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.

1. Power Reduction Verification for Main Ant

This device utilizes a power reduction mechanism for some wireless modes and bands for SAR compliance under hotspot conditions and under some conditions when the device is being used in close proximity to the user's hand for Main Ant1
The proximity sensor(DSI =3) applied to this product has lower priority than the Hotspot(DSI=2) power reduction, so these two conditions do not work simultaneously. and In both cases, powers were reduced to the same Power level.
All Hotspot SAR evaluations for this device were performed at the maximum allowed output Power when Hotspot is activated. FCC KDB Publication 616217D04v01r02 section 6 was used as a guideline for selection SAR test distances for this device when being used in phablet use conditions.
For detailed measurement conducted power results, please refer to the Section .11

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.

1.1. Power Verification Procedure 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.

Power Reduction Verification for MAIN ANT

Mechanism(s)	Mode/Band	Device State Index		
		Un-triggered (Max Power)	Triggered (Reduced Power)	Triggered (Reduced Power)
Grip	GSM1900 /Voice	DSI 0	DSI 3	
Grip	GSM1900 /GPRS 1Tx	DSI 0	DSI 3	
Grip	GSM1900 /GPRS 2Tx	DSI 0	DSI 3	
Grip	GSM1900 /GPRS 3Tx	DSI 0	DSI 3	
Grip	GSM1900 /GPRS 4Tx	DSI 0	DSI 3	
Grip	WCDMA B2	DSI 0	DSI 3	
Grip	LTE Band 2	DSI 0	DSI 3	
Grip	LTE Band 4	DSI 0	DSI 3	
Grip	LTE Band 7	DSI 0	DSI 3	
Grip	LTE Band 66	DSI 0	DSI 3	
Grip	NR Band 2	DSI 0	DSI 3	
Grip	NR Band 66	DSI 0	DSI 3	
Hotspot On	GSM1900 /Voice	DSI 0	DSI 2	
Hotspot On	GSM1900 /GPRS 1Tx	DSI 0	DSI 2	
Hotspot On	GSM1900 /GPRS 2Tx	DSI 0	DSI 2	
Hotspot On	GSM1900 /GPRS 3Tx	DSI 0	DSI 2	
Hotspot On	GSM1900 /GPRS 4Tx	DSI 0	DSI 2	
Hotspot On	WCDMA B2	DSI 0	DSI 2	
Hotspot On	LTE Band 2	DSI 0	DSI 2	
Hotspot On	LTE Band 4	DSI 0	DSI 2	
Hotspot On	LTE Band 7	DSI 0	DSI 2	
Hotspot On	LTE Band 66	DSI 0	DSI 2	
Hotspot On	NR Band 2	DSI 0	DSI 2	
Hotspot On	NR Band 66	DSI 0	DSI 2	
Hotspot On, Then Grip	GSM1900 /Voice	DSI 0	DSI 2	DSI 2
Hotspot On, Then Grip	GSM1900 /GPRS 1Tx	DSI 0	DSI 2	DSI 2
Hotspot On, Then Grip	GSM1900 /GPRS 2Tx	DSI 0	DSI 2	DSI 2
Hotspot On, Then Grip	GSM1900 /GPRS 3Tx	DSI 0	DSI 2	DSI 2
Hotspot On, Then Grip	GSM1900 /GPRS 4Tx	DSI 0	DSI 2	DSI 2
Hotspot On, Then Grip	WCDMA B2	DSI 0	DSI 2	DSI 2
Hotspot On, Then Grip	LTE Band 2	DSI 0	DSI 2	DSI 2
Hotspot On, Then Grip	LTE Band 4	DSI 0	DSI 2	DSI 2
Hotspot On, Then Grip	LTE Band 7	DSI 0	DSI 2	DSI 2
Hotspot On, Then Grip	LTE Band 66	DSI 0	DSI 2	DSI 2
Hotspot On, Then Grip	NR Band 2	DSI 0	DSI 2	DSI 2
Hotspot On, Then Grip	NR Band 66	DSI 0	DSI 2	DSI 2
Grip, then Hotspot On	GSM1900 /Voice	DSI 0	DSI 3	DSI 2
Grip, then Hotspot On	GSM1900 /GPRS 1Tx	DSI 0	DSI 3	DSI 2
Grip, then Hotspot On	GSM1900 /GPRS 2Tx	DSI 0	DSI 3	DSI 2
Grip, then Hotspot On	GSM1900 /GPRS 3Tx	DSI 0	DSI 3	DSI 2
Grip, then Hotspot On	GSM1900 /GPRS 4Tx	DSI 0	DSI 3	DSI 2
Grip, then Hotspot On	WCDMA B2	DSI 0	DSI 3	DSI 2

Grip, then Hotspot On	LTE Band 2	DSI 0	DSI 3	DSI 2
Grip, then Hotspot On	LTE Band 4	DSI 0	DSI 3	DSI 2
Grip, then Hotspot On	LTE Band 7	DSI 0	DSI 3	DSI 2
Grip, then Hotspot On	LTE Band 66	DSI 0	DSI 3	DSI 2
Grip, then Hotspot On	NR Band 2	DSI 0	DSI 3	DSI 2
Grip, then Hotspot On	NR Band 66	DSI 0	DSI 3	DSI 2

Note: This device uses different Device State Indices(DSI) to configure different time averaged power level based on certain exposure scenarios. For this model, DSI=3 represents the case when the grip sensor is active, DSI=2 represents the case where hotspot mode is active. DSI=1 represents the case where the device is held to ear, and DSI=0 represents the case where the device cannot detect the use condition.

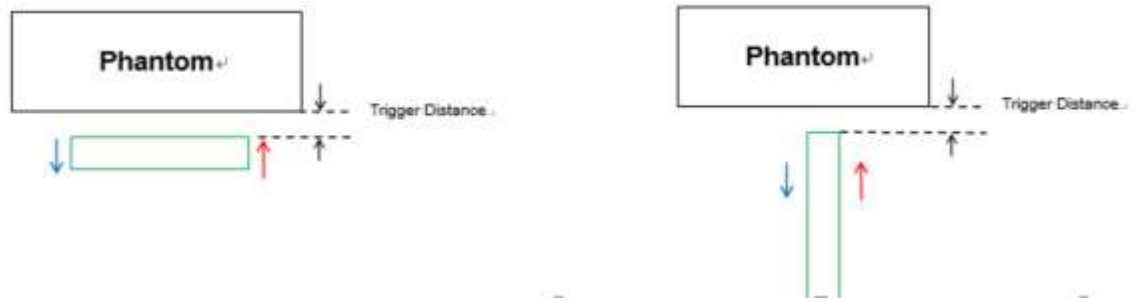
1.2. Procedures for determining proximity sensor triggering distances

(KDB 616217 D04v01r02 §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. For Licensed modes, the device state index(DSI) on the device UI was monitored to determine the triggering state.
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 /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]
1750 MHz	10	11	7	8	12	13
1900 MHz	10	11	7	8	12	13
2600 MHz	10	11	7	8	12	13

Distance Measurement verification for Proximity sensor

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

Mode	Distance to DUT Output power (dBm)									
	15[mm]	14[mm]	13[mm]	12[mm]	11[mm]	10[mm]	9[mm]	8[mm]	7[mm]	6[mm]
GPRS1900 1Tx	29.45	29.31	29.41	29.48	29.42	25.98	25.93	25.98	25.93	25.90
GPRS1900 2Tx	28.50	28.33	28.52	28.56	28.38	24.47	24.46	24.50	24.50	24.34
GPRS1900 3Tx	24.42	24.49	24.46	24.51	24.52	21.44	21.34	21.52	21.49	21.58
GPRS1900 4Tx	24.48	24.44	24.38	24.54	24.47	20.91	20.96	20.84	20.83	20.86
WCDMA 2	23.44	23.45	23.41	23.42	23.47	19.93	19.88	19.96	19.85	19.92
LTE Band 2	23.96	24.08	23.90	23.97	23.88	20.90	21.00	20.93	20.93	21.05
LTE Band 4	23.99	24.03	23.90	24.00	24.04	18.96	18.95	18.83	18.98	18.87
LTE Band 7	20.69	20.72	20.71	20.59	20.58	22.91	22.91	22.99	22.80	22.83
LTE Band 66	18.92	18.90	18.91	18.91	19.01	23.93	24.01	23.91	24.02	23.95
NR Band 2	20.97	20.86	20.95	20.97	20.94	23.97	23.96	23.94	23.90	24.04
NR Band 66	19.98	19.83	19.89	19.97	20.03	24.00	24.03	24.02	23.97	24.05

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

Mode	Distance to DUT Output power (dBm)									
	6[mm]	7[mm]	8[mm]	10[mm]	11[mm]	12[mm]	13[mm]	14[mm]	15[mm]	16[mm]
GPRS1900 1Tx	25.95	26.05	25.89	26.06	26.05	29.49	29.44	29.51	29.53	29.53
GPRS1900 2Tx	24.50	24.38	24.48	24.53	24.52	28.50	28.40	28.40	28.54	28.57
GPRS1900 3Tx	21.44	21.51	21.47	21.43	21.38	24.41	24.43	24.49	24.43	24.43
GPRS1900 4Tx	20.99	21.07	20.84	20.85	20.89	24.43	24.39	24.33	24.43	24.52
WCDMA 2	19.92	19.87	19.99	19.98	19.87	23.48	23.46	23.53	23.45	23.51
LTE Band 2	20.91	20.92	20.89	21.01	20.93	24.00	23.85	23.92	23.86	23.90
LTE Band 4	18.98	18.86	18.88	18.91	18.89	23.98	24.02	23.90	23.97	24.04

LTE Band 7	20.63	20.62	20.64	20.77	20.62	22.92	22.88	22.89	22.96	23.02
LTE Band 66	18.99	19.03	18.90	18.86	18.98	24.00	24.06	24.08	23.86	23.90
NR Band 2	20.93	20.94	20.93	20.84	20.95	23.97	23.99	23.90	23.99	23.90
NR Band 66	19.90	20.06	19.87	19.87	19.83	23.99	23.95	23.89	24.05	23.86

Based on the most conservative measured triggering distance of 10mm, additional Phablet SAR measurements were required at 9mm 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]	11mm]	10[mm]	9[mm]	8[mm]	7[mm]	6[mm]	5[mm]	4[mm]	3[mm]
GPRS1900 1Tx	29.43	29.47	29.57	29.54	29.55	25.97	25.99	25.94	25.94	25.97
GPRS1900 2Tx	28.46	28.53	28.50	28.52	28.47	24.46	24.35	24.51	24.51	24.47
GPRS1900 3Tx	24.44	24.44	24.37	24.51	24.35	21.50	21.34	21.58	21.50	21.47
GPRS1900 4Tx	24.46	24.44	24.36	24.49	24.40	20.91	20.92	20.93	21.05	20.94
WCDMA 2	23.48	23.44	23.40	23.42	23.40	19.96	19.83	20.00	19.95	20.02
LTE Band 2	23.97	23.89	23.96	23.91	23.87	20.94	20.89	21.00	21.08	20.84
LTE Band 4	18.96	19.02	18.95	18.97	18.95	23.95	23.96	23.98	23.99	24.01
LTE Band 7	20.68	20.74	20.57	20.60	20.59	23.00	22.93	23.00	22.81	23.00
LTE Band 66	18.99	18.94	18.91	18.97	18.93	23.95	23.88	24.02	23.90	24.01
NR Band 2	20.96	20.94	20.86	20.87	20.94	23.92	23.93	24.03	23.90	23.92
NR Band 66	19.98	19.97	19.82	20.03	20.02	23.93	23.95	23.90	23.91	23.95

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]
GPRS1900 1Tx	25.98	25.85	25.83	26.03	26.01	29.50	29.43	29.44	29.39	29.42
GPRS1900 2Tx	24.45	24.52	24.48	24.42	24.36	28.42	28.48	28.41	28.48	28.54
GPRS1900 3Tx	21.43	21.43	21.51	21.38	21.34	24.41	24.36	24.47	24.58	24.45
GPRS1900 4Tx	20.97	20.93	21.08	20.94	20.86	24.40	24.53	24.50	24.38	24.40
WCDMA 2	19.98	19.86	19.81	19.96	19.86	23.45	23.38	23.41	23.57	23.49
LTE Band 2	20.99	20.86	20.91	20.84	21.09	23.93	23.90	23.96	23.99	23.95
LTE Band 4	20.94	20.99	20.95	20.97	20.89	23.97	23.97	23.94	24.02	24.06

LTE Band 7	20.60	20.71	20.60	20.63	20.73	22.94	22.92	22.87	22.88	22.98
LTE Band 66	18.94	18.99	18.84	18.96	18.86	23.96	23.91	24.03	23.92	23.98
NR Band 2	20.96	20.95	20.94	21.03	20.98	23.97	23.99	23.98	23.96	23.88
NR Band 66	19.97	19.89	20.05	20.06	19.85	23.91	23.83	23.98	23.85	23.87

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

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

Mode	Distance to DUT Output power (dBm)									
	18[mm]	17mm]	16[mm]	14[mm]	13[mm]	12[mm]	11[mm]	10[mm]	9[mm]	8[mm]
GPRS1900 1Tx	29.45	29.55	29.45	29.46	29.50	25.94	25.91	26.00	25.98	26.02
GPRS1900 2Tx	28.50	28.31	28.50	28.43	28.54	24.41	24.48	24.52	24.46	24.53
GPRS1900 3Tx	24.48	24.31	24.54	24.53	24.55	21.43	21.40	21.46	21.44	21.48
GPRS1900 4Tx	24.44	24.42	24.42	24.41	24.37	20.98	21.03	20.95	20.92	21.10
WCDMA 2	23.45	23.32	23.39	23.50	23.40	19.90	19.98	19.94	19.90	20.03
LTE Band 2	23.97	23.95	24.04	24.07	23.97	20.96	21.00	21.06	20.93	20.96
LTE Band 4	18.94	18.95	18.91	19.08	18.97	23.98	23.86	23.94	23.94	23.93
LTE Band 7	20.66	20.74	20.65	20.68	20.53	22.96	23.01	22.97	22.91	22.86
LTE Band 66	18.91	19.03	19.01	18.98	18.86	23.90	23.91	23.92	24.02	23.96
NR Band 2	20.98	20.87	20.96	20.97	20.94	23.98	23.97	23.99	24.02	23.98
NR Band 66	19.96	19.89	19.94	20.02	20.03	23.95	24.00	23.94	23.97	24.04

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

Mode	Distance to DUT Output power (dBm)									
	9[mm]	10[mm]	11[mm]	12[mm]	13[mm]	14[mm]	15[mm]	16[mm]	17[mm]	18[mm]
GPRS1900 1Tx	25.97	25.88	26.03	26.03	25.90	29.44	29.53	29.46	29.32	29.32
GPRS1900 2Tx	24.44	24.53	24.44	24.34	24.56	28.42	28.57	28.40	28.32	28.40
GPRS1900 3Tx	21.40	21.33	21.37	21.41	21.31	24.45	24.49	24.39	24.46	24.42
GPRS1900 4Tx	20.99	20.91	20.93	20.94	20.90	24.48	24.32	24.34	24.42	24.49
WCDMA 2	19.93	19.89	19.90	19.92	19.97	23.43	23.41	23.52	23.56	23.31
LTE Band 2	20.96	21.05	20.99	20.90	20.96	23.97	23.88	23.99	23.93	24.00
LTE Band 4	18.98	19.04	18.92	19.02	18.91	23.92	23.83	23.94	23.87	23.86

LTE Band 7	20.69	20.70	20.54	20.72	20.70	22.98	22.95	23.05	22.99	23.01
LTE Band 66	18.93	18.91	18.96	18.97	18.95	23.98	23.92	23.92	23.92	23.98
NR Band 2	20.91	20.92	20.99	20.97	20.91	23.94	23.85	24.05	23.97	24.01
NR Band 66	19.96	20.05	19.98	19.92	19.99	24.00	23.93	23.84	23.91	23.93

Based on the most conservative measured triggering distance of 12mm, additional Phablet SAR measurements were required at 11mm from rear side for the above modes.

1.3 Proximity Sensor Coverage for SAR measurements

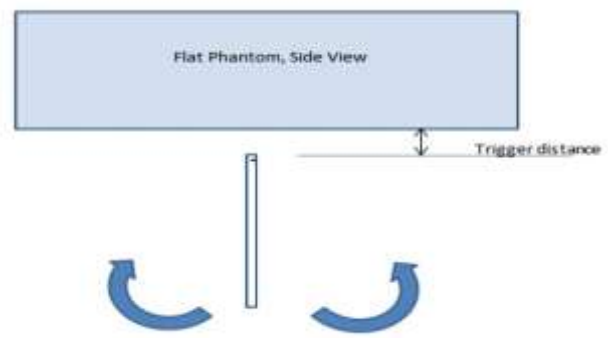
(KDB 616217 D04v01r02 §6.3)

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

1.4 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 ±45°. 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 ±45°.



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

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

Band (MHz)	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	12 mm	On	On	On	On	On	On	On	On	On	On	On
1900 MHz	12 mm	On	On	On	On	On	On	On	On	On	On	On
2600 MHz	12 mm	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 (GSM 900/WCDMA B2 LTEB2/B4/B66/n2/n66)	Rear	9	N/A	N/A	6
	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 Ant

Condition For Power reduction	Wireless Technologies	Conducted Power[dBm]	
		Un-Triggered (Max Power)	Triggered (Reduced Power)
RCV-on (Voice call)	2.4GHz 802.11b (Exclude 12/13ch)	19.01	13.0
RCV-on (Voice call)	2.4GHz 802.11g (Exclude 1/2/11/12/13ch) (Exclude 48Mbps~54Mbps)	16.27	12.68
RCV-on (Voice call)	2.4GHz 802.11n (Exclude 1/11ch) (Exclude MCS5 ~ MCS7)	19.06	12.52
RCV-on (Voice call)	5GHz 802.11a (Exclude 24ps~54Mbps)	17.32	13.01
RCV-on (Voice call)	5GHz 802.11n 20MHz (Exclude MCS4~ MCS7)	17.24	12.92
RCV-on (Voice call)	5GHz 802.11n 40MHz (Exclude MCS4~ MCS7)	14.51	14.51
RCV-on (Voice call)	5GHz 802.11ac 20MHz (Exclude MCS4~ MCS8)	15.33	12.81
RCV-on (Voice call)	5GHz 802.11ac 40MHz (Exclude MCS4~ MCS7)	14.46	14.46
RCV-on (Voice call)	5GHz 802.11ac 80MHz (Exclude MCS9.5~MCS9)	11.96	11.85

3. Power reduction Verification for MAIN ANT with mmWave Ant

Power Reduction Verification for MAIN ANT with 5G FR2

status	Mechanism(s)	Mode/Band	Device State Index		
			Un-triggered (Max Power)	Triggered (Reduced Power)	Triggered (Reduced Power)
mmWave Antenna Active	Grip	LTE B2	DSI 0	DSI 3	
	Hotspot On		DSI 0	DSI 2	
	Hotspot On, Then Grip		DSI 0	DSI 2	DSI 2
	Grip, then Hotspot On		DSI 0	DSI 3	DSI 2
mmWave Antenna Active	Grip	LTE B66	DSI 0	DSI 3	
	Hotspot On		DSI 0	DSI 2	
	Hotspot On, Then Grip		DSI 0	DSI 2	DSI 2
	Grip, then Hotspot On		DSI 0	DSI 3	DSI 2

Note: This device uses different Device State Indices(DSI) to configure different time averaged power level based on certain exposure scenarios. For this model, DSI=3 represents the case when the grip sensor is active, DSI=2 represents the case where hotspot mode is active. DSI=1 represents the case where the device is held to ear, and DSI=0 represents the case where the device cannot detect the use condition.