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Part 0 SAR Characterization

1. SAR Characterization

1.1 DSI and SAR Determination

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

When 1g SAR and 10g SAR exposure comparison is needed, the worst-case was determined from SAR normalized to 1g or 10g SAR limit.

The device state index (DSI) conditions used in Table 10 represent different exposure scenarios.

Table 10
DSI and Corresponding Exposure Scenarios

Scenario	Description	SAR Test Cases
Free Sapce (DSI = 1)	- Device is used away from head and body - A sensor is not triggered	Not applicable
Head (DSI = 2)	- Device positioned next to head and a sensor is triggered. - Ear speaker is activated.	Head SAR per KDB Publication 648474 D04.
Body-Worn (DSI = 3)	- Device being used with a body-worn accessory and a sensor is triggered. - Ear speaker is not activated.	Body-worn SAR per KDB Publication 648474 D04.
Hotspot (DSI = 3)	- Device transmits in hotspot mode near body. - Hotspot Mode Active	Hotspot SAR per KDB Publication 941225 D06.
Phablet Grip (DSI = 3)	- Device being used with a body-worn accessory and a sensor is triggered. - Ear speaker is not activated.	Phablet SAR per KDB Publication 648474 D04.

1.2 SAR Design Target

SAR_design_target is determined by ensuring that it is less than FCC SAR limit after accounting for total device designed related uncertainties specified by the manufacturer (see Table 11).

Table 11
SAR_design_target Calculation

SAR_design_target			
$SAR_design_target < SAR_regulatory_limit \times 10^{\frac{-Total\ Uncertainty}{10}}$			
1g SAR (W/kg)		10g SAR (W/kg)	
Total Uncertainty	1.0 dB	Total Uncertainty	1.0 dB
SAR_regulatory_limit	1.6 W/kg	SAR_regulatory_limit	4.0 W/kg
SAR_design_target	1.0 W/kg	SAR_design_target	2.5 W/kg

1.3 SAR Char

SAR test results corresponding to Pmax for each antenna/technology/band/DSI can be found in Part 1 SAR Report.

Plimit is calculated by linearly scaling with the measured SAR at the Pmax to correspond to the SAR_design_target. Plimit determination for each exposure scenario corresponding to SAR_design_target are shown in Table 12.

Table 12
Limit Determination

Device State Index (DSI)	Plimit Determination Scenarios
1	Free space. SAR measurement is not applicable
2	Plimit is calculated based on the following scenarios: 1g Head SAR
3	Plimit is calculated based on the following scenarios: 1g Body-worn SAR measured at 10mm 10g Extremity SAR measured at 0mm for six surfaces

Table 13 : SAR Characterizations

(1) FreeSpace(DSI=1) : Power table #1			
Band	Antenna	P Limit* (dBm)	Pmax* (dBm)
GSM850	Main	22.7	22.7
GSM1900	Main	20.6	20.6
UMTS II	Main	23.0	23.0
UMTS IV	Main	23.0	23.0
UMTS V	Main	24.0	24.0
LTE B25/2	Main	24.0	24.0
LTE B66/4	Main	24.0	24.0
LTE B5	Main	24.0	24.0
LTE B12/17	Main	24.0	24.0
LTE B13	Main	24.0	24.0
LTE B30	Main	23.0	23.0
LTE B41	Main	22.0	22.0
LTE B48	Main	22.0	22.0
LTE B71	Main	24.0	24.0
5GNR n25/n2	Main	24.0	24.0
5GNR n5	Main	24.0	24.0
5GNR n30	Main	23.0	23.0
5GNR n41	Main	26.0	24.0
5GNR n41 PC2	Main	26.0	26.0
5GNR n66	Main	24.0	24.0
5GNR n71	Main	24.0	24.0
5GNR n77	Main	26.5	24.3
5GNR n77 PC2	Main	26.5	26.5
LTE B5	Sub(ASDiv)	23.5	23.5
LTE B12/17	Sub(ASDiv)	23.5	23.5
LTE B13	Sub(ASDiv)	23.5	23.5
LTE B48	Sub-UHB(ASDiv)	21.0	21.0
5GNR n5	Sub(ASDiv)	24.0	24.0
5GNR n77	Sub-UHB(ASDiv)	22.5	20.3
5GNR n77 PC2	Sub-UHB(ASDiv)	22.5	22.5
LTE B2	Sub(ENDC)	23.0	23.0
LTE B30	Sub(ENDC)	22.0	22.0
LTE B66	Sub(ENDC)	23.0	23.0
NR n41 UL-MIMO	Main	19.5	19.5
NR n41 UL-MIMO	Sub	19.5	19.5
NR n77 UL-MIMO	Main	19.8	19.8
NR n77 UL-MIMO	Sub-UHB	19.8	19.8
NR n41 SRS Tx-Switching 1T4R	Main	26.0	24.0
NR n41 SRS Tx-Switching 1T4R	Sub	21.5	19.5
NR n41 SRS Tx-Switching 1T4R	3rd	21.5	19.5
NR n41 SRS Tx-Switching 1T4R	4th	23.0	21.0
NR n41 SRS Tx-Switching 1T4R PC2	Main	26.0	26.0
NR n41 SRS Tx-Switching 1T4R PC2	Sub	21.5	21.5
NR n41 SRS Tx-Switching 1T4R PC2	3rd	21.5	21.5
NR n41 SRS Tx-Switching 1T4R PC2	4th	23.0	23.0
NR n41 SRS Tx-Switching 2T4R	Main	19.5	19.5
NR n41 SRS Tx-Switching 2T4R	Sub	19.5	19.5
NR n41 SRS Tx-Switching 2T4R	3rd	15.0	15.0
NR n41 SRS Tx-Switching 2T4R	4th	16.5	16.5
NR n77 SRS Tx-Switching 1T4R	Main	26.5	24.3
NR n77 SRS Tx-Switching 1T4R	3rd	21.0	18.8
NR n77 SRS Tx-Switching 1T4R	4th	22.5	20.3
NR n77 SRS Tx-Switching 1T4R	Sub-UHB	22.5	20.3
NR n77 SRS Tx-Switching 1T4R PC2	Main	26.5	26.5
NR n77 SRS Tx-Switching 1T4R PC2	3rd	21.0	21.0
NR n77 SRS Tx-Switching 1T4R PC2	4th	22.5	22.5
NR n77 SRS Tx-Switching 1T4R PC2	Sub-UHB	22.5	22.5
NR n77 SRS Tx-Switching 2T4R	Main	19.8	19.8
NR n77 SRS Tx-Switching 2T4R	3rd	14.3	14.3
NR n77 SRS Tx-Switching 2T4R	4th	13.8	13.8
NR n77 SRS Tx-Switching 2T4R	Sub-UHB	19.8	19.8

* Frame averaged power
** Meshed cells are work with time average

(3) Body-Worn, Hotspot(DSI=3) : Power table #3								
Band	Antenna	Test Distance (mm)	Measured Power* (dBm)	Measured 1g SAR (W/kg)	Position	Calculated upper power limit* (dBm)	P Limit* (dBm)	Pmax* (dBm)
GSM850	Main	10	22.7	0.032	Back	39.69	22.7	22.7
GSM1900	Main	10	17.8	0.028	Bottom	35.37	17.8	20.6
UMTS II	Main	10	19.0	0.364	Bottom	25.43	19.0	23.0
UMTS IV	Main	10	18.0	0.174	Bottom	27.64	18.0	23.0
UMTS V	Main	10	22.0	0.328	Back	28.88	22.0	24.0
LTE B25/2	Main	10	19.0	0.109	Bottom	30.67	19.0	24.0
LTE B66/4	Main	10	18.0	0.051	Bottom	32.97	18.0	24.0
LTE B5	Main	10	21.0	0.123	Back	32.14	21.0	24.0
LTE B12/17	Main	10	21.0	0.071	Back	34.53	21.0	24.0
LTE B13	Main	10	21.0	0.104	Back	32.87	21.0	24.0
LTE B30	Main	10	19.0	0.047	Bottom	34.32	19.0	23.0
LTE B41	Main	10	17.0	0.023	Front	35.42	17.0	22.0
LTE B48	Main	10	17.0	0.052	Back	31.88	17.0	22.0
LTE B71	Main	10	22.0	0.094	Back	34.31	22.0	24.0
5GNR n25/n2	Main	10	19.0	0.385	Bottom	25.19	19.0	24.0
5GNR n5	Main	10	21.0	0.263	Back	28.84	21.0	24.0
5GNR n30	Main	10	19.0	0.052	Bottom	33.88	19.0	23.0
5GNR n41	Main	10	19.0	0.217	Front	27.68	19.0	24.0
5GNR n41 PC2	Main	10	19.0	0.217	Front	27.68	19.0	26.0
5GNR n66	Main	10	19.0	0.231	Bottom	27.41	19.0	24.0
5GNR n71	Main	10	22.0	0.151	Back	32.25	22.0	24.0
5GNR n77	Main	10	18.0	0.284	Back	25.50	18.0	24.3
5GNR n77 PC2	Main	10	18.0	0.284	Back	25.50	18.0	26.5
LTE B5	Sub(ASDiv)	10	22.0	0.118	Front	33.32	22.0	23.5
LTE B12/17	Sub(ASDiv)	10	22.0	0.203	Back	30.97	22.0	23.5
LTE B13	Sub(ASDiv)	10	22.0	0.159	Back	32.03	22.0	23.5
LTE B48	Sub-UHB(ASDiv)	10	15.0	0.048	Left	30.23	15.0	21.0
5GNR n5	Sub(ASDiv)	10	21.0	0.096	Front	33.22	21.0	24.0
5GNR n77	Sub-UHB(ASDiv)	10	13.0	0.096	Back	25.22	13.0	20.3
5GNR n77 PC2	Sub-UHB(ASDiv)	10	13.0	0.096	Back	25.22	13.0	22.5
LTE B2	Sub(ENDC)	10	15.0	0.262	Top	22.86	15.0	23.0
LTE B30	Sub(ENDC)	10	16.0	0.122	Top	27.18	16.0	22.0
LTE B66	Sub(ENDC)	10	16.0	0.276	Top	23.63	16.0	23.0
NR n41 UL-MIMO	Main	10	17.0	0.137	Front	27.67	17.0	19.5
NR n41 UL-MIMO	Sub	10	17.0	0.132	Top	27.84	17.0	19.5
NR n77 UL-MIMO	Main	10	17.0	0.226	Back	25.50	17.0	19.8
NR n77 UL-MIMO	Sub-UHB	10	17.0	0.241	Back	25.22	17.0	19.8
NR n41 SRS Tx-Switching 1T4R	Main	10	19.0	0.217	Front	27.68	19.0	24.0
NR n41 SRS Tx-Switching 1T4R	Sub	10	14.5	0.074	Top	27.85	14.5	19.5
NR n41 SRS Tx-Switching 1T4R	3rd	10	14.5	0.02	Back	33.53	14.5	19.5
NR n41 SRS Tx-Switching 1T4R	4th	10	16.0	0.082	Back	28.90	16.0	21.0
NR n41 SRS Tx-Switching 1T4R PC2	Main	10	19.0	0.217	Front	27.68	19.0	26.0
NR n41 SRS Tx-Switching 1T4R PC2	Sub	10	14.5	0.074	Top	27.85	14.5	21.5
NR n41 SRS Tx-Switching 1T4R PC2	3rd	10	14.5	0.02	Back	33.53	14.5	21.5
NR n41 SRS Tx-Switching 1T4R PC2	4th	10	16.0	0.082	Back	28.90	16.0	23.0
NR n41 SRS Tx-Switching 2T4R	Main	10	17.0	0.137	Front	27.67	17.0	19.5
NR n41 SRS Tx-Switching 2T4R	Sub	10	17.0	0.132	Top	27.84	17.0	19.5
NR n41 SRS Tx-Switching 2T4R	3rd	10	12.5	0.013	Back	33.40	12.5	15.0
NR n41 SRS Tx-Switching 2T4R	4th	10	14.0	0.052	Back	28.88	14.0	16.5
NR n77 SRS Tx-Switching 1T4R	Main	10	18.0	0.358	Back	24.50	18.0	24.3
NR n77 SRS Tx-Switching 1T4R	3rd	10	12.5	0.008	Back	35.54	12.5	18.8
NR n77 SRS Tx-Switching 1T4R	4th	10	14.0	0.066	Back	27.85	14.0	20.3
NR n77 SRS Tx-Switching 1T4R	Sub-UHB	10	14.0	0.121	Back	25.22	14.0	20.3
NR n77 SRS Tx-Switching 1T4R PC2	Main	10	18.0	0.358	Back	24.50	18.0	26.5
NR n77 SRS Tx-Switching 1T4R PC2	3rd	10	12.5	0.008	Back	35.54	12.5	21.0
NR n77 SRS Tx-Switching 1T4R PC2	4th	10	14.0	0.066	Back	27.85	14.0	22.5
NR n77 SRS Tx-Switching 1T4R PC2	Sub-UHB	10	14.0	0.121	Back	25.22	14.0	22.5
NR n77 SRS Tx-Switching 2T4R	Main	10	17.0	0.226	Back	25.50	17.0	19.8
NR n77 SRS Tx-Switching 2T4R	3rd	10	11.5	0.006	Back	35.76	11.5	14.3
NR n77 SRS Tx-Switching 2T4R	4th	10	11.0	0.033	Back	27.86	11.0	13.8
NR n77 SRS Tx-Switching 2T4R	Sub-UHB	10	17.0	0.241	Back	25.22	17.0	19.8
			* Frame averaged power					
			** Meshed cells are work with time averaging					

(4) Extremity(DSI=3) : Power table #3								
Band	Antenna	Test Distance (mm)	Measured Power* (dBm)	Measured 10g SAR (W/kg)	Position	Calculated upper power limit* (dBm)	P Limit* (dBm)	Pmax* (dBm)
GSM850	Main	0	22.7	0.754	Front	25.97	22.7	22.7
GSM1900	Main	0	17.8	0.569	Front	22.29	17.8	20.6
UMTS II	Main	0	19.0	0.809	Bottom	21.96	19.0	23.0
UMTS IV	Main	0	18.0	0.627	Bottom	22.07	18.0	23.0
UMTS V	Main	0	22.0	0.889	Left	24.55	22.0	24.0
LTE B25/2	Main	0	19.0	0.766	Front	22.20	19.0	24.0
LTE B66/4	Main	0	18.0	0.584	Bottom	22.38	18.0	24.0
LTE B5	Main	0	21.0	0.67	Front	24.78	21.0	24.0
LTE B12/17	Main	0	21.0	0.709	Front	24.53	21.0	24.0
LTE B13	Main	0	21.0	0.769	Front	24.18	21.0	24.0
LTE B30	Main	0	19.0	0.838	Front	21.81	19.0	23.0
LTE B41	Main	0	17.0	0.589	Front	21.34	17.0	22.0
LTE B48	Main	0	17.0	0.603	Back	21.24	17.0	22.0
LTE B71	Main	0	22.0	0.818	Front	24.91	22.0	24.0
5GNR n25/n2	Main	0	19.0	0.8	Front	22.01	19.0	24.0
5GNR n5	Main	0	21.0	0.722	Front	24.46	21.0	24.0
5GNR n30	Main	0	19.0	0.828	Front	21.86	19.0	23.0
5GNR n41	Main	0	19.0	1.1	Front	20.63	19.0	24.0
5GNR n41 PC2	Main	0	19.0	1.1	Front	20.63	19.0	26.0
5GNR n66	Main	0	19.0	0.808	Bottom	21.97	19.0	24.0
5GNR n71	Main	0	22.0	0.829	Front	24.86	22.0	24.0
5GNR n77	Main	0	18.0	1.255	Back	19.05	18.0	24.3
5GNR n77 PC2	Main	0	18.0	1.255	Back	19.05	18.0	26.5
LTE B5	Sub(ASDiv)	0	22.0	0.586	Front	26.36	22.0	23.5
LTE B12/17	Sub(ASDiv)	0	22.0	0.696	Front	25.62	22.0	23.5
LTE B13	Sub(ASDiv)	0	22.0	0.557	Front	26.58	22.0	23.5
LTE B48	Sub-UHB(ASDiv)	0	15.0	0.103	Back	26.91	15.0	21.0
5GNR n5	Sub(ASDiv)	0	21.0	0.539	Front	25.73	21.0	24.0
5GNR n77	Sub-UHB(ASDiv)	0	13.0	1.26	Back	14.04	13.0	20.3
5GNR n77 PC2	Sub-UHB(ASDiv)	0	13.0	1.26	Back	14.04	13.0	22.5
LTE B2	Sub(ENDC)	0	15.0	0.84	Front	17.80	15.0	23.0
LTE B30	Sub(ENDC)	0	16.0	0.429	Front	21.72	16.0	22.0
LTE B66	Sub(ENDC)	0	16.0	0.623	Bottom	20.10	16.0	23.0
NR n41 UL-MIMO	Main	0	17.0	0.694	Front	20.63	17.0	19.5
NR n41 UL-MIMO	Sub	0	17.0	0.65	Front	20.91	17.0	19.5
NR n77 UL-MIMO	Main	0	17.0	0.656	Front	20.87	17.0	19.8
NR n77 UL-MIMO	Sub-UHB	0	17.0	0.879	Back	19.60	17.0	19.8
NR n41 SRS Tx-Switching 1T4R	Main	0	19.0	1.1	Front	20.63	19.0	24.0
NR n41 SRS Tx-Switching 1T4R	Sub	0	14.5	0.366	Front	20.91	14.5	19.5
NR n41 SRS Tx-Switching 1T4R	3rd	0	14.5	0.48	Back	19.73	14.5	19.5
NR n41 SRS Tx-Switching 1T4R	4th	0	16.0	0.832	Back	18.84	16.0	21.0
NR n41 SRS Tx-Switching 1T4R PC2	Main	0	19.0	1.1	Front	20.63	19.0	26.0
NR n41 SRS Tx-Switching 1T4R PC2	Sub	0	14.5	0.206	Front	23.41	14.5	21.5
NR n41 SRS Tx-Switching 1T4R PC2	3rd	0	14.5	0.48	Back	19.73	14.5	21.5
NR n41 SRS Tx-Switching 1T4R PC2	4th	0	16.0	0.832	Back	18.84	16.0	23.0
NR n41 SRS Tx-Switching 2T4R	Main	0	17.0	0.694	Front	20.63	17.0	19.5
NR n41 SRS Tx-Switching 2T4R	Sub	0	17.0	0.65	Front	20.91	17.0	19.5
NR n41 SRS Tx-Switching 2T4R	3rd	0	12.5	0.303	Back	19.73	12.5	15.0
NR n41 SRS Tx-Switching 2T4R	4th	0	14.0	0.525	Back	18.84	14.0	16.5
NR n77 SRS Tx-Switching 1T4R	Main	0	18.0	1.255	Back	19.05	18.0	24.3
NR n77 SRS Tx-Switching 1T4R	3rd	0	12.5	0.147	Back	22.87	12.5	18.8
NR n77 SRS Tx-Switching 1T4R	4th	0	14.0	1.003	Back	16.03	14.0	20.3
NR n77 SRS Tx-Switching 1T4R	Sub-UHB	0	14.0	0.312	Back	21.10	14.0	20.3
NR n77 SRS Tx-Switching 1T4R PC2	Main	0	18.0	0.103	Front	29.91	18.0	26.5
NR n77 SRS Tx-Switching 1T4R PC2	3rd	0	12.5	0.147	Back	22.87	12.5	21.0
NR n77 SRS Tx-Switching 1T4R PC2	4th	0	14.0	1.003	Back	16.03	14.0	22.5
NR n77 SRS Tx-Switching 1T4R PC2	Sub-UHB	0	14.0	0.295	Back	21.34	14.0	22.5
NR n77 SRS Tx-Switching 2T4R	Main	0	17.0	0.792	Back	20.05	17.0	19.8
NR n77 SRS Tx-Switching 2T4R	3rd	0	11.5	0.093	Back	23.87	11.5	14.3
NR n77 SRS Tx-Switching 2T4R	4th	0	11.0	0.399	Back	17.03	11.0	13.8
NR n77 SRS Tx-Switching 2T4R	Sub-UHB	0	17.0	0.879	Back	19.60	17.0	19.8
			* Frame averaged power					
			** Meshed cells are work with time averaging					