## LTE Downlink Carrier Aggregation configurations

1. DL Intra	Band	(contig	uous)

E-UTRA CA	Bandw idth Combinatio	E-UTRA		Allow ed Char	inel BW Per Ca	rrier (MHz)		Max Aggregated	
configuration	n	Band	1st Carrier	2nd Carrier	3rd Carrier	4th Carrier	5th Carrier	BW	
		_	10	20					
	(0)	Band 41	15	15, 20				40	
			20	10, 15, 20					
			5, 10	20					
	(1)	Band 41	15	15, 20				40	
41C			20	5, 10, 15, 20					
		Band 41	10	15, 20					
	(2)				15	10, 15, 20			
			20	10, 15, 20					
	(3)	Band	10	20				40	
	(0)	41	20	20				40	
			10	20	15				
			10	15, 20	20				
41D (0)	(0)	Band	15	20	10, 15			60	
	(3)	41	15	10, 15, 20	20			60	
				20	15, 20	10			
			20	10, 15, 20	15, 20				

**Note:** LTE CA\_41C 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

4 LTE Signaling 1 - Configuration	
PCC SCC1 SCC2 SCC3 SCC4	SCC5 SCC6 SCC7
Path: Scenario	
Duplex Mode	TDD - Use Carrier Specific:
Scenario	Search 1CC - 1x1
<ul> <li>Base Band Unit</li> <li>RF Settings</li> <li>Downlink Power Levels</li> <li>Uplink Power Control</li> <li>Physical Cell Setup</li> <li>Network</li> <li>Connection</li> <li>CQI Reporting</li> <li>UE Measurement Report</li> <li>Messaging (SMS)</li> <li>Shortcut Softkey</li> <li>Message Monitoring</li> <li>Debug</li> </ul>	SUA1 1CC - 1x1 1CC - nx2 1CC - nx4 2CC - 1x1 1x1 2CC - 1x2 nx2 2CC - nx4 nx2 2CC - nx4 nx4 2CC - nx4 nx4 3CC - 1x1 1x1 1x1 3CC - nx2 1x1 1x1

Check the box next to the "Use UL"

-

ITE Signaling 1 - Configuration	
◆ PCC → SCC1 → SCC2 → SCC3 → SCC4 →	SCC5 SCC6 SCC7
Path: Intraband Contiguous UL	
Duplex Mode	TDD ▼ Use Carrier Specific: □
+Frame Structure	Туре 2 💌
Scenario	Search 2CC - 1x1 1x1
	SUA3&4 🔻
	Semiautomatic 💌
Use UL	
Intraband Contiguous UL	Edit
⊞-RF Settings	
Downlink Power Levels	
⊞-Network	
⊞Connection	
⊡ CQI Reporting	
⊞-UE Measurement Report ⊞-Messaging (SMS)	
⊞ Shortcut Softkey	
⊞- Message Monitoring	
⊡∝Debug	

## 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						<b>—</b> ×	LTE
Connection Status	PCC SCC1 SC	C2 SCC3 SCC	4 SCC5 S	SCC6 SCC	7		LTE 1
Cell (T)	Operating Band	Band 41		TDD		/	TX Meas.
Packet Switched 🔼 ON		Downlink		Uplink			
RRC State Idle	Channel	40620	) Ch		40620	Ch	LTE 1
SCC1 State OFF	Frequency	2593.0	) MHz		2593.0	MHz	RX Meas.
	Cell Bandwidth	20.0 MHz		▼ 20.0 I	MHz	<ul> <li>/</li> </ul>	
	RS EPRE	-85.0	) dBm/15	kHz			Go to
Event Log X	Full Cell BW Pov	v54.2	2 dBm				
06:13:39 () State 'Cell On', 2CC 1x1 1x1	PUSCH Open Lo					dBm	
06:13:21  Signaling Unit Startup	PUSCH Closed L	oop Target Powe	er		24.0	dBm	Routing
06:13:21() Data end to end enabled 06:13:20() Starting Data Application Unit							
00.13.20 Starting Data Application Unit							
	Sched. User de	f Channole	•				
	Sched. User de	i. Channels					
UE Info							
IMEI							
IMEI				64	4/256-Q/	AM 🗆	
Voice Domain Pr		Downlink Multicl	uster 🔲 U	plink M	ulticlust	er 🗆	
UE's Usage Setti	# RB		100			1	
Default Bearer IPv4 address IPv6 prefix	Start RB		0			99	
Dedicated Bearer TFT Port Range DL / UL	Mod / TBSI	QPSK 🔻	5	QPS	K 🔻	10	LTE
······································	Code Rate / TBS	0.328	8760	0.	583	144	Signaling
•	Throughput	3.478	Mbit/s	(	.057 M	bit/s	ON
							Config

- Select the SCC1 tab,

## Set operating band, BW, channel, and RB configurations for SCC1

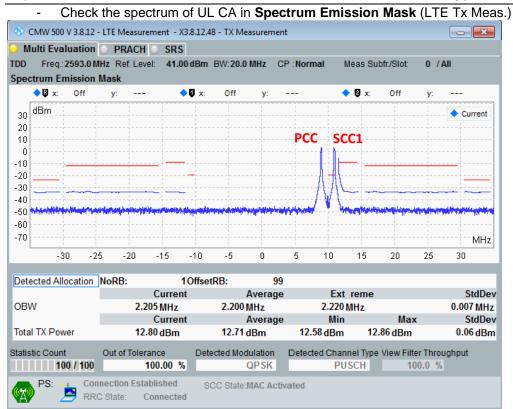
🚸 CMW 500 V 3.8.12 - LTE Signaling 1 - X3	.8.12.48				×	LTE
Connection Status	PCC SCC1 SC	C2 SCC3 SCC4 SC	C5 SCC6 S	CC7		LTE 1
Cell 🥢	Operating Band	Band 41	~	TDD	/	TX Meas.
Packet Switc 🔼 ON		Downlink		Uplink		
RRC State Idle	Channel	40818	Ch	40818	B Ch	LTE 1
SCC1 State OFF	Frequency	2612.8	MHz	2612.8	8 MHz	RX Meas.
	Cell Bandwidth	20.0 MHz	•	20.0 MHz	/	
	RS EPRE	-85.0	dBm/15kHz			Go to
Event Log	Full Cell BW Pow	<i>I</i> . –54.2	dBm			
06:13:39 () State 'Cell On', 2CC 1x1 1x1	PUSCH Open Loo	·			3 dBm	
06:13:21  Signaling Unit Startup	PUSCH Closed L	oop Target Power		24.	0 dBm	Routing
06:13:21 Data end to end enabled 06:13:20 Starting Data Application Unit	PCC <-> SCC1	Current				-
our of the tarting bata Application on t	PUC <-> SUCT	Swap				
UE Info	PCC> SCC1	Сору				
	Sched. User def	f. Channels	▼ □ N	Aulticluster UL		
IMEI			64/256	-QAM		
IMSI						
Voice Domain UE's Usage S		Downlink Multic	cluster 🗏 Up	link		
Default Bearer IPv4 address IPv6 pref	# RB ix Start RB		100		1	
L	Start KD	0000	5		-	
Dedicated Be TFT Port Range DL / UL	Mod / TBSI Code Rate / TBS	QPSK - 0.328	э 8760	QPSK - 0.583	10 144	LTE
	<ul> <li>Code Rate / TBS</li> <li>Throughput</li> </ul>	3.478 Mbit/		0.0057 N		Signaling ON
	moughput	0.410 100	•	01001 11	10100	
						Config

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

🚸 CMW 500 V 3	.8.12 - LTE Signaling I	1 - X3.8.1	2.48				×	LTE
Connection Sta	tus		PCC SCC1 SC	C2 SCC3 SCC4 S	CC5 SCC6 S	CC7		LTE 1
Cell	X)		Operating Band	Band 41	×	TDD	/	TX Meas.
Packet Switc	Connection Est	ablished		Downlink		Uplink	<b>v</b>	
RRC State	Connected		Channel	4081	8 Ch	40818	Ch	LTE 1
SCC1 State	MAC Activated		Frequency	2612.	8 MHz	2612.8	MHz	RX Meas.
			Cell Bandwidth	20.0 MHz	•	20.0 MHz		
			RS EPRE	-85.	0 dBm/15kHz			Go to
Event Log		×	Full Cell BW Pov	v54.	2 dBm			
06:16:44 🕇 State	'Connection Establi	shed 🔺	PUSCH Open Lo				dBm	
	edicated Bearer Es	tablis	PUSCH Closed L	oop Target Power		24.0	dBm	Routing
06:16:43 SCC1: 06:16:41 SCC1:				-	1			
06:16:41 SCC1:			PCC <-> SCC1	Swap				
06-16-30 8 2001-								
			PCC> SCC1	Сору				
UE Info	•		Sched. User de	f. Channels	▼	Multicluster UL		
IMEI	355346630026654				64/256	G-QAM		
IMSI	001010123456063							
	IMS PS Voice prefe	ered C S		Downlink Mul	ticluster 🔲 Up	olink		
UE's Usage S Default Bearer	Data centric IPv4 address IPv6	6 profiv	# RB		100		1	
	192.168.48.129	oprenx	Start RB		0		0	
Dedicated Be	TFT Port Range DL		Mod / TBSI	QPSK 💌	5	QPSK 🔻	10	LTE
<sup>i</sup> 6 (->5, Def	5005 - 5008 / 50		Code Rate / TBS		8760	0.583	144	Signaling
			Throughput	3.478 Mbi	t/s	0.057 M	bit/s	
Detach		SCC1 Off			Send SM	S Inter/II RAT	ntra-	Config

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## Appendix G - LTE Carrier Aggregation



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

- 43	🚸 CMW 500 V 3.8.12 - LTE Measurement - X3.8.12.48 - TX Measurement									
$\overline{\mathbf{O}}$	Multi Evaluation	PRACH O	SRS							
TD	D Freq.: 2593.0 MHz	Ref. Level:	41.00 dBm	BW:20.0 MH	z CP :Norr	mal Me	as Subfr./Slo	t <b>0/A</b>	AII	
ТХ	Measurement									
			Current		Average		LAUGING		Subev	
	VM RMS [%] I/h	0.70	0.75	0.74	0.79	1.13	0.99	0.09	0.06	
	VM Peak [%] I/h	1.80	2.34	1.97	2.34	5.62	3.44	0.37	0.36	
E	VM DMRS [%] I/h	0.72	0.71	0.85	0.96	1.28	1.47	0.16	0.22	
M	Err RMS [%] I/h	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	
M	Err Peak [%] I/h	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	
M	Err DMRS [%] I/h	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	
P	hErr RMS [°] I/h	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	
P	hErr Peak [°] I/h	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	
P	hErr DMRS [°] I/h	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	
IC	Offset [dBc]		-70.19		-72.51		-65.49		5.47	
IC	Gain Imbalance [dB]		NCAP		NCAP		NCAP		NCAP	
IC	Quadrature Error [°]		NCAP		NCAP		NCAP		NCAP	
F	req Error [Hz]		3.51		0.63		9.37		3.76	
Ti	ming Error [Ts]		-6.50		-6.34		-6.82		0.16	
0	BW [MHz]		2.21		2.20		2.21		0.00	
			Current		Average	Min	Max		StdDev	
T)	(Power [dBm]		12.62		12.66	12.59	12.76		0.05	
P	eak Power [dBm]		20.43		19.93	19.14	20.69		0.60	
R	B Power [dBm]		9.80		9.82	9.76	9.90		0.05 🕶	
Sta	itistic Count Ou	ut of Toleranc	e Det	ected Modulat	ion Detec	ted Channe	I Type View F		about	
	100 / 100		.00 %		PSK		SCH	100.0 %	Subar	
	PS: »_ Connec	tion Establis	hed s	CC State:MA	C Activated					
9	🥐 📃 🔼 RRC SI	tate: Conr	nected	o o otato.mAt	- totratou					

## LTE Downlink Carrier Aggregation - Output Power measurement procedures

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

LTE Signaling 1 - Configuration	
◆ PCC ● SCC1 ● SCC2 ◇ SCC3 ◇ SCC4 ◇	SCC5 SCC6 SCC7
Path: Scenario	
Duplex Mode	) 🔻 Use Carrier Specific: 🔽
- Scenario	arch 3CC - 1x1 1x1 1x1
Base Band Unit	1 1CC - 1x1 1CC - nx2
Intraband Contiguous UL	Edit 1CC - nx4
Downlink Power Levels	2CC - 1x1 1x1 2CC - nx2 nx2 2CC - nx4 nx2
Open Loop Nominal Power	2CC - nx2 nx4 Bm@F2CC - nx4 nx4
□ Advanced PRACH/OL Power	3CC - 1x1 1x1 1x1
Enable Advanced Settings	3CC - nx2 1x1 1x1
Reference Signal Power	Bm
Preamble Initial Received	dBm
P0 Nominal PUSCH Pathloss Compensation Alpha	3m
Toggle P0-UE-PUSCH at RR	
Pathloss	0 dB
Expected PRACH Preamble	dBm
Expected OL Power	dBm
Dentropy TDC Control (TPC)	Puura
	dBm
Closed Loop Target Power	

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

<rf -="" c<="" connector="" input="" output="" p=""></rf>	onverter for PCC>	<rf connector="" convert<="" output="" p="" –=""></rf>	ter for SCC1/SCC2>
□ ◆RF Output (TX)			
Connector	RF1COM 🔻		
Converter	RFTX1 🔻		
External Attenuation	0.00 dB		
External Delay Compensation	0 ns	□ RF <u>Settings</u>	
🖻 🔷 RF Input (RX)		🖨 🔶 RF Output (TX)	
Connector	RF1COM 🔻	Connector	RF1COM 🔻
Converter	RFRX1 🔻	Converter	RFTX1 🔻
External Attenuation	0.00 dB	External Attenuation	0.00 dB
External Delay Compensation	0 ns	External Delay Compensation	0 ns

## 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	g 1 - X3.8.12.48					×	LTE
Connection Stat	us		I PCC I SCC1	SCC2 SCC3 SC	C4 SCC5 S	CC6 SCC7		
Cell	<b>(12)</b>		Operating Band	Band 66	-	FDD	/	LTE 1 TX Meas.
Packet Switched	Connection	Established		Downlink	l	Jplink		
RRC State	Connected		Channel	67036	Ch	132572	Ch	LTE 1
SCC1 State	OFF		Frequency	2170.0	MHz	1770.0	MHz	RX Meas.
SCC2 State	OFF		Cell Bandwidth	20.0 MHz	-	20.0 MHz		
			RS EPRE	-85.0	dBm/15kHz			0-1-
Event Log		×	Full Cell BW Pow	54.2 (	dBm			Go to
06:36:17  SCC2:	Off		PUSCH Open Loo	p Nom.Power		23	dBm	
06:36:17 SCC2:			PUSCH Closed L	oop Target Power		24.0	dBm	
06:36:17  SCC2:								Routing
06:36:16 SCC1:								
06:36:16 SCC1: 06:36:16 SCC1:								
00.30.100 3001.		•	Sched. User def	. Channels	▼			
UE Info	•							
1								
IMEI	355346630026	654					_	
IMSI	001010123456			-		64/256-QA		
	. IMS PS Voice p	refered CS Voi		Downlink Multiclus		Multicluste		
UE's Usage Setti. Default Bearer	IPv4 address	IPv6 prefix	# RB		100		1	
	. 192.168.48.129	•	Start RB		0		0	
	r TFT Port Range		Mod / TBSI	QPSK 💌	5	QPSK 💌	10	LTE
<sup>i</sup> 6 (->5, Defaul	t) 5005 - 5008		Code Rate / TBS	0.000	8760	0.583	144	Signaling
		Þ	Throughput	8.734 MI	bit/s	0.144 MI	bit/s	
Detach	Disconnect		SCC1 activate MAC	Multiple SCC Actions	Send SMS	Inter/In RAT	itra-	Config

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## Appendix G - LTE Carrier Aggregation d RB configurations for SCC1/SCC2

- Sele	ect the SCC	1/SCC	2 tab, set op	erating band,	BW, chan	nel and	RB confi	gurations for
🚸 CMW 500 V 3.8.	.12 - LTE Signaling	1 - X3.8.1	2.48				- ×	LTE
Connection Statu	s		PCC 91 SCC1 Operating Band	SCC2 SCC3 SC Co-location active		FDD	/	LTE 1 TX Meas.
Packet Switc RRC State SCC1 State SCC2 State	Connection Es Connected OFF OFF	stablished	Channel Frequency Cell Bandwidth RS EPRE	2120 20.0 MHz	6 Ch .0 MHz ▼ .0 dBm/15kHz	Uplink	Γ	LTE 1 RX Meas.
Event Log		×	Full Cell BW Pov		.2 dBm			Go to
06:36:17  SCC2: 0 06:36:17  SCC2: 0 06:36:17  SCC2: 0 06:36:17  SCC2: R 06:36:16  SCC1: 0	)n RC Added	-	PCC <-> SCC1	Swap				Routing
06:36:16 SCC1: 0 06:36:16 SCC1: R 06:36:12 SCC2: N UE Info	RC Added	-	PCC> SCC1 Sched. User det	Copy f. Channels				
		3	# RB	Downlink Mu	lticluster ┌─ 100			
Default Bearer	IPv4 address IP	v6 prefix	Start RB		0			
5 (cmw50 1 Dedicated Be T	FT Port Range D		Mod / TBSI Code Rate / TBS Throughput	QPSK 0.330 8.734 Mb	5 8760 it/s			LTE Signaling ON
Detach I	Disconnect		SCC1 activate	Multiple S MAC Actions	CC Send SM		er/Intra- T	Config

🚸 CMW 500 V 3.8.12 - LTE Signaling 1	- X3.8.1	.2.48						LTE
Connection Status		@1 PCC @1 SCC1	SCC2	SCC3 SCC4	SCC5 SC	C6 SCC	.7	
Cell		Operating Band	Band		•	FDD	×	LTE 1 TX Meas.
Packet Switc 🔁 Connection Estal	blished		Down	link		Uplink		
RRC State Connected		Channel		68761	Ch			LTE 1
SCC1 State OFF		Frequency		634.5	MHz			RX Meas.
SCC2 State OFF		Cell Bandwidth	20.0	MHz	•			
		RS EPRE		-85.0	dBm/15kHz	z		Go to
Event Log	×	Full Cell BW Pov	V.	-54.2	dBm			
06:36:17 () SCC2: Off 06:36:17 () SCC2: On 06:36:17 () SCC2: RRC Added 06:36:16 () SCC1: Off		PCC <-> SCC2		Swap				Routing
06:36:16 SCC1: On 06:36:16 SCC1: RRC Added 06:36:12 SCC2: MAC Activated	•	PCC> SCC2 Sched. User de	f. Char	Copy	•			
UE Info         ▼           IMEI         355346630026654           IMSI         001010123456063           Voice Domain         IMS PS Voice preference           UE's Usage S         Data centric           Default Bearer         IPv4 address IPv6 [	prefix UL	# RB Start RB Mod / TBSI Code Rate / TBS	-	PSK ▼ 0.330	cluster ☐ 100 0 5 8760			LTE Signaling
	►	Throughput		8.734 Mbit	s			ON
Detach Disconnect		SCC2 activate	мас	Multiple SCC Actions	Send SN		Inter/Intra- RAT	Config

- Co	nnect and Act	ivate	MAC for all	SCCs				
🚸 CMW 500 V 3.	.8.12 - LTE Signaling 1	- X3.8.1	.2.48					LTE
Connection Stat	tus		@1 PCC @1 SCC1	SCC2 SCC3 SCC	4 SCC5 SCC	6 SCC7		
Cell 🤇	<u>w</u> )		Operating Band	Band 71	•	FDD		LTE 1 TX Meas.
Packet Switc	Connection Esta	blished		Downlink		Uplink		
RRC State	Connected		Channel	68761	Ch			LTE 1
SCC1 State	OFF		Frequency	634.5	MHz			RX Meas.
SCC2 State	OFF		Cell Bandwidth	20.0 MHz	•			
			RS EPRE		dBm/15kHz			
Event Log		×	Full Cell BW Pov		dBm			Go to
			PCC <-> SCC2	Swap	ubiii			
06:36:17 SCC2: 06:36:17 SCC2:		<b></b>	FUU <-> 3002	Swap				
06:36:17 SCC2:								Routing
06:36:16 SCC1:								
06:36:16 SCC1:	On		PCC> SCC2	Сору				
06:36:16 SCC1:			FUU> 3002	Сору	-			
06:36:42 6 5002		🚸 M	ultiple SCC Actions	1.12mmm18			×	
UE Info	-	SCC						
	0550 4000000054		State	Action	_			
	355346630026654 001010123456063	SCC	1 OFF			activate	e MAC	
	IMS PS Voice prefe	scc	2 OFF		- T	activate	e MAC	
UE's Usage S								
	IPv4 address IPv6	1	:Set A				·	
	192.168.48.129	S	CC1 SCC2					
	TFT Port Range DL / 5005 - 5008 / 500	Sync	Set B					LTE Signaling
0 ( 0, 00	4	s	CC1 SCC2					
					_	_		
Detach	Disconnect		SCC2 activate	MAC Actions	<sup>C</sup> Send SM		ter/Intra- \T	Config

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

🚸 CMW 500 V 3.8.12 - LTE	Measureme	nt - X3.8.12.4	8 - TX Measurer	ment					LTE
Multi Evaluation     FDD Freq.: 1770.0 MHz     TX Measurement	Ref. Level:					s Subfr./Slot:	0 / AI		Multi Evaluation RUN
EVM RMS [%] I/h EVM Peak [%] I/h EVM DMRS [%] I/h	0.64 1.51 0.61	0.71 2.64 0.65	0.68 1.96 0.61	0.71 2.23 0.60	0.83 3.27 1.02	0.85 3.16 0.90	0.04 0.38 0.10	0.04 0.31 0.09	RF Settings
MErr RMS [%] I/h MErr Peak [%] I/h MErr DMRS [%] I/h PhErr RMS [°] I/h	NCAP NCAP NCAP NCAP	NCAP NCAP NCAP NCAP	NCAP NCAP NCAP NCAP	NCAP NCAP NCAP NCAP	NCAP NCAP NCAP NCAP	NCAP NCAP NCAP NCAP	NCAP NCAP NCAP NCAP	NCAP NCAP NCAP NCAP	Trigger
PhErr Peak [°] I/h PhErr DMRS [°] I/h IQ Offset [dBc]	NCAP NCAP NCAP	NCAP NCAP NCAP -52.22	NCAP NCAP NCAP	NCAP NCAP NCAP -52.32	NCAP NCAP NCAP	NCAP NCAP NCAP -49.92	NCAP NCAP NCAP	NCAP NCAP NCAP 0.85	
IQ Gain Imbalance [dB] IQ Quadrature Error [°] Freq Error [Hz]		NCAP NCAP 0.51		NCAP NCAP 0.09		NCAP NCAP -5.38		NCAP NCAP 1.33	Display
Timing Error [Ts] OBW [MHz]		-6.30 0.27 Current 13.51	l	-5.63 0.27 Average	Min 13.30	-8.52 0.32 Max 13.59		2.54 0.02 StdDev 0.06	
TX Power [dBm] Peak Power [dBm] RB Power [dBm]		13.51 18.40 13.48	L	13.48 18.60 13.46	13.30 17.80 13.37	13.59 19.50 13.50		0.06 0.55 0.03 -	Signaling Parameter
100 / 100	tion Establis	.00 %	ected Modulatio QP S		ed Channel PUS	Type View Fi CH 1	ter Throug 00.0 %	jhput	LTE Signaling ON
Select View									Config

## LTE Downlink 4x4 MIMO - Output Power measurement procedures

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

PCC SCC1 SCC2 SCC3 SCC4	3003 3000 3001	LTE 1 TX Meas.
1		
Duplex Mode	FDD Vse Carrier Specific:	1.75.4
Scenario	Search 1CC - nx4	LTE 1 RX Meas.
Base Band Unit	SUA182 1CC - 1x1	KA MCus.
⊟-RF Settings	100 - nx2	
	2CC - 1x1 1x1	Go to
Connector	RF1COM 2CC - nx2 nx2	
Converter	RFTX1 2CC - nx4 nx2	
External Attenuation	2CC - nx2 nx4 0.00 dB 2CC - nx4 nx4	Doutin
External Delay Compensation	200 - 1124 1124	Routing
⊡ ◆RF Input (RX)	3CC - nx2 1x1 1x1	
Connector	RF1COM 🔻	
Converter	RFRX1 T	
External Attenuation	0.00 dB	
External Delay Compensation		
E RF Frequency	0 115	
Operating Band	Band 66 T	
Additional Frequency Bands		
Channel/Frequency	67036 Ch 2170.0 MHz	
Frequency Offset	0 Hz Use Carrier Specific:	
		LTE
Channel/Frequency		Signaling

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

🚯 LTE Signaling 1 - Configu	uration					×	LTE
C PCC SCC1 SCC2 Path: Base Band Unit	2 SCC3 SCC4		CC6 SCC7				LTE 1 TX Meas.
Duplex Mode		FDD 🔻 Use	e Carrier Spe	cific: 🗌			
F Scenario		Search	1CC - nx4				LTE 1 RX Meas.
Base Band Unit		SUA1&2	-				KA Meds.
E RF Settings E ↔ RF Output (TX) E		RF1COM	Dut 1	Out 2 RF3COM	▼ RF20		Go to
Converter Converter External Atter Converter External Del Converter Converter External Atter Conver Converter Converter Converter Converter Conver Con	enuation ay Compensation	RFTX1 0.00 dB 0 ns	Y	RFTX2	RFT)		Routing
Connector Converter External Atte	enuation ay Compensation	RF1COM RFRX1 0.00 dB 0 ps	•				
B RF Frequency M Operating B Additional Fi B DL M Channe	Band requency Bands I/Frequency	Band 66 67036 Ch 2'		MHz			
E-UL		0 Hz Us ◀	se Carrier Spe	ecific:			LTE Signaling OFF
LTE 1 LTE Signaling 📵 TX Meas.	•						

## - 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.

Overall	PCC	I	SCC1	SCC2	SCC	:3 S	CC4				Extended BLER
<b>♦</b> 🛛 x:	Off	y:		Į x:	Off y:		<b>♦</b> ₿ x:	Of	fy:	_ (	RUN
Mbit/s 15 10	Throughpu Overal Strean Strean	ut: I 1 <mark>1</mark>									
5										Subframes	
-	9500	-8500	) -7500	-6500	-5500	-4500	-3500	-2500	-1500	-500	
			Over	All		Stream	n 1		Strea	m 2	Routing
			Relative	Absolut	е	Relative	Absolute		Relative	Absolute	
ACK			99.99%	1959	B	99.99%	9799		99.99%	9799	1000 March 1
NACK			0.01%		2	0.01%	1		0.01%	1	Display
DTX			0.00%		D	0.00%	0		0.00%	0	
BLER			0.01%			0.01%			0.01%	- mu	
Throug			Relative		lbit/s	Relative	Mbit/	5	Relative	Mbit/s	Marker
Aver	~		99.99%		7.47	99.99%	8.7	3	99.99%	8.73	
Mini Max Subframe	imum		Scheduled:	1	17.38 17.47 CQI PCC						Signaling Parameter
oubirame		300	9800	Stream							1
r P			ction Establishe	ed							LTE Signaling ON
Repetit	ion	Stop	tion Sub	frames							Config

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

🚸 CMW 500 V 3.8.12 - LTI	E Measureme	nt - X3.8.12.4	8 - TX Measure	ment				- ×	LTE
😑 Multi Evaluation 💽	PRACH O	SRS							Multi
FDD Freq.: 1770.0 MHz	Ref. Level:	41.00 dBm	BW: 20.0 MHz	CP :Norma	l Mea	as Subfr./Slot:	0 / AI	I	Evaluation
TX Measurement									RUN
	0.64	0.71	0.68	Average 0.71	0.83	0.85	0.04	0.04	
EVM RMS [%] I/h EVM Peak [%] I/h	1.51	2.64	1.96	2.23	3.27	3.16	0.04	0.04	RF
EVM DMRS [%] I/h	0.61	0.65	0.61	0.60	1.02	0.90	0.30	0.09	Settings
MErr RMS [%] I/h	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	
MErr Peak [%] I/h	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	
MErr DMRS [%] I/h	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	Trigger
PhErr RMS [°] I/h	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	
PhErr Peak [°] I/h	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	
PhErr DMRS [°] I/h	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	
IQ Offset [dBc]	IICAI	-52.22	IICAI	-52.32	IICAI	-49.92	IICAI	0.85	
IQ Gain Imbalance [dB]		NCAP		NCAP		NCAP		NCAP	
IQ Quadrature Error [°]		NCAP		NCAP		NCAP		NCAP	Display
Freq Error [Hz]		0.51		0.09		-5.38		1.33	Display
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 -	Signaling
Ototiotic Count	t of Tolerance	- Date	a ata d Ma dulatia	Detected	Channel	Tune Mieur Fi	lter Throws		Parameter
Statistic Count Ou 100 / 100		e Dete 00 %	ected Modulatio QP		PUS	Type View Fi	100.0 %	Input	
	tion Establis		- up						LTE Signaling
RRC St		nea iected							
	ato. Oom		_	_		_	_		
Select									Config
View									

## 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	200	Restriction	Completely Covered by Measurement Superset	Index	3CC	Restriction	Completely Covered by Measurement Superset
2CC#1	41C			3CC#1	41D		

#### LTE Uplink Carrier Aggregation Combinations

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

UL CA shall be tested based on the worst-case SAR configuration determined from non-CA SAR testing result. The channel BW, channel number, RB Allocation, etc. would be selected to allow contiguous CA of PCC and SCC. Uplink output power for UL CA is the total power measured across the PCC and SCC.

UL CA power measurements were performed with QPSK modulation based on the worst-case standalone SAR. The tune-up limits are provided in table below. The UL CA mode power measurements represent the total power across both carriers. Measurements were made for all supported PCC bandwidths using the channel/RB combination resulting in the highest standalone output power at the least MPR (0 dB). SCCs were set to use configurations similar to the PCC to establish conservative or worst case equivalent SAR test conditions (highest maximum power with MPR of 0 dB).

The standalone power measurement is the power for the PCC in the non-CA mode (i.e. single carrier power). In all cases the UL CA power is less than or equal to the standalone power, which is in accordance with the tune-up limits in table below.

According to November 2017 TCB workshop, Uplink CA SAR Test Guidance as follows;

- a) When the maximum output for UL CA is  $\leq$  standalone LTE mode (without CA)
  - PCC is configured according to the highest standalone SAR configuration tested
  - SCC and subsequent CCs are configured according to procedures used for power measurement and parameters (BW, RB etc.) similar to that used for the PCC.
- b) When the Reported SAR for UL CA configuration, described above, is > 1.2 W/kg, UL CA SAR is also required for all required test channels (PCC based).
- c) UL CA SAR is also required for standalone SAR configurations > 1.2 W/kg when they are scaled to the UL CA power level.

SAR measurement is not required for the 16QAM and 64QAM. When the highest maximum output power for 16QAM and 64QAM is  $\leq$  0.25 dB higher than the QPSK or when the reported SAR for the QPSK configuration is  $\leq$  1.45 W/kg.

			Ва	nds											UL									
RF Exposure	Antonno	E-UTRA CA configuration	PCC	SCC				PCC					SC	C				Standalone			F	PCC + SCC		
conditions	Antenna	(BCS)	1st	2nd	Modulation	RB	Offset	BW	Freq	ch	Modulation	Modulation RB		BW	Freq	ch	MPR	LTE Rel.8	Aggregated	MPR	Tune-Up	CA power	Delta	3GPP
			150	2110	modulation	no	onset		incq	- CII	Wouldton		Offset		incq	CII		LILINCIIO	BW		Limit	(total PCC+SCC)	Denta	Rel.
Head	Ant.B	CA_41C(0)(1)(2)(3)	41C	41C	QPSK	1	0	20	2636.5	41055	QPSK	1	99	20	2616.7	40857	0	24.33	40	0	25.0	24.38	-0.05	16
Bodyworn & Hotspot	Ant.B	CA_41C(0)(1)(2)(3)	41C	41C	QPSK	1	0	20	2593.0	40620	QPSK	1	99	20	2573.2	40422	0	23.55	40	0	24.0	23.30	0.25	16
Head	Ant.F	CA_41C(0)(1)(2)(3)	41C	41C	QPSK	1	0	20	2680.0	41490	QPSK	1	99	20	2660.2	41292	0	19.13	40	0	20.0	19.03	0.10	16
Bodyworn & Hotspot	Ant.F	CA_41C(0)(1)(2)(3)	41C	41C	QPSK	1	0	20	2680.0	41490	QPSK	1	99	20	2660.2	41292	0	21.65	40	0	22.5	21.40	0.25	16

#### Note:

Standalone output power values are referenced from Sec.9.3 in the SAR Part.1 Test Report.

## LTE Release 10 Carrier Aggregation with 4x4 MIMO

Index	200	Restriction	Completely Covered by Measurement Superset	Index	ЗСС	Restriction	Completely Covered by Measurement Superset
2CC#1	[41C]			3CC#1	[41D]		

## 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
41	QPSK	20	41055	2636.5	1/0	24.33	24.27	-0.06

#### 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

			Bar						UL											D	L								LTE Rel 8	LTE Rel 10	
	E-UTRA CA	PCC	SCC1	SCC2	SCC3				PCC					P	cc			sc	:C1			SC	C2			S	C3		Ty Bower	Ty Bower	
•	configutation (BCS)	1st	2nd	3rd	4th	Band	Mode	BW (MHz)	Channel	Freq. (MHz)	RB Allocatio	RB offset	Band	BW (MHz)	Channel	Freq. (MHz)	[dBm]	[dBm]	Delta												
	41C	41C	41C			41	QPSK	20	41055	2636.5	1	0	41	20	41055	2636.5	41	20	41253	2656.3									24.33	24.36	0.03
	41D	41D	41D	41D		41	QPSK	20	41055	2636.5	1	0	41	20	41055	2636.5	41	20	41253	2656.3	41	20	41451	2676.1					24.33	24.45	0.12

#### 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 configutation (BCS)	Bands				-			UL					DL															LTE Rel 8	LTE Rel 10	Delta
	PCC	SCC1	SCC2	SCC3		PCC					PCC				SCC1				SCC2				SCC3				Ty Bower			
	1st	2nd	3rd	4th	Band	Mode	BW (MHz)	Channel	Freq. (MHz)	RB Allocatio	RB offset	Band	BW (MHz)	Channel	Freq. (MHz)	[dBm] [d	[dBm]	Dena												
[41C]	[41C]	[41C]			[41]	QPSK	20	41055	2636.5	1	0	[41]	20	41055	2636.5	[41]	20	41253	2656.3									24.33	24.37	0.04
[41D]	[41D]	[41D]	[41D]		[41]	QPSK	20	41055	2636.5	1	0	[41]	20	41055	2636.5	[41]	20	41253	2656.3	[41]	20	41451	2676.1					24.33	24.41	0.08

## 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.

- END -