

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	384
	LTE Band 13	384
	LTE Band 14 / FR1 n14	384
	LTE Band 26/5 / FR1 n26/5	384
	LTE Band 71 / FR1 n71	384

<Antenna tuner Verification result>

Ant.	RF exposure position														
	Band	Mode	Channel	Power State	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	0.222	0.245	121	0.311	120	0.288	122	0.199	121	0.305
Ant 0	LTE Band 12	10M_QPSK_1_0	23095	ECI6	Back	0.583	0.743	121	0.788	120	0.722	122	0.633	121	0.766
Ant 0	LTE Band 13	10M_QPSK_1_0	23230	ECI2	Left Cheek	0.252	0.273	121	0.322	120	0.291	122	0.203	121	0.312
Ant 0	LTE Band 13	10M_QPSK_1_0	23230	ECI6	Back	0.751	0.776	121	0.988	120	0.923	122	0.711	121	0.972
Ant 0	LTE Band 14	10M_QPSK_1_0	23330	ECI2	Left Cheek	0.260	0.284	196	0.365	195	0.301	197	0.277	196	0.351
Ant 0	LTE Band 14	10M_QPSK_25_0	23330	ECI6	Back	0.745	0.785	196	0.851	195	0.791	197	0.822	196	0.846
Ant 0	LTE Band 26	15M_QPSK_1_0	26865	ECI2	Left Cheek	0.256	0.285	5	0.348	4	0.311	6	0.288	5	0.321
Ant 0	LTE Band 26	15M_QPSK_1_0	26865	ECI6	Back	0.742	0.781	5	0.822	4	0.666	6	0.531	5	0.813
Ant 0	LTE Band 71	20M_QPSK_1_0	133297	ECI2	Left Cheek	0.223	0.240	121	0.329	120	0.301	122	0.277	121	0.318
Ant 0	LTE Band 71	20M_QPSK_1_0	133297	ECI6	Back	0.762	0.766	121	0.856	120	0.811	122	0.689	121	0.843
Ant 0	FR1 n12	15M_BPSK_36_22	141500	ECI2	Left Cheek	0.197	0.207	121	0.298	120	0.281	122	0.255	121	0.291
Ant 0	FR1 n12	15M_BPSK_1_77	141500	ECI6	Back	0.637	0.784	121	0.788	120	0.711	122	0.655	121	0.756
Ant 0	FR1 n14	10M_BPSK_25_14	158600	ECI2	Left Cheek	0.222	0.237	196	0.303	195	0.289	197	0.266	196	0.299
Ant 0	FR1 n14	10M_BPSK_1_1	158600	ECI6	Back	0.685	0.743	196	0.822	195	0.755	197	0.712	196	0.813
Ant 0	FR1 n26	20M_QPSK_1_104	166300	ECI2	Left Cheek	0.219	0.258	5	0.333	4	0.322	6	0.288	5	0.329
Ant 0	FR1 n26	20M_QPSK_50_56	166300	ECI6	Back	0.733	0.764	5	0.819	4	0.805	6	0.755	5	0.810
Ant 0	FR1 n71	35M_BPSK_1_186	136100	ECI2	Left Cheek	0.167	0.225	121	0.266	120	0.244	122	0.211	121	0.235
Ant 0	FR1 n71	35M_BPSK_90_45	136100	ECI6	Back	0.693	0.716	121	0.793	120	0.613	122	0.656	121	0.782