

Appendix L. Multi-Tx Simultaneous Transmission Analysis Results

This device contains transmitters that may operate simultaneously. Therefore, simultaneous transmission analysis is required. Per KDB Publication 447498 D01v06 section 4.3.2 and IEEE 1528-2013 section 6.3.4.1.2, simultaneous transmission SAR test exclusion may be applied when the sum of 1g SAR and 10g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is $\leq 1.6\text{W/kg}$ for 1g SAR and $\leq 4\text{ W/kg}$ for 10g SAR. The different test positions in an exposure condition may be considered collectively to determine SAR exclusion according to the sum of 1g or 10g SAR.

When operating in the same antenna group, Samsung S.LSI TAS algorithm in WWAN directly adds the time-averaged RF exposure from 4G and time-averaged RF exposure from 5G NR. S.LSI algorithm controls the total RF exposure from both 4G and 5G NR to not exceed FCC limit. Therefore, simultaneous transmission compliance between 4G+5G operations within an antenna group is demonstrated in the Part 2 Report during algorithm validation.

This device is enabled with S.LSI Time average SAR algorithm with pre-defined sub6 antenna groups (AG0 and AG1). Simultaneous transmission analysis is performed per antenna groups. Section 14.5 contains analysis to demonstrate the AG0 and AG1 are operate mutually exclusive.

L.1 Sub6 Antenna Groups

S.LSI Time average SAR(TAS) algorithm operates based on pre-defined sub6 antenna groups (AG). 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:

Sum of SAR of one antenna from each of the sub6 AGs and the RF exposure from radios outside TAS is less than regulatory limits. This condition must be demonstrated for all antenna combinations of sub6 AGs. This device supports two sub6 AG: AG0 and AG1, with AG0 having 3 antennas (A, B,C) and AG1 having 4 antennas (E, F,H, I). The conditions are verified through the following criteria.

The highest reported SAR at Plimit (or Pmax when Plimit > Pmax) for each antenna should be obtained out of all supported WWAN technologies and frequency bands for each exposure condition. Demonstrate that the sum of reported SAR of antenna from each of the sub6 AGs and the sum of RF exposure of TAS should be less than the regulatory limit as given below for each RSI.

Obtain the worst-case reported SAR for each antenna group (i.e., maximum reported SAR at Plimit (or Pmax when Plimit > Pmax) 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, and demonstrate that the sum of these RF exposures meets

$$[\text{Max.SAR.AG0} + \text{Max.SAR.AG1}] + [\text{Max.WLAN} + \text{Max.Bluetooth}] \leq 1.6 \text{ (for 1g SAR or 4.0 for 10g)}$$

If the sum result with each antenna group and BT/WLAN exceeds the FCC SAR limit of 1.6 W/kg 1g ,4.0 W/kg 10g, SAR Simultaneous Transmission evaluation was performed by combining the worst case results of each antenna group with each other using fast volume scan measurements to verify compliance with FCC limits.

.

AG0, AG1, WLAN/BT are described in the table below.

AG0	
Ant. A	GSM850/1900 UMTS 2/4/5, LTE 2/4/5/12/13/14/25/26/66/71, NR n2/n5/n12/n14/n25/n26/n66/n70/n71
Ant. B	LTE 30/38/41 NR n30/n38, NR n41 SRS1
Ant. C	NR n41/n48/n77/n78 SRS3

AG1	
Ant. E	NR n48/n77/n78 SRS2
Ant. F	LTE 48, NR n48/n77/n78, NR n41 SRS2
Ant. I	UMTS 2/4, LTE 2/4/7/25/30/38/41/66, NR n2/n7/n25/n30/n38/n41/n66 NR n48/n77/n78 SRS1

WLAN/BT	
Ant. F	Bluetooth Ant.1, WLAN 2.4 GHz, 5 GHz, 6 GHz Ant.1
Ant. H	Bluetooth Ant.2, WLAN 2.4 GHz, 5 GHz, 6 GHz Ant.2

L.2 Head SAR Simultaneous Transmission Analysis

The Maximum measurement result for AG0				
Position	Ant. A	Ant. B	Ant. C	Max.AG0
Left Touch	0.255	0.094	0.025	0.255
Left Tilt	0.134	0.033	0.039	0.134
Right Touch	0.238	0.097	0.011	0.238
Right Tilt	0.122	0.041	0.011	0.122

The Maximum measurement result for AG1				
Position	Ant. E	Ant. F	Ant. I	Max.AG1
Left Touch	0.609	0.124	0.837	0.837
Left Tilt	0.054	0.128	0.183	0.183
Right Touch	0.238	0.605	0.605	0.605
Right Tilt	0.052	0.276	0.360	0.360

The measurement result for WLAN						
Position	WLAN 2.4 GHz Ant. F	WLAN 2.4 GHz Ant. H	WLAN 2.4 GHz Ant. F+H	WLAN 5 GHz Ant. F	WLAN 5 GHz Ant. H	WLAN 5 GHz Ant. F+H
Left Touch	0.031	0.295	0.334	0.166	0.173	0.18
Left Tilt	0.036	0.249	0.213	0.204	0.143	0.176
Right Touch	0.309	0.147	0.327	0.343	0.049	0.414
Right Tilt	0.154	0.116	0.220	0.292	0.053	0.424

The measurement result for WLAN/BT					
Position	WLAN 6 GHz Ant. F	WLAN 6 GHz Ant. H	BT Ant. F	BT Ant. H	BT Ant. F+H
Left Touch	0.175	0.053	0.031	0.318	0.192
Left Tilt	0.108	0.156	0.021	0.131	0.098
Right Touch	0.160	0.042	0.262	0.098	0.108
Right Tilt	0.175	0.042	0.143	0.102	0.167

Summation for Main Head SAR			
Position	Max. AG0	Max. AG1	Main Max
Left Touch	0.255	0.837	1.092
Left Tilt	0.134	0.183	0.317
Right Touch	0.238	0.605	0.843
Right Tilt	0.122	0.360	0.482

Simultaneous Transmission analysis for Head SAR							
Position	AG0+AG1 +BT Ant.F	AG0+AG1 +BT Ant.H	AG0+AG1 +BT Ant. F+H	AG0+AG1 +WLAN	AG0+AG1 +WLAN+ BT Ant. F	AG0+AG1 +WLAN+ BT Ant. H	AG0+AG1 +WLAN+BT Ant.F+H
Left Touch	1.123	1.410	1.284	1.426	1.418	1.590	1.464
Left Tilt	0.338	0.449	0.416	0.566	0.587	0.653	0.620
Right Touch	1.105	0.941	0.951	1.257	1.252	1.355	1.365
Right Tilt	0.625	0.584	0.650	0.906	0.741	1.008	1.074

L.3 Hotspot/Body worn Flip Open SAR Simultaneous Transmission Analysis

The Maximum measurement result for AG0				
Position	Ant. A	Ant. B	Ant. C	Max.AG0
Rear	1.097	0.626	0.186	1.097
Front	0.605	0.473	0.192	0.605
Left	0.390	0.548	0.349	0.548
Right	0.350			0.350
Top				
Bottom	1.186	1.058	0.025	1.186

The Maximum measurement result for AG1				
Position	Ant. E	Ant. F	Ant. I	Max.AG1
Rear	0.155	0.432	0.712	0.712
Front	0.186	0.211	0.663	0.663
Left	0.182	0.656		0.656
Right			1.076	1.076
Top	0.027	0.236	0.066	0.236
Bottom				

The measurement result for WLAN						
Position	WLAN 2.4 GHz Ant. F	WLAN 2.4 GHz Ant. H	WLAN 2.4 GHz Ant. F+H	WLAN 5 GHz Ant. F	WLAN 5 GHz Ant. H	WLAN 5 GHz Ant. F+H
Rear	0.234	0.204	0.424	0.252	0.270	0.263
Front	0.120	0.152	0.218	0.160	0.059	0.241
Left	0.279		0.435	0.227		0.279
Right		0.017	0.013		0.127	0.104
Top	0.101	0.112	0.270	0.094	0.129	0.137
Bottom						

The measurement result for WLAN/BT					
Position	WLAN 6 GHz Ant. F	WLAN 6 GHz Ant. H	BT Ant. F	BT Ant. H	BT Ant. F+H
Rear	0.158	0.115	0.296	0.339	0.422
Front	0.082	0.052	0.000	0.219	0.270
Left	0.086		0.428		0.462
Right		0.132		0.037	0.017
Top	0.031	0.012	0.081	0.274	0.199
Bottom					

Simultaneous Transmission analysis for Body SAR							
Position	AG0+AG1 +BT Ant.F	AG0+AG1 +BT Ant.H	AG0+AG1 +BT Ant. F+H	AG0+AG1 +WLAN	AG0+AG1 +WLAN+ BT Ant. F	AG0+AG1 +WLAN+ BT Ant. H	AG0+AG1 +WLAN+BT Ant.F+H
Rear	Sec. L.6.1	Sec.L.6.1	Sec. L.6.1	Sec. L.6.1	Sec. L.6.1	Sec. L.6.1	Sec. L.6.1
Front	1.268	1.487	1.538	1.509	1.509	Sec. L.6.1	Sec. L.6.1
Left	Sec. L.6.1	1.204	Sec. L.6.1	Sec. L.6.1	Sec. L.6.1	1.483	Sec. L.6.1
Right	1.426	1.463	1.443	1.553	1.553	1.590	1.570
Top	0.317	0.510	0.435	0.506	0.454	0.647	0.572
Bottom	1.186	1.186	1.186	1.186	1.186	1.186	1.186

L.4 Hotspot/BodyWorn Flip close SAR Simultaneous Transmission Analysis

The Maximum measurement result for AG0							
Position	Ant. A	Ant. B	Ant. C	Ant. E	Ant. F	Ant. I	Max.AG0
Rear	0.792	0.459	0.208	0.139	0.049	0.155	0.792
Front	0.228	0.100	0.465	0.192	0.435	0.663	0.663
Left	0.192	0.369	0.257	0.251	0.592		0.592
Right	0.141					1.027	1.027
Top			0.017	0.023		0.049	0.049
Bottom	1.119	0.801	0.157	0.061	0.194	0.079	1.119

The measurement result for WLAN						
Position	WLAN 2.4 GHz Ant. F	WLAN 2.4 GHz Ant. H	WLAN 2.4 GHz Ant. F+H	WLAN 5 GHz Ant. F	WLAN 5 GHz Ant. H	WLAN 5 GHz Ant. F+H
Rear	0.047	0.013	0.092	0.021	0.016	0.026
Front	0.278	0.110	0.298	0.385	0.268	0.299
Left	0.398		0.471	0.361		0.357
Right		0.028	0.008		0.106	0.159
Top						
Bottom	0.080	0.094	0.158	0.096	0.094	0.137

The measurement result for WLAN/BT					
Position	WLAN 6 GHz Ant. F	WLAN 6 GHz Ant. H	BT Ant. F	BT Ant. H	BT Ant. F+H
Rear	0.009	0.016	0.041	0.083	0.045
Front	0.172	0.171	0.398	0.498	0.201
Left	0.110		0.535		0.446
Right		0.029		0.069	0.043
Top					
Bottom	0.080	0.017	0.102	0.257	0.137

Simultaneous Transmission analysis for Body SAR							
Position	AG0+AG1 +BT Ant. F	AG0+AG1 +BT Ant. H	AG0+AG1 +BT Ant. F+H	AG0+AG1 +WLAN	AG0+AG1 +WLAN+ BT Ant. F	AG0+AG1 +WLAN+ BT Ant. H	AG0+AG1 +WLAN+BT Ant. F+H
Rear	0.833	0.875	0.837	0.884	0.859	0.901	0.863
Front	1.061	1.161	0.864	1.048	1.446	1.546	1.249
Left	1.127	0.592	1.038	1.063	1.488	0.953	1.399
Right	1.027	1.096	1.070	1.186	1.186	1.255	1.229
Top	0.049	0.049	0.049	0.049	0.049	0.049	0.049
Bottom	1.221	1.376	1.256	1.277	1.358	1.513	1.393

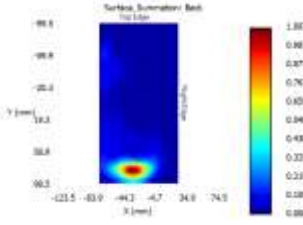
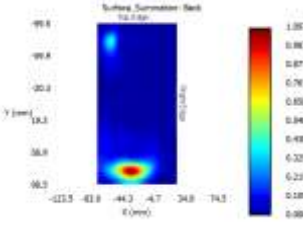
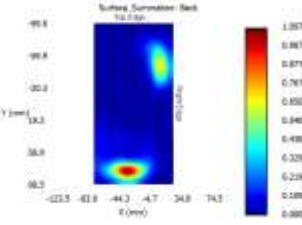
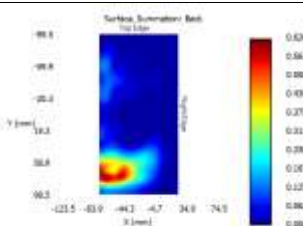
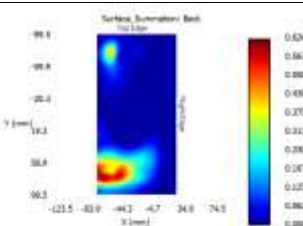
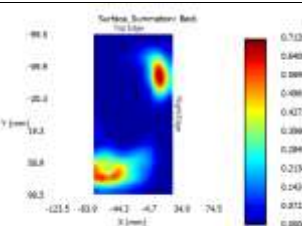
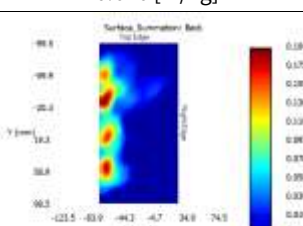
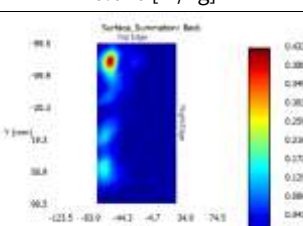
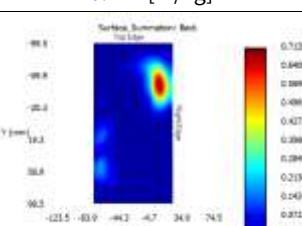
L5 Phablet SAR Simultaneous Transmission Analysis

Position	NFC	Worst
Rear	0	0
Front	0.000 048 4	0.000 048 4
Left	0	0
Right	0.000 007 7	0.000 007 7
Top	0.000 037 9	0.000 037 9
Bottom	0	0

L.6 Fast Volume Scan Combine Analysis

According to the antenna group-based SAR evaluation, it has been sufficiently demonstrated that AG0 is mutually exclusive with AG1 and that SAR limits are not exceeded even in simultaneous transmission scenarios for all antenna group combinations.

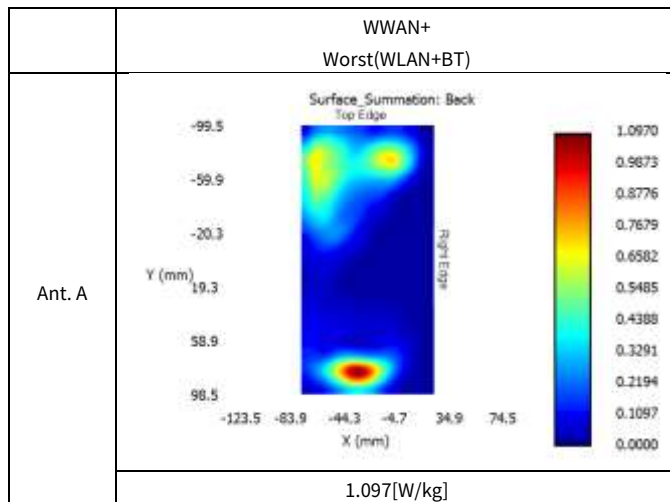
L.6.1 Simultaneous Transmission Analysis Flip open _Body Rear

AG1 AG0	Ant. E 0.155 [W/kg]	Ant. F 0.432 [W/kg]	Ant. I 0.712 [W/kg]
Ant. A 1.097 [W/kg]	 1.097 [W/kg]	 1.097 [W/kg]	 1.097 [W/kg]
Ant. B 0.626 [W/kg]	 0.626 [W/kg]	 0.626 [W/kg]	 0.712 [W/kg]
Ant. C 0.186 [W/kg]	 0.195 [W/kg]	 0.432 [W/kg]	 0.712 [W/kg]

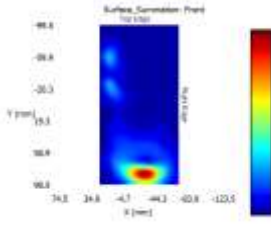
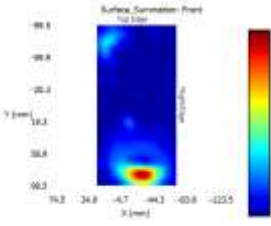
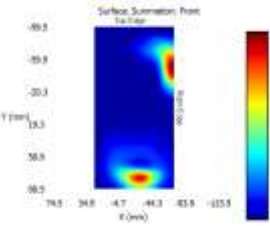
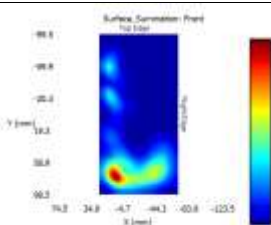
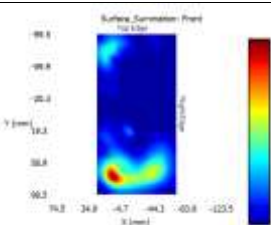
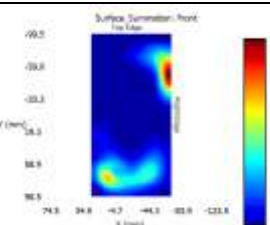
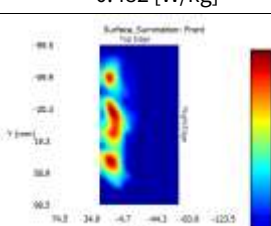
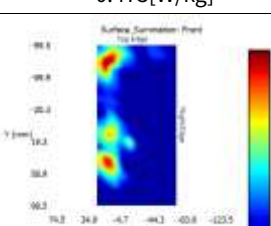
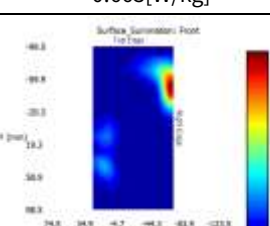
Each antenna is independent Exposure assessment of each antenna combination has little influence on each other.(Except for Ant. C+E)

L.6.1.1. Summation analysis of simultaneous transmissions from different antenna groups on the Rear of the body

	WWAN	WWAN +BT Ant. F	WWAN +BT Ant. H	WWAN +BT Ant. F+H	WWAN +WLAN	WWAN+WLAN +BT Ant. F	WWAN+WLAN +BT Ant. H	WWAN+WLAN +BT Ant. F+H
Ant. A	1.097	1.392	1.524	1.518	1.521	See the table below	See the table below	See the table below
Ant. B	0.626	0.921	1.053	1.047	1.050	1.345	1.477	1.471
Ant. C+E	0.195	0.490	0.622	0.616	0.619	0.914	1.046	1.040
Ant. F	0.432	0.727	0.859	0.853	0.856	1.151	1.283	1.277
Ant. I	0.712	1.007	1.139	1.133	1.136	1.431	1.563	1.557



L.6.2 Simultaneous Transmission Analysis Flip open _Body Front

AG1 AG0	Ant. E 0.186 [W/kg]	Ant. F 0.211 [W/kg]	Ant. I 0.663 [W/kg]
Ant. A 0.605 [W/kg]			
	0.605 [W/kg]	0.605 [W/kg]	0.663 [W/kg]
Ant. B 0.473 [W/kg]			
	0.482 [W/kg]	0.473 [W/kg]	0.663 [W/kg]
Ant. C 0.192 [W/kg]			
	0.200 [W/kg]	0.211 [W/kg]	0.663 [W/kg]

Each antenna is independent Exposure assessment of each antenna combination has little influence on each other. (Except for Ant. B+E ,Ant. C+E)

L.6.2.1 Summation analysis of simultaneous transmissions from different antenna groups on the Front of the body

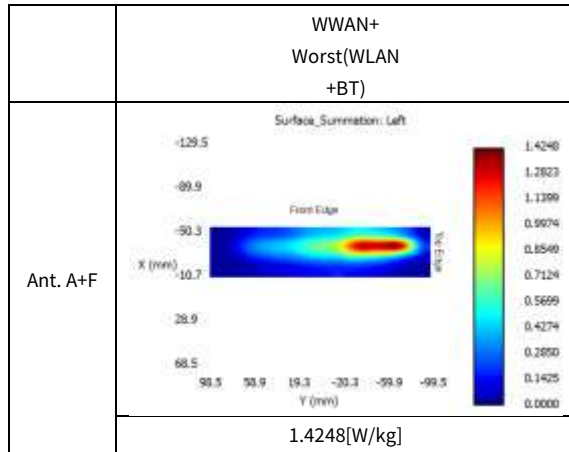
	WWAN	WWAN +BT Ant. F	WWAN +BT Ant. H	WWAN +BT Ant. F+H	WWAN +WLAN	WWAN+WLAN +BT Ant. F	WWAN+WLAN +BT Ant. H	WWAN+WLAN +BT Ant. F+H
Ant. A	0.605	0.605	0.824	0.874	0.846	0.846	1.065	1.115
Ant. B+E	0.482	0.482	0.701	0.751	0.723	0.723	0.942	0.992
Ant. C+E	0.200	0.200	0.419	0.469	0.441	0.441	0.660	0.710
Ant. F	0.211	0.211	0.430	0.480	0.452	0.452	0.671	0.721
Ant. I	0.633	0.633	0.852	0.902	0.874	0.874	1.093	1.143

L.6.3 Simultaneous Transmission Analysis Flip open Body Left side

AG1 AG0	Ant. E 0.182 [W/kg]	Ant. F 0.656 [W/kg]	Ant. I
Ant. A 0.390 [W/kg]			N/A
	0.528 [W/kg]	0.735 [W/kg]	
Ant. B 0.548 [W/kg]			N/A
	0.548 [W/kg]	0.656 [W/kg]	
Ant. C 0.349 [W/kg]			N/A
	0.389 [W/kg]	0.656 [W/kg]	

L.6.3.1 Summation analysis of simultaneous transmissions from different antenna groups on the Left side of the body

	WWAN	WWAN +BT Ant. F	WWAN +BT Ant. H	WWAN +BT Ant. F+H	WWAN +WLAN	WWAN+WLAN +BT Ant. F	WWAN+WLAN +BT Ant. H	WWAN+WLAN +BT Ant. F+H
Ant. A+E	0.956	0.528	0.990	0.963	1.391	0.963	0.956	1.425
Ant. C+E	0.817	0.389	0.851	0.824	1.252	0.824	0.817	1.286
Ant. A+F	1.163	0.735	1.197	1.170	1.598	1.170	1.163	See the table below
Ant. B+F	1.084	0.656	1.118	1.091	1.519	1.091	1.084	1.553



Simultaneous Transmission Analysis Conclusion:

Simultaneous transmission analysis between all antenna groups supported by this model (A3LSMF761U) demonstrated compliance with FCC SAR limits in all combinations of WWAN and WLAN/BT modes and SAR test configuration conditions.