

APPENDIX C: TOTAL EXPOSURE RATIO

FCC ID: A3LSMS711U	NEAR-FIELD POWER DENSITY EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Portable Handset		APPENDIX C: Page 1 of 5

REV 2.0

The Total Exposure Ratio (TER) is calculated by combining all SAR measurements and power density measurements after normalizing to their respective limits. The general expression is below.

$$TER = \sum_{a=1}^A \frac{SAR_a}{SAR_{a,limit}} + \sum_{b=1}^B \frac{psPD_b}{psPD_{b,limit}} < 1$$

The TER shall be less than unity to ensure compliance with the limits.

$$\sum_{n=1}^N \frac{4G SAR_n}{4G SAR_{n,limit}} + \sum_{m=1}^M \frac{5G mmW NR psPD_m}{5G mmW NR psPD_{m,limit}} + \sum_{p=1}^P \frac{WLAN SAR_p}{WLAN SAR_{p,limit}} < 1$$

For 5G mmW NR, since there is total design-related uncertainty arising from TxAGC and device-to-device variation, the worst-case RF exposure should be determined by accounting for device uncertainty. For this device, the manufacturer has added an additional permanent back-off (indicated below as WWAN backoff) for every beam in the calculations for input.power.limits used in the EFS file. The back-off levels can be found in the Part 0 Test report. Therefore, 5G mmW NR RF exposure for this DUT is evaluated by reported psPD calculated as:

$$reported_psPD = (PD_design_target + PD_uncertainty) \times 10^{(-WWAN\ backoff\ in\ dB)/10}$$

Note that since not all the beams supported by this EUT are measured, *reported_psPD* cannot be computed based on limited *measured psPD* data. Alternatively, since *measured psPD* for all the beams will be $\leq PD_design_target + PD_uncertainty$, *reported_psPD* is computed based on this worst-case psPD as shown above.

Note that the above *reported psPD* applies to the worst-case surfaces of the DUT at 2mm evaluation distance.

Worst-case PD on other surfaces of the DUT are calculated from simulated PD data (see Power Density Simulation Report), by multiplying reported psPD with the highest proportion out of all beams and out of all three channels in each band, where the adjustment for each beam/channel is computed as the proportion of “simulated PD on desired surface” to “simulated PD on worst-surface”. For example, to determine worst-case PD on front surface (needed for Head RF Exposure evaluation during simultaneous transmission), highest proportion of (simulated PD on front surface)/(simulated PD on worst surface) was determined out of all supported beams and out of all three channels by the DUT in each band.

In some cases, the simulation vs measurement for some surfaces can exceed the device's total uncertainty. In those cases, if the measured psPD > simulated adjusted psPD (assuming a linear congruency of the psPD across surfaces), then measured psPD should be used towards the simultaneous TX analysis. Table C-1 lists the relevant worst-case reported psPD values based on the additional surfaces and evaluation distances needed to perform the TER analysis. The highest of the adjusted Reported_psPD and Measured Total psPD was chosen for TER analysis and the chosen values are indicated by bolded psPD values.

FCC ID: A3LSMS711U	NEAR-FIELD POWER DENSITY EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Portable Handset		APPENDIX C: Page 2 of 5

**Table C-1
5G mmW NR FR2 psPD**

NR Band	Antenna	Surface	Evaluation Distance (mm)	Adjustment Factor due to Simulation	Adjusted Reported psPD (mW/cm²)	Measured Total psPD (mW/cm²)	Final Reported psPD (mW/cm²)
n258	K	Back	2	1.000	0.794		0.794
n258	K	Front	2	0.658	0.523		0.523
n258	K	Top	2	0.346	0.275		0.275
n258	K	Bottom	2	0.017	0.014		0.014
n258	K	Right	2	0.063	0.050		0.050
n258	K	Left	2	1.000	0.794	0.434	0.794
n261	K	Back	2	0.790	0.672		0.672
n261	K	Front	2	0.575	0.489		0.489
n261	K	Top	2	0.214	0.182		0.182
n261	K	Bottom	2	0.026	0.022		0.022
n261	K	Right	2	0.031	0.026		0.026
n261	K	Left	2	1.000	0.851	0.450	0.851
n260	K	Back	2	0.667	0.530		0.530
n260	K	Front	2	0.667	0.530		0.530
n260	K	Top	2	0.206	0.164		0.164
n260	K	Bottom	2	0.022	0.017		0.017
n260	K	Right	2	0.039	0.031		0.031
n260	K	Left	2	1.000	0.794	0.473	0.794
n258	K	Back	10	0.475	0.377	0.238	0.377
n258	K	Left	10	0.614	0.488	0.291	0.488
n261	K	Back	10	0.347	0.295	0.092	0.295
n261	K	Left	10	0.686	0.584	0.373	0.584
n260	K	Back	10	0.381	0.303	0.080	0.303
n260	K	Left	10	0.685	0.544	0.360	0.544

Note: Adjusted factor is (simulated PD on desired exposure plane)/(PD on worst-surface at 2mm evaluation distance) out of all beams and out of all channels. See Power Density Simulation Report.

FCC ID: A3LSMS711U	NEAR-FIELD POWER DENSITY EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Portable Handset		APPENDIX C: Page 3 of 5

REV 2.0

Table C-2
5G mmW NR FR2 Head Total Exposure Ratio

	NR FR2	2.4 GHz WLAN Ant 2 Reported SAR	2.4 GHz WLAN MIMO Reported SAR	Bluetooth Ant 1 Reported SAR	Bluetooth Ant 2 Reported SAR	5 GHz WLAN MIMO Reported SAR	6 GHz WLAN MIMO Reported SAR	NR FR2 + 2.4 GHz WLAN MIMO	NR FR2 + Bluetooth Ant 1	NR FR2 + Bluetooth Ant 2	NR FR2 + 5 GHz WLAN MIMO	NR FR2 + 6 GHz WLAN MIMO	NR FR2 + 2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO	NR FR2 + 2.4 GHz WLAN MIMO + 6 GHz WLAN MIMO	NR FR2 + 2.4 GHz WLAN Ant 2 + Bluetooth Ant 1	NR FR2 + Bluetooth Ant 1 + 5 GHz WLAN MIMO	NR FR2 + Bluetooth Ant 2 + 5 GHz WLAN MIMO	NR FR2 + Bluetooth Ant 1 + 6 GHz WLAN MIMO	NR FR2 + Bluetooth Ant 2 + 6 GHz WLAN MIMO	NR FR2 + Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN MIMO	NR FR2 + Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 6 GHz WLAN MIMO	
		9.0 dBm	12.0 dBm	9.0 dBm	6.0 dBm	9.0 dBm	10.0 dBm															
		W/kg	W/kg	W/kg	W/kg	W/kg	W/kg															
Applicable Limit	1.0	1.6	1.6	1.6	1.6	1.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Front Side	Reported Value	0.330	0.295	0.305	0.180	0.273	0.339	0.299	0.721	0.543	0.578	0.623	0.698	0.820	0.889	0.770	0.742	0.675	0.811	0.744	0.863	
	Ratio to Limit	0.330	0.228	0.191	0.113	0.168	0.209	0.209														

Table C-3
5G mmW NR FR2 Body-worn Total Exposure Ratio

	NR FR2	2.4 GHz WLAN Ant 2 Reported SAR	2.4 GHz WLAN MIMO Reported SAR	Bluetooth Ant 1 Reported SAR	Bluetooth Ant 2 Reported SAR	5 GHz WLAN MIMO Reported SAR	6 GHz WLAN MIMO Reported SAR	NR FR2 + 2.4 GHz WLAN MIMO	NR FR2 + Bluetooth Ant 1	NR FR2 + Bluetooth Ant 2	NR FR2 + 5 GHz WLAN MIMO	NR FR2 + 6 GHz WLAN MIMO	NR FR2 + 2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO	NR FR2 + 2.4 GHz WLAN MIMO + 6 GHz WLAN MIMO	NR FR2 + 2.4 GHz WLAN Ant 2 + Bluetooth Ant 1	NR FR2 + Bluetooth Ant 1 + 5 GHz WLAN MIMO	NR FR2 + Bluetooth Ant 2 + 5 GHz WLAN MIMO	NR FR2 + Bluetooth Ant 1 + 6 GHz WLAN MIMO	NR FR2 + Bluetooth Ant 2 + 6 GHz WLAN MIMO	NR FR2 + Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN MIMO	NR FR2 + Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 6 GHz WLAN MIMO	
		16.0 dBm	19.0 dBm	16.0 dBm	13.0 dBm	16.0 dBm	13.0 dBm															
		W/kg	W/kg	W/kg	W/kg	W/kg	W/kg															
Applicable Limit	1	2	3	4	5	6	7	1+3	1+4	1+5	1+6	1+7	1+3+6	1+3+7	1+2+4	1+4+6	1+5+6	1+4+7	1+5+7	1+4+2+6	1+4+2+7	
Back Side	Reported Value	0.337	0.058	0.134	0.130	0.020	0.175	0.011	0.401	0.464	0.393	0.486	0.385	0.570	0.469	0.500	0.573	0.500	0.472	0.463	0.610	
	Ratio to Limit	0.337	0.029	0.045	0.032	0.003	0.100	0.008														

Table C-4
5G mmW NR FR2 Hotspot Total Exposure Ratio

	NR FR2	2.4 GHz WLAN Ant 2 Reported SAR	2.4 GHz WLAN MIMO Reported SAR	Bluetooth Ant 1 Reported SAR	5 GHz WLAN MIMO Reported SAR	NR FR2 + 2.4 GHz WLAN MIMO	NR FR2 + Bluetooth Ant 1	NR FR2 + 5 GHz WLAN MIMO	NR FR2 + 2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO	NR FR2 + 2.4 GHz WLAN Ant 2 + Bluetooth Ant 1	NR FR2 + Bluetooth Ant 1 + 5 GHz WLAN MIMO	NR FR2 + Bluetooth Ant 2 + 5 GHz WLAN MIMO	NR FR2 + Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN MIMO
		16.0 dBm	19.0 dBm	16.0 dBm	16.0 dBm								
		W/kg	W/kg	W/kg	W/kg								
Applicable Limit	1	2	3	4	5	1+3	1+4	1+5	1+3+5	1+2+4	1+4+5	1+4+2+5	
Back Side	Reported Value	0.377	0.058	0.134	0.139	0.151	0.461	0.464	0.471	0.555	0.500	0.558	
	Ratio to Limit	0.377	0.036	0.084	0.087	0.094							
Front Side	Reported Value	0.530	0.103	0.203	0.160	0.071	0.657	0.630	0.574	0.701	0.694	0.674	
	Ratio to Limit	0.530	0.064	0.127	0.100	0.044							
Top Edge	Reported Value	0.275	0.000	0.106	0.181	0.054	0.341	0.388	0.309	0.375	0.388	0.422	
	Ratio to Limit	0.275	0.000	0.066	0.113	0.034							
Bottom Edge	Reported Value	0.022	0.000	0.000	0.000	0.000	0.022	0.022	0.022	0.022	0.022	0.022	
	Ratio to Limit	0.022	0.000	0.000	0.000	0.000							
Right Edge	Reported Value	0.050	0.015	0.024	0.019	0.019	0.065	0.050	0.062	0.077	0.059	0.062	
	Ratio to Limit	0.050	0.009	0.015	0.000	0.012							
Left Edge	Reported Value	0.584	0.000	0.211	0.300	0.150	0.716	0.772	0.678	0.810	0.772	0.865	
	Ratio to Limit	0.584	0.000	0.132	0.188	0.094							

FCC ID: A3LSMS711U	NEAR-FIELD POWER DENSITY EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Portable Handset		APPENDIX C: Page 4 of 5

**Table C-5
5G mmW NR FR2 Phablet Total Exposure Ratio**

	NR FR2	5 GHz WLAN MIMO Reported SAR	6 GHz WLAN MIMO Reported SAR	Bluetooth Ant 2 Reported SAR	NR FR2 + 5 GHz WLAN MIMO	NR FR2 + 6 GHz WLAN MIMO	NR FR2 + 5 GHz WLAN MIMO + BT Ant2	NR FR2 + 6 GHz WLAN MIMO + BT Ant2	
		16.0 dBm	13.0 dBm	13.8					
		mW/cm ²	W/kg	W/kg					
	1	2	3	4	1 + 2	1 + 3	1 + 2 + 4	1 + 3 + 4	
Applicable Limit		1.0	4.0	4.0	4.0	1.0	1.0	1.0	1.0
Back Side	Reported Value	0.794	0.445	0.083	0.218				
	Ratio to Limit	0.794	0.111	0.021	0.055	0.905	0.815	0.960	0.869
Front Side	Reported Value	0.530	0.494	0.273	0.505				
	Ratio to Limit	0.530	0.124	0.068	0.126	0.654	0.598	0.780	0.725
Top Edge	Reported Value	0.275	0.117	0.015	0.002				
	Ratio to Limit	0.275	0.029	0.004	0.001	0.304	0.279	0.305	0.279
Bottom Edge	Reported Value	0.022	0.000	0.000	0.000				
	Ratio to Limit	0.022	0.000	0.000	0.000	0.022	0.022	0.022	0.022
Right Edge	Reported Value	0.050	0.070	0.003	0.087				
	Ratio to Limit	0.050	0.018	0.001	0.022	0.068	0.051	0.089	0.073
Left Edge	Reported Value	0.851	0.566	0.144	0.000				
	Ratio to Limit	0.851	0.142	0.036	0.000	0.993	0.887	0.993	0.887

	Worst Case Phablet TER	Worst Case NFC Reported SAR	Phablet Worst Case Scenario + NFC
		W/kg	
	1	2	1 + 2
Applicable Limit	1	4	1
Reported Value		0.024	
Ratio to Limit	0.993	0.006	0.999

Notes:

1. Worst-case power density results for each test configuration among all antenna arrays and among all supported bands were considered for TER analysis.
2. Per FCC guidance, for power density measurements, a test separation distance of 2 mm was used for phablet configuration due to probe restraints.
3. The worst-case between Adjusted Reported_{psPD} and Measured Total psPD was chosen for TER analysis.

The above numerical summed PD and SAR for all the worst-case simultaneous transmission conditions were below the Total Exposure Ratio. Therefore, the above analysis is sufficient to determine no further test cases are required and that simultaneous transmission is compliant to the FCC RF Exposure Limit.

FCC ID: A3LSMS711U	NEAR-FIELD POWER DENSITY EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Portable Handset		APPENDIX C: Page 5 of 5