FCC 47 CFR § 2.1093
IEEE Std 1528-2013

SAR EVALUATION REPORT
(Class II permissive change)

FOR

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

MODEL NUMBER: SM-S906B/DS

FCC ID: A3LSMS906B

REPORT NUMBER: 4790381906-S1V3

ISSUE DATE: 9/20/2022

Prepared for
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IAS ACCREDITED

Testing Laboratory

TL-637

Revision History

Rev.	Date	Revisions	Revised By
V1	8/11/2022	Initial Issue	--
V2	8/25/2022	Revised note.1 in Sec.6.5.	Sunghoon.kim
V3	9/20/2022	Revised simultaneous TX value in section 1. - DTS value of body-worn - PCE value of Product Specific 10g	Seungyeon.Kim

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1. Attestation of Test Results

Applicant Name		SAMSUNG ELECTRONICS CO.,LTD.			
FCC ID		A3LSMS906B			
Model Number		SM-S906B/DS			
Applicable Standards		FCC 47 CFR § 2.1093 IEEE Std 1528-2013 Published RF exposure KDB procedures			
Exposure Category		SAR Limits (W/Kg)			
		Peak spatial-average (1g of tissue)		Product Specific 10g (10g of tissue)	
General population / Uncontrolled exposure		1.6		4.0	
RF Exposure Conditions		Equipment Class - The Highest Reported SAR (W/kg)			
		PCE	DTS	NII	DSS
Body-worn		0.30	0.19	0.53	0.16
Hotspot		0.97	0.43	0.53	0.45
Product Specific 10g		1.97	N/A	2.29	N/A
Simultaneous TX	Body-worn	1.59	1.30	1.59	1.59
	Hotspot	1.46	1.35	1.46	1.46
	Product Specific 10g	2.23	N/A	2.23	N/A
Date Tested		5/29/2022 to 6/14/2022			
Test Results		Pass			

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. 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, ANSI C63.26-2015 the following FCC Published RF exposure KDB procedures:

- 248227 D01 802.11 Wi-Fi SAR v02r02
- 447498 D01 General RF Exposure Guidance v06
- 648474 D04 Handset SAR v01r03
- 690783 D01 SAR Listings on Grants 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
- 941225 D07 UMPC Mini Tablet v01r02
- 971168 D01 Power Meas License Digital System v03r01

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

- TCB workshop October, 2014; RF Exposure Procedures Update (Overlapping LTE Bands)
- TCB workshop October, 2014; RF Exposure Procedures Update (Other LTE Considerations)
- 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 (LTE Test Conditions)
- 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 Update)
- TCB workshop April, 2018; RF Exposure Procedures (LTE Inter-Band Uplink Carrier Aggregation – Interim Procedures)
- TCB workshop April, 2019; RF Exposure Procedures (Tissue Simulating Liquids (TSL))
- TCB workshop October, 2020; 5G RFX Policies (Intra-band and Inter-band NSA-EN-DC evaluation)

3. Facilities and Accreditation

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

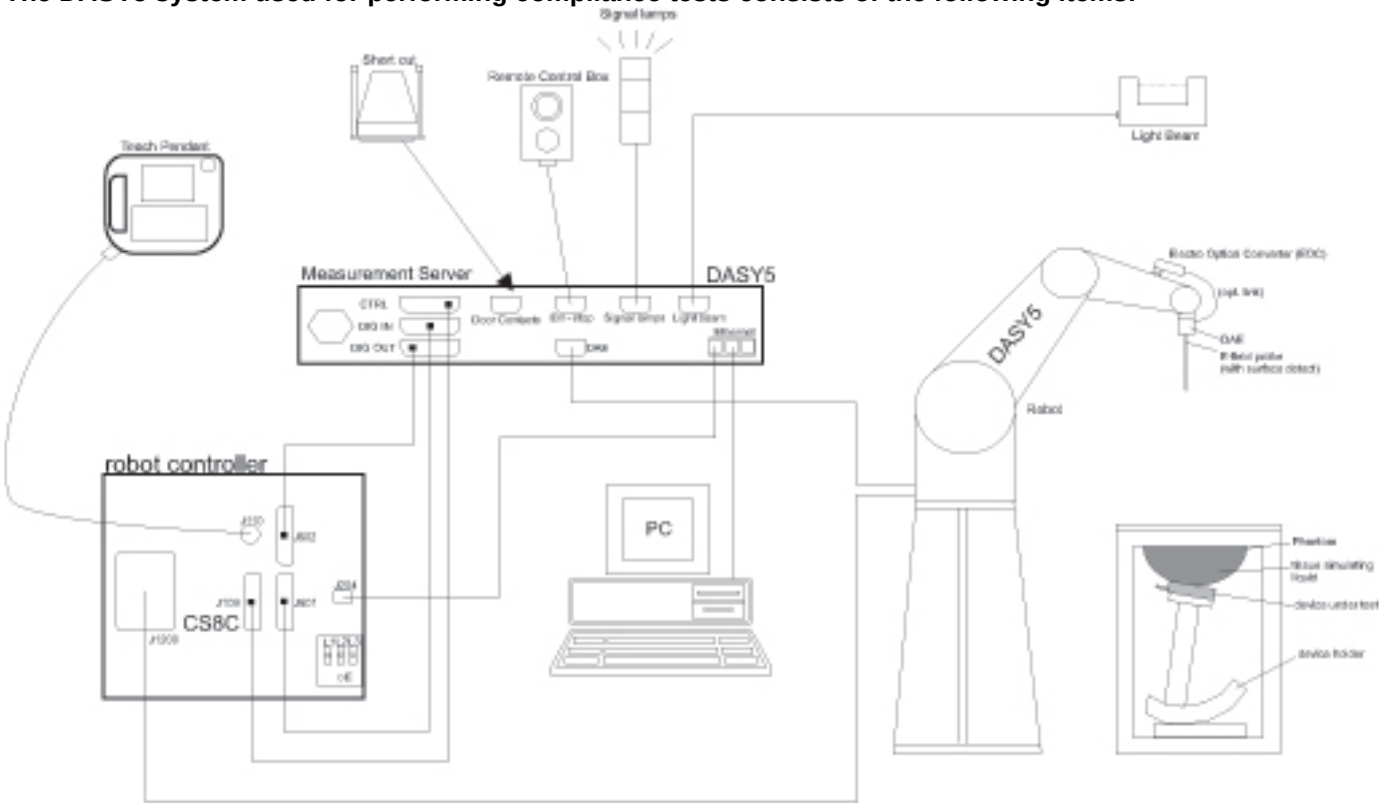
Suwon
SAR 1 Room
SAR 2 Room
SAR 3 Room
SAR 4 Room
SAR 5 Room

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.

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	≤ $1.5 \cdot \Delta z_{Zoom}(n-1)$	
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
Dielectric Assessment Kit	SPEAG	DAK-3.5	1196	7-21-2022
Shorting block	SPEAG	DAK-3.5 Short	SM DAK 200 BA	N/A
Thermometer	LKM	DTM3000	3851	8-4-2022

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
MXG Analog Signal Generator	Agilent	N5181A	MY50145882	8-4-2022
Power Sensor	Agilent	U2000A	MY54260007	8-4-2022
Power Sensor	Agilent	U2000A	MY60180020	8-4-2022
Power Amplifier	EXODUS	1410025-AMP2027-10003	10003	8-4-2022
Directional Coupler	Agilent	772D	MY52180193	8-3-2022
Directional Coupler	Agilent	778D	MY52180432	8-3-2022
Low Pass Filter	MINI-CIRCUITS	NLP-1200	VUU19301915	8-4-2022
Low Pass Filter	MICROLAB	LA-15N	3943	8-3-2022
Low Pass Filter	FILTRON	L14012FL	1410003S	8-3-2022
Low Pass Filter	MICROLAB	LA-60N	3942	8-4-2022
Attenuator	MINI-CIRCUITS	BW-N3W5+	N/A	8-4-2022
Attenuator	Agilent	8491B/003	MY39272275	8-17-2022
Attenuator	Agilent	8491B/010	MY39272011	8-4-2022
Attenuator	Agilent	8491B/020	MY39271973	8-4-2022
E-Field Probe	SPEAG	EX3DV4	7330	1-28-2023
Data Acquisition Electronics	SPEAG	DAE4	1468	9-27-2022
System Validation Dipole	SPEAG	D1750V2	1180	4-27-2023
Thermometer	Lutron	MHB-382SD	AH.50213	8-4-2022
Thermometer	Lutron	MHB-382SD	AJ.45903	8-3-2022
Thermometer	Lutron	MHB-382SD	AK.12123	8-3-2022

Others

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
UXM 5G Wireless Test Platform	Keysight	E7515B	MY57510596	8-6-2022

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. 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.

5.1. DECISION RULE

Decision rule for statement(s) of conformity is based on Procedures 1, Clause 4.4.2 in IEC Guide 115:2007.

6. Device Under Test (DUT) Information

6.1. DUT Description

Device Dimension	Refer to Appendix A.		
Back Cover	☒ The Back Cover is not removable.		
Battery Options	☒ The rechargeable battery is not user accessible		
Wireless Router (Hotspot)	Wi-Fi Hotspot mode permits the device to share its cellular data connection with other Wi-Fi-enabled devices. ☒ Mobile Hotspot (Wi-Fi 2.4 GHz) ☒ Mobile Hotspot (Wi-Fi 5.8 GHz)		
Wi-Fi Direct	Wi-Fi Direct enabled devices transfer data directly between each other ☒ Wi-Fi Direct (Wi-Fi 2.4 GHz) ☒ Wi-Fi Direct (Wi-Fi 5.2 GHz_UNII-1, Wi-Fi 5.8 GHz_UNII-3)		
Test Sample Information	**No.**	**S/N**	**Notes**
	1	UKA2304M	Main conduction
	2	UJS0815M	Main Radiation
	3	UJS2193M	Main Radiation

6.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode		Duty Cycle used for SAR testing
GSM	850 1900	Voice (GMSK) GPRS (GMSK) EGPRS (8PSK)	GPRS Multi-Slot Class: ☐ Class 8 - 1 Up, 4 Down ☐ Class 10 - 2 Up, 4 Down ☐ Class 12 - 4 Up, 4 Down ☒ Class 33 - 4 Up, 5 Down	GSM Voice: 12.5% (E)GPRS: 1 Slot: 12.5% 2 Slots: 25% 3 Slots: 37.5% 4 Slots: 50%
	Does this device support DTM (Dual Transfer Mode)? ☐ Yes ☒ No			
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 12 FDD Band 13 FDD Band 17 FDD Band 25 FDD Band 26 TDD Band 41 Power Class 3 TDD Band 41 Power Class 2 FDD Band 66 **Uplink inter-band Carrier Aggregation(2CC)** CA_2A-4A CA_4A-5A CA_4A-12A CA_5A-66A CA_12A-66A	QPSK 16QAM 64QAM 256QAM Rel. 15 Carrier Aggregation (2 Uplink and 5 Downlinks)		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)	NR Band n5 NR Band n66	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 (HE20)		SISO mode 99.5% (802.11b) MIMO mode 96.4% (802.11g)
	5 GHz	802.11a 802.11n (HT20) & (HT40) 802.11ac (VHT20) & (VHT40) & (VHT80) & (VHT160) 802.11ax (HE20) & (HE40) & (HE80) & (HE160)		MIMO mode 96.4% (802.11a) 94.4% (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 5.0 LE		77.0% (DH5)
NFC	13.56 MHz	Type A/B/F		N/A[4]
UWB	6.24 – 8.24 GHz	BPM-BPSK		N/A[4]

Notes:

1. The Bluetooth protocol is considered source-based averaging. Bluetooth GFSK (DH5) was verified to have the highest duty cycle of 77.0% 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.
4. Measured Duty Cycle is not required due to SAR test exemption.
5. This device supports inter-band Uplink Carrier Aggregation.

6.3. Nominal and Maximum Output Power

KDB 447498 sec.4.1. 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

NR FDD Bands

RF Air interface	Antenna	Mode	Max. RF Output Power (dBm)	Reduced. RF Output Power (dBm)			
				Hotspot back-off	Proximity sensor & Ear-jack back-off	RCV back-off	Gamma detection
NR Band n66	Main 3 Ant.	DFT-s-OFDM QPSK	**25.0**	**22.0**		**19.0**	**22.0**

Note(s):
1. For Main ant.3 in SAR Report, Main ant.3 is same Ant.4 of document.

6.4. Power Back-off Operation

This device's Main.3Ant(NR Band n66) supports multiple power back-off modes: WWAN (Hotspot), WWAN (Gamma detection), WWAN (RCV). Each of the power back-off operates within specific exposure conditions for certain technologies. For full details on how each power back-off mode operates, refer to the Operational Description.

Power Back-off mode	Technologies Supported	Exposure Conditions Active			
		Head	Body-worn	Hotspot	Product Specific 10-g
WWAN (Hotspot)	NR Band n66 (Main.3)	N/A	N/A	✓	N/A
WWAN (RCV)	NR Band n66 (Main.3)	✓	N/A	N/A	N/A
WWAN (Gamma detection)	NR Band n66 (Main.3)	N/A	N/A	N/A	✓

Note(s):
1. WWAN Back-off priority: RCV → Ear-jack → Proximity Sensor → Hotspot → Gamma detection

Product Specific 10g Adjusted SAR Calculation

Wireless technologies	Max Tune-up Limit (dBm)	Reduced Tune-Up Limit (dBm)	Power Factor	Reported SAR Limit (W/kg)
NR Band n66 (Main.3)	25.0	22.0	2.00	0.601

Note(s):
1. Tune-up limit powers for GSM 1900 are frame power(dBm).
2. Hotspot mode supports power reduction. When the measured SAR is scaled to the maximum tune-up limit, the adjusted SAR is < 1.2 W/kg. Therefore, Extremity SAR testing is not required for this band in accordance with KDB 648474 §2.5 b. Refer to §10 for Reported SAR results. If the Reported SAR 1g value in §10 is less than the Reported SAR Limit listed above, then Extremity SAR is not required.
3. LTE 50% RB is scaled up to the Max Tune-Up Limit with MPR included.
4. For Reported SAR limit in above table, it was calculated using Max tune-up Limit & Reduced Tune-up limit & Reported SAR 1.2 W/kg. (Reported SAR Limit = 1.2 W/kg / Power factor, Power factor = 10^((Max tune-up limit – Reduced tune-up limit)/10)

6.5. NR (Sub 6GHz) SAR Test and Reporting Considerations

Item	Description												
Frequency range, Channel Bandwidth, Numbers and Frequencies	Band n66	Frequency range: 1710 - 1780 MHz											
		Channel Bandwidth (MHz)											
		100	90	80	70	60	50	40	30	25	20	15	10	5
	Low										344000 /1720	343500 /1717.5	343000 /1715	342500 /1712.5
	Mid										349000 /1745	349000 /1745	349000 /1745	349000 /1745
	High										354000 /1770	354500 /1772.5	355000 /1775	355500 /1777.5
SCS	15 kHz													
Modulations Supported in UL	DFT-s-OFDM: π/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM CP-OFDM: QPSK, 16QAM, 64QAM, 256QAM													
A-MPR (Additional MPR) disabled for SAR Testing?	Yes													
EN-DC Carrier Aggregation Possible Combinations														
LTE Anchor Bands for NR Band n66 (Main Ant.3)	LTE Band 2													

Notes:

1. SAR test for NR bands and LTE anchor Bands were performed separately due to limitations in SAR probe calibration factors.
2. NR configurations of SAR test were determined according to Section 5.2 of KDB 941225 D05.
3. NR Band n66 (Main Ant.3) only operate to NSA mode.

7. RF Exposure Conditions (Test Configurations)

Refer to Appendix A for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.

Wireless technologies	RF Exposure Conditions	Antenaa	DUT-to-User Separation	Test Position	Antenna-to-edge/surface	SAR Required	Note
WWAN	Head	All Main Antennas	0 mm	Left Touch	N/A	Yes	
				Left Tilt (15°)	N/A	Yes	
				Right Touch	N/A	Yes	
				Right Tilt (15°)	N/A	Yes	
	Body	All Main Antennas	15 mm	Rear	N/A	Yes	
				Front	N/A	Yes	
	Hotspot	Main 3 Ant.	10 mm	Rear	< 25 mm	Yes	
				Front	< 25 mm	Yes	
				Edge 1 (Top)	< 25 mm	Yes	
				Edge 2 (Right)	< 25 mm	Yes	
				Edge 3 (Bottom)	> 25 mm	No	1
				Edge 4 (Left)	> 25 mm	No	1
	Product Specific 10-g	All Main Antennas	0 mm	Rear	Refer to notes 2 & 3		
				Front			
				Edge 1 (Top)			
				Edge 2 (Right)			
				Edge 3 (Bottom)			
				Edge 4 (Left)			

Notes:

1. SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 941225 D06 Hot Spot SAR.
2. For Phablet devices: When hotspot mode applies, Product specific 10-g SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg.
3. For Phablet devices: When hotspot mode applies and power reduction applies to hotspot mode, Product specific 10-g SAR is required for each test position that has and adjusted SAR to maximum power that is > 1.2 W/kg.
4. For Phablet devices: When hotspot mode is not supported, Product specific 10-g SAR is required for all surfaces and edges with an antenna located at ≤ 25mm from that surface or edge in direct contact with a flat phantom, to address interactive hand use exposure conditions.

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.

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

SAR test were performed in All RF exposure conditions using Head tissue according to TCB workshop note of April. 2019.

IEEE Std 1528-2013

Refer to Table 3 within the IEEE Std 1528-2013

Dielectric Property Measurements Results:
SAR 3 Room

Date Tested	System Dipole		T.S. Liquid		Measured Results		Target (Ref. Value)	Delta ±10 %	Plot No.
	Type	Serial #			Zoom Scan to 100 mW	Normalize to 1 W			
2022-06-13	D1750V2	1180	Head	1g	3.38	33.8	36.40	-7.14	1
				10g	1.82	18.2	19.10	-4.71	

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 2.5 mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 1.4 mm
- The dipole input power (forward power) was 100 mW.
- The results are normalized to 1 W input power.

Reference Target SAR Values

The reference SAR values can be obtained from the calibration certificate of system validation dipoles.

System Dipole	Serial No.	Cal. Date	Cal. Due Date	Freq. (MHz)	Target SAR Values (W/kg)	
					1g/10g	Head
D1750V2	1180	4-27-2021	4-27-2023	1750	1g	36.40
					10g	19.10

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.

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.

SAR 3 Room

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
2022-06-13	Head 1750	e'	39.8500	Relative Permittivity (ϵ_r):	39.85	40.08	-0.59	5
		e"	14.0000	Conductivity (σ):	1.36	1.37	-0.49	5
	Head 1710	e'	39.8900	Relative Permittivity (ϵ_r):	39.89	40.15	-0.64	5
		e"	14.1200	Conductivity (σ):	1.34	1.35	-0.29	5
	Head 1755	e'	39.8500	Relative Permittivity (ϵ_r):	39.85	40.08	-0.57	5
		e"	13.9900	Conductivity (σ):	1.37	1.37	-0.48	5

9. Conducted Output Power Measurements

9.1. NR (Sub 6GHz)

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

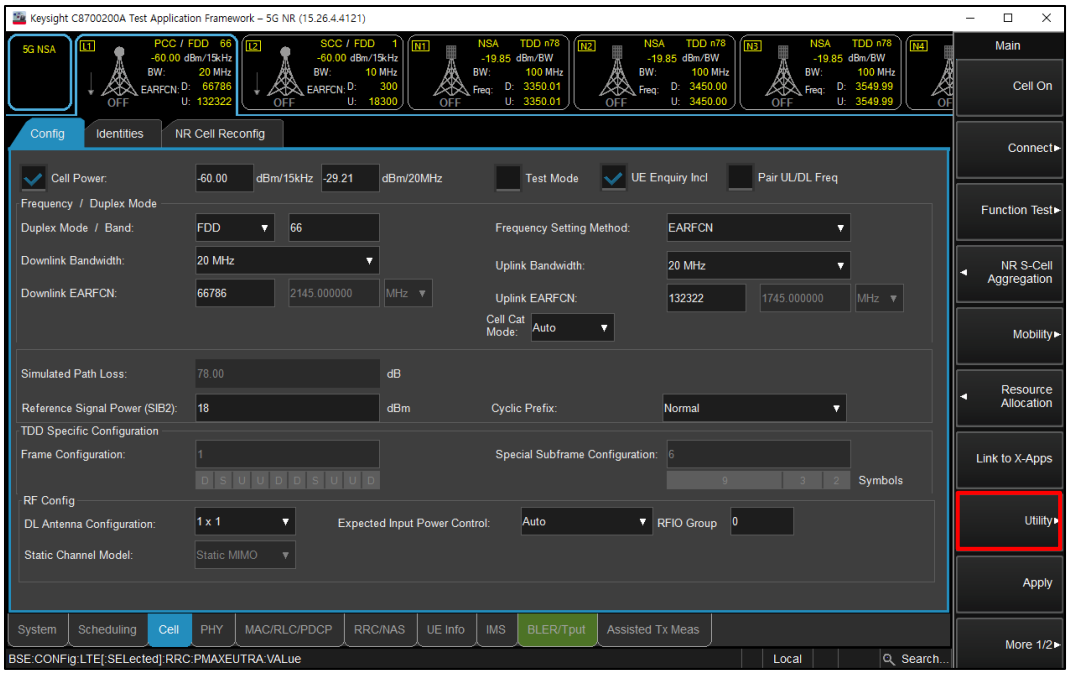
Uplink RB allocations were used to Table 6.1-1 of the 3GPP TS 138.521-1.

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

Procedures used to establish power measurement for NR Bands

Switching to NSA mode or SA mode

- Click the “Utility” button in the right of Test application screen
- Select “5G NR NSA” in the “TA Mode Switch” for NSA mode
- Select “5G NR Standalone” in the “TA Mode Switch” for SA mode

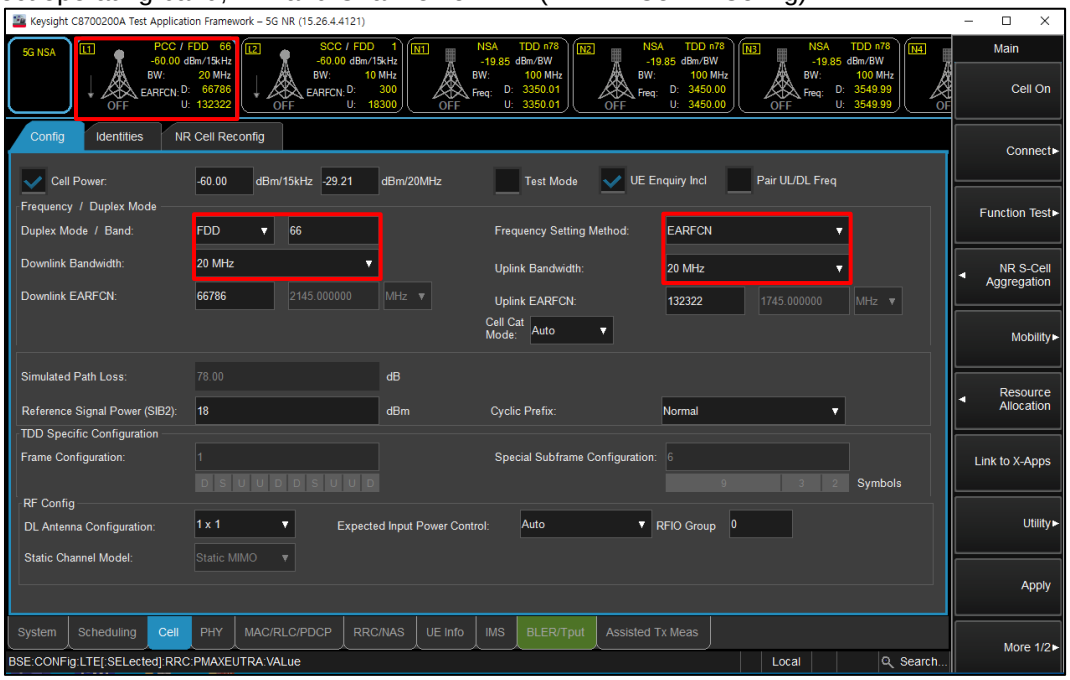


(Figure 1-1)

(Figure 1-2)

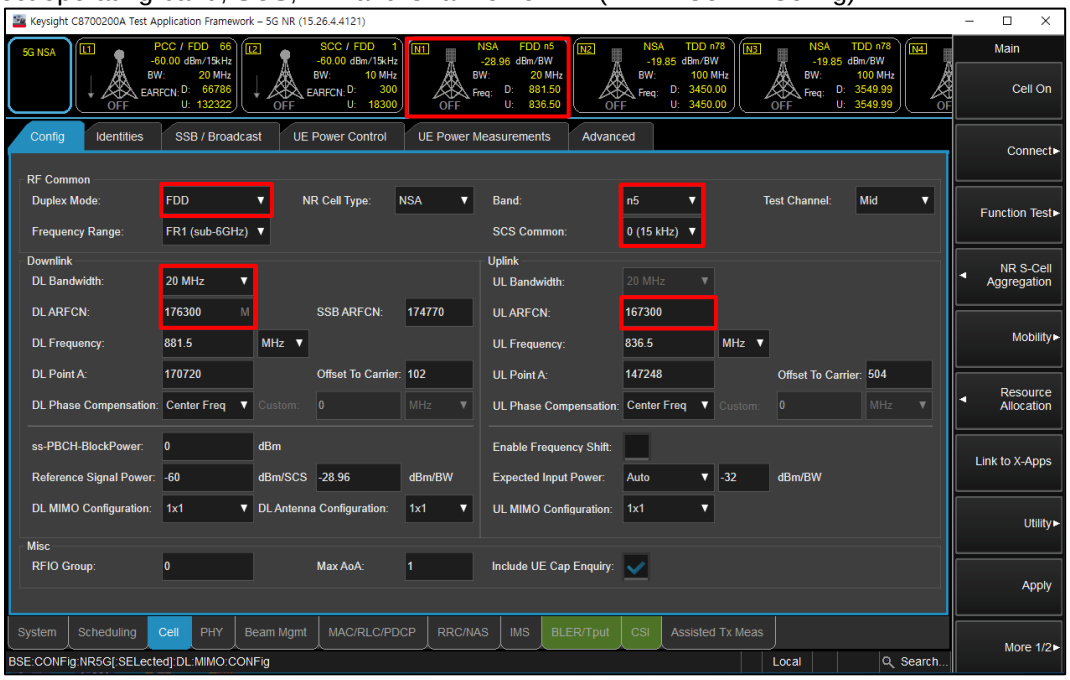
NSA Mode

- Select operating band, BW and Channel for LTE (LTE -> Cell -> Config)



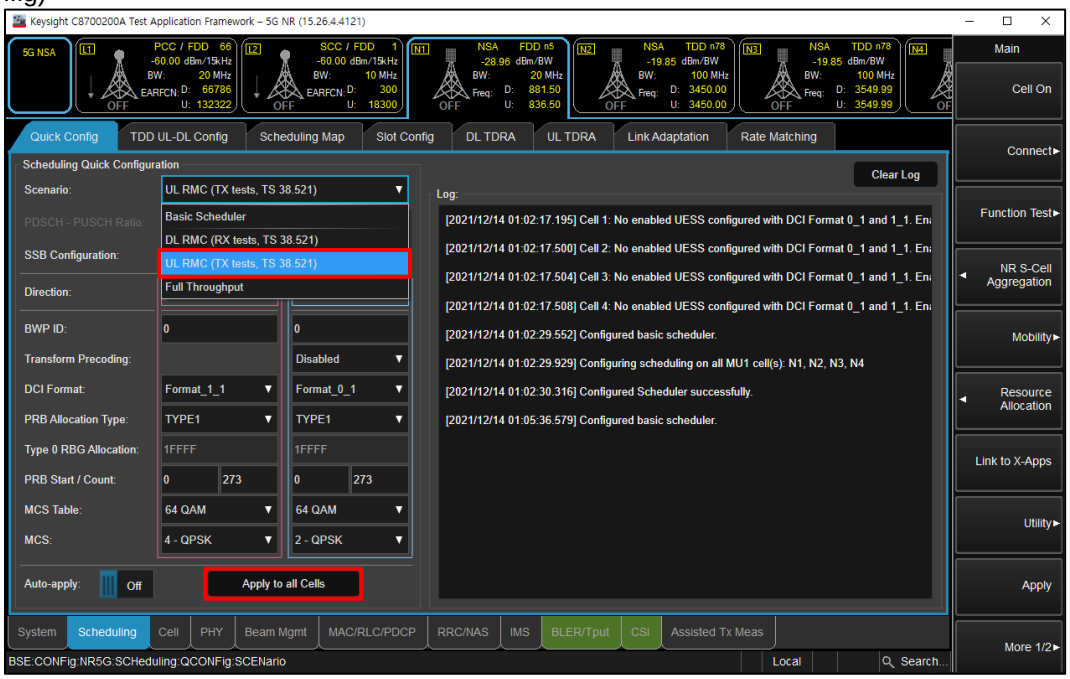
(Figure 2-1)

- Select operating band, SCS, BW and Channel for NR (NR -> Cell -> Config)



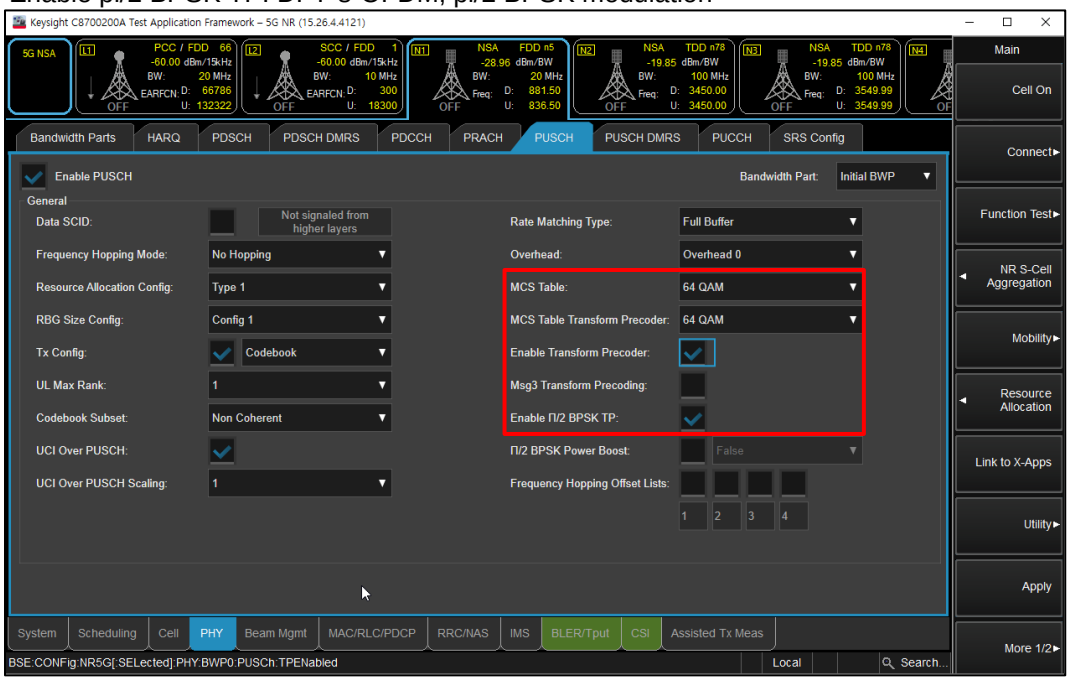
(Figure 2-2)

- Select “UL RMC (TX tests, TS 38.521)” for maximum power RB scheduling (NR -> Scheduling -> Quick Config)



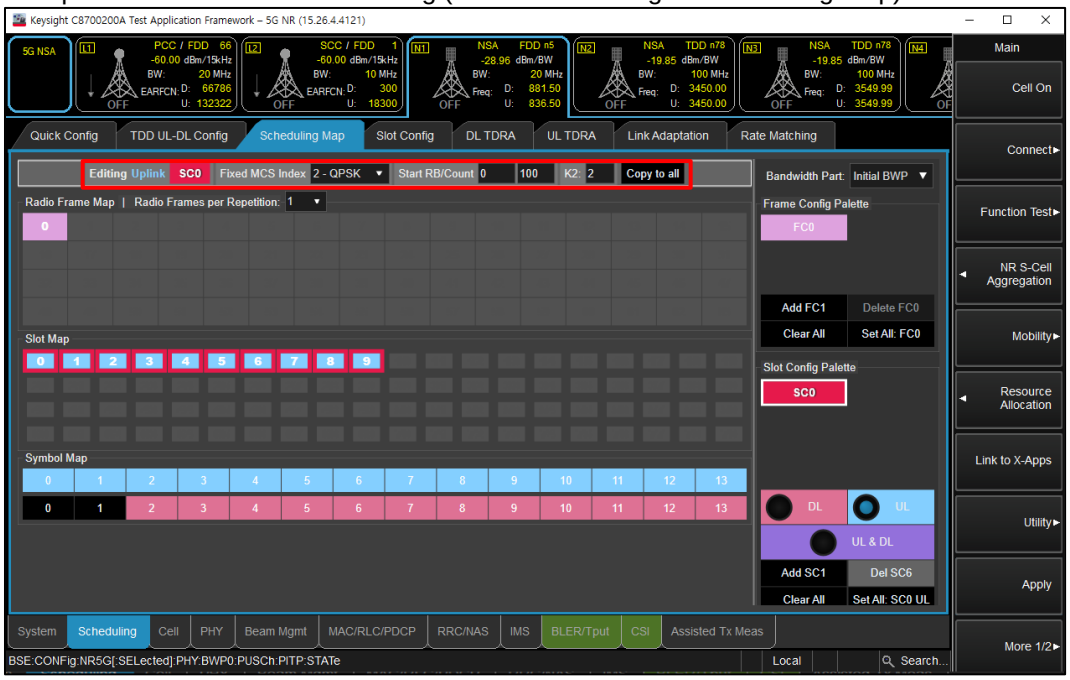
(Figure 2-3)

- To set waveform for NR Band (NR -> PHY -> PUSCH)
  - Select highest modulation in the MCS Table and MCS Table Transform Precoder
  - Enable Transform Precoder: DFT-s-OFDM / disable for CP-OFDM
  - Enable pi/2 BPSK TP: DFT-s-OFDM, pi/2 BPSK modulation



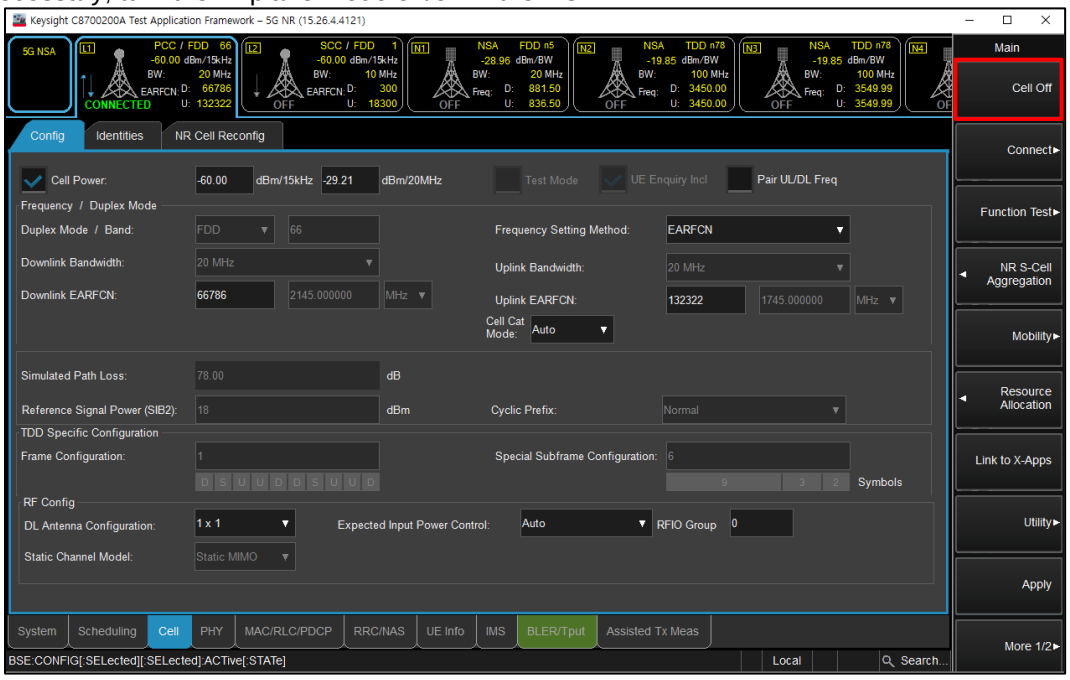
(Figure 2-4)

- Select Uplink Modulation and RB setting (NR -> Scheduling -> Scheduling Map)



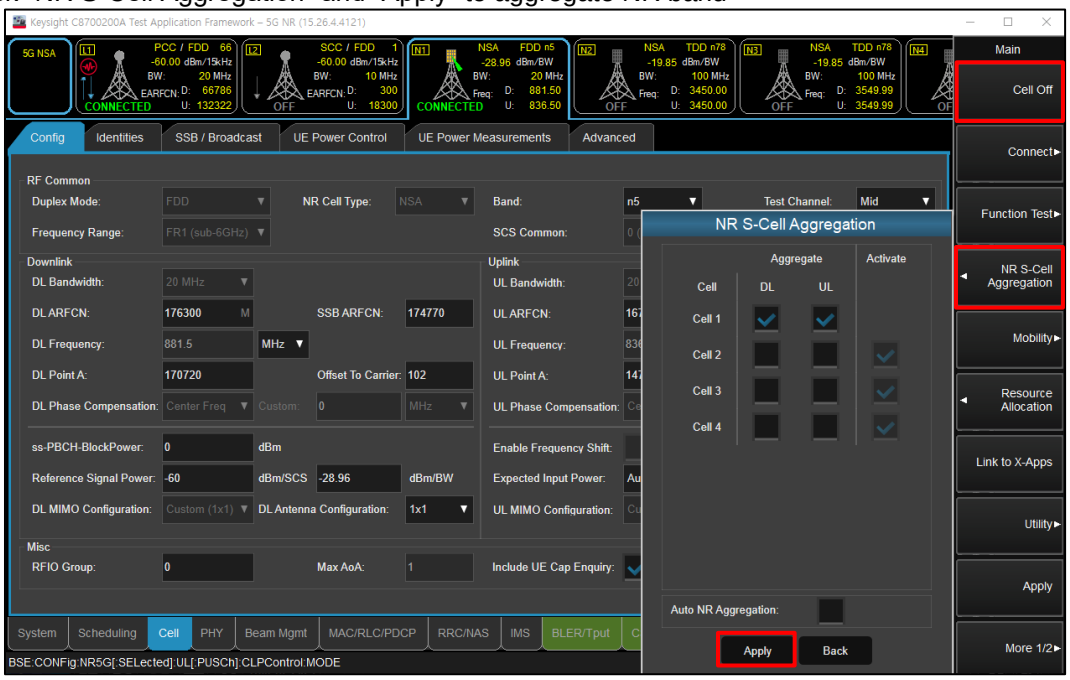
(Figure 2-5)

- Click “Cell On” button in the right of Test application screen in the LTE tab
- If necessary, turn the Airplane Mode on/off in the DUT



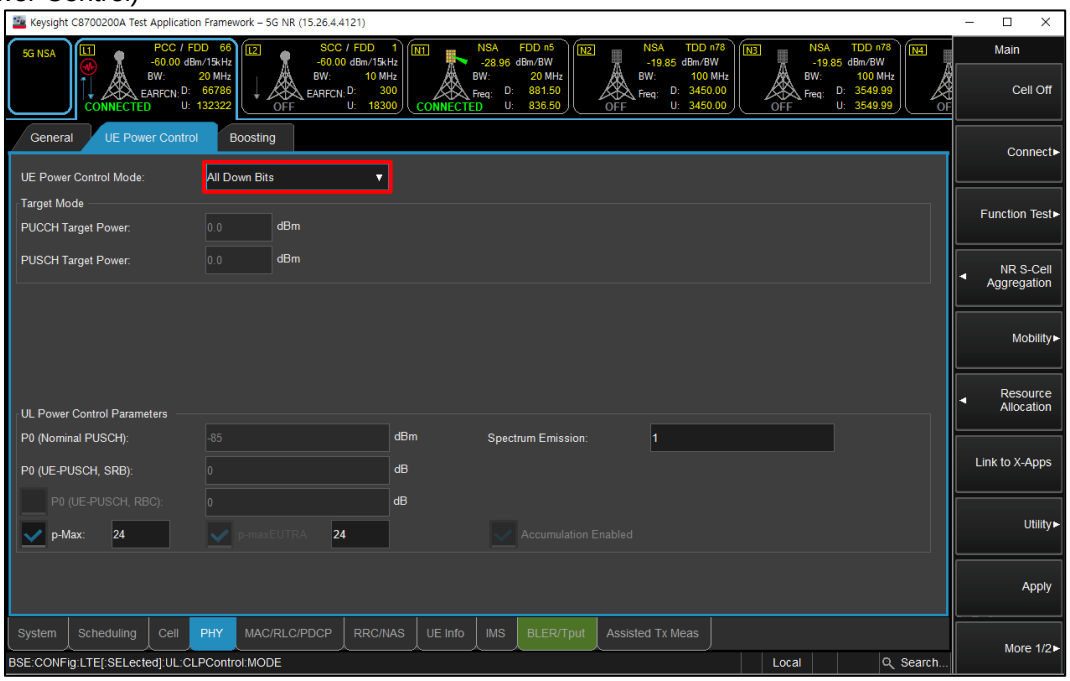
(Figure 2-6)

- Click “Cell On” button in the right of Test application screen in the NR tab
- Click “NR S-Cell Aggregation” and “Apply” to aggregate NR band



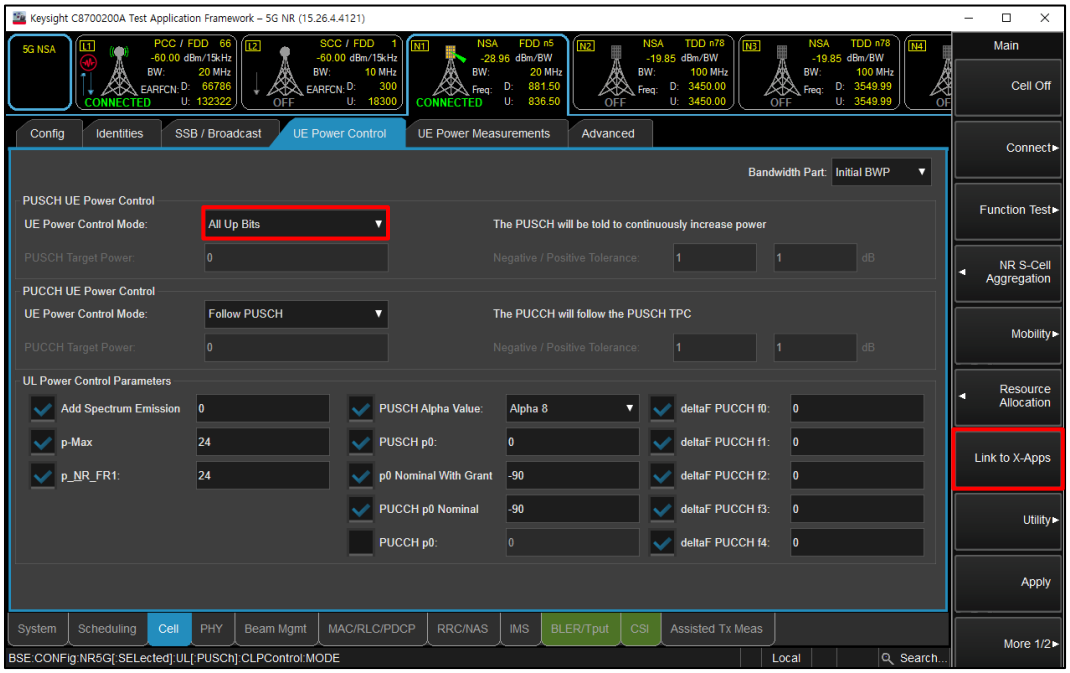
(Figure 2-7)

- Select “All Down Bits” of UL Power control Mode in LTE tab for NR maximum power (LTE -> PHY -> UE Power Control)



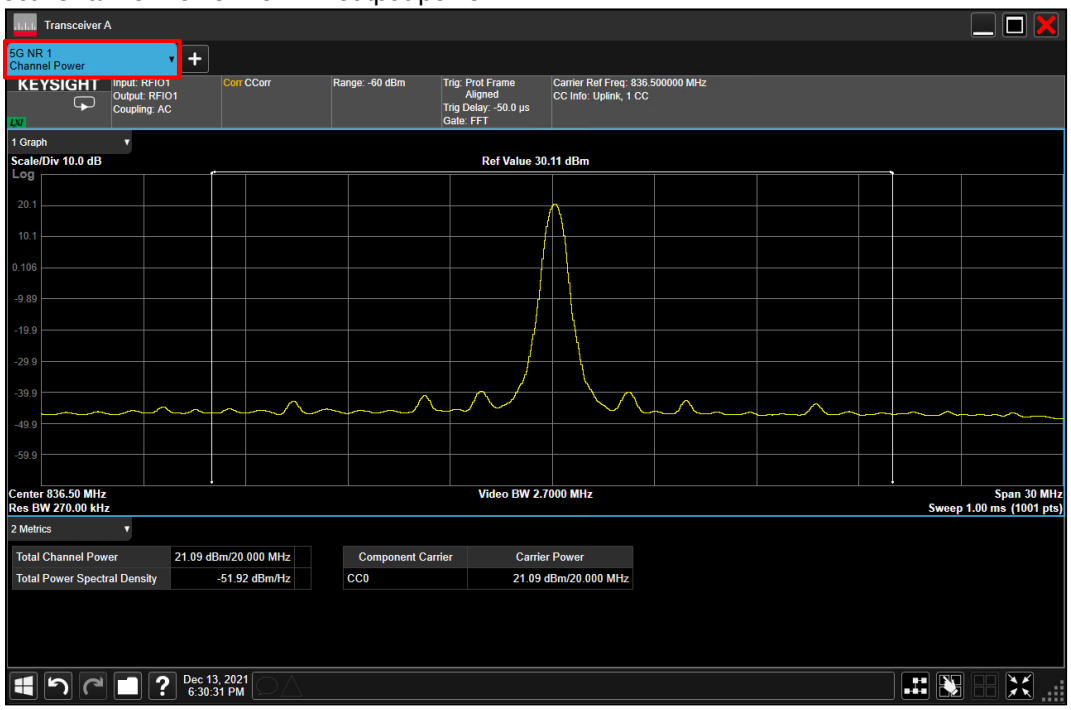
(Figure 2-8)

- Select “All Up Bits” of UL Power control Mode in NR tab for NR maximum power (NR -> Cell -> UE Power Control)
- To read the NR output power, click the “Link to X-Apps” in the NR tab (NR -> Link to X-Apps)
  UE Power Control Mode
  - LTE : All Down Bits
  - NR : All Up Bits
- To read the LTE output power, click the “Link to X-Apps” in the LTE tab (LTE -> Link to X-Apps)
  UE Power Control Mode
  - LTE : All Up Bits
  - NR : All Down Bits



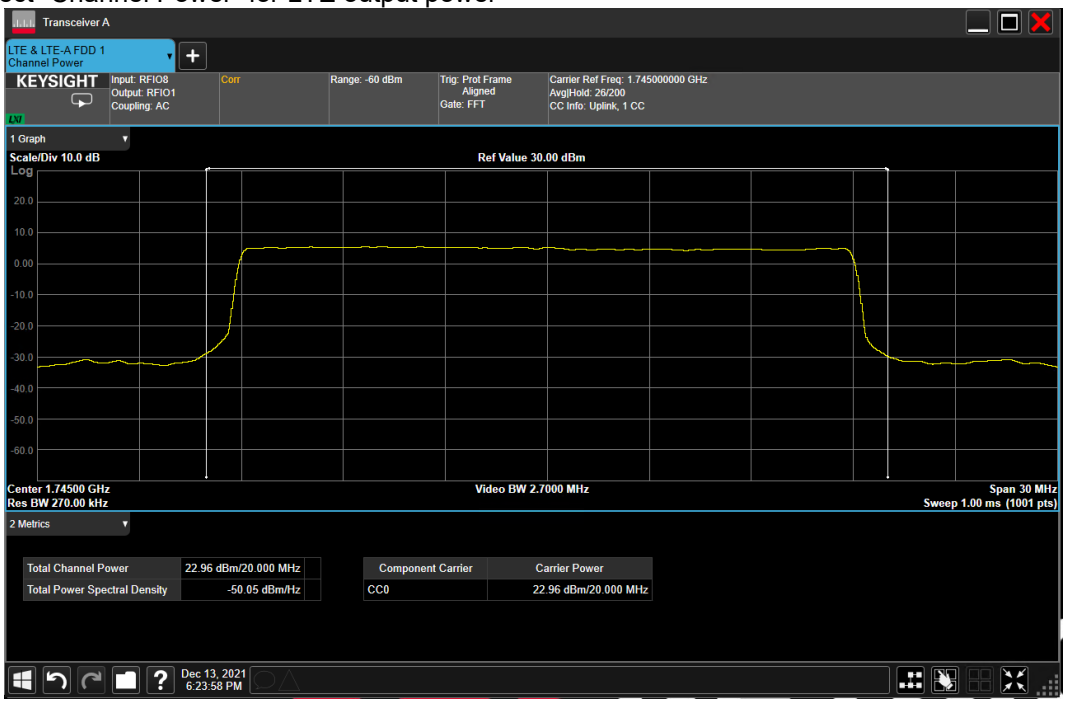
(Figure 2-9)

- Select “Channel Power” for NR output power



(Figure 2-10)

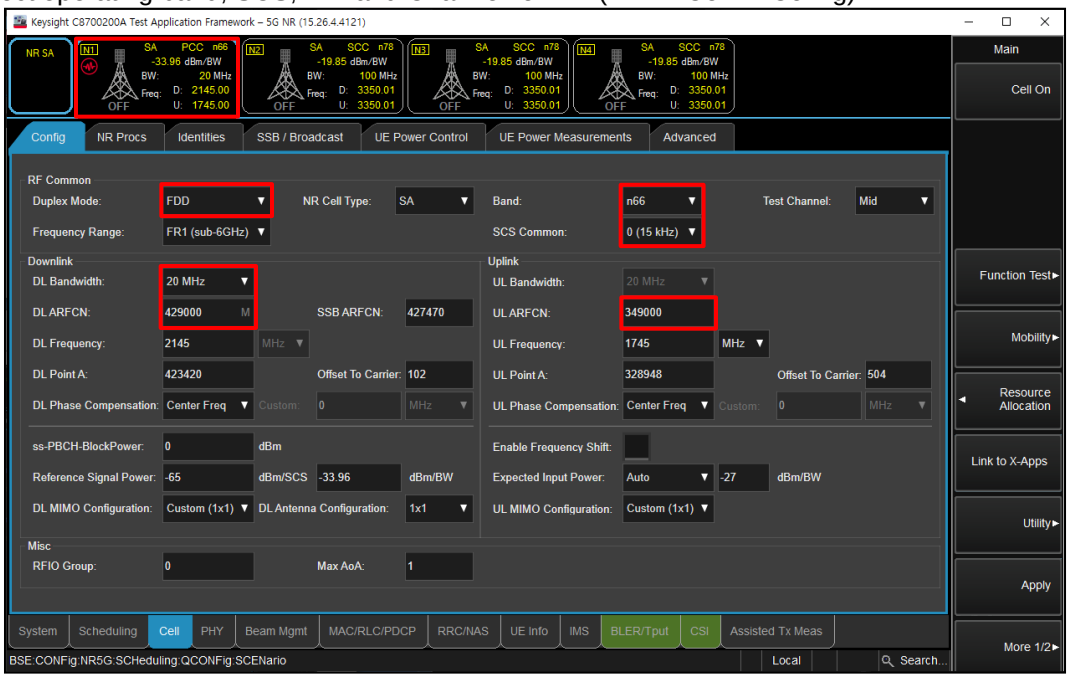
- Select “Channel Power” for LTE output power



(Figure 2-11)

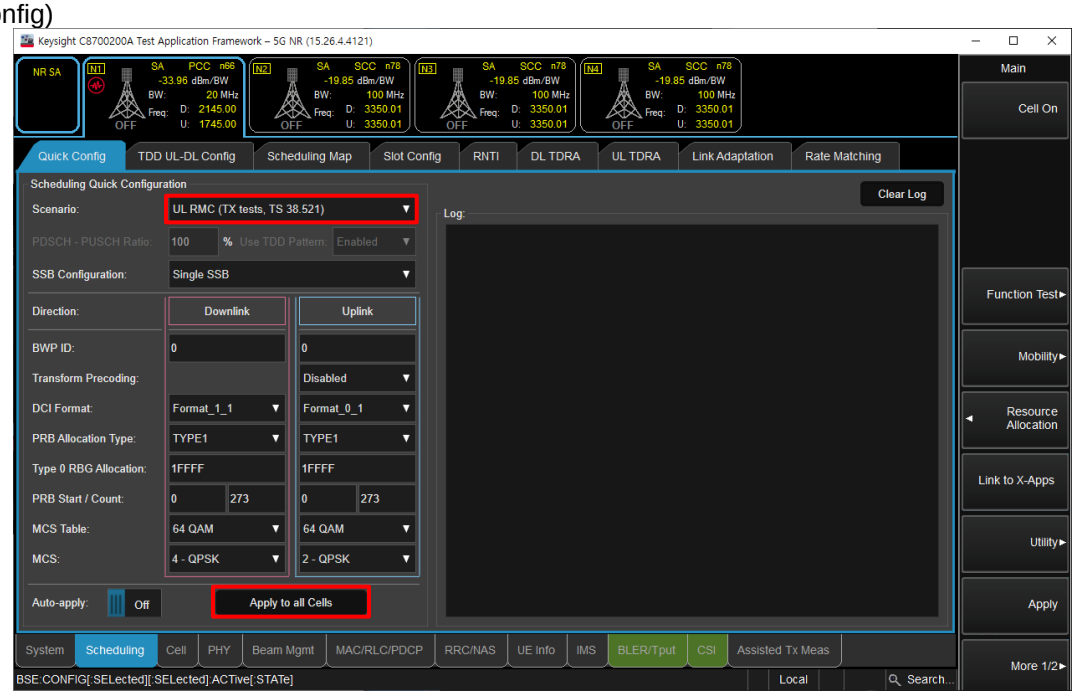
SA Mode

- Select operating band, SCS, BW and Channel for NR (NR -> Cell -> Config)



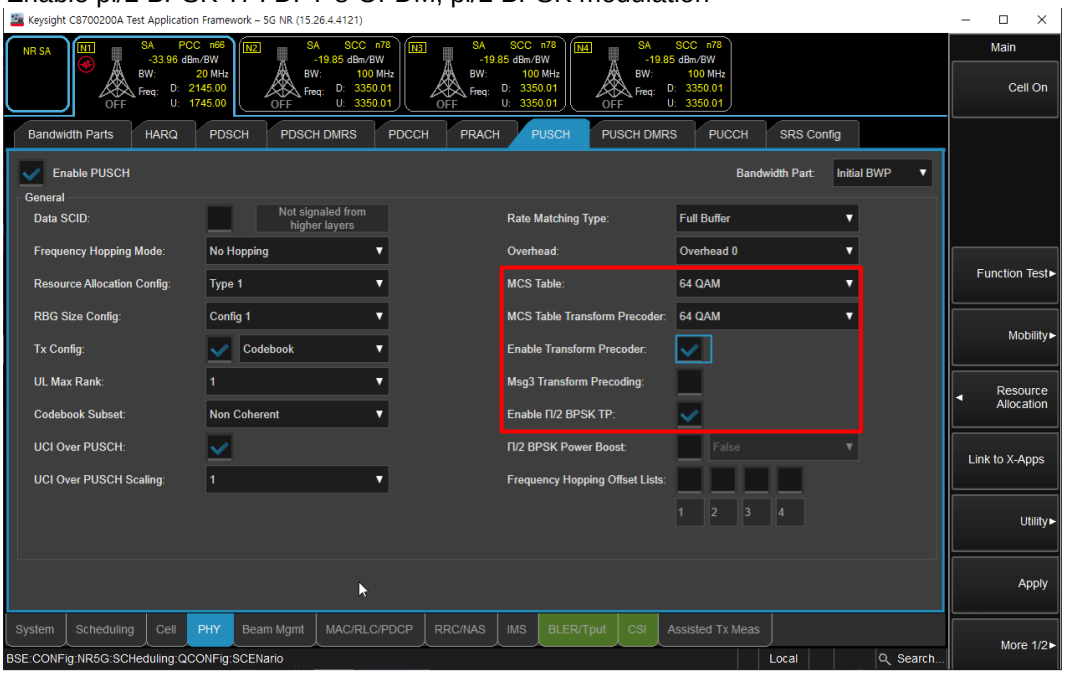
(Figure 3-1)

- Select “UL RMC (TX tests, TS 38.521)” for maximum power RB scheduling (NR -> Scheduling -> Quick Config)



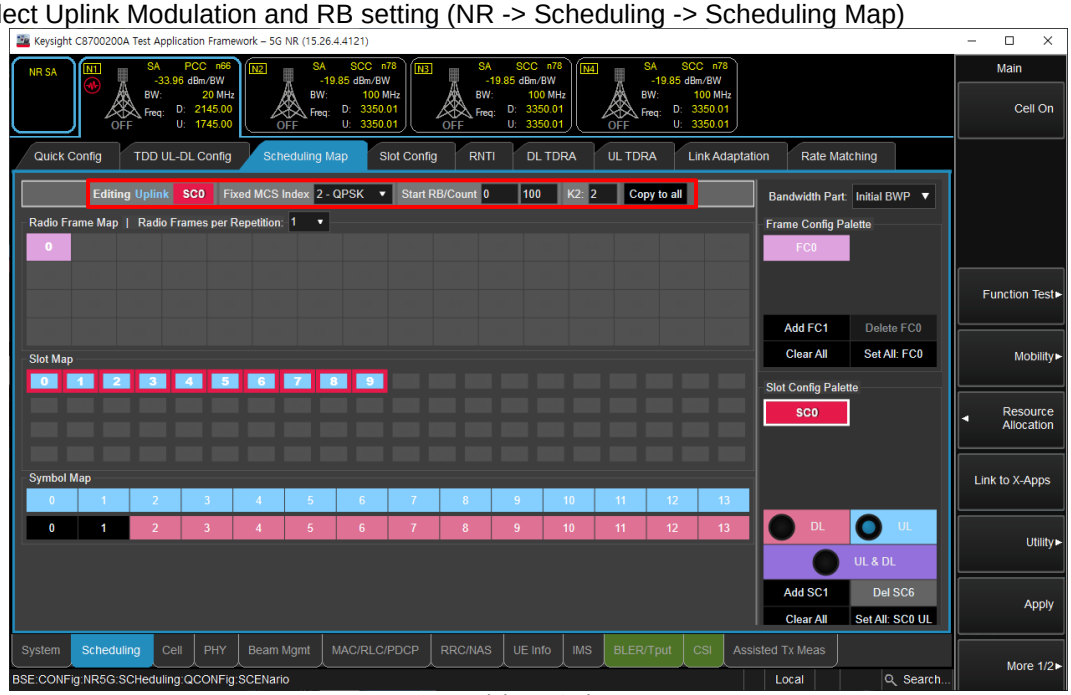
(Figure 3-2)

- To set waveform for NR Band (NR -> PHY -> PUSCH)
  - Select highest modulation in the MCS Table and MCS Table Transform Precoder
  - Enable Transform Precoder: DFT-s-OFDM / disable for CP-OFDM
  - Enable pi/2 BPSK TP: DFT-s-OFDM, pi/2 BPSK modulation



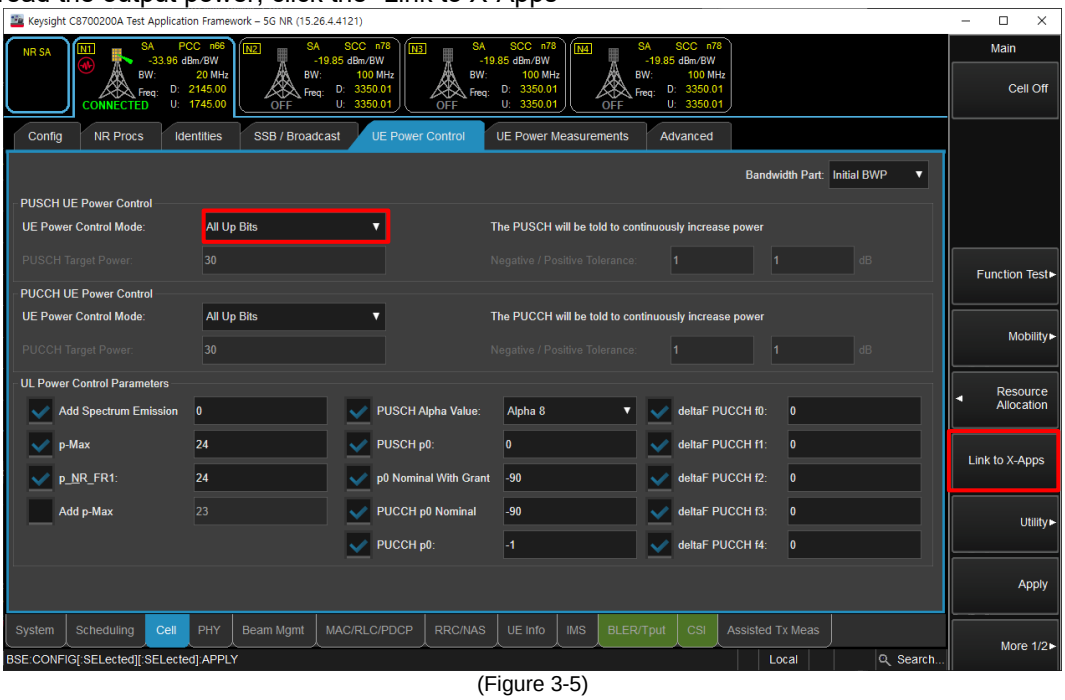
(Figure 3-3)

- Select Uplink Modulation and RB setting (NR -> Scheduling -> Scheduling Map)



(Figure 3-4)

- Click “Cell On” button in the right of Test application screen
- If necessary, turn the Airplane Mode on/off in the DUT
- Select “All Up Bits” of UL Power control Mode (Cell -> UE Power Control)
- To read the output power, click the “Link to X-Apps”



(Figure 3-5)

- Select “Channel Power”

(Figure 3-6)

1. Max power

NR Band n66 (Main Ant.3) Measured Results

BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)				
					Measured Pwr (dBm)			MPR	Tune-up Limit
					344000	349000	354000		
					1720 MHz	1745 MHz	1770 MHz		
20 MHz	DFT-s-OFDM	π/2 BPSK	1	1	24.27	24.25	24.13	0.0	25
			1	53	24.20	24.16	24.01	0.0	25
			1	104	24.21	24.10	23.93	0.0	25
			50	0	24.35	24.34	24.14	0.5	24.5
			50	28	24.25	24.22	24.09	0.0	25
			50	56	24.24	24.17	24.11	0.5	24.5
			100	0	24.30	24.22	24.03	0.5	24.5
		QPSK	1	1	24.42	24.31	24.15	0.0	25
			1	53	24.20	24.20	23.83	0.0	25
			1	104	24.20	24.18	23.78	0.0	25
			50	0	22.26	22.29	22.18	1.0	24
			50	28	24.40	24.25	23.90	0.0	25
			50	56	22.17	22.07	22.17	1.0	24
			100	0	22.29	22.15	22.09	1.0	24
		16QAM	1	1	22.40	22.43	22.26	1.0	24
			1	53	22.25	22.34	22.12	1.0	24
			1	104	22.23	22.33	22.03	1.0	24
		64QAM	1	1	20.72	20.56	20.68	2.5	22.5
		256QAM	1	1	18.92	18.79	18.72	4.5	20.5
	CP-OFDM	QPSK	1	1	21.81	21.68	21.60	1.5	23.5
BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit
					343500	349000	354500		
					1717.5 MHz	1745 MHz	1772.5 MHz		
15 MHz	DFT-s-OFDM	π/2 BPSK	1	1	24.39	24.26	24.12	0.0	25
			1	40	24.40	24.22	24.12	0.0	25
			1	77	24.24	24.17	23.99	0.0	25
			36	0	24.41	24.31	24.10	0.5	24.5
			36	22	24.43	24.31	24.11	0.0	25
			36	43	24.36	24.24	24.16	0.5	24.5
			75	0	24.43	24.29	24.13	0.5	24.5
		QPSK	1	1	24.39	24.19	24.16	0.0	25
			1	40	24.40	24.28	24.13	0.0	25
			1	77	24.23	24.15	24.02	0.0	25
			36	0	22.38	22.25	22.21	1.0	24
			36	22	24.41	24.26	24.14	0.0	25
			36	43	22.42	22.13	22.20	1.0	24
			75	0	22.45	22.20	22.23	1.0	24
		16QAM	1	1	22.31	22.40	22.34	1.0	24
		64QAM	1	1	20.94	20.91	20.76	2.5	22.5
		256QAM	1	1	19.01	18.84	18.78	4.5	20.5
	CP-OFDM	QPSK	1	1	21.95	21.80	21.70	1.5	23.5
BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit
					343000	349000	355000		
					1715 MHz	1745 MHz	1775 MHz		
10 MHz	DFT-s-OFDM	π/2 BPSK	1	1	24.46	24.33	24.11	0.0	25
			1	26	24.41	24.21	24.13	0.0	25
			1	50	24.40	24.18	24.07	0.0	25
			25	0	24.44	24.32	24.09	0.5	24.5
			25	14	24.47	24.28	24.13	0.0	25
			25	27	24.44	24.22	24.14	0.5	24.5
			50	0	24.44	24.27	24.16	0.5	24.5
		QPSK	1	1	24.43	24.35	24.10	0.0	25
			1	26	24.43	24.30	24.14	0.0	25
			1	50	24.38	24.21	24.06	0.0	25
			25	0	22.50	22.34	22.17	1.0	24
			25	14	24.42	24.27	24.13	0.0	25
			25	27	22.42	22.22	22.14	1.0	24
			50	0	22.47	22.30	22.21	1.0	24
		16QAM	1	1	22.50	22.45	22.33	1.0	24
		64QAM	1	1	21.00	20.86	20.70	2.5	22.5
		256QAM	1	1	19.11	18.89	18.84	4.5	20.5
	CP-OFDM	QPSK	1	1	21.96	22.07	21.87	1.5	23.5
BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit
					342500	349000	355500		
					1712.5 MHz	1745 MHz	1777.5 MHz		
5 MHz	DFT-s-OFDM	π/2 BPSK	1	1	24.41	24.24	24.15	0.0	25
			1	13	24.44	24.25	24.18	0.0	25
			1	23	24.43	24.13	24.07	0.0	25
			12	0	24.40	24.30	24.12	0.5	24.5
			12	7	24.43	24.28	24.13	0.0	25
			12	13	24.45	24.26	24.12	0.5	24.5
			25	0	24.39	24.27	24.19	0.5	24.5
		QPSK	1	1	24.40	24.25	24.17	0.0	25
			1	13	24.44	24.25	24.15	0.0	25
			1	23	24.42	24.16	24.09	0.0	25
			12	0	22.41	22.25	22.25	1.0	24
			12	7	24.42	24.28	24.19	0.0	25
			12	13	22.36	22.27	22.10	1.0	24
			25	0	22.40	22.36	22.30	1.0	24
		16QAM	1	1	22.35	22.32	22.22	1.0	24
		64QAM	1	1	21.03	20.84	20.82	2.5	22.5
		256QAM	1	1	19.10	18.77	18.72	4.5	20.5
	CP-OFDM	QPSK	1	1	22.05	21.82	21.67	1.5	23.5

2. Reduced power

NR Band n66 (Main Ant.3) Measured Results

BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Reduced Average Power (dBm) Hotspot back-off					Reduced Average Power (dBm) Gamma Detection				
					Measured Pwr (dBm)			MPR	Tune-up Limit	Measured Pwr (dBm)			MPR	Tune-up Limit
					344000	349000	354000			344000	349000	354000		
					1720 MHz	1745 MHz	1770 MHz			1720 MHz	1745 MHz	1770 MHz		
20 MHz	DFT-s-OFDM	π/2 BPSK	1	1	21.44	21.24	21.20	0.0	22	21.37	21.28	21.19	0.0	22
			1	53	21.33	21.22	21.13	0.0	22	21.38	21.27	21.07	0.0	22
			1	104	21.12	21.05	21.13	0.0	22	21.21	21.04	21.16	0.0	22
			50	0	21.42	21.33	21.20	0.0	22	21.45	21.40	21.22	0.0	22
			50	28	21.41	21.35	21.14	0.0	22	21.46	21.30	21.15	0.0	22
			50	56	21.34	21.23	21.16	0.0	22	21.37	21.26	21.12	0.0	22
			100	0	21.41	21.29	21.14	0.0	22	21.44	21.31	21.13	0.0	22
		QPSK	1	1	21.40	21.27	21.25	0.0	22	21.52	21.25	21.23	0.0	22
			1	53	21.38	21.29	21.21	0.0	22	21.43	21.33	21.18	0.0	22
			1	104	21.28	21.13	21.16	0.0	22	21.32	21.11	21.21	0.0	22
			50	0	21.49	21.33	21.17	0.0	22	21.49	21.39	21.17	0.0	22
			50	28	21.50	21.35	21.15	0.0	22	21.49	21.30	21.13	0.0	22
			50	56	21.39	21.26	21.12	0.0	22	21.37	21.28	21.13	0.0	22
			100	0	21.47	21.27	21.13	0.0	22	21.45	21.28	21.19	0.0	22
		16QAM	1	1	21.35	21.58	21.27	0.0	22	21.52	21.14	21.21	0.0	22
			1	53	21.29	21.16	20.84	0.0	22	21.40	21.29	21.25	0.0	22
			1	104	21.22	21.28	21.00	0.0	22	21.23	21.17	21.19	0.0	22
		64QAM	1	1	21.36	21.29	21.30	0.0	22	21.43	21.24	20.97	0.0	22
		256QAM	1	1	21.01	20.73	20.78	0.0	22	20.95	20.79	20.73	0.0	22
	CP-OFDM	QPSK	1	1	21.46	21.27	21.23	0.0	22	21.40	21.24	21.17	0.0	22
BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit	Measured Pwr (dBm)			MPR	Tune-up Limit
					343500	349000	354500			343500	349000	354500		
					1717.5 MHz	1745 MHz	1772.5 MHz			1717.5 MHz	1745 MHz	1772.5 MHz		
15 MHz	DFT-s-OFDM	π/2 BPSK	1	1	21.43	21.42	21.18	0.0	22	21.40	21.40	21.17	0.0	22
			1	40	21.37	21.27	21.12	0.0	22	21.38	21.29	21.17	0.0	22
			1	77	21.34	21.07	21.15	0.0	22	21.28	21.15	21.18	0.0	22
			36	0	21.49	21.37	21.15	0.0	22	21.49	21.40	21.17	0.0	22
			36	22	21.50	21.28	21.16	0.0	22	21.47	21.33	21.17	0.0	22
			36	43	21.47	21.29	21.23	0.0	22	21.47	21.29	21.20	0.0	22
			75	0	21.51	21.32	21.18	0.0	22	21.53	21.30	21.17	0.0	22
		QPSK	1	1	21.48	21.44	21.16	0.0	22	21.44	21.43	21.17	0.0	22
			1	40	21.38	21.30	21.14	0.0	22	21.41	21.34	21.14	0.0	22
			1	77	21.29	21.13	21.22	0.0	22	21.36	21.12	21.18	0.0	22
			36	0	21.51	21.40	21.18	0.0	22	21.52	21.37	21.16	0.0	22
			36	22	21.49	21.33	21.15	0.0	22	21.50	21.29	21.20	0.0	22
			36	43	21.44	21.26	21.21	0.0	22	21.46	21.31	21.22	0.0	22
			75	0	21.50	21.33	21.17	0.0	22	21.52	21.28	21.14	0.0	22
		16QAM	1	1	21.59	21.43	21.22	0.0	22	21.58	21.50	21.26	0.0	22
		64QAM	1	1	21.32	21.40	21.21	0.0	22	21.41	21.47	21.19	0.0	22
		256QAM	1	1	20.95	20.98	20.65	0.0	22	20.94	20.87	20.60	0.0	22
	CP-OFDM	QPSK	1	1	21.43	21.43	21.12	0.0	22	21.42	21.38	21.16	0.0	22
BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit	Measured Pwr (dBm)			MPR	Tune-up Limit
					343000	349000	355000			343000	349000	355000		
					1715 MHz	1745 MHz	1775 MHz			1715 MHz	1745 MHz	1775 MHz		
10 MHz	DFT-s-OFDM	π/2 BPSK	1	1	21.49	21.39	21.20	0.0	22	21.47	21.43	21.19	0.0	22
			1	26	21.47	21.27	21.17	0.0	22	21.50	21.26	21.18	0.0	22
			1	50	21.45	21.21	21.20	0.0	22	21.50	21.26	21.04	0.0	22
			25	0	21.49	21.37	21.17	0.0	22	21.48	21.37	21.02	0.0	22
			25	14	21.50	21.31	21.20	0.0	22	21.54	21.30	21.05	0.0	22
			25	27	21.48	21.26	21.24	0.0	22	21.51	21.31	21.07	0.0	22
			50	0	21.55	21.30	21.21	0.0	22	21.54	21.29	21.05	0.0	22
		QPSK	1	1	21.57	21.47	21.17	0.0	22	21.48	21.43	21.22	0.0	22
			1	26	21.53	21.32	21.19	0.0	22	21.57	21.31	21.18	0.0	22
			1	50	21.49	21.31	21.22	0.0	22	21.47	21.28	21.22	0.0	22
			25	0	21.48	21.37	21.19	0.0	22	21.51	21.37	21.18	0.0	22
			25	14	21.53	21.31	21.20	0.0	22	21.50	21.32	21.22	0.0	22
			25	27	21.47	21.29	21.22	0.0	22	21.51	21.31	21.23	0.0	22
			50	0	21.52	21.33	21.25	0.0	22	21.49	21.30	21.18	0.0	22
		16QAM	1	1	21.64	21.40	21.18	0.0	22	21.50	21.70	21.31	0.0	22
		64QAM	1	1	21.44	21.48	21.20	0.0	22	21.31	21.41	21.14	0.0	22
		256QAM	1	1	20.97	20.87	20.67	0.0	22	20.95	20.92	20.68	0.0	22
	CP-OFDM	QPSK	1	1	21.44	21.40	21.18	0.0	22	21.46	21.37	21.13	0.0	22
BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit	Measured Pwr (dBm)			MPR	Tune-up Limit
					342500	349000	355500			342500	349000	355500		
					1712.5 MHz	1745 MHz	1777.5 MHz			1712.5 MHz	1745 MHz	1777.5 MHz		
5 MHz	DFT-s-OFDM	π/2 BPSK	1	1	21.46	21.32	21.11	0.0	22	21.43	21.31	21.10	0.0	22
			1	13	21.42	21.31	21.12	0.0	22	21.40	21.32	21.11	0.0	22
			1	23	21.46	21.26	21.21	0.0	22	21.50	21.25	21.20	0.0	22
			12	0	21.46	21.30	21.16	0.0	22	21.49	21.32	21.22	0.0	22
			12	7	21.45	21.32	21.24	0.0	22	21.45	21.33	21.22	0.0	22
			12	13	21.42	21.30	21.24	0.0	22	21.49	21.29	21.24	0.0	22
			25	0	21.44	21.33	21.22	0.0	22	21.46	21.34	21.20	0.0	22
		QPSK	1	1	21.51	21.35	21.14	0.0	22	21.51	21.31	21.20	0.0	22
			1	13	21.42	21.32	21.17	0.0	22	21.46	21.33	21.15	0.0	22
			1	23	21.52	21.29	21.24	0.0	22	21.53	21.33	21.27	0.0	22
			12	0	21.50	21.27	21.23	0.0	22	21.49	21.34	21.20	0.0	22
			12	7	21.47	21.31	21.20	0.0	22	21.49	21.35	21.23	0.0	22
			12	13	21.53	21.29	21.25	0.0	22	21.52	21.31	21.23	0.0	22
			25	0	21.50	21.33	21.20	0.0	22	21.50	21.24	21.22	0.0	22
		16QAM	1	1	21.44	21.20	21.17	0.0	22	21.57	21.27	21.11	0.0	22
		64QAM	1	1	21.42	21.54	21.20	0.0	22	21.38	21.69	21.11	0.0	22
		256QAM	1	1	20.95	20.84	20.61	0.0	22	20.98	20.80	20.57	0.0	22
	CP-OFDM	QPSK	1	1	21.47	21.32	21.09	0.0	22	21.40	21.25	21.04	0.0	22

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 648474 D04 Handset SAR (Phablet Only):

For smart phones, with a display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm.
When hotspot mode does not apply, 10-g extremity SAR is required for all surfaces and edges with an antenna located at ≤ 25mm From that surface or edge in direct contact with a flat phantom, to address interactive hand use exposure conditions. When hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg; However, when power reduction applies to hotspot mode the measured SAR must be scaled to the maximum output power, Including tolerance, allowed for phablet modes to compare with the 1.2 W/kg SAR test reduction threshold.

Additional 1-g SAR testing at 5 mm is not required when hotspot mode 10-g extremity SAR is not required for the surfaces and edges; since all 1-g reported SAR < 1.2 W/kg.

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.

KDB 248227 D01 SAR meas for 802.11:

SAR test reduction for 802.11 Wi-Fi transmission mode configurations are considered separately for DSSS and OFDM. An initial test position is determined to reduce the number of tests required for certain exposure configurations with multiple test positions. An initial test configuration is determined for each frequency band and aggregated band according to maximum output power, channel bandwidth, wireless mode configurations and other operating parameters to streamline the measurement requirements. For 2.4 GHz DSSS, either the initial test position or DSSS procedure is applied to reduce the number of SAR tests; these are mutually exclusive. For OFDM, an initial test position is only applicable to next to the ear, UMPC mini-tablet and hotspot mode configurations, which is tested using the initial test configuration to facilitate test reduction. For other exposure conditions with a fixed test position, SAR test reduction is determined using only the initial test configuration.

The multiple test positions require SAR measurements in head, hotspot mode or UMPC mini-tablet configurations may be reduced according to the highest reported SAR determined using the *initial test position(s)* by applying the DSSS or OFDM SAR measurement procedures in the required wireless mode test configuration(s). The *initial test position(s)* is measured using the highest measured maximum output power channel in the required wireless mode test configuration(s). When the *reported* SAR for the *initial test position* is:

- ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and wireless mode combination within the frequency band or aggregated band. DSSS and OFDM configurations are considered separately according to the required SAR procedures.
- > 0.4 W/kg, SAR is repeated using the same wireless mode test configuration tested in the *initial test position* to measure the subsequent next closet/smallest test separation distance and maximum coupling test position, on the highest maximum output power channel, until the *reported* SAR is ≤ 0.8 W/kg or all required test positions are tested.
  - For subsequent test positions with equivalent test separation distance or when exposure is dominated by coupling conditions, the position for maximum coupling condition should be tested.
  - When it is unclear, all equivalent conditions must be tested.
- For all positions/configurations tested using the *initial test position* and subsequent test positions, when the *reported* SAR is > 0.8 W/kg, measure the SAR for these positions/configurations on the subsequent next highest measured output power channel(s) until the *reported* SAR is ≤ 1.2 W/kg or all required test channels are considered.
  - The additional power measurements required for this step should be limited to those necessary for identifying subsequent highest output power channels to apply the test reduction.
- When the specified maximum output power is the same for both UNII 1 and UNII 2A, begin SAR measurements in UNII 2A with the channel with the highest measured output power. If the reported SAR for UNII 2A is ≤ 1.2 W/kg, SAR is not required for UNII 1; otherwise treat the remaining bands separately and test them independently for SAR.
- When the specified maximum output power is different between UNII 1 and UNII 2A, begin SAR with the band that has the higher specified maximum output. If the highest reported SAR for the band with the highest specified power is ≤ 1.2 W/kg, testing for the band with the lower specified output power is not required; otherwise test the remaining bands independently for SAR.

To determine the *initial test position*, Area Scans were performed to determine the position with the *Maximum Value of SAR (measured)*. The position that produced the highest *Maximum Value of SAR* is considered the worst case position; thus used as the *initial test position*.

10.1. NR Band n66 (20MHz Bandwidth)

Main 3 Ant. SAR results

Antenna	RF Exposure Conditions	Modulation	Mode	PWR Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offest	Power (dBm)		1-g SAR (W/kg)		Plot No.
											Tune-up limit	Meas.	Meas.	Scaled	
Main 3 Ant.	Body-worn	DFT-s-OFDM	QPSK	Off	15	Rear	344000	1720.0	1	1	25.00	24.42	0.266	0.304	1
									50	28	25.00	24.40	0.261	0.300	
						Front	344000	1720.0	1	1	25.00	24.42	0.206	0.235	
									50	28	25.00	24.40	0.190	0.218	
		CP-OFDM	QPSK	Off	15	Rear	344000	1720.0	1	1	23.50	21.80	0.161	0.238	
	Hotspot	DFT-s-OFDM	QPSK	Off	10	Rear	344000	1720.0	1	1	22.00	21.40	0.320	0.367	
									50	28	22.00	21.50	0.320	0.359	
						Front	344000	1720.0	1	1	22.00	21.40	0.241	0.277	
									50	28	22.00	21.50	0.239	0.268	
						Edge 1	344000	1720.0	1	1	22.00	21.40	0.771	0.885	
									50	28	22.00	21.50	0.807	0.905	
									100	0	22.00	21.47	0.762	0.861	
							349000	1745.0	1	1	22.00	21.27	0.820	0.970	2
									50	28	22.00	21.35	0.798	0.927	
							354000	1770.0	1	1	22.00	21.25	0.767	0.912	
									50	28	22.00	21.15	0.741	0.901	
						Edge 2	344000	1720.0	1	1	22.00	21.40	0.091	0.104	
									50	28	22.00	21.50	0.091	0.103	
		CP-OFDM	QPSK	Off	10	Edge 1	344000	1720.0	1	1	22.00	21.27	0.779	0.921	
Antenna	RF Exposure Conditions	Modulation	Mode	PWR Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offest	Power (dBm)		10-g SAR (W/kg)		Plot No.
											Tune-up limit	Meas.	Meas.	Scaled	
Main 3 Ant.	Product specific 10-g SAR	DFT-s-OFDM	QPSK	Off	9	Edge 1	344000	1720.0	1	1	25.00	24.42	0.484	0.553	
									50	28	25.00	24.40	0.500	0.574	
				On	0	Edge 1	344000	1720.0	1	1	22.00	21.52	1.710	1.912	
									50	28	22.00	21.49	1.750	1.968	3
		CP-OFDM	QPSK	On	0	Edge 1	344000	1720.0	1	1	22.00	21.40	1.490	1.711	

Note(s):

CP-OFDM mode were evaluated at worst configuration of DFT-s-OFDM in each exposure conditions.

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.

Peak spatial-average (1g of tissue)

Frequency Band (MHz)	Air Interface	RF Exposure Conditions	Test Position	Repeated SAR (Yes/No)	Highest Measured SAR (W/kg)	Repeated Measured SAR (W/kg)	Largest to Smallest SAR Ratio
1750	NR Band n66	Hotspot	Edge 1	Yes	0.820	0.801	-0.02

Peak spatial-average (10g of tissue)

Frequency Band (MHz)	Air Interface	RF Exposure Conditions	Test Position	Repeated SAR (Yes/No)	Highest Measured SAR (W/kg)	Repeated Measured SAR (W/kg)	Largest to Smallest SAR Ratio
1750	NR Band n66	Product Specific 10-g	Edge 1	No	1.750	N/A	N/A

Note(s):

Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the original and first repeated measurement is not > 1.20.

12. Simultaneous Transmission SAR Analysis

Simultaneous Transmission Condition

RF Exposure Condition	Item	Capable Transmit Configurations								
Head & Body-worn & Hotspot & Phablet-10g	1	WWAN (2G/3G/LTE/NR)	+	DTS Ant.1	or	DTS Ant.2				Non-RSDB Scenarios
	2	WWAN (2G/3G/LTE/NR)	+	DTS MIMO						
	3	WWAN (2G/3G/LTE/NR)	+	UNII MIMO						
	4	WWAN (2G/3G/LTE/NR)	+	BT Ant.1	or	BT Ant.2				
	5	WWAN (2G/3G/LTE/NR)	+	BT MIMO						
	6	WWAN (2G/3G/LTE/NR)	+	UNII MIMO	+	BT Ant.1	or	BT Ant.2		
	7	WWAN (2G/3G/LTE/NR)	+	UNII MIMO	+	BT MIMO				
	8	WWAN (2G/3G/LTE/NR)	+	UNII MIMO	+	DTS Ant.1	or	DTS Ant.2		RSDB Scenarios
	9	WWAN (2G/3G/LTE/NR)	+	UNII MIMO	+	DTS MIMO				
	10	WWAN (ENDC(LTE+NR)	+	DTS Ant.1	or	DTS Ant.2				Non-RSDB Scenarios
	11	WWAN (ENDC(LTE+NR)	+	DTS MIMO						
	12	WWAN (ENDC(LTE+NR)	+	UNII MIMO						
	13	WWAN (ENDC(LTE+NR)	+	BT Ant.1	or	BT Ant.2				
	14	WWAN (ENDC(LTE+NR)	+	BT MIMO						
	15	WWAN (ENDC(LTE+NR)	+	UNII MIMO	+	BT Ant.1	or	BT Ant.2		
	16	WWAN (ENDC(LTE+NR)	+	UNII MIMO	+	BT MIMO				
	17	WWAN (ENDC(LTE+NR)	+	UNII MIMO	+	DTS Ant.1	or	DTS Ant.2		RSDB Scenarios
	18	WWAN (ENDC(LTE+NR)	+	UNII MIMO	+	DTS MIMO				
	19	WWAN (LTE ULCA(PCC+SCC)	+	DTS Ant.1	or	DTS Ant.2				Non-RSDB Scenarios
	20	WWAN (LTE ULCA(PCC+SCC)	+	DTS MIMO						
	21	WWAN (LTE ULCA(PCC+SCC)	+	UNII MIMO						
	22	WWAN (LTE ULCA(PCC+SCC)	+	BT Ant.1	or	BT Ant.2				
	23	WWAN (LTE ULCA(PCC+SCC)	+	BT MIMO						
	24	WWAN (LTE ULCA(PCC+SCC)	+	UNII MIMO	+	BT Ant.1	or	BT Ant.2		
	25	WWAN (LTE ULCA(PCC+SCC)	+	UNII MIMO	+	BT MIMO				
	26	WWAN (LTE ULCA(PCC+SCC)	+	UNII MIMO	+	DTS Ant.1	or	DTS Ant.2		RSDB Scenarios
	27	WWAN (LTE ULCA(PCC+SCC)	+	UNII MIMO	+	DTS MIMO				

Notes:

1. DTS supports Wi-Fi Direct, Hotspot and VoIP.
2. U-NII supports Wi-Fi Direct, Hotspot and VoIP.
3. U-NII only supports MIMO mode.
4. GPRS, W-CDMA, LTE, NR supports Hotspot and VoIP
5. U-NII Radio can transmit simultaneously with Bluetooth Radio.
6. DTS Radio cannot transmit simultaneously with Bluetooth Radio.
7. DTS Radio can transmit simultaneously with U-NII Radio in only RSDB Scenarios.
8. NR Radio support to both SA and NSA(ENDC) Radio.
9. BT tethering is considered about each RF exposure conditions.
10. LTE support UL CA interband configurations.

Simultaneous transmission SAR test exclusion considerations

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

The antennas for the unlicensed transmitters are closely situated. As a result, the associated SAR hotspots are also closely situated. Some of the sum of SAR calculations yielded results over 1.6 W/kg. The SPSLR calculations for these situations were performed by treating the unlicensed SAR values as a single transmitter. The most conservative distance between all the unlicensed hotspots to the licensed hotspot was used for the value of *d* in the SPSLR calculation.

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 DASY5 volume scan postprocessing 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.

DASY5 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 DASY5= 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.

SPLSR Hotspot Combination

Per November 2019 TCB Workshop Notes, SPLSR Hotspot Combination procedure can be applied to evaluate to simultaneous transmission SAR analysis.
Hybrid SPLSR and enlarged zoom scan (Volume scan) can be applied when Simultaneous transmission SAR is over 1.6 or 4.0 W/kg (1-g or 10-g respectively), it does not meet SPLSR criteria, and antenna pair is co-located. Antenna co-location means that SAR distributions overlap because the antennas are not significantly spatially separated.

Test procedure

Step.1 Perform enlarged zoom scan (Volume scan) on the co-located antenna pair to determine 1g/10g aggregate SAR.

Step.2 Apply SPLSR procedure for the spatially separated antenna and aggregate SAR distribution of the co-located antenna pair.

12.1. Sum of the SAR for ENDC(LTE B2 + NR Bn66(Main Ant.3)) & Wi-Fi & BT

Non-RSDB scenarios

RF Exposure	Test Position	Standalone SAR (W/kg)										Sum of SAR (W/kg)													
		WWAN		Non-RSDB scenarios								WWAN+ DTS Ant.1	WWAN+ DTS Ant.2	WWAN+ DTS MIMO	WWAN+ UNII MIMO	WWAN+ BT Ant.1	WWAN+ BT Ant.2	WWAN+ BT MIMO	WWAN+ UNII MIMO+ BT Ant.1	WWAN+ UNII MIMO+ BT Ant.2	WWAN+ UNII MIMO+ BT MIMO	WWAN+ UNII MIMO	WWAN+ UNII MIMO+ BT Ant.1	WWAN+ UNII MIMO+ BT Ant.2	WWAN+ UNII MIMO+ BT MIMO
				DTS Ant.1	DTS Ant.2	DTS MIMO	UNII MIMO (5GHz)	BT Ant.1	BT Ant.2	BT MIMO	UNII MIMO (6GHz)														
		1a	1b	2	3	4	5	6	7	8	9	1+2	1+3	1+4	1+5	1+6	1+7	1+8	1+5+6	1+5+7	1+5+8	1+9	1+6+9	1+7+9	1+8+9
Body-Worn (1-g SAR)	Rear	0.606	0.304	0.157	0.187	0.155	0.528	0.156	0.140	0.030	0.144	1.067	1.097	1.065	1.438	1.066	1.050	0.940	1.594	1.578	1.468	1.054	1.210	1.194	1.084
	Front	0.338	0.235	0.019	0.187	0.155	0.392	0.021	0.080	0.030	0.144	0.592	0.760	0.728	0.965	0.594	0.653	0.603	0.986	1.045	0.995	0.717	0.738	0.797	0.747
Hotspot (1-g SAR)	Rear	0.452	0.367	0.423	0.343	0.281	0.530	0.453	0.318	0.106		1.242	1.162	1.100	1.349	1.272	1.137	0.925	1.802	1.667	1.455				
	Front	0.454	0.277	0.423	0.343	0.202	0.111	0.042	0.198	0.061		1.154	1.074	0.933	0.842	0.773	0.929	0.792	0.884	1.040	0.903				
	Edge 1		0.970	0.044		0.053	0.077	0.026		0.017															
	Edge 2	0.041	0.104																						
	Edge 3	1.285																							
	Edge 4	0.082		0.423	0.426	0.331	0.152	0.003	0.311	0.102		0.505	0.508	0.413	0.234	0.085	0.393	0.184	0.237	0.545	0.336				
Product Specific 10-g (10-g SAR)	Rear						2.286				0.304														
	Front						1.270				0.062														
	Edge 1		1.968				0.262				0.019				2.230							1.987			
	Edge 2																								
	Edge 3	2.236																							
	Edge 4						1.437				0.059														

SAR to Peak Location Separation Ratio (SPLSR)

RF Exposure	Test Position	Standalone SAR (W/kg)										Sum of SAR (W/kg) (1-g or 10-g)		Calculated Distance (mm)	1-g SPLSR (=<0.04) or 10-g SPSLR (=<0.10)	Volume Scan (Yes/No) Note.2	Volume Scan SAR (W/kg)	Figure
		WWAN		DTS Ant.1	DTS Ant.2	DTS MIMO	UNII MIMO (5GHz)	BT Ant.1	BT Ant.2	BT MIMO	UNII MIMO (6GHz)							
		1a	1b	2	3	4	5	6	7	8	9							
Hotspot (1-g SAR)	Rear	0.452	0.367				0.530	0.453				1a+1b+5+6	1.802					
		0.452	0.367									1a+1b	0.819	159.7	0.00	No	0.717	1
							0.530	0.453				5+6	0.983	18.8	0.05	Yes		
Hybrid SPLSR Note.3		0.452					0.717					1a+(5+6)	1.169	150.8	0.01	No		
			0.367				0.717					1b+(5+6)	1.084	44.9	0.03	No		
Hotspot (1-g SAR)	Rear	0.452	0.367				0.530		0.318			1a+1b+5+7	1.667					
		0.452	0.367									1a+1b	0.819	159.7	0.00	No		
		0.452					0.530					1a+5	0.982	147.5	0.01	No		
		0.452							0.318			1a+7	0.770	119.9	0.01	No	N/A	2
			0.367				0.530					1b+5	0.897	48.9	0.02	No		
			0.367						0.318			1b+7	0.685	75.1	0.01	No		
							0.530		0.318			5+7	0.848	34.5	0.02	No		

RSDB scenarios

RF Exposure	Test Position	Standalone SAR (W/kg)							Sum of SAR (W/kg)							
		WWAN		Non-RSDB scenarios					WWAN+ DTS Ant.1+ UNII MIMO	WWAN+ DTS Ant.2+ UNII MIMO	WWAN+ DTS MIMO+ UNII MIMO	DTS MIMO+ UNII MIMO	WWAN+ DTS Ant.1+ UNII MIMO	WWAN+ DTS Ant.2+ UNII MIMO	WWAN+ DTS MIMO+ UNII MIMO	DTS MIMO+ UNII MIMO
				DTS Ant.1	DTS Ant.2	DTS MIMO	UNII MIMO (5GHz)	UNII MIMO (6GHz)								
		1a	1b	2	3	4	5	6	1+2+5	1+3+5	1+4+5	4+5	1+2+6	1+3+6	1+4+6	4+6
Body-Worn (1-g SAR)	Rear	0.606	0.304	0.095	0.097	0.147	0.244	0.144	1.249	1.251	1.301	0.391	1.149	1.151	1.201	0.291
	Front	0.338	0.235	0.095	0.097	0.147	0.244	0.144	0.912	0.914	0.964	0.391	0.812	0.814	0.864	0.291
Hotspot (1-g SAR)	Rear	0.452	0.367	0.247	0.210	0.315	0.214		1.280	1.243	1.348	0.529				
	Front	0.454	0.277	0.023	0.217	0.323	0.214		0.968	1.162	1.268	0.537				
	Edge 1		0.970	0.023		0.323	0.012					0.335				
	Edge 2	0.041	0.104													
	Edge 3	1.285														
	Edge 4	0.082		0.002	0.217	0.323	0.214		0.298	0.513	0.619	0.537				

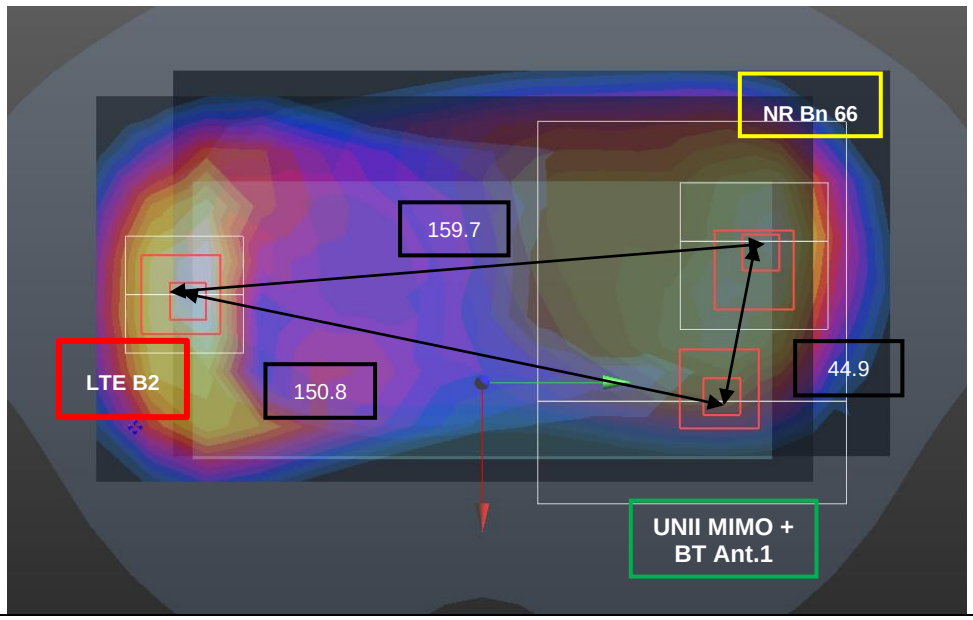
Note(s):

1. Green value is estimated SAR value.
2. SPLSR Hotspot Combination Step.1) Perform enlarged zoom scan (Volume scan) on the co-located antenna pair to determine 1g/10g aggregate SAR. Refer to the Sec.12.21 for detailed Volume Scan Result.
3. SPLSR Hotspot Combination Step.2) Apply SPLSR procedure for the spatially separated antenna and aggregate SAR distribution of the co-located antenna pair. Hybrid SPLSR procedure was applied for the spatially separated main bands and unlicensed bands for Multi-band Combined results.
4. Simultaneous transmission scenarios (1+5 & 1+6) are a subset of (1+5+6) scenario.
5. WiFi & BT SAR data and Volume scan data are refer to original report (4790089626-S1)

Conclusion:

Simultaneous Transmission SAR analysis results is satisfied the FCC Limit requirement according to follow procedures with “Sum of SAR” or “SPLSR” or “SPLSR Hotspot combination (including Volume Scan)”.

Figure (1)

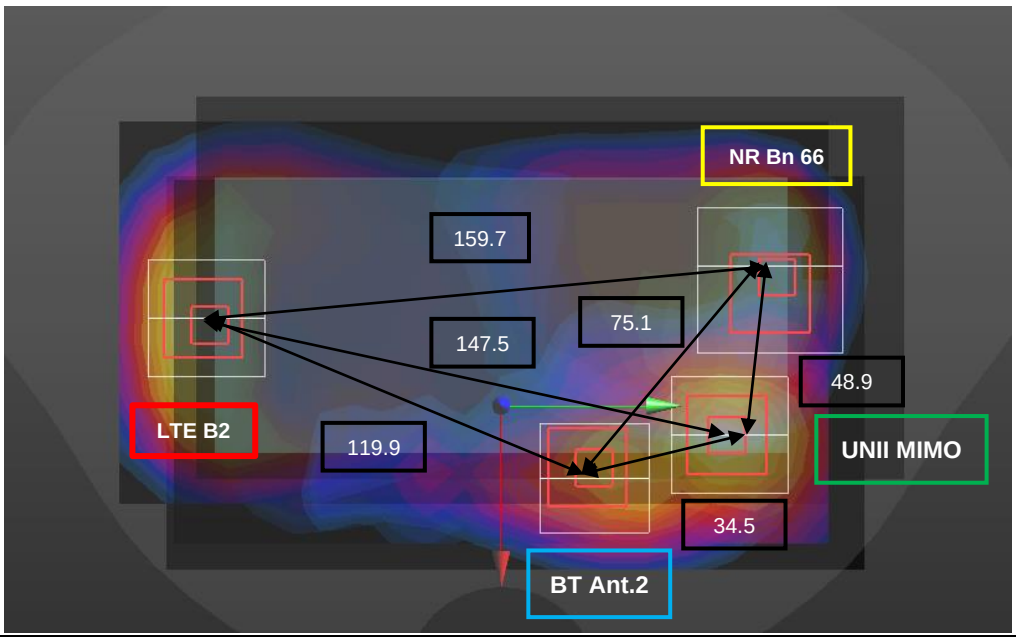


Mode		SAR	X	Y	d: Calculated distance (mm)	
		W/kg	m	m		
LTE B2	1	0.452	-0.0240	-0.0810	1 + 2	159.7
NR Bn 66	2	0.367	-0.0385	0.0780	1 + 3	150.8
UNII MIMO + BT Ant1	3	0.717	0.0050	0.0670	2 + 3	44.9

The Peak Location Separation Distance is computed by using the formula below:

SQRT((X1-X2)^2+(Y1-Y2)^2+(Z1-Z2)^2)

Figure (2)



Mode		SAR	X	Y	d: Calculated distance (mm)	
		W/kg	m	m		
LTE B2	1	0.452	-0.0240	-0.0810	1 + 2	159.7
NR Bn 66	2	0.367	-0.0385	0.0780	1 + 3	147.5
UNII MIMO	3	0.530	0.0080	0.0630	1 + 4	119.9
BT Ant.2	4	0.318	0.0198	0.0306	2 + 3	48.9
					2 + 4	75.1
					3 + 4	34.5

The Peak Location Separation Distance is computed by using the formula below:

Appendixes

Refer to separated files for the following appendixes.

4790381906-S1 FCC Report SAR_App A_Photos & Ant. Locations

4790381906-S1 FCC Report SAR_App B_Highest SAR Test Plots

4790381906-S1 FCC Report SAR_App C_System Check Plots

4790381906-S1 FCC Report SAR_App D_SAR Tissue Ingredients

4790381906-S1 FCC Report SAR_App E_Probe Cal. Certificates

4790381906-S1 FCC Report SAR_App F_Dipole Cal. Certificates

4790381906-S1 FCC Report SAR_App G_Proximity sensor feature

END OF REPORT