

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. Dynamic antenna tuning mechanism is available at Ant.0 for its < 3GHz LTE and NR band. The number of supported tune codes is different for each frequency band as shown in the following table. And it's verified that tune state results in the highest SAR configuration
3. The antenna tuner state shall be controlled remotely such that the DUT position is not moved during the series of single-point SAR measurements.
4. For each air interface, exposure condition, and antenna that supports dynamic antenna tuning (DAT), the following procedure shall be followed:
 - a. An area scan is performed with the DUT positioned for the exposure condition with auto-tuner enabled to determine the peak SAR location
 - b. A single-point SAR measurement (i.e., time sweep) is performed at the peak SAR location of step a (that is, with auto-tuner enabled). The auto-tuner state shall be recorded, after verifying that it is stable. If fluctuations occur, the scan procedure can be restarted, or the state with the highest SAR needs to be recorded
 - c. Without moving the probe, or introducing any other perturbation, the auto-tuner shall be disabled, and two other adjacent tune states shall be chosen by increasing and decreasing the state identification number by 1
 - d. A single point SAR measurement is then performed on both chosen adjacent states and compared with the value of step b. The measured SAR for auto-tuner disabled is expected to be less than or equal to the recorded SAR of step b. If the measured SAR is higher beyond documented tolerance, then the auto-tuning feature is not working as intended and is not suitable for compliance. DAT functionality shall be removed or adjusted by the manufacturer. If the measured SAR is higher than the value of step b but within tolerance, the next adjacent state(s) shall be chosen and the measure repeated until a lower SAR value can be shown; otherwise, the DAT is considered inoperative and shall be removed or adjusted by the manufacturer.
 - e. Repeat step b with auto-tuning enabled as a test for variability within tolerance: the previous measured value in step 2.2 shall be recovered. If the measured SAR is outside the expected tolerance, then the auto-tuning feature is considered not working as intended and not suitable for compliance. DAT functionality shall be removed or adjusted by the manufacturer
 - f. If any single-point SAR measurement result is >1.4 W/kg, then all tune states for that particular combination of air interface, exposure condition, and antenna selection shall be evaluated with single-point SAR measurements.

Antenna	Band	Number of tune states
ANT 0	LTE Band 12/17/ FR1 n12	440
	LTE Band 13 / FR1 n13	440
	LTE Band 14 / FR1 n14	440
	LTE Band 26/5 / FR1 n26/5	440
	LTE Band 71 / FR1 n71	440

<Antenna tuner Verification result>

Ant.	Close Mode													
	Band	Mode	Channel	Test Position	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Auto-tuner enable		Auto-tuner disabled Verify adjacent tuner				Repeat Auto-tuner enable	
							State	Single Point SAR (W/kg)	State	Single Point SAR (W/kg)	State	Single Point SAR (W/kg)	State	Single Point SAR (W/kg)
Ant 0	LTE Band 12	10M QPSK 1 0	23095	Right Cheek	0.163	0.186	434	0.274	433	0.231	435	0.208	434	0.269
Ant 0	LTE Band 12	10M QPSK 1 0	23095	Back 5mm	0.487	0.557	434	0.731	433	0.622	435	0.583	434	0.709
Ant 0	LTE Band 13	10M QPSK 1 0	23230	Right Cheek	0.161	0.189	436	0.264	435	0.201	437	0.222	436	0.271
Ant 0	LTE Band 13	10M QPSK 1 0	23230	Back 5mm	0.611	0.668	432	0.964	431	0.812	433	0.796	432	0.958
Ant 0	LTE Band 14	10M QPSK 1 0	23330	Right Cheek	0.151	0.173	436	0.233	435	0.165	437	0.196	436	0.225
Ant 0	LTE Band 14	10M QPSK 1 0	23330	Back 5mm	0.635	0.729	436	0.932	435	0.841	437	0.787	436	0.940
Ant 0	LTE Band 26	15M QPSK 1 0	26865	Right Cheek	0.167	0.197	436	0.321	435	0.254	437	0.289	436	0.335
Ant 0	LTE Band 26	15M QPSK 1 0	26865	Back 5mm	0.595	0.725	436	0.765	435	0.662	437	0.581	436	0.739
Ant 0	LTE Band 71	20M QPSK 1 0	133297	Right Cheek	0.140	0.161	320	0.288	319	0.199	321	0.165	320	0.274
Ant 0	LTE Band 71	20M QPSK 1 0	133297	Back 5mm	0.411	0.473	320	0.768	319	0.710	321	0.589	320	0.755
Ant 0	FR1 n12	15M BPSK 1 1	141500	Right Cheek	0.179	0.205	434	0.316	433	0.302	435	0.284	434	0.299
Ant 0	FR1 n12	15M BPSK 1 1	141500	Back 5mm	0.487	0.557	434	0.860	433	0.811	435	0.765	434	0.844
Ant 0	FR1 n13	10M BPSK 1 1	156400	Right Cheek	0.164	0.193	436	0.290	435	0.254	437	0.232	436	0.285
Ant 0	FR1 n13	10M BPSK 1 1	156400	Back 5mm	0.675	0.777	432	1.040	431	0.869	433	0.861	432	0.999
Ant 0	FR1 n14	10M BPSK 1 1	158600	Right Cheek	0.153	0.183	436	0.270	435	0.255	437	0.212	436	0.265
Ant 0	FR1 n14	10M BPSK 1 1	158600	Back 5mm	0.692	0.773	436	0.996	435	0.841	437	0.764	436	0.981
Ant 0	FR1 n26	20M BPSK 1 1	166300	Right Cheek	0.170	0.203	436	0.300	435	0.212	437	0.188	436	0.294
Ant 0	FR1 n26	20M BPSK 1 1	166300	Back 5mm	0.693	0.771	436	1.010	435	0.842	437	0.903	436	0.996
Ant 0	FR1 n71	35M BPSK 1 1	136100	Right Cheek	0.150	0.177	320	0.265	319	0.165	321	0.167	320	0.280
Ant 0	FR1 n71	35M BPSK 1 1	136100	Back 5mm	0.325	0.384	320	0.574	319	0.531	321	0.468	320	0.555

Ant.	Open Mode													
	Band	Mode	Channel	Test Position	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Auto-tuner enable		Auto-tuner disabled Verify adjacent tuner				Repeat Auto-tuner enable	
							State	Single Point SAR (W/kg)	State	Single Point SAR (W/kg)	State	Single Point SAR (W/kg)	State	Single Point SAR (W/kg)
Ant 0	LTE Band 12	10M QPSK 1 0	23095	Left Cheek	0.158	0.181	434	0.258	433	0.217	435	0.197	434	0.244
Ant 0	LTE Band 12	10M QPSK 1 0	23095	Front 5mm	0.559	0.639	434	0.912	433	0.765	435	0.698	434	0.923
Ant 0	LTE Band 13	10M QPSK 1 0	23230	Left Cheek	0.210	0.246	432	0.343	431	0.289	433	0.262	432	0.344
Ant 0	LTE Band 13	10M QPSK 1 0	23230	Front 5mm	0.638	0.785	432	1.020	431	0.860	433	0.780	432	1.000
Ant 0	LTE Band 14	10M QPSK 1 0	23330	Left Cheek	0.204	0.234	436	0.333	435	0.281	437	0.255	436	0.355
Ant 0	LTE Band 14	10M QPSK 1 0	23330	Front 5mm	0.638	0.794	436	1.000	435	0.843	437	0.765	436	0.965
Ant 0	LTE Band 26	15M QPSK 1 0	26865	Left Cheek	0.214	0.252	435	0.349	434	0.294	436	0.267	435	0.355
Ant 0	LTE Band 26	15M QPSK 1 0	26865	Front 5mm	0.733	0.778	435	1.100	434	0.922	436	0.842	435	1.010
Ant 0	LTE Band 71	20M QPSK 1 0	133297	Left Cheek	0.145	0.167	315	0.237	314	0.211	316	0.181	315	0.245
Ant 0	LTE Band 71	20M QPSK 1 0	133297	Front 5mm	0.449	0.531	314	0.733	313	0.618	315	0.561	314	0.731
Ant 0	FR1 n12	15M BPSK 1 1	141500	Left Cheek	0.153	0.175	434	0.250	433	0.134	435	0.113	434	0.255
Ant 0	FR1 n12	15M BPSK 1 1	141500	Front 5mm	0.618	0.708	434	1.000	433	0.542	435	0.457	434	1.030
Ant 0	FR1 n13	10M BPSK 1 1	156400	Left Cheek	0.190	0.224	432	0.310	431	0.171	433	0.144	432	0.304
Ant 0	FR1 n13	10M BPSK 1 1	156400	Front 5mm	0.475	0.714	432	0.776	431	0.546	433	0.460	432	0.751
Ant 0	FR1 n14	10M BPSK 1 1	158600	Left Cheek	0.190	0.227	436	0.310	435	0.174	437	0.146	436	0.311
Ant 0	FR1 n14	10M BPSK 1 1	158600	Front 5mm	0.491	0.735	436	0.802	435	0.562	437	0.474	436	0.800
Ant 0	FR1 n26	20M BPSK 1 1	166300	Left Cheek	0.194	0.232	435	0.317	434	0.177	436	0.150	435	0.322
Ant 0	FR1 n26	20M BPSK 1 1	166300	Front 5mm	0.632	0.739	435	0.996	434	0.765	436	0.471	435	0.984
Ant 0	FR1 n71	35M BPSK 1 1	136100	Left Cheek	0.118	0.140	315	0.193	314	0.107	316	0.090	315	0.196
Ant 0	FR1 n71	35M BPSK 1 1	136100	Front 5mm	0.449	0.531	314	0.733	313	0.406	315	0.342	314	0.745