

APPENDIX G POWER REDUCTION VERIFICATION

Per the May 2017 TCBC Workshop Notes, demonstration of proper functioning of the power reduction mechanisms is required to support the corresponding SAR configurations. The verification process was divided into two parts: (1) evaluation of output power levels for individual or multiple triggering mechanisms and (2) evaluation of the triggering distances for proximity-based sensors.

G.1 Power Verification Procedure

The power verification was performed according to the following procedure:

1. A base station simulator was used to establish a conducted RF connection and the output power was monitored. The power measurements were confirmed to be within expected tolerances for all states before and after a power reduction mechanism was triggered.
2. Step 1 was repeated for all relevant modes and frequency bands for the mechanism being investigated.
3. Steps 1 and 2 were repeated for all individual power reduction mechanisms and combinations thereof. For the combination cases, one mechanism was switched to a 'triggered' state at a time; powers were confirmed to be within tolerances after each additional mechanism was activated.

G.2 Distance Verification Procedure

The distance verification procedure was performed according to the following procedure:

1. A base station simulator was used to establish an RF connection and to monitor the power levels. The device being tested was placed below the relevant section of the phantom with the relevant side or edge of the device facing toward the phantom.
2. The device was moved toward and away from the phantom to determine the distance at which the mechanism triggers and the output power is reduced, per KDB Publication 616217 D04v01r02 and FCC Guidance. Each applicable test position was evaluated. The distances were confirmed to be the same or larger (more conservative) than the minimum distances provided by the manufacturer.
3. Steps 1 and 2 were repeated for low, mid, and high bands, as appropriate (see note below Table G-2 for more details).
4. Steps 1 through 3 were repeated for all distance-based power reduction mechanisms.

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G.3 Main Antenna Verification Summary

Table G-1
Power Measurement Verification for Main Antenna

Mechanism(s)		Mode/Band	Conducted Power (dBm)		
1st	2nd		Un-triggered (Max)	Mechanism #1 (Reduced)	Mechanism #2 (Reduced)
Hotspot On		GPRS 1900	25.6	22.59	
Grip		GPRS 1900	25.59	22.58	
Hotspot On	Grip	GPRS 1900	25.6	22.6	22.61
Grip	Hotspot On	GPRS 1900	25.61	22.6	22.59
Hotspot On		UMTS 1750	24.35	21.37	
Grip		UMTS 1750	24.32	21.31	
Hotspot On	Grip	UMTS 1750	24.3	21.38	21.4
Grip	Hotspot On	UMTS 1750	24.28	21.32	21.33
Hotspot On		UMTS 1900	24.62	21.66	
Grip		UMTS 1900	24.6	21.64	
Hotspot On	Grip	UMTS 1900	24.62	21.65	21.66
Grip	Hotspot On	UMTS 1900	24.6	21.65	21.67
Hotspot On		PCS EVDO	24.13	21.02	
Grip		PCS EVDO	24.1	21	
Hotspot On	Grip	PCS EVDO	24.09	21.03	20.96
Grip	Hotspot On	PCS EVDO	24.07	20.99	21.01
Hotspot On		LTE FDD Band 66	24.45	21.26	
Grip		LTE FDD Band 66	24.48	21.27	
Hotspot On	Grip	LTE FDD Band 66	24.43	21.23	21.3
Grip	Hotspot On	LTE FDD Band 66	24.42	21.22	21.2
Hotspot On		LTE FDD Band 4	24.69	21.48	
Grip		LTE FDD Band 4	24.66	21.45	
Hotspot On	Grip	LTE FDD Band 4	24.62	21.49	21.5
Grip	Hotspot On	LTE FDD Band 4	24.63	21.55	21.47
Hotspot On		LTE FDD Band 25	24.59	21.52	
Grip		LTE FDD Band 25	24.6	21.53	
Hotspot On	Grip	LTE FDD Band 25	24.56	21.54	21.56
Grip	Hotspot On	LTE FDD Band 25	24.59	21.53	21.52
Hotspot On		LTE FDD Band 2	24.53	21.5	
Grip		LTE FDD Band 2	24.54	21.51	
Hotspot On	Grip	LTE FDD Band 2	24.57	21.5	21.52
Grip	Hotspot On	LTE FDD Band 2	24.55	21.52	21.44
Hotspot On		LTE FDD Band 7	22.32	20.1	
Hotspot On		LTE TDD Band 41 (PC2)	27.31	24.16	

Table G-2
Distance Measurement Verification for Main Antenna

Mechanism(s)	Test Condition	Band	Distance Measurements (mm)		Minimum Distance per Manufacturer (mm)
			Moving Toward	Moving Away	
Grip	Phablet - Back Side	Mid	16	18	10
Grip	Phablet - Bottom Edge	Mid	7	9	3

*Note: Mid band refers to: CDMA BC1, GSM1900, UMTS B2/4, LTE B2/4/25/66

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G.4 WIFI Verification Summary

Table G-3
Power Measurement Verification WIFI

Mechanism(s)	Mode/Band	Conducted Power (dBm)	
1st		Un-triggered (Max)	Mechanism #1 (Reduced)
Held-to-Ear	802.11b	20.99	11.92
Held-to-Ear	802.11g	18.98	11.93
Held-to-Ear	802.11n (2.4GHz)	18.85	11.77
Held-to-Ear	802.11a	17.76	10.97
Held-to-Ear	802.11n (5GHz, 20MHz BW)	17.00	11.15
Held-to-Ear	802.11ac (20MHz BW)	17.06	11.15
Held-to-Ear	802.11n (5GHz, 40MHz BW)	15.05	11.03
Held-to-Ear	802.11ac (40MHz BW)	15.13	11.15
Held-to-Ear	802.11ac (80MHz BW)	13.70	10.29

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1.2 LTE Downlink Only Carrier Aggregation Test Selection and Setup

SAR test exclusion for LTE downlink Carrier Aggregation is determined by power measurements according to the number component carriers (CCs) supported by the product implementation. For those configurations required by April 2018 TCBC Workshop Notes, conducted power measurements with LTE Carrier Aggregation (CA) (downlink only) active are made in accordance to KDB Publication 941225 D05Av01r02. The RRC connection is only handled by one cell, the primary component carrier (PCC) for downlink and uplink communications. After making a data connection to the PCC, the UE device adds secondary component carrier(s) (SCC) on the downlink only. All uplink communications and acknowledgements remain identical to specifications when downlink carrier aggregation is inactive on the PCC. Additional conducted output powers are measured with the downlink carrier aggregation active for the configuration with highest measured maximum conducted power with downlink carrier aggregation inactive measured among the channel bandwidth, modulation, and RB combinations in each frequency band.

Per FCC KDB Publication 941225 D05Av01r02, no SAR measurements are required for carrier aggregation configurations when the maximum average output power with downlink only carrier aggregation active is not more than 0.25 dB higher than the average output power with downlink only carrier aggregation inactive. All bands required for SAR testing per FCC KDB procedures were considered. Based on the measured maximum powers below, no additional SAR tests were required for DLCA SAR configurations.

General PCC and SCC configuration selection procedure

- PCC uplink channel, channel bandwidth, modulation and RB configurations were selected based on section C)3)b)ii) of KDB 941225 D05 V01r02. The downlink PCC channel was paired with the selected PCC uplink channel according to normal configurations without carrier aggregation.
- To maximize aggregated bandwidth, highest channel bandwidth available for that CA combination was selected for SCC. For inter-band CA, the SCC downlink channels were selected near the middle of their transmission bands. For contiguous intra-band CA, the downlink channel spacing between the component carriers was set to multiple of 300 kHz less than the nominal channel spacing defined in section 5.4.1A of 3GPP TS 36.521. For non-contiguous intra-band CA, the downlink channel spacing between the component carriers was set to be larger than the nominal channel spacing and provided maximum separation between the component carriers.
- All selected PCC and SCC(s) remained fully within the uplink/downlink transmission band of the respective component carrier.

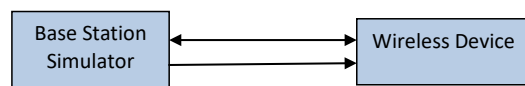


Figure 1
DL CA Power Measurement Setup

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1.3 Downlink Carrier Aggregation RF Conducted Powers

1.3.1 LTE Band 71 as PCC

Table 1
Maximum Output Powers

Combination	PCC									SCC 1				Power	
	PCC Band	PCC BW [MHz]	PCC (UL) Ch.	PCC (UL) Freq. [MHz]	Mod.	PCC UL# RB	PCC UL RB Offset	PCC (DL) Channel	PCC (DL) Freq. [MHz]	SCC Band	SCC BW [MHz]	SCC (DL) Channel	SCC (DL) Freq. [MHz]	LTE Tx Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA 2A-71A	LTE B71	15	133297	680.5	QPSK	1	0	68761	634.5	LTE B2	20	900	1960	25.12	25.14
CA 4A-71A	LTE B71	15	133297	680.5	QPSK	1	0	68761	634.5	LTE B4	20	2175	2132.5	25.12	25.14
CA 66A-71A	LTE B71	15	133297	680.5	QPSK	1	0	68761	634.5	LTE B66	20	66786	2145	25.15	25.14

1.3.2 LTE Band 12 as PCC

Table 2
Maximum Output Powers

Combination	PCC									SCC 1				Power	
	PCC Band	PCC BW [MHz]	PCC (UL) Ch.	PCC (UL) Freq. [MHz]	Mod.	PCC UL# RB	PCC UL RB Offset	PCC (DL) Channel	PCC (DL) Freq. [MHz]	SCC Band	SCC BW [MHz]	SCC (DL) Channel	SCC (DL) Freq. [MHz]	LTE Tx Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA 2A-12A (1)	LTE B12	5	23095	707.5	QPSK	1	12	5095	737.5	LTE B2	20	900	1960	24.78	24.84
CA 4A-12A (1)	LTE B12	5	23095	707.5	QPSK	1	12	5095	737.5	LTE B4	20	2175	2132.5	24.67	24.84
CA 4A-12A (2)	LTE B12	5	23095	707.5	QPSK	1	12	5095	737.5	LTE B4	20	2175	2132.5	24.67	24.84
CA 12A-66A (1)	LTE B12	5	23095	707.5	QPSK	1	12	5095	737.5	LTE B66	20	66786	2145	24.68	24.84
CA 12A-66A (2)	LTE B12	5	23095	707.5	QPSK	1	12	5095	737.5	LTE B66	20	66786	2145	24.68	24.84
CA 7A-12A	LTE B12	5	23095	707.5	QPSK	1	12	5095	737.5	LTE B7	20	3100	2655	24.67	24.84

1.3.3 LTE Band 13 as PCC

Table 3
Maximum Output Powers

Combination	PCC									SCC 1				Power	
	PCC Band	PCC BW [MHz]	PCC (UL) Ch.	PCC (UL) Freq. [MHz]	Mod.	PCC UL# RB	PCC UL RB Offset	PCC (DL) Channel	PCC (DL) Freq. [MHz]	SCC Band	SCC BW [MHz]	SCC (DL) Channel	SCC (DL) Freq. [MHz]	LTE Tx Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA 2A-13A	LTE B13	10	23230	782	QPSK	1	25	5230	751	LTE B2	20	900	1960	24.51	24.57
CA 4A-13A	LTE B13	10	23230	782	QPSK	1	25	5230	751	LTE B4	20	2175	2132.5	24.53	24.57
CA 13A-66A	LTE B13	5	23230	782	QPSK	1	24	5230	751	LTE B66	20	66786	2145	24.61	24.71

1.3.4 LTE Band 26 as PCC

Table 4
Maximum Output Powers

Combination	PCC									SCC 1				Power	
	PCC Band	PCC BW [MHz]	PCC (UL) Ch.	PCC (UL) Freq. [MHz]	Mod.	PCC UL# RB	PCC UL RB Offset	PCC (DL) Channel	PCC (DL) Freq. [MHz]	SCC Band	SCC BW [MHz]	SCC (DL) Channel	SCC (DL) Freq. [MHz]	LTE Tx Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA 25A-26A	LTE B26	10	26740	819	QPSK	1	25	8740	864	LTE B25	20	8365	1962.5	24.82	24.99
CA 26A-41A	LTE B26	10	26740	819	QPSK	1	25	8740	864	LTE B41	20	40620	2593	24.93	24.99

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1.3.5 LTE Band 66 as PCC

Table 5
Maximum Output Powers

Combination	PCC									SCC 1				Power	
	PCC Band	PCC BW [MHz]	PCC (UL) Ch.	PCC (UL) Freq. [MHz]	Mod.	PCC UL# RB	PCC UL RB Offset	PCC (DL) Channel	PCC (DL) Freq. [MHz]	SCC Band	SCC BW [MHz]	SCC (DL) Channel	SCC (DL) Freq. [MHz]	LTE Tx.Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA 66A-66A	LTE B66	10	132322	1745	QPSK	1	0	66786	2145	LTE B66	20	67236	2190	24.57	24.74
CA 66B	LTE B66	10	132322	1745	QPSK	1	0	66786	2145	LTE B66	10	66687	2135.1	24.62	24.74
CA 66C	LTE B66	10	132322	1745	QPSK	1	0	66786	2145	LTE B66	20	66642	2130.6	24.64	24.74
CA 2A-66A	LTE B66	10	132322	1745	QPSK	1	0	66786	2145	LTE B2	20	900	1960	24.65	24.74
CA 5A-66A	LTE B66	10	132322	1745	QPSK	1	0	66786	2145	LTE B5	10	2525	881.5	24.63	24.74
CA 12A-66A (1)	LTE B66	10	132322	1745	QPSK	1	0	66786	2145	LTE B12	10	5095	737.5	24.69	24.74
CA 12A-66A (2)	LTE B66	10	132322	1745	QPSK	1	0	66786	2145	LTE B12	10	5095	737.5	24.64	24.74
CA 13A-66A	LTE B66	10	132322	1745	QPSK	1	0	66786	2145	LTE B13	10	5230	751	24.62	24.74
CA 66A-71A	LTE B66	10	132322	1745	QPSK	1	0	66786	2145	LTE B71	20	68761	634.5	24.65	24.74
CA 7A-66A	LTE B66	10	132322	1745	QPSK	1	0	66786	2145	LTE B7	20	3100	2655	24.76	24.74

1.3.6 LTE Band 25 as PCC

Table 6
Maximum Output Powers

Combination	PCC									SCC 1				Power	
	PCC Band	PCC BW [MHz]	PCC (UL) Ch.	PCC (UL) Freq. [MHz]	Mod.	PCC UL# RB	PCC UL RB Offset	PCC (DL) Channel	PCC (DL) Freq. [MHz]	SCC Band	SCC BW [MHz]	SCC (DL) Channel	SCC (DL) Freq. [MHz]	LTE Tx.Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA 25A-25A (1)	LTE B25	15	26115	1857.5	QPSK	1	36	8115	1937.5	LTE B25	20	8590	1985	24.64	24.65
CA 25A-26A	LTE B25	15	26115	1857.5	QPSK	1	36	8115	1937.5	LTE B26	15	8865	876.5	24.64	24.65
CA 25A-41A	LTE B25	15	26115	1857.5	QPSK	1	36	8115	1937.5	LTE B41	20	40620	2593	24.69	24.65

1.3.7 LTE Band 7 as PCC

Table 7
Maximum Output Powers

Combination	PCC									SCC 1				Power	
	PCC Band	PCC BW [MHz]	PCC (UL) Ch.	PCC (UL) Freq. [MHz]	Mod.	PCC UL# RB	PCC UL RB Offset	PCC (DL) Channel	PCC (DL) Freq. [MHz]	SCC Band	SCC BW [MHz]	SCC (DL) Channel	SCC (DL) Freq. [MHz]	LTE Tx.Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA 2A-7A	LTE B7	20	21100	2535	QPSK	1	0	3100	2655	LTE B2	20	900	1960	22.36	22.43
CA 4A-7A (1)	LTE B7	20	21100	2535	QPSK	1	0	3100	2655	LTE B4	20	2175	2132.5	22.39	22.43
CA 5A-7A	LTE B7	20	21100	2535	QPSK	1	0	3100	2655	LTE B5	10	2525	881.5	22.37	22.43
CA 7A-7A (1)	LTE B7	20	21100	2535	QPSK	1	0	3100	2655	LTE B7	20	2850	2630	22.51	22.43
CA 7A-12A	LTE B7	20	21100	2535	QPSK	1	0	3100	2655	LTE B12	10	5095	737.5	22.48	22.43
CA 7A-66A	LTE B7	20	21100	2535	QPSK	1	0	3100	2655	LTE B66	20	66786	2145	22.51	22.43

1.3.8 LTE Band 41 as PCC

Table 8
Maximum Output Powers

Combination	PCC									SCC 1				Power	
	PCC Band	PCC BW [MHz]	PCC (UL) Ch.	PCC (UL) Freq. [MHz]	Mod.	PCC UL# RB	PCC UL RB Offset	PCC (DL) Channel	PCC (DL) Freq. [MHz]	SCC Band	SCC BW [MHz]	SCC (DL) Channel	SCC (DL) Freq. [MHz]	LTE Tx.Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA 41C (1)	LTE B41	20	40185	2549.5	QPSK	1	0	40185	2549.5	LTE B41	20	40383	2569.3	24.53	24.50
CA 41A-41A	LTE B41	20	40185	2549.5	QPSK	1	0	40185	2549.5	LTE B41	20	41490	2680	24.49	24.50

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1.3.9 LTE Band 41 PC2 as PCC

Table 9
Maximum Output Powers

Combination	PCC									SCC 1				Power	
	PCC Band	PCC BW [MHz]	PCC (UL) Ch.	PCC (UL) Freq. [MHz]	Mod.	PCC UL# RB	PCC UL RB Offset	PCC (DL) Channel	PCC (DL) Freq. [MHz]	SCC Band	SCC BW [MHz]	SCC (DL) Channel	SCC (DL) Freq. [MHz]	LTE Tx Power with DL CA Enabled (dbm)	LTE Single Carrier Tx Power (dbm)
CA 41C (1)	LTE B41 PC2	20	40185	2549.5	QPSK	1	0	40185	2549.5	LTE B41 PC2	20	40383	2569.3	27.73	27.66
CA 41A-41A	LTE B41 PC2	20	40185	2549.5	QPSK	1	0	40185	2549.5	LTE B41 PC2	20	41540	2680	27.61	27.66

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