

Appendix H. – Power reduction verification

Per the May 2017 TCBC Workshop notes, demonstration of proper functioning of the power reduction mechanism is required to support the corresponding SAR Configurations.

The verification process was divided into two parts:

- 1) Evaluation of output power levels for individual triggering mechanism
- 2) Evaluation of the triggering distances for proximity-based sensors.

1. Power Reduction Verification for Main Ant

The Power verification was performed according to the following procedure:

1. A base station simulator was used to establish a conducted RF connection and output power was monitored. The Power measurements were conformed 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. Step 1 and 2 were repeated for all individual power reduction mechanism and combinations thereof. For the combination cases, one mechanism was switched to a “triggered” state at a time; powers were conformed to be within tolerance after each additional mechanism was activated.

Main Antenna Verification Summary

Mechanism(s)	Mode/Band	Power reduction Mechanism		
		Un-triggered (Max Power)	Triggered (Reduced Power)	Triggered (Reduced Power)
Grip	GSM1900 Voice	29.66		27.83
Grip	GSM/GPRS/EDGE1900 1Tx	29.66		27.73
Grip	GSM/GPRS/EDGE1900 2Tx	27.47		25.47
Grip	GSM/GPRS/EDGE1900 3Tx	25.50		23.50
Grip	GSM/GPRS/EDGE1900 4Tx	24.33		22.55
Hotspot On	GSM1900 Voice	29.66	27.83	
Hotspot On	GSM/GPRS/EDGE1900 1Tx	29.66	27.78	
Hotspot On	GSM/GPRS/EDGE1900 2Tx	27.47	25.49	
Hotspot On	GSM/GPRS/EDGE1900 3Tx	25.50	23.53	
Hotspot On	GSM/GPRS/EDGE1900 4Tx	24.33	22.63	
Hotspot On, Then Grip	GSM1900 Voice	29.66	27.83	27.83
Hotspot On, Then Grip	GSM/GPRS/EDGE1900 1Tx	29.66	27.78	27.78
Hotspot On, Then Grip	GSM/GPRS/EDGE1900 2Tx	27.47	25.49	25.49
Hotspot On, Then Grip	GSM/GPRS/EDGE1900 3Tx	25.50	23.53	23.53
Hotspot On, Then Grip	GSM/GPRS/EDGE1900 4Tx	24.33	22.63	22.63
Grip Then Hotspot on	GSM1900 Voice	29.66	27.83	27.83
Grip Then Hotspot on	GSM/GPRS/EDGE1900 1Tx	29.66	27.73	27.78
Grip Then Hotspot on	GSM/GPRS/EDGE1900 2Tx	27.47	25.47	25.49
Grip Then Hotspot on	GSM/GPRS/EDGE1900 3Tx	25.50	23.50	23.53
Grip Then Hotspot on	GSM/GPRS/EDGE1900 4Tx	24.33	22.55	22.63

1.1 Distance Verification Procedure

Procedures for determining proximity sensor triggering distances

(KDB 616217D04v01r02§6.2)

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

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.

1. 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. Each applicable test position was evaluated. The distance was conformed to be the same or larger (more conservative) than the minimum distances provided by the manufacturer.
2. Step 1 and 2 were repeated for the relevant modes, as appropriate.
3. Steps 1 through 3 were repeated for all distance-based power reduction mechanisms.

For detailed measurement conducted power results, please refer to the Section .11



Proximity Sensor Trigger Distance Assessment KDB 616217 D04§6.2 (Rear / Front / Bottom side)

LEGEND

- Direction of DUT travel for determination of power reduction triggering point
- Direction of DUT travel for determination of full power resumption triggering point

Tissue simulating liquid	Trigger distance - Rear		Trigger distance - Front		Trigger distance - Bottom	
	Moving toward phantom [mm]	Moving away from phantom [mm]	Moving toward phantom [mm]	Moving away from phantom [mm]	Moving toward phantom [mm]	Moving away from phantom [mm]
1900 MHz Tissue	11	12	7	8	13	14

Distance Measurement verification for Proximity sensor

Rear side – EUT Moving toward (Trigger) to the Phantom

Mode	Distance to DUT Output power (dBm)									
	16[mm]	15[mm]	14[mm]	13[mm]	12[mm]	11[mm]	10[mm]	9[mm]	8[mm]	7[mm]
GSM 1900 Voice	29.53	29.46	29.52	29.51	29.48	27.55	27.49	27.53	27.52	27.55
GSM 1900 1Tx	29.51	29.50	29.46	29.51	29.51	27.52	27.51	27.49	27.45	27.50
GSM 1900 2Tx	27.38	27.35	27.33	27.36	27.30	25.29	25.21	25.23	25.27	25.24
GSM 1900 3Tx	25.28	25.27	25.22	25.25	25.22	23.46	23.38	23.42	23.40	23.40
GSM 1900 4Tx	24.11	24.20	24.07	24.24	24.06	22.50	22.58	22.67	22.47	22.47

Rear side – EUT Moving away (Release) from the Phantom

Mode	Distance to DUT Output power (dBm)									
	8[mm]	9[mm]	10[mm]	11[mm]	12[mm]	13[mm]	14[mm]	15[mm]	16[mm]	17[mm]
GSM 1900 Voice	27.49	27.43	27.46	27.49	27.53	29.53	29.41	29.50	29.45	29.43
GSM 1900 1Tx	27.49	27.45	27.48	27.45	27.45	29.48	29.43	29.44	29.46	29.48
GSM 1900 2Tx	25.28	25.19	25.22	25.26	25.23	27.30	27.29	27.31	27.29	27.27
GSM 1900 3Tx	23.43	23.30	23.35	23.38	23.39	25.25	25.20	25.14	25.25	25.18
GSM 1900 4Tx	22.47	22.51	22.62	22.45	22.43	24.10	24.17	24.00	24.24	24.00

Based on the most conservative measured triggering distance of 11 mm, additional Phablet SAR measurements were required at 10mm from rear side for the above modes.

Front side – EUT Moving toward (Trigger) to the Phantom

Mode	Distance to DUT Output power (dBm)									
	12[mm]	11[mm]	10[mm]	9[mm]	8[mm]	7[mm]	6[mm]	5[mm]	4[mm]	3[mm]
GSM 1900 Voice	29.46	29.46	29.46	29.46	29.45	27.50	27.47	27.53	27.44	27.47
GSM 1900 1Tx	29.51	29.45	29.45	29.45	29.50	27.46	27.47	27.44	27.45	27.46
GSM 1900 2Tx	27.30	27.28	27.28	27.30	27.30	25.28	25.14	25.22	25.23	25.20
GSM 1900 3Tx	25.24	25.24	25.15	25.20	25.21	23.46	23.32	23.36	23.38	23.32
GSM 1900 4Tx	24.10	24.17	24.02	24.21	24.02	22.47	22.55	22.65	22.40	22.47

Front side – EUT Moving away (Release) from the Phantom

Mode	Distance to DUT Output power (dBm)									
	4[mm]	5[mm]	6[mm]	7[mm]	8[mm]	9[mm]	10[mm]	11[mm]	12[mm]	13[mm]
GSM 1900 Voice	27.54	27.41	27.53	27.49	27.52	29.52	29.42	29.51	29.43	29.46
GSM 1900 1Tx	27.52	27.44	27.47	27.43	27.45	29.47	29.49	29.42	29.51	29.51
GSM 1900 2Tx	25.22	25.20	25.22	25.26	25.18	27.37	27.32	27.29	27.34	27.24
GSM 1900 3Tx	23.39	23.37	23.36	23.37	23.35	25.24	25.23	25.17	25.25	25.18
GSM 1900 4Tx	22.47	22.55	22.62	22.45	22.47	24.10	24.14	24.03	24.23	24.02

Based on the most conservative measured triggering distance of 7mm, additional Phablet SAR measurements were required at 6mm from Front side for the above modes.

Bottom side – EUT Moving toward (Trigger) to the Phantom

Mode	Distance to DUT Output power (dBm)									
	18[mm]	17[mm]	16[mm]	15[mm]	14[mm]	13[mm]	12[mm]	11[mm]	10[mm]	9[mm]
GSM 1900 Voice	29.46	29.41	29.46	29.49	29.41	27.49	27.44	27.50	27.52	27.53
GSM 1900 1Tx	29.43	29.44	29.38	29.45	29.48	27.46	27.44	27.45	27.40	27.43
GSM 1900 2Tx	27.32	27.35	27.27	27.29	27.28	25.23	25.18	25.20	25.24	25.19
GSM 1900 3Tx	25.24	25.22	25.20	25.23	25.20	23.40	23.33	23.38	23.39	23.38
GSM 1900 4Tx	24.09	24.14	24.03	24.23	24.04	22.44	22.50	22.64	22.41	22.47

Bottom side – EUT Moving away (Release) from the Phantom

Mode	Distance to DUT Output power (dBm)									
	10[mm]	11[mm]	12[mm]	13[mm]	14[mm]	15[mm]	16[mm]	17[mm]	18[mm]	19[mm]
GSM 1900 Voice	27.54	27.47	27.46	27.51	27.51	29.49	29.43	29.47	29.45	29.43
GSM 1900 1Tx	27.49	27.51	27.43	27.41	27.45	29.47	29.49	29.39	29.47	29.43
GSM 1900 2Tx	25.24	25.15	25.21	25.20	25.20	27.33	27.31	27.28	27.35	27.26
GSM 1900 3Tx	23.39	23.32	23.40	23.38	23.37	25.23	25.26	25.14	25.21	25.15
GSM 1900 4Tx	22.42	22.50	22.62	22.41	22.46	24.05	24.13	23.99	24.22	23.99

Based on the most conservative measured triggering distance of 13 mm, additional Phablet SAR measurements were required at 12 mm from Bottom side for the above modes.

1.2 Proximity Sensor Coverage for SAR measurements

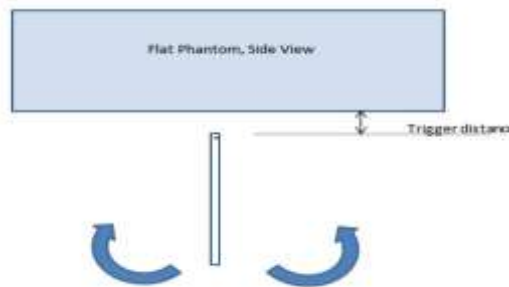
(KDB 616217 D04v01r02§6.3)

As there is no spatial offset between the antenna and the proximity sensor element, proximity sensor coverage did not need to be assessed.

1.3 Proximity Sensor Tilt Angle Assessment

(KDB 616217 D04v01r02 §6.4)

The DUT was positioned directly below the flat phantom at the minimum measured trigger distance with Bottom side parallel to the base of the flat phantom for each band. The EUT was rotated about Bottom side for angles up to $\pm 45^\circ$. If the output power increased during the rotation the DUT was moved 1mm toward the phantom and the rotation repeated. This procedure was repeated until the power remained reduced for all angles up $\pm 45^\circ$.



Proximity sensor tilt angle assessment (Bottom side) KDB 616217 §6.4

Summary of Tablet Tilt Angle influence to Proximity Sensor Triggering (Bottom side)

Tissue	Minimum distance At which power reduction was maintained over-45°	Power reduction status										
		-45°	-40°	-30°	-20°	-10°	0°	10°	20°	30°	40°	45°
1900 MHz Tissue	13 mm	On	On	On	On	On	On	On	On	On	On	On

1.4 Resulting test positions for Phablet SAR measurements

Wireless technologies	Position	§6.2 Triggering Distance [mm]	§6.3 Coverage	§6.4 Tilt Angle	Worst case distance for Phablet SAR [mm]
WWAN (GSM 1900)	Rear	11	N/A	N/A	10
	Front	7	N/A	N/A	6
	Bottom	13	N/A	N/A	12

Note: FCC KDB Publication 616217 D04v01r02 Section 6 was used as a guideline for selecting SAR test distances for this device when being used in phablet use conditions.

2. Power reduction Verification for WLAN Ant

This device uses a power reduction mechanism for SAR compliance for WLAN operations during voice or VoIP held to ear scenarios.

When a user makes or receives a WLAN voice or WLAN VOIP call for WLAN Ant the audio of the call is sent through the Receiver at the top of the device will trigger the Power reduction for WLAN Ant (i.e. reducing output power for Head SAR compliance)

Detailed descriptions of the power reduction mechanism are included in the Main operational description document.

Power Measurement Verification for WLAN

Condition For Power reduction	Wireless Technologies	Conducted Power[dBm]					
		Un-Triggered (Max Power)			Triggered (Reduced Power)		
		Ant1	Ant2	MIMO	Ant1	Ant2	MIMO
RCV-on	2.4 GHz 802.11b	17.97		21.16	12.49		15.44
RCV-on	2.4 GHz 802.11g	16.55		19.76	12.15		15.30
RCV-on	2.4 GHz 802.11n	16.61		19.55	11.94		15.38
RCV-on	2.4 GHz 802.11ax20	16.00		19.14	11.92		15.27
RCV-on	5 GHz 802.11a		15.99	19.23		9.50	12.97
RCV-on	5 GHz 802.11n 20 MHz		16.17	19.37		9.58	12.65
RCV-on	5 GHz 802.11n 40 MHz		13.57	16.81		8.77	12.45
RCV-on	5 GHz 802.11ac 20 MHz		16.15	19.29		9.62	12.94
RCV-on	5 GHz 802.11ac 40 MHz		13.72	16.81		8.90	12.91
RCV-on	5 GHz 802.11ac 80 MHz		11.77	14.65		10.60	13.12
RCV-on	5 GHz 802.11ax 20 MHz		16.88	20.30		9.69	13.08
RCV-on	5 GHz 802.11ax 40 MHz		15.13	18.42		9.21	13.01
RCV-on	5 GHz 802.11ax 80 MHz		13.37	16.32		9.80	13.41

Appendix I. – Down-link CA Power Measurement

1. LTE Down-link Carrier Aggregation Conducted Powers

SAR test exclusion for LTE downlink Carrier Aggregation is determined by power measurements according to the number component carriers(CC)s supported by test 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.

Downlink Carrier aggregation:

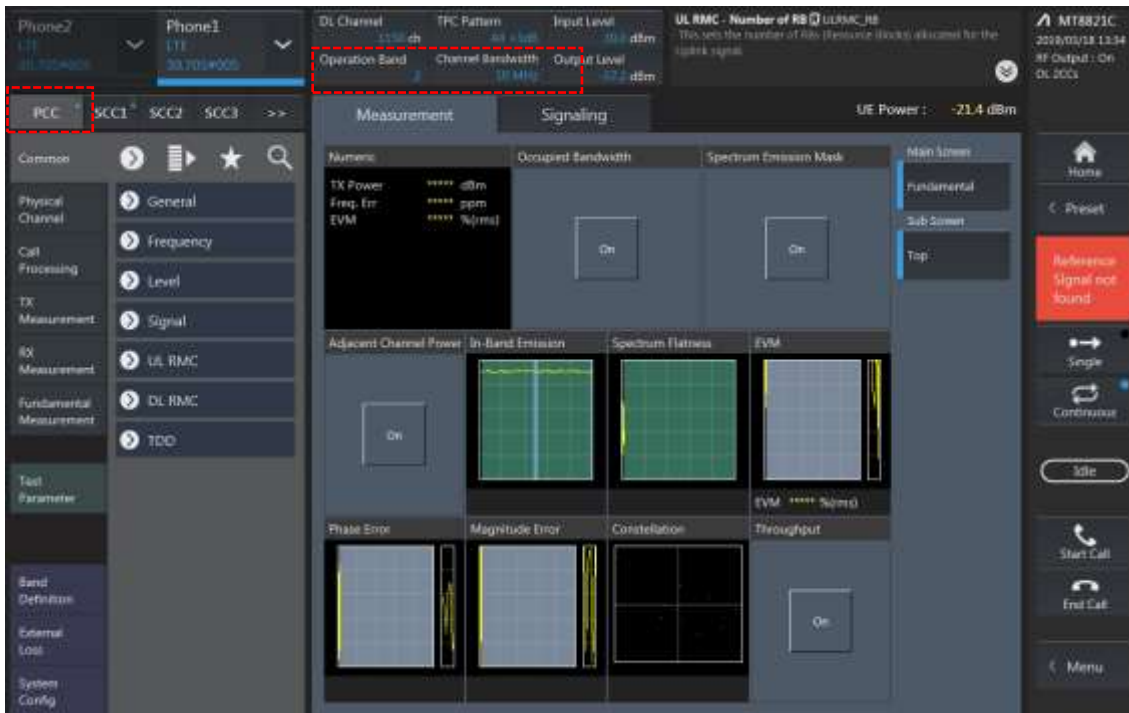
1. This device only supports downlink carrier aggregation. For every supported combination of downlink carrier aggregation, power measurements were performed with the downlink carrier aggregation active for the configuration with highest measured maximum conducted power with downlink carrier aggregation inactive measured among the channel bandwidth, modulation, and RB combinations in each frequency band.
2. All control and acknowledge data is sent on uplink channels that operate identical to specifications when downlink carrier aggregation is inactive.
3. Per FCC KDB publication 941225 D05A v01r02, Section C)3)b)ii), PCC uplink channel was selected at downlink carrier aggregation combinations. The downlink PCC channel was paired with the selected PCC uplink channel according to normal configurations without carrier aggregation.
4. For continuous intra-band carrier aggregation, the downlink channel spacing between the component carriers was set to multiple of 300kHz less than the nominal channel spacing defined in section 5.4.1A of 3GPP TS 36.521.
5. For non-continuous intra-band carrier aggregation, 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.
6. All selected downlink channels remained fully within the downlink transmission band of the respective component carrier.



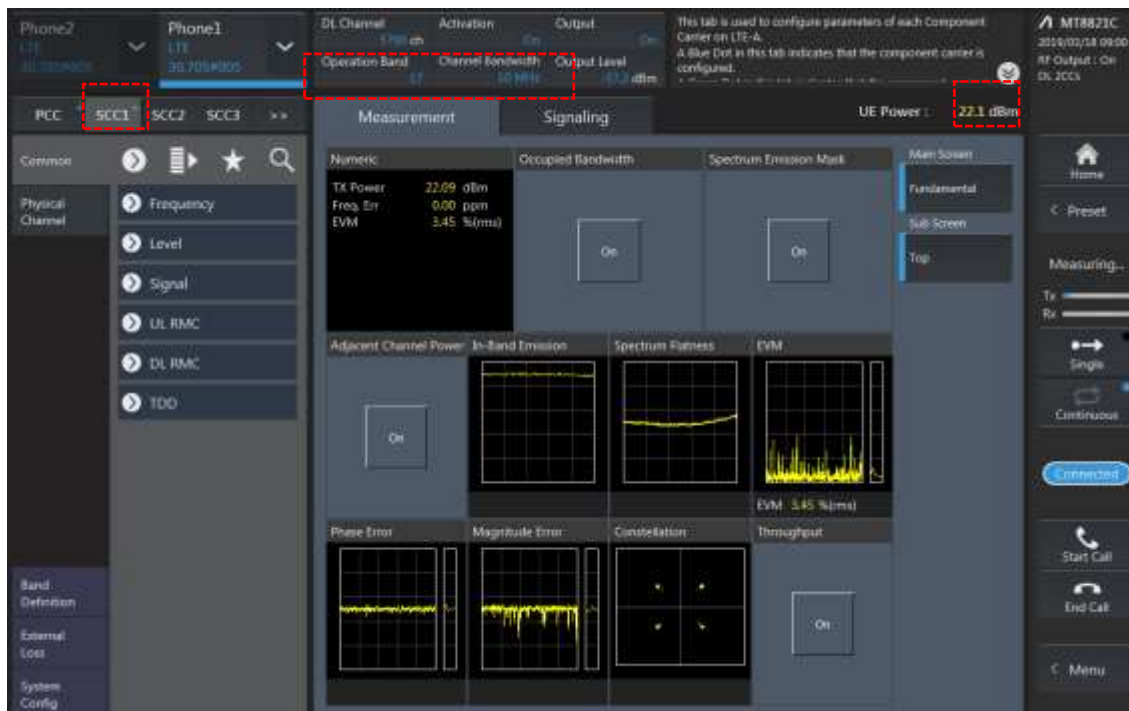
Power Measurement setup

LTE Down Link 2CA Call Setup

PCC Setting: Channel/ RB/ BW/ Modulation



SCC Setting: Channel/ RB/ BW/ Modulation and call Connection

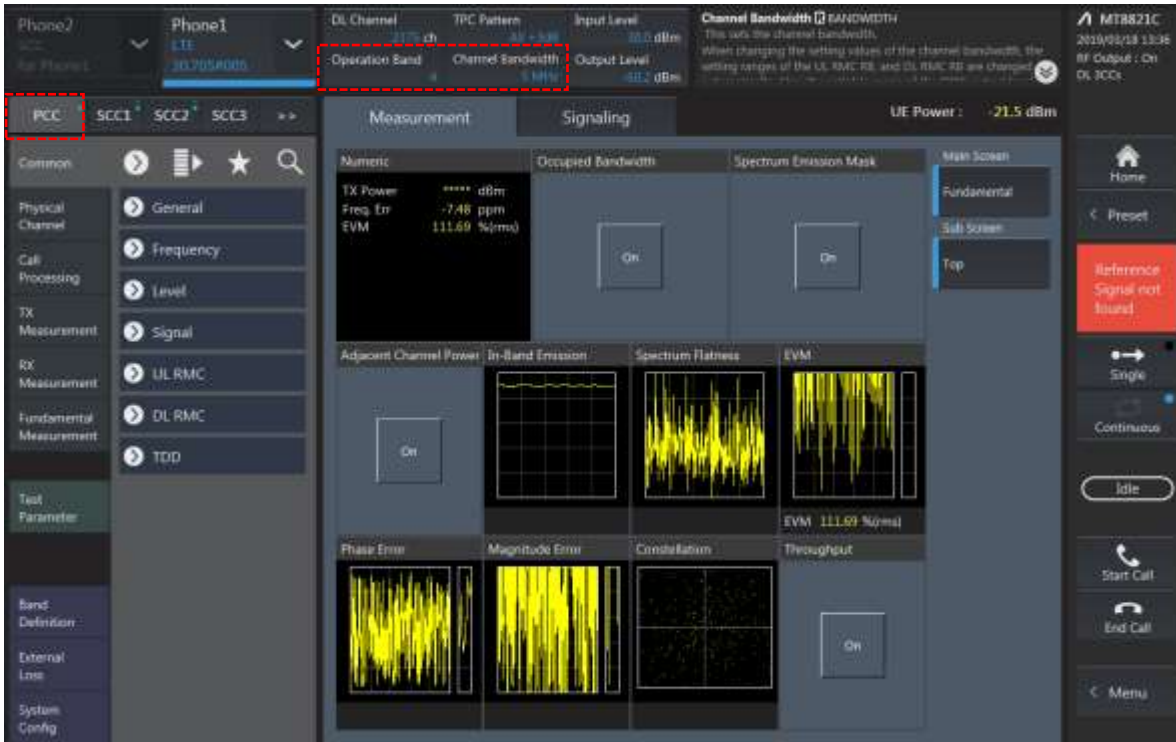


2CA Downlink Carrier aggregation Maximum conducted Powers

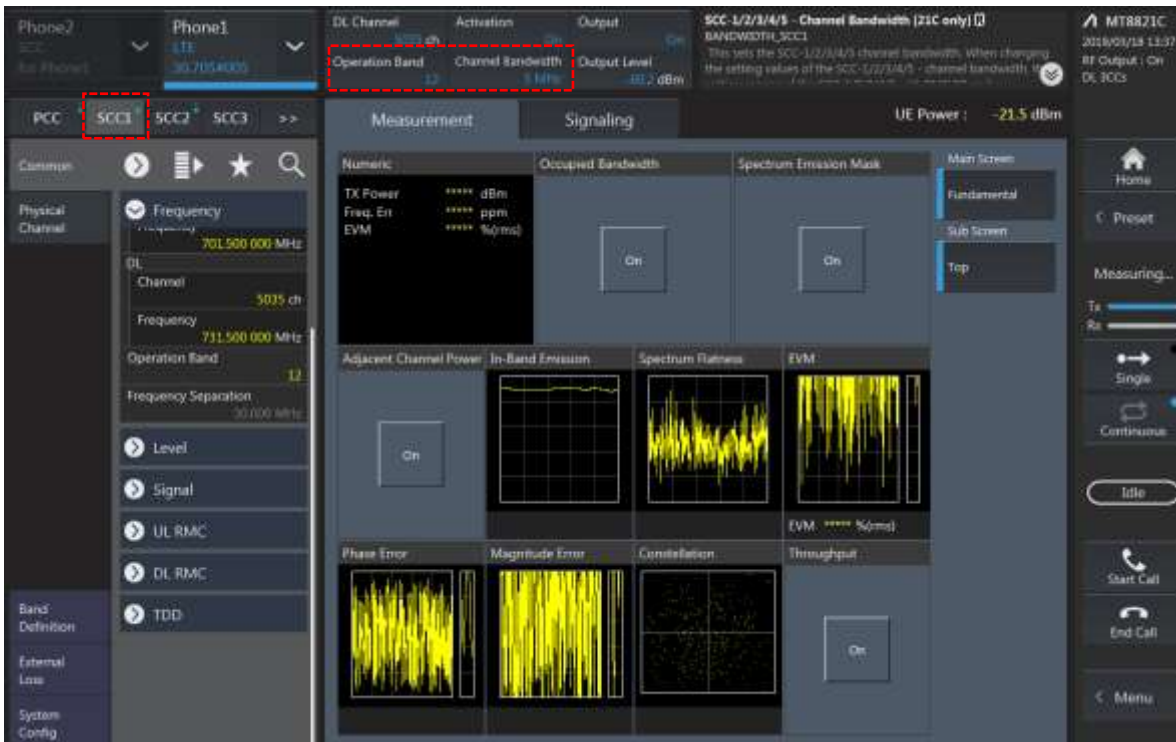
Combination	PCC									SCC				Tx Power		Delta (2)-(1)
	Band	BW	PCC UL Ch.	PCC UL Freq.	PCC DL Ch.	PCC DL Freq.	Modul ation	RB	RB offset	Band	BW	SCC DL Ch.	SCC DL Freq.	LTE Single Carrier Tx Power (dBm) (1)	LTE Tx Power with DL CA Enabled (dBm) (2)	
41A-41A	41	20	40620	2593	40620	2593	QPSK	1	49	41	20	41490	2680	23.33	23.27	-0.06
41C	41	20	40620	2593	40620	2593	QPSK	1	49	41	20	40818	2612.8	23.33	23.24	0.09

LTE Down Link 3CA Call Setup

1) PCC Setting: Channel /RB/BW/Modulation



2) SCC1 Setting: Channel /RB/BW/Modulation



3) SCC2 Setting (Channel /RB/BW/Modulation) and call Connection

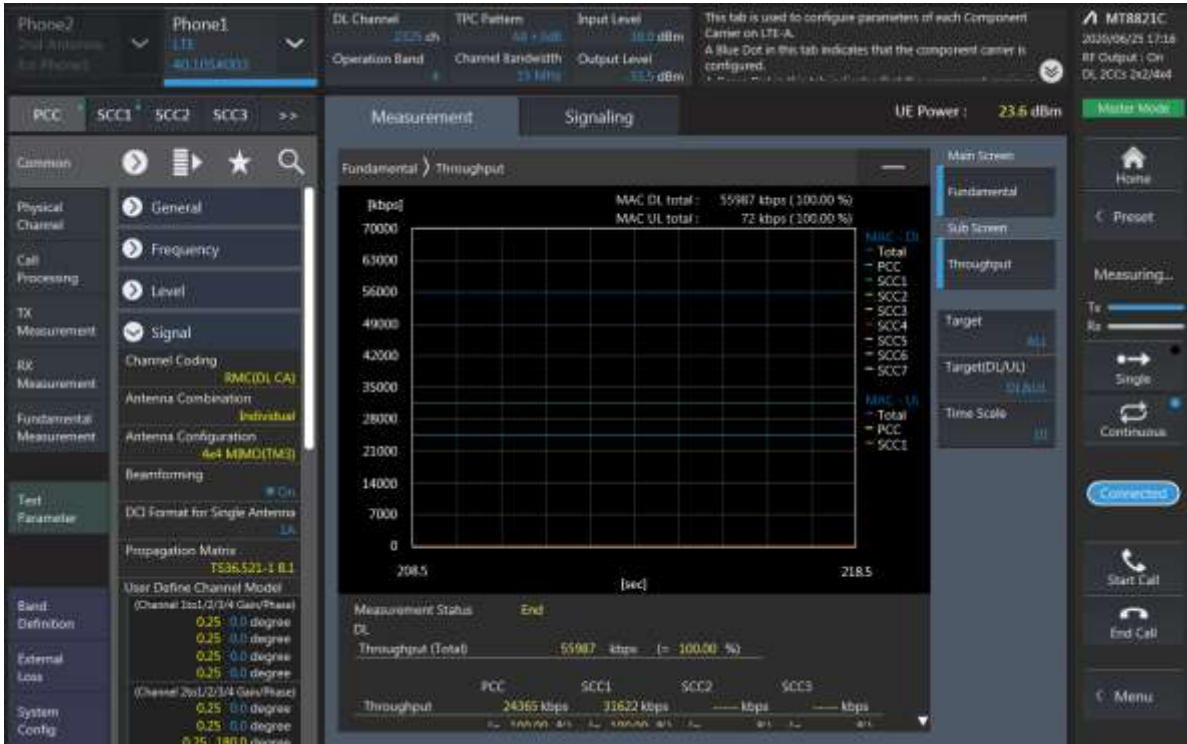


3CA Downlink Carrier aggregation Maximum conducted Powers

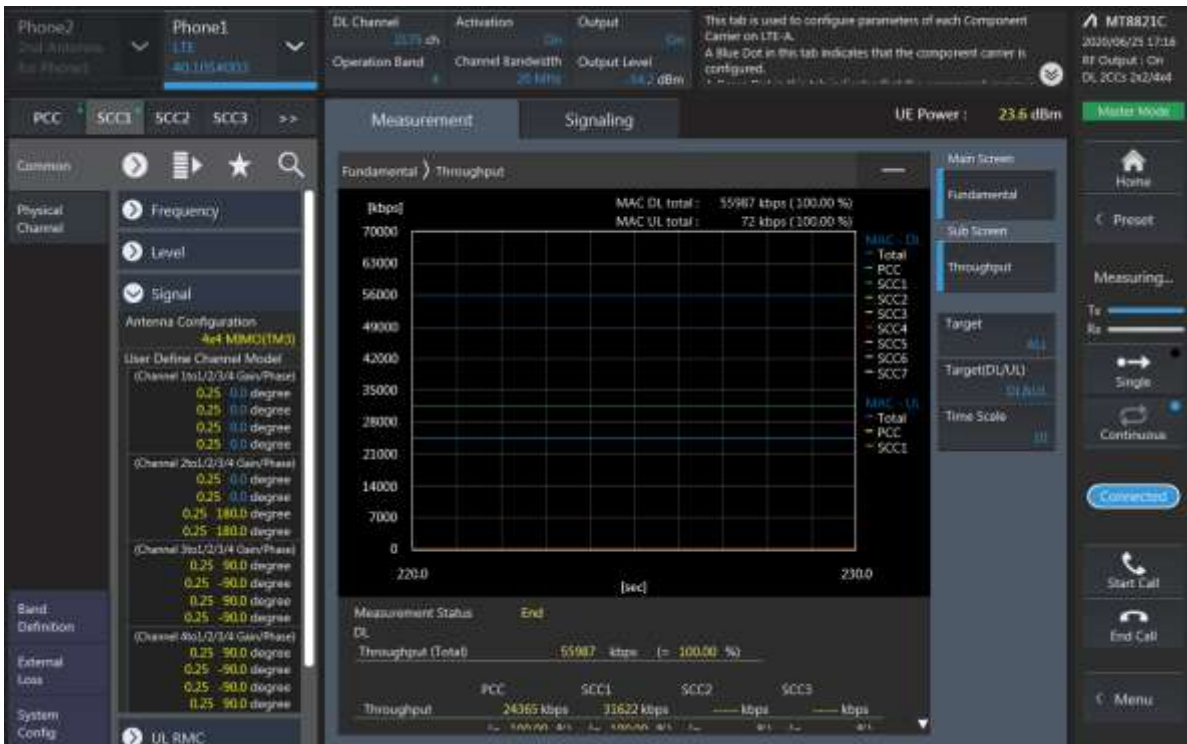
Combination	PCC									SCC				SCC				Tx Power		Delta (2)-(1)
	Band	BW	PCC UL Ch.	PCC UL Freq.	PCC DL Ch.	PCC DL Freq.	Modulation	RB	RB offset	Band	BW	SCC DL Ch.	SCC DL Freq.	Band	BW	SCC DL Ch.	SCC DL Freq.	LTE Single Carrier Tx Power (dBm) (1)	LTE Tx Power with DL CA Enabled (dBm) (2)	
41D	41	20	40620	2593	40620	2593	QPSK	1	49	41	20	40818	2612.8	41	20	41016	2632.6	23.33	23.30	-0.03

LTE Down Link 2CA 4x4 MIMO Call Setup

PCC Setting: Channel/ RB/ BW/ Modulation



SCC Setting: Channel/ RB/ BW/ Modulation and call Connection

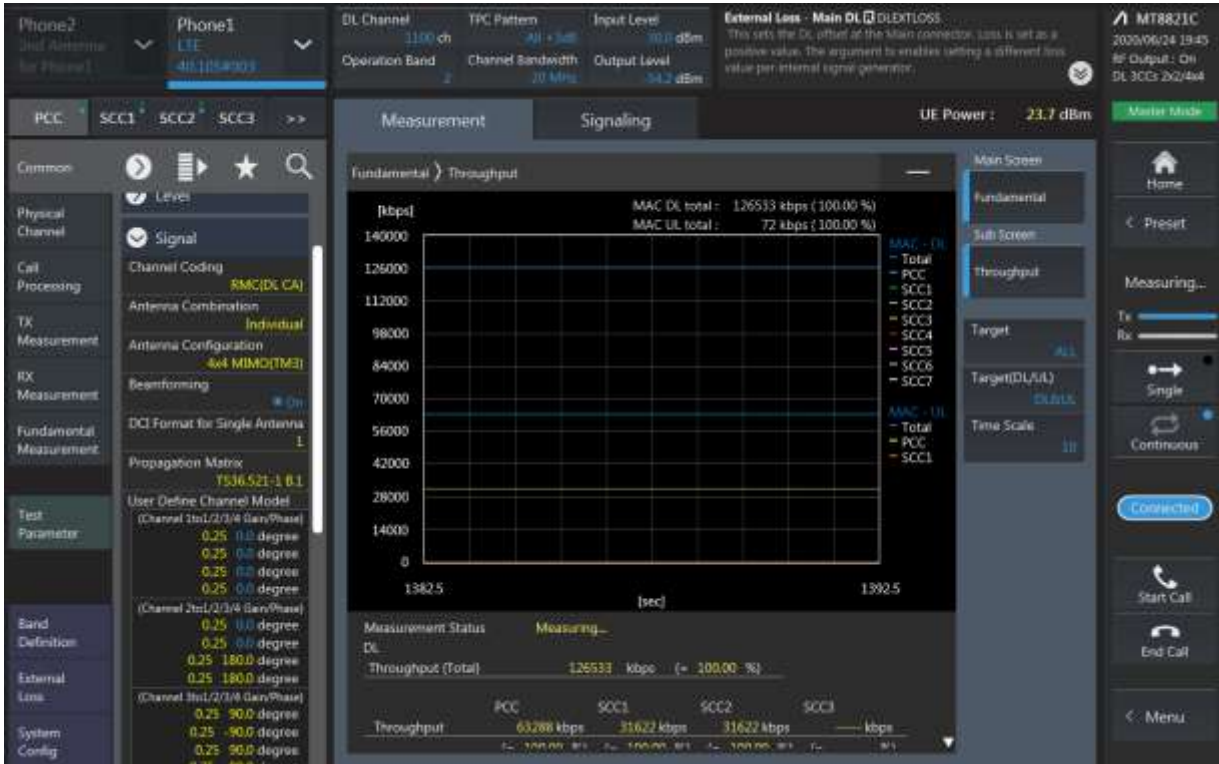


LTE Downlink 2CA 4X4 MIMO Maximum Conducted Power

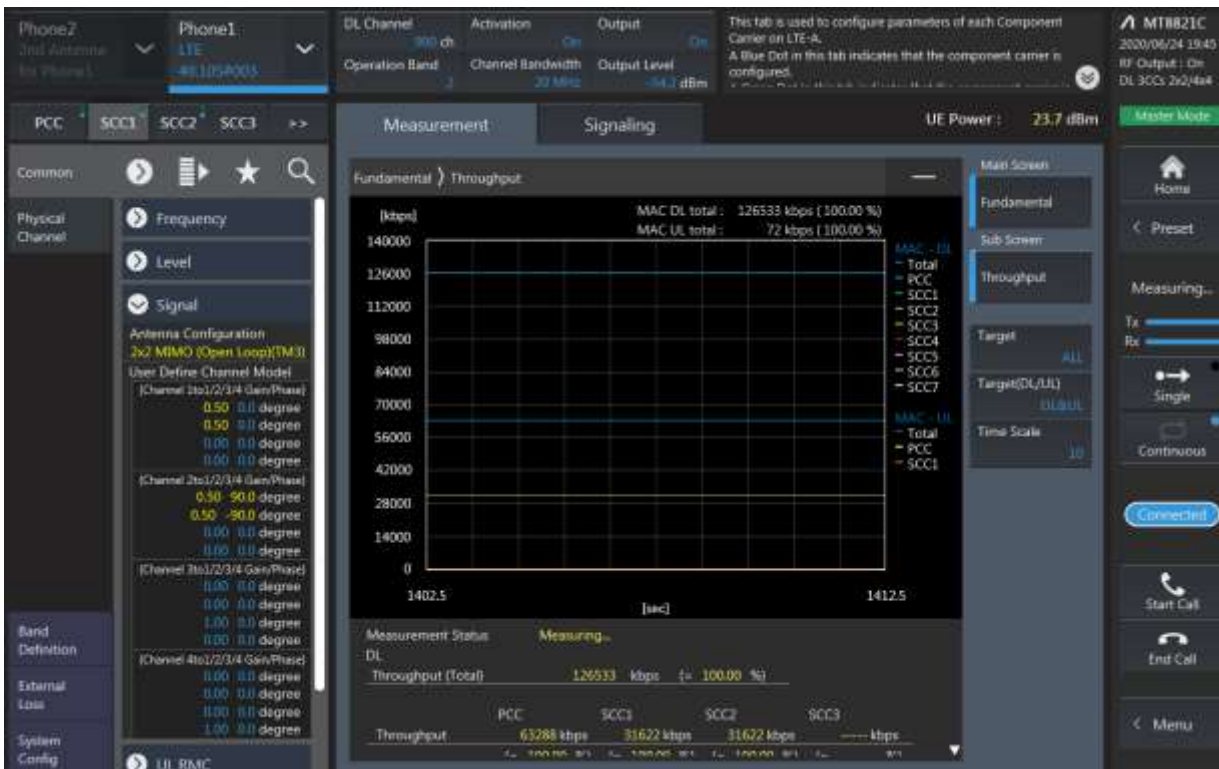
Combination	PCC									SCC				Tx Power		Delta (2)-(1)
	Band	BW	PCC UL Ch.	PCC UL Freq.	PCC DL Ch.	PCC DL Freq.	Modul ation	RB	RB offset	Band	BW	SCC DL Ch.	SCC DL Freq.	LTE Single Carrier Tx Power (dBm) (1)	LTE Tx Power with DL CA Enabled (dBm) (2)	
[41A]-41A	41	20	40620	2593	40620	2593	QPSK	1	49	41	20	41490	2680	23.33	23.32	-0.01
41A-[41A]	41	20	40620	2593	40620	2593	QPSK	1	49	41	20	41490	2680	23.33	23.31	-0.02
[41A]-[41A]	41	20	40620	2593	40620	2593	QPSK	1	49	41	20	41490	2680	23.33	23.23	-0.10
[41C]	41	20	40620	2593	40620	2593	QPSK	1	49	41	20	40818	2612.8	23.33	23.28	0.05

LTE Down Link 3CA 4x4 MIMO Call Setup

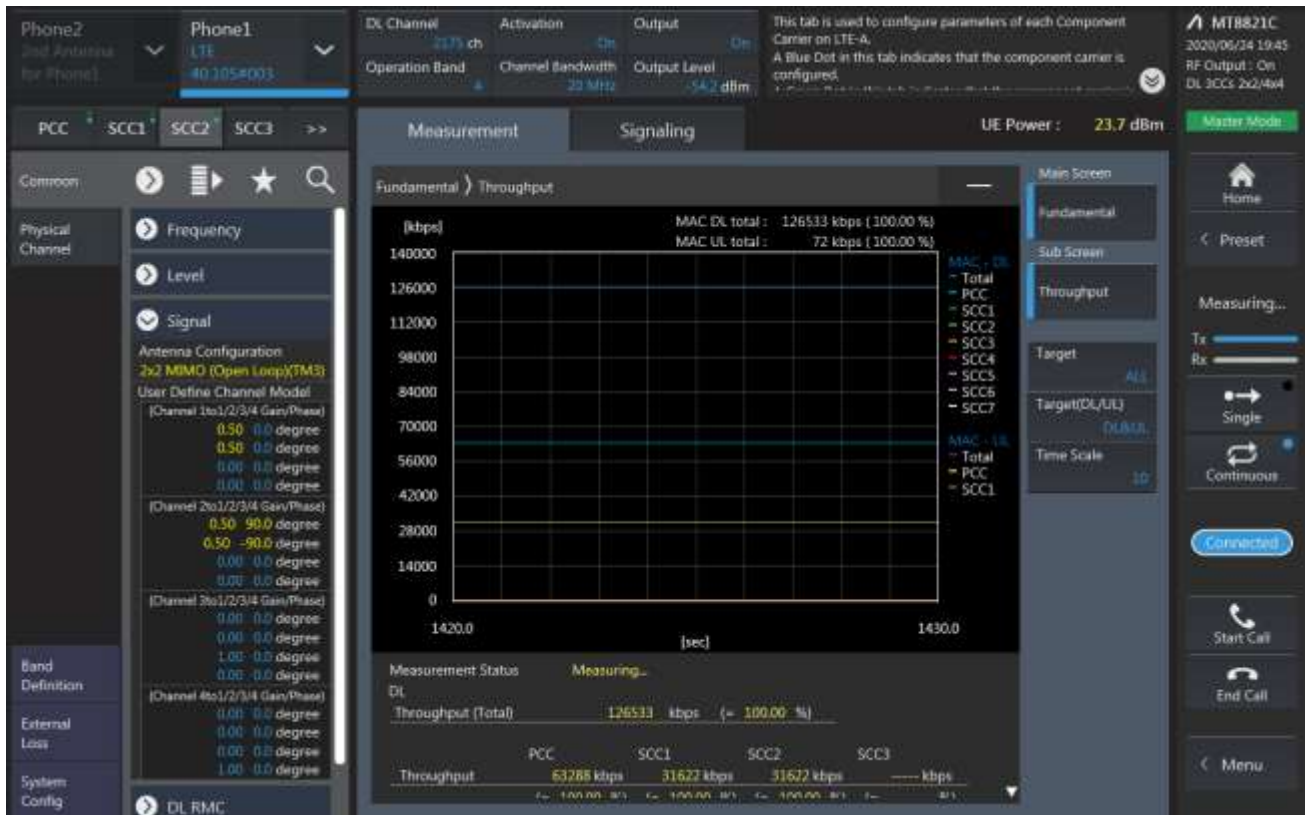
PCC Setting: Channel /RB/BW/Modulation



SCC1 Setting: Channel /RB/BW/Modulation



SCC2 Setting: (Channel /RB/BW/Modulation) and call Connection



LTE Downlink 3CA 4X4 MIMO Maximum Conducted Power

Combination	PCC									SCC				SCC				Tx Power		Delta (2)-(1)
	Band	BW	PCC UL Ch.	PCC UL Freq.	PCC DL Ch.	PCC DL Freq.	Modulation	RB	RB offset	Band	BW	SCC DL Ch.	SCC DL Freq.	Band	BW	SCC DL Ch.	SCC DL Freq.	LTE Single Carrier Tx Power (dBm) (1)	LTE Tx Power with DL CA Enabled (dBm) (2)	
[41D]	41	20	40620	2593	40620	2593	QPSK	1	49	41	20	40818	2612.8	41	20	41016	2632.6	23.33	23.24	-0.09