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#1/2/3

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	GSM Band 850	33.23		30.47
Grip	GSM Band 1900	30.93		27.62
Grip	UMTS Band 2	24.30		21.28
Grip	UMTS Band 4	23.64		20.62
Grip	LTE Band 2	24.26		20.44
Grip	LTE band 2 Upper	25.43		21.32
Grip	LTE band 4	24.41		20.39
Grip	LTE band 66	24.33		21.50
Grip	LTE band 66 Upper	24.18		20.34
Grip	NR Band n5	25.32		22.48
Grip	NR Band n66	24.72		21.82
Hotspot On	GSM Band 850	33.23	30.47	
Hotspot On	GSM Band 1900	30.93	27.62	
Hotspot On	UMTS Band 2	24.30	21.28	
Hotspot On	UMTS Band 4	23.64	20.62	
Hotspot On	LTE Band 2	24.26	20.44	
Hotspot On	LTE band 2 Upper	25.43	21.32	
Hotspot On	LTE band 4	24.41	20.39	
Hotspot On	LTE band 66	24.33	21.50	
Hotspot On	LTE band 66 Upper	24.18	20.34	
Hotspot On	NR Band n5	25.32	22.48	
Hotspot On	NR Band n66	24.72	21.82	
Hotspot On, Then Grip	GSM Band 850	33.23	30.47	30.47
Hotspot On, Then Grip	GSM Band 1900	30.93	27.62	27.62
Hotspot On, Then Grip	UMTS Band 2	24.30	21.28	21.28
Hotspot On, Then Grip	UMTS Band 4	23.64	20.62	20.62
Hotspot On, Then Grip	LTE Band 2	24.26	20.44	20.44

Mechanism(s)	Mode/Band	Power reduction Mechanism		
		Un-triggered (Max Power)	Triggered (Reduced Power)	Triggered (Reduced Power)
Hotspot On, Then Grip	LTE band 2 Upper	25.43	21.32	21.32
Hotspot On, Then Grip	LTE band 4	24.41	20.39	20.39
Hotspot On, Then Grip	LTE band 66	24.33	21.50	21.50
Hotspot On, Then Grip	LTE band 66 Upper	24.18	20.34	20.34
Hotspot On, Then Grip	NR Band n5	25.32	22.48	22.48
Hotspot On, Then Grip	NR Band n66	24.72	21.82	21.82
Grip Then Hotspot on	GSM Band 850	33.23	30.47	30.47
Grip Then Hotspot on	GSM Band 1900	30.93	27.62	27.62
Grip Then Hotspot on	UMTS Band 2	24.30	21.28	21.28
Grip Then Hotspot on	UMTS Band 4	23.64	20.62	20.62
Grip Then Hotspot on	LTE Band 2	24.26	20.44	20.44
Grip Then Hotspot on	LTE band 2 Upper	25.43	21.32	21.32
Grip Then Hotspot on	LTE band 4	24.41	20.39	20.39
Grip Then Hotspot on	LTE band 66	24.33	21.50	21.50
Grip Then Hotspot on	LTE band 66 Upper	24.18	20.34	20.34
Grip Then Hotspot on	NR Band n5	25.32	22.48	22.48
Grip Then Hotspot on	NR Band n66	24.72	21.82	21.82

1.1. Distance Verification Procedure

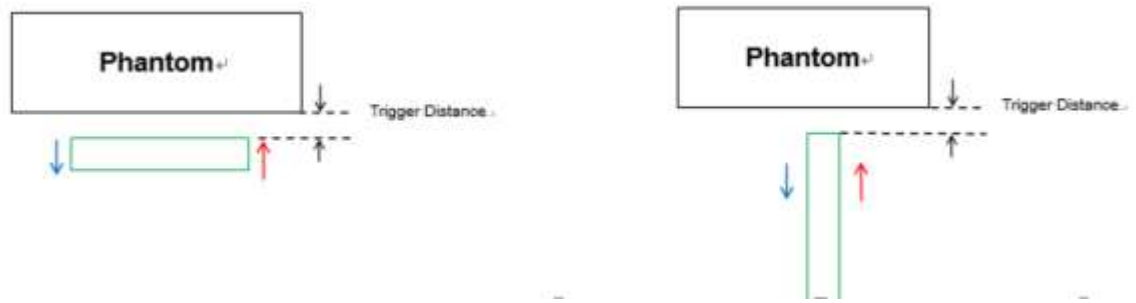
Procedures for determining proximity sensor triggering distances

(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. 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

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 toward phantom [mm]
835 MHz Tissue	12	13	11	12
1800 MHz Tissue	12	13	11	12
1900 MHz Tissue	12	13	11	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)									
	16[mm]	15[mm]	14[mm]	13[mm]	12[mm]	11[mm]	10[mm]	9[mm]	8[mm]	7[mm]
GSM Band 850	33.14	33.21	33.19	33.18	30.37	30.51	30.52	30.45	30.38	30.44
GSM Band 1900	30.86	30.86	30.99	30.99	27.54	27.54	27.65	27.53	27.60	27.62
UMTS Band 2	24.32	24.35	24.23	24.24	21.19	21.27	21.27	21.36	21.22	21.22
UMTS Band 4	23.64	23.72	23.56	23.55	20.71	20.58	20.69	20.68	20.67	20.54
LTE Band 2	24.19	24.20	24.27	24.20	20.39	20.35	20.44	20.34	20.51	20.45
LTE Band 4	25.53	24.51	24.44	24.32	20.44	20.39	20.34	20.41	20.33	20.32
LTE Band 66	24.41	24.32	24.34	24.24	21.57	21.51	21.43	21.50	21.59	21.43
NR Band n5	24.26	25.37	25.26	25.30	22.57	22.52	22.48	22.50	22.40	22.45
NR Band n66	24.19	24.69	24.62	24.69	21.72	21.90	21.78	21.79	21.81	21.80

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	30.55	30.37	30.56	30.55	33.20	33.24	33.21	33.20	33.24
GSM Band 1900	27.72	27.60	27.56	27.54	27.64	31.00	30.91	30.88	30.96	31.03
UMTS Band 2	21.18	21.26	21.18	21.21	21.38	24.20	24.39	24.37	24.37	24.34
UMTS Band 4	20.60	20.65	20.67	20.54	20.63	23.55	23.68	23.62	23.67	23.55
LTE Band 2	20.42	20.38	20.37	20.45	20.38	24.34	24.33	24.16	24.27	24.22
LTE Band 4	20.29	20.45	20.45	20.47	20.33	24.50	24.44	24.42	24.44	24.40
LTE Band 66	21.48	21.59	21.43	21.43	21.54	24.41	24.43	24.41	24.42	24.34
NR Band n5	22.51	22.45	22.42	22.56	22.44	25.28	25.24	25.24	25.26	25.25
NR Band n66	21.72	21.72	21.83	21.82	21.77	24.71	24.82	24.77	24.79	24.63

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.

Bottom side (Main Ant#1/2) – 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]
GSM Band 850	33.23	33.28	33.27	33.29	30.47	30.38	30.56	30.42	30.41	30.57
GSM Band 1900	30.84	30.96	31.02	30.97	27.54	27.70	27.53	27.52	27.55	27.56
UMTS Band 2	24.27	24.33	24.32	24.32	21.31	21.31	21.30	21.18	21.36	21.29
UMTS Band 4	23.69	23.57	23.67	23.61	20.65	20.58	20.62	20.65	20.58	20.69
LTE Band 2	24.29	24.18	24.18	24.22	20.34	20.41	20.53	20.45	20.41	20.40
LTE Band 4	24.39	24.32	24.50	24.40	20.48	20.38	20.36	20.30	20.38	20.39
LTE Band 66	24.30	24.30	24.27	24.39	21.49	21.57	21.55	21.49	21.53	21.53
NR Band n5	25.26	25.41	25.22	25.31	22.54	22.53	22.52	22.46	22.56	22.57
NR Band n66	24.82	24.71	24.64	24.63	21.78	21.92	21.82	21.73	21.80	21.80

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	33.24	33.18	33.29	33.18	33.28	30.41	30.57	30.56	30.50	30.57
GSM Band 1900	30.96	30.98	30.84	31.02	31.01	27.70	27.63	27.52	27.61	27.70
UMTS Band 2	24.22	24.36	24.27	24.32	24.34	21.31	21.30	21.21	21.26	21.20
UMTS Band 4	23.60	23.56	23.68	23.63	23.69	20.64	20.67	20.54	20.58	20.60
LTE Band 2	24.33	24.29	24.34	24.32	24.34	20.53	20.53	20.43	20.44	20.39
LTE Band 4	24.42	24.46	24.33	24.51	24.40	20.29	20.43	20.31	20.35	20.47
LTE Band 66	24.40	24.31	24.27	24.29	24.30	21.47	21.60	21.49	21.54	21.42
NR Band n5	25.29	25.39	25.24	25.22	25.34	22.45	22.43	22.44	22.53	22.52
NR Band n66	24.72	24.66	24.72	24.76	24.71	21.83	21.89	21.81	21.76	21.89

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

Main Ant#3

Tissue simulating liquid	Triggering Distance			
	Rear		Left	
	Moving toward phantom [mm]	Moving away from phantom [mm]	Moving toward phantom [mm]	Moving toward phantom [mm]
1800 MHz Tissue	9	10	7	8
1900 MHz Tissue	9	10	7	8

Distance Measurement verification for Proximity sensor

Rear side (Main Ant#3) – 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]
LTE Band 2 Upper	25.48	25.42	25.39	25.45	21.27	21.42	21.32	21.28	21.28	21.40
LTE Band 66 Upper	24.17	24.19	24.25	24.18	20.33	20.29	20.24	20.23	20.24	20.31

Rear side (Main Ant#3) – EUT Moving away (Release) from the Phantom

Mode	Distance to DUT Output power (dBm)									
	6[mm]	7[mm]	8[mm]	9[mm]	10[mm]	11[mm]	12[mm]	13[mm]	14[mm]	15[mm]
LTE Band 2 Upper	25.42	25.44	25.39	25.37	25.33	21.25	21.25	21.28	21.41	21.25
LTE Band 66 Upper	24.18	24.16	24.26	24.23	24.26	20.41	20.35	20.40	20.24	20.37

Based on the most conservative measured triggering distance of 9mm, additional Phablet SAR measurements were required at 8mm from rear side for the above modes.

Left side (Main Ant#3) – 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 2 Upper	25.41	25.41	25.53	25.46	25.47	21.31	21.36	21.36	21.36	21.35
LTE Band 66 Upper	24.11	24.19	24.23	24.28	24.30	20.39	20.24	20.32	20.31	20.24

Left side (Main Ant#3) – 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 2 Upper	21.25	21.32	21.23	21.40	21.36	25.33	25.50	25.53	25.53	25.33
LTE Band 66 Upper	20.43	20.33	20.40	20.39	20.28	24.18	24.24	24.08	24.16	24.23

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

1.2 Proximity Sensor Coverage for SAR measurements

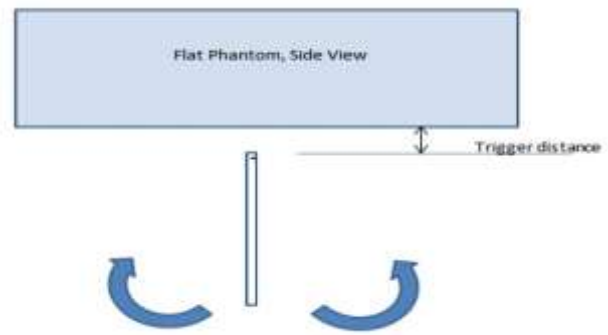
(KDB 616217 D04v01r02§6.3)

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 ±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 For Main Ant #1/#2,Rear side for main #3) 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°
835 MHz Tissue	11mm	On	On	On	On	On	On	On	On	On	On	On
1800 MHz Tissue	11mm	On	On	On	On	On	On	On	On	On	On	On
1900 MHz Tissue	11mm	On	On	On	On	On	On	On	On	On	On	On

Summary of Tablet Tilt Angle influence to Proximity Sensor Triggering (Left side for Main Ant#3)

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°
1800 MHz Tissue	7mm	On	On	On	On	On	On	On	On	On	On	On
1900 MHz Tissue	7mm	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]
Main#1,2 (GSM 850, GSM 1900, UMTS B2/B4, LTE B2/B4/B66/NR n5/n66)	Rear	12	N/A	N/A	11
	Bottom	11	N/A	N/A	10

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

Wireless technologies	Position	§6.2 Triggering Distance [mm]	§6.3 Coverage	§6.4 Tilt Angle	Worst case distance for Phablet SAR [mm]
Main#3 LTE B2/B66	Rear	9	N/A	N/A	8
	Left	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

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

When a user makes or receives a voice call for Main Ant#1 the audio of the call is sent through the Receiver at the top of the device will trigger the Power reduction for Main Ant#1
(i.e. reducing output power for Head SAR compliance)

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

Main Ant#1/2/3

Condition For Power reduction	Wireless Technologies	Power reduction Mechanism	
		Un-Triggered (Max Power)	Triggered (Reduced Power)
RCV-on	UMTS Band 2	24.30	20.31
RCV-on	UMTS Band 4	23.64	19.68
RCV-on	UMTS Band 5	24.51	20.65
RCV-on	LTE Band 2 Upper	25.43	21.32
RCV-on	LTE Band 66 Upper	24.18	20.34

3. 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	2.4GHz 802.11b	17.61	13.15
RCV-on	2.4GHz 802.11g	15.98	12.93
RCV-on	2.4GHz 802.11n	14.95	12.78
RCV-on	5GHz 802.11a	15.58	11.82
RCV-on	5GHz 802.11n 20MHz	15.57	11.80
RCV-on	5GHz 802.11n 40MHz	14.64	12.55
RCV-on	5GHz 802.11ac 20MHz	15.59	11.77
RCV-on	5GHz 802.11ac 40MHz	14.26	12.74
RCV-on	5GHz 802.11ac 80MHz	12.71	11.92

4. Power reduction Verification for Duty Rate(NR TDD)

This device uses a power reduction mechanism for SAR compliance for duty rate specifically declared in the 5G NR TDD bands

The power reduction applied to duty rate was verified for NR TDD n41/n77 of the device. The power is reduced to the fixed level with the reduced power declared in the Duty rate section declared by the manufacturer, and the verification result that the power reduction is verified satisfies all within the Tune-up tolerance of the declared power.

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

Mode	Duty 25[%]	Duty 50[%]	Duty 100[%]
Sub 6 Band n41(100MHz)	24.36	21.35	19.95
Sub 6 Band n41(90MHz)	24.34	21.33	19.89
Sub 6 Band n41(80MHz)	24.33	21.33	19.88
Sub 6 Band n41(70MHz)	24.42	21.47	19.95
Sub 6 Band n41(60MHz)	24.34	21.38	19.94
Sub 6 Band n41(50MHz)	24.36	21.33	19.91
Sub 6 Band n41(40MHz)	24.33	21.30	19.82
Sub 6 Band n41(30MHz)	24.46	21.48	19.98
Sub 6 Band n41(20MHz)	24.34	21.30	19.89
Sub 6 Band n41(15MHz)	24.31	21.36	19.88
Sub 6 Band n41(10MHz)	24.35	21.33	19.93
Sub 6 Band n77(100MHz)	24.70	21.71	20.34
Sub 6 Band n77(90MHz)	24.63	21.63	20.33
Sub 6 Band n77(80MHz)	24.72	21.74	20.41
Sub 6 Band n77(70MHz)	24.62	21.59	20.29
Sub 6 Band n77(60MHz)	24.60	21.62	20.32
Sub 6 Band n77(50MHz)	24.69	21.70	20.31
Sub 6 Band n77(40MHz)	24.68	21.68	20.33
Sub 6 Band n77(30MHz)	24.54	21.63	20.29
Sub 6 Band n77(25MHz)	24.73	21.68	20.29
Sub 6 Band n77(20MHz)	24.65	21.63	20.32
Sub 6 Band n77(15MHz)	24.60	21.63	20.36
Sub 6 Band n77(10MHz)	24.61	21.52	20.24

Sub 6 Band n77 DoD (100MHz)	24.71	21.78	20.42
Sub 6 Band n77 DoD (90MHz)	24.64	21.72	20.32
Sub 6 Band n77 DoD (80MHz)	24.61	21.67	20.28
Sub 6 Band n77 DoD (70MHz)	24.56	21.67	20.33
Sub 6 Band n77 DoD (60MHz)	24.56	21.65	20.24
Sub 6 Band n77 DoD (50MHz)	24.44	21.50	20.21
Sub 6 Band n77 DoD (40MHz)	24.56	21.61	20.29
Sub 6 Band n77 DoD (30MHz)	24.73	21.75	20.40
Sub 6 Band n77 DoD (25MHz)	24.53	21.57	20.26
Sub 6 Band n77 DoD (20MHz)	24.49	21.60	20.27
Sub 6 Band n77 DoD (15MHz)	24.58	21.61	20.35
Sub 6 Band n77 DoD (10MHz)	24.61	21.69	20.37