

Part 0 SAR Char Report



The following samples were submitted and identified on behalf of the client as:

Equipment Under Test	Smart phone
Brand Name	HONOR
Model No.	ANY-NX1
Applicant	HONOR Device Co., Ltd. Shum Yip Sky Park, No. 8089, Hongli West Road, Shenzhen, China
Standards	IEEE/ANSI C95.1-1992, IEEE 1528-2013
FCC ID	2AYGCANY-NX1
Date of Receipt	Feb. 17, 2022
Date of Test(s)	Mar. 06, 2022 ~ Mar. 31, 2022
Date of Issue	Apr. 12, 2022

In the configuration tested, the EUT complied with the standards specified above.

Remarks:

This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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Signed on behalf of SGS

Clerk / Ruby Ou	PM / Kiki Lin	Approved By / John Yeh
Ruby Ou	Kiki Lin	John Yeh

Date: Apr. 12, 2022

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Revision History

Report Number	Revision	Description	Issue Date	Revised By	Remark
ES/2022/30012	Rev.00	Initial creation of document	Apr. 08, 2022	Ruby Ou	*
ES/2022/30012	Rev.01	Modify report according to customer requirements	Apr. 11, 2022	Ruby Ou	*
ES/2022/30012	Rev.02	Modify Plimit table in p. 27	Apr. 12, 2022	Ruby Ou	

Note:

1. The mark " * " is the revised version of the report due to comments submitted by the certification.

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0. Guidance applied

The SAR testing method and procedure for this device is in accordance with the following standards:

IEEE/ANSI C95.1-1992

IEEE 1528-2013

KDB648474D04v01r03

KDB865664D01v01r04

KDB865664D02v01r02

KDB941225D01v03r01

KDB941225D05v02r05

KDB941225D05Av01r02

KDB941225D06v02r01

KDB447498D01v06

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1. General Information

1.1 Testing Laboratory

SGS Taiwan Ltd. Central RF Lab	
No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan	
FCC Designation Number	TW0027
Tel	+886-2-2299-3279
Fax	+886-2-2298-0488
Internet	http://www.tw.sgs.com/

1.2 Details of Applicant

Company Name	HONOR Device Co., Ltd.
Company Address	Shum Yip Sky Park, No. 8089, Hongli West Road, Shenzhen, China

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1.3 Description of EUT

Equipment Under Test	Smart phone		
Brand Name	HONOR		
Model No.	ANY-NX1		
Hardware Version	HN3ANYM		
Software Version	4.2.0.42(C900E42R1P3)		
FCC ID	2AYGCANY-NX1		
Mode of Operation	<input checked="" type="checkbox"/> GSM <input checked="" type="checkbox"/> GPRS <input checked="" type="checkbox"/> EDGE <input checked="" type="checkbox"/> WCDMA <input checked="" type="checkbox"/> HSDPA <input checked="" type="checkbox"/> HSUPA <input checked="" type="checkbox"/> DC-HSDPA <input checked="" type="checkbox"/> LTE FDD <input checked="" type="checkbox"/> LTE TDD <input checked="" type="checkbox"/> 5G NR <input checked="" type="checkbox"/> WLAN802.11 <input checked="" type="checkbox"/> Bluetooth		
Duty Cycle	GSM (DTM multi class B)	1/8.3	
	GPRS / EDGE (support multi class 12 max)	1/2 (1Dn4UP) 1/2.76 (1Dn3UP) 1/4.1 (1Dn2UP) 1/8.3 (1Dn1UP)	
	WCDMA	1	
	LTE FDD	1	
	LTE TDD	0.633	
	5G NR	1	
	WLAN802.11	1	
	Bluetooth	1	
TX Frequency Range (MHz)	GSM850	824	— 849
	GSM1900	1850	— 1910
	WCDMA Band II	1850	— 1910
	WCDMA Band V	824	— 849

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TX Frequency Range (MHz)	LTE FDD Band 5	824 – 849
	LTE FDD Band 7	2500 – 2570
	LTE TDD Band 38	2570 – 2620
	LTE TDD Band 41	2496 – 2690
	n7	2500 – 2570
	n38	2570 – 2620
	n41	2496 – 2690
	WLAN802.11 b/g/n	2.4GHz (2400.0 – 2483.5)
	WLAN802.11 a/n/ac	5.2GHz (5150.0 – 5350.0) 5.6GHz (5470.0 – 5725.0) 5.8GHz (5725.0 – 5850.0)
	Bluetooth	2.4GHz (2400.0 – 2483.5)
RX Frequency Range (MHz)	GSM850	869-894
	GSM1900	1930-1990
	WCDMA Band II	1930-1990
	WCDMA Band V	869-894
	LTE FDD Band 5	869–894
	LTE FDD Band 7	2620–2690
	LTE TDD Band 38	2570–2620
	LTE TDD Band 41	2496-2690
	n7	2620–2690
	n38	2570-2620
	n41	2496-2690
	WLAN802.11 b/g/n	2.4GHz (2400.0 – 2483.5)
	WLAN802.11 a/n/ac	5.2GHz (5150.0 – 5350.0) 5.6GHz (5470.0 – 5725.0) 5.8GHz (5725.0 – 5850.0)

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RX Frequency Range (MHz)	Bluetooth	2.4GHz (2400.0 – 2483.5)
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This device uses the Qualcomm® Smart Transmit feature to control and manage transmitting power in real time and to ensure the time-averaged RF exposure is in compliance with the FCC requirement at all times for 2G/3G/4G/5G Sub-6 NR WWAN operations. Additionally, this device supports WLAN/BT technologies, but the output power of these modems is not controlled by the Smart Transmit algorithm.

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1.4 Time-Averaging for SAR

This device is enabled with Qualcomm® Smart Transmit algorithm to control and manage transmitting power in real time and to ensure that the time-averaged RF exposure from 2G/3G/4G/5G Sub-6 NR WWAN is in compliance with FCC requirements. This Part 0 report shows SAR characterization of WWAN radios for 2G/3G/4G and 5G Sub-6 NR. Characterization is achieved by determining Plimit for 2G/3G/4G and 5G Sub-6 NR that correspond to the exposure design targets after accounting for all device design related uncertainties, i.e., SAR_design_target (< FCC SAR limit) for sub-6 radio. The SAR characterization is denoted as SAR Char in this report. Section 1.5 includes a nomenclature of the specific terms used in this report.

The compliance test under the static transmission scenario and simultaneous transmission analysis are reported in Part 1 report. The validation of the time-averaging algorithm and compliance under the dynamic (time-varying) transmission scenario for WWAN technologies are reported in Part 2 report (report Number could be found in Section 1.6 – Bibliography).

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1.5 Nomenclature for Part 0 Report

Technology	Term	Description
2G/3G/4G/5G Sub-6 NR	Plimit	The time-averaged RF power which corresponds to SAR_design_target
	Pmax	Maximum tune-up power level
	SAR_design_target	The SAR design target for SAR compliance. It shall be less than SAR limit after accounting for all device design related uncertainties.
	SAR Char	Plimit for all technologies/bands for all applicable DSI

1.6 Bibliography

Report Type	Report Number
FCC SAR Test Report (Part 1)	ES/2022/30012
RF Exposure Part 2 Test Report	ES/2022/30012

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1.7 Test Environment

Ambient Temperature: 22±2° C

Tissue Simulating Liquid: 22±2° C

1.8 Operation Description

For WWAN, the EUT is controlled by using a Radio Communication Tester, and the communication between the EUT and the tester is established by air link. The device was tested based on KDB648474D04v01r03.

Head SAR (0mm)

Cheek/Touch Position:

The handset was brought toward the mouth of the head phantom by pivoting against the ear reference point until any point of the mouthpiece or keypad touched the phantom.

Ear/Tilt Position:

With the phone aligned in the Cheek/Touch position, the handset was tilted away from the mouth with respect to the test device reference point by 15 degrees

Body-worn SAR (15mm)

Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in KDB Publication 447498 D01 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. When the same wireless transmission configuration is used for testing body-worn accessory and hotspot mode SAR, respectively, in voice and data mode, SAR results for the most conservative test separation distance configuration may be used to support both SAR conditions. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for the body-worn accessory with a headset attached to the handset.

Hotspot SAR (10mm)

A test separation distance of 10 mm is required between the phantom and all

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surfaces and edges with a transmitting antenna located within 25 mm from that surface or edge when the form factor of a handset is larger than 9 cm × 5 cm.

Product specific 10-g SAR (0mm)

Since the device is a phablet (overall diagonal dimension > 16.0 cm), the UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna located at ≤ 25 mm from that surface or edge, in direct contact with a flat phantom, for product specific 10-g SAR. When hotspot mode applies, product specific 10-g SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg. However, when power reduction applies to hotspot mode the measured SAR must be scaled to the maximum output power, including tolerance, allowed for phablet modes to compare with the 1.2 W/kg SAR test reduction threshold. Based on KDB941225D06v02r01, the hotspot mode and body-worn accessory SAR test configurations may overlap for handsets. When the same wireless mode transmission configurations for voice and data are required for SAR measurements, the more conservative configuration with a smaller separation distance should be tested for the overlapping SAR configurations.

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1.9 The SAR Measurement System

A block diagram of the SAR measurement System is given in Fig. a. This SAR Measurement System uses a Computer-controlled 3-D stepper motor system (SPEAG DASY 5 professional system). The model EX3DV4 field probe is used to determine the internal electric fields. The SAR can be obtained from the equation $SAR = \sigma (|E_i|^2) / \rho$ where σ and ρ are the conductivity and mass density of the tissue-simulant.

The DASY 5 system for performing compliance tests consists of the following items:

1. A standard high precision 6-axis robot (Staubli RX family) with controller, teach pendant and software. An arm extension is for accommodating the data acquisition electronics (DAE).
2. A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage intissue simulating liquid. The probe is equipped with an optical surface detector system.
3. 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.

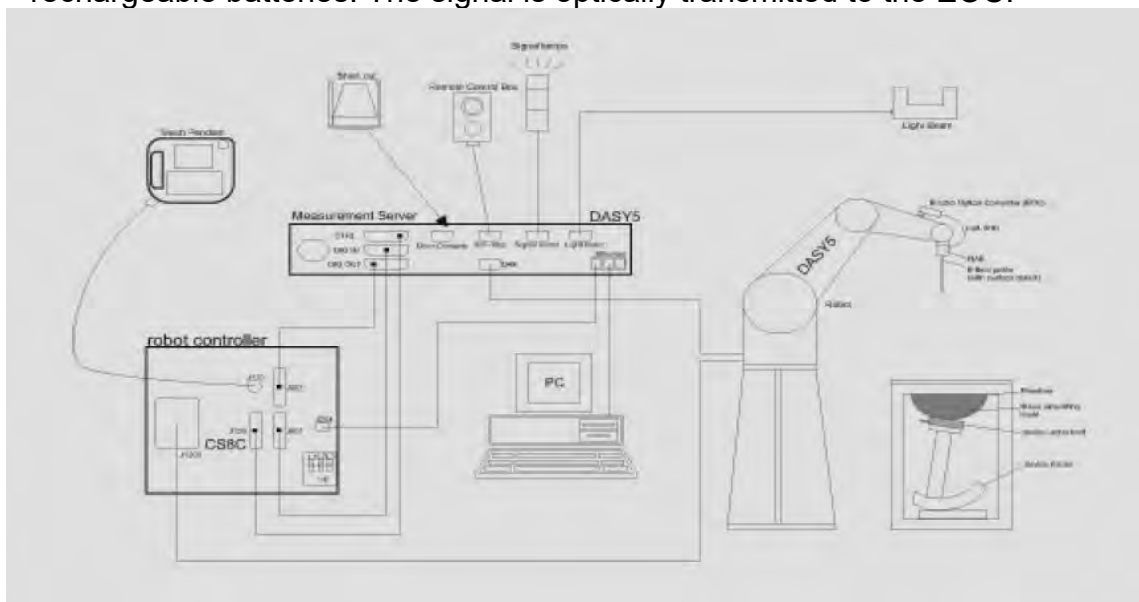


Fig. a The block diagram of SAR system

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4. The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
5. 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.
6. A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
7. A computer operating Windows 7.
8. DASY 5 software.
9. Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
10. Tissue simulating liquid mixed according to the given recipes.
11. Validation dipole kits allowing to validate the proper functioning of the system.


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1.10 System Components

EX3DV4 E-Field Probe

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Calibration	Basic Broad Band Calibration in air Conversion Factors (CF) for HSL 835/1900/2600MHz Additional CF for other liquids and frequencies upon request	
Frequency	10 MHz to > 6 GHz	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 µW/g to > 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 µW/g)	
Dimensions	Tip diameter: 2.5 mm	
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.	


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Phantom

Model	Twin SAM	
Construction	<p>The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209.</p> <p>It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points with the robot.</p>	
Shell Thickness	2 ± 0.2 mm	
Filling Volume	Approx. 25 liters	
Dimensions	Height: 850 mm; Length: 1000 mm; Width: 500 mm	

DEVICE HOLDER

Construction	<p>In combination with the Twin SAM Phantom V4.0/V4.0C or Twin SAM, the Mounting Device (made from POM) enables the rotation of the mounted transmitter in spherical coordinates, whereby the rotation point is the ear opening. The devices can be easily and accurately positioned according to IEC, IEEE, CENELEC, FCC or other specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).</p>	 <p style="text-align: center;">Device Holder</p>
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1.11 Evaluation Procedures

The entire evaluation of the spatial peak values is performed within the Post-processing engine (SEMCAD). The system always gives the maximum values for the 1 g and 10 g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

1. The extraction of the measured data (grid and values) from the Zoom Scan.
2. The calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
3. The generation of a high-resolution mesh within the measured volume
4. The interpolation of all measured values from the measurement grid to the high-resolution grid
5. The extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
6. The calculation of the averaged SAR within masses of 1g and 10g.

The probe is calibrated at the center of the dipole sensors that is located 1 to 2.7mm away from the probe tip. During measurements, the probe stops shortly above the phantom surface, depending on the probe and the surface detecting system. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated. The angle between the probe axis and the surface normal line is less than 30 degree.

In the Area Scan, the gradient of the interpolation function is evaluated to find all the extreme of the SAR distribution. The uncertainty on the locations of the extreme is less than 1/20 of the grid size. Only local maximum within -2 dB of the global maximum are searched and passed for the Cube Scan measurement. In the Cube Scan, the interpolation function is used to extrapolate the Peak SAR from the lowest measurement points to the inner phantom surface (the extrapolation distance). The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5mm.

The maximum search is automatically performed after each area scan measurement. It is based on splines in two or three dimensions. The procedure can find the maximum for most SAR distributions even with relatively large grid spacing. After the area scanning measurement, the probe is automatically moved to a position at the interpolated maximum. The following scan can directly use this position for reference, e.g., for a finer resolution grid or the cube evaluations. The 1g and 10g peak evaluations are only available for the predefined cube 7x7x7 scans. The routines are verified and optimized for the grid dimensions used in these cube measurements.

The measured volume of 30x30x30mm contains about 30g of tissue.

The first procedure is an extrapolation (incl. Boundary correction) to get the points

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between the lowest measured plane and the surface. The next step uses 3D interpolation to get all points within the measured volume. In the last step, a 1g cube is placed numerically into the volume and its averaged SAR is calculated. This cube is moved around until the highest averaged SAR is found. If the highest SAR is found at the edge of the measured volume, the system will issue a warning: higher SAR values might be found outside of the measured volume. In that case the cube measurement can be repeated, using the new interpolated maximum as the center.

1.12 Probe Calibration Procedures

For the calibration of E-field probes in lossy liquids, an electric field with an accurately known field strength must be produced within the measured liquid. For standardization purposes it would be desirable if all measurements which are necessary to assess the correct field strength would be traceable to standardized measurement procedures. In the following two different calibration techniques are summarized:

1.12.1 Transfer Calibration with Temperature Probes

In lossy liquids the specific absorption rate (SAR) is related both to the electric field (E) and the temperature gradient ($\delta T / \delta t$) in the liquid.

$$SAR = \frac{\sigma}{\rho} |E|^2 = c \frac{\delta T}{\delta t}$$

whereby σ is the conductivity, ρ the density and c the heat capacity of the liquid.

Hence, the electric field in lossy liquid can be measured indirectly by measuring the temperature gradient in the liquid. Non-disturbing temperature probes (optical probes or thermistor probes with resistive lines) with high spatial resolution (<1-2 mm) and fast reaction time (<1 s) are available and can be easily calibrated with high precision [1]. The setup and the exciting source have no influence on the calibration; only the relative positioning uncertainties of the standard temperature probe and the E-field probe to be calibrated must be considered. However, several problems limit the available accuracy of probe calibrations with temperature probes:

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1. The temperature gradient is not directly measurable but must be evaluated from temperature measurements at different time steps. Special precaution is necessary to avoid measurement errors caused by temperature gradients due to energy equalizing effects or convection currents in the liquid. Such effects cannot be completely avoided, as the measured field itself destroys the thermal equilibrium in the liquid. With a careful setup these errors can be kept small.
2. The measured volume around the temperature probe is not well defined. It is difficult to calculate the energy transfer from a surrounding gradient temperature field into the probe. These effects must be considered, since temperature probes are calibrated in liquid with homogeneous temperatures. There is no traceable standard for temperature rise measurements.
3. The calibration depends on the assessment of the specific density, the heat capacity and the conductivity of the medium. While the specific density and heat capacity can be measured accurately with standardized procedures ($\sim 2\%$ for c ; much better for ρ), there is no standard for the measurement of the conductivity. Depending on the method and liquid, the error can well exceed $\pm 5\%$.
4. Temperature rise measurements are not very sensitive and therefore are often performed at a higher power level than the E-field measurements. The nonlinearities in the system (e.g., power measurements, different components, etc.) must be considered.

Considering these problems, the possible accuracy of the calibration of E-field probes with temperature gradient measurements in a carefully designed setup is about $\pm 10\%$ (RSS) [2]. Recently, a setup which is a combination of the waveguide techniques and the thermal measurements was presented in [3]. The estimated uncertainty of the setup is $\pm 5\%$ (RSS) when the same liquid is used for the calibration and for actual measurements and $\pm 7-9\%$ (RSS) when not, which is in good agreement with the estimates given in [2].

1.12.2 Calibration with Analytical Fields

In this method a technical setup is used in which the field can be calculated analytically from measurements of other physical magnitudes (e.g., input power). This corresponds to the standard field method for probe calibration in air; however, there is no standard defined for fields in lossy liquids.

When using calculated fields in lossy liquids for probe calibration, several points must be considered in the assessment of the uncertainty:

1. The setup must enable accurate determination of the incident power.
2. The accuracy of the calculated field strength will depend on the assessment of the dielectric parameters of the liquid.

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3. Due to the small wavelength in liquids with high permittivity, even small setups might be above the resonant cutoff frequencies. The field distribution in the setup must be carefully checked for conformity with the theoretical field distribution.

References

1. N. Kuster, Q. Balzano, and J.C. Lin, Eds., *Mobile Communications Safety*, Chapman & Hall, London, 1997.
2. K. Meier, M. Burkhardt, T. Schmid, and N. Kuster, "Broadband calibration of E-field probes in lossy media", *IEEE Transactions on Microwave Theory and Techniques*, vol. 44, no. 10, pp. 1954-1962, Oct. 1996.
3. K. Jokela, P. Hyysalo, and L. Puranen, "Calibration of specific absorption rate (SAR) probes in waveguide at 900 MHz", *IEEE Transactions on Instrumentation and Measurements*, vol. 47, no. 2, pp. 432-438, Apr. 1998.

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1.13 Test Standards and Limits

According to FCC 47CFR §2.1093(d) The limits to be used for evaluation are based generally on criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (“SAR”) in Section 4.2 of “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz,” ANSI/IEEE C95.1, By the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in “Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields,” NCRP Report No. 86, Section 17.4.5. Copyright NCRP, 1986, Bethesda, Maryland 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards. The criteria to be used are specified in paragraphs (d)(1) and (d)(2) of this section and shall apply for portable devices transmitting in the frequency range from 100 kHz to 6 GHz. Portable devices that transmit at frequencies above 6 GHz are to be evaluated in terms of the MPE limits specified in § 1.1310 of this chapter. Measurements and calculations to demonstrate compliance with MPE field strength or power density limits for devices operating above 6 GHz should be made at a minimum distance of 5 cm from the radiating source.

1. Limits for Occupational/Controlled exposure: 0.4 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 8 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 20 W/kg, as averaged over an 10 grams of tissue (defined as a tissue volume in the shape of a cube).
2. Occupational/Controlled limits apply when persons are exposed as a consequence of their employment provided these persons are fully aware of and exercise control over their exposure. Awareness of exposure can be accomplished by use of warning labels or by specific training or education through appropriate means, such as an RF safety program in a work environment.
3. Limits for General Population/Uncontrolled exposure: 0.08 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 1.6 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 4 W/kg, as averaged over any 10 grams of

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tissue (defined as a tissue volume in the shape of a cube). General Population/Uncontrolled limits apply when the general public may be exposed, or when persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or do not exercise control over their exposure. Warning labels placed on consumer devices such as cellular telephones will not be sufficient reason to allow these devices to be evaluated subject to limits for occupational/controlled exposure in paragraph (d)(1) of this section. (Table 4.)

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Peak SAR (Brain)	1.60 W/Kg	8.00 W/Kg
Spatial Average SAR (Whole Body)	0.08 W/Kg	0.40 W/Kg
Spatial Peak SAR (Hands/Feet/Ankle/Wrist)	4.00 W/Kg	20.00 W/Kg

Table 4. RF exposure limits

Notes:

1. Uncontrolled environments are defined as locations where there is potential exposure of individuals who have no knowledge or control of their potential exposure.
2. Controlled environments are defined as locations where there is potential exposure of individuals who have knowledge of their potential exposure and can exercise control over their exposure.

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2. Instruments List

Manufacturer	Device	Type	Serial number	Date of last calibration	Date of next calibration
SPEAG	Dosimetric E-Field Probe	EX3DV4	7686	Oct.05,2021	Oct.04,2022
SPEAG	System Validation Dipole	D835V2	4d063	Oct.18,2021	Oct.17,2022
		D1900V2	5d173	Apr.15,2021	Apr.14,2022
		D2600V2	1005	Jan.18,2022	Jan.17,2023
SPEAG	Data acquisition Electronics	DAE4	1665	Feb.28,2022	Feb.27,2023
SPEAG	Software	DASY 52 V52.10.4	N/A	Calibration not required	Calibration not required
SPEAG	Phantom	SAM	N/A	Calibration not required	Calibration not required
SPEAG	Dielectric Assessment Kit	DAKS-3.5	1053	Feb.28,2022	Feb.27,2023
Agilent	Dual-directional coupler	772D	MY46151242	Aug.16,2021	Aug.15,2022
		778D	MY48220468	Aug.16,2021	Aug.15,2022
Agilent	RF Signal Generator	N5181A	MY50145142	Dec.23,2021	Dec.22,2022
R&S	Power Meter	NRX	102191	Jan.22,2022	Jan.21,2023
R&S	Power Sensor	NRP18S	101358	Jan.22,2022	Jan.21,2023
			109065	Oct.12,2021	Oct.11,2022
TECPEL	Digital thermometer	DTM-303A	TP190085	Jan.14,2022	Jan.13,2023
Anritsu	Radio Communication Test	MT8820C	6201061014	Jun.06,2021	Jun.05,2022
R&S	Radio Communication Test	CMW 500	125470	May.03,2021	May.02,2022

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3. Uncertainty Budget

Measurement Uncertainty evaluation template for DUT SAR test (3-6G)

A	c	D	e		f	g	h=c * f / e	i=c * g / e	k
Source of Uncertainty	Tolerance/ Uncertainty	Probabilit y	Div	Div Value	ci (1g)	ci (10g)	Standard uncertainty	Standard uncertainty	vi, or Veff
Measurement system									
Probe calibration	6.55%	N	1	1	1	1	6.55%	6.55%	∞
<i>Isotropy , Axial</i>	3.50%	R	√3	1.732	1	1	2.02%	2.02%	∞
<i>Isotropy, Hemispherical</i>	9.60%	R	√3	1.732	1	1	5.54%	5.54%	∞
Modulation Response	2.40%	R	√3	1.732	1	1	1.40%	1.40%	∞
Boundary Effect	1.00%	R	√3	1.732	1	1	0.58%	0.58%	∞
Linearity	4.70%	R	√3	1.732	1	1	2.71%	2.71%	∞
Detection Limits	1.00%	R	√3	1.732	1	1	0.58%	0.58%	∞
Readout Electronics	0.30%	N	1	1	1	1	0.30%	0.30%	∞
Response time	0.80%	R	√3	1.732	1	1	0.46%	0.46%	∞
Integration Time	2.60%	R	√3	1.732	1	1	1.50%	1.50%	∞
Measurement drift (class A evaluation)									
RF ambient condition - noise	3.00%	R	√3	1.732	1	1	1.73%	1.73%	∞
RF ambient conditions - reflections	3.00%	R	√3	1.732	1	1	1.73%	1.73%	∞
Probe positioner Mechanical restrictions	0.40%	R	√3	1.732	1	1	0.23%	0.23%	∞
Probe Positioning with respect to phantom	2.90%	R	√3	1.732	1	1	1.67%	1.67%	∞
Post-processing	1.00%	R	√3	1.732	1	1	0.58%	0.58%	∞
Max SAR Eval	1.00%	R	√3	1.732	1	1	0.58%	0.58%	∞
Test Sample related									
Test sample positioning	2.90%	N	1	1	1	1	2.90%	2.90%	M-1
Device Holder Uncertainty	3.60%	N	1	1	1	1	3.60%	3.60%	M-1
Drift of output power	5.00%	R	√3	1.732	1	1	2.89%	2.89%	∞
Phantom and Setup									
Phantom Uncertainty	4.00%	R	√3	1.732	1	1	2.31%	2.31%	∞
Liquid permittivity (mea.)	1.07%	N	1	1	0.64	0.43	0.68%	0.46%	M
Liquid Conductivity (mea.)	0.85%	N	1	1	0.6	0.49	0.51%	0.42%	M
Combined standard uncertainty		RSS					11.75%	11.72%	
Expant uncertainty (95% confidence)							23.49%	23.45%	

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Measurement Uncertainty evaluation template for DUT SAR test (0.3-3G)

A	c	D	e		f	g	h=c * f / e	i=c * g / e	k
Source of Uncertainty	Tolerance/ Uncertainty	Probabilit y	Div	Div Value	ci (1g)	ci (10g)	Standard uncertainty	Standard uncertainty	vi, or Veff
Measurement system									
Probe calibration	6.00%	N	1	1	1	1	6.00%	6.00%	∞
Isotropy , Axial	3.50%	R	√3	1.732	1	1	2.02%	2.02%	∞
Isotropy, Hemispherical	9.60%	R	√3	1.732	1	1	5.54%	5.54%	∞
Modulation Response	2.40%	R	√3	1.732	1	1	1.40%	1.40%	∞
Boundary Effect	1.00%	R	√3	1.732	1	1	0.58%	0.58%	∞
Linearity	4.70%	R	√3	1.732	1	1	2.71%	2.71%	∞
Detection Limits	1.00%	R	√3	1.732	1	1	0.58%	0.58%	∞
Readout Electronics	0.30%	N	1	1	1	1	0.30%	0.30%	∞
Response time	0.80%	R	√3	1.732	1	1	0.46%	0.46%	∞
Integration Time	2.60%	R	√3	1.732	1	1	1.50%	1.50%	∞
Measurement drift (class A evaluation)	1.75%	R	√3	1.732	1	1	1.01%	1.01%	∞
RF ambient condition - noise	3.00%	R	√3	1.732	1	1	1.73%	1.73%	∞
RF ambient conditions - reflections	3.00%	R	√3	1.732	1	1	1.73%	1.73%	∞
Probe positioner Mechanical restrictions	0.40%	R	√3	1.732	1	1	0.23%	0.23%	∞
Probe Positioning with respect to phantom	2.90%	R	√3	1.732	1	1	1.67%	1.67%	∞
Post-processing	1.00%	R	√3	1.732	1	1	0.58%	0.58%	∞
Max SAR Eval	1.00%	R	√3	1.732	1	1	0.58%	0.58%	∞
Test Sample related									
Test sample positioning	2.90%	N	1	1	1	1	2.90%	2.90%	M-1
Device Holder Uncertainty	3.60%	N	1	1	1	1	3.60%	3.60%	M-1
Drift of output power	5.00%	R	√3	1.732	1	1	2.89%	2.89%	∞
Phantom and Setup									
Phantom Uncertainty	4.00%	R	√3	1.732	1	1	2.31%	2.31%	∞
Liquid permittivity (mea.)	1.15%	N	1	1	0.64	0.43	0.74%	0.49%	M
Liquid Conductivity (mea.)	1.36%	N	1	1	0.6	0.49	0.82%	0.67%	M
Combined standard uncertainty		RSS					11.47%	11.44%	
Expant uncertainty (95% confidence)							22.94%	22.88%	

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4. SAR Characterization

4.1 SAR_design_target and Uncertainty

SAR_design_target is determined by ensuring that it is less than FCC SAR limit after accounting for total device designed related uncertainties specified by the manufacturer (see Table 4-1).

$$SAR_design_target < SAR_limit \times 10^{(-total\ uncertainty/10)}$$

	Uncertainty dB 2/3/4G (except B7/B38/B41)	Uncertainty dB B7/B38/B41	Uncertainty dB NR
TxAGC Uncertainty	1	1.2	1.5
Device to device variation	0.5	0.5	0.5
Total uncertainty	1.1	1.3	1.55

Exposure	Frequency band	SAR_design_target
Head / Body-worn / Hotspot	All	1g, 1.0 W/Kg
Product specific 10-g SAR	All	10g, 2.8 W/Kg

4.2 SAR Characterization

SAR test results corresponding to Pmax for each antenna/technology/band/DSI can be found in next chapter.

Plimit is calculated by linearly scaling the measured SAR at the Pmax to SAR_design_target. Plimit determination corresponding to SAR_design_target are shown in next chapter.

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SGS Taiwan Ltd. No.134,Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan/新北市五股區新北產業園區五工路 134 號

<Plimit for supported technologies and bands (calculated Plimit)>

Band	Antenna	Plimit (average)			Pmax* (average)
		Body-worn / product-specific 10g-SAR	Head	Hotspot	
		DSI 3	DSI 8	DSI 13	
GSM_B850	1	31.4	32.2	-	23.6
GPRS_B850_2TxSlot	1	27.4	-	29.2	23.7
GSM_B1900	0	29.7	29.8	-	20.3
GSM_B1900	2	28.1	18.8	-	20.3
GPRS 1900 4Tx Slot	0	24.3	-	24.8	20.5
GPRS 1900 4Tx Slot	2	23.7	-	24	20.5
LTE_B5	1	26.7	32.2	29.5	24
LTE_B7	4	22.3	19.8	23.4	22.5
LTE_B7	0	23.7	32.7	20	22.5
LTE_B38	4	22.3	20	23.7	21.5
LTE_B38	0	25	33.8	23.8	21.5
LTE_B38	3	22.5	25.8	23.1	20.8
LTE_B38	7	25.9	22.3	26.3	20.5
LTE_B41	4	22.3	20	20	21.5
LTE_B41	0	24.8	31	23.3	21.5
LTE_B41	3	22.6	23.7	22.8	21
LTE_B41	7	25.5	22	25.9	20.5
NR5G_N7	4	21.8	18.5	23.7	22.5
NR5G_N7	0	21	32.6	19.5	22.5
NR5G_N38	4	20.9	18.5	18.5	23.5
NR5G_N38	0	21.5	34.3	21.5	23.5
NR5G_N38	3	21	25.1	19.3	22.8
NR5G_N38	7	24.9	20.5	26	22.5
NR5G_N41	4	21	18.5	18.5	23.5
NR5G_N41	0	23.8	34.1	21.5	23.5
NR5G_N41	3	21	26.8	17.5	23
NR5G_N41	7	24.7	20.5	26.1	22.5
WCDMA_B2	0	21.5	30.9	20	22.5
WCDMA_B2	2	19.5	18.5	18.5	22.5
WCDMA_B5	1	28	31.9	28.3	24

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Body-worn

Band / Mode	Antenna	Bandwidth	Modulation	RB size	RB offset	Frequency (MHz)	Channel	Duty cycle	Test position	Test Distance	MPR (dBm)	Measured conducted power (dBm)	Duty Correction	Measured 1g-SAR (W/Kg)	Plimit** (dBm)	Minimum Plimit** (dBm)	Pmax* (dBm)
GSM 850	1	na	GMSK	na	na	824.2	128	12.05%	Back Surface	15mm	0	32.11	22.92	0.135	31.62		23.6
GSM 850	1	na	GMSK	na	na	848.8	251	12.05%	Back Surface	15mm	0	32.27	23.08	0.138	31.68	31.48	23.6
GSM 850	1	na	GMSK	na	na	836.6	190	12.05%	Front Surface	15mm	0	32.34	23.15	0.123	32.25		23.6
GSM 850	1	na	GMSK	na	na	836.6	190	12.05%	Back Surface	15mm	0	32.34	23.15	0.147	31.48		23.6
GSM 1900	0	na	GMSK	na	na	1850.2	512	12.05%	Back Surface	15mm	0	29.53	20.34	0.094	31.10		20.3
GSM 1900	0	na	GMSK	na	na	1880	661	12.05%	Back Surface	15mm	0	29.62	20.43	0.118	29.71	29.71	20.3
GSM 1900	0	na	GMSK	na	na	1909.8	810	12.05%	Front Surface	15mm	0	29.66	20.47	0.111	30.02		20.3
GSM 1900	0	na	GMSK	na	na	1909.8	810	12.05%	Back Surface	15mm	0	29.66	20.47	0.117	29.79		20.3
GSM 1900	2	na	GMSK	na	na	1850.2	512	12.05%	Back Surface	15mm	0	29.45	20.26	0.159	28.25		20.3
GSM 1900	2	na	GMSK	na	na	1909.8	810	12.05%	Back Surface	15mm	0	29.50	20.31	0.162	28.21	28.12	20.3
GSM 1900	2	na	GMSK	na	na	1880	661	12.05%	Front Surface	15mm	0	29.51	20.32	0.115	29.71		20.3
GSM 1900	2	na	GMSK	na	na	1880	661	12.05%	Back Surface	15mm	0	29.51	20.32	0.166	28.12		20.3
WCDMA II	0	na	3GPP Rel99	na	na	1852.4	9262	100.00%	Back Surface	15mm	0	22.18		0.387	26.30	24.30	22.5
WCDMA II	0	na	3GPP Rel99	na	na	1880	9400	100.00%	Back Surface	15mm	0	22.38		0.642	24.30		22.5
WCDMA II	0	na	3GPP Rel99	na	na	1907.6	9538	100.00%	Front Surface	15mm	0	22.48		0.284	27.95		22.5
WCDMA II	0	na	3GPP Rel99	na	na	1907.6	9538	100.00%	Back Surface	15mm	0	22.48		0.405	26.41		22.5
WCDMA II	2	na	3GPP Rel99	na	na	1852.4	9262	100.00%	Back Surface	15mm	0	22.14		0.281	27.65		22.5
WCDMA II	2	na	3GPP Rel99	na	na	1880	9400	100.00%	Back Surface	15mm	0	22.18		0.485	25.32		22.5
WCDMA II	2	na	3GPP Rel99	na	na	1907.6	9538	100.00%	Front Surface	15mm	0	22.22		0.225	28.70	25.32	22.5
WCDMA II	2	na	3GPP Rel99	na	na	1907.6	9538	100.00%	Back Surface	15mm	0	22.22		0.345	26.84		22.5
WCDMA V	1	na	3GPP Rel99	na	na	826.4	4132	100.00%	Back Surface	15mm	0	23.75		0.233	30.08		24
WCDMA V	1	na	3GPP Rel99	na	na	846.6	4233	100.00%	Back Surface	15mm	0	23.82		0.236	30.09		24
WCDMA V	1	na	3GPP Rel99	na	na	836.6	4183	100.00%	Front Surface	15mm	0	23.83		0.213	30.54		24
WCDMA V	1	na	3GPP Rel99	na	na	836.6	4183	100.00%	Back Surface	15mm	0	23.83		0.318	28.80		24
LTE B5	1	10	QPSK	1	0	829	20450	100.00%	Back Surface	15mm	0	23.85		0.152	32.03		24
LTE B5	1	10	QPSK	1	0	844	20600	100.00%	Back Surface	15mm	0	23.84		0.159	31.83		24
LTE B5	1	10	QPSK	1	0	836.5	20525	100.00%	Front Surface	15mm	0	23.93		0.135	32.63	31.65	24
LTE B5	1	10	QPSK	1	0	836.5	20525	100.00%	Back Surface	15mm	0	23.93		0.169	31.65		24

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Band / Mode	Antenna	Bandwidth	Modulation	RB size	RB offset	Frequency (MHz)	Channel	Duty cycle	Test position	Test Distance	MPR (dBm)	Measured conducted power (dBm)	Duty Correction	Measured 1g-SAR (W/Kg)	Plimit** (dBm)	Minimum Plimit** (dBm)	Pmax* (dBm)
5G n7	4	20	P/2 BPSK	1	1	2510	502000	100.00%	Back Surface	15mm	0	22.33		0.181	29.75		22.5
5G n7	4	20	P/2 BPSK	1	1	2535	507000	100.00%	Back Surface	15mm	0	22.54		0.253	28.51	28.35	22.5
5G n7	4	20	P/2 BPSK	1	1	2560	512000	100.00%	Front Surface	15mm	0	22.60		0.128	31.53		22.5
5G n7	4	20	P/2 BPSK	1	1	2560	512000	100.00%	Back Surface	15mm	0	22.60		0.266	28.35		22.5
5G n7	0	20	P/2 BPSK	1	1	2535	507000	100.00%	Back Surface	15mm	0	22.10		0.136	30.76		22.5
5G n7	0	20	P/2 BPSK	1	1	2560	512000	100.00%	Back Surface	15mm	0	22.05		0.202	29.00	29.00	22.5
5G n7	0	20	P/2 BPSK	1	1	2510	502000	100.00%	Front Surface	15mm	0	22.17		0.126	31.17		22.5
5G n7	0	20	P/2 BPSK	1	1	2510	502000	100.00%	Back Surface	15mm	0	22.17		0.165	30.00		22.5
5G n38	4	20	P/2 BPSK	1	1	2595	519000	100.00%	Back Surface	15mm	0	23.22		0.272	28.87		23.5
5G n38	4	20	P/2 BPSK	1	1	2610	522000	100.00%	Back Surface	15mm	0	23.21		0.261	29.04		23.5
5G n38	4	20	P/2 BPSK	1	1	2580	516000	100.00%	Front Surface	15mm	0	23.40		0.169	31.12	28.87	23.5
5G n38	4	20	P/2 BPSK	1	1	2580	516000	100.00%	Back Surface	15mm	0	23.40		0.221	29.96		23.5
5G n38	0	20	P/2 BPSK	1	1	2580	516000	100.00%	Back Surface	15mm	0	23.16		0.150	31.40		23.5
5G n38	0	20	P/2 BPSK	1	1	2610	522000	100.00%	Back Surface	15mm	0	23.09		0.169	30.81		23.5
5G n38	0	20	P/2 BPSK	1	1	2595	519000	100.00%	Front Surface	15mm	0	23.25		0.110	32.84	30.31	23.5
5G n38	0	20	P/2 BPSK	1	1	2595	519000	100.00%	Back Surface	15mm	0	23.25		0.197	30.31		23.5
5G n38	3	20	P/2 BPSK	1	1	2595	519000	100.00%	Back Surface	15mm	0	22.90		0.098	32.98		22.8
5G n38	3	20	P/2 BPSK	1	1	2610	522000	100.00%	Back Surface	15mm	0	22.80		0.121	31.97	31.97	22.8
5G n38	3	20	P/2 BPSK	1	1	2580	516000	100.00%	Front Surface	15mm	0	22.95		0.087	33.55		22.8
5G n38	3	20	P/2 BPSK	1	1	2580	516000	100.00%	Back Surface	15mm	0	22.95		0.102	32.86		22.8
5G n38	7	20	P/2 BPSK	1	1	2595	519000	100.00%	Back Surface	15mm	0	23.17		0.130	32.03		22.5
5G n38	7	20	P/2 BPSK	1	1	2610	522000	100.00%	Back Surface	15mm	0	22.60		0.105	32.39		22.5
5G n38	7	20	P/2 BPSK	1	1	2580	516000	100.00%	Front Surface	15mm	0	23.40		0.090	33.86	30.43	22.5
5G n38	7	20	P/2 BPSK	1	1	2580	516000	100.00%	Back Surface	15mm	0	23.40		0.198	30.43		22.5
5G n41	4	100	P/2 BPSK	1	1	2546.01	509202	100.00%	Back Surface	15mm	0	23.26		0.201	30.23		23.5
5G n41	4	100	P/2 BPSK	1	1	2640	528000	100.00%	Back Surface	15mm	0	23.34		0.297	28.61	28.61	23.5
5G n41	4	100	P/2 BPSK	1	1	2592.99	518598	100.00%	Front Surface	15mm	0	23.43		0.164	31.28		23.5
5G n41	4	100	P/2 BPSK	1	1	2592.99	518598	100.00%	Back Surface	15mm	0	23.43		0.249	29.47		23.5
5G n41	0	100	P/2 BPSK	1	1	2592.99	518598	100.00%	Back Surface	15mm	0	23.08		0.163	30.96		23.5
5G n41	0	100	P/2 BPSK	1	1	2640	528000	100.00%	Back Surface	15mm	0	23.10		0.159	31.09		23.5
5G n41	0	100	P/2 BPSK	1	1	2546.01	509202	100.00%	Front Surface	15mm	0	23.33		0.132	32.12		23.5
5G n41	0	100	P/2 BPSK	1	1	2546.01	509202	100.00%	Back Surface	15mm	0	23.33		0.191	30.52		23.5
5G n41	3	100	P/2 BPSK	1	1	2546.01	509202	100.00%	Back Surface	15mm	0	23.02		0.069	34.63		23
5G n41	3	100	P/2 BPSK	1	1	2640	528000	100.00%	Back Surface	15mm	0	22.80		0.168	30.55		23
5G n41	3	100	P/2 BPSK	1	1	2592.99	518598	100.00%	Front Surface	15mm	0	23.07		0.051	35.99	30.55	23
5G n41	3	100	P/2 BPSK	1	1	2592.99	518598	100.00%	Back Surface	15mm	0	23.07		0.095	33.29		23
5G n41	7	100	P/2 BPSK	1	1	2546.01	509202	100.00%	Back Surface	15mm	0	23.57		0.124	32.64		22.5
5G n41	7	100	P/2 BPSK	1	1	2640	528000	100.00%	Back Surface	15mm	0	22.80		0.105	32.59		22.5
5G n41	7	100	P/2 BPSK	1	1	2592.99	518598	100.00%	Front Surface	15mm	0	23.69		0.100	33.69	29.76	22.5
5G n41	7	100	P/2 BPSK	1	1	2592.99	518598	100.00%	Back Surface	15mm	0	23.69		0.247	29.76		22.5

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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