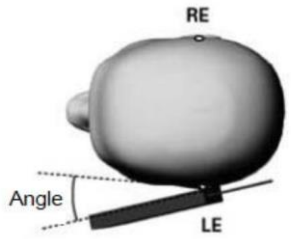
1 Proximity sensor validation

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

Proximity sensor validation procedure for Head exposure condition					
Rotate the device from 0 degree to 90 degree _Right Head			Rotate the device from 90 degree to 0 degree _Right Head		
	Angle	**Proximity sensor**		Angle	**Proximity sensor**
Device angle (degree)	0	On	Device angle (degree)	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
	29	On		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
Rotate the device from 0 degree to 90 degree_Left Head			Rotate the device from 90 degree to 0 degree_Left Head		
	Angle	**Proximity sensor**		Angle	**Proximity sensor**
Device angle (degree)	0	On	Device angle (degree)	90	Off
	10	On		81	Off
	20	On		80	Off
	22	On		79	Off
	23	On		78	Off
	24	On		77	Off
	25	On		76	Off
	26	On		75	On
	27	On		74	On
	28	On		73	On
	29	On		72	On
	30	On		71	On
	31	Off		70	On
	32	Off		60	On
	33	Off		50	On
	34	Off		40	On
	40	Off		30	On
	50	Off		20	On
	60	Off		10	On
	70	Off		0	On
	80	Off			
	90	Off			

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**
Device Trigger distance	120	Off	Device Trigger distance	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
	95	Off		23	ON
	92	Off		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**
Device Trigger distance	25	Off	Device Trigger distance	23	ON
	24	Off		24	ON
	23	Off		25	ON
	22	Off		26	ON
	21	Off		27	ON
	20	ON		28	Off
	19	ON		29	Off
	18	ON		30	Off
	17	ON		31	Off
	16	ON		32	Off

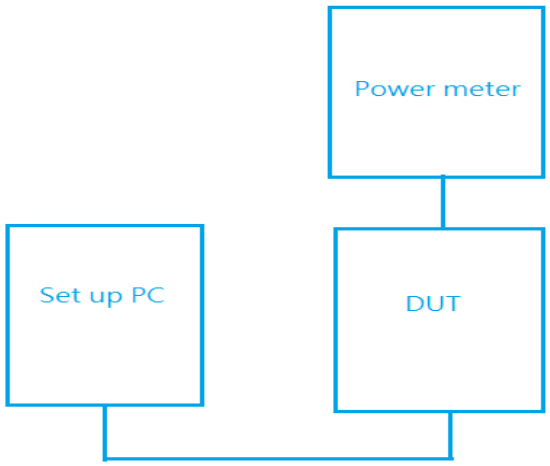
Remark

- 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

1.2.2 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	24.05
	20	ON	-73.41

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:

1. 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 30 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 2/25/7 is set at 'highest BW, 1RB, RB Offset = 0, QPSK'.
   c. Establish data connection monitor body worn power state.
      - LTE Band 30 is set at 'highest BW, 1RB, RB Offset = 0, QPSK', WCDMA II is set AMR 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 30 is set at 'highest BW, 1RB, RB Offset = 0, QPSK', WCDMA II is set AMR 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	18.79	19.6	22.35	23.20
LTE Band 30	Ant 3	15.45	16.2	19.66	20.40

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 25(2)	Ant 2	22.45	23.2	20.62	21.7	19.11	20.2
LTE Band 7	Ant 3	19.78	20.9	18.25	19.4	16.56	17.9

Body worn& Extremity exposure condition

Body Worn exposure condition		Output Power (data connection)			
		Stationary		Grip	
RFID Status		On		OFF	
Power state		WWAN DSI5		WWAN DSI0	
Wireless Technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
WCDMA II	Ant 2	20.56	21.7	22.53	23.2
LTE Band 30	Ant 3	17.25	18.4	19.67	20.4