FCC WLAN 6GHz RF Exposure

Applicant	**:**	**Zebra Technologies Corporation**
Equipment	**:**	**Personal Shopper**
Brand Name	**:**	**ZEBRA**
Model Name	**:**	**PS30JP**
FCC ID	**:**	**UZ7PS30JP**
Standard	**:**	**FCC 47 CFR Part 2 (2.1093)**

We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the test procedures given in 47 CFR Part 2.1093 and FCC KDB and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

Si Zhang

Approved by: Si Zhang

ilac-MRA

ACCREDITED Cert #5145.02

Sporton International Inc. (Kunshan)
No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China

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History of this test report

Report No.	Version	Description	Issued Date
FA3D0816B	01	Initial issue of report	Feb. 19, 2024

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Zebra Technologies Corporation, Personal Shopper, PS30JP,** are as follows.

Band	Tx Frequency (MHz)	Reported SAR		Measured APD		Scaled PD
		Body (1g SAR W/kg)	Product Specific (10g SAR W/kg)	Body (W/m^2)	Product Specific (W/m^2)	psPD (W/m^2)
WLAN6GHz	5925-7125	<0.10	0.79	0.26	16.1	7.95
Date of Testing:		2024/1/8~2024/1/15				

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg for Partial-Body 1g SAR, 4.0 W/kg for Product Specific 10g SAR) and Power density exposure limits (1 mW/cm^2 = 10 W/m^2) specified in FCC 47 CFR part 2 (2.1093), ANSI/IEEE C95.1-1992 and FCC 47 CFR Part1.1310, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications.

2. Administration Data

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Testing Laboratory			
Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	SAR04-KS	CN1257	314309

Applicant	
Company Name	Zebra Technologies Corporation
Address	1 Zebra Plaza, Holtsville, NY 11742

Manufacturer	
Company Name	Zebra Technologies Corporation
Address	1 Zebra Plaza, Holtsville, NY 11742

3. Guidance Applied

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards.

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- IEC/IEEE 62209-1528:2020
- SPEAG DASY6 System Handbook
- SPEAG DASY6 Application Note (Interim Procedure for Device Operation at 6GHz-10GHz)
- IEC TR 63170:2018
- IEC 62479:2010
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02

4. Equipment Under Test (EUT) Information

4.1 General Information

Product Feature & Specification	
Equipment Name	Personal Shopper
Brand Name	ZEBRA
Model Name	PS30JP
FCC ID	UZ7PS30JP
S/N	233405247E0141
Wireless Technology and Frequency Range	WLAN 6GHz U-NII-5: 5925 MHz ~ 6425 MHz WLAN 6GHz U-NII-6: 6425 MHz ~ 6525 MHz WLAN 6GHz U-NII-7: 6525 MHz ~ 6875 MHz WLAN 6GHz U-NII-8: 6875 MHz ~ 7125 MHz
Mode	WLAN 6GHz 802.11a WLAN 6GHz 802.11ax HE20/HE40/HE80/HE160
HW Version	EV2
SW Version	13-13-11.00-TG-U00-PRD-NEM-04
MFD	13Dec23
EUT Stage	Identical Prototype

Remark:
1. The 6GHz WLAN can transmit in SISO and MIMO mode.
2. The device supports 1S2T (CDD & Tx Beamforming) and 2S2T (SDM) mode; 1S2T: Nss=1, MIMO 2Tx; 2S2T: Nss=2, MIMO 2Tx.
3. This device has two batteries. For battery 1/2 only suppliers are different, so only battery 1 was chosen to perform full SAR testing.
4. This device has one soft holster, and soft holster spot check worst case to ensure the RF exposure is compliance at different exposure conditions.
5. The device support DBS (Dual Band Simultaneous) function, when the device WLAN 2.4GHz and WLAN 5GHz or WLAN 6GHz transmit at the same time the module will limit different output power for simultaneous transmission compliance.

Specification of Accessory				
Battery 1	Brand Name	Zebra	Part Number	BT-000355-0020
Battery 2	Brand Name	Zebra	Part Number	BT-000355-5020

Supported Unit used in test configuration and system				
1-slot cradle	Brand Name	Zebra	Part Number	CRD-MC18-1SLOT-01
Adapter	Brand Name	Zebra	Part Number	PWR-BGA12V108W0WW
Programming USB cable	Brand Name	Zebra	Part Number	CBL-PS30-USBCHG-01
Soft Holster	Brand Name	Zebra	Part Number	SG-PS20-SFTHLT-01

5. RF Exposure Limits

5.1 Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

5.2 Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

5.3 RF Exposure limit for below 6GHz

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

1. Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

5.4 RF Exposure limit for above 6GHz

According to ANSI/IEEE C95.1-1992, the criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310. The unit of power density evaluation is W/m^2 or mW/cm^2.

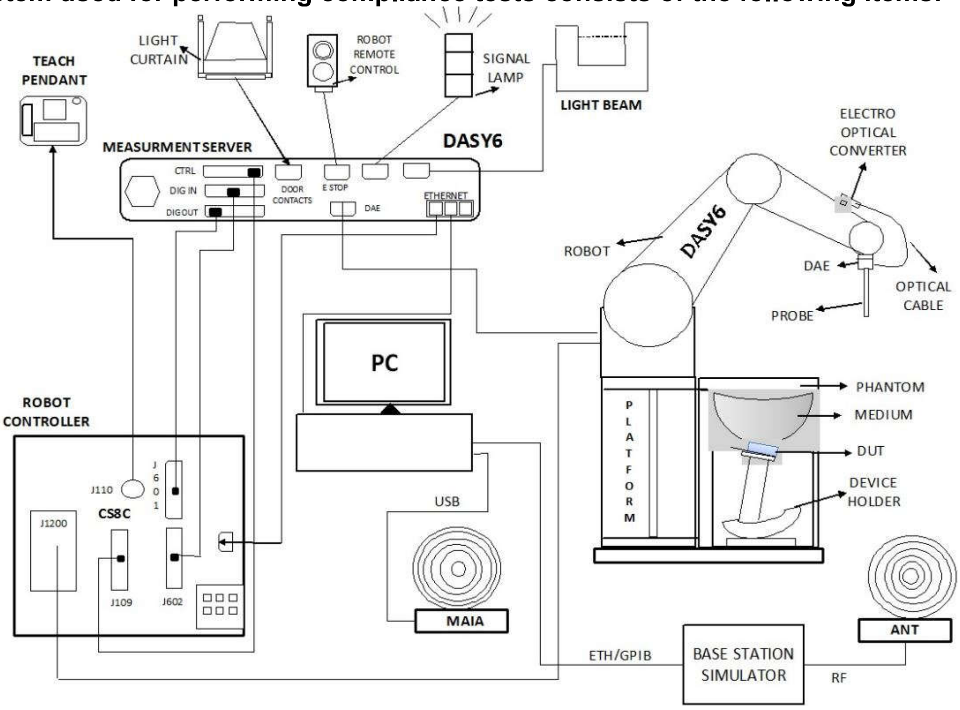
Peak Spatially Averaged Power Density was evaluated over a circular area of $4cm^2$ per interim FCC Guidance for near-field power density evaluations per October 2018 TCB Workshop notes

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f2)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f2)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

Note: 1.0 mW/cm^2 is 10 W/m^2

6. System Description and Setup

The DASY system used for performing compliance tests consists of the following items:



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running Windows 10 and the DASY6(1) software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.
  Note: 1. DASY6 software used: DASY6 mmWave V3.0.0.841 and older generations and used the developed Plane-to-Plane Phase Reconstruction (PTP-PR) Algorithm which was used in PD measurement.

7. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	6500MHz System Validation Kit	D6.5GHzV2	1031	2023/2/22	2024/2/21
SPEAG	5G Verification Source	10GHz	2005	2023/11/20	2024/11/19
SPEAG	Data Acquisition Electronics	DAE4	1279	2023/6/7	2024/6/6
SPEAG	Data Acquisition Electronics	DAE4	690	2023/6/20	2024/6/19
SPEAG	Dosimetric E-Field Probe	EX3DV4	7764	2023/10/5	2024/10/4
SPEAG	EUmmWV Probe Tip Protection	EUmmWV4	9553	2023/10/18	2024/10/17
SPEAG	mmWave Phantom	mmWave	1065	NCR	NCR
SPEAG	SAM Twin Phantom	SAM Twin	TP-2022	NCR	NCR
Testo	Thermo-Hygrometer	608-H1	1241332126	2023/7/10	2024/7/9
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Rohde & Schwarz	Signal Generator	SMB100A	100455	2024/1/2	2025/1/1
Keysight	Preamplifier	83017A	MY57280111	2023/7/5	2024/7/4
Anritsu	Radio Communication Analyzer	MT8821C	6262306175	2023/7/5	2024/7/4
Agilent	ENA Series Network Analyzer	E5071C	MY46111157	2023/7/5	2024/7/4
SPEAG	Dielectric Probe Kit	DAK-3.5	1144	2023/8/17	2024/8/16
Anritsu	Vector Signal Generator	MG3710A	6201682672	2024/1/2	2025/1/1
Rohde & Schwarz	Power Meter	NRVD	102081	2023/7/5	2024/7/4
Rohde & Schwarz	Power Sensor	NRV-Z5	100538	2023/7/5	2024/7/4
Rohde & Schwarz	Power Sensor	NRV-Z5	100539	2023/7/5	2024/7/4
Rohde & Schwarz	Power Sensor	NRP50S	101385	2023/10/11	2024/10/10
Rohde & Schwarz	Spectrum Analyzer	FSV7	101631	2023/10/11	2024/10/10
TES	DIGITAC THERMOMETER	1310	220305411	2023/7/8	2024/7/7
BONN	POWER AMPLIFIER	BLMA 0830-3	087193A	Note 1	
BONN	POWER AMPLIFIER	BLMA 2060-2	087193B	Note 1	
Agilent	Dual Directional Coupler	778D	20500	Note 1	
Agilent	Dual Directional Coupler	11691D	MY48151020	Note 1	
ET Industries	Dual Directional Coupler	C-058-10	N/A	Note 1	
ATM	Dual Directional Coupler	C122H-10	P610410z-02	Note 1	
ARRA	Power Divider	A3200-2	N/A	Note 1	
MCL	Attenuation1	BW-S10W5+	N/A	Note 1	
MCL	Attenuation2	BW-S10W5+	N/A	Note 1	
MCL	Attenuation3	BW-S10W5+	N/A	Note 1	

General Note:

1. Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check source.
2. The dipole calibration interval can be extended to 3 years with justification according to KDB 865664 D01. The dipoles are also not physically damaged, or repaired during the interval. The justification data in appendix C can be found which the return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration for each dipole.

8. SAR System Verification

8.1 SAR Tissue Verification

The tissue dielectric parameters of tissue-equivalent media used for SAR measurements must be characterized within a temperature range of 18℃ to 25℃, measured with calibrated instruments and apparatuses, such as network analyzers and temperature probes. The temperature of the tissue-equivalent medium during SAR measurement must also be within 18℃ to 25℃ and within ± 2℃ of the temperature when the tissue parameters are characterized. The tissue dielectric measurement system must be calibrated before use. The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements.
The liquid tissue depth was at least 15cm in the phantom for all SAR testing

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
6500	22.8	6.060	34.500	6.07	34.50	-0.16	0.00	±5	2024/1/15

8.2 SAR System Performance Check Results

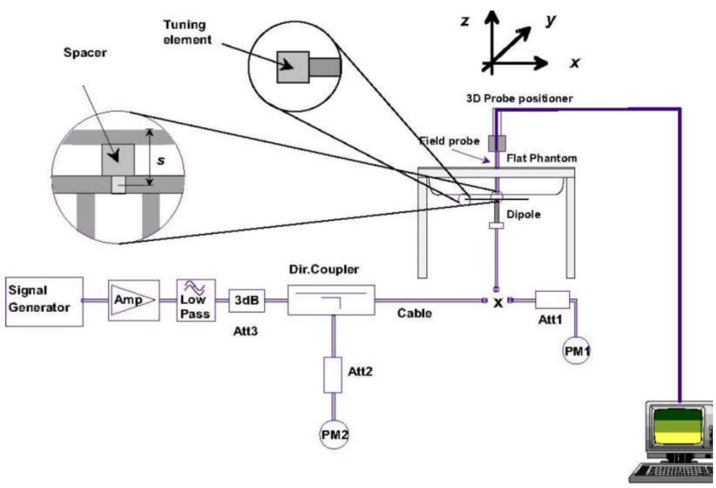
Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

<1g SAR>

Date	Frequency (MHz)	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2024/1/15	6500	50	1031	7764	1279	14.600	297.00	292	-1.68

<10g SAR>

Date	Frequency (MHz)	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 10g SAR (W/kg)	Deviation (%)
2024/1/15	6500	50	1031	7764	1279	2.670	54.80	53.4	-2.55



System Performance Check Setup

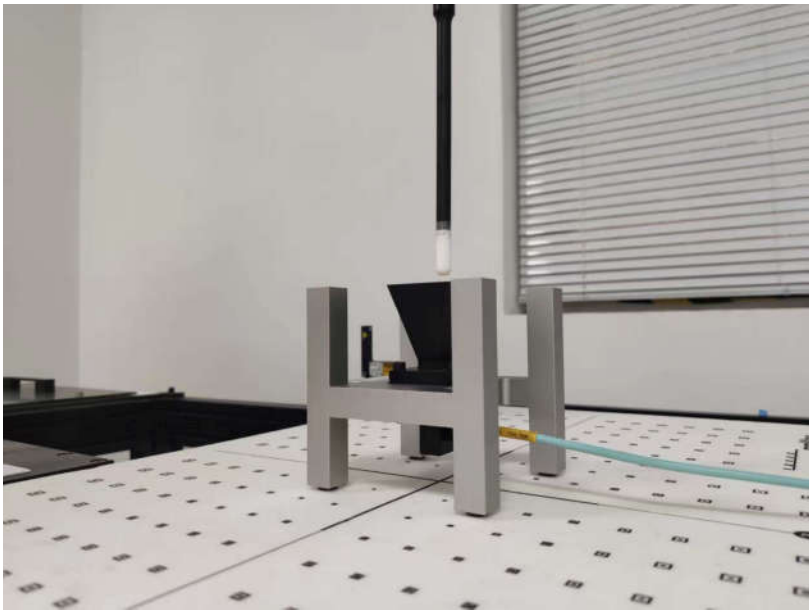
Setup Photo

8.3 PD System Verification Results

The system was verified to be within ±0.66 dB of the power density targets on the calibration certificate according to the test system specification in the user's manual and calibration facility recommendation. The 0.66 dB deviation threshold represents the expanded uncertainty for system performance checks using SPEAG's mmWave verification sources. The same spatial resolution and measurement region used in the source calibration was applied during the system check. The measured power density distribution of verification source was also confirmed through visual inspection to have no noticeable differences, both spatially (shape) and numerically (level) from the distribution provided by the manufacturer, per November 2017 TCBC Workshop Notes.

Frequency (GHz)	5G Verification Source	Probe S/N	DAE S/N	Distance (mm)	Input Power (mW)	Measured 4 cm^2 (W/m^2)	Normalized(1) 4 cm^2 (W/m^2)	Targeted 4 cm^2 (W/m^2)	Deviation (dB)	Date
10	10GHz_2005	9553	690	10	62	57.9	148.0	161	-0.37	2024/1/8

Note: (1) means the measured PD was normalized to Prad power which can be referred to DASY Calibration Certificate in appendix C.



System Verification Setup Photo

9. RF Exposure Positions

9.1 Body Device

(a) To position the device parallel to the phantom surface with all surfaces of the device.

(b) To adjust the device parallel to the flat phantom.

(c) To adjust the distance between the device surface and the flat phantom to 5mm.

9.2 Product Specific/Extremity Exposure

(a) The device shall be placed directly against the flat phantom, for those sides of the device that are in contact with the hand during intended use.

(b) To adjust the device parallel to the flat phantom.

(c) To adjust the distance between the device surface and the flat phantom to 0 cm.

9.3 Miscellaneous Testing Considerations

- Evaluate SAR using 6-7 GHz parameters per IEC/IEEE 62209-1528:2020.
- Per procedures of KDB Pubs. 447498 and 248227, and applicable product-specific procedures among KDB Pubs.
- Where supported by the test system, also report estimated absorbed (epithelial) power density (for reference purposes only, not specifically for compliance) and estimated incident PD, derived from measured SAR.
- In addition, for the highest SAR test configurations evaluate incident PD using the mmw near-field probe and total-field/power-density reconstruction method (2 mm closest meas. plane)
    - Adjust measured results per amount that measurement uncertainty exceeds 30 % (see e.g. IEC 62479:2010)

10. WLAN 6GHz Output Power (Unit: dBm)

General Note:

1. The 6GHz WLAN can transmit in SISO/MIMO antenna mode, for SISO mode power is less than per chain power of MIMO mode. For WLAN SISO & MIMO mode, the whole testing has assessed only MIMO mode by referring to their higher conducted power, SAR and PD for MIMO was evaluated by making a measurement with both antennas transmitting simultaneously.
2. When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel for each frequency band.
3. Per 201904 TCBC workshops, General principles of FCC KDB Publication 248227 D01 can be applied to determine the SAR Initial Test Configurations and test reduction for 802.11ax SAR testing. For the table below the 802.11ax maximum power is SU (non-OFDMA), and the SU maximum power also higher than RU (OFDMA)
4. In applying the test guidance, the IEEE 802.11 mode with the maximum output power (out of all modes) should be considered for testing
5. For modes with the same maximum output power, the guidance from section 5.3.2 a) of FCC KDB Publication 248227 D01 should be applied, with 802.11ax being considered as the highest 802.11 mode for the appropriate frequency bands
6. For WLAN SISO & MIMO(CDD) mode of 802.11a, and WLAN SISO mode is not greater than WLAN MIMO(CDD) mode, so conducted power of WLAN SISO mode is not required. For WLAN SISO & MIMO(CDD) & MIMO(SDM) & TX Beamforming mode of 802.11ax, and WLAN SISO & MIMO(CDD) & TX Beamforming mode is not greater than WLAN MIMO(SDM) mode, so conducted power of WLAN SISO & MIMO(CDD) &Tx Beamforming mode is not required.

				Ant 0		Ant 1		Ant 0+1		
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Duty Cycle %
WiFi 6E	802.11a 6Mbps	1	5955	13.07	14.00	14.06	14.50	16.61	17.50	98.97
		57	6235	12.88	13.00	13.07	13.50	15.99	16.50	
		113	6515	-0.34	0.00	-1.28	-1.00	2.23	2.50	
		173	6815	12.01	12.50	11.09	11.50	14.59	15.00	
		233	7115	1.93	2.00	2.99	3.50	5.51	6.00	
	802.11ax-HE20 MCS0	1	5955	12.89	13.00	13.97	14.50	16.47	17.00	100.00
		57	6235	12.47	13.00	12.82	13.00	15.66	16.00	
		113	6515	2.78	3.00	2.97	3.00	5.89	6.00	
		173	6815	11.85	12.00	10.95	11.00	14.43	14.50	
		229	7095	5.22	5.50	6.22	6.50	8.76	9.00	
		233	7115	-8.53	-8.00	-7.91	-7.00	-5.20	-4.00	
	802.11ax-HE40 MCS0	3	5965	13.50	14.00	14.11	14.50	16.83	17.50	100.00
		59	6245	13.58	14.00	14.14	14.50	16.88	17.50	
		107	6485	5.41	6.00	5.69	6.00	8.56	9.00	
		171	6805	12.39	12.50	11.33	11.50	14.90	15.00	
		227	7085	8.26	8.50	9.24	9.50	11.79	12.00	
	802.11ax-HE80 MCS0	7	5985	13.14	13.50	14.13	14.50	16.67	17.00	100.00
		71	6305	12.68	13.00	13.44	13.50	16.01	16.50	
		119	6545	7.68	8.00	7.63	8.00	10.67	11.00	
		167	6785	10.28	10.50	10.39	10.50	13.35	13.50	
		215	7025	10.43	10.50	11.59	12.00	14.06	14.50	
	802.11ax-HE160 MCS0	15	6025	13.28	14.00	14.38	14.50	16.88	17.50	100.00
		47	6185	13.51	14.00	14.25	14.50	16.91	17.50	
		111	6505	10.85	11.00	10.09	10.50	13.50	14.00	
		143	6665	10.75	12.00	10.53	12.00	13.65	15.00	
		207	6985	10.93	11.00	11.29	11.50	14.12	14.50	

11. Antenna Location

The detailed antenna location information can refer to SAR Test Setup Photos in Appendix D.

12. RF Exposure Test Results

General Note:

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
   b. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
   c. For WLAN: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
2. Per KDB 447498 D01v06, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
   - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
   - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.
4. For WLAN 6GHz doesn't support wireless router capability.
5. Per FCC guidance, SAR was performed using 6.5 GHz SAR probe calibration factors.
6. Per October 2020 TCB Workshop Interim procedures, start instead with a minimum of 5 test channels across the full band, then adapt and apply conducted power and SAR test reduction procedures of KDB Pub. 248227 v02r02.
7. Absorbed power density (APD) using a 4cm^2 averaging area is reported based on SAR measurements.
8. For WLAN SISO & MIMO(CDD) mode of 802.11a, and WLAN SISO mode is not greater than WLAN MIMO(CDD) mode; For WLAN SISO & MIMO(CDD) & MIMO(SDM) & TX Beamforming mode of 802.11ax, and WLAN SISO & MIMO(CDD) & TX Beamforming mode is not greater than WLAN SISO & MIMO(SDM) mode, so WLAN SISO & MIMO(SDM) mode SAR covers WLAN SISO & MIMO(CDD) &Tx Beamforming mode SAR.
9. For determination of the scaling factor for report SAR of MIMO mode, if the hot spots are separated the scaling factors are individually determined from each transmit chain. Further simplification chose the worse SAR value and the worst scaling factor from each transmit chain perform reported SAR calculation conservatively. If the hot spots are not spatially separated, the scaling factor is determined from the worst number of each transmit chain.
10. For testing the WLAN 6GHz of this DUT, the selection of test channels was based on FCC guidance, with five channels selected across the entire WLAN 6GHz Bands. For the U-NII-5/U-NII-7 band supporting Standard AP mode and indoor Client mode, the higher output mode was measured among the selected channels.
11. Per FCC guidance, the WLAN 6GHz Sim-Tx analysis are using the SAR results with the conventional SPLSR etc procedures from KDB 447498 D01. And the Sim-Tx analysis result refers to Sporton SAR report no.: FA3D0816.

WLAN SAR Note:

1. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is ≤ 0.8 W/kg or all required test position are tested.
2. For all positions / configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions / configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.
3. The 6GHz WLAN can transmit in SISO/MIMO antenna mode, for SISO mode power is less than per chain power of MIMO mode. For WLAN SISO & MIMO mode, the whole testing has assessed only MIMO mode by referring to their higher conducted power, so only chose MIMO power to perform SAR testing. Per KDB 248227, SAR for MIMO was evaluated by following the simultaneous SAR provisions from KDB 447498 by making a SAR measurement with both antennas transmitting simultaneously
4. During SAR testing the WLAN 6GHz transmission was verified using a spectrum analyzer.
5. When SAR testing for 802.11ax is required
   a. If the maximum output power is highest for OFDMA scenarios, choose the tone size with the maximum number of tones and the highest maximum output power
   b. Otherwise, consider the fully allocated channel for SAR testing
   c. When SAR testing is required on RU sizes less than the fully allocated channel, use the RU number closest to the middle of the channel, choosing the higher RU number when two RUs are equidistant to the middle of the channel.

12.1 Body SAR Test Result

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Accessory	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Measured APD (W/m^2)
	WLAN6GHz	802.11ax-HE160 MCS0	Front	0mm	Ant 0+1	Soft Holster	47	6185	16.91	17.50	1.146	100	1.000	0.04	0.029	0.033	0.209
	WLAN6GHz	802.11ax-HE160 MCS0	Front	0mm	Ant 0+1(0)	Soft Holster	15	6025	13.28	14.00	1.180	100	1.000	0.01	0.026	0.031	0.215
	WLAN6GHz	802.11ax-HE160 MCS0	Front	0mm	Ant 0+1	Soft Holster	111	6505	13.50	14.00	1.122	100	1.000	-0.01	0.003	0.003	0.019
	WLAN6GHz	802.11ax-HE160 MCS0	Front	0mm	Ant 0+1(1)	Soft Holster	143	6665	10.53	12.00	1.403	100	1.000	0.08	0.005	0.007	0.021
01	WLAN6GHz	802.11ax-HE160 MCS0	Front	0mm	Ant 0+1	Soft Holster	207	6985	14.12	14.50	1.091	100	1.000	0.01	0.037	**0.040**	**0.257**

12.2 Product Specific 10gSAR Test Result

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)	Measured APD (W/m^2)
	WLAN6GHz	802.11ax-HE160 MCS0	Front	0mm	Ant 0+1	47	6185	16.91	17.50	1.146	100	1.000	0.01	0.028	0.032	0.663
02	WLAN6GHz	802.11ax-HE160 MCS0	Back	0mm	Ant 0+1	47	6185	16.91	17.50	1.146	100	1.000	-0.08	0.691	**0.792**	**16.1**
	WLAN6GHz	802.11ax-HE160 MCS0	Back	0mm	Ant 0+1(0)	15	6025	13.28	14.00	1.180	100	1.000	-0.03	0.431	0.509	10.4
	WLAN6GHz	802.11ax-HE160 MCS0	Back	0mm	Ant 0+1	111	6505	13.50	14.00	1.122	100	1.000	0.01	0.374	0.420	8.833
	WLAN6GHz	802.11ax-HE160 MCS0	Back	0mm	Ant 0+1(1)	143	6665	10.53	12.00	1.403	100	1.000	0.05	0.368	0.516	8.77
	WLAN6GHz	802.11ax-HE160 MCS0	Back	0mm	Ant 0+1	207	6985	14.12	14.50	1.091	100	1.000	0.01	0.287	0.313	6.81
	WLAN6GHz	802.11ax-HE160 MCS0	Left Side	0mm	Ant 0+1	47	6185	16.91	17.50	1.146	100	1.000	0.09	0.534	0.612	12.800
	WLAN6GHz	802.11ax-HE160 MCS0	Right Side	0mm	Ant 0+1	47	6185	16.91	17.50	1.146	100	1.000	-0.19	0.205	0.235	4.79

12.3 PD Test Result

Power Density General Notes:

1. The manufacturer has confirmed that the devices tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
2. Batteries are fully charged at the beginning of the measurements.
3. Absorbed power density (APD) using a 4cm^2 averaging area is reported based on SAR measurements.
4. Power density was calculated by repeated E-field measurements on two measurement planes separated by λ/4.
5. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools.
6. Per FCC guidance and equipment manufacturer guidance, power density results were scaled according to IEC 62479:2010 for the portion of the measurement uncertainty > 30%. Total expanded uncertainty of 2.68 dB (85.4%) was used to determine the psPD measurement scaling factor.
7. Per April 2021 TCB Workshop, for the highest SAR test configurations also measure incident PD (total) using power-density reconstruction method in 2 mm closest measurement plane.
8. Since there is no different PD limit on different exposure conditions, therefore select highest 10gSAR at 0 mm test distance and configurations evaluate power density. Since there is no different PD limit on different exposure conditions, therefore the PD test was performed of a 2mm separation between Probe sensor and EUT surface to cover all exposure conditions of this device.
9. IPD is measured for all edges and surfaces of the device with a transmitting antenna located within 25 mm from that surface or edge.
10. Per October 2020 TCB Workshop, PTP-PR algorithm was used during psPD measurement and calculations.
11. The measurement procedure consists of measuring the PDinc at two different distances: 2 mm (compliance distance) and λ/5. The grid extents should be large enough to fully capture the transmitted energy. The grid step should be fine enough to demonstrate that the integrated Power Density iPDn fulfill the criterion described below. Since iPD ratio between the two distances is≥ -1dB, the grid step (0.0625) was sufficient for determining compliance at d=2mm.

$$10 \cdot log_{10} \frac{iPD_n(2mm)}{iPD_n(\lambda/5)} \geq -1$$

<WLAN PD>

Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Grid Step (λ)	iPDn	iPD ratio (≥ -1)	Normal psPD (W/m^2)	Total psPD (W/m^2)
WLAN6GHz	802.11ax-HE160 MCS0	Back	2mm	Ant 0+1	15	6025	13.28	0.0625	3.47	-0.79	2.660	4.140
WLAN6GHz	802.11ax-HE160 MCS0	Back	10mm	Ant 0+1	15	6025	13.28	0.15	4.16		1.78	2.11
WLAN6GHz	802.11ax-HE160 MCS0	Back	2mm	Ant 0+1	207	6985	14.12	0.0625	4.75	0.12	4.08	4.47
WLAN6GHz	802.11ax-HE160 MCS0	Back	8.59mm	Ant 0+1	207	6985	14.12	0.15	4.62		2.280	2.38

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Grid Step (λ)	Scaling Factor for measurement uncertainty	Power Drift (dB)	Normal psPD (W/m^2)	Scaled Normal psPD (W/m^2)	Total psPD (W/m^2)	Scaled Total psPD (W/m^2)
	WLAN6GHz	802.11ax-HE160 MCS0	Back	2mm	Ant 0+1(0)	15	6025	13.28	14.00	1.180	100	1.000	0.0625	1.5535	0.05	2.66	4.88	4.14	7.59
01	WLAN6GHz	802.11ax-HE160 MCS0	Back	2mm	Ant 0+1	47	6185	16.91	17.50	1.146	100	1.000	0.0625	1.5535	-0.06	4.02	7.15	4.47	7.95
	WLAN6GHz	802.11ax-HE160 MCS0	Back	2mm	Ant 0+1	111	6505	13.50	14.00	1.122	100	1.000	0.0625	1.5535	0.01	3.28	5.72	3.68	6.41
	WLAN6GHz	802.11ax-HE160 MCS0	Back	2mm	Ant 0+1(1)	143	6665	10.53	12.00	1.403	100	1.000	0.0625	1.5535	-0.03	3.49	7.61	3.61	7.87
	WLAN6GHz	802.11ax-HE160 MCS0	Back	2mm	Ant 0+1	207	6985	14.12	14.50	1.091	100	1.000	0.0625	1.5535	0.09	4.08	6.92	4.47	7.58
	WLAN6GHz	802.11ax-HE160 MCS0	Front	2mm	Ant 0+1	47	6185	16.91	17.50	1.146	100	1.000	0.0625	1.5535	0.03	0.625	1.11	0.788	1.40
	WLAN6GHz	802.11ax-HE160 MCS0	Left Side	2mm	Ant 0+1	47	6185	16.91	17.50	1.146	100	1.000	0.0625	1.5535	0.05	3.97	7.06	4.40	7.83
	WLAN6GHz	802.11ax-HE160 MCS0	Right Side	2mm	Ant 0+1	47	6185	16.91	17.50	1.146	100	1.000	0.0625	1.5535	-0.06	3.55	6.32	3.69	6.57

Test Engineer： Martin Li, Varus Wang, Light Wang, Ricky Gu

13. Uncertainty Assessment

Declaration of Conformity:
The test results with all measurement uncertainty excluded is presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type An evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in table below.

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor[(a)]	$1/k^{(b)}$	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b) κ is the coverage factor

Standard Uncertainty for Assumed Distribution

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is shown in the following tables.

The judgment of conformity in the report is based on the measurement results excluding the measurement uncertainty.

DASY6 Uncertainty Budget (Frequency band: 4 MHz - 10 GHz range)							
Error Description	**Uncertainty Value (±%)**	**Probability**	**Divisor**	**(Ci) 1g**	**(Ci) 10g**	**Standard Uncertainty (1g) (±%)**	**Standard Uncertainty (10g) (±%)**
Measurement System							
Probe Calibration	18.60	N	2	1	1	9.3	9.3
Probe Calibration Drift	1.00	N	1	1	1	1.0	1.0
Probe Linearity	4.70	R	1.732	1	1	2.7	2.7
Broadband Signal	3.00	N	1	1	1	3.0	3.0
Probe Isotropy	7.60	R	2	1	1	3.8	3.8
Data Acquisition	0.30	N	1.732	1	1	0.2	0.2
RF Ambient	1.80	N	1	1	1	1.8	1.8
Probe Positioning	0.20	N	1	0.33	0.33	0.1	0.1
Data Processing	3.50	N	1	1	1	3.5	3.5
Phantom and Device Errors							
Conductivity (meas.) DAK	2.50	N	1	0.78	0.71	2.0	1.8
Conductivity (temp.) BB	5.40	R	1.732	0.78	0.71	2.4	2.2
Phantom Permittivity	14.00	R	1.732	0.5	0.5	4.0	4.0
Distance DUT - TSL	2.00	N	1	2	2	4.0	4.0
Device Holder	3.60	N	1	1	1	3.6	3.6
DUT Modulationm	2.40	R	1.732	1	1	1.4	1.4
Time-average SAR	2.60	R	1.732	1	1	1.5	1.5
DUT drift	5.00	N	1	1	1	5.0	5.0
Correction to the SAR results							
Deviation to Target	1.90	N	1	1	0.84	1.9	1.6
SAR scalingp	0.00	R	1.732	1	1	0.0	0.0
Combined Std. Uncertainty						14.9%	14.8%
Coverage Factor for 95 %						K=2	K=2
Expanded STD Uncertainty						29.8%	29.6%

SAR Uncertainty Budget for frequency range 4MHz to 10GHz

Uncertainty Budget According to IEC/IEEE 62209-1528 (Frequency band: 4 MHz - 10 GHz range)							
Error Description	**Uncert. Value (±%)**	**Prob. Dist.**	**Div.**	**(Ci) 1g**	**(Ci) 10g**	**Standard Uncertainty (1g) (±%)**	**Standard Uncertainty (10g) (±%)**
Measurement System errors							
Probe calibration	18.6	N	2	1	1	9.3	9.3
Probe calibration drift	1.7	R	1.732	1	1	1.0	1.0
Probe linearity and detection Limit	4.7	R	1.732	1	1	2.7	2.7
Broadband signal	2.8	R	1.732	1	1	1.6	1.6
Probe isotropy	7.6	R	1.732	1	1	4.4	4.4
Other probe and data acquisition errors	2.4	N	1	1	1	2.4	2.4
RF ambient and noise	1.8	N	1	1	1	1.8	1.8
Probe positioning errors	0.006	N	1	0.5	0.5	0.0	0.0
Data processing errors	4.0	N	1	1	1	4.0	4.0
Phantom and Device Errors							
Measurement of phantom conductivity (σ)	2.5	N	1	0.78	0.71	2.0	1.8
Temperature effects (medium)	5.4	R	1.732	0.78	0.71	2.4	2.2
Shell permittivity	14.0	R	1.732	0.5	0.5	4.0	4.0
Distance between the radiating element of the DUT and the phantom medium	2.0	N	1	2	2	4.0	4.0
Repeatability of positioning the DUT or source against the phantom	1.0	N	1	1	1	1.0	1.0
Device holder effects	3.6	N	1	1	1	3.6	3.6
Effect of operating mode on probe sensitivity	2.4	R	1.732	1	1	1.4	1.4
Time-average SAR	1.7	R	1.732	1	1	1.0	1.0
Variation in SAR due to drift in output of DUT	2.5	N	1	1	1	2.5	2.5
Validation antenna uncertainty (validation measurement only)	0.0	N	1	1	1	0.0	0.0
Uncertainty in accepted power (validation measurement only)	0.0	N	1	1	1	0.0	0.0
Correction to the SAR results							
Phantom deviation from target (ε´,σ)	1.9	N	1	1	0.84	1.9	1.6
SAR scaling	0.0	R	1.732	1	1	0.0	0.0
Combined Std. Uncertainty						**14.5%**	**14.4%**
Coverage Factor for 95 %						**K=2**	**K=2**
Expanded STD Uncertainty						**29.0%**	**28.8%**

SAR Uncertainty Budget for frequency range 4MHz to 10GHz

cDASY6 Module mmWave Uncertainty Budget Evaluation Distances to the Antennas > λ/2π In Compliance with IEC TR 63170					
Error Description	**Uncertainty Value (±dB)**	**Probability**	**Divisor**	**(Ci)**	**Standard Uncertainty (±dB)**
Uncertainty terms dep endent on the measurement system					
Probe Calibration	0.49	N	1	1	0.49
Probe correction	0.00	R	1.732	1	0.00
Frequency response	0.20	R	1.732	1	0.12
Sensor cross coupling	0.00	R	1.732	1	0.00
Isotropy	0.50	R	1.732	1	0.29
Linearity	0.20	R	1.732	1	0.12
Probe scattering	0.00	R	1.732	1	0.00
Probe positioning offset	0.30	R	1.732	1	0.17
Probe positioning repeatability	0.04	R	1.732	1	0.02
Sensor mechanical offset	0.00	R	1.732	1	0.00
Probe spatial resolution	0.00	R	1.732	1	0.00
Field impedance dependence	0.00	R	1.732	1	0.00
Amplitude and phase drift	0.00	R	1.732	1	0.00
Amplitude and phase noise	0.04	R	1.732	1	0.02
Measurement area truncation	0.00	R	1.732	1	0.00
Data acquisition	0.03	N	1	1	0.03
Sampling	0.00	R	1.732	1	0.00
Field reconstruction	2.00	R	1.732	1	1.15
Forward transformation	0.00	R	1.732	1	0.00
Power density scaling	0.00	R	1.732	1	0.00
Spatial averaging	0.10	R	1.732	1	0.06
System detection limit	0.04	R	1.732	1	0.02
Uncertainty terms dep endent on the DUT and environmental factors					
Probe coupling with DUT	0.00	R	1.732	1	0.0
Modulation response	0.40	R	1.732	1	0.2
Integration time	0.00	R	1.732	1	0.0
Response time	0.00	R	1.732	1	0.0
Device holder influence	0.10	R	1.732	1	0.1
DUT alignment	0.00	R	1.732	1	0.0
RF ambient conditions	0.04	R	1.732	1	0.0
Ambient reflections	0.04	R	1.732	1	0.0
Immunity / secondary reception	0.00	R	1.732	1	0.0
Drift of the DUT		R	1.732	1	
Combined Std. Uncertainty					1.34
Expanded STD Uncertainty (95%)					**2.68**

PD Uncertainty Budget

14. References

[1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”

[2] ANSI/IEEE Std. C95.1-1992, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”, September 1992

[3] IEEE Std. 1528-2013, “IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”, Sep 2013

[4] FCC KDB 248227 D01 v02r02, “SAR Guidance for IEEE 802.11 (WiFi) Transmitters”, Oct 2015.

[5] FCC KDB 447498 D01 v06, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, Oct 2015

[6] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.

[7] FCC KDB 865664 D02 v01r02, “RF Exposure Compliance Reporting and Documentation Considerations” Oct 2015.

[8] IEC/IEEE 62209-1528:2020, “Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Part 1528: Human models, instrumentation, and procedures (Frequency range of 4 MHz to 10 GHz)”, Oct. 2020

[9] IEC 62479:2010 Assessment of the compliance of low power electronic and electrical equipment with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz)

[10] IEC TR 63170: 2018 Measurement procedure for the evaluation of power density related to human exposure to radio frequency fields from wireless communication devices operating between 6 GHz and 100 GHz

[11] SPEAG DASY System Handbook

[12] SPEAG DASY6 Application Note (Interim Procedures for Devices Operating at 6-10 GHz)

------THE END------