1. Proximity sensor validation

Since proximity sensor validation procedure in KDB 616217 section 6.2/6.3/6.4 are for body exposure condition, therefore that procedure is not full applicable proximity sensor detection verification for the head exposure condition, following sensor validation procedure will be applied for head and near the front of face exposure condition

1.1. Proximity sensor validation procedure for Head exposure condition



The following guidance only for the device integrated proximity sensor to reduce power or disable RFID transmit and applies head exposure condition.

The earpiece of device positioned on the left and right ERP (ear reference point) location of head phantom defined in IEEE Std 1528-2013 and rotates the device along one axis, from 0 degrees to 90 degrees and then reverse the procedure to go from 90 degrees to 0 degrees.

Establish OTT VoIP call (through WIFI data) and audio is actively routed through the earpiece receiver (earpiece is ON).

This process is to determine the angle where a power reduction occurs, by taking power measurements at each step, as indicated in the step listed here below:

i. From the device in 0 degrees, rotate in 10 degrees steps until proximity sensor is release

ii. Lower the device rotate by 5 degrees increments to verify that the "proximity sensor" is triggered

iii. From the position of the previous step, rotate the device in 1 degree increments until proximity sensor is Triggered again

iv. Continue rotate the device in 1 degree increments until at least 5 degrees past where proximity sensor is release was obtained, then continue rotate device in 10 degrees steps until the device opened to 90 degrees with proximity sensor is release.

v. Reverse the previous procedure to go from device 90 degrees back down to 0 degrees

Appendix G

	Proximity sensor validation procedure for Head exposure condition						
Rotate the device fro	to 90 degree _Right Head	Rotate the device from 90 degree to 0 degree _Right Head					
	Angle	Proximity sensor		Angle	Proximity sensor		
	0	On	-	90	Off		
	10	On		80	Off		
	20	On	-	74	Off		
	23	On	-	73	Off		
	24	On	-	72	Off		
	25	On	-	71	Off		
	26	On	-	70	Off		
	27	On	-	69	On		
	28	On	-	68	On		
Device angle (degree)	29	On	Device angle (degree)	67	On		
	30	On		66	On		
	31	Off	-	65	On		
	32	Off		64	On		
	33	Off		63	On		
	34	Off		60	On		
	40	Off		50	On		
	50	Off	-	40	On		
	60	Off	-	30	On		
	70	Off	-	20	On		
	80	Off	-	10	On		
	90	Off		0	On		
Dotate the device f	tom O degree	a ta 00 dagraga Laft Llagd	Detete the device f	om 00 dogr			
Rotate the device f	rom 0 degre	e to 90 degree_Left Head	Rotate the device f	rom 90 degr	ee to 0 degree_Left Head		
Rotate the device f	rom 0 degre	e to 90 degree_Left Head Proximity sensor	Rotate the device fi	rom 90 degro Angle	ee to 0 degree_Left Head Proximity sensor		
Rotate the device f	rom 0 degree Angle 0	e to 90 degree_Left Head Proximity sensor On	Rotate the device fr	rom 90 degro Angle 90	ee to 0 degree_Left Head Proximity sensor Off Off		
Rotate the device f	rom 0 degree Angle 0 10	e to 90 degree_Left Head Proximity sensor On On On	Rotate the device fi	rom 90 degro Angle 90 81	ee to 0 degree_Left Head Proximity sensor Off Off Off Off		
Rotate the device f	rom 0 degree Angle 0 10 20 22	e to 90 degree_Left Head Proximity sensor On On On On On	Rotate the device fi	rom 90 degro Angle 90 81 80 79	ee to 0 degree_Left Head Proximity sensor Off Off Off Off Off		
Rotate the device f	rom 0 degree Angle 0 10 20 22 23	e to 90 degree_Left Head Proximity sensor On On On On On On On On	Rotate the device fr	rom 90 degro Angle 90 81 80 79 78	ee to 0 degree_Left Head Proximity sensor Off Off Off Off Off Off Off Off Off		
Rotate the device f	rom 0 degrei Angle 0 10 20 22 23 24	e to 90 degree_Left Head Proximity sensor On	Rotate the device fr	rom 90 degru Angle 90 81 80 79 78 78	ee to 0 degree_Left Head Proximity sensor Off Off Off Off Off Off Off O		
Rotate the device f	rom 0 degree Angle 0 10 20 22 23 23 24 25	e to 90 degree_Left Head Proximity sensor On On On On On On On On On O	Rotate the device fr	rom 90 degra 90 81 80 79 78 77 76	ee to 0 degree_Left Head Proximity sensor Off Off Off Off Off Off Off O		
Rotate the device f	rom 0 degree Angle 0 10 20 22 23 24 24 25 26	e to 90 degree_Left Head Proximity sensor On On On On On On On On On O	Rotate the device fr	rom 90 degra 90 81 80 79 78 77 76 75	ee to 0 degree_Left Head Proximity sensor Off Off Off Off Off Off Off O		
Rotate the device f	rom 0 degree Angle 0 10 20 22 23 24 25 26 27	e to 90 degree_Left Head Proximity sensor On On On On On On On On On On	Rotate the device fr	rom 90 degra 90 81 80 79 78 77 76 75 74	ee to 0 degree_Left Head Proximity sensor Off Off Off Off Off Off Off Of		
Rotate the device f	rom 0 degree Angle 0 10 20 22 23 24 25 26 27 28	e to 90 degree_Left Head Proximity sensor On On On On On On On On On On	Rotate the device fr	rom 90 degra Angle 90 81 80 79 78 77 76 76 75 74 73	ee to 0 degree_Left Head Proximity sensor Off Off Off Off Off Off Off Of		
Rotate the device f	rom 0 degree Angle 0 10 20 22 23 24 25 26 27 28 28 29	e to 90 degree_Left Head Proximity sensor On On On On On On On On On On	Rotate the device fr	om 90 degri Angle 90 81 80 79 78 77 76 75 74 74 73 72	ee to 0 degree_Left Head Proximity sensor Off Off Off Off Off Off Off Of		
Rotate the device f	rom 0 degree Angle 0 10 20 22 23 24 25 26 27 28 29 30	e to 90 degree_Left Head Proximity sensor On On On On On On On On On On	Rotate the device fr	om 90 degri Angle 90 81 80 79 78 77 76 75 74 73 72 71	ee to 0 degree_Left Head Proximity sensor Off Off Off Off Off Off Off Of		
Rotate the device f	rom 0 degree Angle 0 10 20 22 23 24 25 26 27 28 29 30 31	e to 90 degree_Left Head Proximity sensor On	Rotate the device fr	rom 90 degra 90 81 80 79 78 77 76 75 74 73 72 71 70	ee to 0 degree_Left Head Proximity sensor Off Off Off Off Off Off Off Of		
Rotate the device f	rom 0 degree Angle 0 10 20 22 23 24 25 26 27 28 29 30 31 32	e to 90 degree_Left Head Proximity sensor On	Rotate the device fr	rom 90 degra Angle 90 81 80 79 78 77 76 75 74 73 72 71 70 60	ee to 0 degree_Left Head Proximity sensor Off Off Off Off Off Off Off Of		
Rotate the device f	rom 0 degree Angle 0 10 20 22 23 24 25 26 27 28 29 30 31 32 33	e to 90 degree_Left Head Proximity sensor On On On On On On On On On On	Rotate the device fr	rom 90 degri Angle 90 81 80 79 78 77 76 75 74 75 74 73 72 71 70 60 50	ee to 0 degree_Left Head Proximity sensor Off Off Off Off Off Off Off Of		
Rotate the device f	rom 0 degree Angle 0 10 20 22 23 24 25 26 27 28 29 30 31 32 33 34	e to 90 degree_Left Head Proximity sensor On On On On On On On On On On	Rotate the device fr Device angle (degree)	rom 90 degri Angle 90 81 80 79 78 77 76 75 74 73 72 71 70 60 50 40	ee to 0 degree_Left Head Proximity sensor Off Off Off Off Off Off Off Of		
Rotate the device f	rom 0 degree Angle 0 10 20 22 23 24 25 26 27 28 29 30 31 32 33 34 40	e to 90 degree_Left Head Proximity sensor On On On On On On On On On On	Rotate the device fr	om 90 degri Angle 90 81 80 79 78 77 76 75 74 73 72 71 70 60 50 40 30	Off On		
Rotate the device f	rom 0 degree Angle 0 10 20 22 23 24 25 26 27 28 29 30 31 32 33 34 40 50	e to 90 degree_Left Head Proximity sensor On On On On On On On On On On	Rotate the device fr	om 90 degri Angle 90 81 80 79 78 77 76 75 74 73 72 71 70 60 50 40 30 20	Off On		
Rotate the device f	rom 0 degree Angle 0 10 20 22 23 24 25 26 27 28 29 30 31 32 33 34 40 50 60	e to 90 degree_Left Head Proximity sensor On On On On On On On On On On	Rotate the device fr	om 90 degri Angle 90 81 80 79 78 77 76 75 74 73 72 71 70 60 50 40 30 20 10	Off On		
Rotate the device f	rom 0 degree Angle 0 10 20 22 23 24 25 26 27 28 29 30 31 32 33 34 40 50 60 70	Proximity sensor On Off	Rotate the device fr	rom 90 degra Angle 90 81 80 79 78 77 76 75 74 73 72 71 70 60 50 40 30 20 10	Proximity sensor Off On On		
Rotate the device f	rom 0 degree Angle 0 10 20 22 23 24 25 26 27 28 29 30 31 32 33 34 40 50 60 70 80	Proximity sensor On Off Off	Rotate the device fr	rom 90 degra Angle 90 81 80 79 78 77 76 75 74 73 72 71 70 60 50 40 30 20 10 0	Proximity sensor Off On		

1.2. Proximity sensor validation procedure for near the front of the face

In order to consider front of device near the front of the face during VOIP call, hereunder is for proximity sensor validation procedure and results for determining proximity sensor triggering distance and ensure the trigger distance is larger than front of device test at 10 mm distance.

a) The entire front surface of the device is positioned below a flat phantom filled with the required tissue-equivalent medium, and positioned at least 20 mm further than the distance that triggers power reduction

b) The front surface is moved toward the phantom in 3 mm steps until the sensor triggers.

c) The front surface is then moved back (further away) from the phantom by at least 5 mm or until maximum output power is returned to the normal maximum level.

d) The front surface is again moved toward the phantom, but in 1 mm steps, until it is at least 5 mm past the triggering point or touching the phantom.

e) If the device is not touching the phantom, it is moved in 3 mm steps until it touches the phantom to confirm that the sensor remains triggered and the maximum power stays reduced.

f) The process is then reversed by moving the device away from the phantom according to steps b) to e), to determine triggering release, until it is at least 10 mm beyond the point that triggers the return of normal maximum power.

i) The measured output power within +/- 5 mm of the triggering points, or until the device is touching the phantom, for movements to and from the phantom should be tabulated in the SAR report.

Proximity sensor validation procedure for near the front of the face							
Front of device moved toward the phantom			Front of device moved back (further away) from the phantom				
	Distance (mm)	Proximity sensor		Distance (mm)	Proximity sensor		
	120	Off		0	ON		
	119	Off		3	ON		
	116	Off		6	ON		
	113	Off		9	ON		
	110	Off		12	ON		
	107	Off		15	ON		
	104	Off		18	ON		
	101	Off		21	ON		
	98	Off		22	ON		
Dovice Trigger distance	95	Off	Dovico Triggor distance	23	ON		
Device Higger distance	92	Off	Device myger distance	24	ON		
	89	Off		25	ON		
	86	Off		26	ON		
	83	Off		27	Off		
	80	Off		28	Off		
	77	Off		29	Off		
	74	Off		30	Off		
	71	Off		33	Off		
	68	Off		36	Off		
	65	Off		39	Off		
	62	Off		42	Off		

59	Off	45	Off
56	Off	48	Off
53	Off	51	Off
50	Off	54	Off
47	Off	57	Off
44	Off	60	Off
41	Off	63	Off
38	Off	66	Off
35	Off	69	Off
32	Off	72	Off
29	Off	75	Off
26	Off	78	Off
23	Off	81	Off
22	Off	84	Off
21	Off	87	Off
20	ON	90	Off
19	ON	93	Off
18	ON	96	Off
17	ON	99	Off
16	ON	102	Off
15	ON	105	Off
14	ON	108	Off
13	ON	111	Off
11	ON	114	Off
 8	ON	117	Off
6	ON	120	Off
3	ON		
0	ON		

1.2.1. Proximity sensor validation on head-shaped phantom

The proximity sensor validation is to verify sensor trigger distance on head-shaped phantom to ensure the trigger distance is determined via 1.2 section is valid and workable on head-shaped phantom.

- a) The entire front surface of the device is positioned below a head-shaped phantom filled with the required tissue-equivalent medium.
- b) According to section 1.2 identified trigger distance, the front surface is then moved back (further away) from the phantom by at least 5 mm or until maximum output power is returned to the normal maximum level.
- c) The front surface is again moved toward the phantom, but in 1 mm steps, until it is at least 5 mm past the triggering point or touching the phantom.
- d) The process is then reversed by moving the device away from the phantom according to steps b) to c),

to determine triggering release, until it is at least 10 mm beyond the point that triggers the return of normal maximum power.

e) The measured output power within +/- 5 mm of the triggering points, or until the device is touching the phantom, for movements to and from the phantom should be tabulated in the SAR report.

Proximity sensor validation on head-shaped phantom							
Front of device moved toward the phantom			Front of device moved back (further away) from the phantom				
	Distance (mm)	Proximity sensor		Distance (mm)	Proximity sensor		
	25	Off		23	ON		
	24	Off		24	ON		
	23	Off		25	ON		
	22	Off		26	ON		
Device Trigger distance	21	Off	Device Trigger distance	27	ON		
	20	ON		28	Off		
	19	ON		29	Off		
	18	ON		30	Off		
	17	ON		31	Off		
	16	ON		32	Off		

Remark

Since P-light sensor detect mechanism is to disable RFID function during WIFI VoIP handset voice mode, therefore above proximity sensor validation results are not applicable for monitor RFID output power, due to when RFID function is disabled, the RFID power can't be returned to normal maximum output power when proximity sensor off, therefore the triggering conditions is to monitor the screen changes corresponding to proximity sensor detection. That reports the triggering conditions and proximity sensor detecting to disable RFID function is separately.

Proximity sensor on	LCD backlight off
Proximity sensor off	LCD backlight on

RFID conducted power verification:

- Establish VOIP call over WIFI and audio routed through the earpiece to monitor output power under head exposure condition.
- To use FTM (Factory Test Model) mode TX tool to configure RFID TX transmission.
- Monitor the RFID output power based on the P-light sensor detection mechanism to trigger disabling RFID Tx transmission under head exposure conditions.
- According to the proximity sensor validation results which the minimum triggering distance is 20 mm determined by front of device moved toward to the phantom, therefore select the condition of front of device moved toward the phantom from 21 mm sensor off to 20 mm sensor on and then monitor RFID output power.
- When RFID Tx off by FTM mode, observed the outpower power by power meter is -70 ~ -80 dBm, the output power is noise floor power level.
- Test setup for measuring power



Verification output power results

Front of device moved toward the phantom						
Device Trigger distance	Distance (mm)	Proximity sensor	RFID power			
	21	Off	23.67			
	20	ON	-72.82			

2. Power reduction mechanism verification

According to the May 2017 TCBC Workshop, Demonstration of proper functioning of the detection and triggering mechanisms is required to support the corresponding RF exposure conditions. The verification is through a base station simulator is used to establish a conducted RF connection and monitor output power under different operating conditions related to the power reduction mechanisms. Detail of power reduction mechanisms referring to Operational Description

1. Power Verification Procedure

The power verification was performed according to the following procedure:

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

General Note:

1. This device uses different Device State Indices (DSI) to configure different time averaged power levels based on certain exposure scenarios, as the following table:

Exposure Condition	DSI	Trigger Conditions
Head	DSI2	Receiver on
Body Worn/Extremity	DSI0	RFID Off + Receiver Off + Hotspot Off
Hotspot	DSI1	RFID Off + Receiver Off + Hotspot On
Hotspot	DSI4	RFID On + Receiver Off + Hotspot On
Body Worn/Extremity	DSI5	RFID On + Receiver Off + Hotspot Off

2. Select the bands with the largest power reduction for power verification:

- a. Establish voice call and audio routed through the earpiece to monitor output power under head transmitting power states.
 - > Tradition voice call for WCDMA, voice over IP CMRS operations for LTE.
 - LTE Band 7 is set at 'highest BW, 1RB, RB Offset = 0, QPSK', WCDMA II is set AMR 12.2Kbps.
- b. Establish data connection monitor hotspot power state.
 - LTE Band 2/7 is set at 'highest BW, 1RB, RB Offset = 0, QPSK'.
- c. Establish data connection monitor body worn power state.
 - LTE Band 7 is set at 'highest BW, 1RB, RB Offset = 0, QPSK', WCDMA II is set RMC 12.2Kbps.
 - Body Detect mechanism was performed for the in-hand and on a stationary object (placed on a table)
- d. Establish data connection monitor extremity power state.
 - LTE Band 7 is set at 'highest BW, 1RB, RB Offset = 0, QPSK', WCDMA II is set RMC 12.2Kbps.
 - Body Detect mechanism was performed for the in-hand and on a stationary object (placed on a table).
- 2. In this power validation purpose is to demonstrate of proper functioning of the detection and triggering mechanisms to support the corresponding RF exposure conditions.
- 3. Verification performed for one technology/Band to demonstrate that the power reduction applies for same technology/band and call origination.

2. Verification output Power Results

Head exposure conditions

Head Exposure condition	Output Power for Voice Call				
Ear acoustic output Status:	ON		OFF		
Power state	WWAN DSI2		WWAN DSI0		
Wireless technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
WCDMA II	Ant 2	19.61	20.3	22.95	24.00
LTE Band 7	Ant 3	16.82	17.6	21.33	22.40

Hotspot exposure condition

Hotspot exposure condition		Output Power for data connection					
Wifi Hotspot Status		OFF		ON		ON	
RFID Status		OFF		OFF		ON	
Power state		WWAN DSI0		WWAN DSI1		WWAN DSI4	
		WiFi Standalone		WiFi Simultaneous		WiFi Simultaneous	
Wireless Technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
LTE Band 2	Ant 2	23.11	24.0	20.53	21.7	19.42	20.3
LTE Band 7	Ant 3	21.69	22.4	20.11	20.9	18.35	19.5

Body worn& Extremity exposure condition

Podu Wore oversure condition	Output Power (data connection)				
Body wom exposure condition	Stationary		Grip		
RFID Status	On		OFF		
Power state	WWAN DSI5		WWAN DSI0		
Wireless Technology	Antenna	Measured (dBm)	Max. Tune-up	Measured (dBm)	Max. Tune-up
			(dBm)		(dBm)
WCDMA II	Ant 2	21.13	22.0	22.75	24.0
LTE Band 7	Ant 3	19.56	20.4	21.39	22.4