FCC 47 CFR § 2.1093
IEEE Std 1528-2013

SAR EVALUATION REPORT
(Part 0 : SAR CHARACTERIZATION)

FOR

WCDMA/LTE/5G NR Tablet + BT/BLE, DTS/UNII a/b/g/n/ac/ax, and NFC

MODEL NUMBER: SM-T638U

FCC ID: A3LSMT638U

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TL-637

Revision History

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1. Attestation of SAR Characterization

Applicant Name	SAMSUNG ELECTRONICS CO.,LTD.
FCC ID	A3LSMT638U
Model Number	SM-T636U
Applicable Standards	FCC 47 CFR § 2.1093 IEEE Std 1528-2013 Published RF exposure KDB procedures
Report type	Part.0 : SAR Characterization
Date Tested	6/21/2022 to 8/8/2022
Part 0 Purpose	Part 0 is the procedures for determining P_{Limit} for 2G/3G/4G/5G NR sub6 to satisfy *SAR_design_target* in order to FCC limit's requirement.

UL Korea, Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Korea, Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. 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 IAS, any agency of the Federal Government, or any agency of any government

Approved & Released By:	Prepared By:
	
Justin Park Operations Leader UL Korea, Ltd. Suwon Laboratory	Seungyeon Kim Senior Laboratory Technician UL Korea, Ltd. Suwon Laboratory

2. Introduction

The equipment under test (EUT) is SAMSUNG Smartphone (FCC ID : A3LSMT638U), it contains the Qualcomm modems supporting 3G/4G/5G NR technologies. These modems are enable with Qualcomm Smart Transmit feature to control and manage transmitting power in real time and to ensure at all times the time-averaged RF exposure is in compliance with FCC requirement.

This purpose of the part 0 report is to determine SAR char is derived from SAR test measurements and conducted power measurements to determine P_{Limit} for each technology/band. The P_{Limit} represents the maximum time-averaged power level for the corresponding radio/antenna configuration.

3. Facilities and Accreditation

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

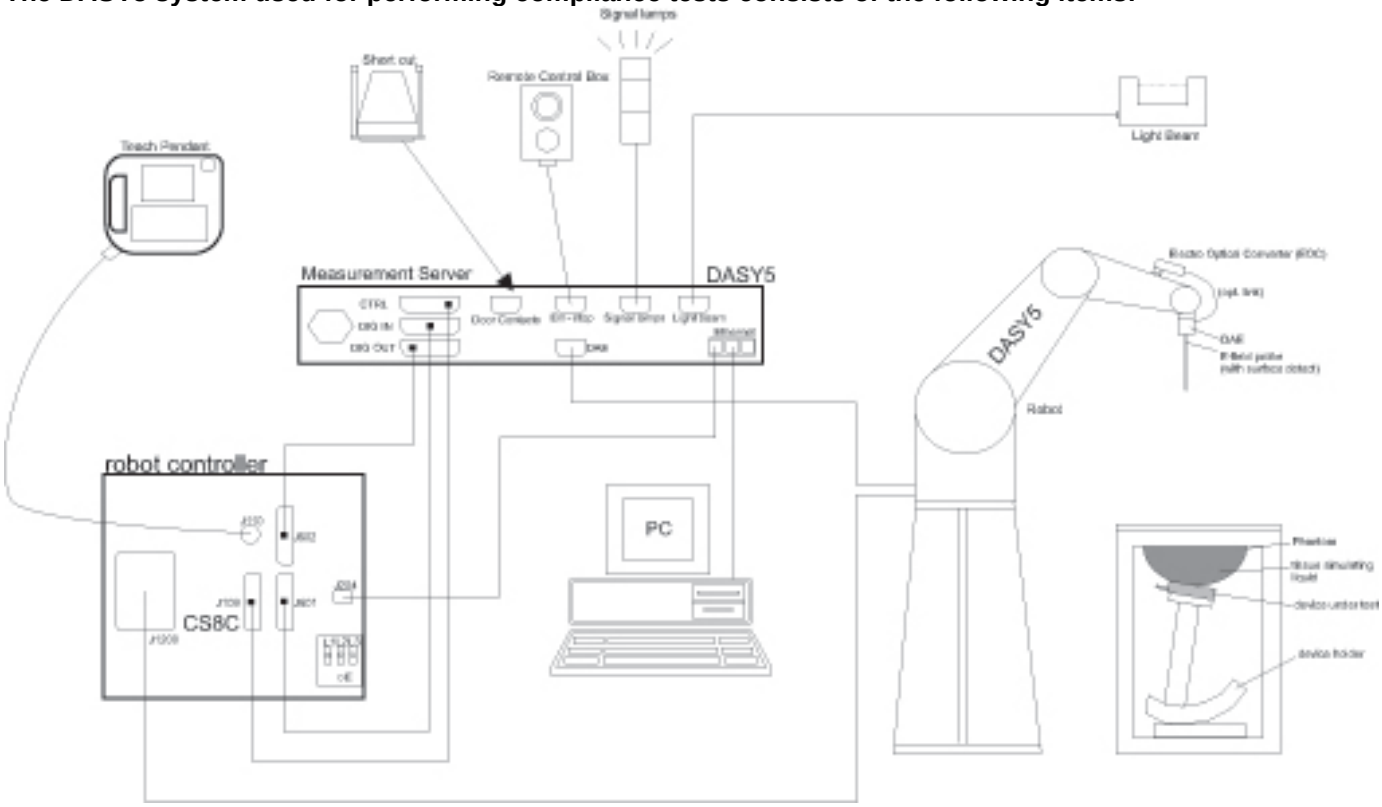
Suwon
SAR 1 Room
SAR 2 Room
SAR 3 Room
SAR 4 Room
SAR 5 Room
SAR 9 Room

UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-637.
The full scope of accreditation can be viewed at https://www.iasonline.org/wp-content/uploads/2017/05/TL-637-cert-New.pdf.

4. SAR Measurement System & Test Equipment

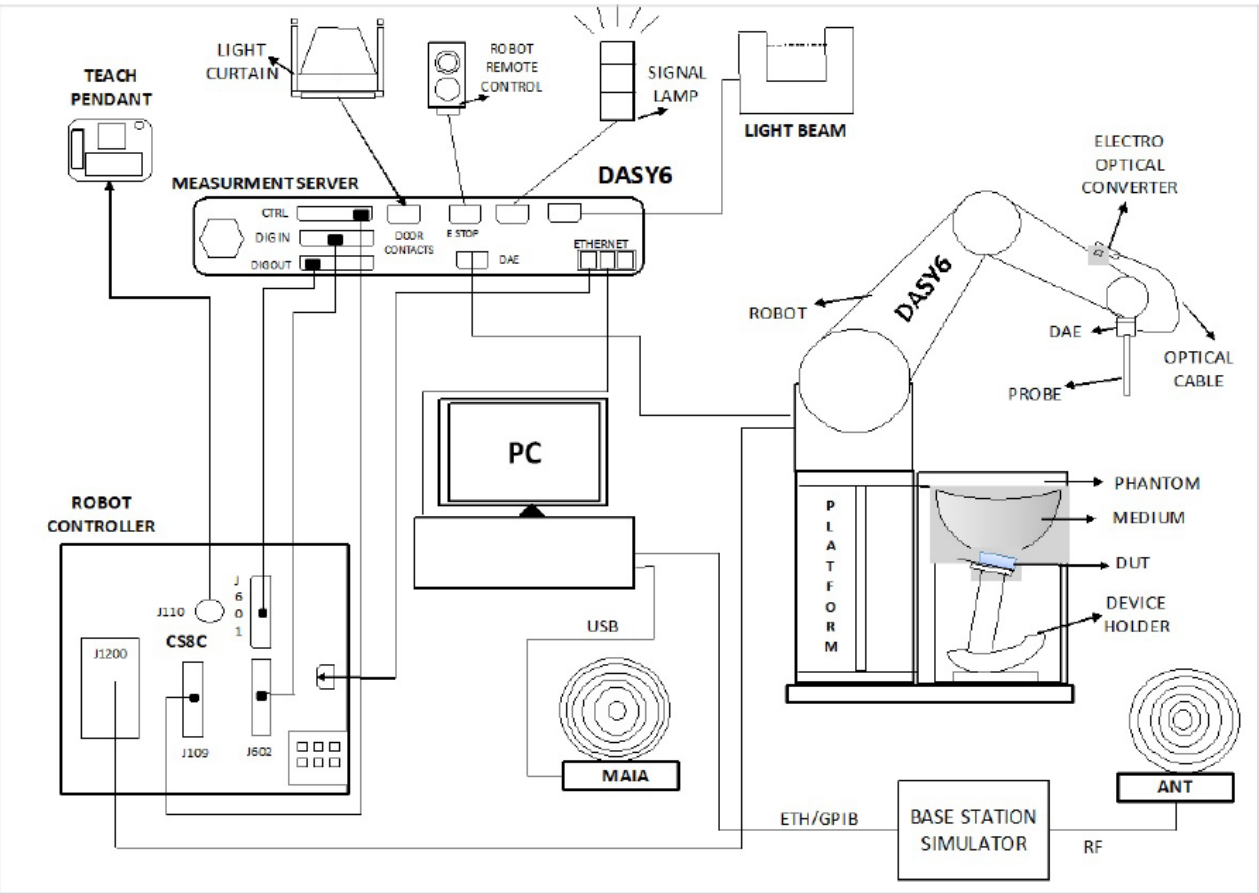
4.1. SAR Measurement System

The DASY5 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 WinXP or Win7 and the DASY5 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.

The DASY6 & 8 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 Win10 and the DASY6 or 8 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.

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.

Step 5: Z-Scan (FCC only)

The Z Scan measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. In order to get a reasonable extrapolation the extrapolated distance should not be larger than the step size in Z-direction.

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	Agilent	E5071C	MY46522054	8/6/2022
				8/5/2023
Network Analyzer	ROHDE & SCHWARZ	ZNB 20	102256	8/6/2022
				8/5/2023
Dielectric Assessment Kit	SPEAG	DAK-3.5	1158	10/20/2022
Dielectric Assessment Kit	SPEAG	DAKS-3.5	1133	3/28/2023
Dielectric Assessment Kit	SPEAG	DAKS_VNA R140	0060221	4/22/2023
Shorting block	SPEAG	DAK-3.5 Short	SM DAK 200 BA	N/A
Thermometer	LKM	DTM3000	3851	8/4/2022
				8/3/2023
Thermometer	LKM	DTM3000	3862	8/4/2022
				8/3/2023

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
MXG Analog Signal Generator	Agilent	N5181A	MY50145882	8/4/2022
				8/4/2023
MXG Analog Signal Generator	Keysight	N5181B	MY59100587	8/4/2022
				8/4/2023
MXG Analog Signal Generator	Keysight	N5173B	MY59101083	8/4/2022
				8/4/2023
Power Sensor	Keysight	U2000A	MY60180020	8/4/2022
				8/3/2023
Power Sensor	Agilent	U2000A	MY54260007	8/4/2022
				8/3/2023
Power Sensor	Keysight	U2000A	MY60490008	8/4/2022
				8/3/2023
Power Sensor	Keysight	U2000A	MY61060004	8/4/2022
				8/3/2023
Power Sensor	Keysight	U2000A	MY61010006	8/4/2022
				8/3/2023
Power Sensor	Keysight	U2000A	MY61010010	8/4/2022
				8/3/2023
Power Amplifier	EXODUS	AMP2027ADB	10002	3/30/2023
Directional Coupler	Agilent	772D	MY52180193	8/3/2022
				8/3/2023
Directional Coupler	H.P	778D	16133	8/3/2022
				8/3/2023
Directional Coupler	MINI-CIRCUITS	ZUDC20-183+	N/A	8/3/2022
				8/3/2023
Directional Coupler	MINI-CIRCUITS	ZUDC20-183+	N/A	8/3/2022
				8/3/2023
Low Pass Filter	MICROLAB	LA-15N	3943	8/3/2022
				8/3/2023
Low Pass Filter	FILTRON	L14012FL	1410003S	8/3/2022
				8/3/2023
Low Pass Filter	MICROLAB	LA-60N	3942	8/3/2022
				8/3/2023
Low Pass Filter	MINI-CIRCUITS	NLP-1200	VUU19301915	8/4/2022
				8/2/2023
Attenuator	KEYSIGHT	8491B/003	VE2017A0283	8/4/2022
				8/3/2023
Attenuator	KEYSIGHT	8491B/010	MY39271981	8/4/2022
				8/3/2023
Attenuator	KEYSIGHT	8491B/010	MY39272011	8/4/2022
				8/2/2023
Attenuator	KEYSIGHT	8491B/020	MY39271973	8/4/2022
				8/3/2023

Test Equipment (Continued)

E-Field Probe	SPEAG	EX3DV4	7651	5/30/2023
E-Field Probe	SPEAG	EX3DV4	7313	3/2/2023
E-Field Probe	SPEAG	EX3DV4	7314	5/31/2023
E-Field Probe	SPEAG	EX3DV4	7652	4/28/2023
E-Field Probe	SPEAG	EX3DV4	7376	7/30/2022
E-Field Probe	SPEAG	EX3DV4	7645	4/29/2023
E-Field Probe	SPEAG	EX3DV4	7646	3/29/2023
E-Field Probe	SPEAG	EX3DV4	7330	1/28/2023
Data Acquisition Electronics	SPEAG	DAE4	1343	8/23/2022
Data Acquisition Electronics	SPEAG	DAE4	1671	5/31/2023
Data Acquisition Electronics	SPEAG	DAE4	1670	6/7/2023
Data Acquisition Electronics	SPEAG	DAE4	1447	3/25/2023
Data Acquisition Electronics	SPEAG	DAE4	1668	4/27/2023
System Validation Dipole	SPEAG	CLA-13	1015	10/12/2022
System Validation Dipole	SPEAG	D750V3	1205	4/27/2023
System Validation Dipole	SPEAG	D835V2	4d194	3/24/2023
System Validation Dipole	SPEAG	D1750V2	1125	2/24/2023
System Validation Dipole	SPEAG	D1900V2	5d190	11/24/2022
System Validation Dipole	SPEAG	D2450V2	939	7/21/2022
System Validation Dipole	SPEAG	D2450V2	960	3/24/2023
System Validation Dipole	SPEAG	D2600V2	1178	4/23/2023
System Validation Dipole	SPEAG	D3500V2	1121	4/21/2023
System Validation Dipole	SPEAG	D3700V2	1036	5/21/2023
System Validation Dipole	SPEAG	D3900V2	1069	4/21/2023
System Validation Dipole	SPEAG	D5GHzV2	1209	11/24/2022
Thermometer	Lutron	MHB-382SD	AH.91463	8/4/2022
				8/4/2023
Thermometer	Lutron	MHB-382SD	AH.50215	8/3/2022
Thermometer	Lutron	MHB-382SD	AH.50213	8/4/2022
				8/4/2023
Thermometer	Lutron	MHB-382SD	AH.45903	8/3/2022
Thermometer	Lutron	MHB-382SD	AK.18789	8/4/2022
Thermometer	Lutron	MHB-382SD	AK.12102	8/3/2022

Others

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Base Station Simulator	R & S	CMW500	150313	8/3/2022
				8/2/2023
Base Station Simulator	R & S	CMW500	150314	8/4/2022
				8/2/2023
Base Station Simulator	R & S	CMW500	162790	8/3/2022
				8/2/2023
Base Station Simulator	R & S	CMW500	169803	5/27/2023
Base Station Simulator	R & S	CMW500	169799	8/3/2022
				8/2/2023
Base Station Simulator	R & S	CMW500	169800	8/2/2023
Base Station Simulator	R & S	CMW500	169797	8/3/2022
				8/2/2023
Base Station Simulator	R & S	CMW500	169798	8/3/2022
				8/2/2023
UXM 5G Wireless Test Platform	Keysight	E7515B	MY59150850	12/13/2022
UXM 5G Wireless Test Platform	Keysight	E7515B	MY57510596	8/6/2022
				8/5/2023
Radio Communication Test Station	Anritsu	MT8000A	6272398203	6/17/2023

Note(s):

1. For System Validation Dipole, Calibration interval applied every 2 years according to referencing KDB 865664 guidance.
2. Refer to Appendix F that mentioned about justification for Extended SAR Dipole Calibrations. (for blue box items)
3. All equipments were used until Cal.Due data.

5. Device Under Test (DUT) Information

5.1. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode	Duty Cycle used for SAR testing
W-CDMA (UMTS)	Band II Band IV Band V	UMTS Rel. 99 (Voice & Data) HSDPA (Category 24) HSUPA (Category 6) DC-HSDPA (Category 24) HSPA+ (DL only)	100%
LTE	FDD Band 2 FDD Band 4 FDD Band 5 FDD Band 7 FDD Band 12 FDD Band 13 FDD Band 14 FDD Band 25 FDD Band 26 TDD Band 41 – Power Class 2 TDD Band 41 – Power Class 3 TDD Band 48 – Power Class 3 FDD Band 66 FDD Band 71	QPSK 16QAM 64QAM 256QAM Rel. 16 Carrier Aggregation (2 Uplinks and 4 Downlinks) **Uplink inter-band Carrier Aggregation(2CC)** CA_41C	100% (FDD) 63.3% (TDD) Power Class 3 43.3% (TDD) Power Class 2
	Does this device support SV-LTE (1xRTT-LTE)? ☐ Yes ☒ No		
5G NR (Sub 6)	FDD Band n2 FDD Band n5 FDD Band n25 FDD Band n66 FDD Band n71 TDD Band n41– Power Class 2 TDD Band n41– Power Class 3 TDD Band n77– Power Class 2 TDD Band n77– Power Class 3 TDD Band n78– Power Class 3	DFT-s-ODFM: ■ π/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM CP-ODFM: ■QPSK, 16QAM, 64QAM, 256QAM	100%
Wi-Fi	2.4 GHz	802.11b 802.11g 802.11n (HT20) 802.11ax	SISO : 99.4% (802.11b) MIMO : 96.4% (802.11g)
	5 GHz	802.11a 802.11n (HT20) & (HT40) 802.11ac (VHT20) & (VHT40) & (VHT80) 802.11ax (HE20) & (HE40) & (HE80)	SISO & MIMO : 96.7% (802.11a) 94.5% (802.11ac (VHT80)
	Does this device support bands 5.60 ~ 5.65 GHz? ☒ Yes ☐ No		
	Does this device support Band gap channel(s)? ☒ Yes ☐ No		
Bluetooth	2.4 GHz	Version 5.2 LE	76.7% (DH5)
NFC	13.56 MHz	Type A/B/F	100%

Notes

1. The Bluetooth protocol is considered source-based averaging. Bluetooth GFSK (DH5) was verified to have the highest duty cycle of 76.7% and was considered and used for SAR Testing.
2. Duty cycle for Wi-Fi is referenced from the DTS and UNII report.
3. This device supports Power Class 2(HPUE) and Power Class 3 for LTE Band 41 & NR Band n41 & NR Band n77
4. NR TDD Band n77 has support SRS(0,1,2,3) modes.
5. This device supports LTE Band 41 UL CA intra-band Contiguous.

5.2. Time-Averaging for SAR

This device is enabled with Qualcomm Smart Transmit algorithm to control and manage transmitting power in real time and to ensure that the time-averaged RF exposure from 3G/4G/5G NR Sub6 WWAN is compliance with FCC requirement. This part.0 report shows SAR characterization of WWAN radios for 3G/4G/5G NR Sub6. Characterization is achieved by determining P_{limit} for 3G/4G/5G NR Sub6 that correspond to the *SAR_design_target* after accounting for all device design related uncertainty. The SAR Characterization is denoted as SAR Char in this report.

5.3. Nomenclature for Part 0 Report

Technology	Term	Description
2G/3G/4G/ 5G NR Sub6	P_{limit}	Power level that corresponds to the exposure design target (*SAR_design_target*) after accounting for all device design related uncertainties
	P_{max}	Maximum tune up output power
	SAR_design_target	Target SAR level < FCC SAR limit after accounting for all device design related uncertainties
	SAR Char	Table containing P_{limit} for all technologies and bands

6. SAR Characterizations

6.1. SAR Design Target

SAR_Design_target is determined by ensuring that it is less than FCC SAR limit after accounting for total device designed related uncertainties specified by the manufacturer.

SAR_design_target	
$SAR\_design\_target < SAR\_regulatory\_limit \times 10^{\frac{-Total\ Uncertainty}{10}}$	
1g SAR (W/kg)	
Total Uncertainty	**1.0 dB**
SAR_regulatory_limit	**1.6 W/kg**
SAR_design_target	**1.0 W/kg**

6.2. DSI and SAR Determination

This device uses different Device State Index (DSI) to configure different time averaged power levels based on certain exposure scenarios. Depending on the detection scheme implemented in the Tablet, the worst-case SAR was determined by measurements for the relevant exposure conditions for that DSI. Detailed descriptions of the detection mechanisms are included in the operational description.

The device state index (DSI) conditions used in below table represent different exposure scenarios.

DSI and Corresponding Exposure Scenarios

RF exposure Scenarios	DSI No.	Description	KDB guide For SAR test
Standalone exposure Without triggering sensor	0	Proximity sensor is not triggered even if Device was touched to user's body or hands. Proximity sensor is not triggered due to triggering distance.	KDB 616217 D04
Standalone exposure With triggering sensor	1	Proximity sensor is triggered, when Device was touched to user's body or hands.	KDB 616217 D04

6.3. SAR Char

SAR results corresponding to P_{max} for each antenna/technology/band/DSI can be found in Section.7. P_{limit} is calculated by linearly scaling with the measured SAR at the P_{max} to correspond to *the SAR_ design_target*. P_{limit} determination for each exposure scenario corresponding to *SAR_design_target* are shown in table.

P_{Limit} Determination

Device State Index (DSI)	Plimit Determination Scenarios
DSI = 0	The w orst-case SAR exposure is determined as maximum SAR normalized To the limit among; 1. Standalone SAR measured at 17, 18 mm spacing for Rear, Edge1. Standalone SAR measured at 0 mm for Edge2 (Main Ant.1) 2. Standalone SAR measured at 16, 12 mm spacing for Rear, Edge1. Standalone SAR measured at 0 mm for Edge2 (Main Ant.2) 3. Standalone SAR measured at 0 mm for Rear, Edge2, Edge 3 (Sub Ant.4) 4. Standalone SAR measured at 0 mm for Rear, Edge1, Edge2, Edge4 (Sub Ant.3) 5. Standalone SAR measured at 0 mm for Rear, Edge3 (Sub Ant.2)
DSI = 1	1. Plimit is calculated based on Standalone SAR (1-g SAR) at 0 mm for Rear, Edge1 (Main Ant.1 & Main Ant.2)

Notes:

Sub Ant.4, Sub Ant.3 and Sub Ant,2 has same Plimit for both DSI=0 and DSI=1.

For DSI = 0, P_{limit} is calculated by:

Main Ant.1)

P_{limit} = min{ P_{limit} corresponding to 1g Standalone SAR evaluation at 17 (Rear), 18 (Edge1) mm spacing, P_{limit} corresponding to 1g Standalone SAR evaluation at 0 mm for Edge2 surface}

Main Ant.2)

P_{limit} = min{ P_{limit} corresponding to 1g Standalone SAR evaluation at 16 (Rear), 12 (Edge1) mm spacing, P_{limit} corresponding to 1g Standalone SAR evaluation at 0 mm for Edge2 surface}

Sub Ant.2)

P_{limit} = min{ P_{limit} corresponding to 1g Standalone SAR evaluation at 0 mm for Rear, Edge3 surface}

Sub Ant.3)

P_{limit} = min{ P_{limit} corresponding to 1g Standalone SAR evaluation at 0 mm for Rear, Edge1, Edge2, Edge 4 surface}

Sub Ant.4)

P_{limit} = min{ P_{limit} corresponding to 1g Standalone SAR evaluation at 0 mm for Rear, Edge2, Edge3 surface}

SAR Characterizations

Exposure condition		Standalone (Proximity Sensor Off)	Standalone (Proximity Sensor On)	Pmax (Maximum tune-up Power) (dBm)
Averaging Volume		1g	1g	
test distance		18/17/0 mm - Main.1, 16/12/0 mm - Main.2 0 mm - Sub4, Sub3, Sub2	0 mm	
DSI:		0	1	
RF Air Interface	Antenna	Plimit corresponding to 1.0 W/kg (SAR_design_target)	Plimit corresponding to 1.0 W/kg (SAR_design_target)	
WCDMA Band II	Main.1	23.51	10.00	21.50
WCDMA Band IV	Main.1	23.43	11.00	22.00
WCDMA Band V	Main.1	26.56	14.00	24.00
LTE Band 5	Main.1	27.00	15.00	24.00
LTE Band 7	Main.2	24.83	12.50	22.50
LTE Band 12	Main.1	29.86	14.00	24.00
LTE Band 13	Main.1	26.89	14.00	24.00
LTE Band 14	Main.1	27.09	16.00	24.00
LTE Band 25/2	Main.1	22.96	12.00	22.50
LTE Band 26	Main.1	26.80	16.00	24.00
LTE Band 41-PC3	Main.2	25.39	11.00	21.00
LTE Band 41-PC2	Main.2	26.26	11.40	22.40
LTE Band 48	Main.2	28.89	12.00	19.70
LTE Band 66/4	Main.1	23.99	11.50	22.50
LTE Band 71	Main.1	28.67	16.00	24.00
NR Band n5	Main.1	27.46	15.00	24.00
NR Band n25/n2	Main.1	23.87	11.00	22.50
NR Band n66	Main.1	23.45	11.00	22.00
NR Band n71	Main.1	28.94	16.00	24.00
NR Band n41-PC3	Main.2	20.00	11.00	23.50
NR Band n41-PC2	Main.2	20.00	11.00	26.50
NR Band n77(SRS0)/n78-PC3	Main.2	18.30	8.50	24.30
NR Band n77(SRS1)-PC3	Sub.4	11.00	11.00	21.00
NR Band n77(SRS2)-PC3	Sub.3	9.50	9.50	19.50
NR Band n77(SRS3)-PC3	Sub.2	9.50	9.50	21.00
NR Band n77(SRS0)-PC2	Main.2	18.30	8.50	26.50
NR Band n77(SRS1)-PC2	Sub.4	11.00	11.00	22.00
NR Band n77(SRS2)-PC2	Sub.3	9.50	9.50	21.00
NR Band n77(SRS3)-PC2	Sub.2	9.50	9.50	21.50

Notes:

1. If P_{limit} is higher than P_{max} for some modes / bands, The modes/bands will operate at a power level up to P_{max}.
2. P_{max} (Maximum tune-up power) is specified in tune-up document. The maximum allowed power is equal to maximum tune up power + 1 dB device design uncertainty.
3. All P_{limit} EFS and maximum tune up output Pmax levels entered in above Table correspond to average power levels after accounting for duty cycle in the case of LTE TDD modulation schemes.
4. Some band's DSIs were determined more conservative P_{limit} instead of calculation P_{limit} in Section.7.

7. SAR Test results for P_{limit} calculations

Standalone (Proximity sensor Off) (DSI = 0)

RF Exposure Conditions	Antenna	band	mode	DSI	Ch.	Test distance (mm)	Test position	Output power (dbm)	meas SAR 1g (W/kg)	Plimit (dBm)	Minimim Plimit (dBm)
Standalone	Main Ant.1	WCDMA Band II	Rel.99	0	9400	17	Rear	22.10	0.676	23.80	23.51
					9400	18	Edge 1	22.10	0.722	23.51	
					9400	0	Edge 2	22.10	0.015	40.34	
Standalone	Main Ant.1	WCDMA Band IV	Rel.99	0	1513	17	Rear	22.27	0.766	23.43	23.43
					1513	18	Edge 1	22.27	0.748	23.53	
					1413	0	Edge 2	22.16	0.335	26.91	
Standalone	Main Ant.1	WCDMA Band V	Rel.99	0	4183	17	Rear	23.63	0.284	29.10	26.56
					4183	18	Edge 1	23.63	0.160	31.59	
					4183	0	Edge 2	23.63	0.509	26.56	
Standalone	Main Ant.1	LTE Band 5	QPSK BW=10 RB 1/0	0	20525	17	Rear	23.42	0.369	27.75	27.00
					20525	18	Edge 1	23.42	0.147	31.75	
					20525	0	Edge 2	23.42	0.439	27.00	
Standalone	Main Ant.2	LTE Band 7	QPSK BW=20 RB 1/0	0	20850	16	Rear	23.11	0.673	24.83	24.83
					20850	12	Edge 1	23.11	0.568	25.57	
					20850	0	Edge 2	23.11	0.245	29.22	
Standalone	Main Ant.1	LTE Band 12	QPSK BW=10 RB 1/0	0	23095	17	Rear	23.12	0.140	31.66	29.86
					23095	18	Edge 1	23.12	0.079	34.14	
					23095	0	Edge 2	23.12	0.212	29.86	
Standalone	Main Ant.1	LTE Band 13	QPSK BW=10 RB 1/0	0	23230	17	Rear	23.80	0.263	29.60	26.89
					23230	18	Edge 1	23.80	0.100	33.80	
					23230	0	Edge 2	23.80	0.491	26.89	
Standalone	Main Ant.1	LTE Band 14	QPSK BW=10 RB 1/0	0	23330	17	Rear	23.63	0.335	28.38	27.09
					23095	18	Edge 1	23.63	0.132	32.42	
					23095	0	Edge 2	23.63	0.451	27.09	
Standalone	Main Ant.1	LTE Band 25/2	QPSK BW=20 RB 1/99	0	26365	17	Rear	22.68	0.905	23.11	22.96
					26365	18	Edge 1	22.68	0.937	22.96	
					26365	0	Edge 2	22.68	0.237	28.93	
Standalone	Main Ant.1	LTE Band 26	QPSK BW=15 RB 1/37	0	26865	17	Rear	23.44	0.254	29.39	26.80
					26865	18	Edge 1	23.44	0.151	31.65	
					26865	0	Edge 2	23.44	0.461	26.80	
Standalone	Main Ant.2	LTE Band 41 (Power Class 3)	QPSK BW=20 RB 1/99	0	39750	16	Rear	22.73	0.342	27.39	27.39
					39750	12	Edge 1	22.73	0.257	28.63	
					39750	0	Edge 1	22.73	0.107	32.44	
Standalone	Main Ant.2	LTE Band 41 (Power Class 2)	QPSK BW=20 RB 1/0	0	39750	16	Rear	25.16	0.339	29.86	29.86
Standalone	Main Ant.2	LTE Band 48	QPSK BW=20 RB 1/0	0	55773	16	Rear	21.83	0.101	31.79	28.89
					55773	12	Edge 1	21.83	0.197	28.89	
					55773	0	Edge 2	21.83	0.182	29.23	
Standalone	Main Ant.1	LTE Band 66/4	QPSK BW=20 RB 1/49	0	132072	17	Rear	22.72	0.746	23.99	23.99
					132072	18	Edge 1	22.72	0.668	24.47	
					132072	0	Edge 2	22.72	0.369	27.05	
Standalone	Main Ant.1	LTE Band 71	QPSK BW=20 RB 1/0	0	133297	17	Rear	23.20	0.183	30.58	28.67
					133297	18	Edge 1	23.20	0.063	35.21	
					133297	0	Edge 2	23.20	0.284	28.67	
Standalone	Main Ant.1	NR Band n5	DFT-s-OFDM QPSK BW=20 RB 1/1	0	167300	17	Rear	24.04	0.455	27.46	27.46
					167300	18	Edge 1	24.04	0.168	31.79	
					167300	0	Edge 2	24.04	0.448	27.53	
Standalone	Main Ant.1	NR Band n2/n25	DFT-s-OFDM QPSK BW=20 RB 50/28	0	376500	17	Rear	23.24	0.864	23.87	23.87
					376500	18	Edge 1	23.24	0.825	24.08	
					376500	0	Edge 2	23.24	0.268	28.96	
Standalone	Main Ant.1	NR Band n66	DFT-s-OFDM QPSK BW=20 RB 50/28	0	344000	17	Rear	22.65	0.831	23.45	23.45
					344000	18	Edge 1	22.65	0.801	23.61	
					344000	0	Edge 2	22.65	0.414	26.48	
Standalone	Main Ant.1	NR Band n71	DFT-s-OFDM QPSK BW=20 RB 50/28	0	136100	17	Rear	24.02	0.203	30.95	28.94
					136100	18	Edge 1	24.02	0.091	34.43	
					136100	0	Edge 2	24.02	0.322	28.94	
Standalone	Main Ant.2	NR TDD Bn41 (PC2/PC3)	DFT-s-OFDM QPSK 135/69	0	518598	16	Rear	20.33	0.327	25.18	24.79
					518598	12	Edge 1	20.33	0.358	24.79	
					518598	0	Edge 2	20.33	0.031	35.42	
Standalone	Main Ant.2	NR TDD Bn77(PC2/PC3) /n78 (PC3)	DFT-s-OFDM QPSK 1/1	0	662000	16	Rear	18.97	0.276	24.56	21.85
					662000	12	Edge 1	18.97	0.515	21.85	
					662000	0	Edge 2	18.97	0.375	23.23	
Standalone	Sub Ant.4	NR TDD Bn77 -SRS 1-	SRS CW	0	650000	0	Rear	11.38	0.947	11.62	11.62
					650000	0	Edge 2	11.38	0.347	15.98	
					650000	0	Edge 3	11.38	0.053	24.14	
Standalone	Sub Ant.3	NR TDD Bn77 -SRS 2-	SRS CW	0	633334	0	Rear	9.65	0.258	15.53	15.53
					633334	0	Edge 1	9.65	0.143	18.10	
					633334	0	Edge 2	9.65	0.064	21.59	
					633334	0	Edge 4	9.65	0.067	21.39	
Standalone	Sub Ant.2	NR TDD Bn77 -SRS 3-	SRS CW	0	633334	0	Rear	10.15	0.936	10.44	10.44
					633334	0	Edge 3	10.15	0.344	14.78	

Notes:

1. The maximum allowed power is equal to maximum tune up power + 1 dB device design uncertainty.
2. Measured Output power refer to Sec.9 in SAR part.1 report.
3. Some bands were determined more conservative P_{limit} instead of calculation P_{limit}

Standalone (Proximity sensor On) (DSI = 1)

RF Exposure Conditions	Antenna	band	mode	DSI	Ch.	Test distance (mm)	Test position	Output power (dbm)	meas SAR 1g (W/kg)	P_{limit} (dBm)	Minimim P_{limit} (dBm)
Standalone	Main Ant.1	WCDMA Band II	Rel.99	1	9400	0	Rear	10.82	0.756	12.03	12.03
					9400	0	Edge 1	10.82	0.521	13.65	
Standalone	Main Ant.1	WCDMA Band IV	Rel.99	1	1513	0	Rear	11.59	0.863	12.23	12.23
					1413	0	Edge 1	11.65	0.671	13.38	
Standalone	Main Ant.1	WCDMA Band V	Rel.99	1	4183	0	Rear	13.80	0.159	21.79	21.79
					4183	0	Edge 1	13.80	0.091	24.21	
Standalone	Main Ant.1	LTE Band 5	QPSK BW=10 RB 1/0	1	20525	0	Rear	14.73	0.170	22.43	22.43
					20525	0	Edge 1	14.73	0.097	24.86	
Standalone	Main Ant.2	LTE Band 7	QPSK BW=20 RB 50/0	1	20850	0	Rear	12.79	0.894	13.28	13.28
					20850	0	Edge 1	12.79	0.303	17.98	
Standalone	Main Ant.1	LTE Band 12	QPSK BW=10 RB 25/12	1	23095	0	Rear	13.41	0.161	21.34	21.34
					23095	0	Edge 1	13.41	0.093	23.73	
Standalone	Main Ant.1	LTE Band 13	QPSK BW=10 RB 25/0	1	23230	0	Rear	13.87	0.176	21.41	21.41
					23230	0	Edge 1	13.87	0.087	24.47	
Standalone	Main Ant.1	LTE Band 14	QPSK BW=10 RB 25/12	1	23330	0	Rear	15.70	0.164	23.55	23.55
					23095	0	Edge 1	15.70	0.125	24.73	
Standalone	Main Ant.1	LTE Band 25/2	QPSK BW=20 RB 50/50	1	26365	0	Rear	12.01	0.878	12.58	12.58
					26365	0	Edge 1	12.01	0.719	13.44	
Standalone	Main Ant.1	LTE Band 26	QPSK BW=15 RB 1/37	1	26865	0	Rear	15.40	0.141	23.91	23.91
					26865	0	Edge 1	15.40	0.082	26.26	
Standalone	Main Ant.2	LTE Band 41 (PC3)	QPSK BW=20 RB 50/50	1	39750	0	Rear	11.63	0.901	12.08	12.08
					39750	0	Edge 1	11.63	0.174	19.22	
Standalone	Main Ant.2	LTE Band 41 (PC2)	QPSK BW=20 RB 1/0	1	39750	0	Rear	11.25	0.741	12.55	12.55
Standalone	Main Ant.2	LTE Band 48	QPSK BW=20 RB 50/24	1	55773	0	Rear	14.44	0.385	18.59	18.59
					55773	0	Edge 1	14.44	0.158	22.45	
Standalone	Main Ant.1	LTE Band 66/4	QPSK BW=20 RB 50/24	1	132322	0	Rear	11.80	0.849	12.51	12.16
					132322	0	Edge 1	11.80	0.921	12.16	
Standalone	Main Ant.1	LTE Band 71	QPSK BW=20 RB 1/0	1	133297	0	Rear	15.42	0.170	23.12	23.12
					133297	0	Edge 1	15.42	0.118	24.70	
Standalone	Main Ant.1	NR Band n5	DFT-s-OFDM QPSK BW=20 RB 1/1	1	167300	0	Rear	15.16	0.178	22.66	22.66
					167300	0	Edge 1	15.16	0.122	24.30	
Standalone	Main Ant.1	NR Band n25/n2	DFT-s-OFDM QPSK BW=20 RB 50/28	1	376500	0	Rear	11.66	0.864	12.29	12.29
					376500	0	Edge 1	11.66	0.676	13.36	
Standalone	Main Ant.1	NR Band n66	DFT-s-OFDM QPSK BW=20 RB 1/1	1	344000	0	Rear	11.71	0.687	13.34	13.34
					344000	0	Edge 1	11.71	0.648	13.59	
Standalone	Main Ant.1	NR Band n71	DFT-s-OFDM QPSK BW=20 RB 1/1	1	136100	0	Rear	16.03	0.227	22.47	22.47
					136100	0	Edge 1	16.03	0.116	25.39	
Standalone	Main Ant.2	NR TDD Bn41 (PC2/PC3)	DFT-s-OFDM QPSK 1/137	1	518598	0	Rear	11.14	0.714	12.60	12.60
					518598	0	Edge 1	11.14	0.187	18.42	
Standalone	Main Ant.2	NR TDD Bn77(PC3/PC2) /n78 (PC3)	DFT-s-OFDM QPSK 1/137	1	662000	0	Rear	8.34	0.669	10.09	10.09
					662000	0	Edge 1	8.34	0.245	14.45	

Notes:

1. The maximum allowed power is equal to maximum tune up power + 1 dB device design uncertainty.
2. Measured Output power refer to Sec.9 in SAR part.1 report.
3. Some bands were determined more conservative P_{limit} instead of calculation P_{limit}

END OF REPORT