

LTE Downlink Carrier Aggregation configurations

1. DL Inter Band(2CC)

E-UTRA CA configuration	Bandwidth Combination Set	E-UTRA Band	Bandwidth					Max Aggregated BW	
			1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz		20 MHz
2A-4A	(0)	Band 2	Yes	Yes	Yes	Yes	Yes	Yes	40
		Band 4			Yes	Yes	Yes	Yes	
	(1)	Band 2			Yes	Yes	Yes	Yes	20
		Band 4			Yes	Yes			
(2)	Band 2			Yes	Yes	Yes	Yes	40	
	Band 4			Yes	Yes	Yes	Yes		
2A-5A	(0)	Band 2			Yes	Yes	Yes	Yes	30
		Band 5			Yes	Yes			
2A-12A	(0)	Band 2			Yes	Yes	Yes	Yes	30
		Band 12			Yes	Yes			
	(1)	Band 2			Yes	Yes	Yes	Yes	30
		Band 12		Yes	Yes	Yes			
(2)	Band 2			Yes	Yes			20	
	Band 12			Yes	Yes				
2A-13A	(0)	Band 2			Yes	Yes	Yes	Yes	30
		Band 13			Yes				
	(1)	Band 2			Yes	Yes			20
		Band 13			Yes				
(2)	Band 2			Yes	Yes	Yes	Yes	20	
	Band 13			Yes	Yes				
2A-17A	(0)	Band 2			Yes	Yes			20
		Band 17			Yes	Yes			
2A-26A	(0)	Band 2			Yes	Yes	Yes	Yes	35
		Band 26			Yes	Yes	Yes	Yes	
2A-66A	(0)	Band 2	Yes	Yes	Yes	Yes	Yes	Yes	40
		Band 66			Yes	Yes	Yes	Yes	
	(1)	Band 2			Yes	Yes			20
		Band 66			Yes	Yes			
(2)	Band 2			Yes	Yes	Yes	Yes	40	
	Band 66			Yes	Yes	Yes	Yes		
4A-5A	(0)	Band 4			Yes	Yes			20
		Band 5			Yes	Yes			
(1)	Band 4			Yes	Yes	Yes	Yes	30	
	Band 5			Yes	Yes				
4A-12A	(0)	Band 4	Yes	Yes	Yes	Yes			20
		Band 12			Yes	Yes			
	(1)	Band 4	Yes	Yes	Yes	Yes	Yes	Yes	30
		Band 12			Yes	Yes			
	(2)	Band 4		Yes	Yes	Yes	Yes	Yes	30
		Band 12		Yes	Yes				
	(3)	Band 4			Yes	Yes			20
		Band 12			Yes	Yes			
(4)	Band 4			Yes	Yes	Yes	Yes	30	
	Band 12			Yes	Yes				
(5)	Band 4			Yes	Yes	Yes		20	
	Band 12			Yes	Yes				
4A-13A	(0)	Band 4			Yes	Yes	Yes	Yes	30
		Band 13			Yes				
	(1)	Band 4			Yes	Yes			20
Band 13				Yes					
4A-17A	(0)	Band 4			Yes	Yes			20
		Band 17			Yes	Yes			
5A-41A	(0)	Band 5			Yes	Yes			30
		Band 41						Yes	
5A-66A	(0)	Band 5			Yes	Yes			30
		Band 66			Yes	Yes	Yes	Yes	
12A-25A	(0)	Band 12			Yes	Yes			30
		Band 25			Yes	Yes	Yes	Yes	

2. DL Inter Band(3CC)

E-UTRA CA configuration	Bandwidth Combination Set	E-UTRA Band	Bandwidth					Max Aggregated BW	
			1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz		20 MHz
2A-4A-5A	(0)	Band 2			Yes	Yes	Yes	Yes	50
		Band 4			Yes	Yes	Yes	Yes	
		Band 5			Yes	Yes			
2A-4A-13A	(0)	Band 2			Yes	Yes	Yes	Yes	50
		Band 4			Yes	Yes	Yes	Yes	
		Band 13			Yes	Yes			
2A-5A-66A	(0)	Band 2			Yes	Yes	Yes	Yes	50
		Band 5			Yes	Yes			
		Band 66			Yes	Yes	Yes	Yes	
2A-66A-66A	(0)	Band 2			Yes	Yes	Yes	60	
Band 66			66A-66A BCS 0						
4A-4A-5A	(0)	Band 4			4A-4A BCS 0				50
		Band 5			Yes	Yes			
4A-4A-12A	(0)	Band 4			4A-4A BCS 0				50
		Band 12			Yes	Yes			
5A-66A-66A	(0)	Band 5			Yes	Yes			50
		Band 66			66A-66A BCS 0				
12A-66A-66A	(0)	Band 12			Yes	Yes			50
		Band 66			66A-66A BCS 0				
26A-41C	(0)	Band 26			Yes	Yes			55
		Band 41			41C BCS 1				

3. DL Intra Band(non-contiguous)

E-UTRA CA configuration	Bandwidth Combination Set	E-UTRA Band	Allowed Channel BW Per Carrier (MHz)				Max Aggregated BW
			1st Carrier	2nd Carrier	3rd Carrier	4th Carrier	
2A-2A	(0)	Band 2	5, 10, 15, 20	5, 10, 15, 20			40
		Band 4	5, 10, 15, 20	5, 10, 15, 20			40
4A-4A	(1)	Band 4	5, 10	5, 10			20
		Band 41	10, 15, 20	10, 15, 20			40
41A-41A	(1)	Band 41	5, 10, 15, 20	5, 10, 15, 20			40
		Band 41	5, 10, 15, 20	41C BCS 1			60
41A-41C	(0)	Band 41	5, 10, 15, 20	41C BCS 1			80
		Band 41	41C BCS 0	5, 10, 15, 20			80
41C-41C	(0)	Band 41	41C BCS 0	41C BCS 0			100
		Band 41	41D BCS 0	5, 10, 15, 20			40
66A-66A	(0)	Band 66	5, 10, 15, 20	5, 10, 15, 20			40

LTE Downlink Carrier Aggregation configurations (Continued)

1. DL Inter Band(2CC)

E-UTRA CA configuration	Bandwidth Combination Set	E-UTRA Band	Bandwidth						Max Aggregated BW
			1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
12A-66A	(0)	Band 12			Yes	Yes			20
		Band 66	Yes	Yes	Yes	Yes			
	(1)	Band 12			Yes	Yes			30
		Band 66	Yes	Yes	Yes	Yes	Yes	Yes	
	(2)	Band 12		Yes	Yes	Yes	Yes		30
		Band 66			Yes	Yes	Yes	Yes	
	(3)	Band 12			Yes	Yes			20
		Band 66			Yes	Yes			
	(4)	Band 12			Yes	Yes			30
		Band 66			Yes	Yes	Yes	Yes	
(5)	Band 12			Yes				20	
	Band 66			Yes	Yes	Yes			
26A-41A	(0)	Band 26			Yes	Yes	Yes		35
		Band 41			Yes	Yes	Yes	Yes	

LTE Downlink Carrier Aggregation configurations (Continued)

4. DL Inter Band(3CC)									
E-UTRA CA configuration	Bandwidth Combination Set	E-UTRA Band	Bandwidth					Max Aggregated BW	
			1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz		20 MHz
2A-4A-5A	(0)	Band 2			Yes	Yes	Yes	Yes	50
		Band 4			Yes	Yes	Yes	Yes	
		Band 5			Yes	Yes			
2A-4A-13A	(0)	Band 2			Yes	Yes	Yes	Yes	50
		Band 4			Yes	Yes	Yes	Yes	
		Band 13				Yes			
2A-5A-66A	(0)	Band 2			Yes	Yes	Yes	Yes	50
		Band 5			Yes	Yes			
		Band 66			Yes	Yes	Yes	Yes	
2A-66A-66A	(0)	Band 2			Yes	Yes	Yes	Yes	60
		Band 66	66A-66A BCS 0						
4A-4A-5A	(0)	Band 4	4A-4A BCS 0						50
		Band 5			Yes	Yes			
4A-4A-12A	(0)	Band 4	4A-4A BCS 0						50
		Band 12			Yes	Yes			
5A-66A-66A	(0)	Band 5			Yes	Yes		50	
		Band 66	66A-66A BCS 0						
12A-66A-66A	(0)	Band 12			Yes	Yes		50	
		Band 66	66A-66A BCS 0						
26A-41C	(0)	Band 26			Yes	Yes		55	
		Band 41	41C BCS 1						

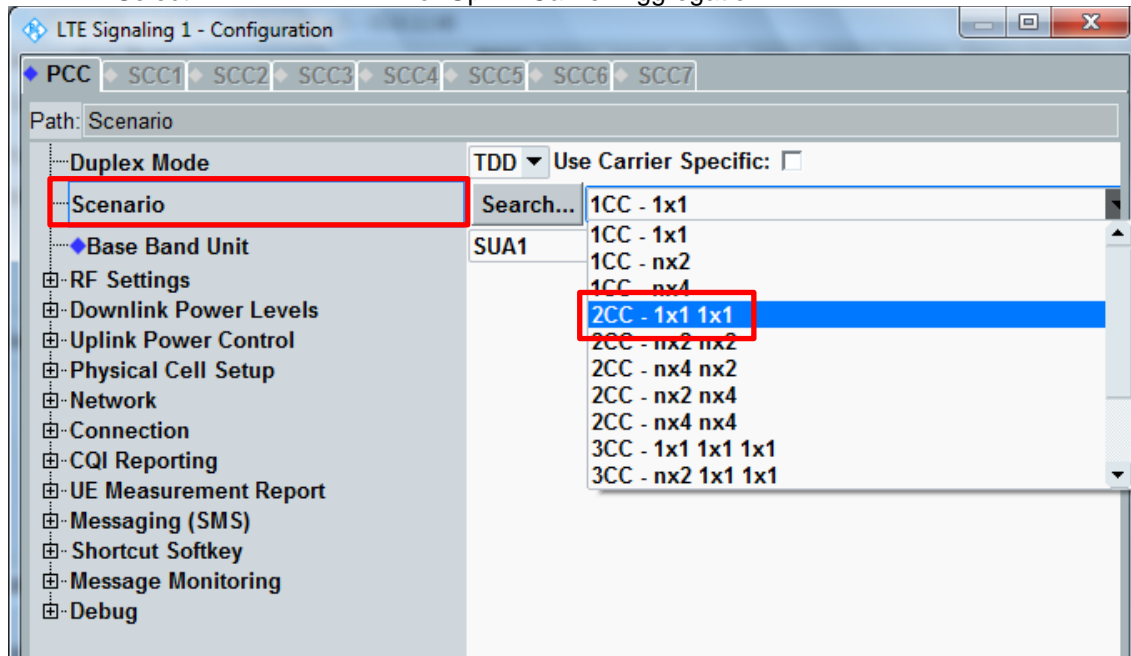
5. DL Intra Band(non-contiguous)							
E-UTRA CA configuration	Bandwidth Combination Set	E-UTRA Band	Allowed Channel BW Per Carrier (MHz)				Max Aggregated BW
			1st Carrier	2nd Carrier	3rd Carrier	4th Carrier	
2A-2A	(0)	Band 2	5, 10, 15, 20	5, 10, 15, 20			40
		Band 4	5, 10, 15, 20	5, 10, 15, 20			
4A-4A	(0)	Band 4	5, 10	5, 10			20
		Band 4	5, 10	5, 10			
41A-41A	(0)	Band 41	10, 15, 20	10, 15, 20			40
		Band 41	5, 10, 15, 20	5, 10, 15, 20			
41A-41C	(0)	Band 41	5, 10, 15, 20	41C BCS 1			60
		Band 41	5, 10, 15, 20	41D BCS 0			
41A-41D	(0)	Band 41	5, 10, 15, 20	41D BCS 0			80
		Band 41	41D BCS 0	5, 10, 15, 20			
41C-41C	(0)	Band 41	41C BCS 0	41C BCS 0			80
41C-41D	(0)	Band 41	41C BCS 0	41D BCS 0			100
		Band 41	41D BCS 0	41C BCS 0			
66A-66A	(0)	Band 66	5, 10, 15, 20	5, 10, 15, 20			40

6. DL Intra Band(contiguous)								
E-UTRA CA configuration	Bandwidth Combination Set	E-UTRA Band	Allowed Channel BW Per Carrier (MHz)					Max Aggregated BW
			1st Carrier	2nd Carrier	3rd Carrier	4th Carrier	5th Carrier	
2C	(0)	Band 2	5	20				40
			10	15,20				
			15	10,15,20				
			20	5,10,15,20				
41C	(0)	Band 41	10	20				40
			15	15, 20				
			20	10, 15, 20				
			20	10, 15, 20				
	(1)	Band 41	5, 10	20				40
			15	15, 20				
			20	5, 10, 15, 20				
			20	5, 10, 15, 20				
(2)	Band 41	10	15, 20				40	
		15	10, 15, 20					
		20	10, 15, 20					
		20	10, 15, 20					
(3)	Band 41	10	20				40	
		20	20					
		10	20	15				60
		10	15, 20	20				
15	20	10, 15						
15	10, 15, 20	20						
20	15, 20	10						
20	10, 15, 20	15, 20						
41E	(0)	Band 41	15, 20	15, 20	15, 20	20	80	
66B	(0)	Band 66	5	5, 10, 15			20	
		Band 66	10	5, 10				
		Band 66	15	5				
66C	(0)	Band 66	5	20			40	
		Band 66	10	15, 20				
		Band 66	15	10, 15, 20				
		Band 66	20	5, 10, 15, 20				

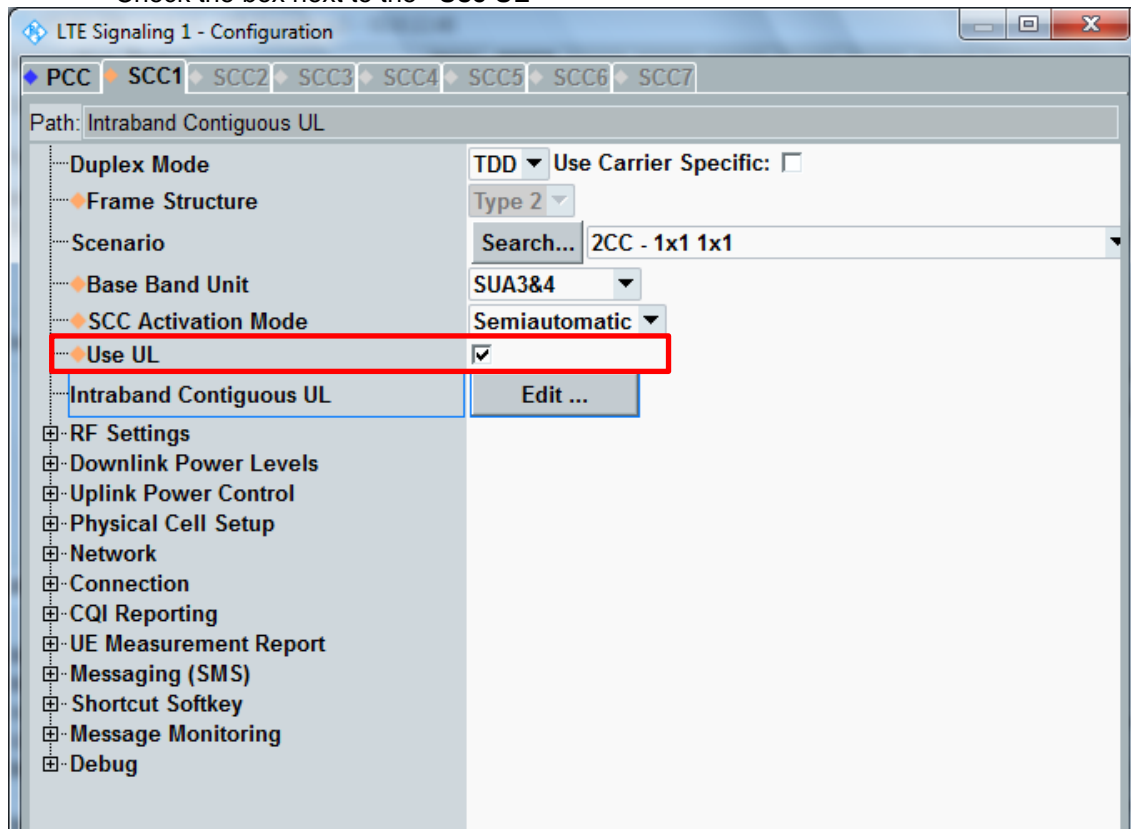
Note: LTE CA_2A-4A, 4A-5A, 4A-12A, 5A-66A, 12A-66A are supported in both Uplink and Downlink, other CA configurations are supported only Downlink

LTE Uplink Carrier Aggregation – Output Power measurement procedures

- Change the Scenario in the Configuration of LTE Signaling
Select **“2CC – 1x1 1x1”** for Uplink Carrier Aggregation



- Check the box next to the **“Use UL”**



- Back to the LTE Signal screen, and then select the PCC tab, Set operating band, BW, channel and RB configurations for PCC

The screenshot shows the CMW 500 V 3.8.12 - LTE Signaling 1 - X3.8.12.48 interface. The 'PCC' tab is selected and highlighted with a red box. The interface is divided into several sections:

- Connection Status:** Shows 'Cell' with a signal icon, 'Packet Switched' ON, 'RRC State' Idle, and 'SCC1 State' OFF.
- Event Log:** Contains a list of system events with timestamps and descriptions.
- UE Info:** A section for user equipment information, currently empty.
- Configuration Parameters:**
 - Operating Band:** Band 41
 - Channel:** 40620 Ch (both Downlink and Uplink)
 - Frequency:** 2593.0 MHz (both Downlink and Uplink)
 - Cell Bandwidth:** 20.0 MHz (both Downlink and Uplink)
 - RS EPRE:** -85.0 dBm/15kHz
 - Full Cell BW Pow.:** -54.2 dBm
 - PUSCH Open Loop Nom.Power:** 23 dBm
 - PUSCH Closed Loop Target Power:** 24.0 dBm
 - Sched.:** User def. Channels
 - Modulation and Coding:** QPSK for both Downlink and Uplink.
 - # RB:** 100 (Downlink), 1 (Uplink)
 - Start RB:** 0 (Downlink), 99 (Uplink)
 - Code Rate / TBS:** 0.328 / 8760 (Downlink), 0.583 / 144 (Uplink)
 - Throughput:** 3.478 Mbit/s (Downlink), 0.057 Mbit/s (Uplink)
- Right Panel:** A vertical sidebar with buttons for 'LTE 1 TX Meas.', 'LTE 1 RX Meas.', 'Go to...', 'Routing', 'LTE Signaling ON', and 'Config ...'.

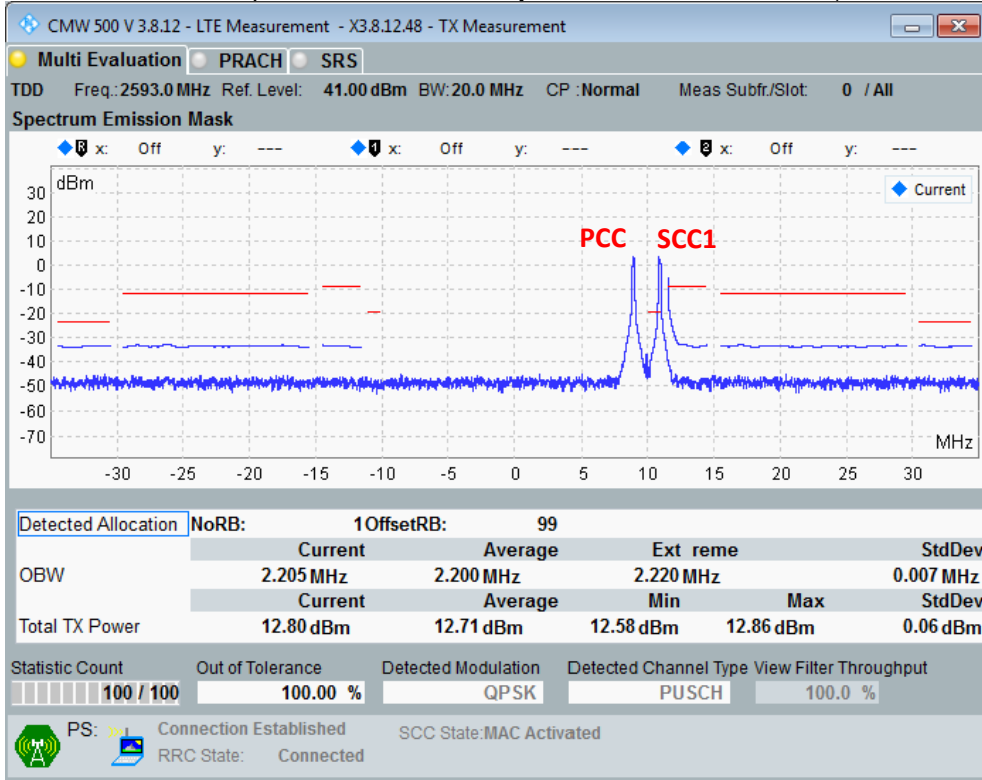
- Select the SCC1 tab, Set operating band, BW, channel, and RB configurations for SCC1

The screenshot shows the CMW 500 V 3.8.12 - LTE Signaling 1 - X3.8.12.48 interface. The 'Connection Status' section shows the cell is ON, Packet Switching is ON, RRC State is Idle, and SCC1 State is OFF. The 'Event Log' shows messages from 06:13:39 to 06:13:20. The 'UE Info' section shows fields for IMEI, IMSI, Voice Domain, UE's Usage S..., Default Bearer, and Dedicated Be... with their respective values. The configuration section shows PCC and SCC1 tabs, with PCC selected. The configuration includes Operating Band (Band 41), Downlink and Uplink channels (40818 Ch), Frequency (2612.8 MHz), Cell Bandwidth (20.0 MHz), RS EPRE (-85.0 dBm/15kHz), Full Cell BW Pow. (-54.2 dBm), PUSCH Open Loop Nom. Power (23 dBm), and PUSCH Closed Loop Target Power (24.0 dBm). The 'PCC <-> SCC1' button is highlighted with a red box. The 'LTE Signaling' indicator is ON.

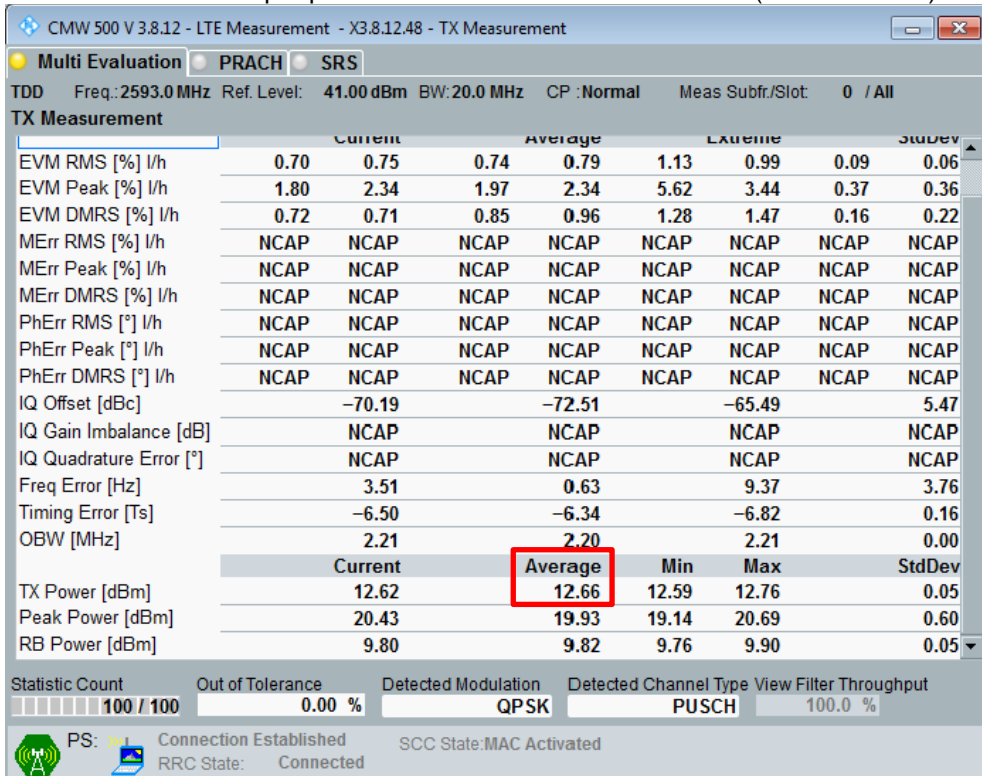
- Click the **“Connect”** button at the bottom of the screen, if necessary, turn the Airplane mode on/off in the DUT

The screenshot shows the CMW 500 V 3.8.12 - LTE Signaling 1 - X3.8.12.48 interface. The 'Connection Status' section shows the cell is ON, Packet Switching is ON, RRC State is Connected, and SCC1 State is MAC Activated. The 'Event Log' shows messages from 06:16:44 to 06:16:30. The 'UE Info' section shows fields for IMEI (355346630026654), IMSI (001010123456063), Voice Domain (IMS PS Voice preferred CS), UE's Usage S... (Data centric), Default Bearer (IPv4 address 192.168.48.129), and Dedicated Be... (5005 - 5008 / 5005 - 5008). The configuration section shows PCC and SCC1 tabs, with PCC selected. The configuration includes Operating Band (Band 41), Downlink and Uplink channels (40818 Ch), Frequency (2612.8 MHz), Cell Bandwidth (20.0 MHz), RS EPRE (-85.0 dBm/15kHz), Full Cell BW Pow. (-54.2 dBm), PUSCH Open Loop Nom. Power (23 dBm), and PUSCH Closed Loop Target Power (24.0 dBm). The 'PCC <-> SCC1' button is highlighted with a red box. The 'LTE Signaling' indicator is ON. At the bottom, the 'Disconnect' button is highlighted with a red box.

- Check the spectrum of UL CA in **Spectrum Emission Mask** (LTE Tx Meas.)

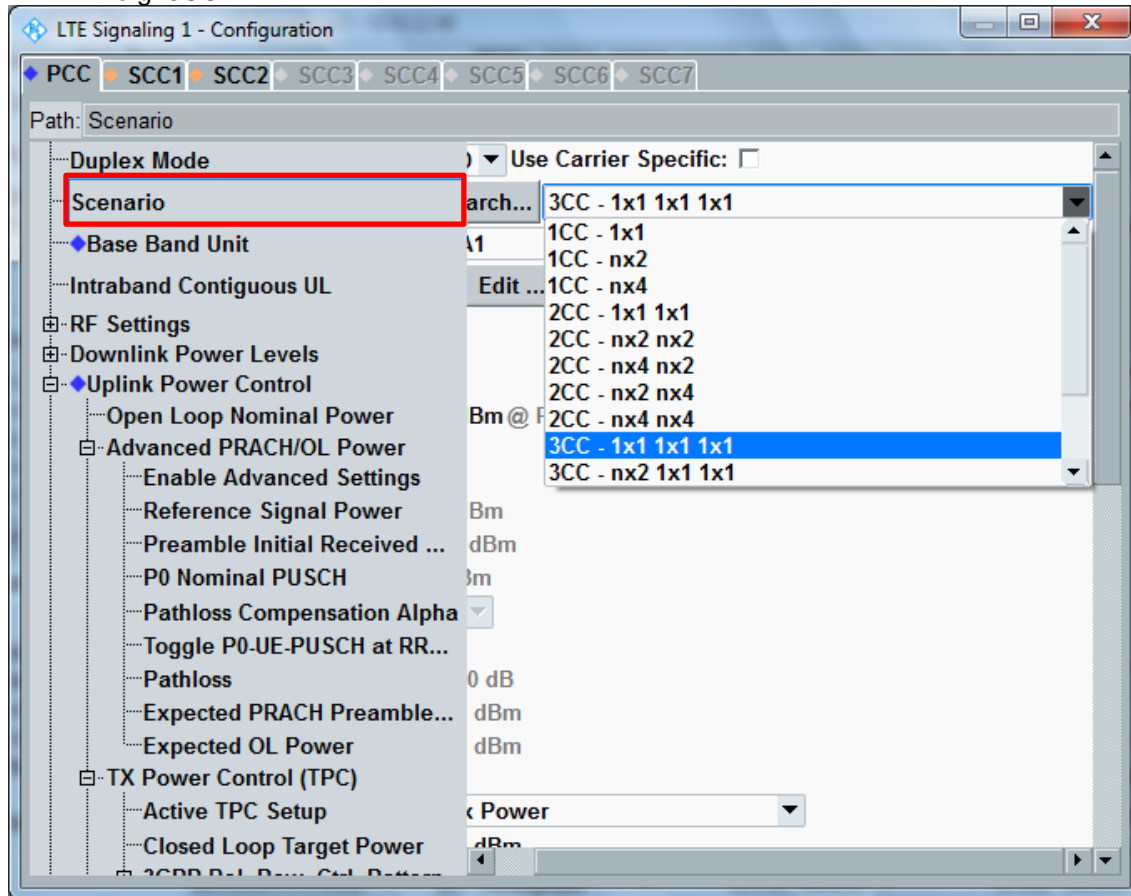


- Read the output power of UL CA in **TX Measurement** (LTE Tx Meas.)

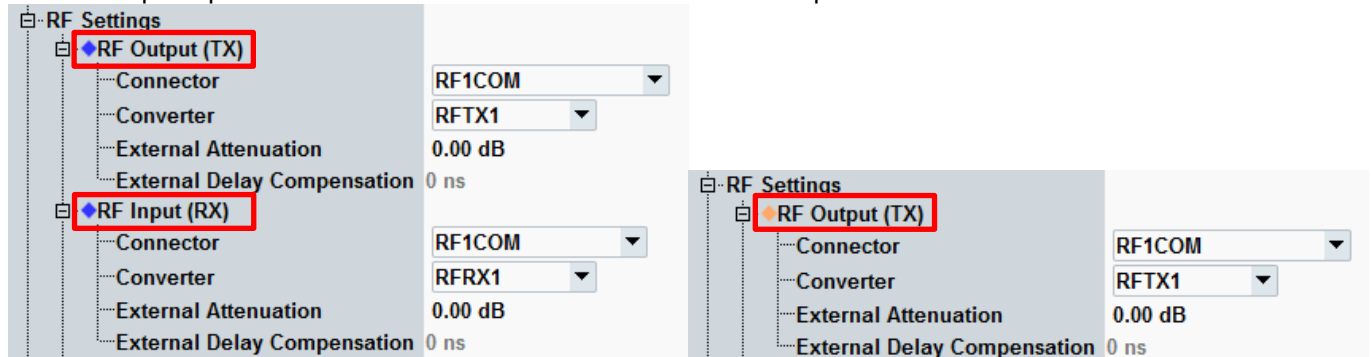


LTE Downlink Carrier Aggregation - Output Power measurement procedures

- Change the Scenario in the Configuration of LTE Signaling
e.g. 3CC – 1x1 1x1 1x1



- Set the RF Output/Input Connector and Converter for PCC/SCC1/SCC2 in each tab.
<RF Output/Input - Connector/Converter for PCC> <RF Output – Connector/Converter for SCC1/SCC2>



- Back to the LTE Signal screen, and then select the PCC tab, Set operating band, BW, channel and RB configurations for PCC

CMW 500 V 3.8.12 - LTE Signaling 1 - X3.8.12.48

Connection Status

Cell: Connection Established

RRC State: Connected
 SCC1 State: OFF
 SCC2 State: OFF

Event Log

06:36:17 SCC2: Off
 06:36:17 SCC2: On
 06:36:17 SCC2: RRC Added
 06:36:16 SCC1: Off
 06:36:16 SCC1: On
 06:36:16 SCC1: RRC Added
 06:36:12 SCC2: MAC Activated

UE Info

IMEI: 355346630026654
 IMSI: 001010123456063
 Voice Domain Pr...: IMS PS Voice preferred CS Voi
 UE's Usage Setti...: Data centric
 Default Bearer: IPv4 address 192.168.48.129
 Dedicated Bearer: TFT Port Range DL / UL 5005 - 5008 / 5005 - 5008

Operating Band: Band 66 (FDD)

Parameter	Downlink	Uplink
Channel	67036 Ch	132572 Ch
Frequency	2170.0 MHz	1770.0 MHz
Cell Bandwidth	20.0 MHz	20.0 MHz
RS EPRE	-85.0 dBm/15kHz	
Full Cell BW Pow.	-54.2 dBm	
PUSCH Open Loop Nom.Power		23 dBm
PUSCH Closed Loop Target Power		24.0 dBm

Sched. User def. Channels

Parameter	Downlink	Uplink
# RB	100	1
Start RB	0	0
Mod / TBSI	QPSK 5	QPSK 10
Code Rate / TBS	0.330 8760	0.583 144
Throughput	8.734 Mbit/s	0.144 Mbit/s

Downlink Multicluster Uplink Multicluster

64/256-QAM

LTE Signaling: ON

Buttons: Detach, Disconnect, SCC1 activate MAC, Multiple SCC Actions, Send SMS, Inter/Intra-RAT ..., Config ...

- Select the SCC1/SCC2 tab, set operating band, BW, channel and RB configurations for SCC1/SCC2

The screenshot shows the configuration for SCC1. The 'SCC1' tab is selected and highlighted with a red box. The configuration parameters are as follows:

Operating Band	Co-location active with PCC	FDD
Channel	66536 Ch	
Frequency	2120.0 MHz	
Cell Bandwidth	20.0 MHz	
RS EPRE	-85.0 dBm/15kHz	
Full Cell BW Pow.	-54.2 dBm	
# RB	100	
Start RB	0	
Mod / TBSI	QPSK	5
Code Rate / TBS	0.330	8760
Throughput	8.734 Mbit/s	

Additional details: The 'Event Log' shows SCC2: Off, SCC2: On, SCC2: RRC Added, SCC1: Off, SCC1: On, SCC1: RRC Added, and SCC2: MAC Activated. The 'UE Info' section shows IMEI 355346630026654, IMSI 001010123456063, and various bearer configurations.

The screenshot shows the configuration for SCC2. The 'SCC2' tab is selected and highlighted with a red box. The configuration parameters are as follows:

Operating Band	Band 71	FDD
Channel	68761 Ch	
Frequency	634.5 MHz	
Cell Bandwidth	20.0 MHz	
RS EPRE	-85.0 dBm/15kHz	
Full Cell BW Pow.	-54.2 dBm	
# RB	100	
Start RB	0	
Mod / TBSI	QPSK	5
Code Rate / TBS	0.330	8760
Throughput	8.734 Mbit/s	

Additional details: The 'Event Log' shows SCC2: Off, SCC2: On, SCC2: RRC Added, SCC1: Off, SCC1: On, SCC1: RRC Added, and SCC2: MAC Activated. The 'UE Info' section shows the same IMEI and IMSI as the previous screenshot.

- Connect and Activate MAC for all SCCs

Multiple SCC Actions

SCC	State	Action
SCC1	OFF	activate MAC
SCC2	OFF	activate MAC

Multiple SCC Actions

- Read the output power of DL CA in TX Measurement (LTE Tx Meas.)

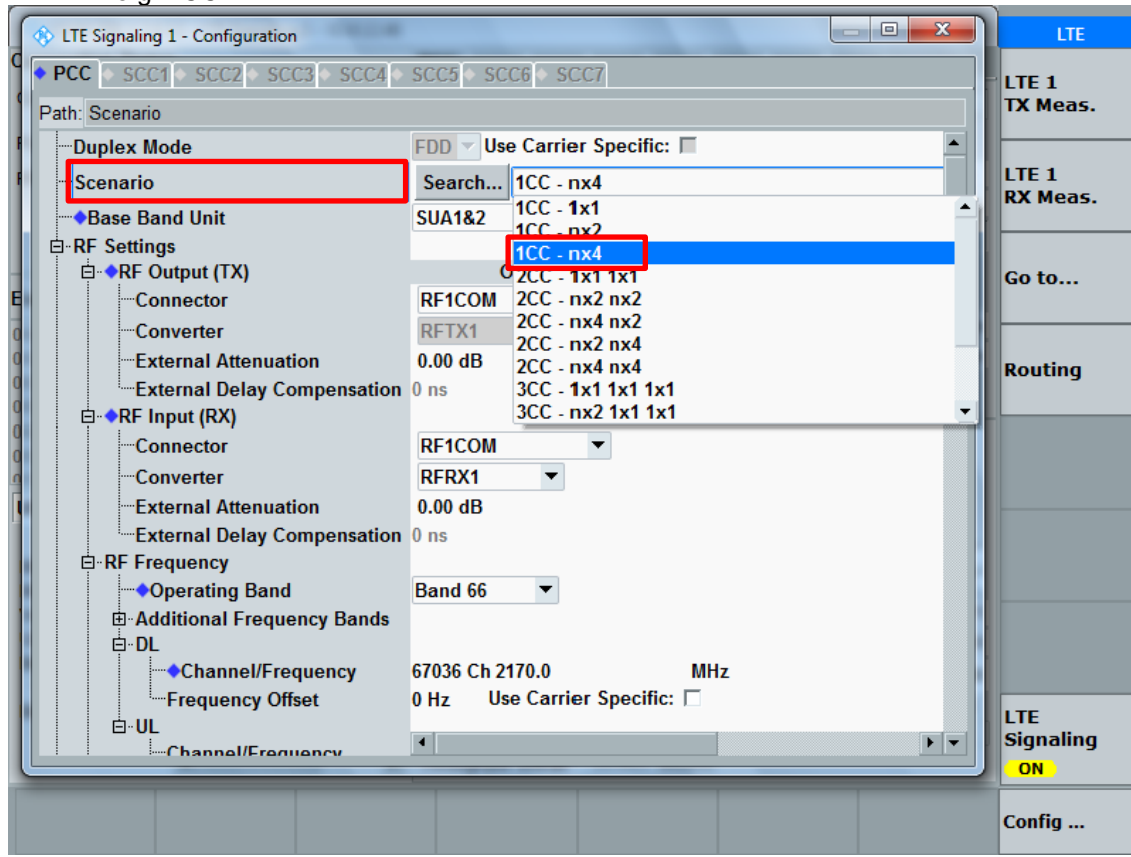
TX Measurement

	Current	Average	Extreme	StdDev	
EVM RMS [%] I/h	0.64	0.71	0.68	0.71	
EVM Peak [%] I/h	1.51	2.64	1.96	2.23	
EVM DMRS [%] I/h	0.61	0.65	0.61	0.60	
MErr RMS [%] I/h	NCAP	NCAP	NCAP	NCAP	
MErr Peak [%] I/h	NCAP	NCAP	NCAP	NCAP	
MErr DMRS [%] I/h	NCAP	NCAP	NCAP	NCAP	
PhErr RMS [°] I/h	NCAP	NCAP	NCAP	NCAP	
PhErr Peak [°] I/h	NCAP	NCAP	NCAP	NCAP	
PhErr DMRS [°] I/h	NCAP	NCAP	NCAP	NCAP	
IQ Offset [dBc]	-52.22	-52.32	-49.92	0.85	
IQ Gain Imbalance [dB]	NCAP	NCAP	NCAP	NCAP	
IQ Quadrature Error [°]	NCAP	NCAP	NCAP	NCAP	
Freq Error [Hz]	0.51	0.09	-5.38	1.33	
Timing Error [Ts]	-6.30	-5.63	-8.52	2.54	
OBW [MHz]	0.27	0.27	0.32	0.02	
	Current	Average	Min	Max	StdDev
TX Power [dBm]	13.51	13.48	13.30	13.59	0.06
Peak Power [dBm]	18.40	18.60	17.80	19.50	0.55
RB Power [dBm]	13.48	13.46	13.37	13.50	0.03

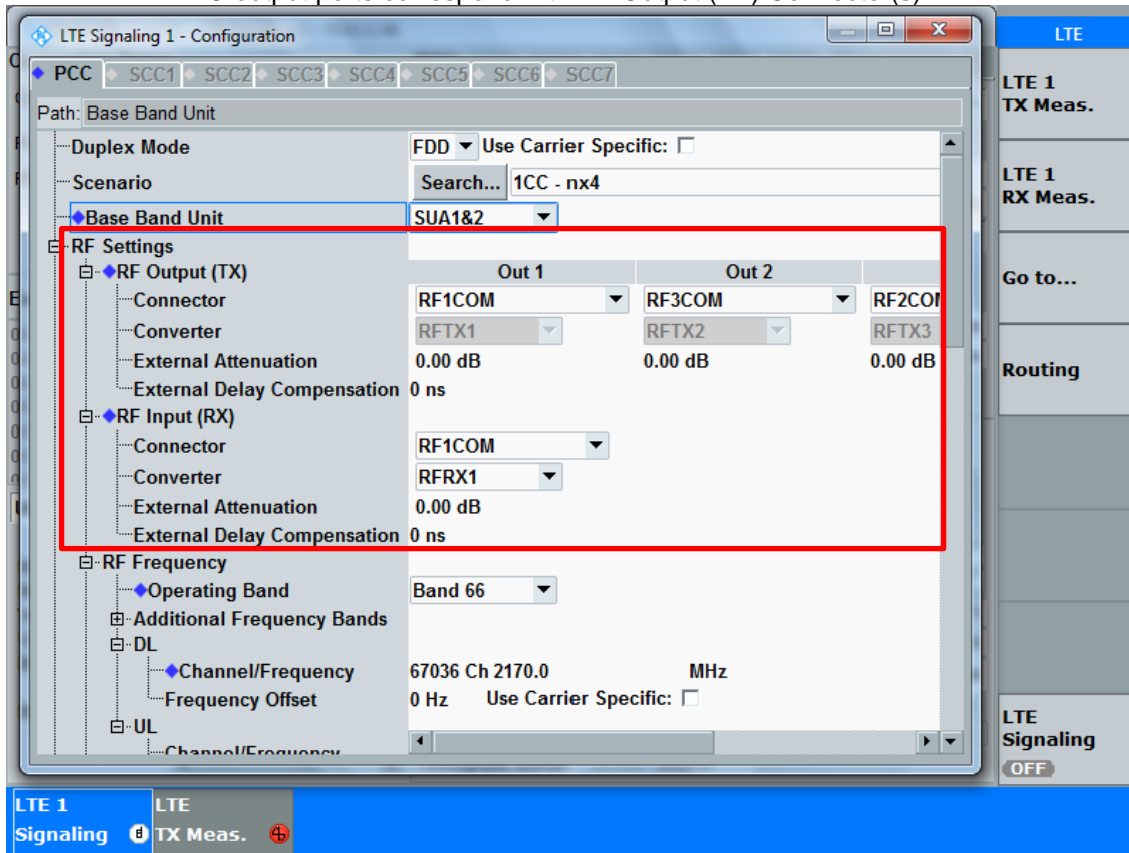
TX Power [dBm] Average: 13.48

LTE Downlink 4x4 MIMO - Output Power measurement procedures

- Change the Scenario in the Configuration of LTE Signaling
e.g. 1CC – nx4



- Set the RF Output/Input Connector and Converter for PCC.
DL MIMO output ports correspond with RF Output (TX) Connector(s).



- Back to the LTE Signal screen, set operating band, BW, channel and RB configurations for PCC

- Check the Throughput of DL 4x4 MIMO in LTE Rx Measurement.

	Over All		Stream 1		Stream 2	
	Relative	Absolute	Relative	Absolute	Relative	Absolute
ACK	99.99%	19598	99.99%	9799	99.99%	9799
NACK	0.01%	2	0.01%	1	0.01%	1
DTX	0.00%	0	0.00%	0	0.00%	0
BLER	0.01%		0.01%		0.01%	
Throughput	Relative	Mbit/s	Relative	Mbit/s	Relative	Mbit/s
Average	99.99%	17.47	99.99%	8.73	99.99%	8.73
Minimum		17.38				
Maximum		17.47				

- Read the output power of DL CA in TX Measurement (LTE Tx Meas.)

	Current	Average	Extreme	StdDev
EVM RMS [%] I/h	0.64	0.71	0.68	0.71
EVM Peak [%] I/h	1.51	2.64	1.96	2.23
EVM DMRS [%] I/h	0.61	0.65	0.61	0.60
MErr RMS [%] I/h	NCAP	NCAP	NCAP	NCAP
MErr Peak [%] I/h	NCAP	NCAP	NCAP	NCAP
MErr DMRS [%] I/h	NCAP	NCAP	NCAP	NCAP
PhErr RMS [°] I/h	NCAP	NCAP	NCAP	NCAP
PhErr Peak [°] I/h	NCAP	NCAP	NCAP	NCAP
PhErr DMRS [°] I/h	NCAP	NCAP	NCAP	NCAP
IQ Offset [dBc]	-52.22	-52.32	-49.92	0.85
IQ Gain Imbalance [dB]	NCAP	NCAP	NCAP	NCAP
IQ Quadrature Error [°]	NCAP	NCAP	NCAP	NCAP
Freq Error [Hz]	0.51	0.09	-5.38	1.33
Timing Error [Ts]	-6.30	-5.63	-8.52	2.54
OBW [MHz]	0.27	0.27	0.32	0.02
	Current	Average	Min	Max
TX Power [dBm]	13.51	13.48	13.30	13.59
Peak Power [dBm]	18.40	18.60	17.80	19.50
RB Power [dBm]	13.48	13.46	13.37	13.50

LTE Downlink Carrier Aggregation Combinations

The DL CA power measurement conditions for various CC's combinations were determined according LTE DL CA SAR Test Exclusion guidance in TCB workshop note (April 2018). Only yellow highlighted cells need power measurement. The following power measurements were performed with a single carrier uplink; CA for this particular project only supports one (1) uplink and up to four (4) downlinks.

LTE Release 10 Carrier Aggregation

Index	2CC	Restriction	Completely Covered by Measurement Superset	Index	3CC	Restriction	Completely Covered by Measurement Superset	Index	4CC	Restriction	Completely Covered by Measurement Superset	Index	5CC	Restriction	Completely Covered by Measurement Superset
2CC#1	2A-2A			3CC#1	2A-4A-5A			4CC#1	41A-41D			5CC#1	41C-41D		
2CC#2	2C			3CC#2	2A-4A-13A			4CC#2	41C-41C						
2CC#3	2A-4A		3CC#1	3CC#3	2A-5A-66A			4CC#3	41E						
2CC#4	2A-5A		3CC#3	3CC#4	2A-66A-66A										
2CC#5	2A-12A			3CC#5	4A-4A-5A										
2CC#6	2A-13A		3CC#2	3CC#6	4A-4A-12A										
2CC#7	2A-17A			3CC#7	5A-66A-66A										
2CC#8	2A-26A			3CC#8	12A-66A-66A										
2CC#9	2A-66A		3CC#4	3CC#9	26A-41C	B41 SCC only									
2CC#10	4A-4A		3CC#5	3CC#10	41A-41C										
2CC#11	4A-5A		3CC#5	3CC#11	41D		4CC#1								
2CC#12	4A-12A		3CC#6												
2CC#13	4A-13A		3CC#2												
2CC#14	4A-17A														
2CC#15	5A-41A														
2CC#16	5A-66A		3CC#7												
2CC#17	12A-25A														
2CC#18	12A-66A		3CC#8												
2CC#19	26A-41A	B41 SCC only													
2CC#20	41A-41A	B41 SCC only													
2CC#21	41C		3CC#10												
2CC#22	66A-66A		3CC#8												
2CC#23	66B														
2CC#24	66C														

Note: Only yellow highlight cells need power measurement according to LTE DL CA SAR test Exclusion in TCB workshop (April.2018).

LTE Release 10 Carrier Aggregation (Continued)

Index	2CC	Restriction	Completely Covered by Measurement Superset	Index	3CC	Restriction	Completely Covered by Measurement Superset	Index	4CC	Restriction	Completely Covered by Measurement Superset
2CCH1	2A-[4A]		3CC#1	3CC#1	2A-[4A]-5A			4CCH1	[41A]-41D		
2CCH2	2A-[66A]		3CC#3	3CC#2	2A-[4A]-13A			4CCH2	41A-[41D]		
2CCH3	[4A]-4A		3CC#6	3CC#3	2A-5A-[66A]			4CCH3	[41A]-[41D]		
2CCH4	[4A]-[4A]		3CC#7	3CC#4	2A-[66A]-66A			4CCH4	[41C]-41C		
2CCH5	[4A]-5A		3CC#6	3CC#5	2A-[66A]-[66A]			4CCH5	[41C]-[41C]		
2CCH6	[4A]-12A		3CC#8	3CC#6	[4A]-4A-5A			4CCH6	[41E]		
2CCH7	[4A]-13A		3CC#2	3CC#7	[4A]-[4A]-5A						
2CCH8	[4A]-17A			3CC#8	[4A]-4A-12A						
2CCH9	5A-[41A]	B41 SCC only		3CC#9	[4A]-[4A]-12A						
2CCH10	5A-[66A]		3CC#10	3CC#10	5A-[66A]-66A						
2CCH11	12A-[66A]		3CC#12	3CC#11	5A-[66A]-[66A]						
2CCH12	26A-[41A]	B41 SCC only		3CC#12	12A-[66A]-66A						
2CCH13	[41A]-41A			3CC#13	12A-[66A]-[66A]						
2CCH14	[41A]-[41A]			3CC#14	26A-[41C]	B41 SCC only					
2CCH15	[41C]		3CC#16	3CC#15	[41A]-41C						
2CCH16	[66A]-66A		3CC#12	3CC#16	[41A]-[41C]						
2CCH17	[66A]-[66A]		3CC#13	3CC#17	[41D]		4CCH2				

Note: Only yellow highlight cells need power measurement according to LTE DL CA SAR test Exclusion in TCB workshop (April.2018).

LTE Uplink Carrier Aggregation Combinations

Maximum Output Power (Tune-up Limit) for LTE UL Carrier Aggregation

E-UTRA CA configurations	RSI	Antenna	Bands		UL															
			PCC	SCC	PCC								SCC							
			1st	2nd	Mode	BW	Ch.	Freq. (MHz)	RB	offset	Tune-up Limit (dBm)	Rel.10 Tx. PWR (dBm)	Mode	BW	Ch.	Freq. (MHz)	RB	offset	Tune-up Limit (dBm)	Rel.10 Tx. PWR (dBm)
CA_2A-4A	Pmax	Main.1+Sub.2	2A	4A	QPSK	20	18900	1880	1	0	23.5	21.26	QPSK	20	1732.5	1732.5	1	0	23.5	22.74
		Main.1+Sub.2	4A	2A	QPSK	20	1732.5	1732.5	1	0	23.5	22.61	QPSK	20	18900	1880	1	0	23.5	21.01
CA_4A-5A	Pmax	Main.1	4A	5A	QPSK	20	1732.5	1732.5	1	0	23.5	22.64	QPSK	10	20525	836.5	1	0	25	22.58
		Main.1	5A	4A	QPSK	10	20525	836.5	1	0	25	22.68	QPSK	20	1732.5	1732.5	1	0	23.5	22.45
CA_4A-12A	Pmax	Main.1	4A	12A	QPSK	20	1732.5	1732.5	1	0	23.5	22.5	QPSK	10	23095	707.5	1	0	24.5	22.61
		Main.1	12A	4A	QPSK	10	23095	707.5	1	0	24.5	22.86	QPSK	20	1732.5	1732.5	1	0	23.5	22.34
CA_5A-66A	Pmax	Main.1	5A	66A	QPSK	10	20525	836.5	1	0	25	22.68	QPSK	20	132072	1720	1	0	23.5	21.91
		Main.1	66A	5A	QPSK	20	132072	1720	1	0	23.5	22.3	QPSK	10	20525	836.5	1	0	25	22.58
CA_12A-66A	Pmax	Main.1	12A	66A	QPSK	10	23095	707.5	1	0	24.5	24.04	QPSK	20	132072	1720	1	0	23.5	22.05
		Main.1	66A	12A	QPSK	20	132072	1720	1	0	23.5	22.34	QPSK	10	23095	707.5	1	0	24.5	23.2

Note:

1. For ULCA inter band, Each PCC and SCC has same target power in standalone mode.
2. All PCC and SCC result are within standalone target power.

Single Carrier Downlink 4x4 MIMO output power results**Single Carrier Downlink 4x4 MIMO output power results**

LTE Bands	Modulation	BW (MHz)	Channel	Freq. (MHz)	RB/Offset	LTE Rel 8 Tx. Power [dBm]	DL 4x4 MIMO Tx. Power [dBm]	Delta
4	QPSK	20	20175	1732.5	1/0	22.25	22.17	-0.08
41	QPSK	20	40620	2593	1/0	22.83	22.80	-0.03
66	QPSK	20	132072	1720	1/0	22.63	22.59	-0.04

Note:

According to LTE Test Conditions in TCB workshop (May, 2017), SAR is excluded for LTE downlink 4x4 MIMO operation when uplink output with DL MIMO does not exceed highest uplink output power configuration without DL MIMO by more than 1/4 dB. And for DL MIMO with carrier aggregation, the same SAR test exclusion procedure is considered.

DL CA output power results

Bands					UL										DL										LTE Rel 8 Tx. Power [dBm]	LTE Rel 10 Tx. Power [dBm]	Delta				
PCC	SCC1	SCC2	SCC3	SCC4	PCC					SCC1					SCC2					SCC3								SCC4			
1st	2nd	3rd	4th	5th	Mode	BW (MHz)	Channel	Freq. (MHz)	RB Allocation	RB offset	BW (MHz)	Channel	Freq. (MHz)	BW (MHz)	Channel	Freq. (MHz)	BW (MHz)	Channel	Freq. (MHz)	BW (MHz)	Channel	Freq. (MHz)	BW (MHz)	Channel	Freq. (MHz)	BW (MHz)	Channel	Freq. (MHz)			
2A	2A				QPSK	20	18900	1880	1	0	20	900	1960	15	1125	1982.5													21.95	21.95	0
2C	2C				QPSK	20	18900	1880	1	0	20	900	1960	20	1098	1979.8													21.95	21.93	-0.02
2A	12A				QPSK	20	18900	1880	1	0	20	900	1960	10	5095	737.5												21.95	21.93	-0.02	
12A	2A				QPSK	10	23095	707.5	1	0	10	5095	737.5	20	900	1960												24.11	23.99	-0.12	
2A	17A				QPSK	20	18900	1880	1	0	20	900	1960	10	5790	740												21.95	21.95	0	
17A	2A				QPSK	10	23790	710	1	0	10	5790	740	20	900	1960												24.07	23.97	-0.1	
2A	26A				QPSK	20	18900	1880	1	0	20	900	1960	15	8865	876.5												21.95	21.86	-0.09	
26A	2A				QPSK	15	26865	831.5	1	0	15	8865	876.5	20	900	1960												23.84	23.8	-0.04	
4A	17A				QPSK	20	20175	1732.5	1	0	20	2175	2132.5	10	5790	740												22.25	22.2	-0.05	
17A	4A				QPSK	10	23790	710	1	0	10	5790	740	20	2175	2132.5												24.07	23.95	-0.12	
5A	41A				QPSK	10	20525	836.5	1	0	10	2525	881.5	20	40620	2593												23.73	23.69	-0.04	
12A	25A				QPSK	10	23095	707.5	1	0	10	5095	737.5	20	8365	1962.5												24.11	24.06	-0.05	
25A	12A				QPSK	20	26590	1905	1	49	20	8590	1985	10	5095	737.5												22.51	22.38	-0.13	
26A	41A				QPSK	15	26865	831.5	1	0	15	8865	876.5	20	40620	2593												23.84	23.78	-0.06	
41A	41A				QPSK	20	40620	2593	1	0	20	40620	2593	20	39750	2506												22.83	22.72	-0.11	
66B	66B				QPSK	10	132072	1720	1	0	10	2120	66536	10	66635	2129.9												22.63	22.52	-0.11	
66C	66C				QPSK	20	132072	1720	1	0	20	2120	66536	20	66734	2139.8												22.63	22.56	-0.07	
2A	4A	5A			QPSK	20	18900	1880	1	0	20	900	1960	20	2175	2132.5	10	2525	881.5								21.95	21.89	-0.06		
4A	2A	5A			QPSK	20	20175	1732.5	1	0	20	2175	2132.5	20	900	1960	10	2525	881.5								22.25	22.13	-0.12		
5A	2A	4A			QPSK	10	20525	836.5	1	0	10	2525	881.5	20	900	1960	20	2175	2132.5								23.73	23.66	-0.07		
2A	4A	13A			QPSK	20	18900	1880	1	0	20	900	1960	20	2175	2132.5	10	5230	751								21.95	21.88	-0.07		
4A	2A	13A			QPSK	20	20175	1732.5	1	0	20	2175	2132.5	20	900	1960	10	5230	751								22.25	22.15	-0.1		
13A	2A	4A			QPSK	10	23230	782	1	0	10	5230	751	20	900	1960	20	2175	2132.5								23.87	23.8	-0.07		
2A	5A	66A			QPSK	20	18900	1880	1	0	20	900	1960	10	2525	881.5	20	66786	2145								21.95	21.95	0		
5A	2A	66A			QPSK	10	20525	836.5	1	0	10	2525	881.5	20	900	1960	20	66786	2145								23.73	23.66	-0.07		
66A	2A	5A			QPSK	20	132072	1720	1	0	20	2120	66536	20	900	1960	10	2525	881.5								22.63	22.5	-0.13		
2A	66A	66A			QPSK	20	18900	1880	1	0	20	900	1960	20	67036	2170	20	66536	2120								21.95	21.93	-0.02		
66A	66A	2A			QPSK	20	132072	1720	1	0	20	2120	66536	20	67036	2170	20	900	1960								22.63	22.53	-0.1		
4A	4A	5A			QPSK	20	20175	1732.5	1	0	20	2175	2132.5	10	2350	2150	10	2525	881.5								22.25	22.23	-0.02		
5A	4A	4A			QPSK	10	20525	836.5	1	0	10	2525	881.5	20	2300	2145	20	2050	2120								23.73	23.62	-0.11		
4A	4A	12A			QPSK	20	20175	1732.5	1	0	20	2175	2132.5	10	2350	2150	10	5095	737.5								22.25	22.14	-0.11		
12A	4A	4A			QPSK	10	23095	707.5	1	0	10	5095	737.5	20	2300	2145	20	2050	2120								24.11	24.1	-0.01		
5A	66A	66A			QPSK	10	20525	836.5	1	0	10	2525	881.5	20	67036	2170	20	66536	2120								23.73	23.67	-0.06		
66A	66A	5A			QPSK	20	132072	1720	1	0	20	2120	66536	20	67036	2170	10	2525	881.5								22.63	22.61	-0.02		
12A	66A	66A			QPSK	10	23095	707.5	1	0	10	5095	737.5	20	67036	2170	20	66536	2120								24.11	24.07	-0.04		
66A	66A	12A			QPSK	20	132072	1720	1	0	20	2120	66536	20	67036	2170	10	5095	737.5								22.63	22.53	-0.1		
26A	41C	41C			QPSK	15	26865	831.5	1	0	15	8865	876.5	20	40620	2593	20	40422	2573.2								23.84	23.75	-0.09		
41A	41C	41C			QPSK	20	40620	2593	1	0	20	40620	2593	20	39750	2506	20	39948	2525.8								22.83	22.74	-0.09		
41C	41C	41A			QPSK	20	40620	2593	1	0	20	40620	2593	20	40818	2612.8	20	39948	2525.8								22.83	22.8	-0.03		
41A	41D	41D	41D		QPSK	20	40620	2593	1	0	20	40620	2593	20	39750	2506	20	39948	2525.8	20	40146	2545.6				22.83	22.83	0			
41D	41D	41D	41A		QPSK	20	40620	2593	1	0	20	40620	2593	20	40818	2612.8	20	41016	2632.6	20	41016	2632.6				22.83	22.73	-0.1			
41C	41C	41C	41C		QPSK	20	40620	2593	1	0	20	40620	2593	20	40818	2612.8	20	39750	2506	20	39948	2525.8				22.83	22.76	-0.07			
41E	41E	41E	41E		QPSK	20	40620	2593	1	0	20	40620	2593	20	40818	2612.8	20	41016	2632.6	20	41214	2652.4				22.83	22.79	-0.04			
41C	41C	41D	41D	41D	QPSK	20	40620	2593	1	0	20	40620	2593	20	40818	2612.8	20	39750	2506	20	39948	2525.8	20	40149	2545.6	22.83	22.73	-0.1			
41D	41D	41D	41C	41C	QPSK	20	40620	2593	1	0	20	40620	2593	20	40818	2612.8	20	41016	2632.6	20	39750	2506	20	39948	2525.8	20	39948	2525.8	22.83	22.76	-0.07

Note:

1. Per KDB 941225 D05A LTE Rel. 10 KDB Inquiry Sheet: SAR is excluded for Carrier Aggregation when measured power does not exceed LTE Release 8 by more than a 1/4 dB.
2. When the same frequency band is used for both contiguous and non-contiguous in DL CA Intra band, power was measured using the configuration with the largest aggregated bandwidth and maximum output power among the contiguous and non-contiguous in DL CA Intra band configurations.

DL CA with 4x4 MIMO output power results

E-UTRA CA configuration (BCS)	Bands				UL										DL									LTE Rel 8 Tx. Power [dBm]	LTE Rel 10 Tx. Power [dBm]	Delta		
	PCC	SCC1	SCC2	SCC3	PCC										SCC1			SCC2			SCC3							
	1st	2nd	3rd	4th	Mode	BW (MHz)	Channel	Freq. (MHz)	RB Allocation	RB offset	BW (MHz)	Channel	Freq. (MHz)	BW (MHz)	Channel	Freq. (MHz)	BW (MHz)	Channel	Freq. (MHz)	BW (MHz)	Channel	Freq. (MHz)	BW (MHz)				Channel	Freq. (MHz)
[4A]-17A	[4A]	17A			QPSK	20	20175	1732.5	1	0	20	2175	2132.5	10	5790	740										22.25	22.18	-0.07
	17A	[4A]			QPSK	10	23790	710	1	0	10	5790	740	20	2175	2132.5										24.07	24.01	-0.06
5A-[41A]	5A	[41A]			QPSK	10	20525	836.5	1	0	10	2525	881.5	20	40620	2593										23.73	23.71	-0.02
26A-[41A]	26A	[41A]			QPSK	15	26865	831.5	1	0	15	8865	876.5	20	40620	2593										23.84	23.77	-0.07
[41A]-41A	[41A]	41A			QPSK	20	40620	2593	1	0	20	40620	2593	20	39750	2506										22.83	22.75	-0.08
	41A	[41A]			QPSK	20	40620	2593	1	0	20	40620	2593	20	39750	2506										22.83	22.73	-0.1
[41A]-[41A]	[41A]	[41A]			QPSK	20	40620	2593	1	0	20	40620	2593	20	39750	2506										22.83	22.79	-0.04
	2A	[4A]	5A		QPSK	20	18900	1880	1	0	20	900	1960	20	2175	2132.5	10	2525	881.5							21.95	21.83	-0.12
2A-[4A]-5A	[4A]	2A	5A		QPSK	20	20175	1732.5	1	0	20	2175	2132.5	20	900	1960	10	2525	881.5							22.25	22.14	-0.11
	5A	2A	[4A]		QPSK	10	20525	836.5	1	0	10	2525	881.5	20	900	1960	20	2175	2132.5							23.73	23.61	-0.12
	2A	[4A]	13A		QPSK	20	18900	1880	1	0	20	900	1960	20	2175	2132.5	10	5230	751							21.95	21.93	-0.02
	[4A]	2A	13A		QPSK	20	20175	1732.5	1	0	20	2175	2132.5	20	900	1960	10	5230	751							22.25	22.15	-0.1
	13A	2A	[4A]		QPSK	10	23230	782	1	0	10	5230	751	20	900	1960	20	2175	2132.5							23.87	23.87	0
	2A	5A	[66A]		QPSK	20	18900	1880	1	0	20	900	1960	10	2525	881.5	20	66786	2145							21.95	21.84	-0.11
	5A	2A	[66A]		QPSK	10	20525	836.5	1	0	10	2525	881.5	20	900	1960	20	66786	2145							23.73	23.63	-0.1
	[66A]	2A	5A		QPSK	20	132072	1720	1	0	20	66536	2120	20	900	1960	10	2525	881.5							22.63	22.52	-0.11
	2A	[66A]	66A		QPSK	20	18900	1880	1	0	20	900	1960	20	67036	2170	20	66536	2120							21.95	21.88	-0.07
	[66A]	66A	2A		QPSK	20	132072	1720	1	0	20	66536	2120	20	67036	2170	20	900	1960							22.63	22.62	-0.01
	66A	[66A]	2A		QPSK	20	132072	1720	1	0	20	66536	2120	20	67036	2170	20	900	1960							22.63	22.62	-0.01
	2A	[66A]	[66A]		QPSK	20	18900	1880	1	0	20	900	1960	20	67036	2170	20	66536	2120							21.95	21.9	-0.05
	[66A]	[66A]	2A		QPSK	20	132072	1720	1	0	20	66536	2120	20	67036	2170	20	900	1960							22.63	22.53	-0.1
	[4A]	4A	5A		QPSK	20	20175	1732.5	1	0	20	2175	2132.5	10	2350	2150	10	2525	881.5							22.25	22.12	-0.13
	4A	[4A]	5A		QPSK	20	20175	1732.5	1	0	20	2175	2132.5	10	2350	2150	10	2525	881.5							22.25	22.2	-0.05
	5A	[4A]	4A		QPSK	10	20525	836.5	1	0	10	2525	881.5	20	2350	2145	20	2050	2120							23.73	23.67	-0.06
	[4A]	[4A]	5A		QPSK	20	20175	1732.5	1	0	20	2175	2132.5	10	2350	2150	10	2525	881.5							22.25	22.22	-0.03
	5A	[4A]	[4A]		QPSK	10	20525	836.5	1	0	10	2525	881.5	20	2300	2145	20	2050	2120							23.73	23.72	-0.01
	[4A]	4A	12A		QPSK	20	20175	1732.5	1	0	20	2175	2132.5	10	2350	2150	10	5095	737.5							22.25	22.16	-0.09
	4A	[4A]	12A		QPSK	20	20175	1732.5	1	0	20	2175	2132.5	10	2350	2150	10	5095	737.5							22.25	22.12	-0.13
	12A	[4A]	4A		QPSK	10	23095	707.5	1	0	10	5095	737.5	20	2300	2145	20	2050	2120							24.11	24.01	-0.1
	[4A]	[4A]	12A		QPSK	20	20175	1732.5	1	0	20	2175	2132.5	10	2350	2150	10	5095	737.5							22.25	22.21	-0.04
	12A	[4A]	[4A]		QPSK	10	23095	707.5	1	0	10	5095	737.5	20	2300	2145	20	2050	2120							24.11	23.99	-0.12
	5A	[66A]	66A		QPSK	10	20525	836.5	1	0	10	2525	881.5	20	67036	2170	20	66536	2120							23.73	23.65	-0.08
	[66A]	66A	5A		QPSK	20	132072	1720	1	0	20	66536	2120	20	67036	2170	10	2525	881.5							22.63	22.53	-0.1
	66A	[66A]	5A		QPSK	20	132072	1720	1	0	20	66536	2120	20	67036	2170	10	2525	881.5							22.63	22.5	-0.13
	5A	[66A]	[66A]		QPSK	10	20525	836.5	1	0	10	2525	881.5	20	67036	2170	20	66536	2120							23.73	23.73	0
	[66A]	[66A]	5A		QPSK	20	132072	1720	1	0	20	66536	2120	10	2525	881.5										22.63	22.63	0
	12A	[66A]	66A		QPSK	10	23095	707.5	1	0	10	5095	737.5	20	67036	2170	20	66536	2120							24.11	23.99	-0.12
	[66A]	66A	12A		QPSK	20	132072	1720	1	0	20	66536	2120	20	67036	2170	10	5095	737.5							22.63	22.61	-0.02
	66A	[66A]	12A		QPSK	20	132072	1720	1	0	20	66536	2120	20	67036	2170	10	5095	737.5							22.63	22.61	-0.02
	12A	[66A]	[66A]		QPSK	10	23095	707.5	1	0	10	5095	737.5	20	67036	2170	20	66536	2120							24.11	24.1	-0.01
	[66A]	[66A]	12A		QPSK	20	132072	1720	1	0	20	66536	2120	10	5095	737.5										22.63	22.5	-0.13
	26A	[41C]	[41C]		QPSK	15	26865	831.5	1	0	15	8865	876.5	20	40620	2593	20	40422	2573.2							23.84	23.83	-0.01
	[41A]-[41C]	[41C]	41C		QPSK	20	40620	2593	1	0	20	40620	2593	20	39750	2506	20	39948	2525.8							22.83	22.74	-0.09
	41C	[41C]	[41A]		QPSK	20	40620	2593	1	0	20	40620	2593	20	40818	2612.8	20	39750	2506							22.83	22.82	-0.01
	[41A]-[41C]	[41C]	[41C]		QPSK	20	40620	2593	1	0	20	40620	2593	20	40818	2612.8	20	39948	2525.8							22.83	22.7	-0.13
	[41A]	41D	41D	41D	QPSK	20	40620	2593	1	0	20	40620	2593	20	39750	2506	20	39948	2525.8	20	40146	2545.6	20	40146	2545.6	22.83	22.77	-0.06
	41D	41D	41D	[41A]	QPSK	20	40620	2593	1	0	20	40620	2593	20	40818	2612.8	20	41016	2632.6	20	39750	2506	20	39750	2506	22.83	22.77	-0.06
	41A	[41D]	[41D]	[41D]	QPSK	20	40620	2593	1	0	20	40620	2593	20	39750	2506	20	39948	2525.8	20	40146	2545.6	20	40146	2545.6	22.83	22.83	0
	[41D]	[41D]	[41D]	41A	QPSK	20	40620																					