

# APPENDIX I: LTE DOWNLINK ONLY CARRIER AGGREGATION TEST REDUCTION METHODOLOGY

SAR test exclusion for LTE downlink Carrier Aggregation is determined by power measurements according to the number of component carriers (CCs) supported by the product implementation. Per April 2018 TCBC Workshop Notes, the following test reduction methodology was applied to determine the combinations required for conducted power measurements.

## LTE DLCA Test Reduction Methodology:

- The supported combinations were arranged by the number of component carriers in columns.
- Any limitations on the PCC or SCC for each combination were identified alongside the combination (e.g. CA\_2A-2A-4A-12A, but B12 can only be configured as a SCC).
- Power measurements were performed for "supersets" (LTE CA combinations with multiple components carriers) and any "subsets" (LTE CA combinations with fewer component carriers) that were not completely covered by the supersets.
- Only subsets that have the exact same components as a superset were excluded for measurement.
- When there were certain restrictions on component carriers that existed in the superset that were not applied for the subset, the subset configuration was additionally evaluated.
- Both inter-band and intra-band downlink carrier aggregation scenarios were considered.



**Table I-1 – Example of Exclusion Table for SISO Configurations**

Index	PCC	Supported Carrier Bandwidth (MHz)					Restrictions	Completely Covered by Measurement Superset	Index	PCC	Supported Carrier Bandwidth (MHz)					Restrictions	Completely Covered by Measurement Superset	Index	PCC	Supported Carrier Bandwidth (MHz)					Restrictions	Completely Covered by Measurement Superset				
		CC1	CC2	CC3	CC4	CC5					CC1	CC2	CC3	CC4	CC5					CC1	CC2	CC3	CC4	CC5						
001-010	CA_2A	5, 10, 15, 20	5, 10, 15, 20				001-010	001-010	CA_2A	5, 10, 15, 20	5, 10, 15, 20				001-010	CA_2A	5, 10, 15, 20	5, 10, 15, 20					001-010	CA_2A	5, 10, 15, 20	5, 10, 15, 20				
011-020	CA_2A-2A	5, 10, 15, 20	5, 10, 15, 20				011-020	011-020	CA_2A-2A	5, 10, 15, 20	5, 10, 15, 20				011-020	CA_2A-2A	5, 10, 15, 20	5, 10, 15, 20					011-020	CA_2A-2A	5, 10, 15, 20	5, 10, 15, 20				
021-030	CA_2A-2A-2A	5, 10, 15, 20	5, 10, 15, 20				021-030	021-030	CA_2A-2A-2A	5, 10, 15, 20	5, 10, 15, 20				021-030	CA_2A-2A-2A	5, 10, 15, 20	5, 10, 15, 20					021-030	CA_2A-2A-2A	5, 10, 15, 20	5, 10, 15, 20				
031-040	CA_2A-2A-4A	5, 10, 15, 20	5, 10, 15, 20				031-040	031-040	CA_2A-2A-4A	5, 10, 15, 20	5, 10, 15, 20				031-040	CA_2A-2A-4A	5, 10, 15, 20	5, 10, 15, 20					031-040	CA_2A-2A-4A	5, 10, 15, 20	5, 10, 15, 20				
041-050	CA_2A-2A-4A-12A	5, 10, 15, 20	5, 10, 15, 20				041-050	041-050	CA_2A-2A-4A-12A	5, 10, 15, 20	5, 10, 15, 20				041-050	CA_2A-2A-4A-12A	5, 10, 15, 20	5, 10, 15, 20					041-050	CA_2A-2A-4A-12A	5, 10, 15, 20	5, 10, 15, 20				

## I.1 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.

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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. All LTE bandwidth conducted powers needed for PCC uplink configuration selection can be found in Section 9.3 and appendix H. 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.

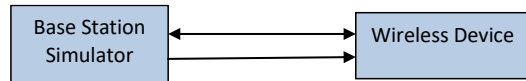


Figure I-1  
DL CA Power Measurement Setup

I.2 Downlink Carrier Aggregation RF Conducted Powers

I.2.1 LTE Band 71 as PCC

Table I-2  
Maximum Output Powers

Combination	PCC Band	PCC BW [MHz]	PCC (UL) Ch.	PCC (UL) Freq. [MHz]	Mod.	PCC				SCC 1				Power	
						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	20	133297	680.5	QPSK	1	0	68761	634.5	LTE B2	20	900	1960	24.23	24.37
CA_4A-71A	LTE B71	20	133297	680.5	QPSK	1	0	68761	634.5	LTE B4	20	2175	2132.5	24.21	24.37
CA_66A-71A	LTE B71	20	133297	680.5	QPSK	1	0	68761	634.5	LTE B66	20	66786	2145	24.19	24.37

I.2.2 LTE Band 12 as PCC

Table I-3  
Maximum Output Powers

Combination	PCC Band	PCC BW [MHz]	PCC (UL) Ch.	PCC (UL) Freq. [MHz]	Mod.	PCC				SCC 1				Power	
						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	10	23095	707.5	QPSK	1	0	5095	737.5	LTE B2	20	900	1960	24.60	24.45
CA_4A-12A (1)	LTE B12	10	23095	707.5	QPSK	1	0	5095	737.5	LTE B4	20	2175	2132.5	24.58	24.45
CA_4A-12A (2)	LTE B12	10	23095	707.5	QPSK	1	0	5095	737.5	LTE B4	20	2175	2132.5	24.58	24.45
CA_7A-12A	LTE B12	10	23095	707.5	QPSK	1	0	5095	737.5	LTE B7	20	3100	2655	24.61	24.45
CA_12A-30A	LTE B12	10	23095	707.5	QPSK	1	0	5095	737.5	LTE B30	10	9820	2355	24.57	24.45
CA_12A-66A (1)	LTE B12	10	23095	707.5	QPSK	1	0	5095	737.5	LTE B66	20	66786	2145	24.59	24.45
CA_12A-66A (2)	LTE B12	10	23095	707.5	QPSK	1	0	5095	737.5	LTE B66	20	66786	2145	24.59	24.45
CA_12B	LTE B12	5	23035	701.5	QPSK	1	12	5035	731.5	LTE B12	5	5083	736.3	24.39	24.22

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### I.2.3 LTE Band 13 as PCC

**Table I-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_2A-13A	LTE B13	10	23230	782	QPSK	1	25	5230	751	LTE B2	20	900	1960	24.12	24.15
CA_4A-13A	LTE B13	10	23230	782	QPSK	1	25	5230	751	LTE B4	20	2175	2132.5	24.10	24.15
CA_13A-66A	LTE B13	10	23230	782	QPSK	1	25	5230	751	LTE B66	20	66786	2145	24.17	24.15

### I.2.4 LTE Band 26 as PCC

**Table I-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_26A-41A	LTE B26	15	26865	831.5	QPSK	1	0	8865	876.5	LTE B41	20	40620	2593	24.31	24.28
CA_25A-26A	LTE B26	1.4	27033	848.3	QPSK	1	0	9033	893.3	LTE B25	20	8365	1962.5	24.44	24.38

### I.2.5 LTE Band 66 as PCC

**Table I-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_2A-66A	LTE B66	15	132047	1717.5	QPSK	1	0	66511	2117.5	LTE B2	20	900	1960	24.53	24.57
CA_5A-66A	LTE B66	15	132047	1717.5	QPSK	1	0	66511	2117.5	LTE B5	10	2525	881.5	24.43	24.57
CA_7A-66A	LTE B66	15	132047	1717.5	QPSK	1	0	66511	2117.5	LTE B7	20	3100	2655	24.40	24.57
CA_12A-66A (1)	LTE B66	1.4	131979	1710.7	QPSK	1	0	66443	2110.7	LTE B12	10	5095	737.5	24.42	24.59
CA_12A-66A (2)	LTE B66	15	132047	1717.5	QPSK	1	0	66511	2117.5	LTE B12	10	5095	737.5	24.54	24.57
CA_13A-66A	LTE B66	15	132047	1717.5	QPSK	1	0	66511	2117.5	LTE B13	10	5230	751	24.58	24.57
CA_66A-66A	LTE B66	15	132047	1717.5	QPSK	1	0	66511	2117.5	LTE B66	20	67236	2190	24.55	24.57
CA_66A-71A	LTE B66	15	132047	1717.5	QPSK	1	0	66511	2117.5	LTE B71	20	68761	634.5	24.35	24.57
CA_66B	LTE B66	15	132047	1717.5	QPSK	1	0	66511	2117.5	LTE B66	5	66604	2126.8	24.37	24.57
CA_66C	LTE B66	15	132047	1717.5	QPSK	1	0	66511	2117.5	LTE B66	20	66682	2134.6	24.42	24.57

### I.2.6 LTE Band 25 as PCC



**Table I-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_25A-25A (1)	LTE B25	10	26365	1882.5	QPSK	1	25	8365	1962.5	LTE B25	20	8140	1940	24.48	24.40
CA_25A-41A	LTE B25	10	26365	1882.5	QPSK	1	25	8365	1962.5	LTE B41	20	40620	2593	24.50	24.40
CA_25A-26A	LTE B25	10	26365	1882.5	QPSK	1	25	8365	1962.5	LTE B26	15	8865	876.5	24.36	24.40

### I.2.7 LTE Band 30 as PCC

**Table I-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_2A-30A	LTE B30	5	27710	2310	QPSK	1	0	9820	2355	LTE B2	20	900	1960	21.77	21.79
CA_5A-30A	LTE B30	5	27710	2310	QPSK	1	0	9820	2355	LTE B5	10	2525	881.5	21.79	21.79
CA_12A-30A	LTE B30	5	27710	2310	QPSK	1	0	9820	2355	LTE B12	10	5095	737.5	21.83	21.79
CA_29A-30A	LTE B30	5	27710	2310	QPSK	1	0	9820	2355	LTE B29	10	9715	722.5	21.78	21.79

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## I.2.8 LTE Band 7 as PCC



**Table I-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_2A-7A	LTE B7	20	21100	2535	QPSK	1	0	3100	2655	LTE B2	20	900	1960	23.73	23.83
CA_4A-7A (1)	LTE B7	20	21100	2535	QPSK	1	0	3100	2655	LTE B4	20	2175	2132.5	23.71	23.83
CA_5A-7A	LTE B7	20	21100	2535	QPSK	1	0	3100	2655	LTE B5	10	2525	881.5	23.77	23.83
CA_7A-7A (1)	LTE B7	20	21100	2535	QPSK	1	0	3100	2655	LTE B7	20	2850	2630	23.74	23.83
CA_7A-12A	LTE B7	20	21100	2535	QPSK	1	0	3100	2655	LTE B12	10	5095	737.5	23.79	23.83
CA_7A-66A	LTE B7	20	21100	2535	QPSK	1	0	3100	2655	LTE B66	20	66786	2145	23.76	23.83

## I.2.9 LTE Band 41 PC3 as PCC

**Table I-10**  
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_41A-41A (1)	LTE B41	20	39750	2506	QPSK	1	99	39750	2506	LTE B41	20	41490	2680	23.81	23.81
CA_41C (1)	LTE B41	20	39750	2506	QPSK	1	99	39750	2506	LTE B41	20	39948	2525.8	23.84	23.81

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