

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. #1,2

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	Triggered	Triggered
		(Max Power)	(Reduced Power)	(Reduced Power)
Grip	GSM Band 850	33.32		30.50
Grip	GSM Band 1900	30.46		27.26
Grip	UMTS Band 2	23.12		20.19
Grip	UMTS Band 4	23.65		20.70
Grip	LTE Band 41	23.44		19.91
Hotspot On	GSM Band 850	33.32	30.49	
Hotspot On	GSM Band 1900	30.45	27.25	
Hotspot On	UMTS Band 2	23.11	20.18	
Hotspot On	UMTS Band 4	23.64	20.69	
Hotspot On	LTE Band 41	23.45	19.88	
Hotspot On, Then Grip	GSM Band 850	33.31	30.48	30.48
Hotspot On, Then Grip	GSM Band 1900	30.45	27.25	27.25
Hotspot On, Then Grip	UMTS Band 2	23.12	20.17	20.17
Hotspot On, Then Grip	UMTS Band 4	23.65	20.68	20.68
Hotspot On, Then Grip	LTE Band 41	23.45	19.88	19.88
Grip Then Hotspot on	GSM Band 850	33.32	30.49	30.49
Grip Then Hotspot on	GSM Band 1900	30.46	27.24	27.25
Grip Then Hotspot on	UMTS Band 2	23.12	20.17	20.17
Grip Then Hotspot on	UMTS Band 4	23.62	20.70	20.66
Grip Then Hotspot on	LTE Band 41	23.44	19.91	19.88

when Hotspot Mode (RSI=2), Grip sensor (RSI=4) and Ear-jack mode(RSI=3) are triggered at the same time, RSI =2(Hotspot) takes higher priority. The Priority for power reduction was given in the order of hotspot(RSI=2), ear-jack.(RSI=3), and grip sensor On (RSI=4).

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 was 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. 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

LEGEND

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

Main Ant#1,2

Tissue simulating liquid	Triggering Distance			
	Rear		Bottom	
	Moving toward phantom [mm]	Moving away from phantom [mm]	Moving toward phantom [mm]	Moving away from phantom [mm]
850 MHz Tissue	13	13	12	12
1800 MHz Tissue	13	13	12	12
1900 MHz Tissue	13	13	12	12
2600 MHz Tissue	13	13	12	12

Distance Measurement verification for Proximity sensor

Rear side (Main Ant#1,2) – 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 Band 850	33.24	33.25	33.30	33.27	33.29	30.43	30.45	30.46	30.42	30.44
GSM Band 1900	30.3	30.37	30.45	30.39	30.39	27.24	27.18	27.23	27.23	27.19
UMTS Band 2	23.10	23.12	23.09	23.07	23.05	20.13	20.09	20.19	20.13	20.10
UMTS Band 4	23.64	23.58	23.61	23.59	23.57	20.69	20.63	20.70	20.62	20.62
LTE Band 41	23.42	23.42	23.37	23.42	23.40	19.86	19.89	19.87	19.84	19.81

Rear side (Main Ant#1,2) – 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]
GSM Band 850	30.45	30.47	30.43	30.39	30.41	33.30	33.22	33.22	33.26	33.25
GSM Band 1900	27.24	27.23	27.21	27.19	27.22	30.46	30.46	30.41	30.44	30.40
UMTS Band 2	20.09	20.09	20.12	20.10	20.18	23.07	23.10	23.04	23.03	23.06
UMTS Band 4	20.68	20.65	20.62	20.68	20.63	23.64	23.62	23.61	23.65	23.62
LTE Band 41	19.90	19.91	19.87	19.89	19.86	23.36	23.39	23.35	23.42	23.38

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

Bottom side (Main Ant#1,2) – EUT Moving toward (trigger) to the Phantom

Mode	Distance to DUT Output power (dBm)									
	17[mm]	16[mm]	15[mm]	14[mm]	13[mm]	12[mm]	11[mm]	10[mm]	9[mm]	8[mm]
GSM Band 850	33.29	33.28	33.27	33.30	33.26	30.48	30.46	30.46	30.40	30.41
GSM Band 1900	30.42	30.37	30.42	30.45	30.42	27.17	27.22	27.24	27.18	27.20
UMTS Band 2	23.03	23.07	23.11	23.09	23.03	20.17	20.18	20.17	20.15	20.10
UMTS Band 4	23.59	23.61	23.61	23.62	23.60	20.69	20.60	20.67	20.62	20.63
LTE Band 41	23.44	23.41	23.35	23.37	23.42	19.87	19.82	19.83	19.86	19.86

Bottom side (Main Ant#1,2) – 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 Band 850	30.39	30.39	30.38	30.41	30.38	33.25	33.29	33.25	33.26	33.29
GSM Band 1900	27.24	27.17	27.22	27.21	27.16	30.45	30.37	30.46	30.38	30.38
UMTS Band 2	20.12	20.14	20.11	20.15	20.12	23.07	23.09	23.04	23.04	23.09
UMTS Band 4	20.63	20.66	20.66	20.65	20.63	23.58	23.58	23.56	23.61	23.55
LTE Band 41	19.89	19.86	19.90	19.85	19.84	23.44	23.42	23.38	23.40	23.41

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

1.2 Proximity Sensor Coverage for SAR measurements

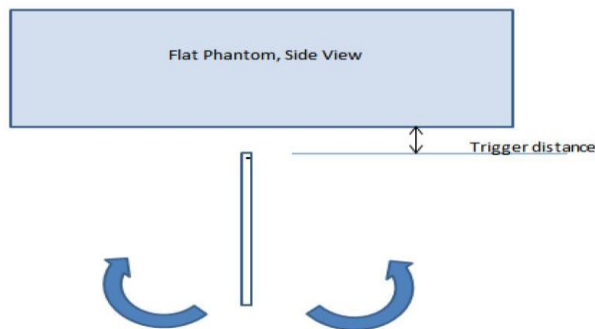
(KDB 616217 D04v01r02§6.3)

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 Left 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 For Main Ant #1) KDB 616217 §6.4

Summary of Tablet Tilt Angle influence to Proximity Sensor Triggering (Bottom side for Main Ant.#1,2)

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°
850 MHz Tissue	12mm	On	On	On	On	On	On	On	On	On	On	On
1 800 MHz Tissue	12mm	On	On	On	On	On	On	On	On	On	On	On
1 900 MHz Tissue	12mm	On	On	On	On	On	On	On	On	On	On	On
2 600 MHz Tissue	12mm	On	On	On	On	On	On	On	On	On	On	On

2. Power Reduction Verification for WiFi 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.

WiFi Antenna Verification Summary

Mechanism(s)	Mode/Band	Power reduction Mechanism		
		Un-triggered	Triggered	Triggered
		(Max Power)	(Reduced Power)	(Reduced Power)
Grip	2.4GHz 802.11b	18.00		13.02
Grip	2.4GHz 802.11b	16.18		13.15
Grip	2.4GHz 802.11b	16.18		13.12
Grip	802.11a	16.10		12.27
Grip	802.11n20	15.79		12.08
Grip	802.11ac20	15.58		12.08
Grip	802.11n40	13.49		11.77
Grip	802.11ac40	13.48		11.50
Grip	802.11ac80	12.20		11.52
RCV On	2.4GHz 802.11b	18.01	13.04	
RCV On	2.4GHz 802.11g	16.20	13.17	
RCV On	2.4GHz 802.11n	16.20	13.19	
RCV On	802.11a	16.09	12.26	
RCV On	802.11n20	15.78	12.07	
RCV On	802.11ac20	15.58	12.08	
RCV On	802.11n40	13.50	11.79	
RCV On	802.11ac40	13.47	11.52	
RCV On	802.11ac80	12.19	11.49	
RCV On, Then Grip	2.4GHz 802.11b	18.01	13.04	13.04
RCV On, Then Grip	2.4GHz 802.11g	16.20	13.17	13.17
RCV On, Then Grip	2.4GHz 802.11n	16.20	13.19	13.19
RCV On, Then Grip	802.11a	16.10	12.24	12.24
RCV On, Then Grip	802.11n20	15.79	12.06	12.06
RCV On, Then Grip	802.11ac20	15.57	12.07	12.07
RCV On Then Grip	802.11n40	13.49	11.81	11.81
RCV On, Then Grip	802.11ac40	13.48	11.50	11.50
RCV On, Then Grip	802.11ac80	12.17	11.47	11.47
Grip Then RCV On	2.4GHz 802.11b	18.00	13.02	13.04
Grip Then RCV On	2.4GHz 802.11g	16.18	13.15	13.17
Grip Then RCV On	2.4GHz 802.11n	16.18	13.12	13.19
Grip Then RCV On	802.11a	16.08	12.26	12.24
Grip Then RCV On	802.11n20	15.77	12.05	12.06
Grip Then RCV On	802.11ac20	15.58	12.08	12.06
Grip Then RCV On	802.11n40	13.47	11.80	11.81

Grip Then RCV On	802.11ac40	13.45	11.46	11.50
Grip Then RCV On	802.11ac80	12.16	11.48	11.47

when Grip sensor on and RCV-ON mode are triggered at the same time, RCV-ON) takes higher priority.

2.1 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:

5. 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.
6. 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.
7. Step 1 and 2 were repeated for the relevant modes, as appropriate
8. 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

LEGEND

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

WIFI ANT.

Tissue simulating liquid	Triggering Distance			
	Rear		Top	
	Moving toward phantom [mm]	Moving away from phantom [mm]	Moving toward phantom [mm]	Moving away from phantom [mm]
2450MHz Tissue	11	11	6	6
5 250 MHz Tissue	11	11	6	6
5 600 MHz Tissue	11	11	6	6
5 750 MHz Tissue	11	11	6	6

Distance Measurement verification for Proximity sensor

Rear side (WIFI Ant.) – 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]
802.11b	17.97	17.99	17.99	17.93	17.92	12.92	12.95	12.95	13.01	12.93
802.11g	16.09	16.17	16.16	16.09	16.13	13.11	13.13	13.07	13.08	13.09
802.11n	16.13	16.14	16.12	16.13	16.09	13.03	13.05	13.09	13.04	13.04
802.11a	16.03	16.06	16.06	16.09	16.07	12.24	12.22	12.26	12.25	12.19
802.11n20	15.72	15.70	15.75	15.70	15.75	12.05	11.99	12.02	12.01	12.08
802.11ac20	15.51	15.52	15.52	15.58	15.50	11.99	12.03	12.04	12.04	11.99
802.11n40	13.44	13.42	13.45	13.42	13.40	11.68	11.73	11.72	11.74	11.73
802.11ac40	13.48	13.45	13.43	13.41	13.43	11.43	11.45	11.41	11.43	11.48
802.11ac80	12.17	12.11	12.18	12.14	12.16	11.44	11.50	11.46	11.49	11.48

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

Mode	Distance to DUT Output power (dBm)									
	7[mm]	8[mm]	9[mm]	10[mm]	11[mm]	12[mm]	13[mm]	14[mm]	15[mm]	16[mm]
802.11b	12.95	12.94	13.01	12.92	12.92	17.96	17.96	17.98	17.94	17.98
802.11g	13.07	13.11	13.13	13.05	13.07	16.12	16.11	16.15	16.13	16.10
802.11n	13.09	13.11	13.13	13.10	13.07	16.12	16.10	16.12	16.16	16.15
802.11a	12.19	12.20	12.27	12.27	12.23	16.02	16.01	16.03	16.02	16.10
802.11n20	11.98	12.08	12.02	12.08	12.04	15.71	15.75	15.71	15.77	15.70
802.11ac20	12.03	12.08	12.01	12.02	12.07	15.49	15.54	15.50	15.50	15.55
802.11n40	11.69	11.76	11.67	11.71	11.68	13.47	13.45	13.40	13.42	13.44
802.11ac40	11.43	11.45	11.42	11.49	11.49	13.42	13.41	13.48	13.42	13.40
802.11ac80	11.47	11.47	11.46	11.42	11.44	12.14	12.11	12.20	12.19	12.12

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

Top side (WIFI Ant.) – EUT Moving toward (trigger) to the Phantom

Mode	Distance to DUT Output power (dBm)									
	11[mm]	10[mm]	9[mm]	8[mm]	7[mm]	6[mm]	5[mm]	4[mm]	3[mm]	2[mm]
802.11b	17.94	17.98	17.95	17.92	17.92	12.97	12.98	12.93	12.97	12.95
802.11g	16.17	16.10	16.12	16.14	16.16	13.13	13.12	13.11	13.10	13.08
802.11n	16.09	16.16	16.15	16.14	16.09	13.07	13.09	13.11	13.11	13.04
802.11a	16.05	16.02	16.08	16.08	16.04	12.26	12.23	12.24	12.25	12.21
802.11n20	15.73	15.73	15.70	15.77	15.76	12.01	12.03	12.00	12.02	12.08
802.11ac20	15.56	15.56	15.51	15.49	15.50	12.05	11.98	12.08	11.98	11.98
802.11n40	13.47	13.43	13.42	13.41	13.48	11.72	11.71	11.71	11.74	11.71
802.11ac40	13.45	13.45	13.39	13.42	13.42	11.46	11.42	11.45	11.41	11.44
802.11ac80	12.17	12.20	12.19	12.13	12.16	11.45	11.46	11.45	11.51	11.46

Top side (WIFI Ant.) – EUT Moving away (Release) from the Phantom

Mode	Distance to DUT Output power (dBm)									
	2[mm]	3[mm]	4[mm]	5[mm]	6[mm]	7[mm]	8[mm]	9[mm]	10[mm]	11[mm]
802.11b	12.99	12.94	13.00	12.98	12.94	17.97	17.96	17.93	17.93	17.92
802.11g	13.12	13.14	13.06	13.08	13.12	16.11	16.13	16.12	16.16	16.13
802.11n	13.07	13.06	13.06	13.05	13.05	16.10	16.17	16.17	16.17	16.09
802.11a	12.25	12.23	12.24	12.27	12.23	16.07	16.06	16.10	16.05	16.09
802.11n20	12.02	12.04	12.01	11.99	12.04	15.75	15.73	15.76	15.70	15.72
802.11ac20	11.98	12.00	12.08	12.03	12.00	15.50	15.51	15.53	15.57	15.55
802.11n40	11.73	11.74	11.76	11.73	11.68	13.40	13.44	13.46	13.42	13.47
802.11ac40	11.49	11.45	11.48	11.43	11.41	13.44	13.43	13.44	13.44	13.47
802.11ac80	11.48	11.48	11.45	11.44	11.44	12.16	12.13	12.11	12.13	12.19

Based on the most conservative measured triggering distance of 6mm, additional Phablet SAR measurements were required at 5mm from Top side for the above modes.

2.2 Proximity Sensor Coverage for SAR measurements

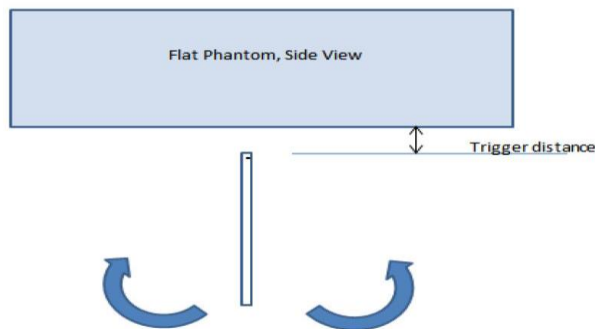
(KDB 616217 D04v01r02§6.3)

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

2.3 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 Left 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 For Main Ant #1) KDB 616217 §6.4

Summary of Tablet Tilt Angle influence to Proximity Sensor Triggering (Top side for WiFi Ant.)

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°
2 450 MHz Tissue	6mm	On	On	On	On	On	On	On	On	On	On	On
5 250 MHz Tissue	6mm	On	On	On	On	On	On	On	On	On	On	On
5 600 MHz Tissue	6mm	On	On	On	On	On	On	On	On	On	On	On
5 750 MHz Tissue	6mm	On	On	On	On	On	On	On	On	On	On	On

3. Power reduction Verification for WiFi 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 WiFi Ant

Condition For Power reduction	Wireless Technologies	Conducted Power[dBm]	
		Un-Triggered (Max Power)	Triggered (Reduced Power)
RCV-on	2.4GHz 802.11b	18.01	13.04
RCV-on	2.4GHz 802.11g	16.20	13.17
RCV-on	2.4GHz 802.11n	16.20	13.19
RCV-on	5GHz 802.11a	16.09	12.26
RCV-on	5GHz 802.11n 20MHz	15.78	12.07
RCV-on	5GHz 802.11n 40MHz	15.58	12.08
RCV-on	5GHz 802.11ac 20MHz	13.50	11.79
RCV-on	5GHz 802.11ac 40MHz	13.47	11.52
RCV-on	5GHz 802.11ac 80MHz	12.19	11.49

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]
Main#1,2 (GSM 850, 1900, UMTS B2/B4, LTE Band 41)	Rear	13	N/A	N/A	12
	Bottom	12	N/A	N/A	11
WLAN (802.11b,802.11g,802.11n, 802.11a,n20,ac20,n40,ac40,ac80)	Rear	11	N/A	N/A	10
	Top	6	N/A	N/A	5

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