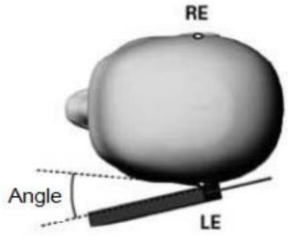
Appendix F. Proximity sensor validation

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

11.1 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

Rotate the device from 0 degree to 90 degree _Right Head		
Device angle (degree)	Angle	**Proximity sensor**
	0	On
	10	On
	20	On
	30	On
	40	On
	50	On
	60	On
	70	On
	80	On
	81	On
	82	On
	83	On
	84	On
	85	On
	86	On
	87	Off
	88	Off
	89	Off
	90	Off

Rotate the device from 90 degree to 0 degree _Right Head		
Device angle (degree)	Angle	**Proximity sensor**
	90	Off
	89	Off
	88	Off
	87	Off
	86	Off
	85	Off
	84	Off
	83	Off
	82	Off
	81	On
	80	On
	70	On
	60	On
	50	On
	40	On
	30	On
	20	On
	10	On
	0	On

Rotate the device from 0 degree to 90 degree_Left Head		
Device angle (degree)	Angle	**Proximity sensor**
	0	On
	10	On
	20	On
	30	On
	40	On
	50	On
	60	On
	70	On
	80	On
	81	On
	82	On
	83	On
	84	On
	85	On
	86	Off
	87	Off
	88	Off
	89	Off
	90	Off

Rotate the device from 90 degree to 0 degree_Left Head		
Device angle (degree)	Angle	**Proximity sensor**
	90	Off
	89	Off
	88	Off
	87	Off
	86	Off
	85	Off
	84	Off
	83	Off
	82	On
	81	On
	80	On
	70	On
	60	On
	50	On
	40	On
	30	On
	20	On
	10	On
	0	On

11.2 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.

Front of device moved toward the phantom		
	Distance (mm)	**Proximity sensor**
Device Trigger distance	120	Off
	118	Off
	115	Off
	112	Off
	109	Off
	106	Off
	103	Off
	100	Off
	97	Off
	94	Off
	91	Off
	88	Off
	85	Off
	83	Off
	80	Off
	77	Off
	74	Off
	71	Off
	68	Off
	65	Off
	63	Off
	62	Off
	61	Off
	60	Off
	59	Off
	58	ON
	57	ON

	56	ON
	55	ON
	54	ON
	53	ON
	50	ON
	47	ON
	44	ON
	41	ON
	38	ON
	35	ON
	32	ON
	29	ON
	26	ON
	23	ON
	20	ON
	17	ON
	14	ON
	11	ON
	8	ON
	5	ON
	2	ON
	0	ON

Front of device moved back (further away) from the phantom		
	Distance (mm)	**Proximity sensor**
Device Trigger distance	0	ON
	3	ON
	6	ON
	9	ON
	12	ON
	15	ON
	18	ON
	21	ON
	24	ON
	27	ON
	30	ON
	33	ON
	36	ON
	39	ON
	42	ON
	45	ON
	48	ON
	51	ON
	54	ON
	57	ON
	60	ON
	63	ON
	66	ON
	69	ON
	72	ON
	75	ON
	78	ON
	81	ON
	84	ON
	87	ON
	90	ON
	93	ON

	95	ON
	96	ON
	97	ON
	98	ON
	99	ON
	100	Off
	111	Off
	112	Off
	113	Off
	114	Off
	115	Off
	118	Off
	120	Off

11.2.1 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 11.2 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 11.2 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.

Front of device moved toward the phantom		
	Distance (mm)	**Proximity sensor**
Device Trigger distance	63	Off
	62	Off
	61	Off
	60	Off
	59	Off
	58	ON
	57	ON
	56	ON
	55	ON
	54	ON

Front of device moved back (further away) from the phantom		
	Distance (mm)	**Proximity sensor**
Device Trigger distance	95	ON
	96	ON
	97	ON
	98	ON
	99	ON
	100	Off
	111	Off
	112	Off
	113	Off
	114	Off

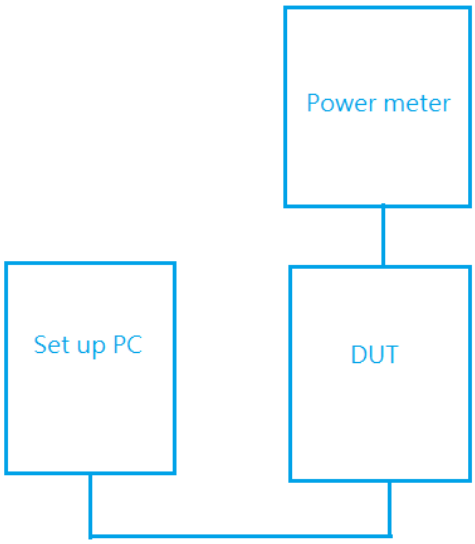
Remark

- 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 58 mm determined by front of device moved toward to the phantom, therefore select the condition of front of device moved toward the phantom from 59 mm sensor off to 58 mm sensor on and then monitor RFID output power.
- When RFID Tx off by FTM mode, observed the outpower power by power meter is -60~-65 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**
	59	Off	23.98
	58	ON	-64.56

Appendix F. WLAN Power reduction mechanism verification

Demonstration of proper functioning of the detection and triggering mechanisms 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

- Establish voice call and audio routed through the earpiece to monitor output power under head exposure condition
- Establish data connection monitor body worn power state.
  - Body Detect mechanism was performed for the in-hand and on a stationary object (placed on a table)
- In this power validation purpose is to demonstrate of proper functioning of the detection and triggering mechanisms to support the corresponding RF exposure conditions.
- Verification performed for each technology to demonstrate that the power reduction applies for both technology and call origination.

2. Test setup for measuring power

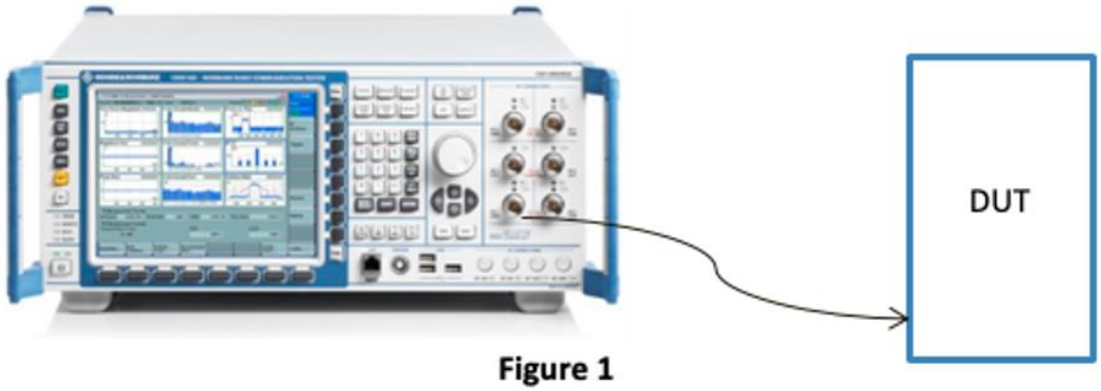


Figure 1

3. Verification output Power Results

Head exposure condition

Head exposure condition		Output Power	
Wireless technology	Antenna	Measured (dBm)	Target power(dBm)
802.11ac UNII3 ,CH155	(Ant6+7)Ant 6	19.1	20 ±1.5
	(Ant6+7)Ant 7	19.4	20 ±1.5

Body worn exposure condition

Display on:

Body exposure condition		Output Power (data connection) G-Sensor status			
Power state		Sensor Off		Sensor On	
Wireless technology	Antenna	Measured (dBm)	Target power(dBm)	Measured (dBm)	Target power(dBm)
802.11ac UNII2 ,CH138	(Ant6+7)Ant 6	18.4	18.5 ±1.5	15	16.5 ±1.5
	(Ant6+7)Ant 7	19.5	18.5 ±1.5	15.2	16.5 ±1.5

Display on to off:

Body exposure condition		Output Power (data connection) (dBm)			
		Display on Stationary Placed on a table		Display off Stationary Placed on a table	
Power state		Full Power		Low Power	
Wireless technology	Antenna	Measured	Max. Tune-up	Measured	Max. Tune-up
802.11ac UNII2 , CH138	(Ant6+7)Ant 6	18.2	19.5 ±1.5	15	16.5 ±1.5
	(Ant6+7)Ant 7	19.2	19.5 ±1.5	15.3	16.5 ±1.5

Note: When the Display is off, the power will remain at the reduce power level.

Conducted Power verification Plan:

a) Body Detect mechanism will be performed for the in-hand and on a stationary object (placed on a table).
b) Verify the functionality of the motion sensor by measuring the output power in the following steps.

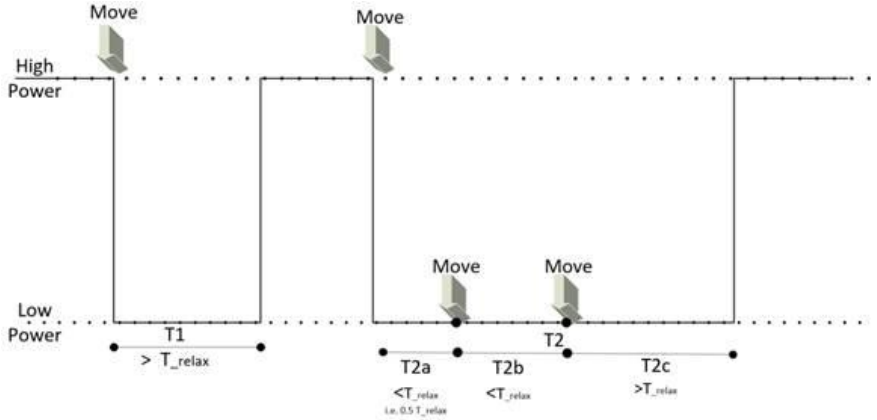


Figure 1 Illustration of the procedure for the validation of the power reduction

The device is embedded with motion sensors only, no proximity sensors are installed.

1. **Placed on a table:** Make the DUT transmit with the maximum output power by using a base station simulator.
   a) Confirm that motion sensor is not triggered by letting the DUT remain stationary with no movements for the period T_{relax} for the motion sensor to reach stationary state.
   b) Record P_{step1} (high power)
2. **In-hand:** Move the DUT to trigger the motion sensor. Apply the motion of the DUT with respect to movements in intended and reasonably foreseeable use conditions of the DUT.
   a) Record P_{step2} (low power)
3. For the validation of T_{relax}, wait a time period $T_1 > T_{relax}$ and confirm DUT restores to high power (P_{step1}).
4. Move the DUT to trigger the motion sensor.
5. Move DUT within T_{relax} to ensure T_{relax} resets when DUT is in motion.
   DUT can be moved once or twice within T_{relax}, (after time periods T_{2a} and T_{2b} in Figure 1.) followed by waiting for a time period greater than T_{relax} (time period T_{2c} in Figure 1.) for DUT to restore high power. The total time duration of this step is T_2, and the power during the whole period T_2 shall be reduced (low power – P_{step2}).

T_{relax}: *60 sec*
Monitor period, T_1: 70 *sec*, T_{2a}: 30 sec, T_{2b}:30 sec, T_{2c}: 70 sec

Exposure Condition		Output Power (data connection) (dBm)											
		Stationary Placed on a table		In hand		Stationary Placed on a table		In hand				Stationary Placed on a table	
Power state		Full Power P_{step1}		Low Power P_{step2}		Full Power P_{step1} & T_1 > T_{relax}		Low Power P_{step2} & T_{2a} < T_{relax}		Low Power P_{step2} & T_{2b} < T_{relax}		Full Power P_{step1} & T_{2c} > T_{relax}	
Wireless technology	Antenna	Measured	Max. Tune-up	Measured	Max. Tune-up	Measured	Max. Tune-up	Measured	Max. Tune-up	Measured	Max. Tune-up	Measured	Max. Tune-up
802.11ac UNII2 , CH138	(Ant6+7) Ant 6	18.2	19.5±1.5	15	16.5±1.5	18.4	19.5±1.5	15	16.5±1.5	15	16.5±1.5	18.2	19.5±1.5
	(Ant6+7) Ant 7	19.2	19.5±1.5	15.2	16.5±1.5	19.2	19.5±1.5	15.2	16.5±1.5	15.2	16.5±1.5	19.2	19.5±1.5

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