Power Density Measurement Report

Report No.	:	**PF200605C24**
Applicant	:	**Kyocera Corporation ℅ Kyocera International, Inc.**
Address	:	**8611 Balboa Avenue, San Diego, CA 92123**
Product	:	**Smart Phone**
FCC ID	:	**V65E7110**
Brand	:	**Kyocera**
Model No.	:	**E7110**
Standards	:	**FCC 47 CFR Part 2 (2.1093), IEC TR 63170:2018** **KDB 865664 D02 v01r02, KDB 447498 D01 v06**
Sample Received Date	:	**Jun. 29, 2020**
Date of Testing	:	**Oct. 13, 2020 ~ Nov. 14, 2020**
Lab Address	:	**No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan**
Test Location	:	**No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City, Taiwan**

CERTIFICATION: The above equipment have been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch – Lin Kou Laboratories**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's characteristics under the conditions specified in this report. It should not be reproduced except in full, without the written approval of our laboratory. The client should not use it to claim product certification, approval, or endorsement by TAF or any government agencies.

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Release Control Record

Report No.	Reason for Change	Date Issued
PF200605C24	Initial release	Nov. 20, 2020

1. Summary of Maximum Value

Mode	Highest Averaged Power Density [W/m^2]
5G NR n260	4.000
5G NR n261	3.425

Simultaneous Transmission	Total Exposure Ratio
LTE + 5G NR + WLAN	0.998

Note:

1. According to 47 CFR part 2.1093, the MPE limits specified in part 1.1310 apply to portable devices that transmit at frequencies above 6 GHz. The localized power density limit for general population exposure is **1.0 mW/cm^2 (equal to 10 W/m^2)** for frequency up to 100 GHz.
2. Per FCC guidance in Oct 2018 TCBC workshop, the total exposure ratio calculated by taking ratio of maximum reported SAR divided by SAR limit and adding it to maximum measured power density divided by power density limit. Numerical sum of the ratios should be less than 1.
3. Per FCC interim guidance for near-field power density measurement, the power density was spatially averaged over a circular area of 4 cm^2.

2. Description of Equipment Under Test

EUT Type	Smart Phone
FCC ID	V65E7110
Brand Name	Kyocera
Model Name	E7110
Tx Frequency Bands [Unit: GHz]	5G NR n260 : 37.0 ~ 40.0 GHz 5G NR n261 : 27.5 ~ 28.35 GHz
Uplink Modulations	5G NR : QPSK, 16QAM, 64QAM
Supported Channel Bandwidth	200 MHz
Supported Carrier Component	2 CC
Uplink Transmission Duty Cycle	100 % Limited to 25 %
EN-DC Combination	LTE2/5/13/48/66 + n260/n261
Antenna Information	There are three QTM's 5G patch antenna modules, and each 5G array antenna module consists of 1x4 Patch Antenna Sub-Array sub-array. 1x4 Patch Antenna Sub-Array cross-polarized patch antennas, patch antenna +/- 45 degrees vertical or horizontal at full gain (falls off 90 degrees). These three 5G arrays antenna modules do not operate simultaneously of each other. The purpose of the three spatially separated 5G arrays is for spatial diversity. The location of the antenna modules is shown in Appendix D.
EUT Stage	Engineering Sample

Note:

1. The above EUT information is declared by manufacturer and for more detailed features description please refers to the manufacturer's specifications or User's Manual.

List of Accessory:

USB Cable	**Brand Name**	Kyocera
	Model Name	SCP-27SDC

3. Power Density Measurement System

3.1 Definition of Power Density

The power density for an electromagnetic field represents the rate of energy transfer per unit area. The local power density (i.e. Poynting vector) at a given spatial point is deduced from electromagnetic fields by the following formula:

$$S = \frac{1}{2}\mathrm{Re}\{E \times H^*\} \cdot \vec{n}$$

Where: E is the complex electric field peak phasor and H is the complex conjugate magnetic field peak phasor.

The spatial-average power density distribution on the evaluation surface is determined per the IEC TR 63170. The spatial area, A is specified by the applicable exposure limit or regulatory requirements. The circular shape was used.

$$S_{av} = \frac{1}{2A}\Re\left(\int E \times H^* \cdot \hat{n} dA\right)$$

3.2 SPEAG DASY6 System

The SPEAG DASY6 system consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY6 software defined. The DASY6 software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion form the optical into digital electric signal of the DAE and transfers data to the PC.

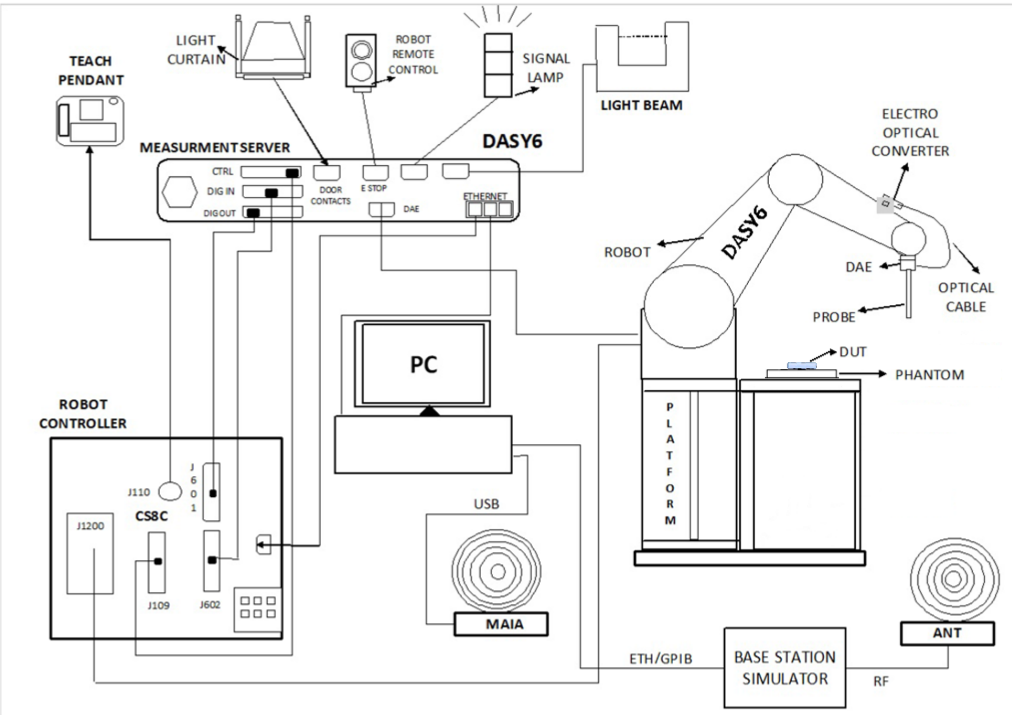


Fig-3.1 SPEAG DASY6 System Configuration

3.2.1 Robot

The DASY6 system uses the high precision robots from Stäubli SA (France). For the 6-axis controller system, the robot controller version of CS8c from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability ±0.035 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)

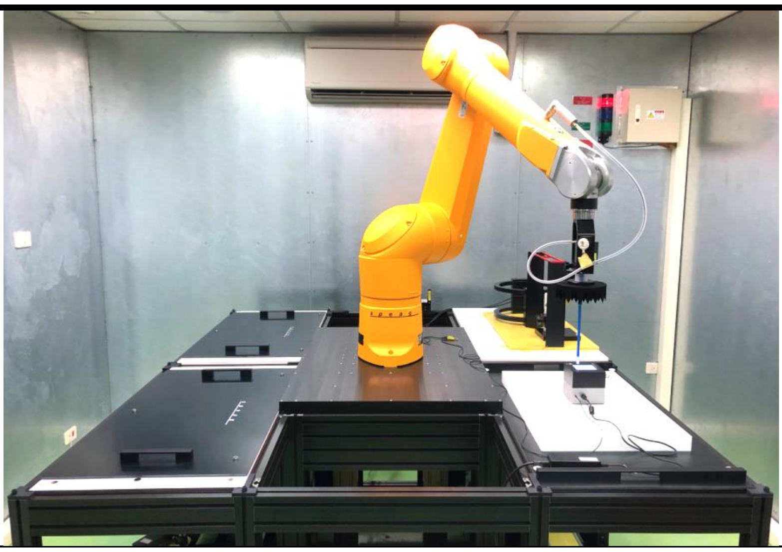


Fig-3.2 SPEAG DASY6 System

3.2.2 EUmmWV2 mm-Wave Probe

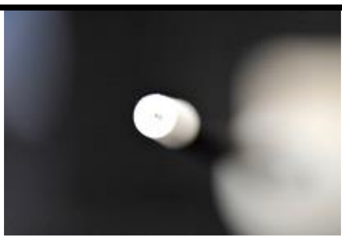
The EUmmWV2 probe is an electric (E) universal (U) field probe with two dipole sensors for field measurements at frequencies up to 110 GHz and as close as 2 mm from any field source or transmitter. The sensors consist of two diode-loaded small dipoles that provide the rectified voltage from the coupled E-field. From the voltages at three different orientations in the field at known angles, both the magnitude of the field component and the field polarization can be calculated. Due to the small size of the sensors, the probe can be used for measurements over an extremely wide frequency range from <1 GHz to 110 GHz. The probe sensors are protected by non-removable 8 mm high-density foam.

The EUmmWV2 probe is based on the pseudo-vector probe design, which not only measures the field magnitude but also derives its polarization ellipse. This probe concept also has the advantage that the sensor angle errors or distortions of the field by the substrate can be largely nullified by calibration. This is particularly important as, at these very high frequencies, field distortions by the substrate are dependent on the wavelength. The design entails two small 0.8 mm dipole sensors mechanically protected by high-density foam, printed on both sides of a 0.9 mm wide and 0.12 mm thick glass substrate. The body of the probe is specifically constructed to minimize distortion by the scattered fields.

The probe consists of two sensors with different angles arranged in the same plane in the probe axis. Three or more measurements of the two sensors are taken for different probe rotational angles to derive the amplitude and polarization information. These probes are the most flexible and accurate probes currently available for measuring field amplitude.

The probe design allows measurements at distances as small as 2 mm from the sensors to the surface of the device under test (DUT). The typical sensor to probe tip distance is 1.5 mm. The exact distance is calibrated.

Model	EUmmWV2
Frequency	750 MHz to 110 GHz
Dynamic Range	< 20 V/m - 10000 V/m with PRE-10 < 50 V/m - 3000 V/m minimum
Linearity	< ±0.2 dB
Hemispherical Isotropy	< 0.5 dB
Position Precision	< 0.2 mm
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: encapsulation 8 mm (internal sensor < 1mm) Distance from probe tip to dipole centers: < 2 mm Sensor displacement to probe's calibration point: < 0.3 mm



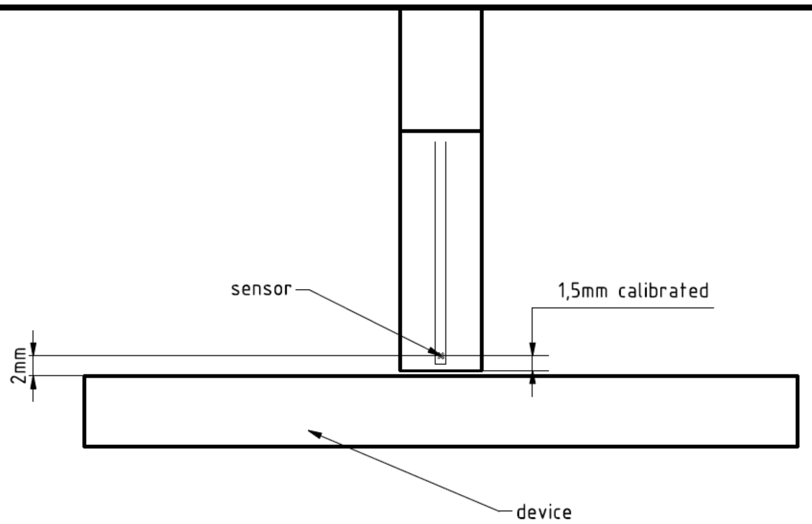
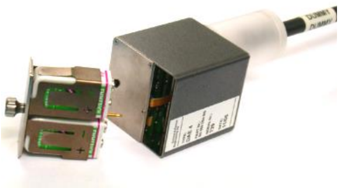


Illustration of Distance - Sensor to DUT Surface

3.2.3 Data Acquisition Electronics (DAE)

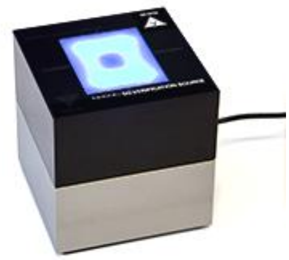
Model	DAE3, DAE4
Construction	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY embedded system (fully remote controlled). Two step probe touch detector for mechanical surface detection and emergency robot stop.
Measurement Range	-100 to +300 mV (16 bit resolution and two range settings: 4mV, 400mV)
Input Offset Voltage	< 5µV (with auto zero)
Input Bias Current	< 50 fA
Dimensions	60 x 60 x 68 mm



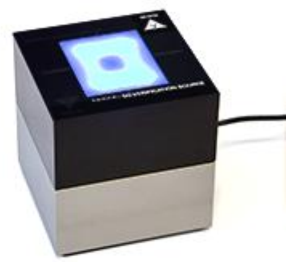
3.2.4 System Verification Sources

System verification device consists of a horn antenna with corresponding gun oscillator packaged within a cube-shaped housing and power supply provided.

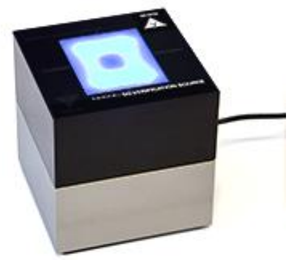
Model	System Verification for Ka-band
Calibrated Frequency	30 GHz at 10mm from the case surface
Frequency Accuracy	± 100 MHz
E-field Polarization	Linear
Harmonics	-20 dBc
Total Radiated Power	14 dBm
Power Stability	0.05 dB
Power Consumption	5 W
Size	100 x 100 x 100 mm
Weight	1 kg



Model	System Verification for V-band
Calibrated Frequency	60 GHz at 10mm from the case surface
Frequency Accuracy	± 100 MHz
E-field Polarization	Linear
Harmonics	-20 dBc
Total Radiated Power	20 dBm
Power Stability	0.1 dB
Power Consumption	5 W
Size	100 x 100 x 100 mm
Weight	1 kg



Model	System Verification for W-band
Calibrated Frequency	90 GHz at 10mm from the case surface
Frequency Accuracy	± 150 MHz
E-field Polarization	Linear
Harmonics	-20 dBc
Total Radiated Power	16 dBm
Power Stability	0.15 dB
Power Consumption	5 W
Size	100 x 100 x 100 mm
Weight	1 kg



3.3 Power Density System Verification

System check provides a fast and reliable method to routinely verify that the measurement system is operational with no system component failures, including probe defects, drifts or deviation from target performance requirements. A system check also verifies the repeatability of the measurement system before compliance testing.

The measurement of a verification source is started from 5G probe installed and the phantom taught. The verification source is placed on the 5G phantom. Due to the internal distance from the horn to the outer surface of the verification source, the measurement distance set in the software should be offset by -4.45 mm; e.g., for measurement of the verification source at 10 mm, the measurement distance set in the software should be 5.55 mm (10mm - 4.45 mm).

The system check is a complete measurement using simple well-defined reference sources. According to the DASY6 specification in the user's manual and SPEAG's recommendation, the deviation threshold of ±0.66 dB represents the expanded standard uncertainty for system performance check. The system check is successful if the measured results are within ±0.66 dB tolerances to the target value shown in the calibration certificate of the verification source. The instrumentation and procedures used for system check should ensure the system is ready for performing compliance tests.

Frequency [GHz]	Grid Step	Grid Extent X/Y [mm]	Measurement Points
10	0.25 (λ /4)	120 / 120	16 x 16
30	0.25 (λ /4)	60 / 60	24 x 24
60	0.25 (λ /4)	32.5 / 32.5	26 x 26
90	0.25 (λ /4)	30 / 30	36 x 36

Table-3.1 Settings for Measurement of Verification Sources

Fig-3.3 System Verification Setup

3.4 Power Density Measurement Procedure

Within a short distance from the transmitting source, power density is determined based on both electric and magnetic fields. Generally, the magnitude and phase of two components of either the E-field or H-field are needed on a sufficiently large surface to fully characterize the total E-field and H-field distributions. Nevertheless, solutions based on direct measurement of E-field and H-field can be used to compute power density. When the measurement surface does not correspond to the evaluation surface, reconstruction algorithms are necessary to project or transform the fields from the measurement surface to the evaluation surface. The general measurement approach is summarized in following:

(a) Measure the E-field on the measurement surface at a reference location where the field is well above the noise level. This reference level will be used at the end of this procedure to assess output power drift of the DUT during the measurement.

(b) Scan the electric field on the measurement surface. The requirements of measurement surface dimensions and spatial resolution are dependent on the measurement system and assessment methodology applied. Measurements are therefore conducted according to the instructions provided by the measurement system manufacturer.

(c) Measurement spatial resolution can depend on the measured field characteristic and measurement methodology used by the system. Planar scanners typically require a step size of less than λ / 2. When measurements are acquired in regions where evanescent modes are not negligible, smaller spatial resolution may be required. Similar criteria also apply to cylindrical scanning systems where the spatial resolution in the vertical direction should be less than λ / 2.

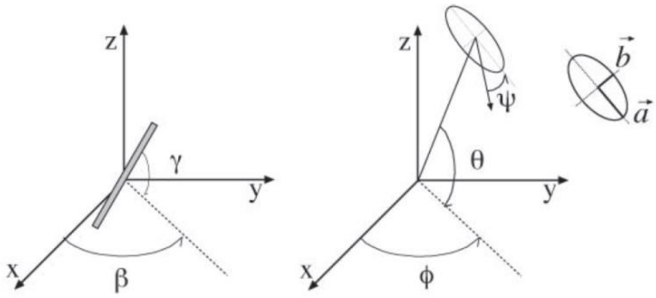
(d) Since only E-field is measured on the measurement system, the H-field is calculated from the measured field using a reconstruction algorithm. As power density requires knowledge of both amplitude and phase, reconstruction algorithms can also be used to obtain field information from the measured data (e.g. the phase from the amplitude if only the amplitude is measured). The measurement involves two planes with three different probe rotations on two measurement planes separated by λ / 4. The grid steps are optimized by the software based on the test frequency. The location of the lowest measurement plane is defined by the distance of first measurement layer from device under test entered by the user. In addition, when the measurement surface does not correspond to the evaluation surface, reconstruction algorithms are employed to project or transform the fields from the measurement surface to the evaluation surface. In substance, reconstruction algorithms are the set of algorithms, mathematical techniques and procedures that are applied to the measured field on the measurement surface to determine E- and H-field (amplitude and phase) on the evaluation surface.

(e) To determine the spatial-average power density distribution on the evaluation surface. The spatial averaging area, A, is specified by the applicable exposure limits or regulatory requirements. If the shape of the area is not provided by the relevant regulatory requirements, a circular shape is recommended.

(f) Measure the E-field on the measurement surface position at the reference location chosen in step (a). The power drift of the DUT is estimated as the difference between the squared amplitude of the field values taken in steps (a) and (f). When the drift is smaller than ± 5 %, this term should be considered in the uncertainty budget. Drifts larger than 5 % due to the design and operating characteristics of the device should be accounted for or addressed according to regulatory requirements to determine compliance.

3.4.1 Computation of the Electric Field Polarization Ellipse

For the numerical description of an arbitrarily oriented ellipse in three-dimensional space, five parameters are needed: the semi-major axis (a), the semi-minor axis (b), two angles describing the orientation of the normal vector of the ellipse (Φ, θ), and one angle describing the tilt of the semi-major axis (ψ). For the two extreme cases, i.e., circular and linear polarizations, three parameters only (a, Φ, and θ) are sufficient for the description of the incident field.



For the reconstruction of the ellipse parameters from measured data, the problem can be reformulated as a nonlinear search problem. The semi-major and semi-minor axes of an elliptical field can be expressed as functions of the three angles (Φ, θ, and ψ). The parameters can be uniquely determined towards minimizing the error based on least-squares for the given set of angles and the measured data. In this way, the number of free parameters is reduced from five to three, which means that at least three sensor readings are necessary to gain sufficient information for the reconstruction of the ellipse parameters. However, to suppress the noise and increase the reconstruction accuracy, it is desirable that the system of equations be over-determined. The solution use a probe consisting of two sensors angled by γ_1 and γ_2 toward the probe axis and to perform measurements at three angular positions of the probe, i.e., at β_1, β_2, and β_3, results in over-determinations by a factor of two. If there is a need for more information or increased accuracy, more rotation angles can be added.

The reconstruction of the ellipse parameters can be separated into linear and non-linear parts that are best solved by the givens algorithm combined with a downhill simplex algorithm. To minimize the mutual coupling, sensor angles are set with a shift of 90° ($\gamma_2 = \gamma_1 + 90°$), and, to simplify, the first rotation angle of the probe (β_1) can be set to 0°.

3.4.2 Total Field and Power Flux Density Reconstruction

Computation of the power density in general requires knowledge of the electric (E-) and magnetic (H-) field amplitudes and phases in the plane of incidence. Reconstruction of these quantities from pseudo-vector E-field measurements is feasible, as they are constrained by Maxwell's equations. The SPEAG have developed a reconstruction approach based on the Gerchberg-Saxton algorithm, which benefits from the availability of the E-field polarization ellipse information obtained with the EUmmWV2 probe. This reconstruction algorithm, together with the ability of the probe to measure extremely close to the source without perturbing the field, permits reconstruction of the E- and H-fields, as well as of the power density, on measurement planes located as near as λ / 5 away.

3.4.3 Power Flux Density Averaging

The average of the reconstructed power density is evaluated over a circular area in each measurement plane. The area of the circle is defined by the user; the default is 1 cm^2. The computed peak average value is displayed in the box at the top right. Note that the average is evaluated only for grid points where the averaging circle is completely filled with values; for points at the edge where the averaging circle is only partly filled with values, the average power density is set to zero. Two average power density values are computed:

1) $|\mathrm{Re}(S)|$ is the average total power density.
2) $\vec{n} \cdot \mathrm{Re}(S)$ is the average incident power density.

4. Power Density Measurement Evaluation

4.1 EUT Configuration and Setting

The 5G NR signal in this device under test was configured by engineering testing software of QRCT (Qualcomm Radio Control Tool) provided by manufacturer that can be used to set the relevant 5G radio parameters such as Tx carrier, RFM device, Beam ID, polarization, Tx band, channel, bandwidth, Tx mode, modulation, output power, RB allocation etc. which can provide continuous transmitting RF signal. During power density testing, this device was operated to transmit continuously at the 100 % transmission duty with specified transmission mode, operating frequency, and maximum output power.

4.2 EUT Testing Position

According to the Power Density simulation report provided by KYOCERA, the antenna configuration of maximum transmitting power for each array antenna module was used to configure transmission with specific antenna and Beam ID for the power density measurement. All other beam ID configurations result in lower EIRP. Therefore, additional evaluations of other beam configurations were not considered.

There are three mm-Wave array antenna modules for 5G NR in this device which is highly directional and located in Left side, Right side and Rear Face respectively. The power density measurement for each array antenna module was tested on its beam direction.

The patch antenna module 0 is located on the Left side of the device, module1 is located on the Right of the device and module 2 is on the Top Side of the device. The power density measurement was performed on all surfaces for all 3 modulations with lowest, mid and highest channels on both polarization of horizontal and vertical.

4.3 System Verification

The measuring result for system verification is tabulated as below.

Test Date	Frequency [GHz]	mm-Wave Probe S/N	Verification Source S/N	Averaging Area [cm²]	Distance [mm]	Target Power Density [W/m²]	Measured Power Density [W/m²]	Deviation [dB]
Oct. 13, 2020	30	9438	1016	4	10.0	37.0	36.8	-0.54%
Oct. 14, 2020	30	9438	1016	4	10.0	37.0	36.4	-1.62%
Oct. 15, 2020	30	9438	1016	4	10.0	37.0	37.2	0.54%
Oct. 16, 2020	30	9438	1016	4	10.0	37.0	36.2	-2.16%
Oct. 17, 2020	30	9438	1016	4	10.0	37.0	37.3	0.81%
Oct. 19, 2020	30	9438	1016	4	10.0	37.0	36.7	-0.81%
Nov. 04, 2020	30	9454	1016	4	10.0	37.0	35.4	-4.32%
Nov. 05, 2020	30	9454	1016	4	10.0	37.0	35.6	-3.78%
Nov. 09, 2020	30	9361	1016	4	10.0	37.0	37.1	0.27%
Nov. 11, 2020	30	9361	1016	4	10.0	37.0	36.7	-0.81%
Nov. 14, 2020	30	9361	1016	4	10.0	37.0	36.1	-2.43%

Note:

Comparing to the reference value provided by SPEAG, the validation data should be within its specification of ±0.66 dB. The result indicates the system check can meet the variation criterion and the plots can be referred to Appendix A of this report.

4.4 Power Density Testing Results

4.4.1 Test Considerations

1. The radio configurations of maximum output power found in part 30 RF report as 2CC, BW 100 MHz, SCS 120 kHz, QPSK modulation, 1RB, 65 RB offset, low channel and power setting was used to set the EUT during the power density testing.
2. The test duty cycle was 100 % to facilitate test measurements only. It was confirmed by the manufacturer that the device was not over driven at this test duty cycle, to facilitate linear scaling in the test report. The power density results were scaled down from the test software duty cycle of 100 % to the final production duty cycle of 25 % to demonstrate compliance.
3. The power density measurement was performed at the 29 mm separation distance due to the proximity sensor triggering distance of 30 mm.
4. The Beam ID for maximum radiation configuration for each array antenna module in the Power Density simulation report provided by KYOCERA was used to test power density accordingly. All other beam ID configurations were not considered due to it result in lower EIRP.
5. The power density measurement for each array antenna module was tested on its beam direction due to its highly directional characteristic.
6. The power density measurement was performed at the 10 mm separation distance due to its form factor per KDB 941225 D06.
7. Both horizontal and vertical polarization have been tested and are generated using patch array antenna configurations of module 2.
8. The antenna location on right side has been fully tested for all 3 modulations, 3 required channels and 2 polarizations due to it is major radiation direction of module 2. These are all the configurations the device will operate in. The adjacent surfaces as front face, rear face and bottom side have been verified using worst configuration of right side for compliance consideration.
9. The test duty cycle was 100 % to facilitate test measurements only. It was confirmed by the manufacturer that the device was not over driven at this test duty cycle, to facilitate linear scaling in the test report. The power density results were scaled down from the test software duty cycle of 100 % to the final production duty cycle of 25 % to demonstrate compliance. Letter of attestation from the network operator indicating it will not schedule more than 25 % UL for the life of the device.

4.4.2 Power Density Test Results

Plot No.	Band	Modulation	Test Position	Evaluation Distance [mm]	Channel	Frequency [MHz]	RB Size	RB Offset	Active Component Carriers	Antenna	Beam ID(V)	Beam ID(H)	Averaging Area [cm²]	Avg- Incident Power Density [W/m²]	Avg-Total Power Density [W/m²]	Test Duty Cycle [%]	Production Duty Cycle [%]	Scaled Avg-Total P.D. [W/m²]
	n260	QPSK100M	Left Side	2	2254165	38499.96	1	0	1	QTM#0	25		4	5.29	5.80	100.0	25.0	1.450
	n260	QPSK100M	Left Side	2	2254165	38499.96	1	0	1	QTM#0		167	4	7.36	8.35	100.0	25.0	2.088
	n260	QPSK100M	Left Side	2	2254165	38499.96	1	0	1	QTM#0	39	167	4	10.2	12.1	100.0	25.0	3.025
	n260	QPSK100M	Left Side	2	2254165	38499.96	33	0	1	QTM#0	39	167	4	11.0	13.3	100.0	25.0	3.325
01	n260	QPSK100M	Left Side	2	2254165	38499.96	66	0	1	QTM#0	39	167	4	11.8	14.1	100.0	25.0	**3.525**
	n260	16QAM100M	Left Side	2	2254165	38499.96	66	0	1	QTM#0	39	167	4	8.66	10.5	100.0	25.0	2.625
	n260	64QAM100M	Left Side	2	2254165	38499.96	66	0	1	QTM#0	39	167	4	4.83	5.83	100.0	25.0	1.458
	n260	QPSK50M	Left Side	2	2254165	38499.96	32	0	1	QTM#0	39	167	4	11.4	13.6	100.0	25.0	3.400
	n260	QPSK100M	Left Side	2	2254165 2255812	38499.96 38598.78	66	0	2	QTM#0	39	167	4	1.87	2.21	100.0	25.0	0.553
	n260	QPSK100M	Left Side	2	2229999	37050	66	0	1	QTM#0	26	154	4	12.3	13.4	100.0	25.0	3.350
	n260	QPSK100M	Left Side	2	2278332	39949.98	66	0	1	QTM#0	39	167	4	11.6	13.4	100.0	25.0	3.350
	n260	QPSK100M	Front Face	2	2254165	38499.96	66	0	1	QTM#0	39	167	4	3.32	3.67	100.0	25.0	0.918
	n260	QPSK100M	Rear Face	2	2254165	38499.96	66	0	1	QTM#0	39	167	4	4.86	5.51	100.0	25.0	1.378
	n260	QPSK100M	Right Side	2	2254165	38499.96	66	0	1	QTM#0	39	167	4	0.024	0.037	100.0	25.0	0.009
	n260	QPSK100M	Top Side	2	2254165	38499.96	66	0	1	QTM#0	39	167	4	0.021	0.030	100.0	25.0	0.008
	n260	QPSK100M	Bottom Side	2	2254165	38499.96	66	0	1	QTM#0	39	167	4	0.028	0.040	100.0	25.0	0.010
	n260	QPSK100M	Left Side	10	2254165	38499.96	66	0	1	QTM#0	39	167	4	7.59	8.29	100.0	25.0	2.073
	n260	QPSK100M	Rear Face	15	2254165	38499.96	66	0	1	QTM#0	39	167	4	1.48	1.37	100.0	25.0	0.343
	n260	QPSK100M	Right Side	2	2254165	38499.96	1	0	1	QTM#1	20		4	6.56	7.96	100.0	25.0	1.990
	n260	QPSK100M	Right Side	2	2254165	38499.96	1	0	1	QTM#1		163	4	5.8	6.42	100.0	25.0	1.605
	n260	QPSK100M	Right Side	2	2254165	38499.96	1	0	1	QTM#1	20	148	4	10.9	12.8	100.0	25.0	3.200
	n260	QPSK100M	Right Side	2	2254165	38499.96	33	0	1	QTM#1	20	148	4	13.4	15.0	100.0	25.0	3.750
02	n260	QPSK100M	Right Side	2	2254165	38499.96	66	0	1	QTM#1	20	148	4	13.9	16.0	100.0	25.0	**4.000**
	n260	16QAM100M	Right Side	2	2254165	38499.96	66	0	1	QTM#1	20	148	4	10.4	11.7	100.0	25.0	2.925
	n260	64QAM100M	Right Side	2	2254165	38499.96	66	0	1	QTM#1	20	148	4	5.77	6.36	100.0	25.0	1.590
	n260	QPSK50M	Right Side	2	2254165	38499.96	66	0	1	QTM#1	20	148	4	13.3	15.6	100.0	25.0	3.900
	n260	QPSK100M	Right Side	2	2254165 2255812	38499.96 38598.78	66	0	2	QTM#1	20	148	4	5.05	5.60	100.0	25.0	1.400
	n260	QPSK100M	Right Side	2	2229999	37050	66	0	1	QTM#1	35	163	4	9.23	11.3	100.0	25.0	2.825
	n260	QPSK100M	Right Side	2	2278332	39949.98	66	0	1	QTM#1	34	162	4	9.57	11.5	100.0	25.0	2.875
	n260	QPSK100M	Front Face	2	2254165	38499.96	66	0	1	QTM#1	20	148	4	2.65	3.07	100.0	25.0	0.768
	n260	QPSK100M	Rear Face	2	2254165	38499.96	66	0	1	QTM#1	20	148	4	4.39	5.34	100.0	25.0	1.335
	n260	QPSK100M	Left Side	2	2254165	38499.96	66	0	1	QTM#1	20	148	4	0.0	0.0	100.0	25.0	0.000
	n260	QPSK100M	Top Side	2	2254165	38499.96	66	0	1	QTM#1	20	148	4	0.0	0.0	100.0	25.0	0.000
	n260	QPSK100M	Right Side	10	2254165	38499.96	66	0	1	QTM#1	20	148	4	9.69	10.6	100.0	25.0	2.650
	n260	QPSK100M	Rear Face	15	2254165	38499.96	66	0	1	QTM#1	20	148	4	1.46	1.6	100.0	25.0	0.403
	n260	QPSK100M	Rear Face	2	2254165	38499.96	1	0	1	QTM#2	42		4	5.19	7.18	100.0	25.0	1.795
03	n260	QPSK100M	Rear Face	2	2254165	38499.96	1	0	1	QTM#2		156	4	10.90	12.40	100.0	25.0	**3.100**
	n260	QPSK100M	Rear Face	2	2254165	38499.96	1	0	1	QTM#2	28	156	4	7.58	11.30	100.0	25.0	2.825
	n260	QPSK100M	Rear Face	2	2254165	38499.96	33	0	1	QTM#2		156	4	8.7	10.8	100.0	25.0	2.700
	n260	QPSK100M	Rear Face	2	2254165	38499.96	66	0	1	QTM#2		156	4	8.6	10.9	100.0	25.0	2.725
	n260	16QAM100M	Rear Face	2	2254165	38499.96	1	0	1	QTM#2		156	4	5.8	7.5	100.0	25.0	1.865
	n260	64QAM100M	Rear Face	2	2254165	38499.96	1	0	1	QTM#2		156	4	3.7	4.7	100.0	25.0	1.173
	n260	QPSK50M	Rear Face	2	2254165	38499.96	1	0	1	QTM#2		156	4	7.35	9.02	100.0	25.0	2.255
	n260	QPSK100M	Rear Face	2	2254165 2255812	38499.96 38598.78	1 1	0	2	QTM#2		156	4	0.699	0.802	100.0	25.0	0.201
	n260	QPSK100M	Rear Face	2	2229999	37050	1	0	1	QTM#2		156	4	5.09	5.97	100.0	25.0	1.493
	n260	QPSK100M	Rear Face	2	2278332	39949.98	1	0	1	QTM#2		159	4	5.20	6.28	100.0	25.0	1.570
	n260	QPSK100M	Front Face	2	2254165	38499.96	1	0	1	QTM#2		156	4	0.00	0.00	100.0	25.0	0.000
	n260	QPSK100M	Left Side	2	2254165	38499.96	1	0	1	QTM#2		156	4	0.00	0.00	100.0	25.0	0.000
	n260	QPSK100M	Right Side	2	2254165	38499.96	1	0	1	QTM#2		156	4	0.00	0.00	100.0	25.0	0.000
	n260	QPSK100M	Top Side	2	2254165	38499.96	1	0	1	QTM#2		156	4	0.81	1.01	100.0	25.0	0.253
	n260	QPSK100M	Rear Face	10	2254165	38499.96	1	0	1	QTM#2		156	4	3.33	3.49	100.0	25.0	0.873
	n260	QPSK100M	Rear Face	15	2254165	38499.96	1	0	1	QTM#2		156	4	2.81	2.88	100.0	25.0	0.720

Plot No.	Band	Modulation	Test Position	Evaluation Distance [mm]	Channel	Frequency [MHz]	RB Size	RB Offset	Active Component Carriers	Antenna	Beam ID(V)	Beam ID(H)	Averaging Area [cm²]	Avg- Incident Power Density [W/m²]	Avg-Total Power Density [W/m²]	Test Duty Cycle [%]	Production Duty Cycle [%]	Scaled Avg-Total P.D. [W/m²]
	n261	QPSK100M	Left Side	2	2077916	27925.02	1	0	1	QTM#0	39		4	8.2	8.7	100.0	25.0	2.185
	n261	QPSK100M	Left Side	2	2077916	27925.02	1	0	1	QTM#0		151	4	4.0	5.2	100.0	25.0	1.300
	n261	QPSK100M	Left Side	2	2077916	27925.02	1	0	1	QTM#0	23	151	4	5.82	7.78	100.0	25.0	1.945
	n261	QPSK100M	Left Side	2	2077916	27925.02	33	0	1	QTM#0	39		4	8.33	8.99	100.0	25.0	2.248
04	n261	QPSK100M	Left Side	2	2077916	27925.02	66	0	1	QTM#0	39		4	8.71	9.30	100.0	25.0	2.325
	n261	16QAM100M	Left Side	2	2077916	27925.02	66	0	1	QTM#0	39		4	6.89	7.39	100.0	25.0	1.848
	n261	64QAM100M	Left Side	2	2077916	27925.02	66	0	1	QTM#0	39		4	3.75	3.98	100.0	25.0	0.995
	n261	QPSK50M	Left Side	2	2077916	27925.02	66	0	1	QTM#0	39		4	8.59	9.19	100.0	25.0	2.298
	n261	QPSK100M	Left Side	2	2077916 2079558	27925.02 28023.54	66	0	2	QTM#0	39		4	2.51	2.66	100.0	25.0	0.665
	n261	QPSK100M	Left Side	2	2071832	27560	66	0	1	QTM#0	25		4	8.64	9.23	100.0	25.0	2.308
	n261	QPSK100M	Left Side	2	2083999	28290	66	0	1	QTM#0	24		4	7.03	7.72	100.0	25.0	1.930
	n261	QPSK100M	Front Face	2	2077916	27925.02	66	0	1	QTM#0	39		4	2.9	3.1	100.0	25.0	0.785
	n261	QPSK100M	Rear Face	2	2077916	27925.02	66	0	`1	QTM#0	39		4	2.5	3.7	100.0	25.0	0.915
	n261	QPSK100M	Right Side	2	2077916	27925.02	66	0	1	QTM#0	39		4	0.0	0.0	100.0	25.0	0.000
	n261	QPSK100M	Top Side	2	2077916	27925.02	66	0	1	QTM#0	39		4	0.0	0.0	100.0	25.0	0.000
	n261	QPSK100M	Bottom Side	2	2077916	27925.02	66	0	1	QTM#0	39		4	0.0	0.0	100.0	25.0	0.000
	n261	QPSK100M	Left Side	10	2077916	27925.02	66	0	1	QTM#0	39		4	6.9	7.1	100.0	25.0	1.785
	n261	QPSK100M	Rear Face	15	2077916	27925.02	66	0	1	QTM#0	39		4	0.1	0.1	100.0	25.0	0.023
	n261	QPSK100M	Right Side	2	2077916	27925.02	1	0	1	QTM#1	20		4	7.9	8.5	100.0	25.0	2.115
	n261	QPSK100M	Right Side	2	2077916	27925.02	1	0	1	QTM#1		150	4	2.9	3.7	100.0	25.0	0.925
	n261	QPSK100M	Right Side	2	2077916	27925.02	1	0	1	QTM#1	22	150	4	8.64	10.5	100.0	25.0	2.625
	n261	QPSK100M	Right Side	2	2077916	27925.02	33	0	1	QTM#1	22	150	4	8.26	10.6	100.0	25.0	2.650
	n261	QPSK100M	Right Side	2	2077916	27925.02	66	0	1	QTM#1	22	150	4	7.93	10.8	100.0	25.0	2.700
	n261	16QAM100M	Right Side	2	2077916	27925.02	66	0	1	QTM#1	22	150	4	6.00	8.10	100.0	25.0	2.025
	n261	64QAM100M	Right Side	2	2077916	27925.02	66	0	1	QTM#1	22	150	4	3.36	4.33	100.0	25.0	1.083
	n261	QPSK50M	Right Side	2	2077916	27925.02	66	0	1	QTM#1	22	150	4	7.86	10.1	100.0	25.0	2.525
	n261	QPSK100M	Right Side	2	2077916 2079558	27925.02 28023.54	66	0	2	QTM#1	22	150	4	0.998	1.20	100.0	25.0	0.300
	n261	QPSK100M	Right Side	2	2071832	27560	66	0	1	QTM#1	22	150	4	8.52	10.9	100.0	25.0	2.725
05	n261	QPSK100M	Right Side	2	2083999	28290	66	0	1	QTM#1	19	147	4	11.6	12.7	100.0	25.0	3.175
	n261	QPSK100M	Front Face	2	2083999	28290	66	0	1	QTM#1	19	147	4	2.28	2.58	100.0	25.0	0.645
	n261	QPSK100M	Rear Face	2	2083999	28290	66	0	1	QTM#1	19	147	4	4.84	5.93	100.0	25.0	1.483
	n261	QPSK100M	Left Side	2	2083999	28290	66	0	1	QTM#1	19	147	4	0.00	0.00	100.0	25.0	0.000
	n261	QPSK100M	Top Side	2	2083999	28290	66	0	1	QTM#1	19	147	4	0.00	0.00	100.0	25.0	0.000
	n261	QPSK100M	Right Side	10	2083999	28290	66	0	1	QTM#1	19	147	4	8.42	9.35	100.0	25.0	2.338
	n261	QPSK100M	Rear Face	15	2083999	28290	66	0	1	QTM#1	19	147	4	1.86	1.97	100.0	25.0	0.493
06	n261	QPSK100M	Rear Face	2	2077916	27925.02	1	0	1	QTM#2	30		4	11.1	13.7	100.0	25.0	3.425
	n261	QPSK100M	Rear Face	2	2077916	27925.02	1	0	1	QTM#2		160	4	5.4	8.1	100.0	25.0	2.028
	n261	QPSK100M	Rear Face	2	2077916	27925.02	1	0	1	QTM#2	32	160	4	8.59	10.8	100.0	25.0	2.700
	n261	QPSK100M	Rear Face	2	2077916	27925.02	33	0	1	QTM#2	30		4	8.3	9.9	100.0	25.0	2.468
	n261	QPSK100M	Rear Face	2	2077916	27925.02	66	0	1	QTM#2	30		4	9.3	10.9	100.0	25.0	2.725
	n261	16QAM100M	Rear Face	2	2077916	27925.02	1	0	1	QTM#2	30		4	7.5	8.9	100.0	25.0	2.225
	n261	64QAM100M	Rear Face	2	2077916	27925.02	1	0	1	QTM#2	30		4	3.39	4.15	100.0	25.0	1.038
	n261	QPSK50M	Rear Face	2	2077916	27925.02	1	0	1	QTM#2	30		4	9.43	11.1	100.0	25.0	2.775
	n261	QPSK100M	Rear Face	2	2077916 2079558	27925.02 28023.54	1	0	2	QTM#2	30		4	0.761	0.95	100.0	25.0	0.238
	n261	QPSK100M	Rear Face	2	2071832	27560	1	0	1	QTM#2	30		4	9.66	12.1	100.0	25.0	3.025
	n261	QPSK100M	Rear Face	2	2083999	28290	1	0	1	QTM#2	30		4	10.6	12.5	100.0	25.0	3.125
	n261	QPSK100M	Front Face	2	2077916	27925.02	1	0	1	QTM#2	30		4	0.00	0.0	100.0	25.0	0.000
	n261	QPSK100M	Left Side	2	2077916	27925.02	1	0	1	QTM#2	30		4	0.00	0.0	100.0	25.0	0.000
	n261	QPSK100M	Right Side	2	2077916	27925.02	1	0	1	QTM#2	30		4	0.00	0.0	100.0	25.0	0.000
	n261	QPSK100M	Top Side	2	2077916	27925.02	1	0	1	QTM#2	30		4	2.0	2.4	100.0	25.0	0.595
	n261	QPSK100M	Rear Face	10	2077916	27925.02	1	0	1	QTM#2	30		4	5.72	6.16	100.0	25.0	1.540
	n261	QPSK100M	Rear Face	15	2077916	27925.02	1	0	1	QTM#2	30		4	4.16	4.75	100.0	25.0	1.188

4.4.3 Simultaneous Transmission Evaluation

<Possibilities of Simultaneous Transmission>

The simultaneous transmission possibilities for this device are listed as below.

Simultaneous TX Combination	Capable Transmit Configurations	Head Exposure Condition	Body-worn Exposure Condition	Hotspot Exposure Condition
1	EN-DC + WLAN(2.4G) Ant0 + WLAN(5G) Ant1	Yes	Yes	Yes
2	EN-DC + WLAN(2.4G) Ant1 + WLAN(5G) Ant0	Yes	Yes	Yes
3	EN-DC + WLAN(2.4G) MIMO	Yes	Yes	Yes
4	EN-DC + WLAN(5G) Ant1 + BT Ant0	Yes	Yes	Yes
5	EN-DC+WLAN(5G) MIMO + BT Ant0	Yes	Yes	Yes

<Total Exposure Ratio Analysis>

The fields generated by the antennas can be correlated or uncorrelated. At different frequencies, fields are always uncorrelated, and the aggregate power density contributions can be summed according to spatially averaged values of corresponding sources at any point in space, r, to determine the total exposure ratio (TER). Assuming I sources, the TER at each point in space is equal to

$$\mathrm{TER}^{\mathrm{uncorr}}(\mathrm{r}) = \sum_{\mathrm{i}=1}^{\mathrm{I}} \mathrm{ER}_{\mathrm{i}} = \sum_{\mathrm{i}=1}^{\mathrm{I}} \frac{\mathrm{S}_{\mathrm{av,i}}(\mathrm{r}, \mathrm{f}_{\mathrm{i}})}{\mathrm{S}_{\mathrm{lim}}(\mathrm{f}_{\mathrm{i}})}$$

where $S_{av,i}$ is the power density for the source i operating at a frequency f_i, and S_{lim} is the power density limit as specified by the relevant standard.

Exposure from transmitters operating above and below 6 GHz, where 6 GHz denotes the transition frequency where the basic restrictions change from being defined in terms of SAR to being defined in terms of power density, are therefore uncorrelated and the TER is determined as

$$\mathrm{TER}^{\mathrm{uncorr}}(\mathrm{r}) = \mathrm{TER}(\mathrm{r})_{\mathrm{f} \leq 6\mathrm{GHz}} + \mathrm{TER}(\mathrm{r})_{\mathrm{f} > 6GHz}$$

According to the FCC guidance in Oct 2018 TCBC workshop and IEC TR 63170, the total exposure ratio calculated by taking ratio of maximum reported SAR divided by SAR limit and adding it to maximum measured power density divided by power density limit. Numerical sum of the ratios should be less than 1. The TER analysis for this device is listed as below.

The TER analysis please refer Appendix E

Note: The SAR evaluation for LTE and WLAN was assessed in separate SAR report (by BVADT, report number SF200605C24), and the maximum SAR value here referred from that SAR report.

Test Engineer：Willy Chang, and Rex Tseng

5. Calibration of Test Equipment

Equipment	Manufacturer	Model	SN	Cal. Date	Cal. Interval
cDASY6 Module mmWave Software	SPEAG	V1.4.0.14682	N/A	N/A	N/A
E-Field Probe	SPEAG	EUmmWV4	9454	Sep. 24, 2020	1 Year
E-Field Probe	SPEAG	EUmmWV4	9438	May. 29, 2020	1 Year
System Verification Source	SPEAG	5G Verification Source 30 GHz	1016	Sep. 18, 2020	1 Year
Data Acquisition Electronics	SPEAG	DAE3	579	Aug. 12, 2020	1 Year
Data Acquisition Electronics	SPEAG	DAE4	1585	May. 28, 2020	1 Year

6. Measurement Uncertainty

Source of Uncertainty	Uncertainty (± dB)	Probability Distribution	Divisor	Ci	Standard Uncertainty (± dB)	Vi
Measurement System						
Probe Calibration	0.49	Normal	1	1	0.49	∞
Hemispherical Isotropy	0.50	Rectangular	√3	1	0.29	∞
Linearity	0.20	Rectangular	√3	1	0.12	∞
System Detection Limits	0.04	Rectangular	√3	1	0.02	∞
Modulation Response	0.40	Rectangular	√3	1	0.23	∞
Readout Electronics	0.03	Normal	1	1	0.03	∞
Response Time	0.00	Rectangular	√3	1	0.00	∞
Integration Time	0.00	Rectangular	√3	1	0.00	∞
RF Ambient Conditions – Noise	0.20	Rectangular	√3	1	0.12	∞
RF Ambient Conditions – Reflections	0.20	Rectangular	√3	1	0.12	∞
Probe Positioner Mechanical Tolerance	0.04	Rectangular	√3	1	0.02	∞
Probe Positioning with Respect to Phantom	0.30	Rectangular	√3	1	0.17	∞
S_{avg} Reconstruction	0.60	Rectangular	√3	1	0.35	∞
Test Sample Related						
Power Drift of Measurement	0.20	Rectangular	√3	1	0.12	∞
Input Power	0.00	Normal	1	1	0.00	∞
Combined Standard Uncertainty					± 0.76	
Expanded Uncertainty (K=2)					**± 1.52**	

Uncertainty Budget for mm-Wave Power Density Measurement

7. Information on the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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Web Site: https://ee.bureauveritas.com.tw/BVInternet/Default

The road map of all our labs can be found in our web site also.

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Appendix A. Plots of System Verification

The plots for system verification with largest deviation for each system combination are shown as follows.

Test Lab: Bureau Veritas ADT SAR/HAC/PD Testing Lab

Power Density Plot No.:

PD_System Check_30 GHz_2020.10.13

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
SPEAG	100.0 x 100.0 x 100.0	SN: 1016	5G Verification Source 30GHz

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5GAir	FRONT, 5.55	Validation band	CW,	30000.0,	1.0

Hardware Setup

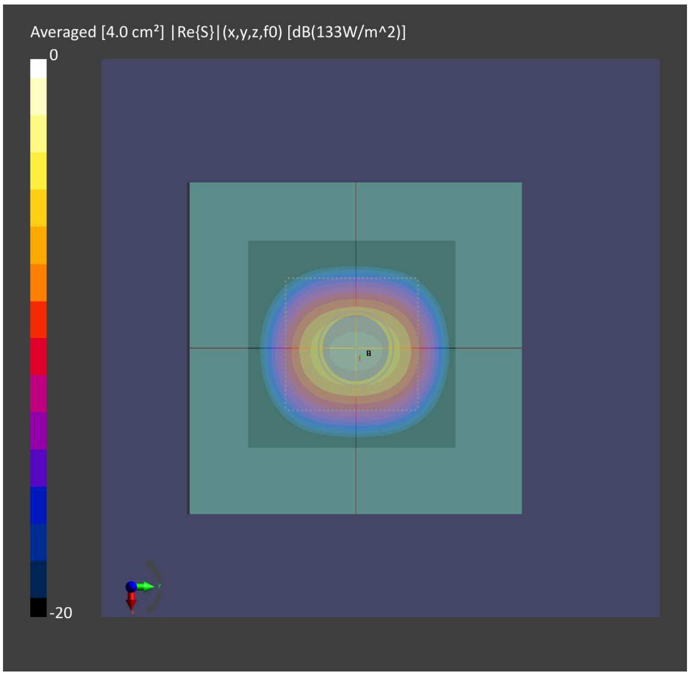
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave _1030	--Air--	EUmmWV4 - SN9438, 2020-05-29	DAE4 Sn1585, 2020-05-28

Scan Setup

	5G Scan
Grid Extents [mm]	60.0 x 60.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

	5G Scan
Date	2020-10-13
Avg. Area [cm^2]	4.00
$pS_{tot}avg$[W/m^2]	36.8
$pS_{n}avg$ [W/m^2]	35.7
E_{peak} [V/m]	135



Test Lab: Bureau Veritas ADT SAR/HAC/PD Testing Lab

Power Density Plot No.:

PD_System Check_30 GHz_2020.10.14

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
SPEAG	100.0 x 100.0 x 100.0	SN: 1016	5G Verification Source 30GHz

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5GAir	FRONT, 5.55	Validation band	CW,	30000.0,	1.0

Hardware Setup

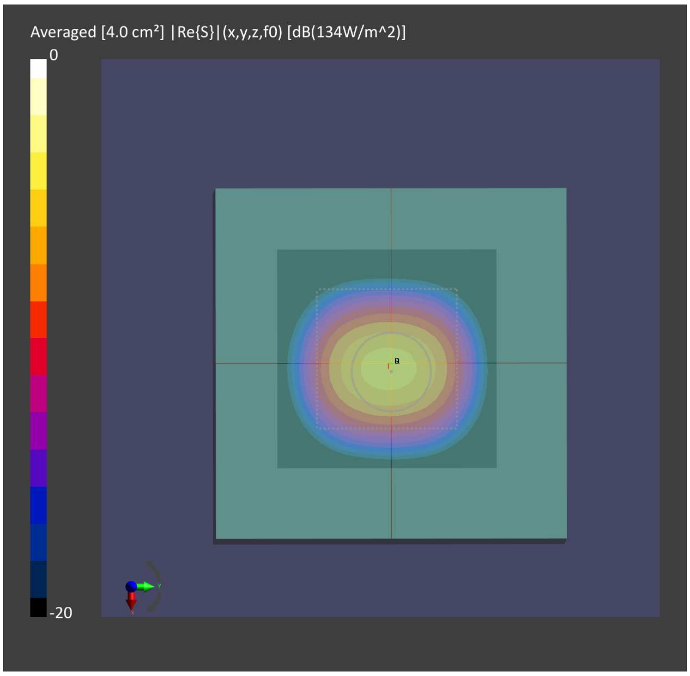
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave _1030	--Air--	EUmmWV4 - SN9438, 2020-05-29	DAE4 Sn1585, 2020-05-28

Scan Setup

	5G Scan
Grid Extents [mm]	60.0 x 60.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

	5G Scan
Date	2020-10-14
Avg. Area [cm^2]	4.00
$pS_{tot}avg$[W/m^2]	36.4
$pS_n avg$ [W/m^2]	36.0
E_{peak} [V/m]	134



Test Lab: Bureau Veritas ADT SAR/HAC/PD Testing Lab

Power Density Plot No.:

PD_System Check_30 GHz_2020.10.15

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
SPEAG	100.0 x 100.0 x 100.0	SN: 1016	5G Verification Source 30GHz

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5GAir	FRONT, 5.55	Validation band	CW,	30000.0,	1.0

Hardware Setup

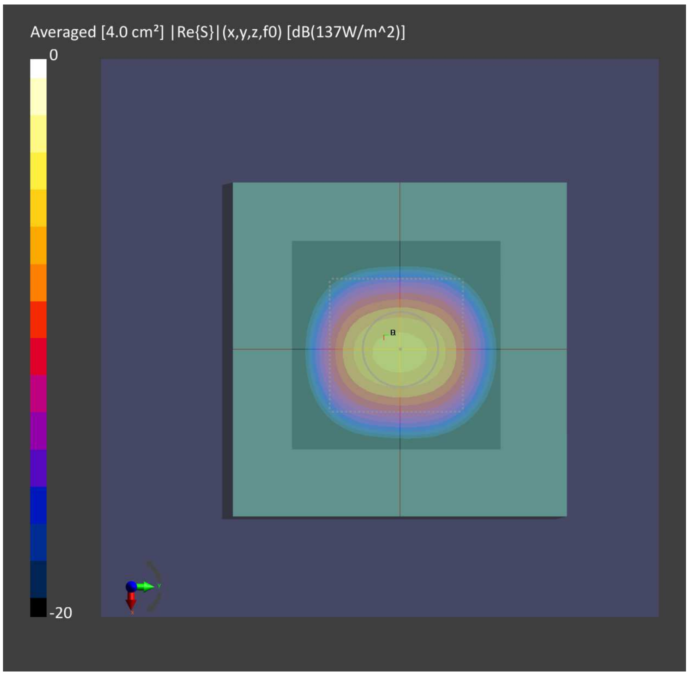
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave_1030	--Air--	EUmmWV4 - SN9438, 2020-05-29	DAE4 Sn1585, 2020-05-28

Scan Setup

	5G Scan
Grid Extents [mm]	60.0 x 60.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

	5G Scan
Date	2020-10-15
Avg. Area [cm^2]	4.00
$pS_{tot}avg$ [W/m^2]	37.2
$pS_{n}avg$ [W/m^2]	36.8
E_{peak} [V/m]	137



Test Lab: Bureau Veritas ADT SAR/HAC/PD Testing Lab

Power Density Plot No.:

PD_System Check_30 GHz_2020.10.16

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
SPEAG	100.0 x 100.0 x 100.0	SN: 1016	5G Verification Source 30GHz

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5GAir	FRONT, 5.55	Validation band	CW,	30000.0,	1.0

Hardware Setup

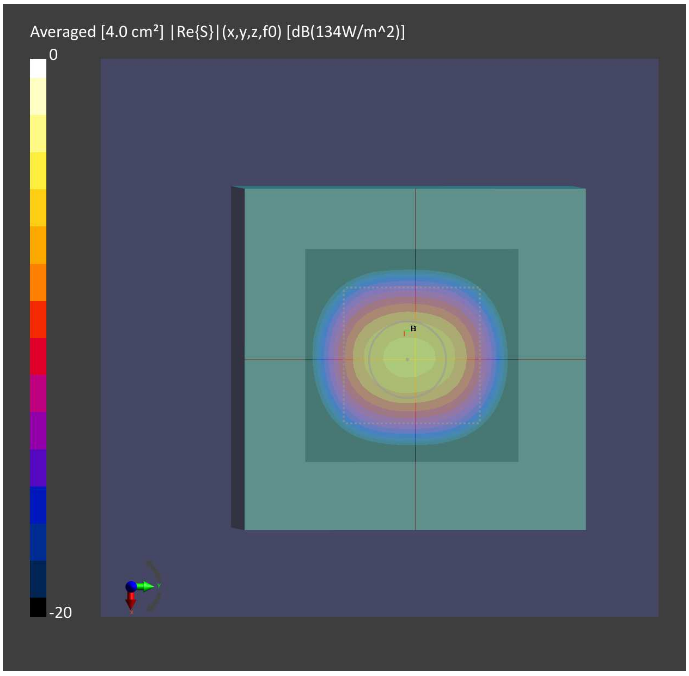
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave_1030	--Air--	EUmmWV4 - SN9438, 2020-05-29	DAE4 Sn1585, 2020-05-28

Scan Setup

	5G Scan
Grid Extents [mm]	60.0 x 60.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

	5G Scan
Date	2020-10-16
Avg. Area [cm^2]	4.00
$pS_{tot}avg$[W/m^2]	36.2
$pS_{n}avg$ [W/m^2]	35.8
E_{peak} [V/m]	134



Test Lab: Bureau Veritas ADT SAR/HAC/PD Testing Lab

Power Density Plot No.:

PD_System Check_30 GHz_2020.10.17

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
SPEAG	100.0 x 100.0 x 100.0	SN: 1016	5G Verification Source 30GHz

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5GAir	FRONT, 5.55	Validation band	CW,	30000.0,	1.0

Hardware Setup

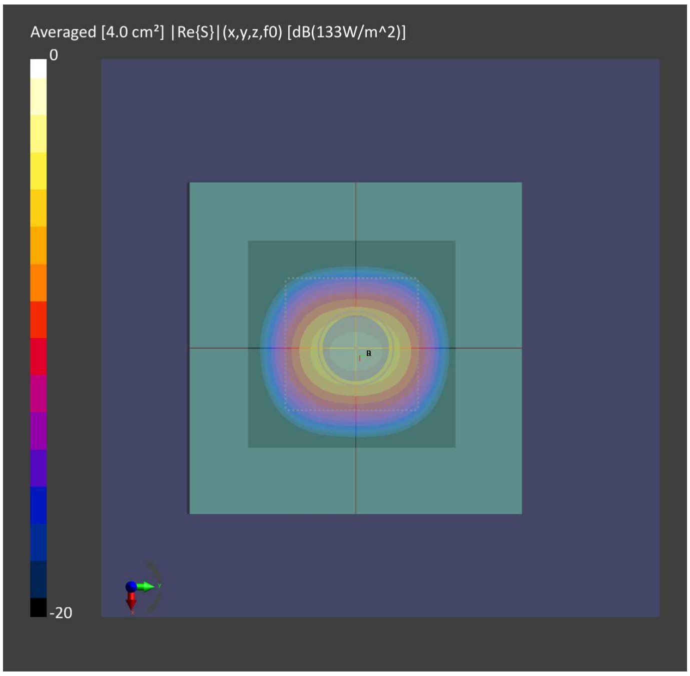
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave _1030	--Air--	EUmmWV4 - SN9438, 2020-05-29	DAE4 Sn1585, 2020-05-28

Scan Setup

	5G Scan
Grid Extents [mm]	60.0 x 60.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

	5G Scan
Date	2020-10-17
Avg. Area [cm²]	4.00
$pS_{tot}avg$[W/m²]	37.3
$pS_{n}avg$ [W/m²]	36.2
E_{peak} [V/m]	138



Test Lab: Bureau Veritas ADT SAR/HAC/PD Testing Lab

Power Density Plot No.:

PD_System Check_30 GHz_2020.10.19

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
SPEAG	100.0 x 100.0 x 100.0	SN: 1016	5G Verification Source 30GHz

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5GAir	FRONT, 5.55	Validation band	CW,	30000.0,	1.0

Hardware Setup

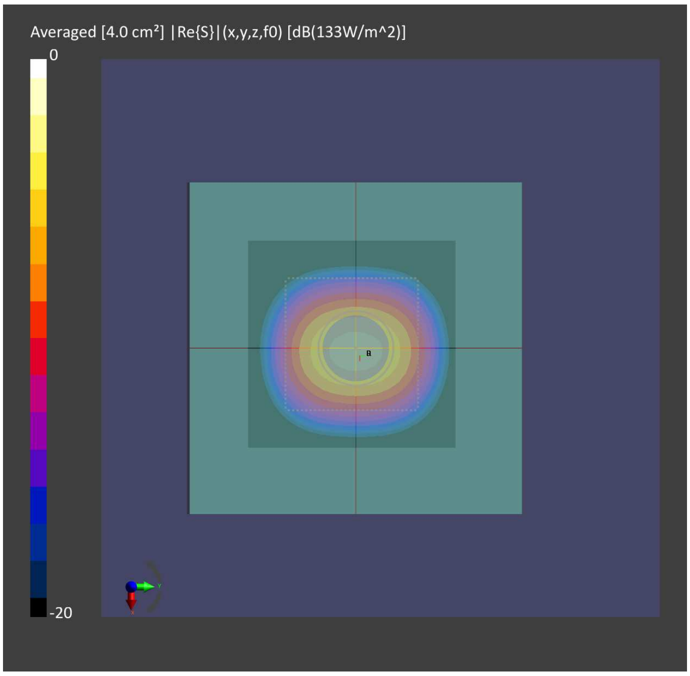
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave _1030	--Air--	EUmmWV4 - SN9438, 2020-05-29	DAE4 Sn1585, 2020-05-28

Scan Setup

	5G Scan
Grid Extents [mm]	60.0 x 60.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

	5G Scan
Date	2020-10-19
Avg. Area [cm^2]	4.00
$pS_{tot}avg$[W/m^2]	36.7
$pS_n avg$ [W/m^2]	35.6
E_{peak} [V/m]	134



Test Lab: Bureau Veritas ADT SAR/HAC/PD Teating Lab

Power Density Plot NO:

PD_System Check_30 GHz_2020.11.04

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
SPEAG	100.0 x 100.0 x 100.0	SN: 1016	5G Verification Source 30 GHz

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G Air	FRONT, 5.55	Validation band	CW,	30000.0,	1.0

Hardware Setup

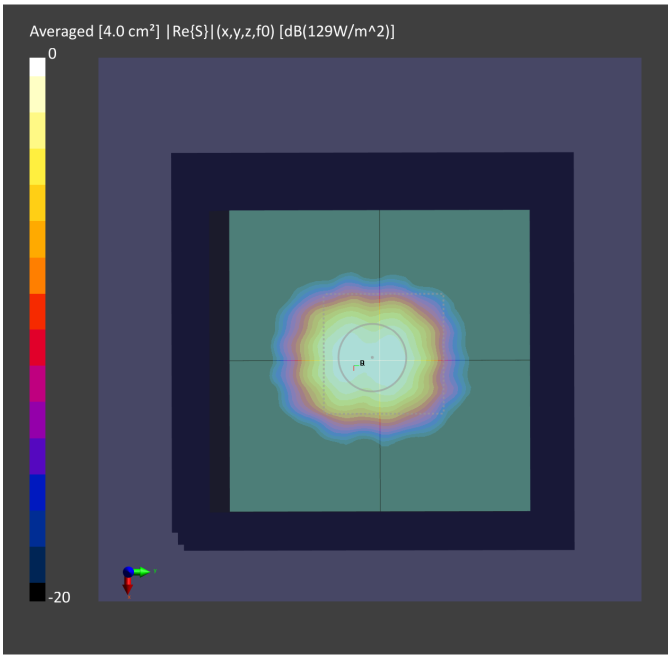
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave_1030	--Air--	EUmmWV4 - SN9454, 2020-09-24	DAE3 Sn579, 2020-08-12

Scan Setup

	5G Scan
Grid Extents [mm]	60.0 x 60.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

	5G Scan
Date	2020-11-04
Avg. Area [cm²]	4.00
pS_{tot} avg [W/m²]	35.4
pS_n avg [W/m²]	34.9
E_{peak} [V/m]	129



Test Lab: Bureau Veritas ADT SAR/HAC/PD Teating Lab

Power Density Plot NO:

PD_System Check_30 GHz_2020.11.05

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
SPEAG	100.0 x 100.0 x 100.0	SN: 1016	5G Verification Source 30 GHz

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G Air	FRONT, 5.55	Validation band	CW,	30000.0,	1.0

Hardware Setup

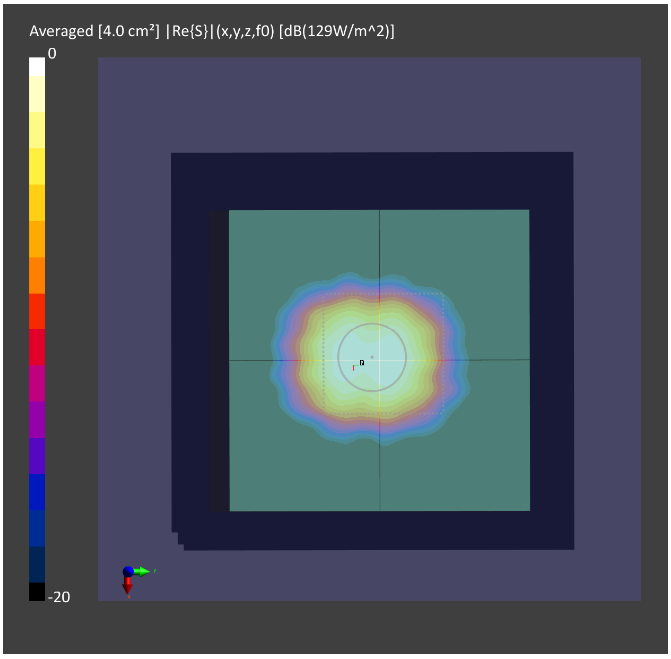
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave_1035	--Air--	EUmmWV4 - SN9454, 2020-09-24	DAE4 Sn1590, 2020-09-15

Scan Setup

	5G Scan
Grid Extents [mm]	60.0 x 60.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

	5G Scan
Date	2020-11-05
Avg. Area [cm^2]	4.00
pS_{tot} avg [W/m^2]	35.6
pS_n avg [W/m^2]	34.9
E_{peak} [V/m]	139



Test Lab: Bureau Veritas ADT SAR/HAC/PD Testing Lab

Power Density Plot No.:

PD_System Check_30 GHz_2020.11.09

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
SPEAG	100.0 x 100.0 x 100.0	SN: 1016	5G Verification Soruce 30GHz

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5GAir	FRONT, 5.55	Validation band	CW,	30000.0,	1.0

Hardware Setup

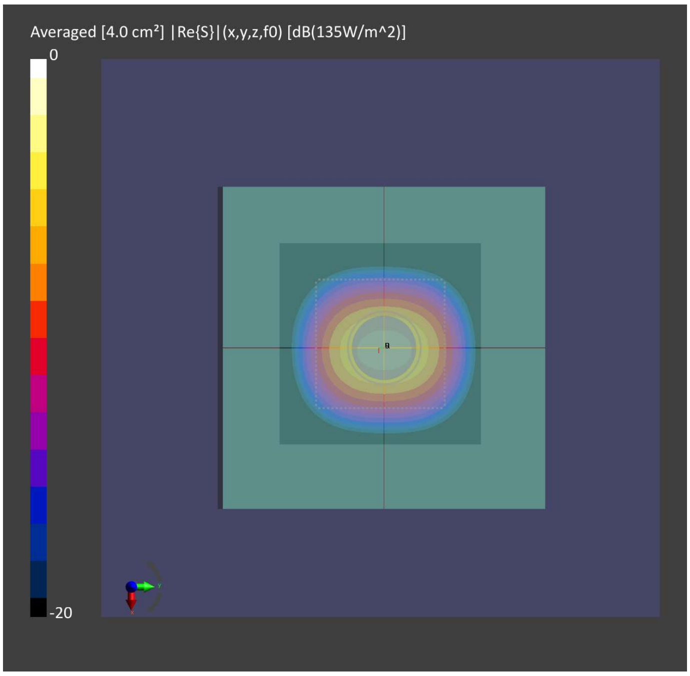
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave_1035	--Air--	EUmmWV3 - SN9361, 2020-09-24	DAE4 Sn1431, 2020-03-18

Scan Setup

	5G Scan
Grid Extents [mm]	60.0 x 60.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

	5G Scan
Date	2020-11-09
Avg. Area [cm^2]	4.00
$pS_{tot}avg$[W/m^2]	37.1
$pS_n avg$ [W/m^2]	36.7
E_{peak} [V/m]	135



Test Lab: Bureau Veritas ADT SAR/HAC/PD Testing Lab

Power Density Plot No.:

PD_System Check_30 GHz_2020.11.11

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
SPEAG	100.0 x 100.0 x 100.0	SN: 1016	5G Verification Source 30GHz

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5GAir	FRONT, 5.55	Validation band	CW,	30000.0,	1.0

Hardware Setup

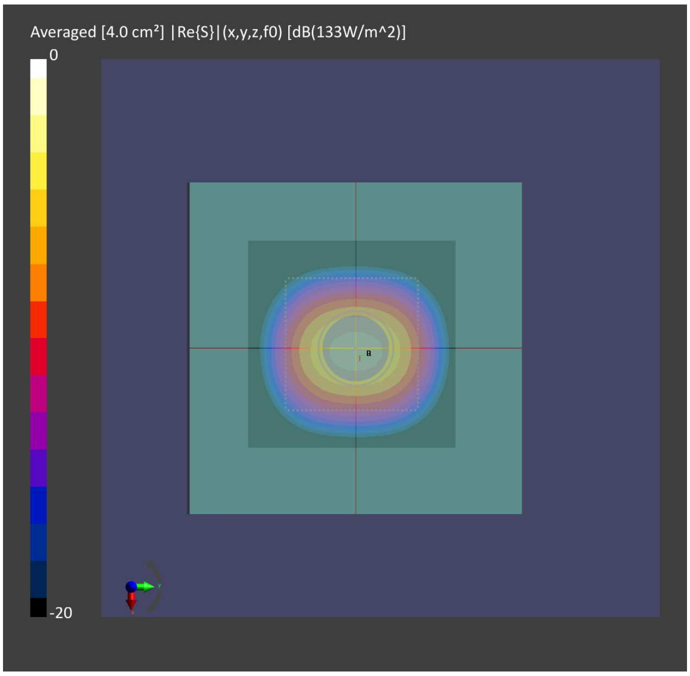
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave _1035	--Air--	EUmmWV3 - SN9361, 2020-09-24	DAE4 Sn1431, 2020-03-18

Scan Setup

	5G Scan
Grid Extents [mm]	60.0 x 60.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

	5G Scan
Date	2020-11-11
Avg. Area [cm^2]	4.00
$pS_{tot}avg$ [W/m^2]	36.7
$pS_{n}avg$ [W/m^2]	35.8
E_{peak} [V/m]	135



Test Lab: Bureau Veritas ADT SAR/HAC/PD Testing Lab

Power Density Plot No.:

PD_System Check_30 GHz_2020.11.14

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
SPEAG	100.0 x 100.0 x 100.0	SN: 1016	5G Verification Source 30GHz

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5GAir	FRONT, 5.55	Validation band	CW,	30000.0,	1.0

Hardware Setup

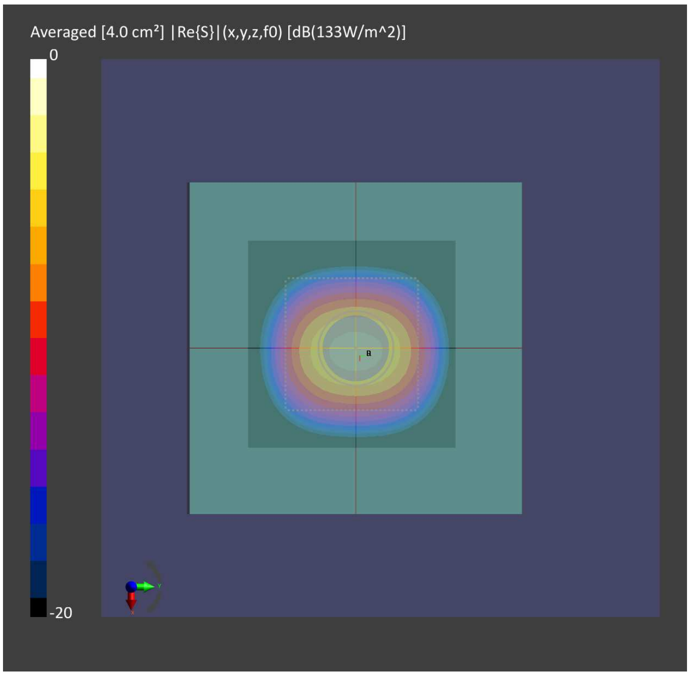
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave _1035	--Air--	EUmmWV3 - SN9361, 2020-09-24	DAE4 Sn1431, 2020-03-18

Scan Setup

	5G Scan
Grid Extents [mm]	60.0 x 60.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

	5G Scan
Date	2020-11-14
Avg. Area [cm^2]	4.00
$pS_{tot}avg$[W/m^2]	36.1
$pS_n avg$ [W/m^2]	35.6
E_{peak} [V/m]	133



Appendix B. Plots of Power Density Measurement

The plots for highest maximum averaged power density in each exposure configuration, wireless mode and frequency band combination are shown as follows.

Test Lab: Bureau Veritas ADT SAR/HAC/PD Testing Lab

Power Density Plot No.: P01

5GNR n260_QPSK100M_Left Side_2mm_Ch2254165_66RB_OS0_Ant QTM#0_Beam ID 39_167

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
200605C24	165.0x75.0x15.0		E7710

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5GAir	Left Side 2.00	n260	5G NR FR2 TDD 10870	38499.96	1.0

Hardware Setup

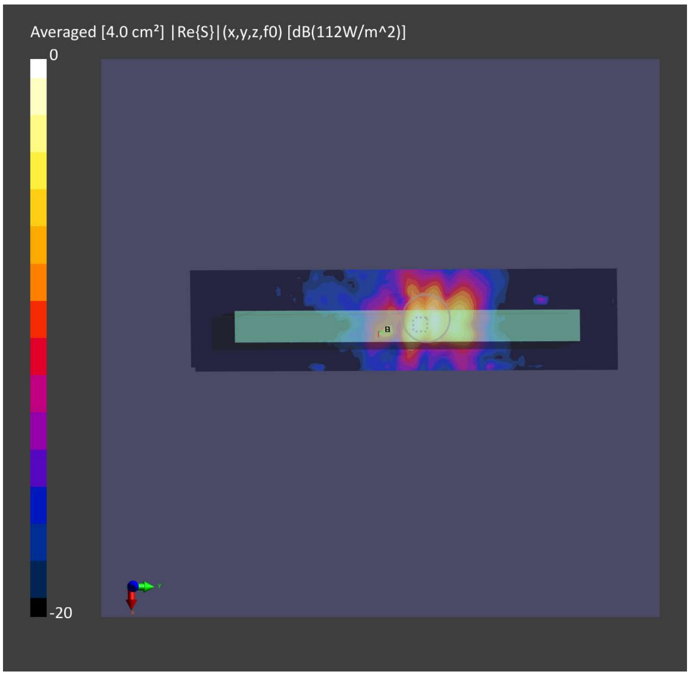
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave-1030	--Air--	SN9438, 2020-05-29	DAE4 Sn1585, 2020-05-28

Scan Setup

	5G Scan
Grid Extents [mm]	10.0x6.0
Grid Steps [lambda]	0.25x0.25
Sensor Surface [mm]	2.0

Measurement Results

	5G Scan
Date	2020-10-14
Avg. Area [cm²]	4.00
$pS_{tot}avg$[W/m²]	14.1
$pS_{n}avg$ [W/m²]	11.8
E_{peak} [V/m]	143



Test Lab: Bureau Veritas ADT SAR/HAC/PD Testing Lab

Power Density Plot No.: P02

5GNR n260_QPSK100M_Right Side_2mm_Ch2254165_66RB_OS0_Ant QTM#1_Beam ID 20_148

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
200605C24	165.0x75.0x15.0		E7710

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5GAir	Right Side 2.00	n260	5G NR FR2 TDD 10869	38499.96	1.0

Hardware Setup

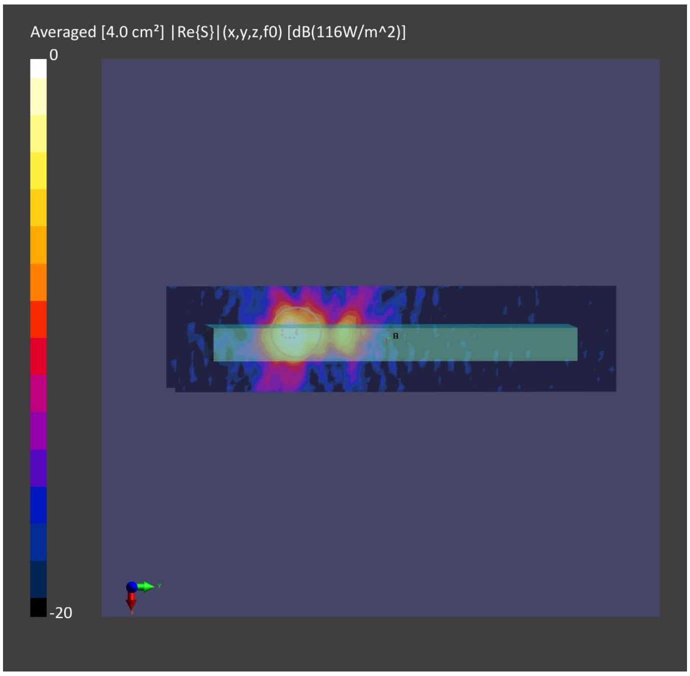
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave-1030	--Air--	SN9438, 2020-05-29	DAE4 Sn1585, 2020-05-28

Scan Setup

	5G Scan
Grid Extents [mm]	6.0x6.0
Grid Steps [lambda]	0.25x0.25
Sensor Surface [mm]	2.0

Measurement Results

	5G Scan
Date	2020-10-15
Avg. Area [cm²]	4.00
$pS_{tot}avg$ [W/m²]	16.0
$pS_{n}avg$ [W/m²]	13.9
E_{peak} [V/m]	127



Test Lab: Bureau Veritas ADT SAR/HAC/PD Testing Lab

Power Density Plot No.: P03

5GNR n260_QPSK100M_Rear Face_2mm_Ch2254165_1RB_OS0_Ant QTM#2_Beam ID 156

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
200605C24,	165.0x75.0x15.0		E7110

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5GAir	Rear Face 2.00	n260	5G NR FR2 TDD 10869	38499.96	1.0

Hardware Setup

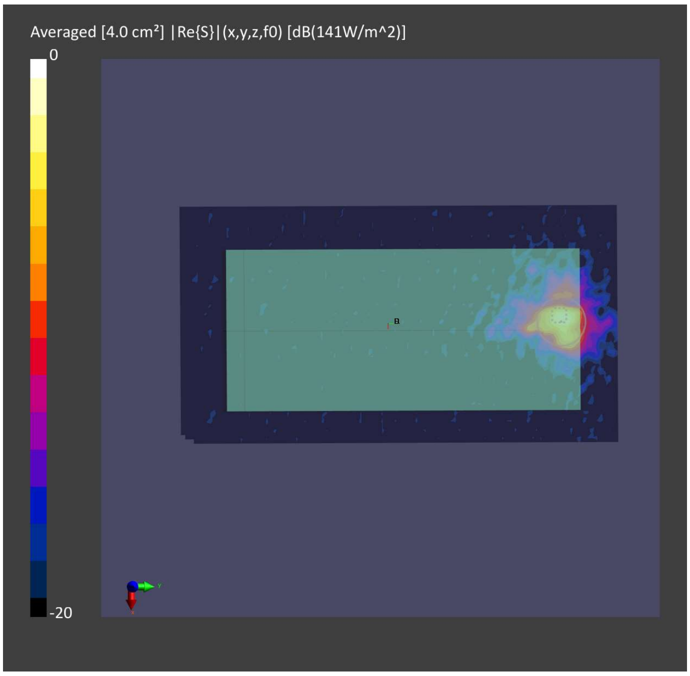
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave-1030	--Air--	EUmmWV4 - SN9438, 2020-05-29	DAE4 Sn1585, 2020-05-28

Scan Setup

	5G Scan
Grid Extents [mm]	8.0x4.0
Grid Steps [lambda]	0.25x0.25
Sensor Surface [mm]	2.0

Measurement Results

	5G Scan
Date	2020-10-16
Avg. Area [cm²]	4.00
$pS_{tot}avg[W/m^2]$	12.4
$pS_{n}avg$ [W/m²]	10.9
E_{peak} [V/m]	141



Test Lab: Bureau Veritas ADT SAR/HAC/PD Testing Lab

Power Density Plot No.: P04

5GNR n261_QPSK100M_Left Side_2mm_Ch2077916_66RB_OS0_Ant QTM#0_Beam ID 39

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
200605C24	165.0x75.0x15.0		E7710

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5GAir	Left Side 2.00	n261	5G NR FR2 TDD 10870	27925.02	1.0

Hardware Setup

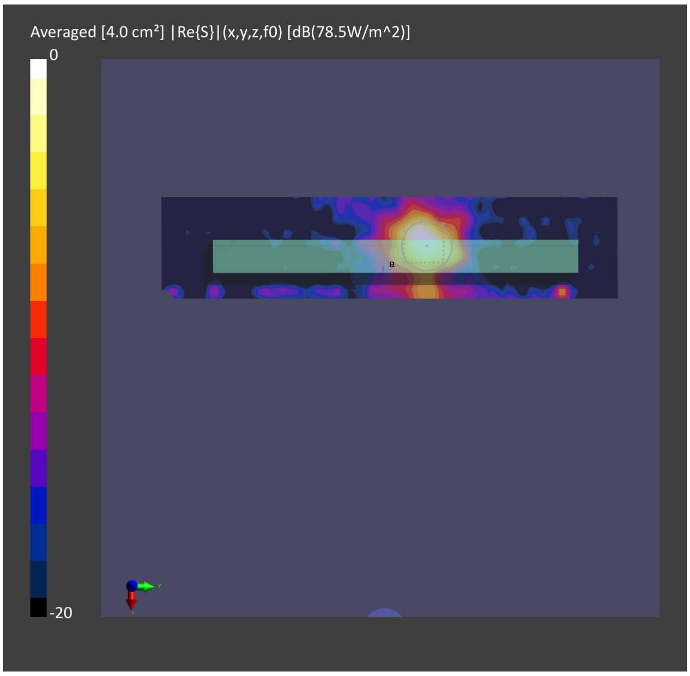
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave-1030	--Air--	SN9438, 2020-05-28	DAE4 Sn1585, 2020-05-29

Scan Setup

	5G Scan
Grid Extents [mm]	8.0x12.0
Grid Steps [lambda]	0.25x0.25
Sensor Surface [mm]	2.0

Measurement Results

	5G Scan
Date	2020-10-17
Avg. Area [cm²]	4.00
$pS_{tot}avg$[W/m²]	9.30
$pS_{n}avg$ [W/m²]	8.71
E_{peak} [V/m]	90.0



Test Lab: Bureau Veritas ADT SAR/HAC/PD Testing Lab

Power Density Plot No.: P05

5GNR n261_QPSK100M_Right Side_2mm_Ch2083999_66RB_OS0_Ant QTM#1_Beam ID 19_147

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
200605C24	165.0x75.0x15.0		E7110

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5GAir	Right Side 2.00	n261	5G NR FR2 TDD 10870	28290.0	1.0

Hardware Setup

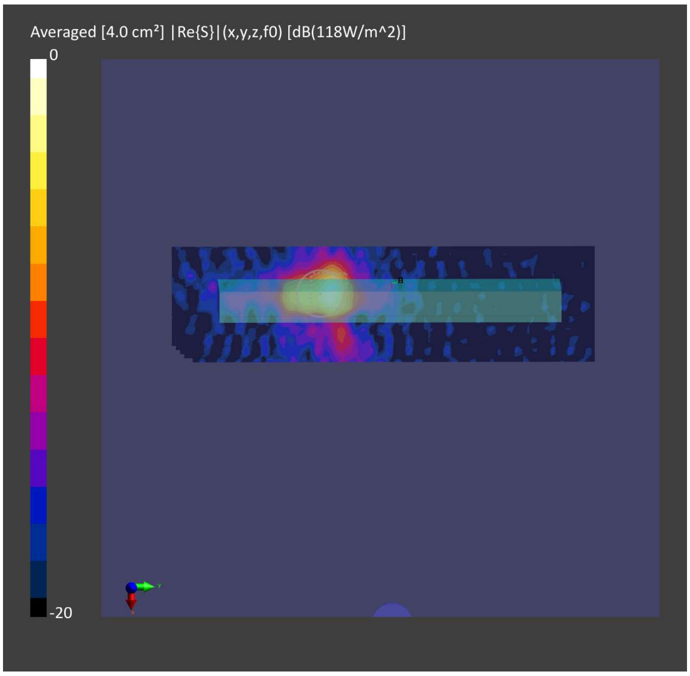
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave-1030	--Air--	SN9438, 2020-05-29	DAE4 Sn1585, 2020-05-28

Scan Setup

	5G Scan
Grid Extents [mm]	6.0x10.0
Grid Steps [lambda]	0.25x0.25
Sensor Surface [mm]	2.0

Measurement Results

	5G Scan
Date	2020-10-19
Avg. Area [cm²]	4.00
$pS_{tot}avg[W/m^2]$	12.7
$pS_{n}avg\ [W/m^2]$	11.6
E_{peak} [V/m]	118



Test Lab: Bureau Veritas ADT SAR/HAC/PD Testing Lab

Power Density Plot No.: P06

5GNR n261_QPSK100M_Rear Face_2mm_Ch2077916_1RB_OS0_Ant QTM#2_Beam ID 30

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
200605C24	165.0x75.0x15.0		E7710

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5GAir	Rear Face 2.00	n261	5G NR FR2 TDD 10870	27925.02	1.0

Hardware Setup

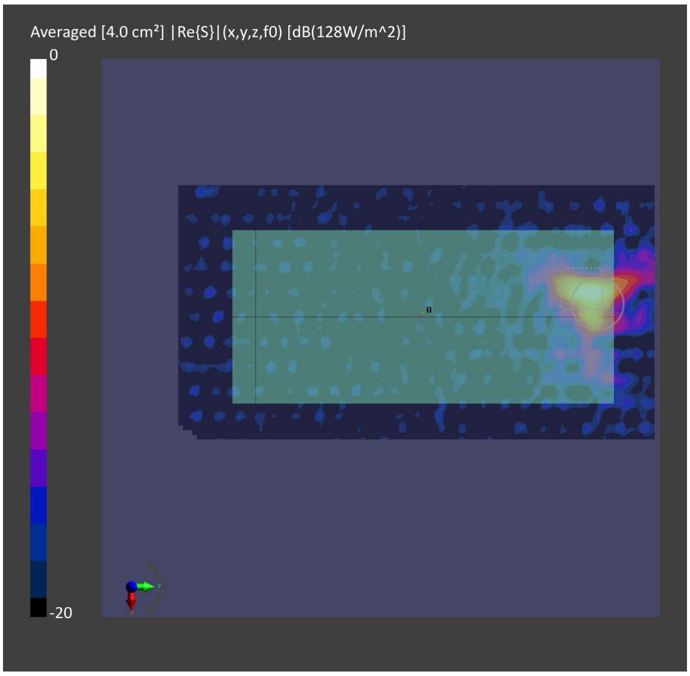
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave-1030	--Air--	SN9438, 2020-05-29	DAE4 Sn1585, 2020-05-28

Scan Setup

	5G Scan
Grid Extents [mm]	8.0x4.0
Grid Steps [lambda]	0.25x0.25
Sensor Surface [mm]	2.0

Measurement Results

	5G Scan
Date	2020-10-19
Avg. Area [cm²]	4.00
$pS_{tot}avg$[W/m²]	13.7
$pS_{n}avg$ [W/m²]	11.1
E_{peak} [V/m]	128



Appendix C. Calibration Certificate for Probe and System Verification Source

The SPEAG calibration certificates are shown as follows.

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 **B.V. ADT (Auden)**

Certificate No: EUmmWV4-9454_Sep20

CALIBRATION CERTIFICATE

Object	EUmmWV4 - SN:9454
Calibration procedure(s)	QA CAL-02.v9, QA CAL-25.v7, QA CAL-42.v2 Calibration procedure for E-field probes optimized for close near field evaluations in air
Calibration date:	September 24, 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
Reference Probe ER3DV6	SN: 2328	05-Oct-19 (No. ER3-2328_Oct19)	Oct-20
DAE4	SN: 789	27-Dec-19 (No. DAE4-789_Dec19)	Dec-20
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-20)	In house check: Jun-22
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-19)	In house check: Oct-20

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	[signature]
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