

APPENDIX D: ANTENNA GROUPING ANALYSIS & JUSTIFICATION

D.1 Sub6 Antenna Groups

The standalone reported SAR and antenna group separation distances in the original filing was used to determine simultaneous transmission compliance as they are more conservative. Please see the original filing for complete evaluation of simultaneous transmission analysis and standalone reported SAR for modes and bands not evaluated for this permissive change.

The 2nd generation of Smart Transmit (GEN2) operates based on pre-defined sub6 antenna groups (AG) and mmW module groups (MG). Sub6 Tx antennas in the device are grouped based on spatial variation of RF exposure distributions, where the RF exposure of one AG is mutually exclusive from other AG. This is accomplished by demonstrating either of below conditions for all exposure scenarios:

- a) Sum of SAR of one antenna from each of the sub6 AGs and the RF exposure from radios outside Smart Transmit is less than regulatory limits. This condition must be demonstrated for all antenna combinations of sub6 AGs.
(or)
- b) Every antenna from each sub6 AG meets SPLSR criteria (Section 4.3.2(c) in FCC KDB 447498 D01) with every antenna from another sub6 AG. This criteria must be demonstrated for all antenna combinations for each pair of AGs.

This device supports two sub6 AG: AG0 and AG1, with AG0 having 4 antennas (A, B, C, D) and AG1 having 4 antennas (E, F, I, K), and two WIFI/BT antennas outside of Smart Transmit. The conditions are verified through the following criteria:




i) (SAR1 + SAR2 criteria): If SPLSR criteria is not used, then the highest reported SAR at P_{limit} (or P_{max} when $P_{limit} > P_{max}$) for each antenna should be obtained out of all supported technologies and frequency bands for each DSI. Demonstrate that the sum of reported SAR of one antenna from each of the sub6 AGs and the sum of RF exposure from all supported radios outside of Smart Transmit should be less than the regulatory limit as given below for each DSI.

1. Obtain the worst-case reported SAR for each antenna group (i.e., maximum reported SAR at P_{limit} (or P_{max} when $P_{limit} > P_{max}$) out of all supported technologies, frequency bands and antennas in AG0 and AG1), denoted as max.SAR.AG0 and max.SAR.AG1, and obtain the worst-case RF exposure for each external radio, and demonstrate that the sum of these RF exposures meets: $\{ [\text{max.SAR.AG0} + \text{max.SAR.AG1}] + \text{WIFI/BT Ant 1} + \text{WIFI/BT Ant 2} \} \leq 1.6$ (for 1g, or 4.0 for 10g).

ii) (SPLSR criteria): For each antenna, obtain the highest reported SAR value at P_{limit} out of all supported technologies for each frequency band. Using these values, demonstrate for a given DSI that every antenna from one sub6 AG meets SPLSR criteria with every antenna in another sub6 AG for all frequency bands. This criteria must be demonstrated for all antenna pair combinations irrespective of supported simultaneous transmission scenarios as given below for each DSI:

- SPLSR criteria should be met for all antenna pair combinations of AG0 and AG1: {antenna (A, B, C, D) in AG0; antenna (E, F, I, K) in AG1. As it can be seen, these include all combinations of antenna groups, antennas, and frequency bands.

iii) (combination of SPLSR & SAR1+SAR2 criteria): If SPLSR criteria for all the combinations of sub6 antenna groups in (i) is demonstrated to show that each AG is mutually exclusive from other AGs, and if the WIFI/BT antennas supported outside of Smart Transmit do not meet SPLSR criteria, then the condition in (ii) reduces to: $\{\text{max.SAR.AG0} + \text{WIFI/BT Ant 1} + \text{WIFI/BT Ant 2}\} \leq 1.6$ and $\{\text{max.SAR.AG1} + \text{WIFI/BT Ant 1} + \text{WIFI/BT Ant 2}\} \leq 1.6$ for compliance demonstration (for 1g, or 4.0 for 10g).

FCC ID A3LSMS906U	 PCTEST Proud to be part of 	SAR EVALUATION REPORT		Approved by: Quality Manager
Test Dates: 10/25/21 - 11/1/21	DUT Type: Portable Handset			APPENDIX D: Page 1 of 7

If SPLSR criteria evaluation and analysis is needed to determine compliance for a certain DSI configuration, SPLSR is performed by taking the highest reported SAR for each of the supported technologies and bands per antenna, along with the peak SAR locations. Per Qualcomm guidance, only Y-axis coordinates are recorded in the analysis for calculation simplicity (assumes all 0mm of separation on the x-axis). Peak locations are documented in Section D.7 below for each DSI configuration.

For bottom AG0, Y_max coordinate represents the worst case hotspot location that is closest to the top AG1. Similarly, for top AG1, Y_min coordinate represents the worst case hotspot location that is closest to the bottom AG0.

The following formula is used to calculate the SPLSR between AG0 and AG1 for each exposure configuration:

$$SPLSR = \frac{(Max\ SAR\ AG0 + Max\ SAR\ AG1)^{1.5}}{|Y_{max} - Y_{min}|}$$

D.2 Head (DSI = 2) SAR Antenna Group Analysis



Table D-1
DSI=2 Held-to-ear AG1 Highest Reported SAR

AG1						
Head SAR	Configuration	E	F	I	K	Max
	Right Cheek	0.280	0.945	0.520	0.000	0.945
	Right Tilt	0.195	0.399	0.850	0.000	0.850
	Left Cheek	0.197	0.160	1.049	0.000	1.049
	Left Tilt	0.168	0.153	1.186	0.000	1.186

Please refer to Table E-1 in Appendix E for highest reported simultaneous held-to-ear SAR of WLAN/BT antennas.

Table D-2
DSI=2 Held-to-ear AG Verification

	Configuration	AG0	AG1	WLAN/BT Worst-case Combination	AG0 + AG1 + WLAN/BT Worst-case
Head SAR	Right Cheek	0.345	0.945	0.303	1.593
	Right Tilt	0.219	0.850	0.202	1.271
	Left Cheek	0.267	1.049	0.257	1.573
	Left Tilt	0.232	1.186	0.052	1.470

FCC ID A3LSMS906U	 PCTEST <small>Proud to be part of element</small>	SAR EVALUATION REPORT		Approved by: Quality Manager
Test Dates: 10/25/21 - 11/1/21	DUT Type: Portable Handset			APPENDIX D: Page 2 of 7

D.3 Max Phablet (DSI = 0) SAR Antenna Group Analysis

Per FCC KDB Publication 648474 D04 Handset SAR, Phablet SAR tests were not required if wireless router 1g SAR (scaled to the maximum output power, including tolerance) < 1.2 W/kg. Therefore no further analysis beyond the tables included in this section was required to determine that possible simultaneous transmission scenarios would not exceed the SAR limit.

Table D-3
DSI=0 Max Phablet AG1 Highest Reported SAR

AG1						
Phablet SAR	Configuration	E	F	I	K	Max
	Back	0.000	1.716	1.435	0.836	1.716
	Front	0.000	0.000	0.000	0.000	-
	Top	0.000	0.000	3.144	0.000	3.144
	Bottom	0.000	0.000	0.000	0.000	-
	Right	0.000	0.000	0.000	0.000	-
	Left	0.000	2.719	0.000	0.000	2.719

Please refer to Table E-7 in Appendix E for highest reported simultaneous phablet SAR of WLAN/BT antennas.

Table D-4
DSI=0 Max Phablet AG Verification



	Configuration	AG0	AG1	WLAN/BT	AG0 + AG1 +
				Worst-case	WLAN/BT
				Combination	Worst-case
Phablet SAR	Back	1.386	1.716	1.303	See Table Below
	Front	1.428	0.000	0.535	1.963
	Top	0.000	3.144	0.072	3.216
	Bottom	1.611	0.000	-	1.611
	Right	0.478	0.000	-	0.478
	Left	2.540	2.719	0.518	See Table Below

Back							
Ant Combination	AG0		AG1		WLAN/BT Worst-case	AG0 + AG1 + WLAN/BT	SPLSR
	SAR	Position	SAR	Position			
Ant A-Ant F	1.386	-75.000	1.716	58.700	1.303	See Note 2	0.04
Ant A-Ant I	1.386	-75.000	1.435	75.400	1.303	See Note 2	0.03
Ant A-Ant K	1.386	N/A	0.836	N/A	1.303	3.525	N/A
Ant B-Ant F	0.419	N/A	1.716	N/A	1.303	3.438	N/A
Ant B-Ant I	0.419	N/A	1.435	N/A	1.303	3.157	N/A
Ant B-Ant K	0.419	N/A	0.836	N/A	1.303	2.558	N/A
Ant D-Ant F	0.758	N/A	1.716	N/A	1.303	3.777	N/A
Ant D-Ant I	0.758	N/A	1.435	N/A	1.303	3.496	N/A
Ant D-Ant K	0.758	N/A	0.836	N/A	1.303	2.897	N/A

Left							
Ant Combination	AG0		AG1		WLAN/BT Worst-case	AG0 + AG1 + WLAN/BT	SPLSR
	SAR	Position	SAR	Position			
Ant A-Ant F	1.135	-59.300	2.719	60.200	0.518	See Note 2	0.06
Ant B-Ant F	2.540	-61.100	2.719	60.200	0.518	See Note 2	0.10

Notes:

1. For all combinations where the sum of AG0+AG1+WLAN/BT is less than 1.6 W/kg, no further analysis is required for compliance demonstration.
2. No evaluation was performed to determine the aggregate 10g SAR for these configurations as the SPLSR ratio between the antenna pairs was not greater than 0.10 per FCC KDB 447498 D01v06. Please see Section D.7 for Y-axis peak locations.

FCC ID A3LSMS906U	 PCTEST Proud to be part of element	SAR EVALUATION REPORT		Approved by: Quality Manager
Test Dates: 10/25/21 - 11/1/21	DUT Type: Portable Handset			APPENDIX D: Page 3 of 7

D.4 Reduced Phablet (DSI = 1) SAR Antenna Group Analysis

Per FCC KDB Publication 648474 D04 Handset SAR, Phablet SAR tests were not required if wireless router 1g SAR (scaled to the maximum output power, including tolerance) < 1.2 W/kg. Therefore no further analysis beyond the tables included in this section was required to determine that possible simultaneous transmission scenarios would not exceed the SAR limit.

Table D-5
DSI=1 Reduced Phablet AG1 Highest Reported SAR

AG1						
Phablet SAR	Configuration	E	F	I	K	Max
	Back	0.000	1.716	1.435	0.836	1.716
	Front	0.000	0.000	0.000	0.000	-
	Top	0.000	0.000	3.144	0.000	3.144
	Bottom	0.000	0.000	0.000	0.000	-
	Right	0.000	0.000	0.000	0.000	-
	Left	0.000	2.719	0.000	0.000	2.719

Please refer to Table E-7 in Appendix E for highest reported simultaneous phablet SAR of WLAN/BT antennas.

Table D-6
DSI=1 Reduced Phablet AG Verification



Phablet SAR	Configuration	AG0	AG1	WLAN/BT Worst-case Combination	AG0 + AG1 + WLAN/BT Worst-case
		Back	3.010	1.716	1.303
Front	2.402	0.000	0.535	2.937	
Top	0.000	3.144	0.072	3.216	
Bottom	3.144	0.000	-	3.144	
Right	0.478	0.000	-	0.478	
Left	2.540	2.719	0.518	See Table Below	

Back							
Ant Combination	AG0		AG1		WLAN/BT Worst-case	AG0 + AG1 + WLAN/BT	SPLSR
	SAR	Position	SAR	Position			
Ant A-Ant F	2.870	-71.900	1.716	58.700	1.303	See Note 2	0.08
Ant A-Ant I	2.870	-71.900	1.435	75.400	1.303	See Note 2	0.06
Ant A-Ant K	2.870	-71.900	0.836	59.600	1.303	See Note 2	0.05
Ant B-Ant F	3.010	-73.100	1.716	58.700	1.303	See Note 2	0.08
Ant B-Ant I	3.010	-73.100	1.435	75.400	1.303	See Note 2	0.06
Ant B-Ant K	3.010	-73.100	0.836	59.600	1.303	See Note 2	0.06
Ant D-Ant F	0.758	N/A	1.716	N/A	1.303	3.777	N/A
Ant D-Ant I	0.758	N/A	1.435	N/A	1.303	3.496	N/A
Ant D-Ant K	0.758	N/A	0.836	N/A	1.303	2.897	N/A

Left							
Ant Combination	AG0		AG1		WLAN/BT Worst-case	AG0 + AG1 + WLAN/BT	SPLSR
	SAR	Position	SAR	Position			
Ant A-Ant F	1.135	-59.300	2.719	60.200	0.518	See Note 2	0.06
Ant B-Ant F	2.540	-61.100	2.719	60.200	0.518	See Note 2	0.10

Notes:

- For all combinations where the sum of AG0+AG1+WLAN/BT is less than 1.6 W/kg, no further analysis is required for compliance demonstration.
- No evaluation was performed to determine the aggregate 10g SAR for these configurations as the SPLS ratio between the antenna pairs was not greater than 0.10 per FCC KDB 447498 D01v06. Please see Section D.7 for Y-axis peak locations.

FCC ID A3LSMS906U	 PCTEST Proud to be part of @element	SAR EVALUATION REPORT		Approved by: Quality Manager
Test Dates: 10/25/21 - 11/1/21	DUT Type: Portable Handset			APPENDIX D: Page 4 of 7

D.5 Highest Report SAR and SAR Hotspot Locations

As a conservative assessment, the distances between AG0 and AG1 were determined using the y-axis coordinates of the peak locations only (assumes 0 mm separation on x/z axis)

Table D-7
DSI=0 Back Side Max Phablet Peak Y Coordinates

Mode/Band	Distance (mm)	AG0	AG1	AG1
		A	F	I
		8	0	0
GSM 1900	SAR	0.563		
	Y-Axis	-78.000		
UMTS 1750	SAR	1.151		
	Y-Axis	-76.500		
UMTS 1900	SAR	1.037		
	Y-Axis	-84.000		
LTE Band 66 (AWS)	SAR	1.147		
	Y-Axis	-79.500		
LTE Band 25 (PCS)	SAR	1.239		
	Y-Axis	-81.000		
LTE Band 30	SAR	0.730		
	Y-Axis	-77.000		
NR Band n66 (AWS)	SAR	1.386		
	Y-Axis	-78.000		
NR Band n25 (PCS)	SAR	1.112		
	Y-Axis	-75.000		
NR Band n30	SAR	0.674		
	Y-Axis	-77.800		
NR Band n41	SAR			1.435
	Y-Axis			75.400
NR Band n48	SAR		1.716	
	Y-Axis		61.500	
NR Band n77	SAR		1.212	
	Y-Axis		58.700	




FCC ID A3LSMS906U	 PCTEST Proud to be part of 	SAR EVALUATION REPORT		Approved by: Quality Manager
Test Dates: 10/25/21 - 11/1/21	DUT Type: Portable Handset			APPENDIX D: Page 5 of 7

Table D-8
DSI=0/1 Left Edge Max Phablet Peak Y Coordinates

Mode/Band	Distance (mm)	AG0		AG1
		A	B	F
		0	0	0
GSM 1900	SAR	0.505		
	Y-Axis	-64.500		
UMTS 1750	SAR	0.768		
	Y-Axis	-63.000		
UMTS 1900	SAR	0.686		
	Y-Axis	-63.000		
LTE Band 66 (AWS)	SAR	0.848		
	Y-Axis	-66.000		
LTE Band 25 (PCS)	SAR	0.814		
	Y-Axis	-73.500		
LTE Band 30	SAR	1.135		
	Y-Axis	-59.300		
LTE Band 7	SAR		2.239	
	Y-Axis		-61.100	
LTE Band 41	SAR		2.241	
	Y-Axis		-65.500	
NR Band n66 (AWS)	SAR	1.024		
	Y-Axis	-66.000		
NR Band n25 (PCS)	SAR	0.744		
	Y-Axis	-67.500		
NR Band n30	SAR	1.127		
	Y-Axis	-61.700		
NR Band n7	SAR		2.540	
	Y-Axis		-62.800	
NR Band n48	SAR			2.719
	Y-Axis			64.800
NR Band n77 DoD	SAR			1.752
	Y-Axis			62.100
NR Band n77	SAR			2.587
	Y-Axis			60.200






FCC ID A3LSMS906U	 PCTEST Proud to be part of 	SAR EVALUATION REPORT		Approved by: Quality Manager
Test Dates: 10/25/21 - 11/1/21	DUT Type: Portable Handset			APPENDIX D: Page 6 of 7

Table D-9
DSI=1 Back Side Reduced Phablet Peak Y Coordinates

		AG0		AG1		
		A	B	F	I	K
Mode/Band	Distance (mm)	0	0	0	0	0
GSM 1900	SAR	1.646				
	Y-Axis	-75.000				
UMTS 1750	SAR	2.487				
	Y-Axis	-73.500				
UMTS 1900	SAR	2.439				
	Y-Axis	-75.000				
LTE Band 66 (AWS)	SAR	1.407				
	Y-Axis	-81.500				
LTE Band 25 (PCS)	SAR	2.146				
	Y-Axis	-75.900				
LTE Band 30	SAR	2.690				
	Y-Axis	-74.100				
LTE Band 7	SAR		3.010			
	Y-Axis		-73.100			
LTE Band 41	SAR		2.131			
	Y-Axis		-73.100			
NR Band n66 (AWS)	SAR	2.870				
	Y-Axis	-75.000				
NR Band n25 (PCS)	SAR	1.885				
	Y-Axis	-75.000				
NR Band n30	SAR	2.753				
	Y-Axis	-71.900				
NR Band n7	SAR		2.841			
	Y-Axis		-76.900			
NR Band n41	SAR				1.435	
	Y-Axis				75.400	
NR Band n48	SAR			1.716		
	Y-Axis			61.700		
NR Band n77	SAR			1.212		
	Y-Axis			58.700		
NR Band n77	SAR					0.836
	Y-Axis					59.600

D.6 Conclusion

The above SPLSR criteria for all of the combinations of sub6 antenna groups is demonstrated to show that AG0 is mutually exclusive from AG1. Additional analysis for simultaneous analysis for the antenna groups and WIFI/BT antennas compliance demonstration is included in Appendix E

FCC ID A3LSMS906U	 PCTEST Proud to be part of element	SAR EVALUATION REPORT		Approved by: Quality Manager
Test Dates: 10/25/21 - 11/1/21	DUT Type: Portable Handset			APPENDIX D: Page 7 of 7