	17.45	18.50	100.00
		44	5220	17.44	18.50	
		42	5210	16.11	17.00	

5GHz WLAN		Ant 1+2 Full Power				
5.0GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Time-Up Limit	Duty Cycle %
	802.11n 6Mbps	52	5260	20.72	21.50	99.27
		56	5280	21.00	21.50	
		60	5300	20.93	21.50	
	802.11n-HT20 MCS9	64	5320	20.99	21.50	100.00
		52	5260	21.15	22.00	
		56	5280	21.28	22.00	
	802.11n-HT40 MCS9	60	5300	21.36	22.00	100.00
		64	5320	21.36	22.00	
		54	5270	17.18	18.00	
	802.11ac-VHT20 MCS9	62	5310	17.38	18.00	100.00
		52	5260	20.91	22.00	
		56	5280	21.16	22.00	
	802.11ac-VHT40 MCS9	60	5300	21.15	22.00	100.00
		64	5320	21.17	22.00	
		54	5270	17.12	18.00	
	802.11ac-HE20 MCS9	62	5310	17.34	18.00	100.00
		58	5290	16.42	17.00	
		52	5260	20.07	21.00	
	802.11ac-HE40 MCS9	56	5280	20.32	21.00	100.00
		60	5300	20.26	21.00	
		64	5320	20.33	21.00	
	802.11ac-HE80 MCS9	54	5270	17.58	18.50	100.00
		62	5310	17.76	18.50	
		58	5290	16.48	17.00	

5GHz WLAN		Ant +2 Full Power				
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Time-Up Limit	Duty Cycle %
5.0GHz WLAN	802.11n 6Mbps	108	5500	20.91	21.50	99.27
		116	5580	21.03	21.50	
		124	5660	21.05	21.50	
		132	5640	20.29	21.50	
	802.11n-HT20 MCS9	140	5700	19.94	21.50	100.00
		144	5720	19.84	21.50	
		100	5500	21.31	22.00	
		116	5680	21.41	22.00	
	802.11n-HT40 MCS9	124	5620	21.32	22.00	100.00
		132	5660	20.71	22.00	
		140	5700	20.31	22.00	
		144	5720	20.25	22.00	
	802.11ac-VHT20 MCS9	102	5510	17.42	18.50	100.00
		110	5550	17.54	18.50	
		126	5630	17.39	18.50	
		134	5670	16.70	18.50	
	802.11ac-VHT40 MCS9	140	5710	16.28	17.50	100.00
		100	5500	21.06	22.00	
		116	5680	21.20	22.00	
		124	5620	21.17	22.00	
	802.11ac-HE20 MCS9	132	5660	20.46	22.00	100.00
		140	5700	20.11	21.50	
		144	5720	20.02	21.00	
		102	5510	17.39	18.50	
802.11ac-HE40 MCS9	110	5550	17.46	18.50	100.00	
	126	5630	17.36	18.50		
	134	5670	16.80	17.50		
	142	5710	16.26	17.50		
802.11ac-HE80 MCS9	106	5530	16.40	17.50	100.00	
	122	5610	16.58	17.50		
	138	5690	15.51	17.00		
	138	5690	15.51	17.00		
802.11ac-HE160 MCS9	100	5500	20.26	21.50	100.00	
	116	5680	20.41	21.50		
	132	5660	20.36	21.50		
	140	5700	19.86	21.50		
802.11ac-HE320 MCS9	140	5700	19.26	20.50	100.00	
	144	5720	19.20	20.50		
	102	5510	17.81	19.00		
	110	5550	17.32	19.00		
802.11ac-HE640 MCS9	126	5630	17.81	19.00	100.00	
	134	5670	17.11	18.00		
	142	5710	16.87	18.00		
	106	5530	16.52	17.50		
802.11ac-HE1280 MCS9	122	5610	16.58	17.50	100.00	
	138	5690	15.51	17.00		
	138	5690	15.51	17.00		
	138	5690	15.51	17.00		

5GHz WLAN		Ant 1+2 Full Power				
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Time-Up Limit	Duty Cycle %
5.0GHz WLAN	802.11n Mbps	148	5745	16.76	21.50	99.27
		157	5785	20.29	21.50	
		166	5825	20.40	21.50	
	802.11n-HT20 MCS9	149	5745	20.13	22.00	100.00
		157	5785	20.86	22.00	
		166	5825	20.97	22.00	
	802.11n-HT40 MCS9	151	5755	16.30	18.00	100.00
		159	5795	16.93	18.00	
		148	5745	19.88	21.50	
	802.11ac-VHT20 MCS9	157	5785	20.46	21.50	100.00
		166	5825	20.58	21.50	
		151	5755	16.30	17.50	
	802.11ac-VHT40 MCS9	159	5795	16.87	17.50	100.00
		157	5785	16.70	17.50	
		149	5745	19.18	20.50	
802.11ac-HE20 MCS9	157	5785	19.55	20.50	100.00	
	166	5825	19.72	20.50		
	151	5755	16.78	18.00		
802.11ac-HE40 MCS9	159	5795	17.31	18.00	100.00	
	156	5775	16.73	17.00		
	156	5775	16.73	17.00		
802.11ac-HE80 MCS9	148	5745	16.76	21.50	100.00	
	157	5785	20.29	21.50		
	166	5825	20.40	21.50		
802.11ac-HE160 MCS9	149	5745	20.13	22.00	100.00	
	157	5785	20.86	22.00		
	166	5825	20.97	22.00		
802.11ac-HE320 MCS9	151	5755	16.30	18.00	100.00	
	159	5795	16.93	18.00		
	149	5745	19.88	21.50		
802.11ac-HE640 MCS9	157	5785	20.46	21.50	100.00	
	166	5825	20.58	21.50		
	151	5755	16.30	17.50		
802.11ac-HE1280 MCS9	159	5795	16.87	17.50	100.00	
	157	5785	16.70	17.50		
	149	5745	19.18	20.50		
802.11ac-HE2560 MCS9	157	5785	19.55	20.50	100.00	
	166	5825	19.72	20.50		
	151	5755	16.78	18.00		
802.11ac-HE5120 MCS9	159	5795	17.31	18.00	100.00	
	156	5775	16.73	17.00		
	156	5775	16.73	17.00		

BT BR/EDR

Mode	Channel	Frequency (MHz)	Average power (dBm)			Tune-up Limit
			1Mbps	2Mbps	3Mbps	
BR / EDR	CH 00	2402	12.41	9.79	9.90	12.50
	CH 39	2441	13.69	11.06	11.04	14.00
	CH 78	2480	12.48	10.33	10.32	12.50

BT LE 4.0

Mode	Channel	Frequency (MHz)	Average power (dBm)		Tune-up Limit
			GFSK		
LE	CH 00	2402	5.95		7.00
	CH 19	2440	7.33		8.00
	CH 39	2480	6.47		7.00

BT LE 5.0

Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-up Limit
			1Mbps	
LE	CH 00	2402	6.18	7.00
	CH 19	2440	7.61	8.00
	CH 39	2480	6.64	7.00