

Appendix G. Supplemental Antenna Tuner Tests Results

General Note:

1. This device implements antenna tuning techniques in the several frequency band and list as below. SAR test proposal was measured according to the normally required SAR configurations with the tuner active and worst tune state (auto tune) was used for SAR testing and this design will provide the highest power at different user scenarios and would not influence to the antenna characteristics other than impedance matching.
2. The following test procedure was followed to demonstrate that the SAR results in this report represent the appropriate SAR test conditions. For bands with dynamic tuning implemented, SAR will be measured according to the required FCC SAR test procedures with the dynamic tuner active to allow the device to automatically tune to the antenna state for the respective RF exposure test configurations. Additional single point SAR time-sweep measurements will be evaluated for other tuner states to determine that the other tuner configurations would result in equivalent or lower SAR values.
3. The number of supported tune codes is different for each frequency band as shown in the following table.
4. Dynamic antenna tuning mechanism is available at Ant.0 for its < 3GHz LTE and NR band, details are illustrated in the operational description, all supported tuning states for each band are tested and it's verified that auto-tune state results in the highest SAR configuration.
5. The tuner state was established remotely through Wi-Fi so that the device is not moved for the entire series of single point SAR for the tuner states in each combination (band, mode, exposure conditions).

Antenna	Band	Number of tuning states
Ant0	LTE B12/B17	60
	LTE B13	20
	LTE B14	25
	LTE B26/B5	59
	LTE B71	60
	NR n5	57
	NR n71	60



<Supplemental Head SAR results>

Head (Ant0)	RF exposure position									Average Value of Time Sweep Single Point SAR (W/kg)									
	Band	Mode	Channel	Test Position	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Auto-Tuner (State)	Auto-Tuner Single Point SAR (W/kg)	Default-Tuner (State)										
										1	2	3	4	5	6	7	8	9	10
LTE Band 12	10M_QPSK_1_0	Middle	23095	Left Cheek	0.220	0.311	40	0.278	40	0.247	0.171	0.274	0.244	0.161	0.259	0.109	0.160	0.241	0.101
										11	12	13	14	15	16	17	18	19	20
										0.176	0.264	0.089	0.107	0.100	0.259	0.029	0.101	0.037	0.049
										21	22	23	24	25	26	27	28	29	30
										0.074	0.163	0.241	0.175	0.244	0.102	0.260	0.148	0.101	0.186
										31	32	33	34	35	36	37	38	39	40
										0.164	0.100	0.104	0.068	0.059	0.084	0.075	0.042	0.175	0.278
										41	42	43	44	45	46	47	48	49	50
										0.245	0.163	0.143	0.082	0.185	0.100	0.261	0.073	0.084	0.041
										51	52	53	54	55	56	57	58	59	60
LTE Band 13	10M_QPSK_1_0	Middle	23230	Left Cheek	0.318	0.454	3	0.337	3	0.098	0.163	0.265	0.089	0.067	0.069	0.070	0.040	0.161	0.171
										1	2	3	4	5	6	7	8	9	10
										0.317	0.315	0.337	0.169	0.323	0.107	0.118	0.103	0.145	0.180
										11	12	13	14	15	16	17	18	19	20
										0.247	0.329	0.314	0.155	0.038	0.063	0.065	0.097	0.097	0.143
										1	2	3	4	5	6	7	8	9	10
										0.344	0.325	0.347	0.340	0.225	0.343	0.339	0.154	0.126	0.127
										11	12	13	14	15	16	17	18	19	20
										0.333	0.346	0.334	0.330	0.243	0.173	0.224	0.325	0.325	0.061
										21	22	23	24	25					
LTE Band 14	10M_QPSK_1_0	Middle	23330	Left Cheek	0.316	0.453	3	0.347	3	0.059	0.081	0.090	0.096	0.306					
										1	2	3	4	5	6	7	8	9	10
										0.408	0.404	0.421	0.370	0.415	0.345	0.356	0.185	0.168	0.336
										11	12	13	14	15	16	17	18	19	20
										0.334	0.412	0.176	0.302	0.181	0.414	0.236	0.052	0.106	0.173
										21	22	23	24	25	26	27	28	29	30
										0.313	0.389	0.303	0.300	0.312	0.284	0.186	0.396	0.394	0.376
										31	32	33	34	35	36	37	38	39	40
										0.357	0.197	0.112	0.104	0.299	0.268	0.251	0.273	0.330	0.221
										41	42	43	44	45	46	47	48	49	50
LTE Band 26	15M_QPSK_1_0	Middle	26865	Left Cheek	0.339	0.462	3	0.421	2	0.365	0.343	0.302	0.351	0.340	0.409	0.173	0.112	0.222	0.369
										51	52	53	54	55	56	57	58	59	
										0.184	0.086	0.100	0.081	0.143	0.118	0.168	0.079	0.062	
										1	2	3	4	5	6	7	8	9	10
										0.205	0.234	0.191	0.166	0.232	0.200	0.061	0.117	0.231	0.187
										11	12	13	14	15	16	17	18	19	20
										0.227	0.185	0.184	0.061	0.094	0.086	0.192	0.033	0.017	0.032
										21	22	23	24	25	26	27	28	29	30
										0.067	0.068	0.087	0.083	0.186	0.206	0.228	0.188	0.193	0.223
										31	32	33	34	35	36	37	38	39	40
LTE Band 71	20M_QPSK_1_0	Middle	133297	Left Cheek	0.215	0.291	2	0.234	5	0.188	0.176	0.091	0.117	0.232	0.062	0.086	0.186	0.031	0.030
										41	42	43	44	45	46	47	48	49	50
										0.061	0.067	0.075	0.070	0.131	0.203	0.233	0.067	0.232	0.187
										51	52	53	54	55	56	57	58	59	60
										0.187	0.229	0.068	0.089	0.229	0.032	0.033	0.042	0.066	0.132
										1	2	3	4	5	6	7	8	9	10
										0.344	0.247	0.344	0.357	0.228	0.276	0.393	0.354	0.152	0.111
										11	12	13	14	15	16	17	18	19	20
										0.169	0.257	0.362	0.108	0.169	0.244	0.152	0.157	0.092	0.086
										21	22	23	24	25	26	27	28	29	30
FR1 n5	20M_BPSK_50_28	Middle	167300	Left Cheek	0.325	0.459	7	0.393	7										



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										0.076	0.100	0.348	0.377	0.333	0.318	0.307	0.174	0.167	0.227
										31	32	33	34	35	36	37	38	39	40
										0.176	0.348	0.342	0.376	0.363	0.069	0.147	0.107	0.197	0.184
										41	42	43	44	45	46	47	48	49	50
										0.339	0.255	0.356	0.260	0.392	0.163	0.104	0.158	0.345	0.239
										51	52	53	54	55	56	57			
										0.263	0.160	0.156	0.088	0.087	0.105	0.063			
FR1 n71	20M_BPSK_1_53	Middle	136100	Left Cheek	0.209	0.279	5	0.223	10	1	2	3	4	5	6	7	8	9	10
										0.180	0.222	0.162	0.143	0.223	0.172	0.056	0.100	0.217	0.205
										11	12	13	14	15	16	17	18	19	20
										0.209	0.156	0.156	0.051	0.081	0.084	0.208	0.026	0.015	0.025
										21	22	23	24	25	26	27	28	29	30
										0.064	0.068	0.083	0.101	0.206	0.181	0.211	0.164	0.208	0.201
										31	32	33	34	35	36	37	38	39	40
										0.160	0.151	0.087	0.102	0.219	0.053	0.083	0.206	0.027	0.023
										41	42	43	44	45	46	47	48	49	50
										0.056	0.066	0.076	0.069	0.146	0.174	0.218	0.065	0.219	0.206
										51	52	53	54	55	56	57	58	59	60
										0.205	0.208	0.055	0.086	0.212	0.025	0.026	0.038	0.065	0.143

<Supplemental Body SAR results>

Body (Ant0)	RF exposure position									Average Value of Time Sweep Single Point SAR (W/kg)									
	Band	Mode	Channel	Test Position	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Auto-Tuner (State)	Auto-Tuner Single Point SAR (W/kg)	Default-Tuner (State)										
										1	2	3	4	5	6	7	8	9	10
LTE Band 12	10M_QPSK_1_0	Middle	23095	Left Side	0.422	0.596	40	0.498	40	0.400	0.297	0.420	0.392	0.279	0.408	0.183	0.262	0.388	0.182
										11	12	13	14	15	16	17	18	19	20
										0.299	0.414	0.175	0.185	0.182	0.396	0.054	0.179	0.073	0.091
										21	22	23	24	25	26	27	28	29	30
										0.134	0.280	0.388	0.300	0.391	0.184	0.409	0.241	0.158	0.317
										31	32	33	34	35	36	37	38	39	40
										0.283	0.182	0.149	0.117	0.101	0.143	0.133	0.079	0.359	0.498
										41	42	43	44	45	46	47	48	49	50
										0.469	0.330	0.290	0.174	0.379	0.217	0.493	0.162	0.185	0.096
										51	52	53	54	55	56	57	58	59	60
										0.220	0.334	0.495	0.213	0.145	0.155	0.157	0.093	0.332	0.297
										1	2	3	4	5	6	7	8	9	10
LTE Band 13	10M_QPSK_1_0	Middle	23230	Left Side	0.662	0.734	3	0.685	3	0.671	0.657	0.685	0.400	0.680	0.289	0.294	0.286	0.382	0.405
										11	12	13	14	15	16	17	18	19	20
										0.521	0.674	0.656	0.385	0.119	0.187	0.172	0.230	0.231	0.329
										1	2	3	4	5	6	7	8	9	10
										0.826	0.748	0.835	0.824	0.525	0.829	0.816	0.464	0.351	0.380
										11	12	13	14	15	16	17	18	19	20
										0.763	0.834	0.827	0.808	0.650	0.489	0.524	0.733	0.743	0.201
										21	22	23	24	25					
										0.202	0.264	0.285	0.247	0.679					
										1	2	3	4	5	6	7	8	9	10
										0.702	0.661	0.730	0.703	0.692	0.674	0.687	0.329	0.305	0.526
										11	12	13	14	15	16	17	18	19	20
LTE Band 26	15M_QPSK_1_0	Middle	26865	Left Side	0.540	0.735	3	0.730	2	0.524	0.703	0.361	0.532	0.327	0.678	0.472	0.110	0.207	0.269
										21	22	23	24	25	26	27	28	29	30
										0.610	0.696	0.587	0.578	0.597	0.550	0.326	0.632	0.650	0.664



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Overall Performance Metrics											31	32	33	34	35	36	37	38	39	40
											0.645	0.392	0.221	0.206	0.529	0.394	0.368	0.424	0.589	0.381
											41	42	43	44	45	46	47	48	49	50
											0.640	0.618	0.538	0.622	0.533	0.698	0.312	0.227	0.389	0.646
											51	52	53	54	55	56	57	58	59	
											0.387	0.174	0.200	0.150	0.258	0.268	0.363	0.168	0.118	
	LTE Band 71	20M_QPSK_1_0	Middle	133297	Left Side	0.350	0.474	2	0.452	5	1	2	3	4	5	6	7	8	9	10
											0.385	0.452	0.353	0.324	0.450	0.372	0.131	0.234	0.449	0.396
											11	12	13	14	15	16	17	18	19	20
											0.426	0.338	0.339	0.121	0.186	0.188	0.398	0.066	0.041	0.063
											21	22	23	24	25	26	27	28	29	30
											0.144	0.170	0.190	0.197	0.397	0.383	0.428	0.351	0.398	0.412
											31	32	33	34	35	36	37	38	39	40
											0.345	0.329	0.195	0.237	0.449	0.127	0.189	0.391	0.068	0.058
											41	42	43	44	45	46	47	48	49	50
											0.127	0.146	0.186	0.153	0.283	0.376	0.448	0.144	0.444	0.393
											51	52	53	54	55	56	57	58	59	60
	0.391	0.425	0.131	0.193	0.435	0.065	0.067	0.091	0.147	0.285										
	FR1 n5	20M_BPSK_50_28	Middle	167300	Left Side	0.496	0.669	7	0.690	7	1	2	3	4	5	6	7	8	9	10
											0.606	0.418	0.551	0.627	0.397	0.466	0.690	0.646	0.268	0.211
											11	12	13	14	15	16	17	18	19	20
											0.288	0.430	0.643	0.208	0.284	0.474	0.313	0.321	0.186	0.167
											21	22	23	24	25	26	27	28	29	30
											0.130	0.171	0.635	0.633	0.617	0.598	0.579	0.297	0.300	0.385
											31	32	33	34	35	36	37	38	39	40
											0.303	0.552	0.536	0.634	0.633	0.144	0.293	0.196	0.290	0.269
											41	42	43	44	45	46	47	48	49	50
											0.593	0.433	0.639	0.436	0.680	0.282	0.195	0.268	0.599	0.400
											51	52	53	54	55	56	57			
	0.440	0.325	0.319	0.176	0.167	0.199	0.110													
	FR1 n71	20M_BPSK_1_53	Middle	136100	Back	0.352	0.469	5	0.432	10	1	2	3	4	5	6	7	8	9	10
											0.355	0.431	0.320	0.290	0.432	0.344	0.126	0.216	0.430	0.422
											11	12	13	14	15	16	17	18	19	20
											0.408	0.310	0.311	0.105	0.177	0.187	0.423	0.057	0.037	0.052
											21	22	23	24	25	26	27	28	29	30
											0.144	0.099	0.184	0.227	0.422	0.357	0.406	0.321	0.422	0.387
31											32	33	34	35	36	37	38	39	40	
0.316											0.298	0.188	0.215	0.427	0.110	0.181	0.419	0.062	0.048	
41											42	43	44	45	46	47	48	49	50	
0.122											0.147	0.108	0.156	0.299	0.344	0.427	0.144	0.428	0.419	
51											52	53	54	55	56	57	58	59	60	
0.419	0.399	0.112	0.192	0.409	0.054	0.057	0.086	0.148	0.299											

Appendix G. Supplemental SAR Tests Results

SAR test result

1. The test data is selected according to the worst case SAR configuration per cellular technology.
2. The test data is to demonstrate the device is in compliance with FCC requirements at 25mm when all power reduction mechanisms are OFF. The worst case body SAR at 10mm was used for simultaneous transmission SAR analysis since they are more conservative than the 25mm SAR.

Band	Mode	Test Position	Gap (mm)	Power State	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
GSM1900_Ant 2	GPRS (4 Tx slots)	Front	25mm	Index 1	661	1880	27.01	28.00	1.256	-	1.000	-0.03	0.155	0.195
WCDMA II_Ant 2	RMC 12.2Kbps	Front	25mm	Index 1	9538	1907.6	25.13	25.70	1.140	-	1.000	-0.18	0.213	0.243
LTE Band 48_Ant 6	20M_QPSK_1_0	Left Side	25mm	Index 1	56640	3690	24.01	25.20	1.315	62.9	1.006	-0.13	0.313	0.414
FR1 n77_Ant 6	100M_BPSK_1_1	Left Side	25mm	Index 1	656000	3840	24.38	25.20	1.208	-	1.000	-0.01	0.473	0.571
WLAN2.4GHz	802.11b 1Mbps	Top Side	25mm	Index 0	13	2472	20.60	21.00	1.096	98.62	1.014	-0.01	0.114	0.127
WLAN5GHz	802.11a 6Mbps	Back	25mm	Index 0	144	5720	19.50	19.50	1.000	93.6	1.068	0.07	0.215	0.230
Bluetooth	1Mbps	Top Side	25mm	Index 0	78	2480	19.76	20.00	1.057	77.07	1.081	-0.08	0.100	0.114