

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	409
	LTE Band 13 / FR1 n13	409
	LTE Band 14 / FR1 n14	409
	LTE Band 26/5 / FR1 n26/5	409
	LTE Band 71 / FR1 n71	409

<Antenna tuner Verification result>

Ant.	RF exposure position														
	Band	Mode	Channel	Setting	Test Position	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Auto-tuner enable_Initial		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	ECI2	Left Cheek	0.254	0.278	405	0.321	404	0.222	406	0.266	405	0.315
Ant 0	LTE Band 12	10M_QPSK_1_0	23095	ECI6	Back	0.634	0.694	405	0.833	404	0.655	406	0.511	405	0.823
Ant 0	LTE Band 13	10M_QPSK_1_0	23230	ECI2	Left Cheek	0.225	0.251	405	0.296	404	0.244	406	0.150	405	0.291
Ant 0	LTE Band 13	10M_QPSK_1_0	23230	ECI6	Back	0.796	0.796	405	0.966	404	0.933	406	0.923	405	0.955
Ant 0	LTE Band 14	10M_QPSK_1_0	23330	ECI2	Left Cheek	0.230	0.257	405	0.302	404	0.281	406	0.251	405	0.295
Ant 0	LTE Band 14	10M_QPSK_25_0	23330	ECI6	Back	0.671	0.709	405	0.866	404	0.713	406	0.801	405	0.855
Ant 0	LTE Band 26	15M_QPSK_1_0	26865	ECI2	Left Cheek	0.344	0.385	405	0.496	404	0.423	406	0.444	405	0.487
Ant 0	LTE Band 26	15M_QPSK_36_0	26865	ECI6	Back	0.642	0.736	405	0.911	404	0.833	406	0.785	405	0.903
Ant 0	LTE Band 71	20M_QPSK_1_0	133297	ECI2	Left Cheek	0.215	0.234	405	0.282	404	0.255	406	0.266	405	0.280
Ant 0	LTE Band 71	20M_QPSK_1_0	133297	ECI6	Left Edge	0.649	0.707	405	0.878	404	0.815	406	0.789	405	0.870
Ant 0	FR1 n12	15M_BPSK_1_1	141500	ECI2	Left Cheek	0.217	0.238	405	0.286	404	0.244	406	0.261	405	0.281
Ant 0	FR1 n12	15M_BPSK_36_22	141500	ECI6	Back	0.710	0.790	405	0.899	404	0.810	406	0.752	405	0.895
Ant 0	FR1 n13	10M_BPSK_25_14	141500	ECI2	Left Cheek	0.295	0.331	405	0.401	404	0.333	406	0.305	405	0.398
Ant 0	FR1 n13	10M_BPSK_25_27	141500	ECI6	Back	0.765	0.794	405	0.922	404	0.855	406	0.811	405	0.918
Ant 0	FR1 n14	10M_BPSK_25_14	158600	ECI2	Left Cheek	0.285	0.325	405	0.433	404	0.371	406	0.388	405	0.428
Ant 0	FR1 n14	10M_BPSK_50_0	158600	ECI6	Back	0.818	0.834	405	0.988	404	0.901	406	0.855	405	0.981
Ant 0	FR1 n26	20M_BPSK_1_1	166300	ECI2	Left Cheek	0.292	0.341	405	0.413	404	0.355	406	0.402	405	0.407
Ant 0	FR1 n26	20M_BPSK_50_0	166300	ECI6	Back	0.740	0.827	405	0.979	404	0.878	406	0.821	405	0.961
Ant 0	FR1 n71	35M_BPSK_90_45	136100	ECI2	Left Cheek	0.218	0.235	405	0.303	404	0.232	406	0.222	405	0.295
Ant 0	FR1 n71	35M_BPSK_90_45	136100	ECI6	Back	0.685	0.739	405	0.910	404	0.844	406	0.799	405	0.906