

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

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	Conducted Power (dBm)		
		Un-triggered (Max Power)	Triggered (Reduced Power)	Triggered (Reduced Power)
Grip	WCDMA B4	23.16	20.89	
Grip	WCDMA B2	23.54	20.26	
Grip	LTE Band 2	22.91	20.16	
Grip	LTE Band 41	22.67	20.63	
Hotspot On	GSM/GPRS/EDGE 850	31.87	29.56	
Hotspot On	GSM/GPRS/EDGE 1900	29.33	26.95	
Hotspot On	WCDMA B4	23.16	21.23	
Hotspot On	WCDMA B2	23.54	20.19	
Hotspot On	LTE Band 2	22.91	20.16	
Hotspot On	LTE Band 4	22.48	20.69	
Hotspot On	LTE Band 41	22.67	17.79	
Hotspot On, Then Grip	GSM/GPRS/EDGE 850	31.87	29.56	29.56
Hotspot On, Then Grip	GSM/GPRS/EDGE 1900	29.33	26.95	26.95
Hotspot On, Then Grip	WCDMA B4	23.16	21.23	21.23
Hotspot On, Then Grip	WCDMA B2	23.54	20.19	20.19
Hotspot On, Then Grip	LTE Band 2	22.91	20.16	20.16
Hotspot On, Then Grip	LTE Band 4	22.48	20.69	20.69
Hotspot On, Then Grip	LTE Band 41	22.67	17.79	17.79
Grip, then Hotspot On	WCDMA B4	23.16	20.89	21.23
Grip, then Hotspot On	WCDMA B2	23.54	20.26	20.19
Grip, then Hotspot On	LTE Band 2	22.91	20.16	20.16
Grip, then Hotspot On	LTE Band 41	22.67	20.63	17.79

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:

1. A base station simulator was used to establish an RF connection and to monitor the power levels. The device being tested was placed below the relevant section of the phantom with the relevant side or edge of the device facing toward the phantom.
2. The device was moved toward and away from the phantom to determine the distance at which the mechanism triggers and the output power is reduced, per KDB Publication 616217 D04v01r02 .Each applicable test position was evaluated. The distance were conformed to be the same or larger (more conservative) than the minimum distances provided by the manufacturer.
3. Step 1 and 2 were repeated for the relevant modes, as appropriate
4. Steps1 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 / Left side/ 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 – Left side		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]
1750MHz Tissue	8	9	NA	NA	4	5
1900MHz Tissue	8	9	NA	NA	4	5
2600MHz Tissue	11	12	7	8	NA	NA

Distance Measurement verification for Proximity sensor

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

Mode	Distance to DUT Output power (dBm)									
	13[mm]	12 [mm]	11[mm]	10[mm]	9[mm]	8[mm]	7[mm]	6[mm]	5[mm]	4[mm]
WCDMA B4	23.06	23.18	23.10	23.22	23.25	20.87	20.81	20.99	20.83	20.83
WCDMA B2	23.45	23.62	23.55	23.57	23.49	20.32	20.25	20.27	20.34	20.26
LTE Band 2	22.94	22.83	22.93	22.90	22.89	20.08	20.07	20.08	20.24	20.17

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]
LTE Band 41	22.69	22.69	22.63	22.76	22.69	20.66	20.68	20.66	20.69	20.72

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

Mode	Distance to DUT Output power (dBm)									
	5[mm]	6[mm]	7[mm]	8[mm]	9[mm]	10[mm]	11mm]	12[mm]	13[mm]	14[mm]
WCDMA B4	20.82	20.98	20.93	20.95	20.97	23.10	23.16	23.23	23.15	23.12
WCDMA B2	20.32	20.30	20.27	20.25	20.33	23.47	23.61	23.49	23.56	23.54
LTE Band 2	20.06	20.09	20.26	20.14	20.13	22.94	22.87	22.82	22.90	22.87

Based on the most conservative measured triggering distance for WCDMA B4/2, and LTE 2 of 8mm, additional Phablet SAR measurements for WCDMA B4/2, and LTE 2 were required at 7mm from rear side for the above modes

Mode	Distance to DUT Output power (dBm)									
	8[mm]	9[mm]	10[mm]	11[mm]	12[mm]	13[mm]	11mm]	12[mm]	13[mm]	14[mm]
LTE Band 41	20.55	20.65	20.54	20.55	20.65	22.77	22.65	22.74	22.71	22.57

Based on the most conservative measured triggering distance for LTE B41 of 11mm, additional Phablet SAR measurements for LTE B41 were required at 10mm from rear side for the above modes

Left 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]
LTE Band 41	22.75	22.64	22.62	22.74	22.72	20.60	20.70	20.61	20.72	20.62

Left 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]
LTE Band 41	20.72	20.53	20.58	20.55	20.53	22.70	22.58	22.61	22.63	22.63

Based on the most conservative measured triggering distance for LTE B41 of 7mm, additional Phablet SAR measurements for LTE B41 were required at 6mm from Left side for the above modes

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

Mode	Distance to DUT Output power (dBm)									
	9[mm]	8 [mm]	7[mm]	6[mm]	5[mm]	4[mm]	3[mm]	2[mm]	1[mm]	0[mm]
WCDMA B4	23.18	23.24	23.23	23.21	23.18	20.90	20.84	20.85	20.87	20.88
WCDMA B2	23.54	23.51	23.45	23.49	23.46	20.34	20.28	20.24	20.33	20.18
LTE Band 2	22.82	22.96	22.93	22.87	22.97	20.08	20.09	20.14	20.20	20.06

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

Mode	Distance to DUT Output power (dBm)									
	1[mm]	2[mm]	3[mm]	4[mm]	5[mm]	6[mm]	7mm]	8[mm]	9[mm]	10[mm]
WCDMA B4	20.98	20.82	20.99	20.99	20.85	23.15	23.18	23.23	23.15	23.25
WCDMA B2	20.32	20.33	20.29	20.35	20.21	23.60	23.50	23.50	23.58	23.53
LTE Band 2	20.18	20.22	20.17	20.12	20.12	22.85	22.94	22.86	22.81	23.00

Based on the most conservative measured triggering distance of 4mm, additional Phablet SAR measurements for WCDMA B4/2, and LTE 2 were required at 3mm from Bottom side for the above modes

1.2 Proximity Sensor Coverage for SAR measurements

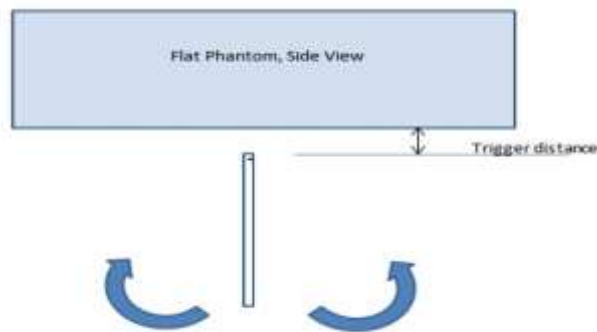
(KDB 616217 D04v01r02§6.3)

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 to $\pm 45^\circ$.



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°	
1750 MHz Tissue	4 mm	On	On	On	On	On	On	On	On	On	On	On	On
1900 MHz Tissue	4 mm	On	On	On	On	On	On	On	On	On	On	On	On

1.5 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 (WCDMA B4/ B2 /LTE B2)	Rear	8	N/A	N/A	7
	Bottom	4	N/A	N/A	3
WWAN (LTE B41)	Rear	11	N/A	N/A	10
	Left side	7	N/A	N/A	6

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 RCV-On configuration

This device uses a power reduction mechanism for SAR compliance for LTE B41 operations during voice or VoIP held to ear scenarios.

When a user makes or receives a LTE B41 voice or Vo LTE call for LTE B41 the audio of the call is sent through the Receiver at the top of the device will trigger the Power reduction for LTE B41 (i.e. reducing output power for Head SAR compliance)

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

Condition For Power reduction	Wireless Technologies	Conducted Power[dBm]	
		Un-Triggered (Max Power)	Triggered (Reduced Power)
RCV-on (Voice call)	LTE B41	22.77	20.14

Appendix I. – DLCA 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(CCs) 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:

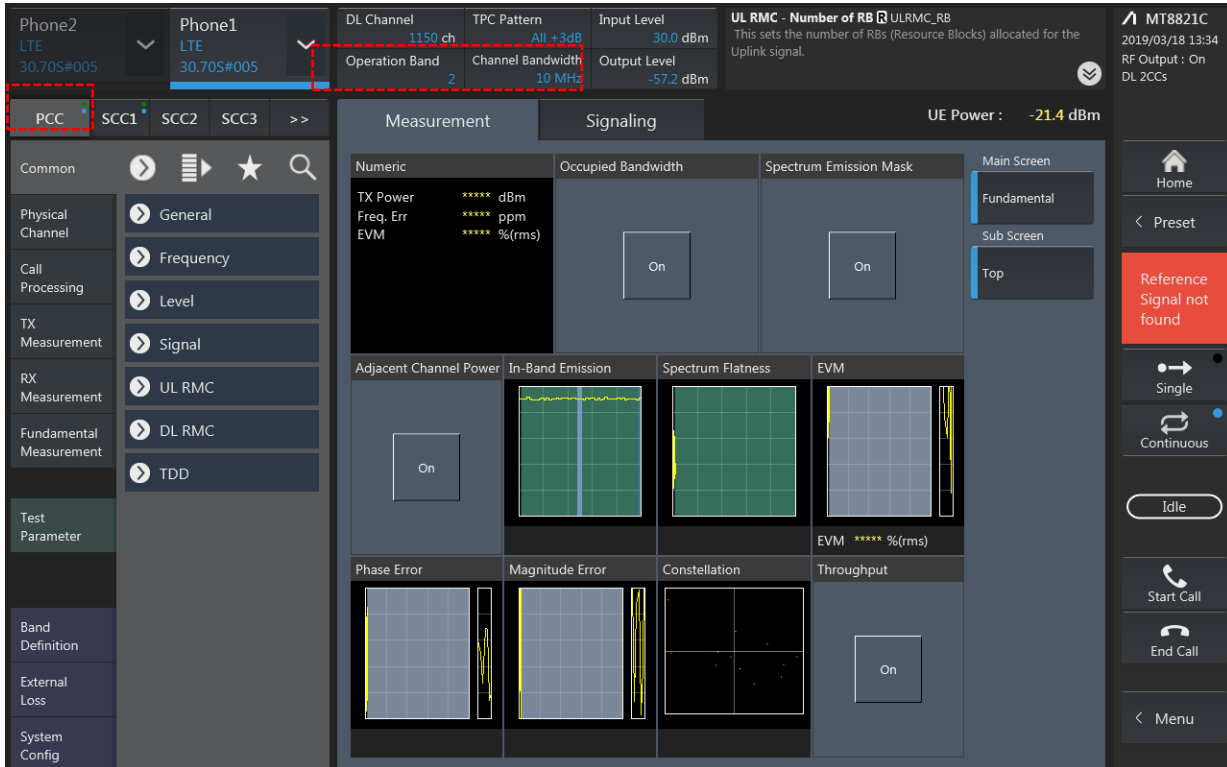
1. This device only supports downlink carrier aggregation. For every supported combination of downlink carrier aggregation, power measurements were performed with the downlink carrier aggregation active for the configuration with highest measured maximum conducted power with downlink carrier aggregation 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.



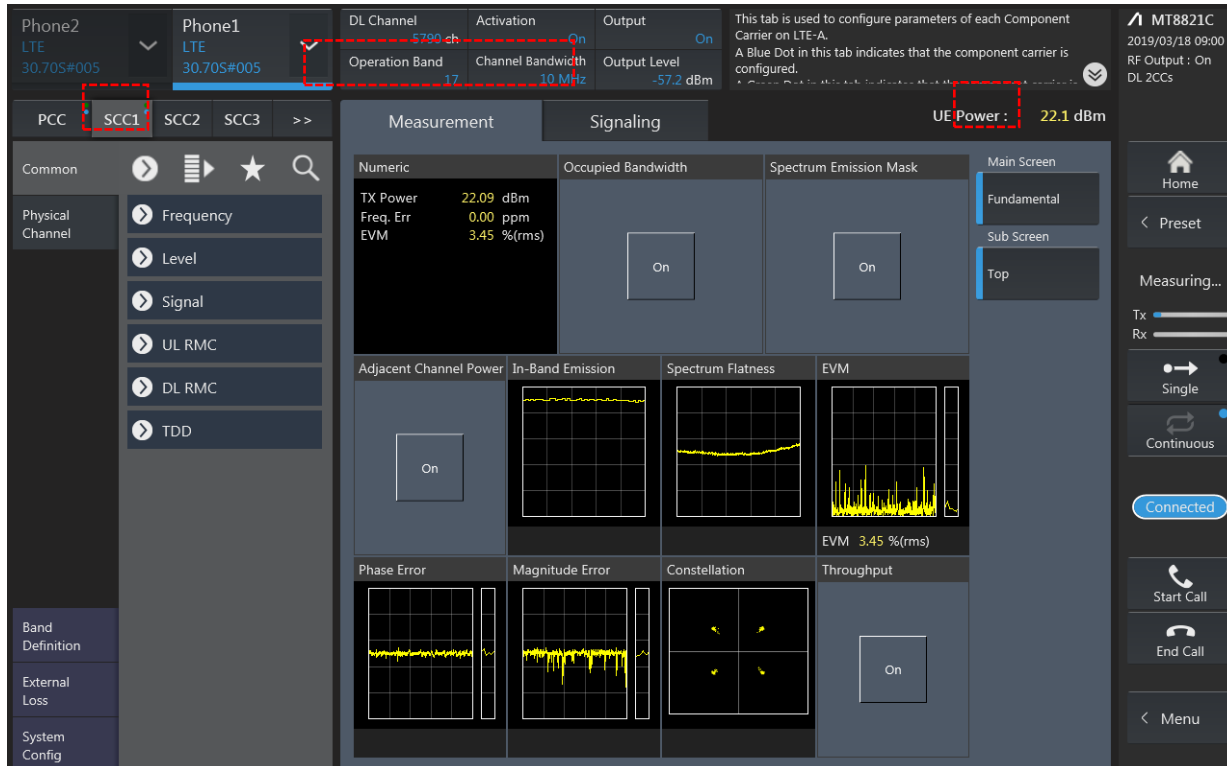
Power Measurement setup

LTE Down Link 2CA Call Setup

PCC Setting : Channel/ RB/ BW/ Modulation



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



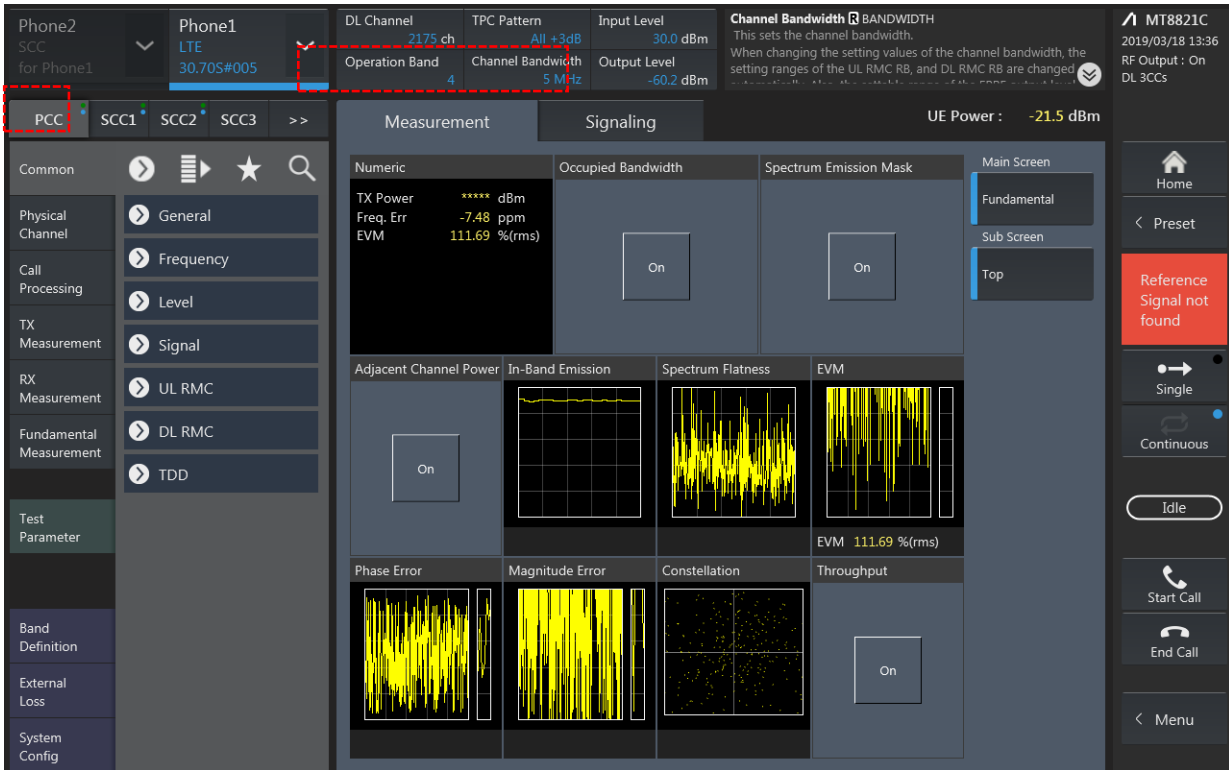
2CA Downlink Carrier aggregation conducted Powers

LTE Downlink 2CA Maximum Conducted Power

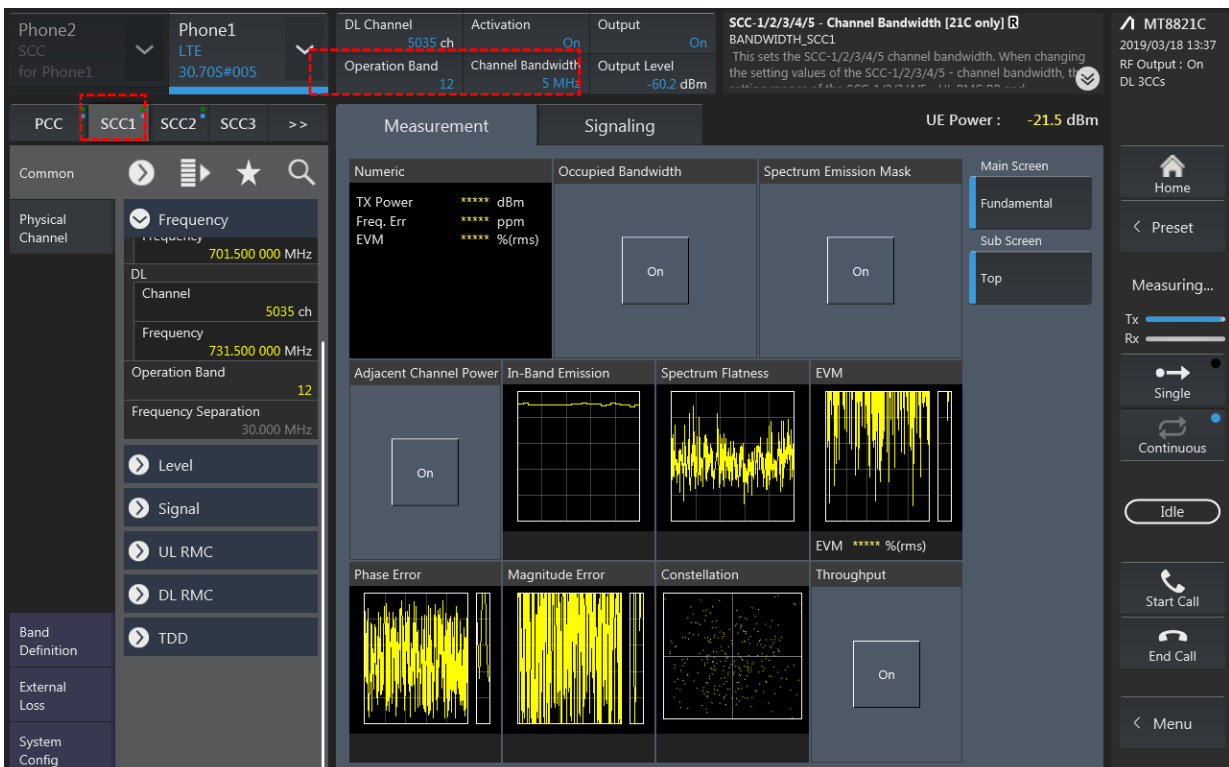
Combination (MAX)	PCC									SCC				Tx Power	
	Band	BW	PCC UL Channel	PCC UL Frequency	PCC DL Channel	PCC DL Frequency	Modulation	RB	offset	Band	BW	SCC DL Channel	SCC DL Frequency	LTE Single Carrier Tx Power (dBm)	LTE Tx Power with DL CA Enabled(dBm)
2A-2A	2	5	18625	1852.5	625	1932.5	QPSK	1	12	2	20	1100	1980	23.3	23.19
2A-12A(0,1,2)	2	5	18625	1852.5	625	1932.5	QPSK	1	12	12	10	5095	737.5	23.3	23.18
2A-12A(0,1)	12	10	23095	707.5	5095	737.5	QPSK	1	0	2	20	900	1960	23.27	23.2
2A-12A(2)	12	10	23095	707.5	5095	737.5	QPSK	1	0	2	10	900	1960	23.27	23.29
4A-4A(0)	4	10	20000	1715	2000	2115	QPSK	1	24	4	20	2300	2145	23.15	23.06
4A-4A(1)	4	10	20000	1715	2000	2115	QPSK	1	24	4	10	2350	2150	23.15	23.12
4A-5A(0,1)	4	10	20000	1715	2000	2115	QPSK	1	24	5	10	2525	881.5	23.15	23.13
4A-5A(0)	5	5	20425	826.5	2425	871.5	QPSK	1	12	4	10	2175	2132.5	24.31	24.04
4A-5A(1)	5	5	20425	826.5	2425	871.5	QPSK	1	12	4	20	2175	2132.5	24.31	24.02
4A-17A	4	10	20000	1715	2000	2115	QPSK	1	12	17	10	5790	740	23.15	23.22
41C(1) PC3	41	5	40620	2593	40620	2593	QPSK	1	12	41	20	40503	2581.3	23.16	23.04
41C(0,2,3) PC3	41	20	40620	2593	40620	2593	QPSK	1	49	41	20	40818	2612.8	23.08	23.06
41A-41A(0,1) PC3	41	5	40620	2593	40620	2593	QPSK	1	12	41	20	41490	2680	23.16	23.01

LTE Down Link 3CA Call Setup

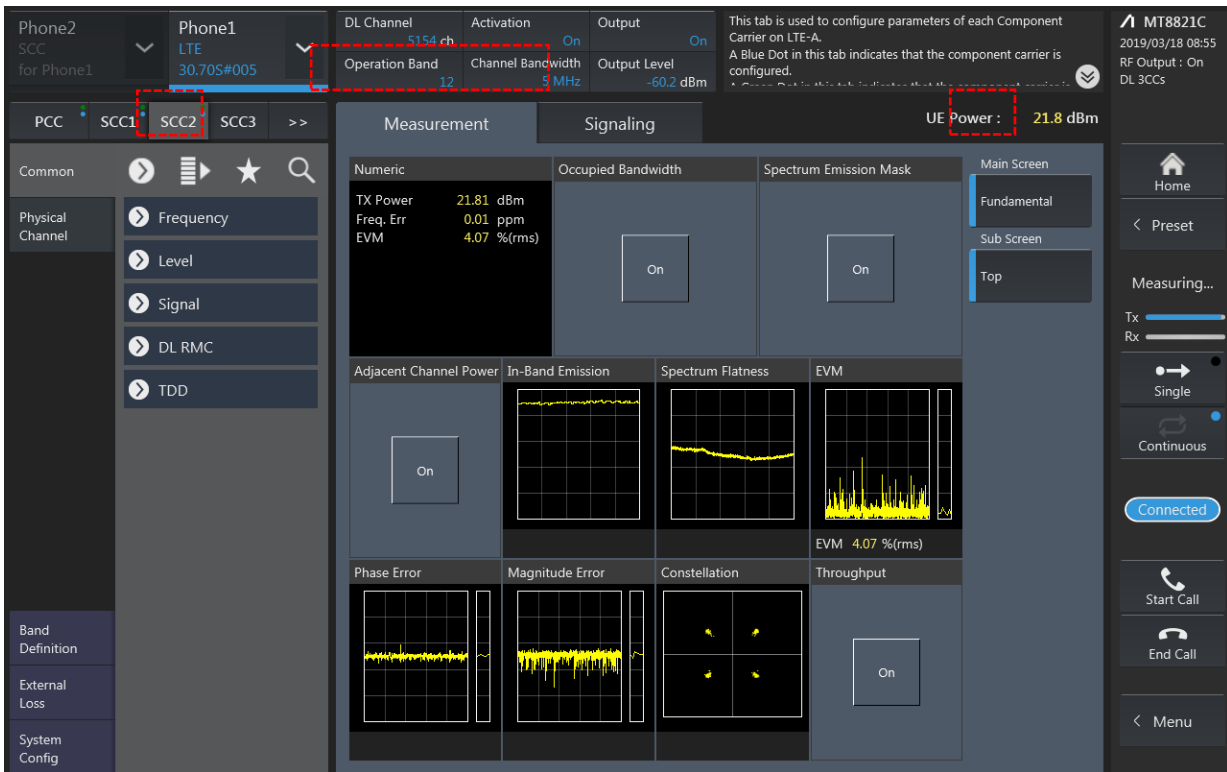
1) PCC Setting: Channel /RB/BW/Modulation



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



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



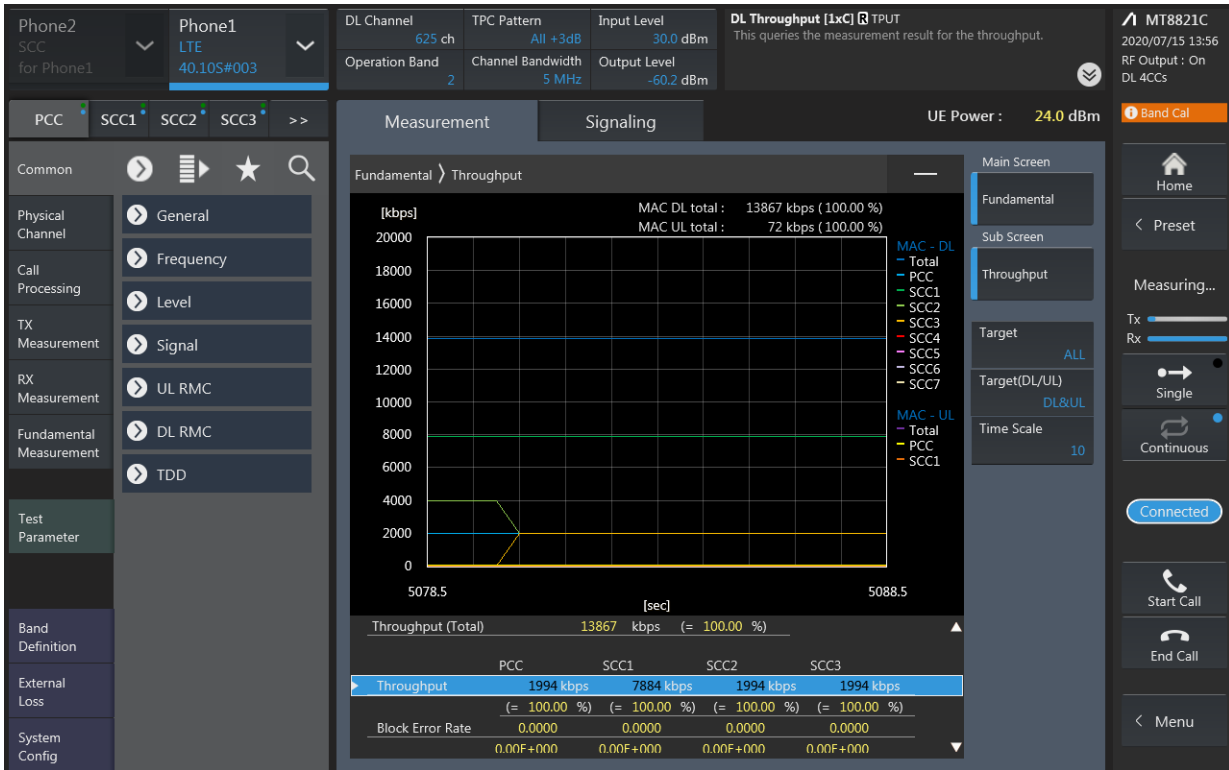
3CA Downlink Carrier aggregation conducted Powers

LTE Downlink 3CA Maximum Conducted Power

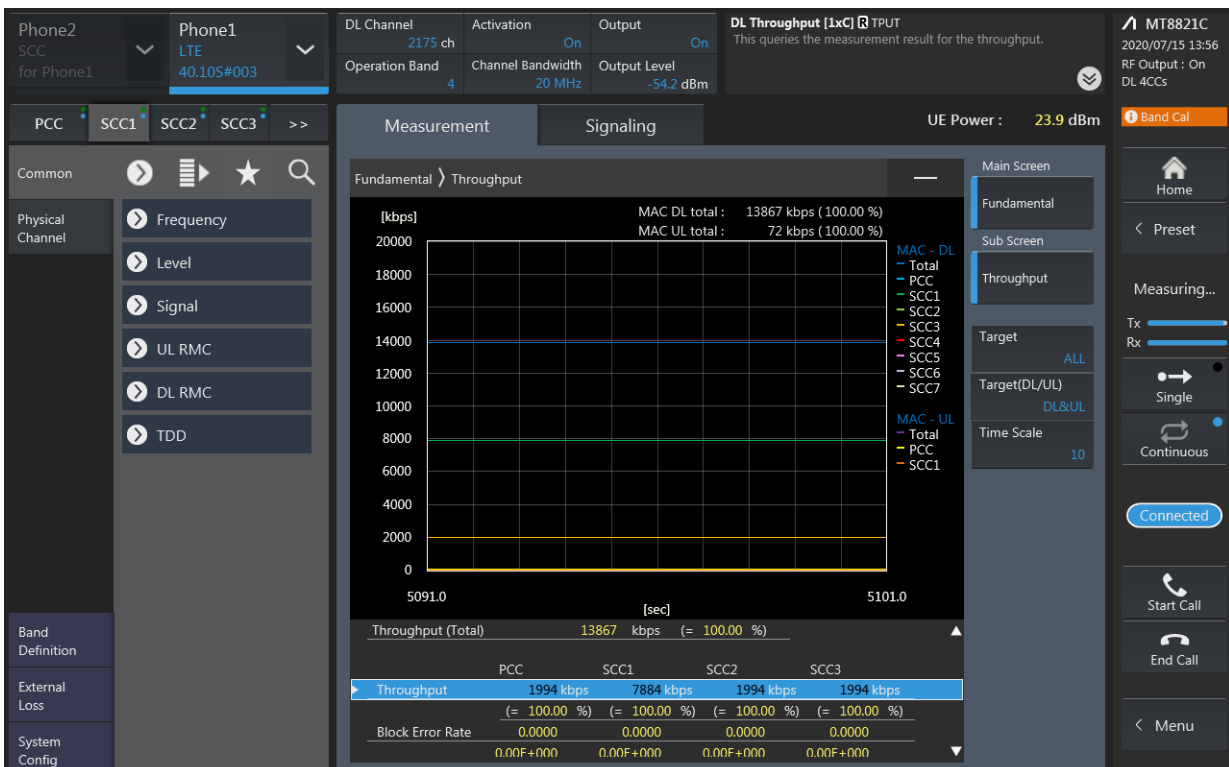
Combination	PCC									SCC				SCC				Tx Power	
	Band	BW	PCC UL Channel	PCC UL Frequency	PCC DL Channel	PCC DL Frequency	Modulation	RB	offset	Band	BW	SCC DL Channel	SCC DL Frequency	Band	BW	SCC DL Channel	SCC DL Frequency	LTE Single Carrier Tx Power (dBm)	LTE Tx Power with DL CA Enabled(dBm)
41A-41C PC3	41	5	40620	2593	40620	2593	QPSK	1	12	41	20	41490	2680	41	20	41292	2660.2	23.16	23.03
41D PC3	41	20	40620	2593	40620	2593	QPSK	1	12	41	20	40818	2612.8	41	20	41016	2632.6	23.08	23.02

LTE Down Link 4CA Call Setup

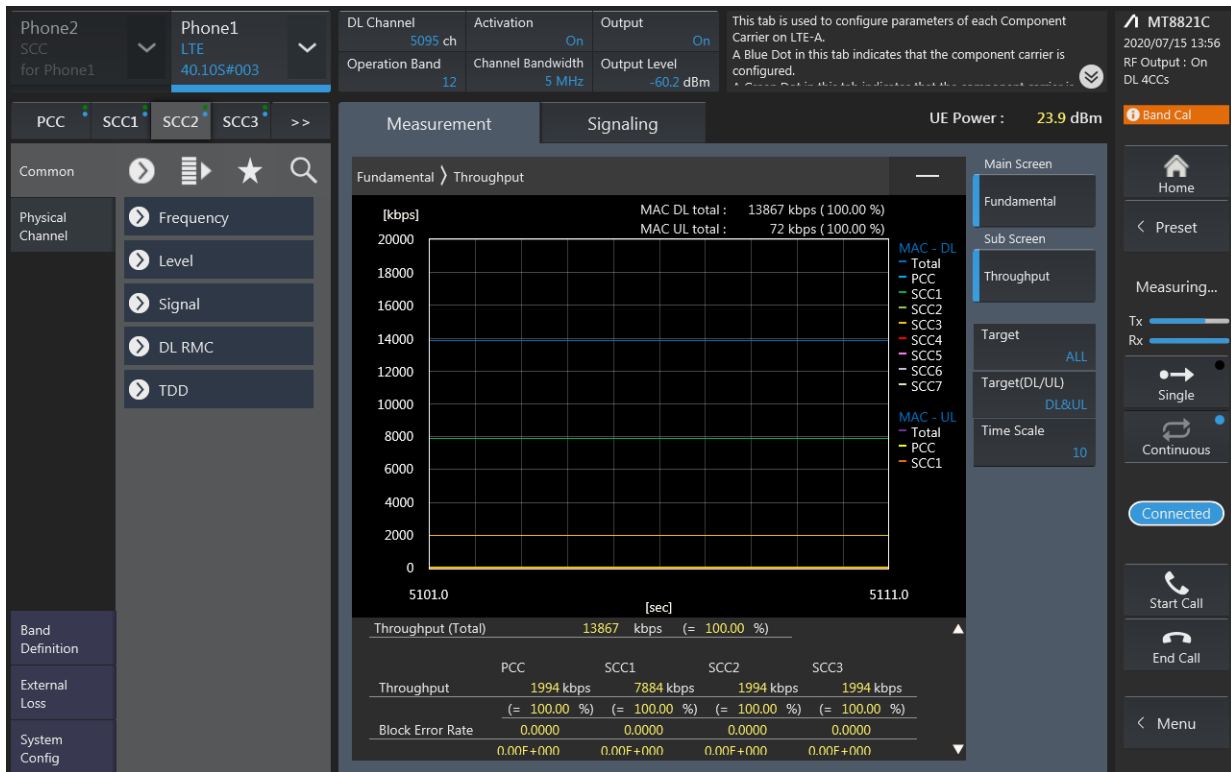
PCC Setting: Channel /RB/BW/Modulation



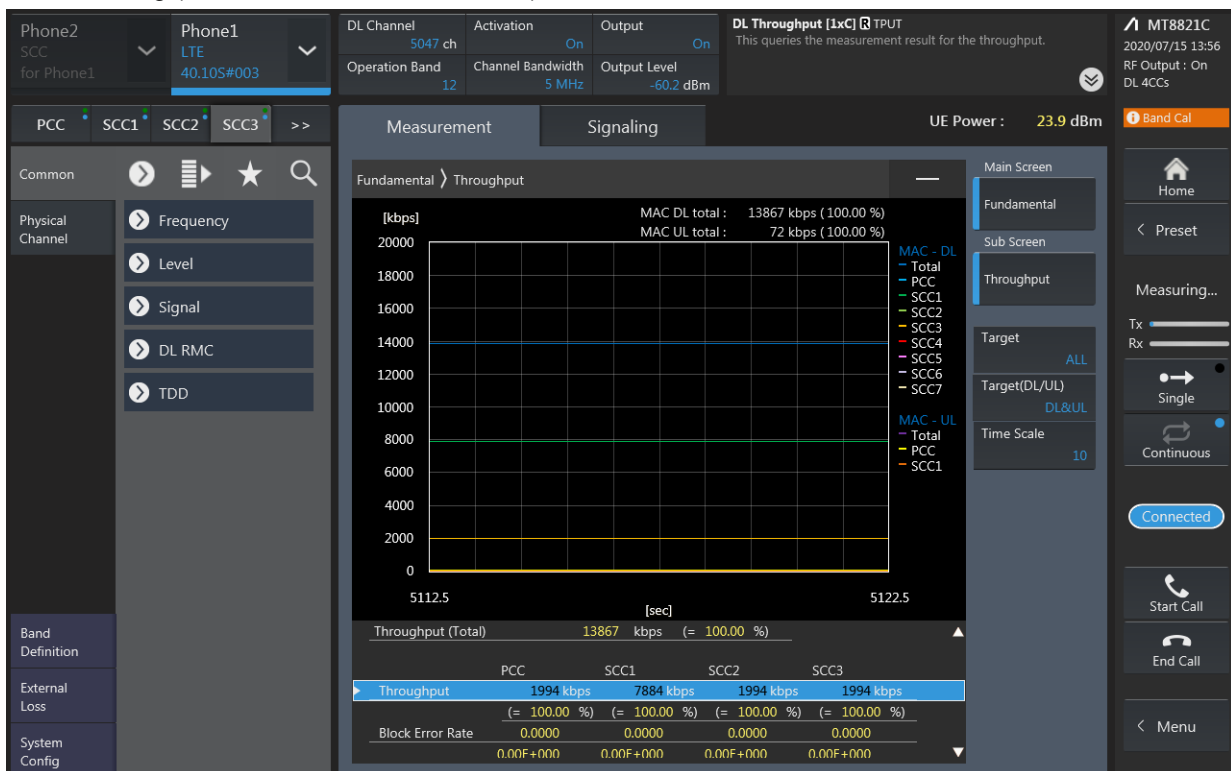
SCC1 Setting (Channel /RB/BW/Modulation)and call Connection



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



SCC3 Setting (Channel /RB/BW/Modulation)and call Connection



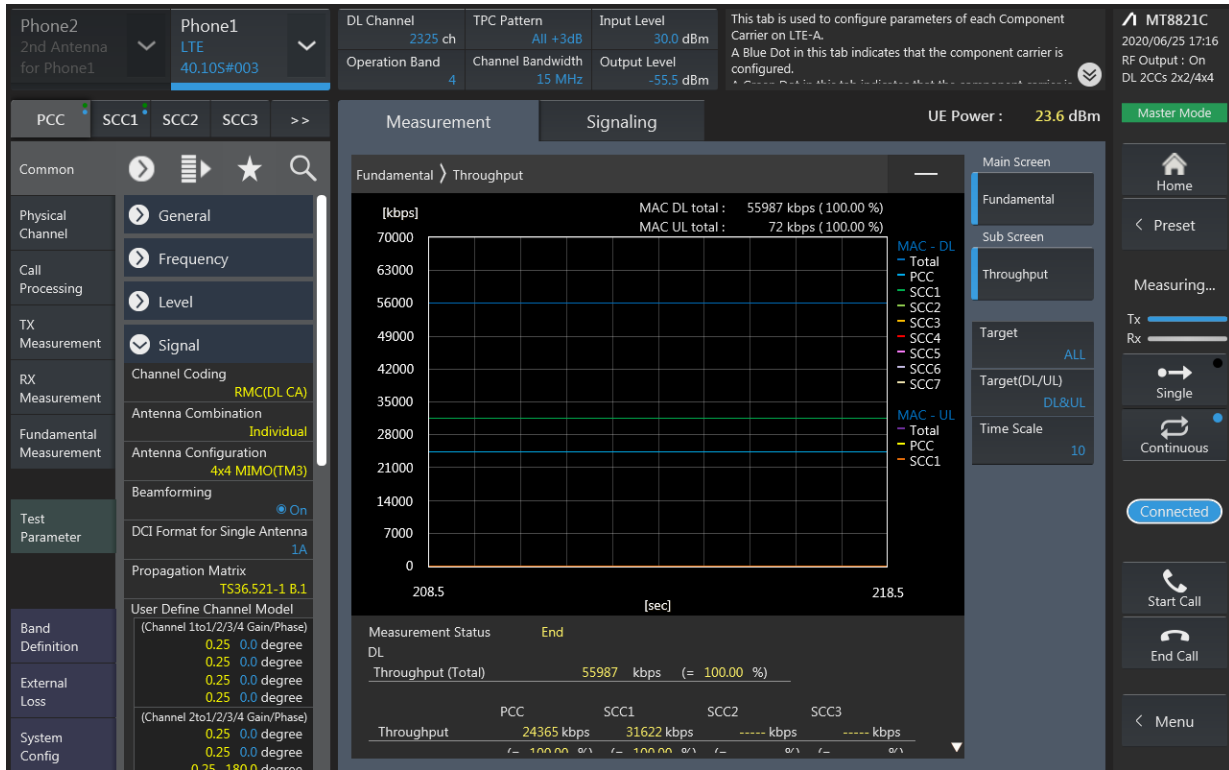
4CA Downlink Carrier aggregation conducted Powers

LTE Downlink 4CA Maximum Conducted Power

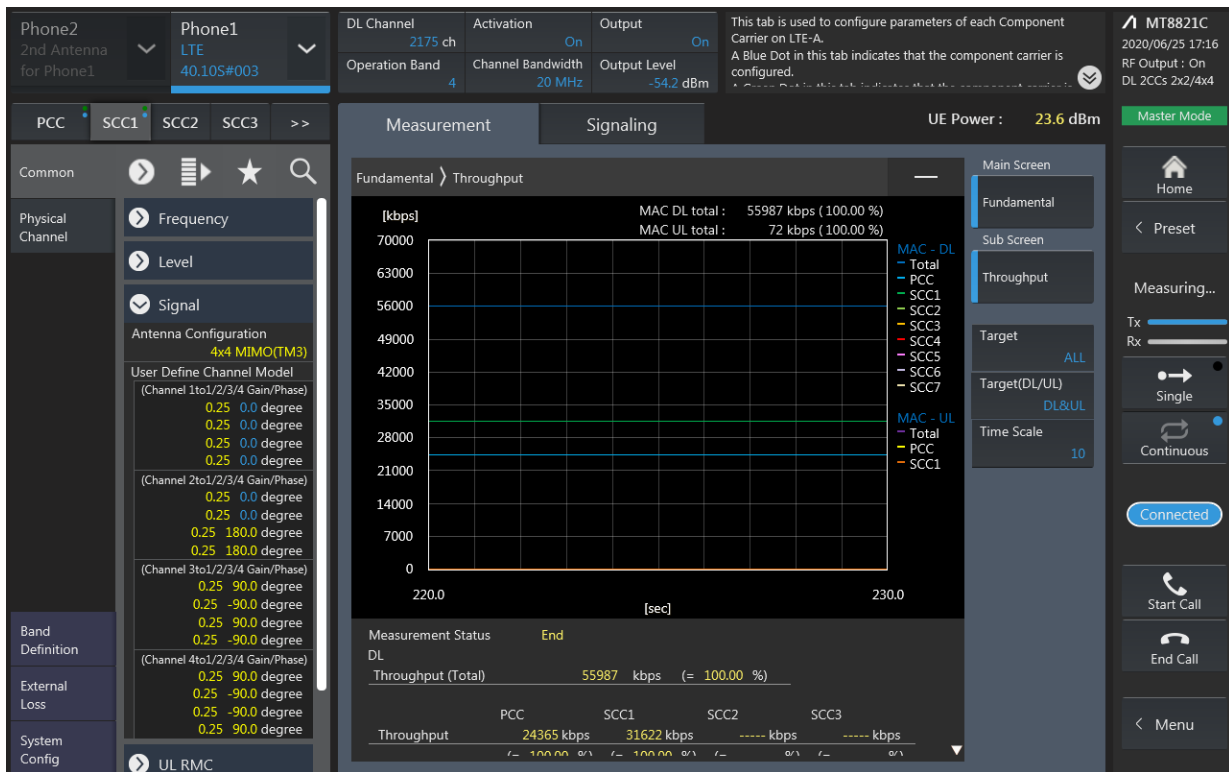
Combination	PCC									SCC				SCC				SCC				Tx Power	
	Band	BW	PCC UL Channel	PCC UL Frequency	PCC DL Channel	PCC DL Frequency	Modulation	RB	offset	Band	BW	SCC DL Channel	SCC DL Frequency	Band	BW	SCC DL Channel	SCC DL Frequency	Band	BW	SCC DL Channel	SCC DL Frequency	LTE Single Carrier Tx Power (dBm)	LTE Tx Power with DL CA Enabled(dBm)
41E PC3	41	20	40620	2593	40620	2593	QPSK	1	49	41	20	40818	2612.8	41	20	41016	2632.6	41	20	41214	2652.4	23.08	23.03
41C-41C PC3	41	20	40620	2593	40620	2593	QPSK	1	49	41	20	40818	2612.8	41	20	41490	2680	41	20	41292	2660.2	23.08	23.03
41A-41D	41	5	40620	2593	40620	2593	QPSK	1	12	41	20	41490	2680	41	20	41292	2660.2	41	20	41094	2640.4	23.16	23.11

LTE Down Link 2CA 4x4 MIMO Call Setup

PCC Setting : Channel/ RB/ BW/ Modulation



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

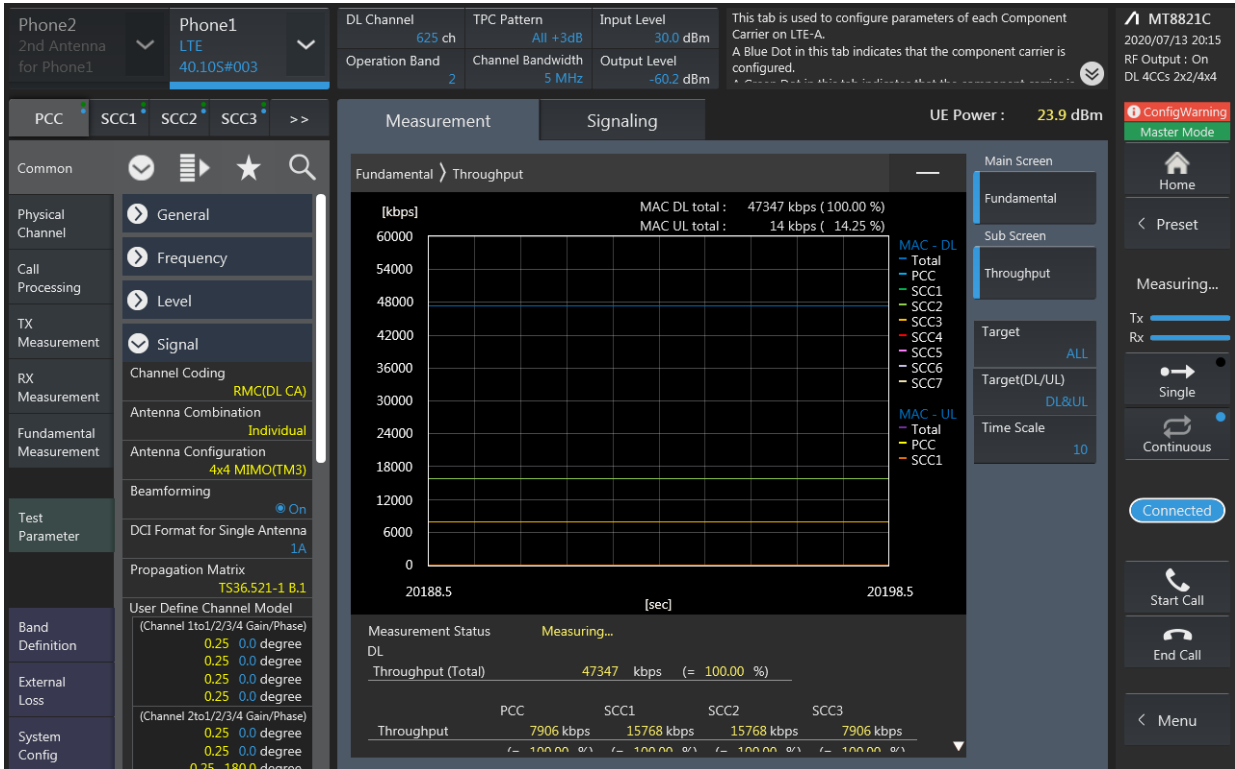


LTE Downlink 2CA 4X4 MIMO Maximum Conducted Power

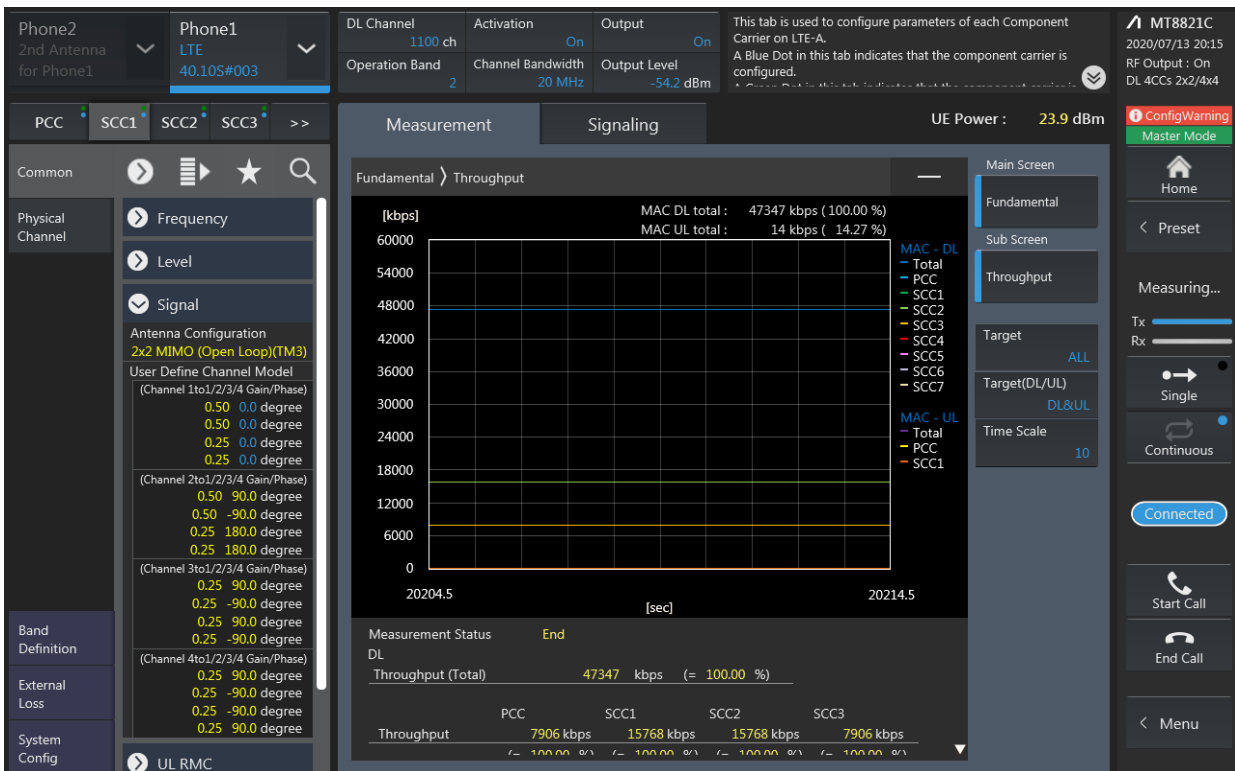
Combination (MAX)	PCC									SCC				Tx Power	
	Band	BW	PCC UL Channel	PCC UL Frequency	PCC DL Channel	PCC DL Frequency	Modulation	RB	offset	Band	BW	SCC DL Channel	SCC DL Frequency	LTE Single Carrier Tx Power (dBm)	LTE Tx Power with DL CA Enabled(dBm)
[41C(1)] PC3	41	5	40620	2593	40620	2593	QPSK	1	12	41	20	40503	2581.3	23.16	23.17
[41C(0,2,3)] PC3	41	20	40620	2593	40620	2593	QPSK	1	49	41	20	40818	2612.8	23.08	23.06
[41A]-[41A(0,1)] PC3	41	5	40620	2593	40620	2593	QPSK	1	12	41	20	41490	2680	23.16	23.04

LTE Down Link 4CA 4x4 MIMO Call Setup

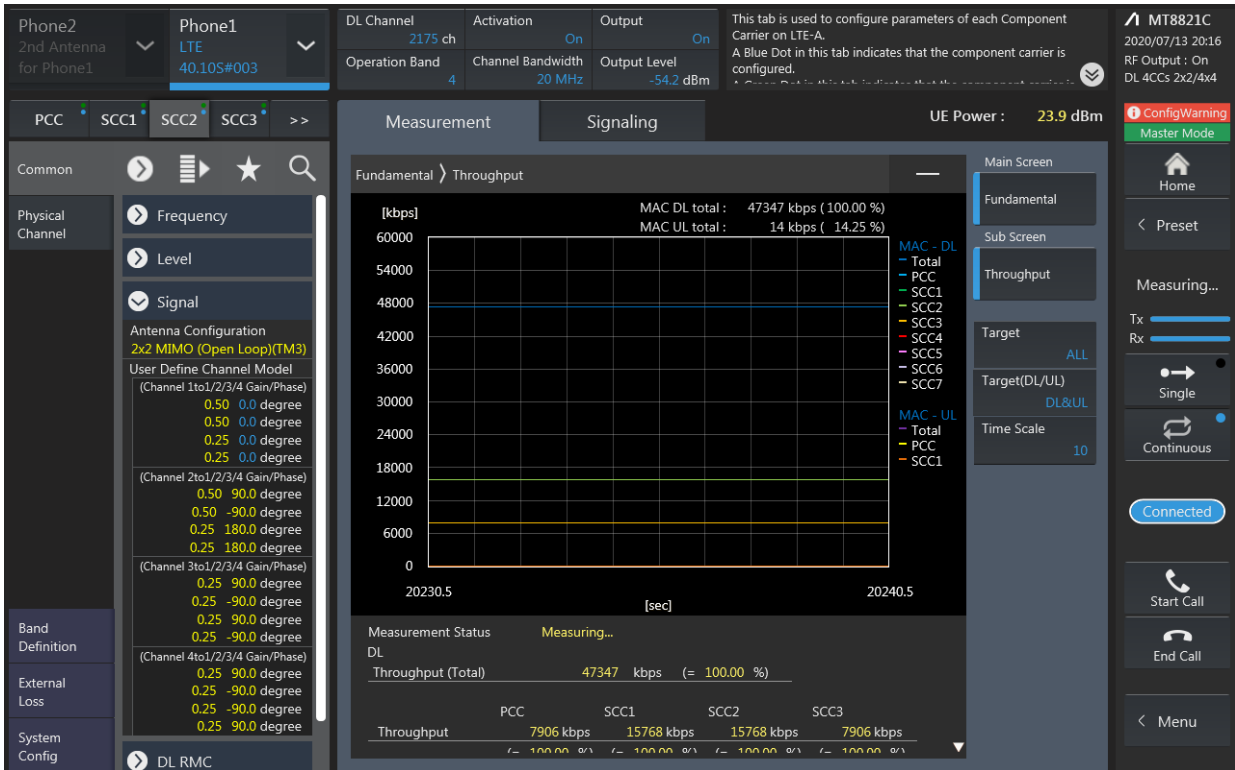
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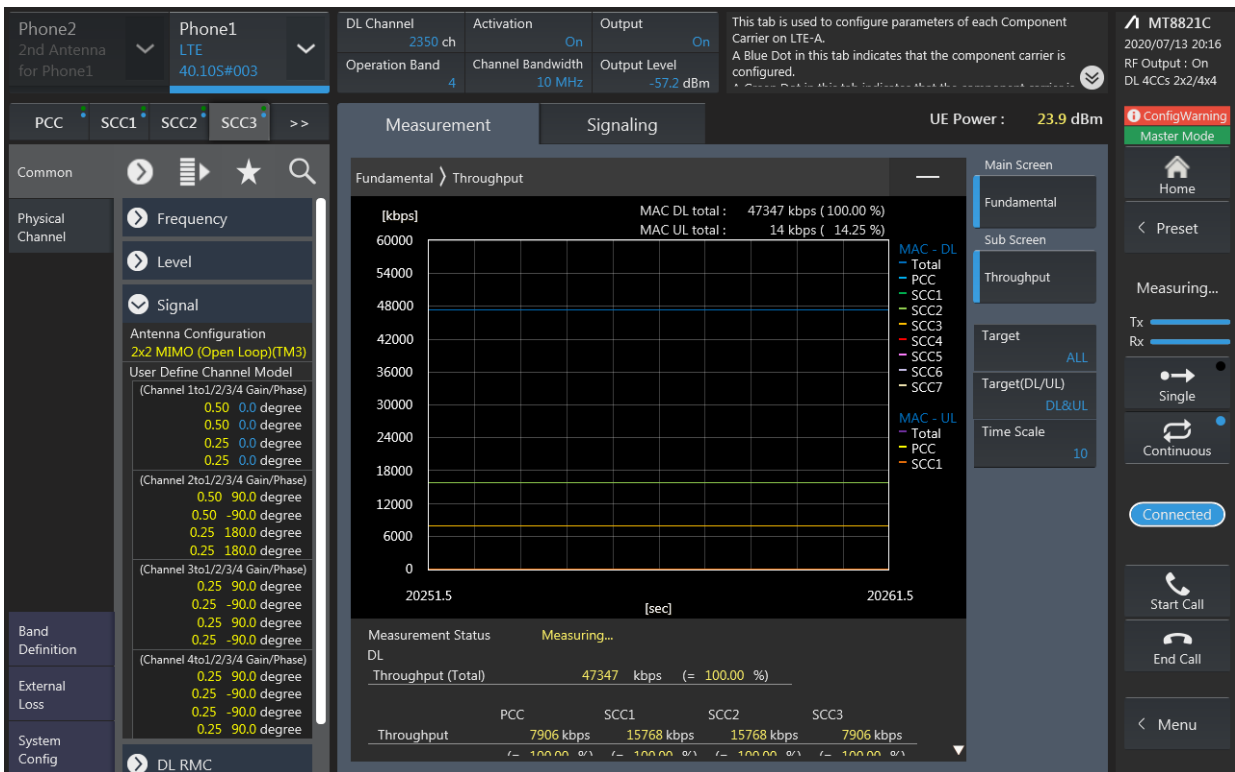
SCC1 Setting : Channel /RB/BW/Modulation



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



SCC3 Setting (Channel /RB/BW/Modulation) and call Connection



LTE Downlink 4CA 4X4 MIMO Maximum Conducted Power

Combination	PCC									SCC				SCC				SCC		Tx Power			
	Band	BW	PCC UL Channel	PCC UL Frequency	PCC DL Channel	PCC DL Frequency	Modulation	RB	offset	Band	BW	SCC DL Channel	SCC DL Frequency	Band	BW	SCC DL Channel	SCC DL Frequency	Band	BW	SCC DL Channel	SCC DL Frequency	LTE Single Carrier Tx Power (dBm)	LTE Tx Power with DL CA Enabled(dBm)
41C-[41C] PC3	41	20	40620	2593	40620	2593	QPSK	1	49	41	20	40818	2613	41	20	41490	2680	41	20	41292	2660.2	23.08	22.92
[41C]-41C PC3	41	20	40620	2593	40620	2593	QPSK	1	49	41	20	40818	2613	41	20	41490	2680	41	20	41292	2660.2	23.08	22.93