SAR EVALUATION REPORT

FCC 47 CFR § 2.1093
IEEE Std 1528-2013

For
SMARTPHONE

FCC ID: BCG-E4000A (Parent Model)
BCG-E4002A, BCG-E4033A, BCG-E4034A (Variant Models)
Model Name: A2483 (Parent Model)
A2636, A2638, A2639, A2640 (Variant Models)

Report Number: 13571601-S9V3
Issue Date: 6/27/2023

Prepared for
APPLE INC.
1 APPLE PARK WAY
CUPERTINO, CA 95014-2084

Prepared by
UL VERIFICATION SERVICES INC.
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888

ACCREDITED
CERT #0751.05

Revision History

Rev.	Date	Revisions	Revised By
V1	5/10/2023	Initial Issue	--
V2	6/14/2023	Updated section 1 statement.	Devin Chang
V3	6/27/2023	Updated section 6.1	Dave Weaver

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1. Attestation of Test Results

Applicant Name		APPLE INC.	
FCC ID		BCG-E4000A (Parent Model) BCG-E4002A, BCG-E4033A, BCG-E4034A (Variant Models)	
Model Name		A2483 (Parent Model) A2636, A2638, A2639, A2640 (Variant Models)	
Applicable Standards		FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Std 1528-2013	
Exposure Category		SAR Limits (W/Kg)	
		Peak spatial-average(1g of tissue)	Extremities (hands, wrists, ankles, etc.) (10g of tissue)
General population / Uncontrolled exposure		1.6	4
RF Exposure Conditions		Equipment Class - Highest Reported SAR (W/kg)	
		CBE	
Head		0.782	
Body-worn (Dist.= 5 mm)		0.819	
Hotspot (Dist.= 5 mm)		0.819	
Simultaneous TX	Head	1.174	
	Body-worn	1.302	
	Hotspot	1.302	
Date Tested		7/1/2021 to 7/2/2021	
Test Results		Pass	

This is C2PC report to add NR n48 as documented in C2PC letter. WLAN/BT data used for simultaneous transmission evaluation is based on the original SAR report 13571601-S1.

This lead model is representative of variant models A2636, A2638, A2639, A2640 (FCC ID: BCG-E4002A, BCG-E4033A, BCG-E4034A). SAR data reuse for these variants from the lead model was approved via KDB inquiry with spot checks required for the worst case exposure condition for each equipment code. As the original LTE band 48 data represents worst case for equipment code CBE no additional spot checks for the variant models are required.

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

This report contains data provided by the customer which can impact the validity of results. UL Verification Services Inc. is only responsible for the validity of results after the integration of the data provided by the customer.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, any agency of the Federal Government, or any agency of the U.S. government.

Approved & Released By:	Prepared By:
	
Devin Chang Senior Test Engineer UL Verification Services Inc.	AJ Newcomer Laboratory Test Engineer UL Verification Services Inc.

2. Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with FCC 47 CFR § 2.1093, IEEE STD 1528-2013, the following FCC Published RF exposure KDB procedures:

- 248227 D01 802.11 Wi-Fi SAR v02r02
- 447498 D01 General RF Exposure Guidance v06
- 447498 D03 Supplement C Cross-Reference v01
- 648474 D04 Handset SAR v01r03
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02
- 941225 D01 3G SAR Procedures v03r01
- 941225 D05 SAR for LTE Devices v02r05
- 941225 D05A LTE Rel.10 KDB Inquiry Sheet v01r02
- 941225 D06 Hotspot Mode v02r01

In addition to the above, the following information was used:

- TCB workshop October 2014; RF Exposure Procedures (Other LTE Considerations)
- TCB workshop April 2015; RF Exposure Procedures (Overlapping LTE Bands)
- TCB workshop October 2015; RF Exposure Procedures (KDB 941225 D05A)
- TCB workshop April 2016; RF Exposure Procedures (LTE Carrier Aggregation for DL)
- TCB workshop October 2016; RF Exposure Procedures (LTE Carrier Aggregation for UL)
- TCB workshop October 2016; RF Exposure Procedures (Bluetooth Duty Factor)
- TCB workshop October 2016; RF Exposure Procedures (DUT Holder Perturbations)
- TCB workshop May 2017; RF Exposure Procedures (Broadband Liquid Above 3 GHz)
- TCB workshop May 2017; RF Exposure Procedures (LTE Band 41 Power Class 2)
- TCB workshop November 2017; RF Exposure Procedures (LTE UL/DL Carrier Aggregation SAR)
- TCB workshop April 2018; RF Exposure Procedures (LTE DL CA SAR Test Exclusion)
- TCB workshop October 2018; RF Exposure Procedures (LTE Inter-Band Uplink Carrier Aggregation – Interim Procedures)
- TCB workshop April 2019; RF Exposure Procedures (802.11ax SAR Testing)
- TCB workshop November 2019; RF Exposure Policy Updates (5G NR FR1 NSA EN-DCUE SAR Evaluations)
- TCB workshop April 2021; RF Exposure Procedures (Remarks on Test Reductions via Data Referencing for Closely Related Products)

3. Facilities and Accreditation

The test sites and measurement facilities used to collect data are located at

47173 Benicia Street	47266 Benicia Street	5440 Patrick Henry Drive
SAR Lab A	SAR Lab 1	PHD 1
SAR Lab B	SAR Lab 2	PHD 2
SAR Lab C	SAR Lab 3	PHD 3
SAR Lab D	SAR Lab 4	PHD 4
SAR Lab E	SAR Lab 5	
SAR Lab F	SAR Lab 6	
SAR Lab G	SAR Lab 8	
SAR Lab H	SAR Lab 9	
	SAR Lab 10	
	SAR Lab 11	
	SAR Lab 12	
	SAR Lab 13	
	SAR Lab 14	
	SAR Lab 15	
	SAR Lab 16	

UL Verification Services Inc. is accredited by A2LA, Certificate Number 0751.05

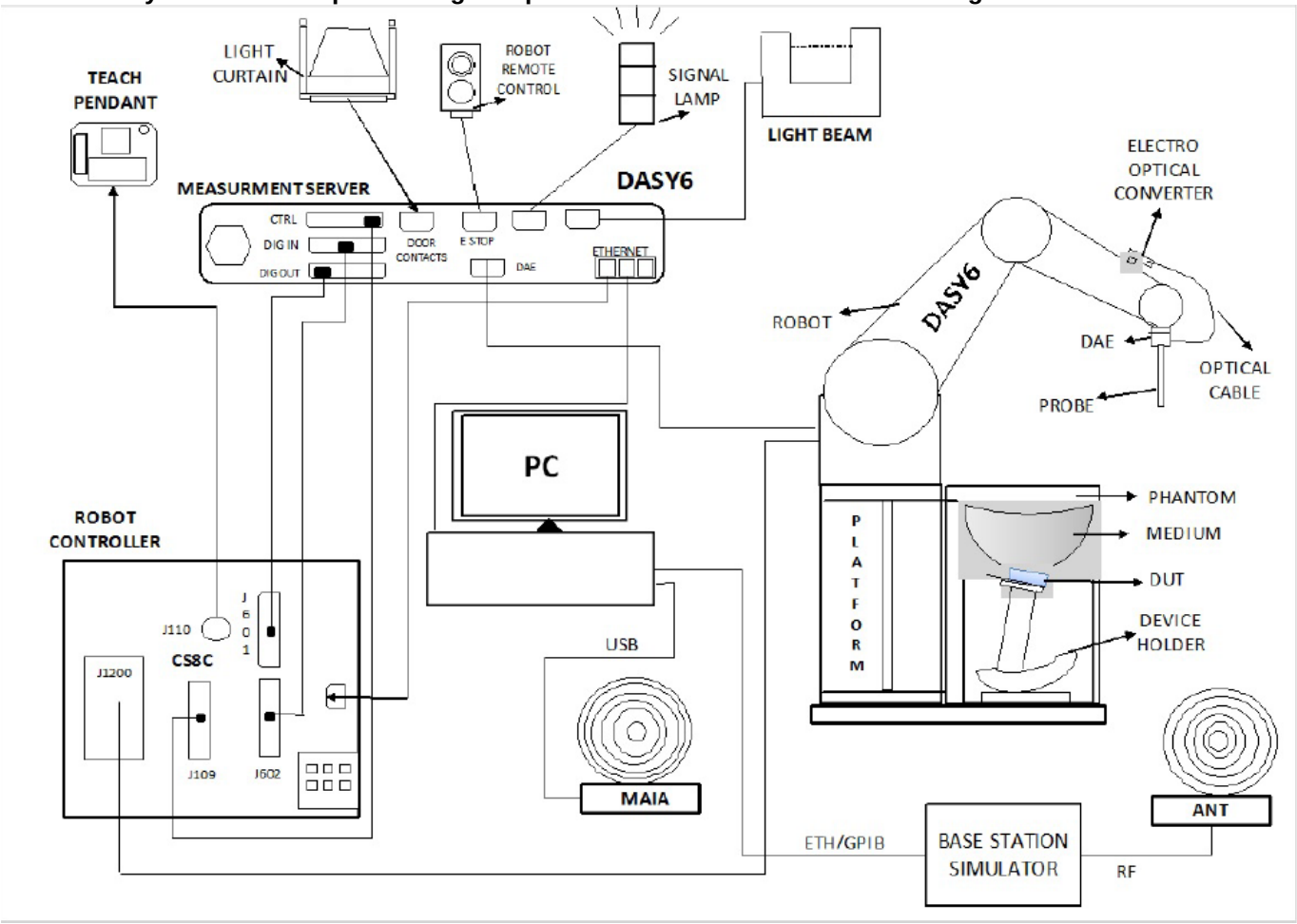
The Test Lab Conformity Assessment Body Identifier (CABID)

Location	CABID	Company Number
47173 Benicia Street, Fremont, CA, 94538 UNITED STATES	US0104	2324A
47266 Benicia Street, Fremont, CA, 94538 UNITED STATES		22541
5440 Patrick Henry Drive, Santa Clara, CA, 95054 UNITED STATES		27500

4. SAR Measurement System & Test Equipment

4.1. SAR Measurement System

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



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running Win7, Win10 and the DASY52[1] and DASY6[2] software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

[1] DASY52 software used: DASY52.10.4 & S 14.6.14 and older generations.

[2] DASY6 software used: DASY6.14 & S 14.6.14 and older generations.

4.2. SAR Scan Procedures

Step 1: Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 2.1 mm. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

Step 2: Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

Area Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

Step 3: Zoom Scan

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures points (refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

Zoom Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

			≤ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5·$\Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

Step 4: Power drift measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

4.3. Test Equipment

The measuring equipment used to perform the tests documented in this report has been calibrated in accordance with the manufacturers' recommendations, and is traceable to recognized national standards.

Dielectric Property Measurements

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Network Analyzer	Rohde & Schwarz	ZNLE6	101273	2/26/2022
Dielectric Probe kit	SPEAG	DAK-3.5	1087	11/12/2021
Shorting block	SPEAG	DAK-3.5 Short	SM DAK200BA	11/12/2021
Thermometer	Fischer Scientific	4242	150378159	8/5/2021
Network Analyzer	Rohde & Schwarz	ZNLE6	101274	2/26/2022
Dielectric Probe kit	SPEAG	DAK-3.5	1082	9/9/2021
Shorting block	SPEAG	DAK-3.5 Short	SM DAK200DA	9/9/2021
Thermometer	Control Company	15-078-179	170064398	7/30/2021
Network Analyzer	Copper Mountain Technologies	Planar R140 Vector Reflectomete	170514	9/9/2021
Dielectric Probe kit	SPEAG	DAKS -3.5 Probe	1050	9/9/2021
Shorting block	SPEAG	DAK-1.2/3.5 Short	SM DAK 200 CA	9/9/2021
Thermometer	Fischer Scientific	N/A	N/A	2/14/2022

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Signal Generator	Keysight Technologies	N5181A-506	MY50140610	1/21/2022
Power Meter	Keysight Technologies	N1912A	MY50001018	1/21/2022
Power Sensor	Keysight Technologies	N1921A	MY53020038	1/28/2022
DC Power Supply	Ametek	XT15-4	1802A01877	N/A
Amplifier	Miteq	AMF-4D-00400600-50-30P	1795092	N/A
Signal Generator	Rohde & Schwarz	SMB100A03	180969	2/16/2022
3-Path Diode Power Sensor	Rohde & Schwarz	NRP18A	100992	2/16/2022
Signal Generator	Rohde & Schwarz	SMB100A03	180970	2/16/2022
Power Meter	Keysight Technologies	437B	3125U11347	1/26/2022
3-Path Diode Power Sensor	Rohde & Schwarz	NRP18A	100995	2/26/2022
Bi-Directional Coupler	Werlatone	C8060-102	4063	N/A
Signal Generator	Rohde & Schwarz	SMW 200A	1412.0000K02-102870-AX	7/20/2021 *
Power Sensor	Rohde & Schwarz	NRP-Z81	1137.9009.02.106321-pu	7/1/2022
Power Sensor	Rohde & Schwarz	NRP-Z81	1137.9009.02-101575-em	7/17/2022
Power Meter	HP	NRX	1424.7005K02-102214-ea	7/2/2022
Amplifier	RF/Microwave Instrumentation	20S1G4M4	337209	N/A

Note(s):

*Equipment not used past calibration due date.

Lab Equipment

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
E-Field Probe (SAR Lab 8)	SPEAG	EX3DV4	7582	3/1/2022
Data Acquisition Electronics (SAR Lab 8)	SPEAG	DAE4	1248	2/19/2022

Note(s):

*Equipment not used past calibration due date.

Lab Equipment

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
System Validation Dipole	SPEAG	D3700V2	1039	4/16/2022

OTHER

Name of Equipment	Manufacturer	Type/Model	T Number	Serial No.	Cal. Due Date
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	959	137873-WG	2/19/2022
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	268	124593-ss	2/26/2022
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	1871	164541	2/24/2022
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	978	137877-ms	2/16/2022
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	960	135384-pJ	2/28/2022
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	957	134852-cy	2/17/2022
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	948	135393-VQ	2/24/2022
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	375	132910-cp	2/17/2022
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	259	124594-HX	2/19/2022
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	953	135390-WS	2/19/2022
Power Meter	Keysight Technologies	N1912A	N/A	MY55196004	1/21/2022
Power Sensor	Keysight Technologies	N1921A	N/A	MY52270022	1/28/2022
Power Meter	Keysight Technologies	N1911A	N/A	MY55196015	1/20/2022
Power Sensor	Keysight Technologies	N1921A	N/A	MY52200012	1/28/2022

5. Measurement Uncertainty

Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be ≤ 30%, for a confidence interval of k = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval.

Therefore, the measurement uncertainty is not required.

6. Device Under Test (DUT) Information

6.1. DUT Description

The Apple iPhone is a smartphone with multimedia functions (music, application support, and video), cellular GSM, GPRS, EGPRS, UMTS, LTE, 5G, CDMA, IEEE 802.11a/b/g/n/ac/ax, Bluetooth, Ultra-Wideband, GPS, and NFC. All models support at least one UICC based SIM. The second SIM is either an UICC based p-SIM (physical SIM) or e-SIM (electronic SIM). The device supports a built-in inductive charging transmitter and receiver. The rechargeable battery is not user accessible.

The device utilizes two power modes: Mode A(DSI=0) and Mode B(DSI=1). Power selection is determined by the device's positioning and use case as described in Sec. 10. Mode A power is used when the device is used against the user's head, or away from the body. Mode B is used when the device is used in a body-worn configuration by the user.

The WWAN transmit antenna switching mechanism between WWAN antennas is implemented with a physical "break-before-make" switch so that only one antenna can be used for WWAN transmission at one time.

In Airplay mode, the device uses same power and power control mechanism as Wi-Fi. Airplay is not supported in hotspot mode. Airplay utilize the same 802.11 modes, modulation, MIMO, Channel Bandwidth, etc. as Wi-Fi does. Therefore Airplay usage is categorized by the Wi-Fi SAR testing contained in Section 10.

There are two vendors of the Wi-Fi/Bluetooth radio modules: variant 1 and variant 2. The Wi-Fi/BT radio modules have the same mechanical outline (e.g., the same package dimension and pin-out layout), use the same on-board antenna matching circuit, have an identical antenna structure, and are built and tested to conform to the same specifications and to operate within the same tolerances. It is confirmed that Variant 1 represents the worst case.

This product utilizes a time-averaged power control mechanism – Wi-Fi Time-Averaged SAR(TAS) within the Wi-Fi chipset – that ensures total power across all Wi-Fi transmitters does not exceed applicable regulatory limits. For further details, refer to the technical description document.

Device Dimension	Overall (Length x Width): 147.6 mm x 71.5 mm Overall Diagonal: 164.0 mm (6.4 inch) Display Diagonal: 153.9 mm (6.0 inch)
Back Cover	The Back Cover is not removable
Battery Options	The rechargeable battery is not user accessible.
Accessory	Headset
Wireless Router (Hotspot)	Wi-Fi Hotspot mode permits the device to share its WWAN data connection with other Wi-Fi-enabled devices. ☒ Mobile Hotspot (Wi-Fi 2.4 GHz) ☐ Mobile Hotspot (Wi-Fi 5.2/5.8 GHz)
AirPlay	AirPlay mode enabled devices transfer data directly between each other ☒ AirPlay (Wi-Fi 2.4 GHz) ☒ AirPlay (Wi-Fi 5 GHz)
Bluetooth Tethering (Hotspot)	BT Tethering mode permits the device to share its cellular data connection with other devices. ☒ BT Tethering (Bluetooth 2.4 GHz)

6.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode	Duty Cycle used for SAR testing
5G NR (FR1)	TDD band n48	CP-OFDM: Pi/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM DFT-s-OFDM: QPSK, 16QAM, 64QAM, 256QAM	100%

6.3. General 5G NR(FR1) SAR Test and Reporting Considerations

n48	SCS (kHz)	Frequency range: 3550 - 3700 MHz (BW = 150 MHz)												
		Channel Bandwidth (MHz)												
		100	90	80	70	60	50	40	30	25	20	15	10	5
Low	30							638000 /3570			637332 /3559.98		637000 /3555	
Low-Mid	30							640444 /3606.66			640222 /3603.33		640110 /3601.65	
Mid	30							642888 /3643.32			643110 /3646.65		643220 /3648.3	
High	30							645332 /3679.98			645998 /3689.97		646332 /3694.98	

SCS	30 kHz (n48)
NR(FR1) transmitter and antenna implementation	Refer to section 7 and Appendix A.
A-MPR(Additional MPR) disabled for SAR testing?	Yes
EN-DC Carrier Aggregation Possible Combinations	
LTE Anchor Bands for NR band n48	LTE Band 2/5/13/66

Notes:

1. Maximum bandwidth does not support at least three non-overlapping channels in certain channel bandwidths. When a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing per FCC Guidance.
2. SAR test for NR bands and LTE anchor Bands were performed separately due to limitations in SAR probe calibration factors. And, due to test setup limitations, SAR testing for NR was performed using test mode software to establish the connection.
3. FR1 supported standalone.

6.4. Time-Average Feature

The equipment under test (EUT) incorporates the Smart Transmit (SmartTX) SAR averaging algorithm provided by Qualcomm for cellular technologies. Smart Transmit controls the Tx power of the cellular-based wireless device in real-time to maintain the time-averaged Tx power, and in turn, time-averaged RF exposure, below the predefined time-average power limit characterized for each technology and band.

The purpose of the Part 1 test in this report is to demonstrate that the EUT meets the FCC SAR limits when transmitting in static transmission scenario at maximum allowable time-averaged power levels.

The Smart Transmit algorithm maintains the time-averaged transmit power, in turn, time-averaged RF exposure of SAR_design_target or PD_design_target, below the predefined time-average power limit, for each characterized technology and band.

Smart Transmit allows the device to transmit at higher power instantaneously as high as P_{max}, when needed, but enforces power limiting to maintain time-averaged transmit power to P_{limit}. Below table shows P_{limit} EFS settings and maximum tune up output power P_{max} configured for this EUT for various transmit conditions (DSI – Device State Index).

The maximum time-averaged output power (dBm) for any 2G/3G/4G/5G NR WWAN technology band, and DSI = minimum of "P_{limit} EFS" and "Maximum tune up output power P_{max}" includes device uncertainty.

SAR values in this report were scaled to the maximum time-averaged output power to determine compliance following KDB 447498 D01.

P_{design}	The power level that corresponds to the exposure design target (SAR_design_target) after accounting for all device design related uncertainties.
P_{limit}	Maximum tune-up output power for SAR Mode A and Mode B
P_{max}	Maximum tune-up output power for RF
SAR Characterization	Table containing P_{limit} for all technologies and bands

SAR Characterization

Exposure Scenario		factor	Head				Body-worn & Hotspot				P_{max} (dBm) Tune-up power table	
Spatial-average			1g				1g					
Test Distance			0 mm				5 mm					
Power Mode (DSI)			Mode A (DSI=0)				Mode B (DSI=1)					
Antenna	Tech/Band		P_{design} (dBm) corresponding to 1.0 W/kg (SAR_design_target)	P_{limit} (dBm) Tune-up power table	P_{design} (dBm) corresponding to 1.0 W/kg (SAR_design_target)	P_{limit} (dBm) Tune-up power table	P_{design} (dBm) corresponding to 1.0 W/kg (SAR_design_target)	P_{limit} (dBm) Tune-up power table	P_{design} (dBm) corresponding to 1.0 W/kg (SAR_design_target)	P_{limit} (dBm) Tune-up power table		
	Transmit Average		Burst Average		Frame Average		Burst Average		Frame Average		Burst Average	Frame Average
ANT4	NR n48[1]	1	20.37	19.30	20.37	19.30	21.17	20.30	21.17	20.30	22.70	22.70
ANT7	NR n48[1]	1	30.56	23.70	30.56	23.70	21.72	20.50	21.72	20.50	25.60	25.60
ANT8	NR n48[1]	1	22.99	21.00	22.99	21.00	21.93	21.00	21.93	21.00	23.20	23.20
ANT9	NR n48[1]	1	34.67	23.70	34.67	23.70	23.79	22.50	23.79	22.50	25.20	25.20

Note(s):

1. All P_{limit} EFS and maximum tune up output P_{max} levels entered in above Table correspond to average power levels after accounting for duty cycle in the case of TDD modulation schemes (for e.g., GSM & LTE TDD).
2. Measurement Condition: All conducted power and SAR measurements in this report (Part 1 test) were performed by setting Reserve_power_margin (Smart Transmit EFS entry) to 0 dB.
3. Only P_{limit} is considered for SAR Evaluation.

7. RF Exposure Conditions (Test Configurations)

This device has a total of 9 antennas. From Front of the device, antennas and supported frequencies are described and located as follows:

Antenna	Band	Rear	Front	Edge 1	Edge 2	Edge 3	Edge 4
				(Top Edge)	(Right Edge)	(Bottom Edge)	(Left Edge)
ANT4	5G(FR1) n48	Yes	Yes	Yes	Yes	No	No
ANT7	5G(FR1) n48	Yes	Yes	No	Yes	Yes	No
ANT8	5G(FR1) n48	Yes	Yes	Yes	No	No	Yes
ANT9	5G(FR1) n48	Yes	Yes	No	No	Yes	Yes

Note(s):

1. SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 941225 D06 Hotspot Mode.
2. The Body-worn minimum separation distance is 5 mm. To cover both body-worn and hotspot RF exposure conditions testing was performed at a separation distance of 5 mm.

8. Dielectric Property Measurements & System Check

8.1. Dielectric Property Measurements

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within ± 2°C of the temperature when the tissue parameters are characterized.
The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements. The parameters should be re-measured after each 3 – 4 days of use; or earlier if the dielectric parameters can become out of tolerance; for example, when the parameters are marginal at the beginning of the measurement series.
Tissue dielectric parameters were measured at the low, middle and high frequency of each operating frequency range of the test device.
The dielectric constant (εr) and conductivity (σ) of typical tissue-equivalent media recipes are expected to be within ± 5% of the required target values; but for SAR measurement systems that have implemented the SAR error compensation algorithms documented in IEEE Std 1528-2013, to automatically compensate the measured SAR results for deviations between the measured and required tissue dielectric parameters, the tolerance for εr and σ may be relaxed to ± 10%. This is limited to frequencies ≤ 3 GHz.

Tissue Dielectric Parameters

FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

Target Frequency (MHz)	Head		Body	
	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5000	36.2	4.45	49.3	5.07
5100	36.1	4.55	49.1	5.18
5200	36.0	4.66	49.0	5.30
5300	35.9	4.76	48.9	5.42
5400	35.8	4.86	48.7	5.53
5500	35.6	4.96	48.6	5.65
5600	35.5	5.07	48.5	5.77
5700	35.4	5.17	48.3	5.88
5800	35.3	5.27	48.2	6.00

IEEE Std 1528-2013
Refer to Table 3 within the IEEE Std 1528-2013

IEC 62209-1
Refer to Table A.3 within the IEC 62209-1

Dielectric Property Measurements Results:

SAR Lab	Date	Band (MHz)	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
					Measured	Target	Delta (%)	Measured	Target	Delta (%)
8	7/1/2021	3700	Head	3700	38.96	37.70	3.34	3.07	3.12	-1.61
				3600	39.15	37.82	3.53	2.96	3.01	-1.66
				3800	38.80	37.59	3.23	3.16	3.22	-1.76

8.2. System Check

SAR system verification is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device. The same SAR probe(s) and tissue-equivalent media combinations used with each specific SAR system for system verification must be used for device testing. When multiple probe calibration points are required to cover substantially large transmission bands, independent system verifications are required for each probe calibration point. A system verification must be performed before each series of SAR measurements using the same probe calibration point and tissue-equivalent medium. Additional system verification should be considered according to the conditions of the tissue-equivalent medium and measured tissue dielectric parameters, typically every three to four days when the liquid parameters are re-measured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

System Performance Check Measurement Conditions:

- The measurements were performed in the flat section of the TWIN SAM or ELI phantom, shell thickness: 2.0 ±0.2 mm (bottom plate) filled with Body or Head simulating liquid of the following parameters.
- The depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm for SAR measurements ≤ 3 GHz and ≥ 10.0 cm for measurements > 3 GHz.
- The DASY system with an E-Field Probe was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.
  For 5 GHz band - The coarse grid with a grid spacing of 10 mm was aligned with the dipole.
- Special 7x7x7 (below 3 GHz) and/or 8x8x7 (above 3 GHz) fine cube was chosen for the cube.
- Distance between probe sensors and phantom surface was set to 3 mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.5 mm
- The dipole input power (forward power) was 100 mW.
- The results are normalized to 1 W input power.

System Check Results

The 1-g and 10-g SAR measured with a reference dipole, using the required tissue-equivalent medium at the test frequency, must be within ±10% of the manufacturer calibrated dipole SAR target. Refer to Appendix B for the SAR System Check Plots.

SAR Lab	Date	Tissue Type	Dipole Type _Serial #	Dipole Cal. Due Data	Measured Results for 1g SAR				Measured Results for 10g SAR				Plot No.
					Zoom Scan to 100 mW	Normalize to 1 W	Target (Ref. Value)	Delta ±10 %	Zoom Scan to 100 mW	Normalize to 1 W	Target (Ref. Value)	Delta ±10 %	
8	7/1/2021	Head	D3700V2 SN:1039	4/16/2022	6.260	62.60	66.40	-5.72	2.350	23.50	24.00	-2.08	1,2

9. Conducted Output Power Measurements

Power measurements were performed in accordance to the device's two power modes, Mode A and Mode B for each antenna. Mode A power is used when the device is used against the user's head or away from the body. Mode B power is used when the device is used in a Body-worn configuration by the user.

The selection between antennas in the application is based on RSSI based antenna selection. The full details of power selections are described in the operational description. Refer to Sec. 7 and Sec. 10 for details of the testing. Test reductions have applied accordingly following the SAR KDB Procedure for the supported wireless technologies of the DUT. This is noted in detail for each technology in their respective Sections.

The Tune-up limit already includes component tolerance. KDB 447498 sec.4.1.(d) at the maximum rated output power and within the tune-up tolerance range specified for the product, but not more than 2 dB lower than the maximum tune-up tolerance limit.

Two different powers are being displayed in this section:

- Target Output Power: Power not including the + tolerance
- Tune-Up Limit: Power of target + tolerance.

9.1. 5G NR(FR1)

The following tests were conducted according to the test requirements outlined in section 6.2 of the 3GPP TS 138.521-1 specification.

UE Power Class: 3 (23 +/- 2dBm). The allowed Maximum Power Reduction (MPR) for the maximum output power due to higher order modulation and transmit bandwidth configuration (resource blocks) is specified in Table 6.2.3-1 of the 3GPP TS138.521-1.

Table 6.2.2.3-1: Maximum Power Reduction (MPR) for Power 3

Modulation	MPR (dB)		
	Edge RB allocations	Outer RB allocations	Inner RB allocations
DFT-s-OFDM PI/2 BPSK	≤ 3.5[1]	≤ 1.2[1]	≤ 0.2[1]
	≤ 0.5[2]		0[2]
DFT-s-OFDM QPSK	≤ 1		0
DFT-s-OFDM 16 QAM	≤ 2		≤ 1
DFT-s-OFDM 64 QAM	≤ 2.5		
DFT-s-OFDM 256 QAM	≤ 4.5		
CP-OFDM QPSK	≤ 3		≤ 1.5
CP-OFDM 16 QAM	≤ 3		≤ 2
CP-OFDM 64 QAM	≤ 3.5		
CP-OFDM 256 QAM	≤ 6.5		
NOTE 1: Applicable for UE operating in TDD mode with PI/2 BPSK modulation and UE indicates support for UE capability *powerBoosting-pi2BPSK* and if the IE *powerBoostPi2BPSK* is set to 1 and 40 % or less slots in radio frame are used for UL transmission for bands n40, n41, n77, n78 and n79. The reference power of 0dB MPR is 26dBm.			
NOTE 2: Applicable for UE operating in FDD mode, or in TDD mode in bands other than n40, n41, n77, n78 and n79 and if the IE *powerBoostPi2BPSK* is set to 0 and if more than 40% of slots in radio frame are used for UL transmission for bands n40, n41, n77, n78 and n79.			

The allowed A-MPR values specified below in Table 6.2.3.3.1-1 of 3GPP TS138.521-1 are in addition to the allowed MPR requirements. All the measurements below were performed with A-MPR disabled, by using Network Signaling Value of "NS_01"

Table 6.2.3.3.1-1: Additional maximum power reduction (A-MPR)

Network Signalling label	Requirements (subclause)	NR Band	Channel bandwidth (MHz)	Resources Blocks (N_{RB})	A-MPR (dB)
NS_01		Table 5.2-1	5, 10, 15, 20, 25, 30, 40, 50, 60, 80, 90, 100	Table 5.3.2-1	N/A

Uplink RB allocations were used to Table 6.1-1 of the 3GPP TS 138.521-1.

Channel Bandwidth	SCS(kHz)	OFDM	RB allocation							
			Edge_Full_Left	Edge_Full_Right	Edge_1RB_Left	Edge_1RB_Right	Outer_Full	Inner_Full	Inner_1RB_Left	Inner_1RB_Right
5MHz	15	DFT-s	2@0	2@23	1@0	1@24	25@0	12@6	1@1	1@23
		CP	2@0	2@23	1@0	1@24	25@0	13@6	1@1	1@23
	30	DFT-s	2@0	2@9	1@0	1@10	10@0	5@2[1]	1@1	1@9
		CP	2@0	2@9	1@0	1@10	11@0	5@2[1]	1@1	1@9
	60	DFT-s	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		CP	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10MHz	15	DFT-s	2@0	2@50	1@0	1@51	50@0	25@12	1@1	1@50
		CP	2@0	2@50	1@0	1@51	52@0	26@13	1@1	1@50
	30	DFT-s	2@0	2@22	1@0	1@23	24@0	12@6	1@1	1@22
		CP	2@0	2@22	1@0	1@23	24@0	12@6	1@1	1@22
	60	DFT-s	2@0	2@9	1@0	1@10	10@0	5@2[1]	1@1	1@9
		CP	2@0	2@9	1@0	1@10	11@0	5@2[1]	1@1	1@9
15MHz	15	DFT-s	2@0	2@77	1@0	1@78	75@0	36@18	1@1	1@77
		CP	2@0	2@77	1@0	1@78	79@0	39@19[1]	1@1	1@77
	30	DFT-s	2@0	2@36	1@0	1@37	36@0	18@9	1@1	1@36
		CP	2@0	2@36	1@0	1@37	38@0	19@9	1@1	1@36
	60	DFT-s	2@0	2@16	1@0	1@17	18@0	9@4	1@1	1@16
		CP	2@0	2@16	1@0	1@17	18@0	9@4	1@1	1@16
20MHz	15	DFT-s	2@0	2@104	1@0	1@105	100@0	50@25	1@1	1@104
		CP	2@0	2@104	1@0	1@105	106@0	53@26	1@1	1@104
	30	DFT-s	2@0	2@49	1@0	1@50	50@0	25@12	1@1	1@49
		CP	2@0	2@49	1@0	1@50	51@0	25@12[1]	1@1	1@49
	60	DFT-s	2@0	2@22	1@0	1@23	24@0	12@6	1@1	1@22
		CP	2@0	2@22	1@0	1@23	24@0	12@6	1@1	1@22
25MHz	15	DFT-s	2@0	2@131	1@0	1@132	128@0	64@32	1@1	1@131
		CP	2@0	2@131	1@0	1@132	133@0	67@33	1@1	1@131
	30	DFT-s	2@0	2@63	1@0	1@64	64@0	32@16	1@1	1@63
		CP	2@0	2@63	1@0	1@64	65@0	33@16	1@1	1@63
	60	DFT-s	2@0	2@29	1@0	1@30	30@0	15@7[1]	1@1	1@29
		CP	2@0	2@29	1@0	1@30	31@0	15@7[1]	1@1	1@29
30MHz	15	DFT-s	2@0	2@158	1@0	1@159	160@0	80@40	1@1	1@158
		CP	2@0	2@158	1@0	1@159	160@0	80@40	1@1	1@158
	30	DFT-s	2@0	2@76	1@0	1@77	75@0	36@18	1@1	1@76
		CP	2@0	2@76	1@0	1@77	78@0	39@19	1@1	1@76
	60	DFT-s	2@0	2@36	1@0	1@37	36@0	18@9	1@1	1@36
		CP	2@0	2@36	1@0	1@37	38@0	19@9	1@1	1@36
40MHz	15	DFT-s	2@0	2@214	1@0	1@215	216@0	108@54	1@1	1@214
		CP	2@0	2@214	1@0	1@215	216@0	108@54	1@1	1@214
	30	DFT-s	2@0	2@104	1@0	1@105	100@0	50@25	1@1	1@104
		CP	2@0	2@104	1@0	1@105	106@0	53@26	1@1	1@104
	60	DFT-s	2@0	2@49	1@0	1@50	50@0	25@12	1@1	1@49
		CP	2@0	2@49	1@0	1@50	51@0	25@12[1]	1@1	1@49
50MHz	15	DFT-s	2@0	2@268	1@0	1@269	270@0	135@67	1@1	1@268
		CP	2@0	2@268	1@0	1@269	270@0	135@67	1@1	1@268
	30	DFT-s	2@0	2@131	1@0	1@132	128@0	64@32	1@1	1@131
		CP	2@0	2@131	1@0	1@132	133@0	67@33	1@1	1@131
	60	DFT-s	2@0	2@63	1@0	1@64	64@0	32@16	1@1	1@63
		CP	2@0	2@63	1@0	1@64	65@0	33@16	1@1	1@63
60MHz	15	DFT-s	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		CP	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	30	DFT-s	2@0	2@160	1@0	1@161	162@0	81@40	1@1	1@160
		CP	2@0	2@160	1@0	1@161	162@0	81@40	1@1	1@160
	60	DFT-s	2@0	2@77	1@0	1@78	75@0	36@18	1@1	1@77
		CP	2@0	2@77	1@0	1@78	79@0	39@19[1]	1@1	1@77
80MHz	15	DFT-s	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		CP	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	30	DFT-s	2@0	2@215	1@0	1@216	216@0	108@54	1@1	1@215
		CP	2@0	2@215	1@0	1@216	217@0	109@54	1@1	1@215
	60	DFT-s	2@0	2@105	1@0	1@106	100@0	50@25	1@1	1@105
		CP	2@0	2@105	1@0	1@106	107@0	53@26[1]	1@1	1@105
90MHz	15	DFT-s	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		CP	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	30	DFT-s	2@0	2@243	1@0	1@244	240@0	120@60	1@1	1@243
		CP	2@0	2@243	1@0	1@244	245@0	123@61	1@1	1@243
	60	DFT-s	2@0	2@119	1@0	1@120	120@0	60@30	1@1	1@119
		CP	2@0	2@119	1@0	1@120	121@0	61@30	1@1	1@119
100MHz	15	DFT-s	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		CP	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	30	DFT-s	2@0	2@271	1@0	1@272	270@0	135@67	1@1	1@271
		CP	2@0	2@271	1@0	1@272	273@0	137@68	1@1	1@271
	60	DFT-s	2@0	2@133	1@0	1@134	135@0	64@32	1@1	1@133
		CP	2@0	2@133	1@0	1@134	135@0	67@33[1]	1@1	1@133

Note 1: The allocated RB number L_{CRB} is ceil(N_{RB}/2) -1 in order to meet Inner RB allocation definition ($RB_{Start,Low} \leq RB_{Start} \leq RB_{Start,High}$) described in subclause 6.2.2 of TS 38.101-1 [2].

Output Power for 5G NR (FR1)

According to April 2015 TCB workshop, SAR test exclusion can be applied for testing overlapping 5G NR(FR1) bands as follows:

a) The maximum output power, including tolerance, for the smaller band must be ≤ the larger band to qualify for the SAR test exclusion.
b) The channel bandwidth and other operating parameters for the smaller band must be fully supported by the larger band.

Maximum bandwidth does not support at least three non-overlapping channels in certain channel bandwidths. When a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing per KDB 941225 D05 SAR for LTE Devices.

SAR measurement is not required for the Pi/2 BPSK, 16QAM, 64QAM and 256QAM. When the highest maximum output power for Pi/2 BPSK, 16QAM, 64QAM and 256QAM is ≤ ½ dB higher than the QPSK or when the reported SAR for the QPSK configuration is ≤ 1.45 W/kg.

Please refer to section 6.5. for 5G NR(FR1) detail test channels.

RF Air interface	Mode	Target Output Power (dBm)								Tolerance	Maximum Output Power (Tune-up Limit) (dBm)							
		ANT7		ANT8		ANT9		ANT4			ANT7		ANT8		ANT9		ANT4	
		Mode A	Mode B	Mode A	Mode B	Mode A	Mode B	Mode A	Mode B	+ / -	Mode A	Mode B	Mode A	Mode B	Mode A	Mode B	Mode A	Mode B
NR n48	QPSK	22.70	19.50	20.00	20.00	22.70	21.50	18.30	19.30	1.0 / -1.0	23.70	20.50	21.00	21.00	23.70	22.50	19.30	20.30

NR Band 48 Measured Results (ANT7)

BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)						Reduced Average Power (dBm)					
					638000	640444	642888	645332	MPR	Tune-up Limit	638000	640444	642888	645332	MPR	Tune-up Limit
					3570 MHz	3606.66 MHz	3643.32 MHz	3679.98 MHz			3570 MHz	3606.66 MHz	3643.32 MHz	3679.98 MHz		
40	DFS-s OFDM	PI/2 BPSK	1	1	23.25	23.36	23.29	23.26	0.00	23.70	19.92	19.88	19.93	19.85	0.00	20.50
			1	52	23.22	23.36	23.32	23.16	0.00	23.70	19.88	19.96	19.70	19.88	0.00	20.50
			1	104	23.34	23.23	23.25	23.30	0.00	23.70	19.90	20.00	19.84	19.90	0.00	20.50
			50	25	23.36	23.27	23.32	23.26	0.00	23.70	19.74	19.90	19.90	19.73	0.00	20.50
			100	0	22.74	22.85	22.90	22.88	0.00	23.70	19.73	19.87	19.92	19.76	0.00	20.50
		QPSK	1	1	23.21	23.32	23.19	23.30	0.00	23.70	19.78	20.00	19.98	19.99	0.00	20.50
			1	52	23.36	23.24	23.37	23.24	0.00	23.70	19.76	19.87	20.00	19.80	0.00	20.50
			1	104	23.31	23.39	23.30	23.20	0.00	23.70	19.89	19.97	19.72	19.99	0.00	20.50
			50	25	23.30	23.32	23.36	23.27	0.00	23.70	19.69	19.77	20.01	19.74	0.00	20.50
			100	0	22.22	22.31	22.38	22.27	0.00	23.70	19.72	19.88	19.95	19.77	0.00	20.50
		16QAM	1	1	22.28	22.29	22.18	22.21	0.00	23.70	19.68	19.98	19.87	19.76	0.00	20.50
		64QAM	1	1	22.97	23.12	23.07	23.06	0.50	23.20	19.92	19.86	19.90	19.86	0.00	20.50
		256QAM	1	1	21.13	21.06	21.01	21.19	2.50	21.20	19.12	19.17	19.10	19.13	0.00	20.50
	CP-OFDM	QPSK	1	1	22.30	22.29	22.32	22.40	0.00	23.70	19.89	19.95	19.99	19.89	0.00	20.50

BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)						Reduced Average Power (dBm)					
					637332	640222	643110	645998	MPR	Tune-up Limit	637332	640222	643110	645998	MPR	Tune-up Limit
					3559.98 MHz	3603.33 MHz	3646.65 MHz	3689.97 MHz			3559.98 MHz	3603.33 MHz	3646.65 MHz	3689.97 MHz		
20	DFS-s OFDM	PI/2 BPSK	1	1	23.17	22.99	23.18	23.11	0.00	23.70	19.87	19.78	19.87	19.96	0.00	20.50
			1	25	23.13	23.05	23.07	22.99	0.00	23.70	19.77	19.89	19.72	19.98	0.00	20.50
			1	49	23.20	23.18	23.18	23.09	0.00	23.70	19.94	19.81	19.77	19.95	0.00	20.50
			25	12	23.10	22.97	22.98	22.87	0.00	23.70	19.83	19.92	19.87	19.77	0.00	20.50
			50	0	22.60	22.55	22.53	22.48	0.00	23.70	19.85	19.93	19.94	19.78	0.00	20.50
		QPSK	1	1	23.20	23.01	23.09	22.97	0.00	23.70	19.76	19.80	19.94	19.87	0.00	20.50
			1	25	23.11	23.13	22.88	23.02	0.00	23.70	19.98	19.88	19.82	19.96	0.00	20.50
			1	49	23.19	23.09	22.97	23.07	0.00	23.70	19.94	19.92	19.96	19.86	0.00	20.50
			25	12	23.13	23.01	23.05	22.98	0.00	23.70	19.79	20.00	19.89	19.99	0.00	20.50
			50	0	22.32	22.25	22.18	22.10	0.00	23.70	19.88	19.95	19.94	19.78	0.00	20.50
		16QAM	1	1	22.17	22.30	22.40	22.33	0.00	23.70	19.93	19.77	19.94	19.96	0.00	20.50
		64QAM	1	1	23.11	23.07	23.19	23.04	0.50	23.20	19.87	19.89	19.95	19.74	0.00	20.50
		256QAM	1	1	21.20	21.08	21.18	21.19	2.50	21.20	19.10	19.14	19.14	19.05	0.00	20.50
	CP-OFDM	QPSK	1	1	22.34	22.32	22.31	22.38	0.00	23.70	19.90	19.93	19.79	19.76	0.00	20.50

BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)						Reduced Average Power (dBm)					
					637000	640110	643220	646332	MPR	Tune-up Limit	637000	640110	643220	646332	MPR	Tune-up Limit
					3555 MHz	3601.65 MHz	3648.3 MHz	3694.98 MHz			3555 MHz	3601.65 MHz	3648.3 MHz	3694.98 MHz		
10	DFS-s OFDM	PI/2 BPSK	1	1	23.20	23.10	22.60	23.13	0.00	23.70	19.87	19.94	19.94	19.82	0.00	20.50
			1	11	23.14	23.14	23.12	22.73	0.00	23.70	19.93	19.95	19.76	19.98	0.00	20.50
			1	22	23.12	22.73	23.12	23.17	0.00	23.70	19.80	19.88	19.92	20.00	0.00	20.50
			12	6	22.98	23.20	23.10	22.80	0.00	23.70	19.87	19.72	19.77	19.87	0.00	20.50
			24	0	22.69	22.68	22.62	22.70	0.00	23.70	19.79	19.98	19.88	19.97	0.00	20.50
		QPSK	1	1	23.18	23.07	23.13	23.13	0.00	23.70	19.87	19.96	19.86	19.99	0.00	20.50
			1	11	23.12	22.98	23.20	23.10	0.00	23.70	19.72	19.77	19.87	19.94	0.00	20.50
			1	22	22.98	22.78	23.14	23.13	0.00	23.70	19.87	19.88	19.97	19.96	0.00	20.50
			12	6	23.01	23.18	23.14	23.06	0.00	23.70	19.82	19.96	19.89	19.94	0.00	20.50
			24	0	22.18	22.35	22.32	22.30	0.00	23.70	19.79	19.88	19.88	19.97	0.00	20.50
		16QAM	1	1	22.40	22.33	22.17	22.30	0.00	23.70	19.83	19.85	19.76	19.98	0.00	20.50
		64QAM	1	1	23.19	23.14	23.11	23.17	0.50	23.20	19.96	19.89	19.94	19.94	0.00	20.50
		256QAM	1	1	21.18	21.19	21.20	21.08	2.50	21.20	19.15	19.09	19.19	19.14	0.00	20.50
	CP-OFDM	QPSK	1	1	22.38	22.34	22.32	22.31	0.00	23.70	19.77	19.87	19.94	19.94	0.00	20.50

NR Band 48 Measured Results (ANT8)

BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)				MPR	Tune-up Limit	Reduced Average Power (dBm)				MPR	Tune-up Limit
					638000	640444	642888	645332			638000	640444	642888	645332		
					3570 MHz	3606.66 MHz	3643.32 MHz	3679.98 MHz			3570 MHz	3606.66 MHz	3643.32 MHz	3679.98 MHz		
40	DFS-s OFDM	PI/2 BPSK	1	1	20.41	20.40	20.44	20.62	0.00	21.00	20.41	20.40	20.44	20.62	0.00	21.00
			1	52	20.24	20.50	20.44	20.68	0.00	21.00	20.24	20.50	20.44	20.68	0.00	21.00
			1	104	20.43	20.69	20.60	20.70	0.00	21.00	20.43	20.69	20.60	20.70	0.00	21.00
			50	25	20.23	20.48	20.38	20.60	0.00	21.00	20.23	20.48	20.38	20.60	0.00	21.00
			100	0	19.75	19.99	19.93	20.18	0.00	21.00	19.75	19.99	19.93	20.18	0.00	21.00
		QPSK	1	1	20.34	20.44	20.43	20.60	0.00	21.00	20.34	20.44	20.43	20.60	0.00	21.00
			1	52	20.20	20.46	20.70	20.60	0.00	21.00	20.20	20.46	20.70	20.60	0.00	21.00
			1	104	20.34	20.62	20.61	20.70	0.00	21.00	20.34	20.62	20.61	20.70	0.00	21.00
			50	25	20.19	20.39	20.37	20.65	0.00	21.00	20.19	20.39	20.37	20.65	0.00	21.00
			100	0	19.76	19.96	19.87	19.92	0.00	21.00	19.76	19.96	19.87	19.92	0.00	21.00
		16QAM	1	1	19.79	19.69	19.79	19.99	0.00	21.00	19.79	19.69	19.79	19.99	0.00	21.00
		64QAM	1	1	20.46	20.28	20.43	20.43	0.30	20.70	20.46	20.28	20.43	20.43	0.30	20.70
		256QAM	1	1	18.39	18.14	17.93	17.93	2.30	18.70	18.39	18.14	17.93	17.93	2.30	18.70
	CP-OFDM	QPSK	1	1	20.89	20.99	20.97	20.95	0.00	21.00	20.89	20.99	20.97	20.95	0.00	21.00

BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)				MPR	Tune-up Limit	Reduced Average Power (dBm)				MPR	Tune-up Limit
					637332	640222	643110	645998			637332	640222	643110	645998		
					3559.98 MHz	3603.33 MHz	3646.65 MHz	3689.97 MHz			3559.98 MHz	3603.33 MHz	3646.65 MHz	3689.97 MHz		
20	DFS-s OFDM	PI/2 BPSK	1	1	20.57	20.54	20.63	20.63	0.00	21.00	20.57	20.54	20.63	20.63	0.00	21.00
			1	25	20.47	20.58	20.60	20.61	0.00	21.00	20.47	20.58	20.60	20.61	0.00	21.00
			1	49	20.68	20.64	20.63	20.70	0.00	21.00	20.68	20.64	20.63	20.70	0.00	21.00
			25	12	20.65	20.48	20.56	20.37	0.00	21.00	20.65	20.48	20.56	20.37	0.00	21.00
			50	0	20.14	20.08	20.16	20.00	0.00	21.00	20.14	20.08	20.16	20.00	0.00	21.00
		QPSK	1	1	20.67	20.70	20.62	20.66	0.00	21.00	20.67	20.70	20.62	20.66	0.00	21.00
			1	25	20.66	20.54	20.64	20.55	0.00	21.00	20.66	20.54	20.64	20.55	0.00	21.00
			1	49	20.48	20.66	20.65	20.54	0.00	21.00	20.48	20.66	20.65	20.54	0.00	21.00
			25	12	20.53	20.66	20.68	20.56	0.00	21.00	20.53	20.66	20.68	20.56	0.00	21.00
			50	0	19.78	19.87	19.92	19.75	0.00	21.00	19.78	19.87	19.92	19.75	0.00	21.00
		16QAM	1	1	19.93	19.91	19.89	19.80	0.00	21.00	19.93	19.91	19.89	19.80	0.00	21.00
		64QAM	1	1	20.50	20.31	20.33	20.29	0.30	20.70	20.50	20.31	20.33	20.29	0.30	20.70
		256QAM	1	1	18.42	18.40	18.44	18.42	2.30	18.70	18.42	18.40	18.44	18.42	2.30	18.70
	CP-OFDM	QPSK	1	1	20.91	20.68	20.89	20.97	0.00	21.00	20.91	20.68	20.89	20.97	0.00	21.00

BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)				MPR	Tune-up Limit	Reduced Average Power (dBm)				MPR	Tune-up Limit
					637000	640110	643220	646332			637000	640110	643220	646332		
					3555 MHz	3601.65 MHz	3648.3 MHz	3694.98 MHz			3555 MHz	3601.65 MHz	3648.3 MHz	3694.98 MHz		
10	DFS-s OFDM	PI/2 BPSK	1	1	20.64	20.65	20.62	20.52	0.00	21.00	20.64	20.65	20.62	20.52	0.00	21.00
			1	11	20.56	20.64	20.67	20.53	0.00	21.00	20.56	20.64	20.67	20.53	0.00	21.00
			1	22	20.70	20.64	20.69	20.70	0.00	21.00	20.70	20.64	20.69	20.70	0.00	21.00
			12	6	20.68	20.60	20.52	20.51	0.00	21.00	20.68	20.60	20.52	20.51	0.00	21.00
			24	0	20.12	20.18	20.10	20.04	0.00	21.00	20.12	20.18	20.10	20.04	0.00	21.00
		QPSK	1	1	20.59	20.54	20.66	20.62	0.00	21.00	20.59	20.54	20.66	20.62	0.00	21.00
			1	11	20.63	20.67	20.58	20.70	0.00	21.00	20.63	20.67	20.58	20.70	0.00	21.00
			1	22	20.70	20.67	20.59	20.58	0.00	21.00	20.70	20.67	20.59	20.58	0.00	21.00
			12	6	20.64	20.58	20.70	20.67	0.00	21.00	20.64	20.58	20.70	20.67	0.00	21.00
			24	0	19.99	19.93	19.91	19.97	0.00	21.00	19.99	19.93	19.91	19.97	0.00	21.00
		16QAM	1	1	19.79	19.87	19.88	19.93	0.00	21.00	19.79	19.87	19.88	19.93	0.00	21.00
		64QAM	1	1	20.37	20.50	20.41	20.31	0.30	20.70	20.37	20.50	20.41	20.31	0.30	20.70
		256QAM	1	1	18.44	18.20	18.50	18.46	2.30	18.70	18.44	18.20	18.50	18.46	2.30	18.70
	CP-OFDM	QPSK	1	1	21.00	20.91	20.92	20.99	0.00	21.00	21.00	20.91	20.92	20.99	0.00	21.00

NR Band 48 Measured Results (ANT9)

BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)						Reduced Average Power (dBm)					
					638000	640444	642888	645332	MPR	Tune-up Limit	638000	640444	642888	645332	MPR	Tune-up Limit
					3570 MHz	3606.66 MHz	3643.32 MHz	3679.98 MHz			3570 MHz	3606.66 MHz	3643.32 MHz	3679.98 MHz		
40	DFS-s OFDM	PI/2 BPSK	1	1	23.54	23.38	23.42	23.42	0.00	23.70	22.04	22.05	21.86	22.08	0.00	22.50
			1	52	23.31	23.51	23.29	23.51	0.00	23.70	21.91	21.97	21.78	21.73	0.00	22.50
			1	104	23.57	23.65	23.45	23.34	0.00	23.70	21.92	21.94	21.89	22.03	0.00	22.50
			50	25	23.27	23.49	23.28	23.59	0.00	23.70	22.00	21.94	21.78	21.72	0.00	22.50
			100	0	22.75	23.05	23.12	23.16	0.00	23.70	22.04	21.99	21.83	21.71	0.00	22.50
		QPSK	1	1	23.55	23.47	23.50	23.65	0.00	23.70	22.09	21.77	22.04	22.08	0.00	22.50
			1	52	23.26	23.57	23.65	23.63	0.00	23.70	22.04	22.06	22.10	21.82	0.00	22.50
			1	104	23.58	23.62	23.61	23.45	0.00	23.70	21.93	22.07	21.85	21.93	0.00	22.50
			50	25	23.19	23.54	23.26	23.58	0.00	23.70	21.98	21.95	22.10	21.75	0.00	22.50
			100	0	22.26	22.58	22.59	22.70	0.00	23.70	21.86	22.10	21.82	21.78	0.00	22.50
		16QAM	1	1	22.45	22.31	22.39	22.35	0.00	23.70	21.81	21.74	22.00	22.02	0.00	22.50
		64QAM	1	1	21.15	21.02	21.16	21.00	1.00	22.70	21.01	21.07	21.04	21.12	0.00	22.50
		256QAM	1	1	19.10	19.06	19.09	19.00	3.00	20.70	19.14	19.02	19.01	19.01	1.80	20.70
	CP-OFDM	QPSK	1	1	22.05	22.01	22.07	22.09	0.00	23.70	22.09	21.83	22.05	22.14	0.00	22.50
BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)						Reduced Average Power (dBm)					
					637332	640222	643110	645998	MPR	Tune-up Limit	637332	640222	643110	645998	MPR	Tune-up Limit
					3559.98 MHz	3603.33 MHz	3646.65 MHz	3689.97 MHz			3559.98 MHz	3603.33 MHz	3646.65 MHz	3689.97 MHz		
20	DFS-s OFDM	PI/2 BPSK	1	1	23.49	23.15	23.64	23.65	0.00	23.70	21.92	21.81	21.99	22.05	0.00	22.50
			1	25	23.39	23.22	23.64	23.63	0.00	23.70	22.00	21.91	21.91	21.82	0.00	22.50
			1	49	23.38	23.35	23.63	23.67	0.00	23.70	22.10	21.98	22.01	21.91	0.00	22.50
			25	12	23.41	23.29	23.58	23.42	0.00	23.70	22.07	21.79	21.90	21.89	0.00	22.50
			50	0	22.94	22.72	23.08	22.87	0.50	23.20	22.07	21.88	21.94	21.99	0.00	22.50
		QPSK	1	1	23.53	23.10	23.56	23.66	0.00	23.70	22.08	21.77	21.95	22.04	0.00	22.50
			1	25	23.39	23.26	23.69	23.48	0.00	23.70	22.07	21.86	21.88	21.80	0.00	22.50
			1	49	23.61	23.45	23.60	23.33	0.00	23.70	22.04	22.04	22.06	21.78	0.00	22.50
			25	12	23.41	23.21	23.57	23.41	0.00	23.70	22.06	21.81	21.89	21.99	0.00	22.50
			50	0	22.42	22.21	22.63	22.40	0.00	23.70	22.03	21.87	21.92	21.83	0.00	22.50
		16QAM	1	1	22.57	22.51	22.63	22.60	0.00	23.70	21.95	22.04	21.95	22.06	0.00	22.50
		64QAM	1	1	22.12	21.72	22.18	21.99	0.50	23.20	21.17	20.81	21.07	21.13	0.00	22.50
		256QAM	1	1	19.20	19.53	20.13	19.84	2.50	21.20	19.10	19.02	19.14	19.16	1.80	20.70
	CP-OFDM	QPSK	1	1	22.18	22.15	22.02	22.18	0.00	23.70	22.07	21.69	21.87	22.12	0.00	22.50
BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)						Reduced Average Power (dBm)					
					637000	640110	643220	646332	MPR	Tune-up Limit	637000	640110	643220	646332	MPR	Tune-up Limit
					3555 MHz	3601.65 MHz	3648.3 MHz	3694.98 MHz			3555 MHz	3601.65 MHz	3648.3 MHz	3694.98 MHz		
10	DFS-s OFDM	PI/2 BPSK	1	1	23.48	23.20	23.56	23.66	0.00	23.70	22.05	21.80	21.86	21.87	0.00	22.50
			1	11	23.25	23.13	23.70	23.53	0.00	23.70	22.03	21.67	21.71	21.64	0.00	22.50
			1	22	23.32	23.13	23.56	23.68	0.00	23.70	21.96	21.72	21.81	21.74	0.00	22.50
			12	6	23.44	23.08	23.50	23.65	0.00	23.70	21.99	21.65	21.82	21.74	0.00	22.50
			24	0	22.90	22.63	22.95	23.18	0.50	23.20	21.98	21.74	21.85	21.78	0.00	22.50
		QPSK	1	1	23.49	23.20	23.68	23.67	0.00	23.70	22.07	21.78	21.80	21.78	0.00	22.50
			1	11	23.43	23.20	23.56	23.69	0.00	23.70	21.94	21.76	21.78	21.90	0.00	22.50
			1	22	23.42	23.03	23.66	23.47	0.00	23.70	21.99	21.86	22.05	21.75	0.00	22.50
			12	6	23.41	23.12	23.45	23.69	0.00	23.70	21.95	21.75	21.82	21.80	0.00	22.50
			24	0	22.36	22.10	22.45	22.65	0.00	23.70	21.96	21.70	21.86	21.75	0.00	22.50
		16QAM	1	1	22.64	22.45	22.29	22.66	0.00	23.70	22.06	21.88	22.08	21.95	0.00	22.50
		64QAM	1	1	21.98	21.66	22.05	22.05	0.50	23.20	20.91	20.93	21.14	21.15	0.00	22.50
		256QAM	1	1	19.74	19.65	19.99	20.14	2.50	21.20	19.02	19.06	19.19	19.14	1.80	20.70
	CP-OFDM	QPSK	1	1	23.05	22.68	23.18	23.15	0.00	23.70	21.90	21.69	22.12	22.19	0.00	22.50

NR Band 48 Measured Results (ANT4)

BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)				MPR	Tune-up Limit	Reduced Average Power (dBm)				MPR	Tune-up Limit
					638000	640444	642888	645332			638000	640444	642888	645332		
					3570 MHz	3606.66 MHz	3643.32 MHz	3679.98 MHz			3570 MHz	3606.66 MHz	3643.32 MHz	3679.98 MHz		
40	DFS-s OFDM	PI/2 BPSK	1	1	18.87	18.64	18.77	18.91	0.00	19.30	19.61	19.87	19.07	19.57	0.00	20.30
			1	52	18.83	18.73	18.62	18.85	0.00	19.30	19.89	19.95	18.92	19.43	0.00	20.30
			1	104	18.87	18.84	18.87	18.77	0.00	19.30	19.97	19.95	19.37	19.47	0.00	20.30
			50	25	18.63	18.67	18.65	18.65	0.00	19.30	19.86	19.92	18.95	19.93	0.00	20.30
			100	0	18.77	18.69	18.74	18.66	0.00	19.30	19.27	19.34	19.04	19.37	0.00	20.30
		QPSK	1	1	18.92	18.65	18.76	18.79	0.00	19.30	19.83	19.92	19.92	19.52	0.00	20.30
			1	52	18.70	18.67	18.73	18.75	0.00	19.30	19.85	19.87	20.00	19.30	0.00	20.30
			1	104	18.92	18.81	18.88	18.67	0.00	19.30	19.99	19.89	19.80	19.52	0.00	20.30
			50	25	18.70	18.67	19.00	18.63	0.00	19.30	19.90	19.88	18.94	19.30	0.00	20.30
			100	0	18.77	18.66	18.72	18.65	0.00	19.30	19.00	18.92	19.02	19.00	0.00	20.30
		16QAM	1	1	18.94	18.64	18.79	18.85	0.00	19.30	19.30	19.27	19.39	19.04	0.00	20.30
		64QAM	1	1	18.07	17.89	17.81	18.16	0.00	19.30	19.70	19.70	19.81	19.57	0.10	20.20
		256QAM	1	1	18.15	18.00	18.02	17.87	1.10	18.20	17.85	17.69	17.82	17.35	2.10	18.20
	CP-OFDM	QPSK	1	1	18.95	18.62	18.81	18.69	0.00	19.30	19.77	19.45	19.51	18.98	0.00	20.30
BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)				MPR	Tune-up Limit	Reduced Average Power (dBm)				MPR	Tune-up Limit
					637332	640222	643110	645998			637332	640222	643110	645998		
					3559.98 MHz	3603.33 MHz	3646.65 MHz	3689.97 MHz			3559.98 MHz	3603.33 MHz	3646.65 MHz	3689.97 MHz		
20	DFS-s OFDM	PI/2 BPSK	1	1	18.80	18.83	18.65	18.90	0.00	19.30	19.94	19.85	19.93	19.91	0.00	20.30
			1	25	18.90	18.63	18.55	18.80	0.00	19.30	19.89	19.61	19.87	19.84	0.00	20.30
			1	49	18.70	18.77	18.65	18.65	0.00	19.30	19.77	19.76	19.83	19.94	0.00	20.30
			25	12	18.40	18.57	18.75	18.75	0.00	19.30	19.57	19.71	19.94	19.94	0.00	20.30
			50	0	18.60	18.59	18.95	18.85	0.00	19.30	19.16	19.38	19.32	19.42	0.00	20.30
		QPSK	1	1	18.70	18.61	18.85	18.75	0.00	19.30	19.93	19.66	19.63	19.92	0.00	20.30
			1	25	18.70	18.59	18.75	18.65	0.00	19.30	19.66	19.65	19.92	19.82	0.00	20.30
			1	49	18.80	18.90	18.65	18.55	0.00	19.30	19.68	19.80	19.85	19.99	0.00	20.30
			25	12	18.70	18.62	18.55	18.65	0.00	19.30	19.91	19.62	19.81	19.93	0.00	20.30
			50	0	18.90	18.57	18.55	18.85	0.00	19.30	18.89	18.70	18.79	18.60	0.00	20.30
		16QAM	1	1	18.50	18.35	18.65	18.95	0.00	19.30	19.24	19.34	19.34	19.19	0.00	20.30
		64QAM	1	1	18.21	18.17	18.05	18.05	0.00	19.30	19.69	19.73	19.70	19.79	0.10	20.20
		256QAM	1	1	18.13	18.17	17.95	17.85	1.10	18.20	17.52	17.72	17.66	17.88	2.10	18.20
	CP-OFDM	QPSK	1	1	18.70	18.87	18.90	18.90	0.00	19.30	19.56	19.76	19.49	19.75	0.00	20.30
BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)				MPR	Tune-up Limit	Reduced Average Power (dBm)				MPR	Tune-up Limit
					637000	640110	643220	646332			637000	640110	643220	646332		
					3555 MHz	3601.65 MHz	3648.3 MHz	3694.98 MHz			3555 MHz	3601.65 MHz	3648.3 MHz	3694.98 MHz		
10	DFS-s OFDM	PI/2 BPSK	1	1	18.80	18.40	18.90	18.70	0.00	19.30	19.80	19.72	19.98	19.55	0.00	20.30
			1	11	18.90	18.50	18.72	18.60	0.00	19.30	19.71	19.85	19.91	19.34	0.00	20.30
			1	22	18.90	18.90	18.88	18.70	0.00	19.30	19.89	19.64	19.71	19.41	0.00	20.30
			12	6	18.70	18.70	18.90	18.80	0.00	19.30	19.79	19.98	19.84	19.90	0.00	20.30
			24	0	18.60	18.60	18.93	18.80	0.00	19.30	19.21	19.47	19.38	19.31	0.00	20.30
		QPSK	1	1	18.88	18.70	18.87	18.90	0.00	19.30	19.75	19.90	19.81	19.48	0.00	20.30
			1	11	18.90	18.80	18.77	18.70	0.00	19.30	19.86	19.95	19.75	19.21	0.00	20.30
			1	22	18.90	18.90	18.81	18.70	0.00	19.30	19.72	19.94	19.91	19.50	0.00	20.30
			12	6	18.70	18.80	18.65	18.65	0.00	19.30	19.54	19.92	19.94	19.24	0.00	20.30
			24	0	18.90	18.70	18.61	18.95	0.00	19.30	18.99	18.71	18.92	18.80	0.00	20.30
		16QAM	1	1	18.60	18.70	18.88	18.90	0.00	19.30	19.36	19.00	19.27	19.27	0.00	20.30
		64QAM	1	1	18.00	17.90	18.25	17.75	0.00	19.30	19.76	19.80	19.74	19.85	0.10	20.20
		256QAM	1	1	18.10	18.00	18.19	17.85	1.10	18.20	17.61	17.81	17.87	17.76	2.10	18.20
	CP-OFDM	QPSK	1	1	18.80	18.90	18.88	18.93	0.00	19.30	19.74	19.85	19.71	19.45	0.00	20.30

10. Measured and Reported (Scaled) SAR Results

SAR Test Reduction criteria are as follows:

- Reported SAR(W/kg) for WWAN = Measured SAR *Tune-up Scaling Factor
- Reported SAR(W/kg) for Wi-Fi and Bluetooth = Measured SAR * Tune-up scaling factor * Duty Cycle scaling factor
- Duty Cycle scaling factor = 1 / Duty cycle (%)

KDB 447498 D01 General RF Exposure Guidance:

Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:

- ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
- ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

KDB 648474 D04 Handset SAR:

With headset attached, when the reported SAR for 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 that body-worn accessory with a headset attached to the handset.

KDB 941225 D01 SAR test for 3G devices:

When the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤ ¼ dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode.

KDB 941225 D05 SAR for LTE Devices:

SAR test reduction is applied using the following criteria:

- Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB, and 50% RB allocation, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel.
- When the reported SAR is > 0.8 W/kg, testing for other Channels is performed at the highest output power level for 1RB, and 50% RB configuration for that channel.
- Testing for 100% RB configuration is performed at the highest output power level for 100% RB configuration across the Low, Mid and High Channel when the highest reported SAR for 1 RB and 50% RB are > 0.8 W/kg. Testing for the remaining required channels is not needed because the reported SAR for 100% RB Allocation < 1.45 W/kg.
- Testing for 16-QAM modulation is not required because the reported SAR for QPSK is < 1.45 W/Kg and its output power is not more than 0.5 dB higher than that of QPSK.
- Testing for the other channel bandwidths is not required because the reported SAR for the highest channel bandwidth is < 1.45 W/Kg and its output power is not more than 0.5 dB higher than that of the highest channel bandwidth.
- For LTE bands that do not support at least three non-overlapping channels in certain channel bandwidths, test the available non-overlapping channels instead. When a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing; therefore, the requirement for H, M and L channels may not fully apply.

10.1. 5G NR Band n48 (40MHz Bandwidth)

Antenna	RF Exposure Conditions	Mode	Power Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offset	Power (dBm)		1-g SAR (W/kg)		10-g SAR (W/kg)		Plot No.
										Tune-up Limit	Meas.	Meas.	Scaled	Meas.	Scaled	
ANT7	Head	DFT-s-OFDM QPSK	Mode A	0	Right Touch	642888	3643.3	1	52	23.70	23.37	0.191	0.206	0.076	0.082	1
	Body & Hotspot	DFT-s-OFDM QPSK	Mode B	5	Rear	642888	3643.3	50	25	20.50	20.01	0.692	0.775	0.264	0.296	2
	Body & Hotspot	DFT-s-OFDM QPSK	Mode B	5	Edge 2	642888	3643.3	50	25	20.50	20.01	0.675	0.756	0.270	0.302	3
Antenna	RF Exposure Conditions	Mode	Power Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offset	Power (dBm)		1-g SAR (W/kg)		10-g SAR (W/kg)		Plot No.
										Tune-up Limit	Meas.	Meas.	Scaled	Meas.	Scaled	
ANT8	Head	DFT-s-OFDM QPSK	Mode A	0	Right Touch	642888	3643.3	1	52	21.00	20.70	0.590	0.632	0.249	0.267	4
	Body & Hotspot	DFT-s-OFDM QPSK	Mode B	5	Rear	642888	3643.3	1	52	21.00	20.70	0.753	0.807	0.276	0.296	5
Antenna	RF Exposure Conditions	Mode	Power Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offset	Power (dBm)		1-g SAR (W/kg)		10-g SAR (W/kg)		Plot No.
										Tune-up Limit	Meas.	Meas.	Scaled	Meas.	Scaled	
ANT9	Head	DFT-s-OFDM QPSK	Mode A	0	Left Touch	642888	3643.3	1	52	23.70	23.65	0.077	0.078	0.020	0.020	6
	Body & Hotspot	DFT-s-OFDM QPSK	Mode B	5	Front	642888	3643.3	1	52	22.50	22.10	0.678	0.743	0.291	0.319	7
	Body & Hotspot	DFT-s-OFDM QPSK	Mode B	5	Edge 4	642888	3643.3	50	25	22.50	22.10	0.405	0.444	0.145	0.159	8
Antenna	RF Exposure Conditions	Mode	Power Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offset	Power (dBm)		1-g SAR (W/kg)		10-g SAR (W/kg)		Plot No.
										Tune-up Limit	Meas.	Meas.	Scaled	Meas.	Scaled	
ANT4	Head	DFT-s-OFDM QPSK	Mode A	0	Left Touch	642888	3643.3	50	25	19.30	19.00	0.730	0.782	0.284	0.304	9
	Body & Hotspot	DFT-s-OFDM QPSK	Mode B	5	Rear	642888	3643.3	1	52	20.30	20.00	0.764	0.819	0.279	0.299	10
	Hotspot	DFT-s-OFDM QPSK	Mode B	5	Edge 2	642888	3643.3	1	52	20.30	20.00	0.653	0.700	0.246	0.264	11

11. SAR Measurement Variability

In accordance with published RF Exposure KDB 865664 D01 SAR measurement 100 MHz to 6 GHz. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

1) Repeated measurement is not required when the original highest measured SAR is <0.8 or 2 W/kg (1-g or 10-g respectively); steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.8 or 2 W/kg (1-g or 10-g respectively), repeat that measurement once.
3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 or 3.6 W/kg (~ 10% from the 1-g or 10-g respective SAR limit).
4) Perform a third repeated measurement only if the original, first, or second repeated measurement is ≥ 1.5 or 3.75 W/kg (1-g or 10-g respectively) and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Note(s):

Repeated measurement is not required since the original highest measured SAR is <0.8 W/kg (1-g) or 2 W/kg (10-g) .

12. Simultaneous Transmission Conditions

KDB 447498 D01 General RF Exposure Guidance provides two procedures for determining simultaneous transmission SAR test exclusion: Sum of SAR and SAR to Peak Location Ratio (SPLSR)

Sum of SAR

To qualify for simultaneous transmission SAR test exclusion based upon Sum of SAR the sum of the reported standalone SARs for all simultaneously transmitting antennas shall be below the applicable standalone SAR limit. If the sum of the SARs is above the applicable limit then simultaneous transmission SAR test exclusion may still apply if the requirements of the SAR to Peak Location Ratio (SPLSR) evaluation are met.

SAR to Peak Location Ratio (SPLSR)

KDB 447498 D01 General RF Exposure Guidance explains how to calculate the SAR to Peak Location Ratio (SPLSR) between pairs of simultaneously transmitting antennas:

$$SPLSR = (SAR_1 + SAR_2)^{1.5} / Ri$$

Where:

SAR_1 is the highest reported or estimated SAR for the first of a pair of simultaneous transmitting antennas, in a specific test operating mode and exposure condition

SAR_2 is the highest reported or estimated SAR for the second of a pair of simultaneous transmitting antennas, in the same test operating mode and exposure condition as the first

Ri is the separation distance between the pair of simultaneous transmitting antennas. When the SAR is measured, for both antennas in the pair, it is determined by the actual x, y and z coordinates in the 1-g SAR for each SAR peak location, based on the extrapolated and interpolated result in the zoom scan measurement, using the formula of $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$

In order for a pair of simultaneous transmitting antennas with the sum of 1-g SAR > 1.6 W/kg to qualify for exemption from Simultaneous Transmission SAR measurements, it has to satisfy the condition of:

$$(SAR_1 + SAR_2)^{1.5} / Ri \leq 0.04$$

When an individual antenna transmits at on two bands simultaneously, the sum of the highest *reported* SAR for the frequency bands should be used to determine SAR_1.or SAR_2. When SPLSR is necessary, the smallest distance between the peak SAR locations for the antenna pair with respect to the peaks from each antenna should be used.

The antennas in all antenna pairs that do not qualify for simultaneous transmission SAR test exclusion must be tested for SAR compliance, according to the enlarged zoom scan and volume scan post-processing procedures in KDB Publication 865664 D01

Simultaneous transmission SAR measurement

When simultaneous transmission SAR measurements are required in different frequency bands not covered by a single probe calibration point then separate tests for each frequency band are performed. The tests are performed using enlarged zoom scans which are processed, by means of superposition, using the DASY volume scan post-processing procedures to determine the 1-g SAR for the aggregate SAR distribution.

The spatial resolution used for all enlarged zoom scans is the same as used for the most stringent zoom scans. I.E. the scan parameters required for the highest frequency assessed are used for all enlarged zoom scans. The scans cover the complete area of the device to ensure all transmitting antennas and radiating structures are assessed.

DASY provides the ability to perform Multiband Evaluations according to the latest standards using the Volume Scan job as well as appropriate routines for the Post-processing.

In order to extract and process measurements within different frequency bands, the SEMCAD X Post-processor performs the combination and subsequent superposition of these measurement data via DASY = Combined MultiBand Averaged SAR.

Combined Multi Band Averaged SAR allows - in addition to the data extraction - an evaluation of the 1 g, 10 g and/or arbitrary averaged mass SAR.

Power Scaling Factor is used to allow the volume scans to be scaled by a value other than "1", this is important when the results need to be scaled to different maximum power levels. The Power Scaling Factor is applied to each individual point of the scan. When power scaling is used in multi-band combinations the scaling factor is applied to each individual point of the first scan, the second factor is then applied to each individual point of the second scan and so on. The scans are then combined.

Simultaneous transmission SAR Exclusion

According to KDB 248227 D01, simultaneous SAR provisions in KDB 447498 D01 apply to determine simultaneous transmission SAR test exclusion for Wi-Fi MIMO. If the sum of 1-g single transmission chain SAR measurements is <1.6W/kg and/or the MIMO output power is equal or less than a single chain, then no additional SAR measurements for simultaneously at the specified maximum output power of MIMO operation.

When antennas are spatially separated to the extent that SAR distributions do not overlap and can be treated independently, SAR compliance for simultaneous transmission is determined separately for each individual antenna.

In Airplay mode, the device uses same power and power control mechanism as Wi-Fi. Airplay is not supported in hotspot mode. Airplay utilize the same 802.11 modes, modulation, MIMO, Channel Bandwidth, etc. as Wi-Fi does. Therefore Airplay usage is categorized by the Wi-Fi SAR testing contained in Section 10.

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

RF Exposure Condition	Item	Capable Transmit Configurations		
Head Body Worn Accessory Hotspot	1	WWAN & 5G OFF (CELLULAR ANTENNAS OFF)	+ (ANT5) Wi-Fi 5 GHz SISO	+ (ANT3) Bluetooth (P_{High})
	2		+ (ANT6) Wi-Fi 5 GHz SISO	+ (ANT3) Bluetooth (P_{High})
	3		+ Wi-Fi 5 GHz MIMO	+ (ANT3) Bluetooth (P_{High})
	4		+ (ANT5) Wi-Fi 5 GHz SISO	+ (ANT4) Bluetooth (P_{High})
	5		+ (ANT6) Wi-Fi 5 GHz SISO	+ (ANT4) Bluetooth (P_{High})
	6		+ Wi-Fi 5 GHz MIMO	+ (ANT4) Bluetooth (P_{High})
	7	WWAN & 5G ON (CELLULAR ANTENNAS ON)	+ (ANT3) Wi-Fi 2.4 GHz SISO	
	8		+ (ANT4) Wi-Fi 2.4 GHz SISO	
	9		+ Wi-Fi 2.4 GHz MIMO	
	10			+ (ANT3) Bluetooth (P_{High})
	11			+ (ANT4) Bluetooth (P_{High})
	12		+ (ANT5) Wi-Fi 5 GHz SISO	
	13		+ (ANT6) Wi-Fi 5 GHz SISO	
	14		+ Wi-Fi 5 GHz MIMO	
	15		+ (ANT5) Wi-Fi 5 GHz SISO	+ (ANT3) Bluetooth (P_{low})
	16		+ (ANT6) Wi-Fi 5 GHz SISO	+ (ANT3) Bluetooth (P_{low})
	17		+ Wi-Fi 5 GHz MIMO	+ (ANT3) Bluetooth (P_{low})
	18		+ (ANT5) Wi-Fi 5 GHz SISO	+ (ANT4) Bluetooth (P_{low})
	19		+ (ANT6) Wi-Fi 5 GHz SISO	+ (ANT4) Bluetooth (P_{low})
	20		+ Wi-Fi 5 GHz MIMO	+ (ANT4) Bluetooth (P_{low})

Note(s):

1. Wi-Fi 2.4GHz & Bluetooth cannot transmit simultaneously.
2. Wi-Fi 2.4GHz & Wi-Fi 5GHz cannot transmit simultaneously.
3. WWAN cannot transmit simultaneously.
4. Bluetooth P_{low} is used with Wi-Fi and WWAN antennas are active.
5. Bluetooth P_{high} is used when Wi-Fi antenna is active and WWAN antenna is inactive or with Wi-Fi inactive and WWAN antenna is active.
6. Bluetooth $P_{standalone}$ is used with Wi-Fi and WWAN antennas are inactive.
7. Wi-Fi SISO mode SAR result can also represent for MIMO mode SAR and is used for MIMO mode simultaneous transmission analysis because antennas are not overlapping and the MIMO mode maximum power is equal or less than SISO mode.
8. 5G NR only supported NSA mode.
9. For EN-DC mode, Qualcomm Smart Transmit algorithm in WWAN adds directly the time-averaged RF exposure from 4G(LTE) and time-averaged RF exposure from 5G NR. Smart Transmit algorithm controls the total RF exposure from both 4G and 5G NR to not exceed FCC limit. Therefore, simultaneous transmission compliance between 4G+5G NR operation is demonstrated in the Part 2 Report during algorithm validation. In Part 1 Report, simultaneous transmission compliance was evaluated individually with other Radios (WLAN or BT) using one of 4G or 5G NR.

12.1. Sum of the SAR for Worst case WWAN Cell-on(ANT4) & Wi-Fi & BT results

RF Exposure conditions	Test Position	Standalone SAR (W/kg)					∑ 1-g SAR (W/kg)			
		1	2	3	6	7	1+2	1+3	1+6	1+7
		WWAN Cell-on ANT4	Wi-Fi 2.4G ANT3	Wi-Fi 2.4G ANT4	BT(P_{high}) ANT3	BT(P_{high}) ANT4				
Head	Left Touch	0.782	0.228	0.378	0.213	0.392	1.010	1.160	0.995	1.174
Body-worn & Hptspot	Rear	0.819	0.315	0.452	0.396	0.238	1.134	1.271	1.215	1.057

RF Exposure conditions	Test Position	Standalone SAR (W/kg)					∑ 1-g SAR (W/kg)			
		1	4	5	8	9	1+4+8	1+4+9	1+5+8	1+5+9
		WWAN Cell-on ANT4	Wi-Fi 5G ANT5	Wi-Fi 5G ANT6	BT(P_{Low}) ANT3	BT(P_{Low}) ANT4				
Head	Left Touch	0.782	0.043	0.282	0.030	0.073	0.855	0.898	1.094	1.137
Body-worn & Hptspot	Rear	0.819	0.387	0.395	0.096	0.081	1.302	1.287	1.310	1.295

Appendixes

Refer to separated files for the following appendixes.

Appendix A: SAR Setup Photos

Appendix B: SAR System Check Plots

Appendix C: SAR Highest Test Plots

Appendix D: SAR Tissue Ingredients

Appendix E: SAR Probe Certificates

Appendix F: SAR Dipole Certificates

END OF REPORT