REPORT No.: SZ21010412S02

RF EXPOSURE EVALUATION REPORT

APPLICANT	:	Reliance Communications LLC
PRODUCT NAME	:	Orbic Myra
MODEL NAME	:	R678L5
BRAND NAME	:	Orbic
FCC ID	:	2ABGH-R678L5
STANDARD(S)	:	FCC 47 CFR Part 2(2.1093)
RECEIPT DATE	:	2021-03-12
TEST DATE	:	2021-04-13 to 2021-04-22
ISSUE DATE	:	2021-07-22

Edited by : Liang Yumei (Rapporteur)

Approved by: Shen Junsheng (Supervisor)

DIRECTORY

Annex D Plots of Power Density Measurement
Annex E DASY Calibration Certificate

Changed History		
Version	**Date**	**Reason for Change**
1.0	2021-05-29	First edition
2.0	2021-07-22	Disable the antenna module 1 and replace the version 1

1. SAR Results Summary

The maximum results of power density found during test as bellows:

<Highest Total Power Density>

Frequency Band		Standalone Transmission	
		Averaging over 4cm² (mW/cm²)	Limt (FCC Part 1.310) (mW/cm²)
5G NR	n260	0.109	1.0
	n261	0.119	

Highest Simultaneous Transmission with Multiple transmitters	Total RF Exposure Radio
SAR & Power Density	0.811

Note:

1. This device is in compliance with power density for general population or uncontrolled exposure limits (1.0 mW/cm² specified in FCC 47 CFR part 1.310), and had been tested in accordance with the measurement methods and procedures specified in TCBC workshop notes and IEC TR 63170.
2. When the test result is a critical value, we will use the measurement uncertainty give the judgment result based on the 95% risk level.

2. Technical Information

Note: Provide by applicant.

2.1. Applicant and Manufacturer Information

Applicant:	Reliance Communications LLC
Applicant Address:	91 Colin Drive, Unit 1, HOLBROOK, New York 11741, United States
Manufacturer:	ZJY RIGHT SOURCE INDIA PRIVATE LIMITED
Manufacturer Address:	MIDC industrial Area, Shiravane, Nerul, India

2.2. Equipment under Test (EUT) Description

Product Name:	Orbic Myra
IMEI:	357758890003678
Hardware Version:	V2.2
Software Version:	ORB678L5_v1.0.42_BVZ
Frequency Bands:	5G NR n260(120kHz): 37 GHz ~ 40 GHz 5G NR n261(120kHz): 27.5 GHz ~ 28.35 GHz
Modulation Mode:	5G NR: QPSK, 16QAM, 64QAM for CP-OFDM
Channel Bandwidth:	50MHz, 100MHz
Maximum Number of Contiguous Component Carriers:	4CC
5G NR Operation:	NSA
Antenna Information:	Fixed Internal Antenna

Note: For a more detailed description, please refer to specification or user manual supplied by the applicant and/or manufacturer.

2.3. Environment of Test Site/Conditions

Normal Temperature (NT):	20-25 °C
Relative Humidity:	30-75 %
Air Pressure:	980-1020 hPa

Test Frequency:	5G NR n260/261
Operation Mode:	Call established
Power Level:	TDD 5G NR n260/261(Maximum output power)

During SAR test, EUT is in Traffic Mode (Channel Allocated) at Normal Voltage Condition. A communication link is set up with a System Simulator (SS) by air link, and a call is established.

The EUT shall use its internal transmitter. The antenna(s), battery and accessories shall be those specified by the Factory. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output. If a wireless link is used, the antenna connected to the output of the base station simulator shall be placed at least 50 cm away from the handset.
The signal transmitted by the simulator to the antenna feeding point shall be lower than the output power level of the handset by at least 35 dB.

3. RF Exposure Limits

3.1. Uncontrolled Environment

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

3.2. Controlled Environment

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

Limits for Maximum Permissible Exposure (MPE)

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

4. Applied Reference Documents

Leading reference documents for testing:

Identity	Document Title	Method Determination /Remark
FCC 47 CFR Part 2(2.1093)	Radio Frequency Radiation Exposure Evaluation: Portable Devices	No deviation
KDB 447498 D01v06	General RF Exposure Guidance	No deviation
KDB 865664 D01v01r04	SAR Measurement 100 MHz to 6 GHz	No deviation
KDB 865664 D02v01r02	RF Exposure Reporting	No deviation
KDB 648474 D04v01r03	SAR Evaluation Consideration for Wireless Handset	No deviation
IEC TR 63170:2018	Measurement procedure for the evaluation of power density related to human exposure to radio frequency fields from wireless communication devices operating between 6 GHz and 100 GHz	No deviation

Note 1: The test item is not applicable.
Note 2: Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table.

5. SAR Measurement System

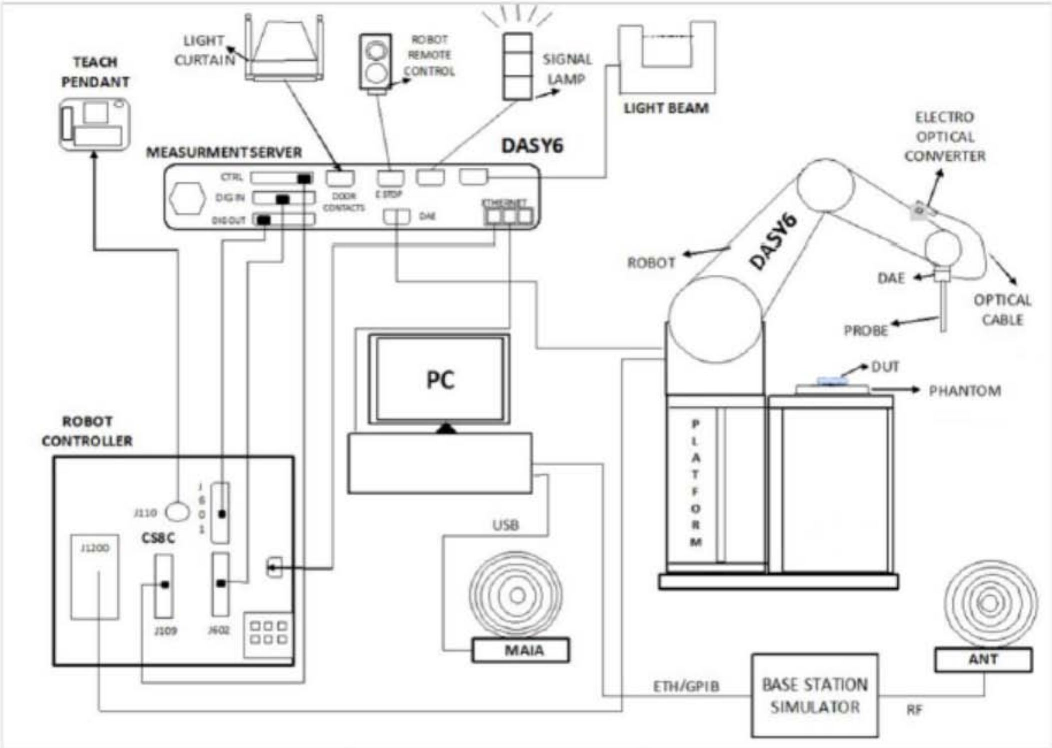


Fig 5.1 SPEAG DASY System Configurations

The DASY system for performance compliance tests is illustrated above graphically. This system consists of the following items:

- A standard high precision 6-axis robot with controller, a teach pendant and software.
- A data acquisition electronic (DAE) attached to the robot arm extension.
- A dosimetric probe equipped with an optical surface detector system.
- The electro-optical converter (ECO) performs the conversion between optical and electrical signals
- A measurement server performs the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the accuracy of the probe positioning.
- A computer operating Windows XP.
- DASY software.
- Remove control with teach pendant and additional circuitry for robot safety such as warming lamps, etc.
- The SAM twin phantom.
- A device holder.
- Tissue simulating liquid.
- Dipole for evaluating the proper functioning of the system.
- Some of the components are described in details in the following sub-sections.

5.1. EUmmWave Probe

The probe designed allows measurement at distances as small as 2mm from the sensor to the surface of EUT. The typical senor to the tip of probe is 1.5mm.

Frequency	750 MHz ~110 GHz
Probe Overall Length	320 mm
Probe Body Diameter	8.0 mm
Tip Length	23.0 mm
Tip Diameter	8.0 mm
Two dipoles' Length of Probe	0.9 mm – Diode located
Dynamic Range	＜20 V/m – 10000 V/m with PRE-10 (min ＜50 V/m – 3000 V/m)
Linearity	＜0.2 dB
Position Precision	＜0.2 mm
Distance between Diode Sensors and Probe's tip	1.5 mm
Minimum Mechanical Separation between Probe Tip and a Surface	0.5 mm
Applications	E-field measurement of mm-Wave transmitters operating above 10 GHz in ＜ 2mm distance from device (free-space) power density H-field and far-field analysis using total field reconstruction.
Compatibility	cDASY 6 + 5G Module SW1.0 and higher

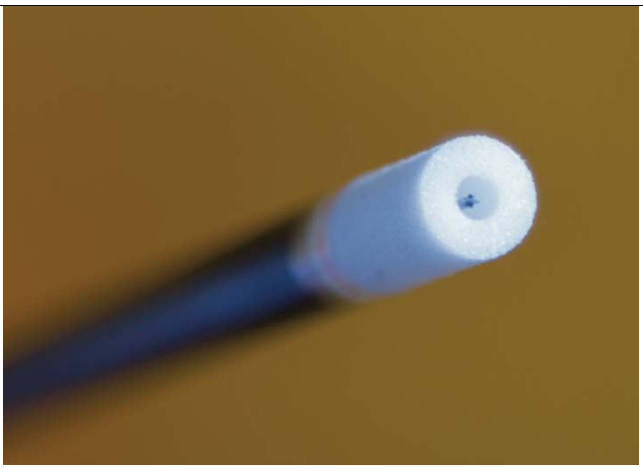
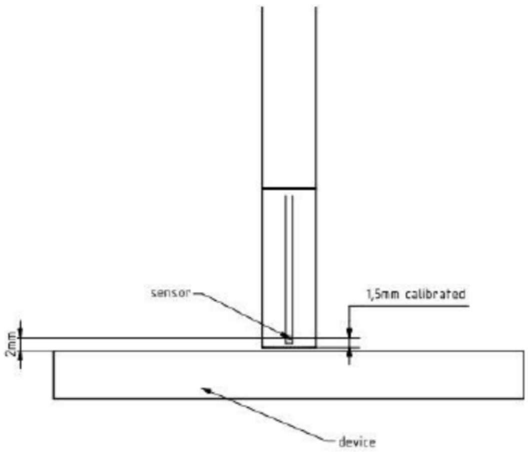


Fig 5.1 Photo of EUmmWave Probe



5.2. Data Acquisition Electronics (DAE)

The data acquisition electronics(DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast16 bit AD-converter and a command decoder and control logic unit. AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock. The input impedance of the DAE is 200MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Fig 5.2 Photo of DAE

5.3. Robot

The SPEAG DASY system uses the high precision robots (DASY4: RX90BL; DASY5: TX90XL) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY4: CS7MB; DASY5: 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 5.3 Photo of DASY6

5.4. Measurement Server

The measurement server is based on a PC/104 CPU board with CPU (DASY4: 166 MHz, Intel Pentium; DASY5: 400 MHz, Intel Celeron), chip disk (DASY4: 32 MB; DASY5: 128 MB), RAM (DASY4: 64 MB, DASY5: 128 MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O board, which is directly connected to the PC/104 bus of the CPU board.
The measurement server performs all the real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operations.

5.5. Data Storage and Evaluation

➢ **Data Storage**

The DASY software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files. The post-processing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.
The measured data can be visualized or exported in different units or formats, depending on the selected probe type (e.g., [V/m], [A/m], [mW/g]). Some of these units are not available in certain situations or give meaningless results, e.g., a SAR-output in a non-lose media, will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

➢ **Data Evaluation**

The DASY post-processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software.

Probe parameters:	- Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion factor	$ConvF_i$
	- Diode compression point	dcpi
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multi-meter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power.

The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \times \frac{cf}{dcp_i}$$

With Vi = compensated signal of channel i, (i = x, y, z)
Ui = input signal of channel i, (i = x, y, z)
cf = crest factor of exciting field (DASY parameter)
dcpi = diode compression point (DASY parameter)

From the compensated input signals, the primary field data for each channel can be evaluated:

$$\text{E-field Probes:} E_i = \sqrt{\frac{V_i}{Norm_i \times ConvF}}$$

$$\text{H-field Probes:} H_i = \sqrt{V_i} \times \frac{a_{i0} + a_{i1} + a_{i2} f^2}{f}$$

With V_i = compensated signal of channel i, (i = x, y, z)
$Norm_i$ = sensor sensitivity of channel i, (i = x, y, z), $\mu V/(V/m)^2$ forE-field Probes
ConvF = sensitivity enhancement in solution
a_{ij} = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
E_i = electric field strength of channel i in V/m
H_i = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \times \frac{\sigma}{\rho \times 1000}$$

with SAR = local specific absorption rate in mW/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm^3

Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.

5.6. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	5G Verification Source	30GHz	1077	2020.11.02	2021.11.01
SPEAG	EUmmWave Probe	EUmmMV4	9512	2020.11.02	2021.11.01
SPEAG	Data Acquisition Electronics	DAE4	1643	2020.11.30	2021.11.29
R&S	Spectrum Analyzer	E4445A	MY44300685	2020.10.28	2021.10.27
KTJ	Thermo meter	TA298	N/A	2021.01.15	2022.01.14

Note:

The calibration certificate of DASY can be referred to appendix E of this report.

6. System Verification Source

The system verification sources at 30GHz and above comprise born-antennas and very stable signal generators.

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

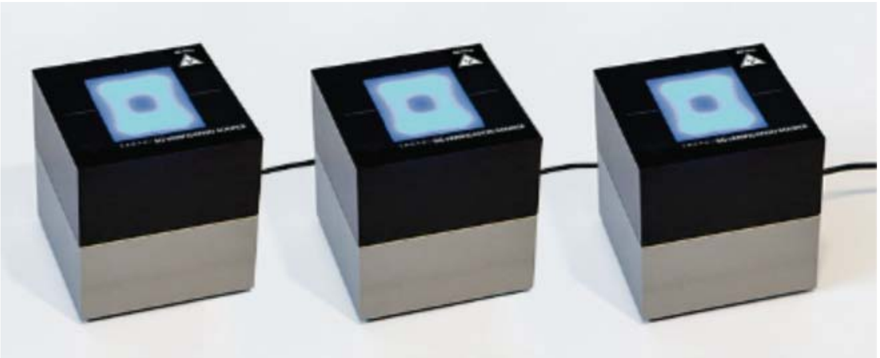


Fig 6.1 Photos of Verification Sources

7. Power Density System Verification

➢ **General description**

The EUT is replaced by a calibrated source, the same spatial resolution, measurement region and test separation used in the calibration was applied to system check. Through visual inspection into the measured power density distribution, both the spatially (shape) and numerically (level) have no noticeable difference. The measurement results should be within ±10% of the calibrated targets.

Frequency [GHz]	Grid step	Grid extent X/Y [mm]	Measurement points
10	0.25 ($\frac{\lambda}{4}$)	120/120	16 × 16
30	0.25 ($\frac{\lambda}{4}$)	60/60	24 × 24
60	0.25 ($\frac{\lambda}{4}$)	32.5/32.5	26 × 26
90	0.25 ($\frac{\lambda}{4}$)	30/30	36 × 36

Setting for measurement of verification sources

Fig 7.1 Photos of Verification Setup

➢ **Validation Results**

After system check testing, the results of power density will be compared with the reference value derived from the certificate report. The deviation of system check should be within ±10%.

<Validation Setup>

Frequency (GHz)	5G Verification Source	Probe S/N	DAE S/N
30	30GHz-SN 1077	9512	1643

<Validation Results>

Date	Frequency (GHz)	Test Ditance (mm)	Measured 4cm² (W/m²)	Targeted 4cm² (W/m²)	Deviation (%)
2021.04.13	30	5.5	28.0	28.4	-1.41
2021.04.22	30	5.5	27.8	28.4	-2.11

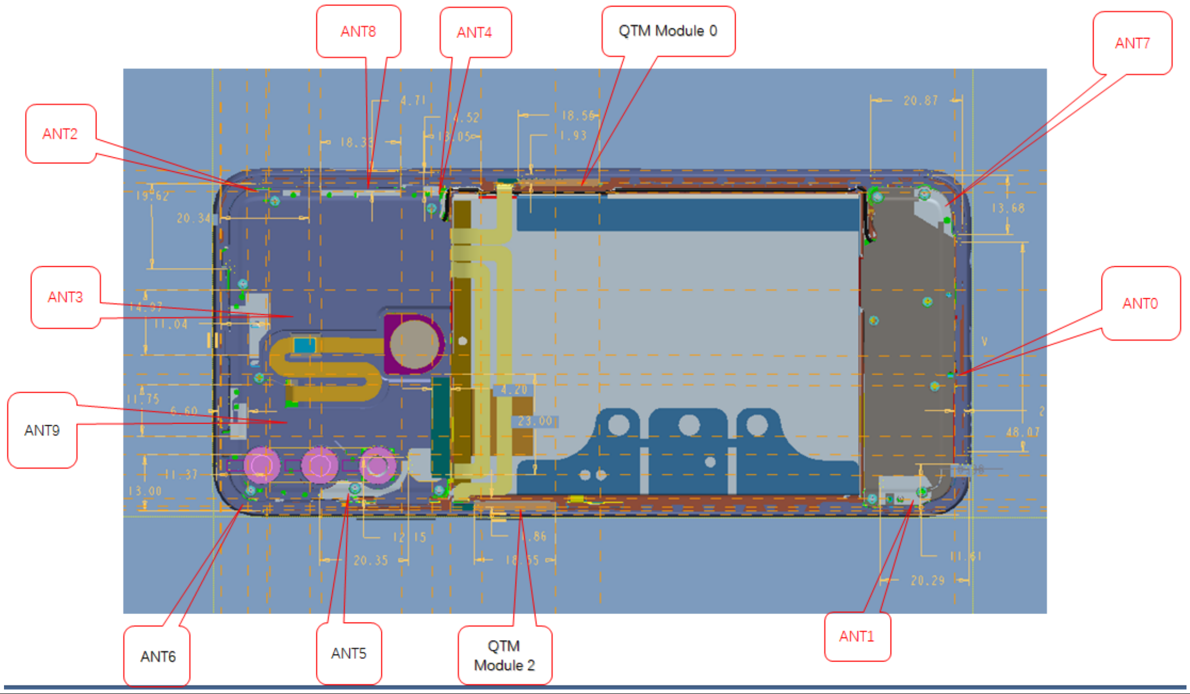
Note: System checks the specific test data please refer to Annex C.

8. Results of EIRP

Remark:

The EIRP power refers to I21Z60526-EMC01.

9. Antenna Information



Antenna supports TX bands:

ANT 0: GSM 850, UMTS Band V, LTE Band 5/12/13, 5G n5;

ANT 2: GSM 850, UMTS Band V, LTE Band 5/12/13, 5G n5;

ANT 3: GSM1900,WCDMA Band 2/4, LTE Band 2/4/66, 5G n77;

ANT 5: WLAN 2.4GHz CH0, WLAN 5GHz CH0, Bluetooth;

ANT 6: WLAN 5GHz CH1;

ANT 8: 5G n2/66;

ANT 9: WLAN 2.4GHz CH1;

mmWave Module 0/2: n260/261

Antenna supports RX bands:

ANT 0: GSM 850, UMTS Band V, LTE Band 5/12/13, 5G n5;

ANT 1: LTE Band 2/4/66, 5G n2/77/66;

ANT 2: GSM 850, UMTS Band V, LTE Band 5/12/13, 5G n5;

ANT 3: LTE Band 2/4/66, 5G n2/66/77;

ANT 4: 5G n77;

ANT 5: WLAN 2.4GHz CH0, WLAN 5GHz CH0, Bluetooth, LTE Band 46;

ANT 6: GPS L1/L5; WLAN 5GHz CH1， LTE Band 46;

ANT 7: LTE Band 2/4/66, 5G n2/66/77;

ANT 8: GSM1900,WCDMA Band 2/4, LTE Band 2/4/66, 5G n2/66;

ANT 9: WLAN 2.4GHz CH1;

10. Power Density Assessment

➢ **General Description**

1. The 5G NR mmWave signal under testing was configured by the test tool of Qualcomm Software, and it is only limited to operate at EN-DC for 5G NR implementation according to the character of the device.
2. This device would be configured to maximum power when transmitting and tested at 100% duty cycle for each RB configuration, modulation, bandwidth, and channel.
3. According to the manufacturer that summation for different antenna modules and exposure planes, the worst case would be selected for power density measurement.
4. According to TCBC workshop in October 2018 that 4cm^2 averaging area may now be considered.

➢ **mmWave EN-DC Combination**

EN-DC Combination	mmWave (FR2) 4G DL 4x4 MIMO	4G UL	5G-NR UL	2x2 UL MIMO
DC_2A_n261A	2A	2A	n261A	n261A
DC_2A_n261I	2A	2A	n261I	n261G
DC_2A_n261(A-H)	2A	2A	n261A, n261H	n261A, n261G
DC_5A_n261A	-	5A	n261A	n261A
DC_5A_n261I	-	5A	n261I	n261G
DC_5A_n261(A-H)	-	5A	n261A, n261H	n261A, n261G
DC_13A_n261A	-	13A	n261A	n261A
DC_13A_n261I	-	13A	n261I	n261G
DC_13A_n261(A-H)	-	13A	n261A, n261H	n261A, n261G
DC_66A_n261A	66A	66A	n261A	n261A
DC_66A_n261I	66A	66A	n261I	n261G
DC_66A_n261(A-H)	66A	66A	n261A, n261H	n261A, n261G
DC_2A-5A_n261A	-	2A, 5A	n261A	n261A
DC_2A-5A_n261I	-	2A, 5A	n261I	n261G
DC_2A-5A_n261(A-H)	-	2A, 5A	n261A, n261H	n261A, n261G
DC_2A-13A_n261A	-	2A, 13A	n261A	n261A
DC_2A-13A_n261I	-	2A, 13A	n261I	n261G
DC_2A-13A_n261(A-H)	-	2A, 13A	n261A, n261H	n261A, n261G
DC_2A-66A_n261A	-	2A, 66A	n261A	n261A
DC_2A-66A_n261I	-	2A, 66A	n261I	n261G
DC_2A-66A_n261(A-H)	-	2A, 66A	n261A, n261H	n261A, n261G
DC_5A-66A_n261A	-	5A, 66A	n261A	n261A

DC_5A-66A_n261I	-	5A, 66A	n261I	n261G
DC_5A-66A_n261(A-H)	-	5A, 66A	n261A, n261H	n261A, n261G
DC_13A-66A_n261A	-	13A, 66A	n261A	n261A
DC_13A-66A_n261I	-	13A, 66A	n261I	n261G
DC_13A-66A_n261(A-H)	-	13A, 66A	n261A, n261H	n261A, n261G
DC_66A-66A_n261A	-	66A	n261A	n261A
DC_66A-66A_n261I	-	66A	n261I	n261G
DC_66A-66A_n261(A-H)	-	66A	n261A, n261H	n261A, n261G
DC_2A_n260A	2A	2A	n260A	n260A
DC_2A_n260I	2A	2A	n260I	n260G
DC_5A_n260A	-	5A	n260A	n260A
DC_5A_n260I	-	5A	n260I	n260G
DC_13A_n260A	-	13A	n260A	n260A
DC_13A_n260I	-	13A	n260I	n260G
DC_66A_n260A	66A	66A	n260A	n260A
DC_66A_n260I	66A	66A	n260I	n260G
DC_2A-5A_n260A	-	2A, 5A	n260A	n260A
DC_2A-5A_n260I	-	2A, 5A	n260I	n260G
DC_2A-13A_n260A	-	2A, 13A	n260A	n260A
DC_2A-13A_n260I	-	2A, 13A	n260I	n260G
DC_2A-66A_n260A	-	2A, 66A	n260A	n260A
DC_2A-66A_n260I	-	2A, 66A	n260I	n260G
DC_5A-66A_n260A	-	5A, 66A	n260A	n260A
DC_5A-66A_n260I	-	5A, 66A	n260I	n260G
DC_13A-66A_n260A	-	13A, 66A	n260A	n260A
DC_13A-66A_n260I	-	13A, 66A	n260I	n260G
DC_66A-66A_n260A	-	66A	n260A	n260A
DC_66A-66A_n260I	-	66A	n260I	n260G
DC_2A_n261(2G)	2A	2A	n261G	n261G
DC_5A_n261(2G)	-	5A	n261G	n261G
DC_13A_n261(2G)	-	13A	n261G	n261G
DC_66A_n261(2G)	66A	66A	n261G	n261G
DC_13A-66A_n261(2G)	-	13A, 66A	n261G	n261G
DC_2A-66A_n261(2G)	-	2A, 66A	n261G	n261G
DC_2A-13A_n261(2G)	-	2A, 13A	n261G	n261G
DC_5A-66A_n261(2G)	-	5A, 66A	n261G	n261G

DC_2A-5A_n261(2G)	-	2A, 5A	n261G	n261G
DC_66A-66A_n261(2G)	-	66A	n261G	n261G

- **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.

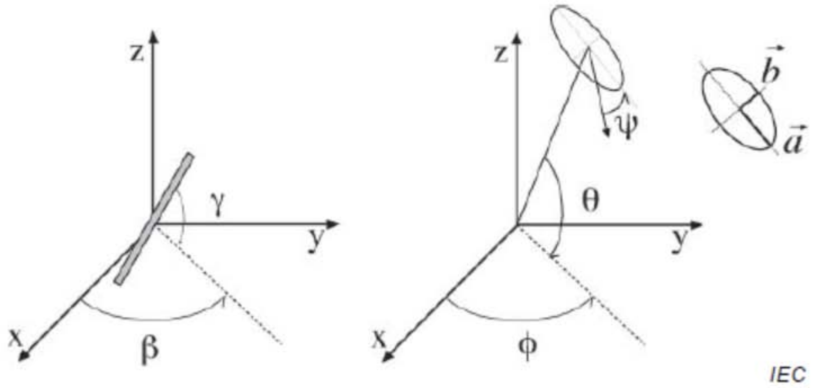


Fig 9.1 Illustration of the angles used for the numerical description of the sensor and the orientation of an ellipse in 3-D space

For the construction 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 express 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 numbers of three parameters is reduced from five to three, which means that least three sensors readings are necessary to gain sufficient information for the reconstruction of ellipse parameters. However, to suppress the noise and increase the reconstruction accuracy, it is desirable to have an over determined system of equations. The solution to 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 determination of two. If there is a need for more information or increased accuracy, more rotation angles can be added.

The reconstruction of 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 90° shift ($\gamma_1=\gamma_2+90°$), and, to simplify, the first rotation angle of the probe (β_1) can be set to 0°.

Total Field and Power Density Reconstruction

Computation of the power density in general requires knowledge of the electric and magnetic 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. 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.
The average of the reconstructed power density is evaluated over a circular area in each measurement plane. Two average power density values can be computed, the average total power density and the average incident power density, and the average total power density is used to determine compliance.

- $|Re\{S\}|$ is the total Poynting vector
- $\mathrm{n} \cdot Re\{S\}$ is the normal Poything vector

The software post-processing reports to values, “S avg tot” and “S avg inc”. “S avg tot” represents average total power density (all three xyz components included), and “S avg inc” represents average normal power density. The average total power density “S avg tot” is reported to determine the device compliance.

11. Test Results of RF Exposure

➢ **General Note**

1. For each array module, the maximum EIRP condition was selected for power density testing for different combination, and the other conditions including RB configuration, modulation, bandwidth and channels would be verified the worst case.
2. The worst RB location of 1RB for n260 and 100% RB for n261 were selected for testing according to the EIRP list recorded in I21Z60526-EMC01.
3. The worst beam ID would be selected for power density testing according to the antenna information.
4. The test separation distance and configurations of power density were performed followed FCC KDB inquiry submitted of the lab.

➢ **Test Results**

Plot No.	Band	BW (MHz)	Fre. (GHz)	Mod.	Exposure Position	Gap (mm)	Beam ID		Measured Field		Measured $4cm^2$ Average PD (W/m^2)	
							1	2	E-Field	H-Field	Normal	Total
Antenna Module 0												
	n260	50	40	QPSK	Front Face	2	161	33	18.8	0.039	0.12	0.17
	n260	50	40	QPSK	Back Face	2	161	33	20.5	0.042	0.36	0.56
	n260	50	40	QPSK	Left Edge	2	161	33	23.3	0.062	0.42	0.48
1#	n260	50	40	QPSK	Right Edge	2	161	33	27	0.58	0.90	1.09
	n260	50	40	QPSK	Top Edge	2	161	33	30.8	0.067	0.49	0.60
	n260	50	40	QPSK	Bottom Edge	2	161	33	21.6	0.053	0.28	0.05
	n260	50	37.1	QPSK	Right Edge	2	161	33	19.9	0.045	0.84	1.01
	n260	50	38.5	QPSK	Right Edge	2	161	33	22.4	0.66	0.89	1.01

Plot No.	Band	BW (MHz)	Fre. (GHz)	Mod.	Exposure Position	Gap (mm)	Beam ID		Measured Field		Measured $4cm^2$ Average PD (W/m^2)	
							1	2	E-Field	H-Field	Normal	Total
Antenna Module 2												
	n260	50	40	QPSK	Front Face	2	167	39	13.9	0.035	0.30	0.31
2#	n260	50	40	QPSK	Back Face	2	167	39	20.5	0.055	0.53	0.57
	n260	50	40	QPSK	Left Edge	2	167	39	21.9	0.057	0.09	0.18
	n260	50	40	QPSK	Right Edge	2	167	39	25.5	0.06	0.107	0.133
	n260	50	40	QPSK	Top Edge	2	167	39	46.5	0.112	0.30	0.358
	n260	50	40	QPSK	Bottom Edge	2	167	39	23	0.061	0.14	0.31
	n260	50	37.1	QPSK	Back Face	2	167	39	36.9	0.089	0.19	0.48
	n260	50	38.5	QPSK	Back Face	2	167	39	21	0.082	0.03	0.18
Verify the worst case at antenna module 0												

	n260	100	40	64QAM	Right Edge	2	157	29	21.6	0.048	0.64	0.75
	n260	50	38.5	16QAM	Right Edge	2	157	29	23.4	0.056	0.89	0.99
	n260	50	38.5	64QAM	Right Edge	2	157	29	22.7	0.039	0.77	0.82

Plot No.	Band	BW (MHz)	Fre. (GHz)	Mod.	Exposure Position	Gap (mm)	Beam ID		Measured Field		Measured $4cm^2$ Average PD (W/m^2)	
							1	2	E-Field	H-Field	Normal	Total
Antenna Module 0												
	n261	50	27.5	16QAM	Front Face	2	175	47	24.5	0.05	0.27	0.39
	n261	50	27.5	16QAM	Back Face	2	175	47	19.3	0.068	0.13	0.20
	n261	50	27.5	16QAM	Left Edge	2	175	47	20.6	0.049	0.12	0.20
3#	n261	50	27.5	16QAM	Right Edge	2	175	47	21.5	0.059	0.44	0.53
	n261	50	27.5	16QAM	Top Edge	2	175	47	22.6	0.07	0.07	0.21
	n261	50	27.5	16QAM	Bottom Edge	2	175	47	22.5	0.056	0.12	0.25
	n261	50	27.9	16QAM	Right Edge	2	175	47	23.6	0.046	0.38	0.41
	n261	50	28.3	16QAM	Right Edge	2	175	47	22.1	0.05	0.40	0.44

Plot No.	Band	BW (MHz)	Fre. (GHz)	Mod.	Exposure Position	Gap (mm)	Beam ID		Measured Field		Measured $4cm^2$ Average PD (W/m^2)	
							1	2	E-Field	H-Field	Normal	Total
Antenna Module 2												
	n261	50	27.5	16QAM	Front Face	2	180	52	37.2	0.12	0.42	0.60
4#	n261	50	27.5	16QAM	Back Face	2	180	52	46.2	0.107	0.72	1.19
	n261	50	27.5	16QAM	Left Edge	2	180	52	36.2	0.093	0.16	0.30
	n261	50	27.5	16QAM	Right Edge	2	180	52	37.5	0.094	0.33	0.44
	n261	50	27.5	16QAM	Top Edge	2	180	52	30	0.071	0.25	0.34
	n261	50	27.5	16QAM	Bottom Edge	2	180	52	27	0.083	0.30	0.41
	n261	50	27.9	16QAM	Rear Face	2	180	52	43.1	0.09	0.63	0.94
	n261	50	28.3	16QAM	Rear Face	2	180	52	44.2	0.102	0.68	0.81
Verify the worst case at antenna module 2												
	n261	100	27.9	16QAM	Back Face	2	180	52	38.3	0.058	0.51	0.62
	n261	50	27.5	QPSK	Back Face	2	180	52	40.4	0.071	0.66	0.77
	n261	50	27.5	64QAM	Back Face	2	180	52	41.5	0.063	0.72	0.84

12. Simultaneous Transmission Assessment

➢ **Simultaneous Transmission Consideration**

No.	Simultaneous Transmission Consideration	Support
1	WWAN LTE Bands+5G NR FR2	Yes
2	WWAN LTE Bands+5G NR FR2+WLAN 2.4GHz/5GHz (MIMO)	Yes

Note:

Both the 2.4GHz & 5GHz WLAN cannot transmit simultaneously at the same time according to the user manual.

➢ **Total Exposure Radio 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

$$\mathrm{TER}^{\mathrm{uncorr}}(\mathrm{r}) = \sum_{i=1}^{I} \mathrm{ER}_i = \sum_{i=1}^{I} \frac{S_{av,i}(r, f_i)}{S_{lim}(f_i)}$$

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 6GHz, where 6GHz denotes the transmission frequency where the basic restrictions change from being defined in terms of SAR to being defined in terms of power density, therefore uncorrelated and the TER is determined as

$$\mathrm{TER}^{\mathrm{uncorr}}(\mathrm{r}) = \sum_{i=1}^{I} \mathrm{ER}_i = \sum_{i=1}^{I} \frac{S_{av,i}(r, f_i)}{S_{lim}(f_i)}$$

According to the FCC guidance in 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 by its limit. Numerical sum of the ratios should be less or equal to 1. Therefore the simultaneous transmission should be follows:

$$\sum \frac{\mathrm{Max.\ SAR}}{1.6} + \sum \frac{\mathrm{Max.\ PD}}{\mathrm{Limit\ of\ MPE}} \leqslant 1$$

➢ Simultaneous Transmission Assessment

Exposure Position	Maximum Reported SAR (W/kg)				Summation SAR (W/kg)		
	1	2	3	4	1+4	2+4	3+4
	LTE B2	LTE B5	LTE B13	LTE B66			
Front	0.035	0.038	0.094	0.012	0.047	0.05	0.106
Back	0.074	0.055	0.165	0.023	0.097	0.078	0.188
Left	0.008	0.041	0.087	0.005	0.013	0.046	0.092
Right	0.007	0.020	0.023	0.004	0.011	0.024	0.027
Top	0.091	0.044	0.077	0.031	0.122	0.075	0.108
Bottom	0.000	0.033	0.031	0.000	0.000	0.033	0.031

Note:

The maximum summation SAR of 1+4/2+4 or 3+4 combination would be used to calculating the simultaneous with the power density.

Exposure Position	Maximum Reported SAR (W/kg)					Power Density (W/m^2)	Total Exposure Ratio	
	1	2	3	Sum. 1+2	Sum. 1+3	4		
	LTE Com.	WLAN MIMO 2.4GHz	WLAN MIMO 5GHz			FR2	1+2+4	1+3+4
Front	0.106	0.076	0.350	0.182	0.456	0.6	0.242	0.516
Back	0.188	0.272	0.504	0.46	0.692	1.19	0.579	0.811
Left	0.092	0.034	0.000	0.126	0.092	0.48	0.174	0.14
Right	0.027	0.122	0.344	0.149	0.371	1.09	0.258	0.48
Top	0.122	0.091	0.383	0.213	0.505	0.6	0.273	0.565
Bottom	0.033	0.000	0.000	0.033	0.033	0.54	0.087	0.087

Note:

1. The test results of WWAN/WLAN and Bluetooth were referred to the SAR report SZ21010412S01.
2. The power density above should be converted into mW/cm^2.

13. Uncertainty Assessment

The budget is valid for evaluation distance ＞λ/2π. For specific tests and configurations, the uncertainty can be considered smaller.

Error Description	**Uncertainty ± %**	**Probability**	Divisor	***ci***	Standard Uncertainty (±%)	ν_i or ν_{eff}
Uncertainty terms dependent on the measurement system						
Probe calibration	0.43	1	R	1	0.49	∞
Probe correction	0.48	1.732	R	0.7	0.49	∞
Isotropy	0.48	1.732	R	0.7	0.29	∞
Multiple reflections	0.19	1.732	R	1	0.12	∞
System linearity	0.24	1.732	R	1	0.12	∞
Probe positioning	0.28	1.732	R	1	0.17	∞
Sensor location	0.2	1.732	R	1	0.18	∞
Amplitude and phase drift	0.02	1	R	1	0.0	∞
Amplitude and phase noise	0.18	1.732	R	1	0.12	∞
Data point spacing	0.06	1.732	R	1	0.08	∞
Measurement area truncation	0.63	1.732	R	1	0.6	∞
Reconstruction algorithms	0.04	1.732	R	1	0.05	∞
Uncertainty terms dependent on the DUT and environmental factors						
Probe coupling with DUT	0.05	1.732	R	1	0.08	∞
Modulation response	0.34	1.732	R	1	0.23	∞
Integration time	0.01	1	R	1	0.00	∞
DUT alignment	0.12	1.732	R	1	0.3	∞
RF ambient conditions	0.20	1.732	R	1	0.12	∞
Immunity / secondary reception	0.03	1.732	R	1	0.04	∞
Drift of the DUT	0.06	1	R	1	0.01	∞
Combined standard uncertainty					0.71 dB	∞
Coverage Factor for 95%					K=2	N/A
Expanded standard uncertainty					1.5 dB	

Annex A General Information

1. Identification of the Responsible Testing Laboratory

Laboratory Name:	Morlab Laboratory of Shenzhen Morlab Communications Technology Co., Ltd.
Laboratory Address:	FL.1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

3. Facilities and Accreditations

The FCC designation number is CN1192, the test firm registration number is 226174.

****** END OF MAIN REPORT ******