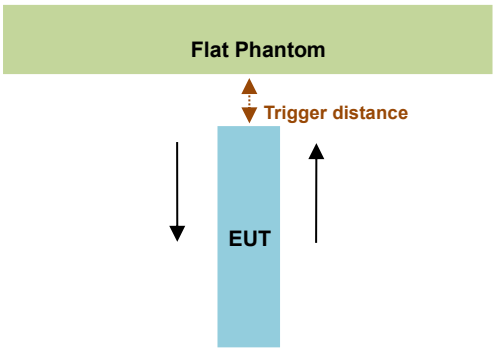
Appendix E. Proximity Sensor Verification

<Proximity Sensor Triggering Distance (KDB 616217 D04 section 6.2)>:

For the device is fully integrated, touch sensing capacitive sensor. It uses a charge transfer capacitive acquisition method that is capable of near range proximity detection. In this device offers a state-of-the-art capacitive sensing engine with an embedded sampling capacitor and voltage regulator allowing the overall solution cost to be reduced and improving system immunity in noisy environments.
Proximity sensor triggering distance testing was performed according to the procedures outlined in KDB 616217 D04 section 6.2, and EUT moving further away from the flat phantom and EUT moving toward the flat phantom were both assessed. The details are illustrated as following, and the shortest triggering distances were reported and used for SAR assessment.
In the preliminary triggering distance testing, the tissue-equivalent medium for different frequency bands were used for verification; no other frequency bands tissue-equivalent medium was found to result in shortest triggering distance than that for 1900MHz, and the tissue-equivalent medium for 1900MHz was used for formal proximity sensor triggering testing.



Ant 1 Proximity Trigger Distance								
Position	Front		Back		Right Edge		Top Edge	
Minimum (mm)	Moving towards	Moving away	Moving towards	Moving away	Moving towards	Moving away	Moving towards	Moving away
	20	27	20	21	25	25	18	19

Ant 4 Proximity Trigger Distance						
Position	Front		Back		Top Edge	
Minimum (mm)	Moving towards	Moving away	Moving towards	Moving away	Moving towards	Moving away
	17	21	17	23	23	24

<Proximity Sensor Triggering Coverage (KDB 616217 D04 section 6.3)>:

Since the antenna and sensor are collocated and all of the peak SAR location is overlapping with the sensor pad for this device, therefore, According to KDB 616217 section6.3, these procedures do not apply and are not required for this device. due to the antenna and sensor are collocated and the peak SAR location is overlapping with the sensor on this device.

Proximity sensor power reduction in open mode

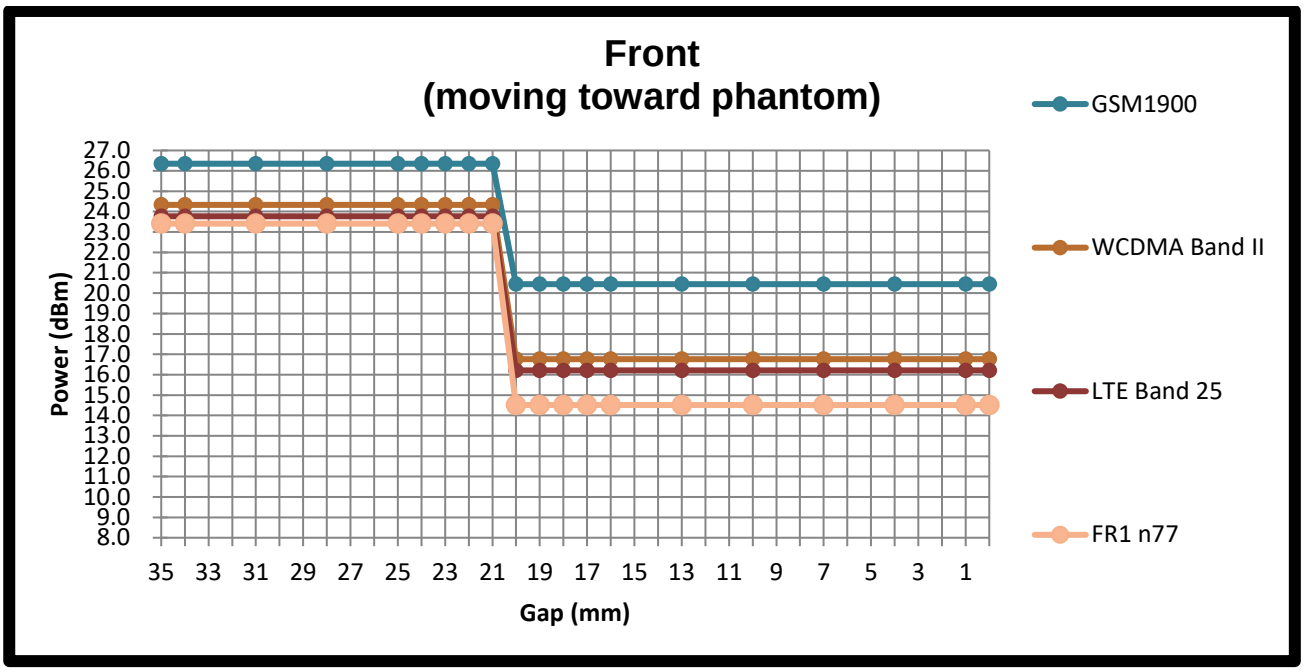
Transmit Ant 1		Transmit Ant 4	
Exposure Position / wireless Band	Front, Back, Right Side, Top Side(1)	Exposure Position / wireless Band	Front, Back, Top Side(1)
GSM1900	1.92 dB	WLAN 2.4GHz	4.36 dB
WCDMA Band II	2.88 dB	WLAN 5GHz	0.90 dB
LTE Band 2	2.56 dB	WLAN 6GHz	5.45 dB
LTE Band 7	2.97 dB		
LTE Band 25	2.59 dB		
LTE Band 30	1.25 dB		
LTE Band 38	0.50 dB		
LTE Band 38 HPUE	0.50 dB		
LTE Band 41	0.50 dB		
LTE Band 41 HPUE	0.50 dB		
FR1 n2	1.28 dB		
FR1 n7	2.38 dB		
FR1 n25	1.29 dB		
FR1 n30	0.76 dB		
FR1 n38	1.87 dB		
FR1 n41	2.17 dB		
FR1 n41 HPUE	1.21 dB		
FR1 n48	1.34 dB		
FR1 n77 27O	2.88 dB		
FR1 n77 27O HPUE	2.03 dB		
FR1 n77 27Q	3.00 dB		
FR1 n77 27Q HPUE	2.08 dB		
FR1 n78 27O	2.78 dB		
FR1 n78 27O HPUE	2.11 dB		
FR1 n78 27Q	3.04 dB		
FR1 n78 27Q HPUE	2.03 dB		

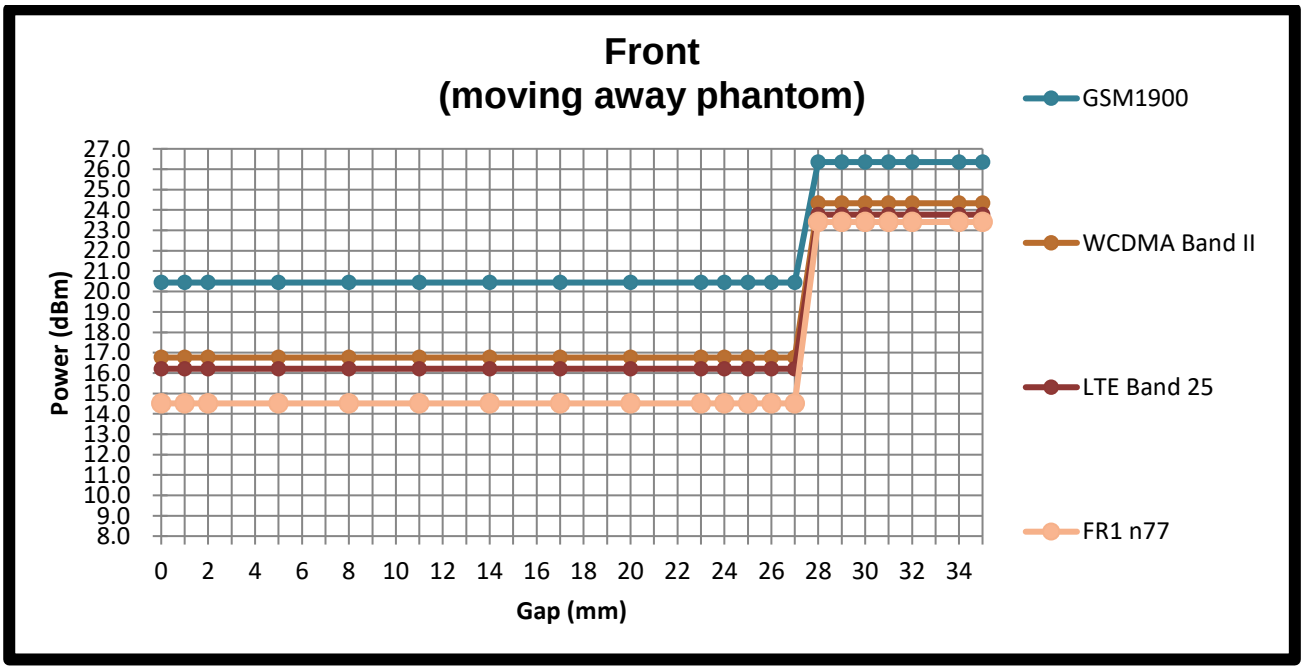
General Note:

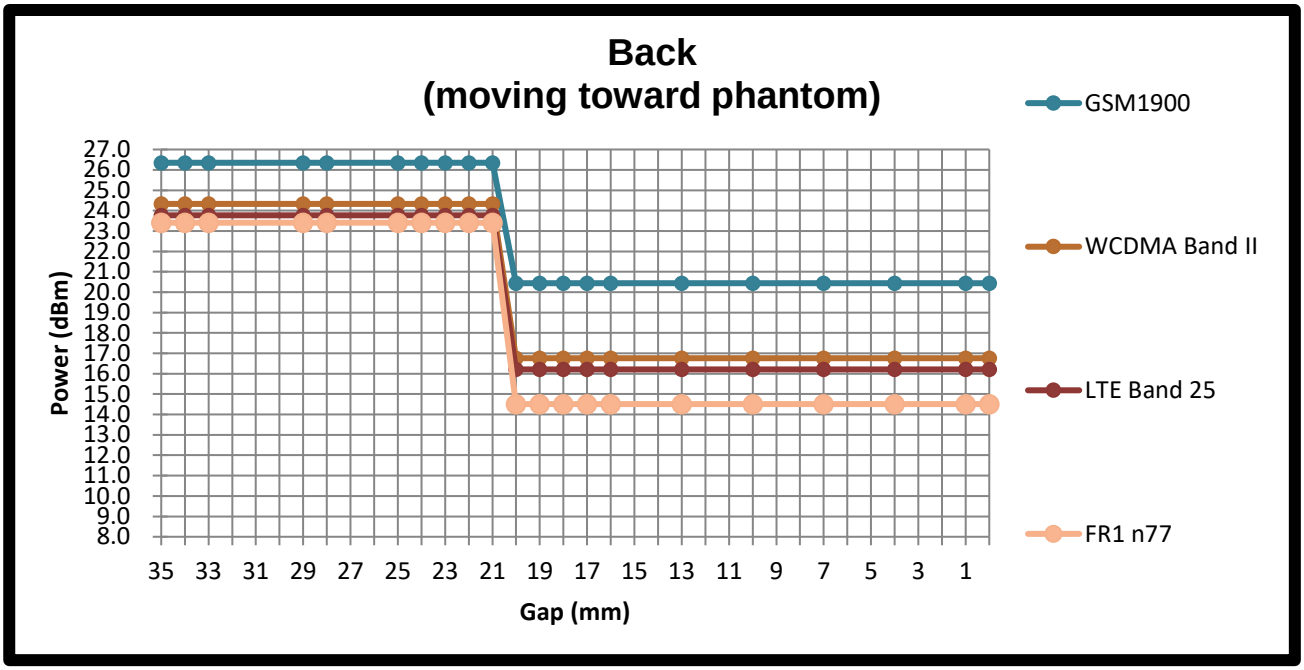
1. (1): Reduced maximum limit applied by activation of proximity sensor.
2. Tests were performed in accordance with KDB 616217 D04 section 6.1, 6.2, 6.3, 6.4 and 6.5 and compliant results are shown below
3. For the power verification was selected worst case power reduction level of band of each transmit antenna to verify.

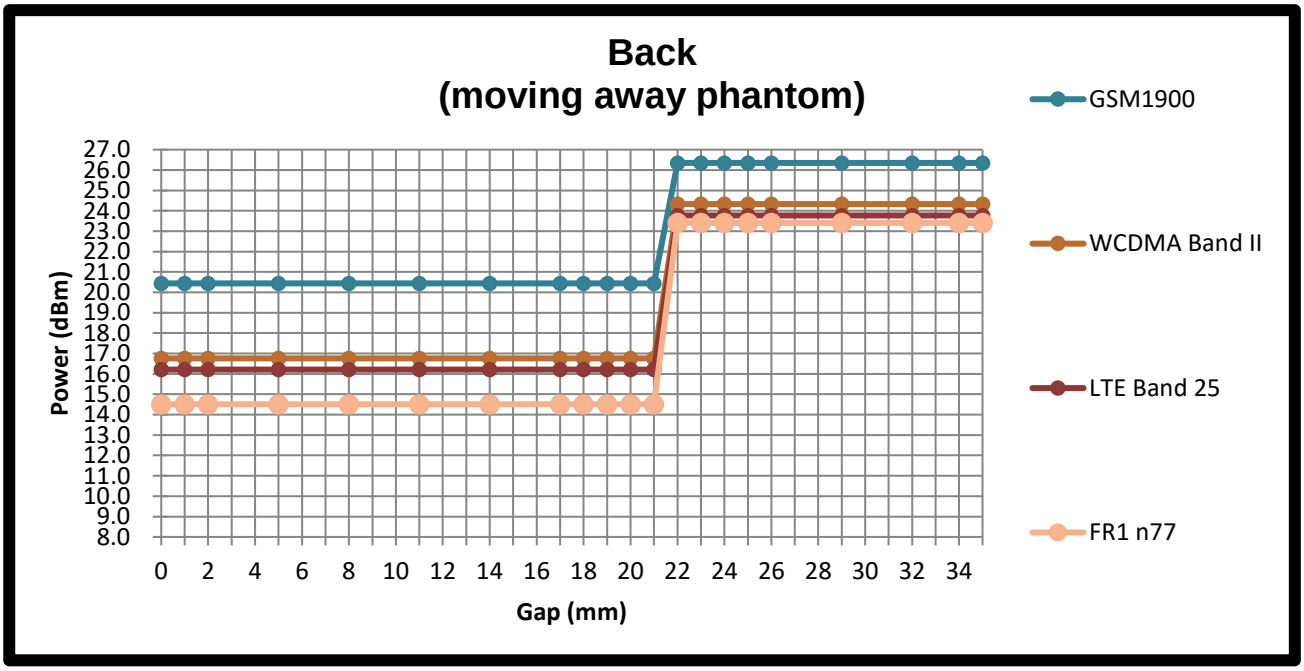
Power Measurement during Sensor Trigger distance testing

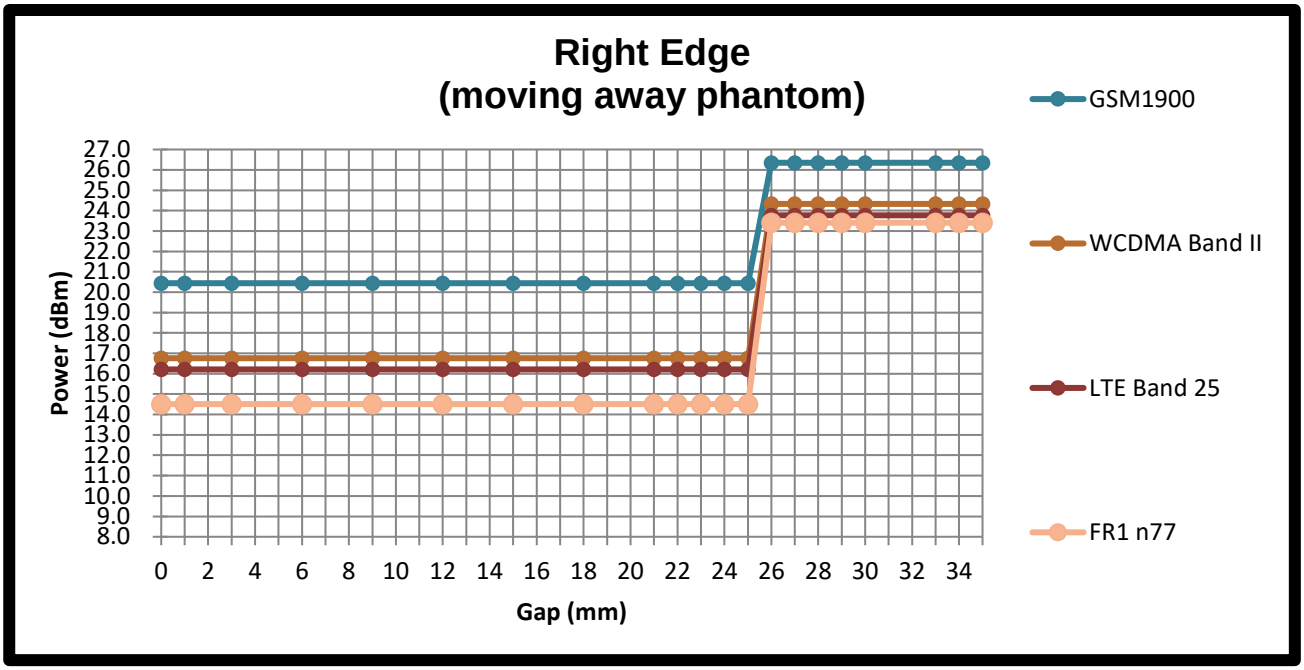
Ant 1

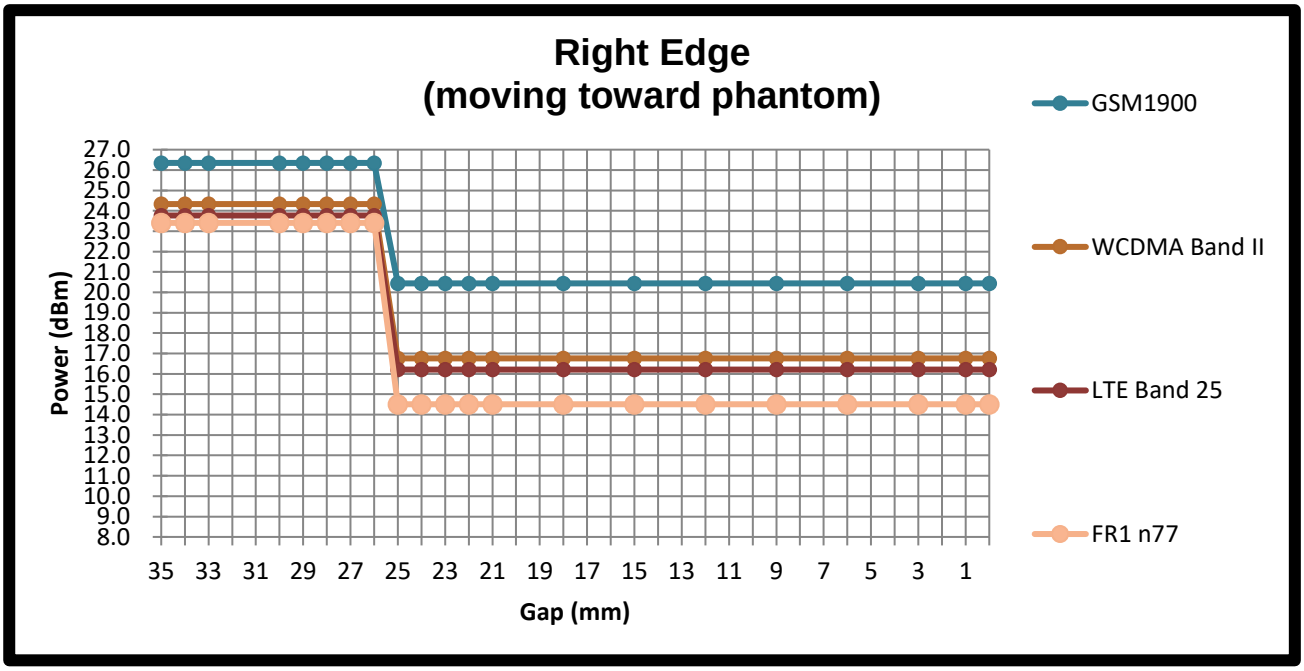


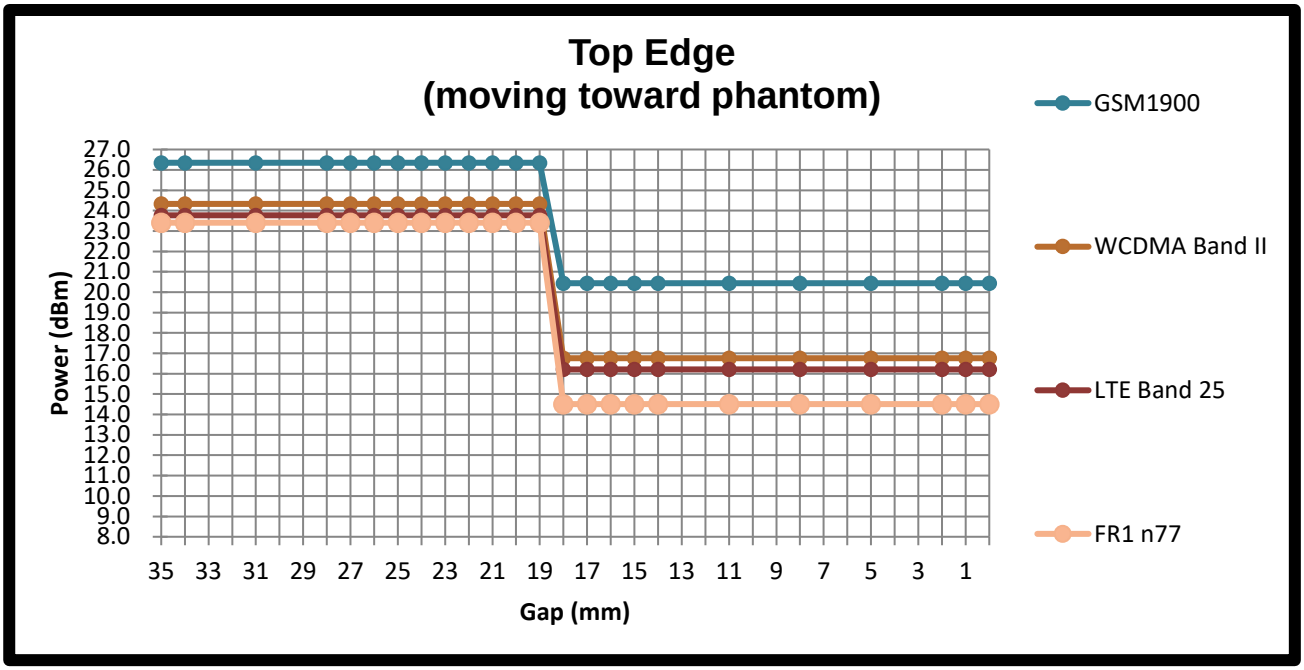


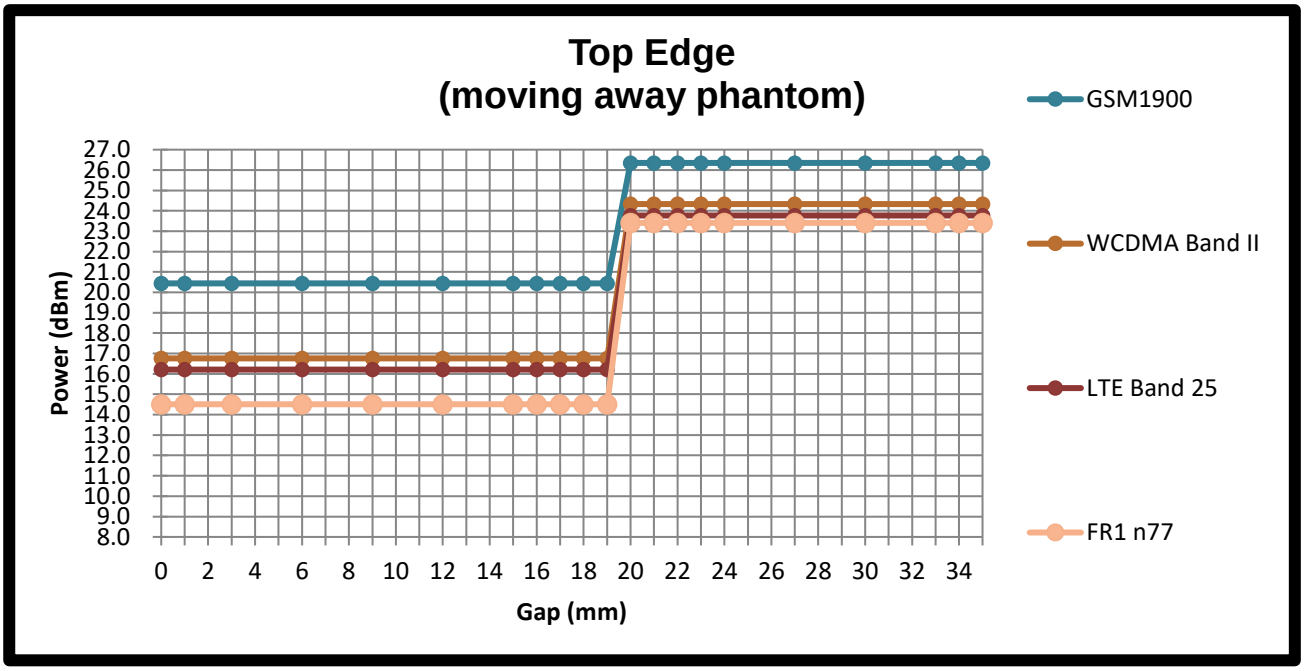

Back
(moving toward phantom)
Power (dBm)
27.0
26.0
25.0
24.0
23.0
22.0
21.0
20.0
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
35 33 31 29 27 25 23 21 19 17 15 13 11 9 7 5 3 1
Gap (mm)
GSM1900
WCDMA Band II
LTE Band 25
FR1 n77


Back
(moving away phantom)
Power (dBm)
27.0
26.0
25.0
24.0
23.0
22.0
21.0
20.0
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
Gap (mm)
GSM1900
WCDMA Band II
LTE Band 25
FR1 n77

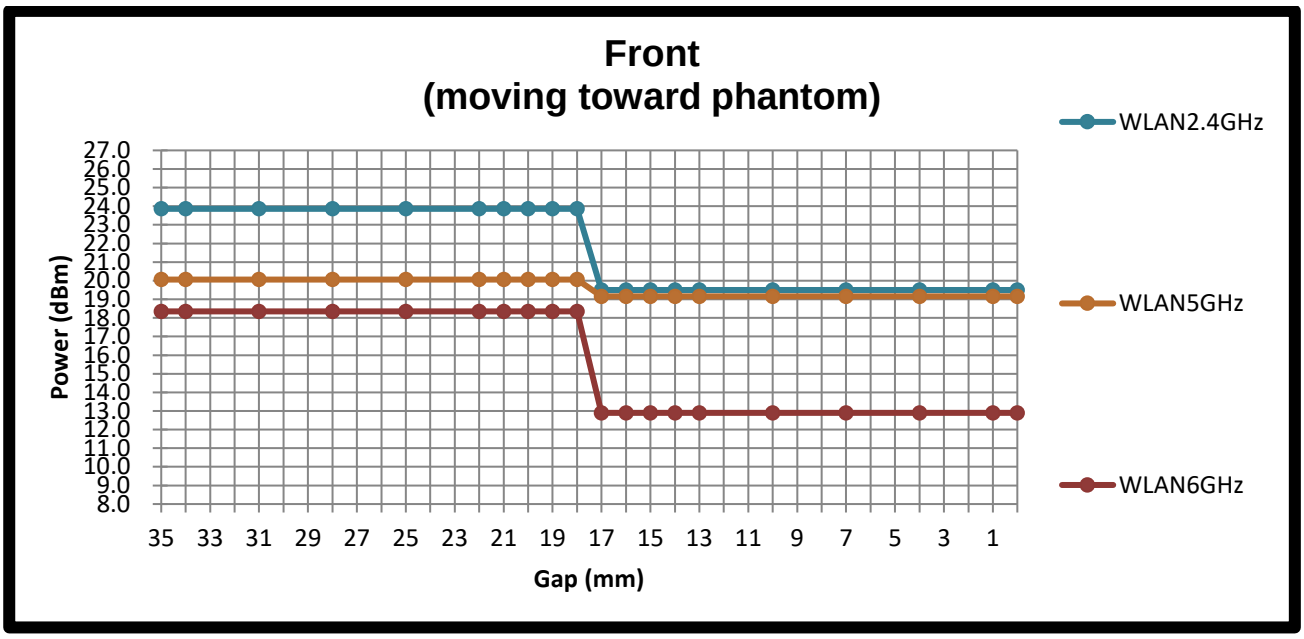

Right Edge
(moving away phantom)
Power (dBm)
27.0
26.0
25.0
24.0
23.0
22.0
21.0
20.0
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
Gap (mm)
GSM1900
WCDMA Band II
LTE Band 25
FR1 n77

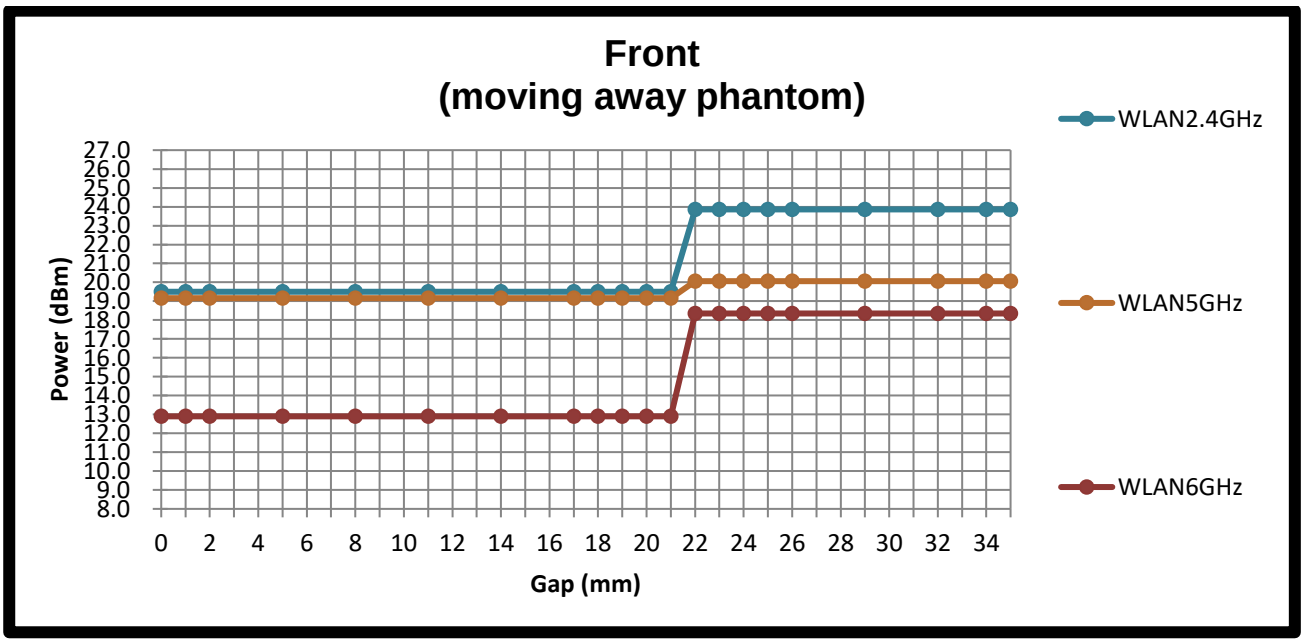

Right Edge
(moving toward phantom)
Power (dBm)
27.0
26.0
25.0
24.0
23.0
22.0
21.0
20.0
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
35 33 31 29 27 25 23 21 19 17 15 13 11 9 7 5 3 1
Gap (mm)
GSM1900
WCDMA Band II
LTE Band 25
FR1 n77

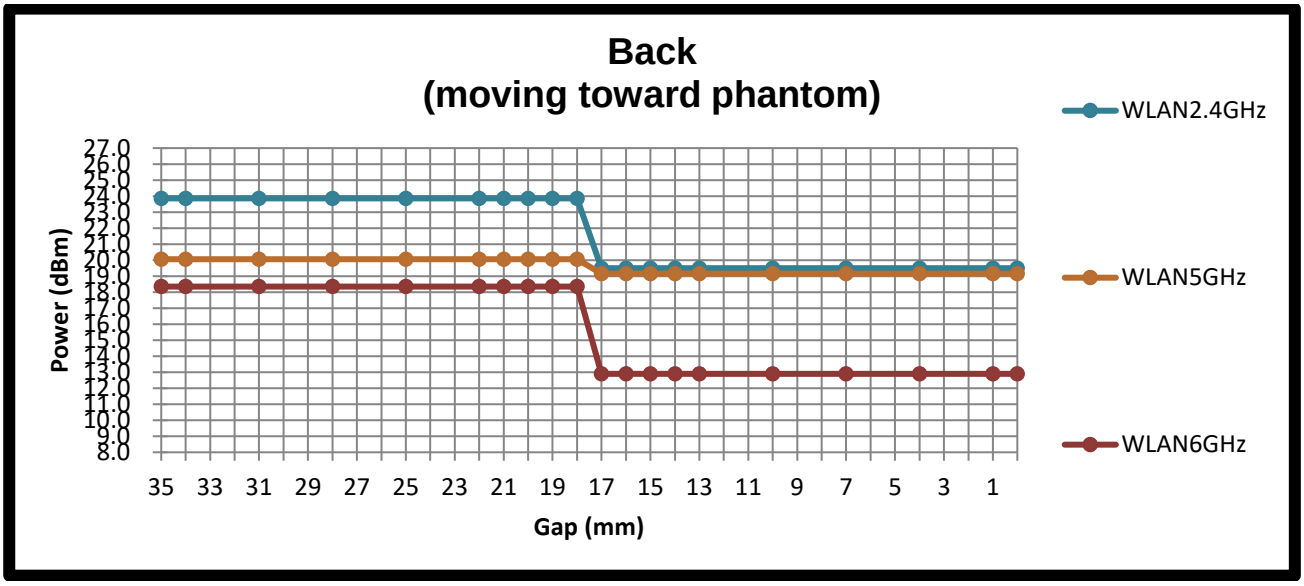

Top Edge
(moving toward phantom)
GSM1900
WCDMA Band II
LTE Band 25
FR1 n77
Power (dBm)
27.0
26.0
25.0
24.0
23.0
22.0
21.0
20.0
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
35 33 31 29 27 25 23 21 19 17 15 13 11 9 7 5 3 1
Gap (mm)

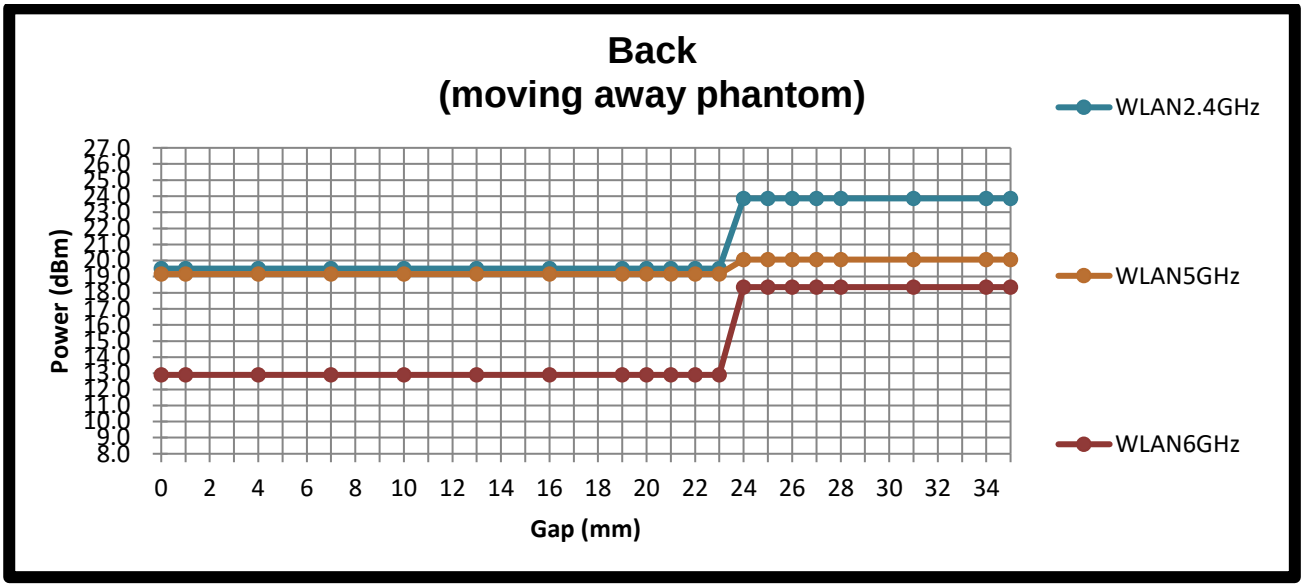

Top Edge
(moving away phantom)
GSM1900
WCDMA Band II
LTE Band 25
FR1 n77
Power (dBm)
27.0
26.0
25.0
24.0
23.0
22.0
21.0
20.0
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
Gap (mm)

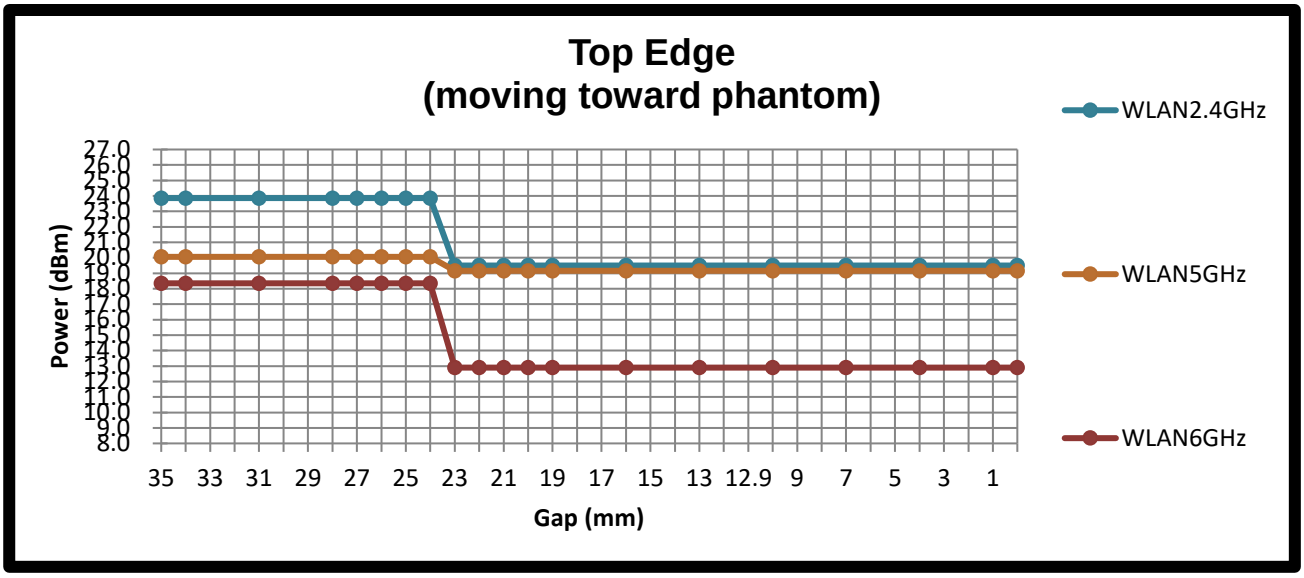
Ant 4

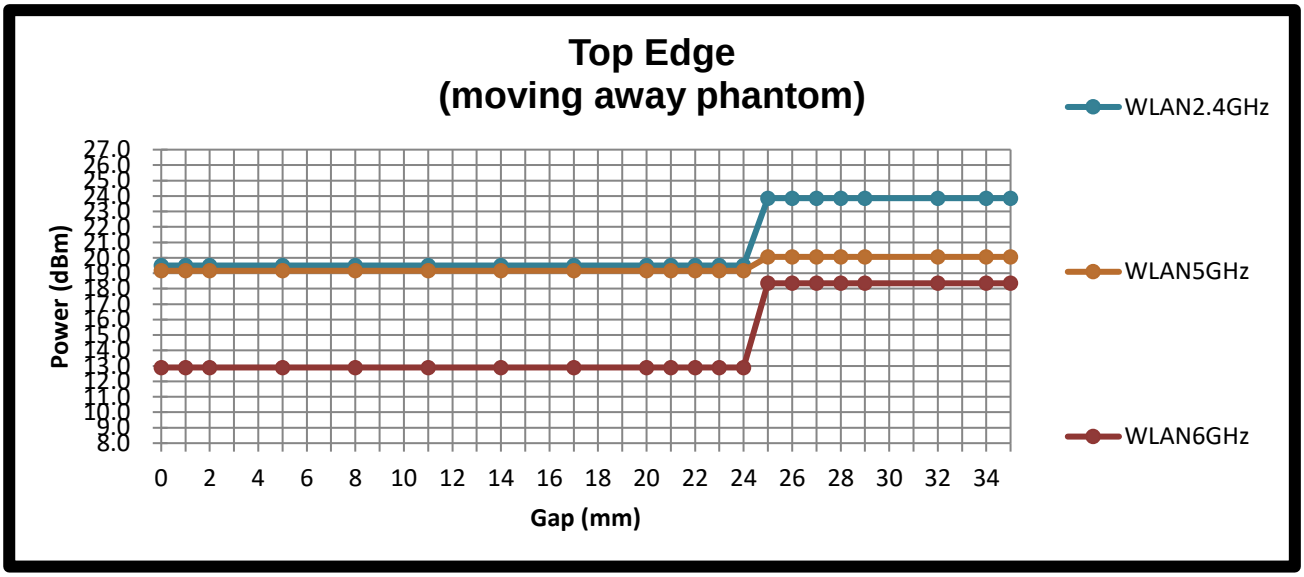

Front
(moving toward phantom)
Power (dBm)
27.0
26.0
25.0
24.0
23.0
22.0
21.0
20.0
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
35 33 31 29 27 25 23 21 19 17 15 13 11 9 7 5 3 1
Gap (mm)
WLAN2.4GHz
WLAN5GHz
WLAN6GHz


Front
(moving away phantom)
Power (dBm)
27.0
26.0
25.0
24.0
23.0
22.0
21.0
20.0
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
Gap (mm)
WLAN2.4GHz
WLAN5GHz
WLAN6GHz


Back
(moving toward phantom)
WLAN2.4GHz
WLAN5GHz
WLAN6GHz
Power (dBm)
27.0
26.0
25.0
24.0
23.0
22.0
21.0
20.0
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
35 33 31 29 27 25 23 21 19 17 15 13 11 9 7 5 3 1
Gap (mm)

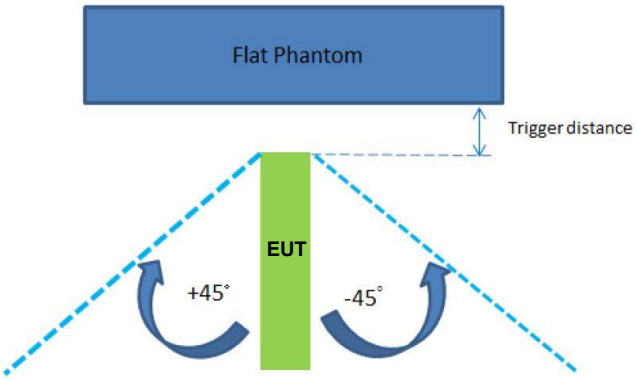

Back
(moving away phantom)
WLAN2.4GHz
WLAN5GHz
WLAN6GHz
Power (dBm)
27.0
26.0
25.0
24.0
23.0
22.0
21.0
20.0
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
Gap (mm)


Top Edge
(moving toward phantom)
WLAN2.4GHz
WLAN5GHz
WLAN6GHz
Power (dBm)
27.0
26.0
25.0
24.0
23.0
22.0
21.0
20.0
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
35 33 31 29 27 25 23 21 19 17 15 13 12.9 9 7 5 3 1
Gap (mm)


Top Edge
(moving away phantom)
WLAN2.4GHz
WLAN5GHz
WLAN6GHz
Power (dBm)
27.0
26.0
25.0
24.0
23.0
22.0
21.0
20.0
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
Gap (mm)

<Tablet Tilt angle influences to proximity sensor triggering (KDB 616217 D04 section 6.4)>:

The influence of table tilt angles to proximity sensor triggering was determined by positioning each tablet edge that contains a transmitting antenna, perpendicular to the flat phantom, at above separation distance.
Rotating the tablet around the edge next to the phantom in ≤ 10° increments until the tablet is ± 45° from the vertical position at 0°, and the maximum output power remains in the reduced mode.



Ant 1 Proximity Trigger Distance				
Position	Right Edge		Top Edge	
Minimum (mm)	+45	-45	+45	-45
	25	25	18	18

Ant 4 Proximity Trigger Distance		
Position	Top Edge	
Minimum (mm)	+45	-45
	23	23

<SAR measurement procedure involving proximity sensors>

Two different maximum output power levels are applied according to the triggering conditions of the proximity sensor. SAR measurements shall be performed for the two different maximum output power state and test distance combinations.

SAR measurements at these two power and distance combinations are enough to ensure compliance for the use conditions requiring proximity sensing and power reduction at the applicable device to user distance.

a) Full power: The smallest separation distance determined in 6.2, 6.3 and 6.4 for each triggering condition minus 1 mm should be used in the SAR measurements.

Ant 1:

Front: 19 mm
Back: 19 mm
Right Side: 24 mm
Top Side: 17 mm

Ant 4:

Front: 16 mm
Back: 16 mm
Top Side: 22 mm

b) Reduced power: SAR tests shall be performed at the closest intended use distance or at the closest distance required by the regulator. SAR measurements at these two power and distance combinations are enough to ensure compliance for the use conditions requiring proximity sensing and power reduction at the applicable device to user distance.

Ant 1:

Front: 0 mm, 10 mm
Back: 0 mm, 10mm
Right Side: 0 mm
Top Side: 0 mm

Ant 4:

Front: 0 mm, 10mm
Back: 0 mm, 10mm
Top Side: 0 mm

Appendix E. Lid angle and power verification

General Note:

1. The following guidance should be applied to device that use Hall Effect or gravity sensors to detect lid angle for the purpose of power reduction:
   Step 1: With the lid is in closed mode (0 degrees), open the screen in 10 degree steps until laptop mode is obtained
   Step 2: Lower the screen 5 degrees. Closed mode should be reobtained. If not keep lowering in 5 degree steps
   Step 3: Open the screen in 1 degree steps until device is reobtained
   Step 4: Continue opening the screen in 1 degree steps until at least 5 degrees past where device was obtained
   Step 5: Then continue opening the screen in 10 degree steps until device is obtained
   Step 6: Power measurements should be taken at each step
   Step 7: Reverse this procedure going from device in open mode back down to device into closed mode
2. The bands demonstrating the worst power reduction were selected to verify power behavior and are listed below.
3. WWAN power behavior is verified in body-worn standalone mode, where WLAN and Bluetooth functions are disabled, and the motion and proximity sensors are active. The verification focuses on observing the WWAN power state transition between index 5 (closed mode) and index 10 (open mode) in response to lid angle changes.
4. WLAN power behavior is verified in body-worn standalone mode, where the WWAN function is disabled and the motion and proximity sensors are active. The verification focuses on observing the WLAN power state transition between index 3 (closed mode) and index 8 (open mode) in response to lid angle changes.

Lid angle verification between close mode an open mode																	
Screen angle (degree) v.s. power	Wireless		GSM			WCDMA			LTE						FR1				
	Antenna		Ant 0	Ant 1	Ant 2	Ant 0	Ant 2	Ant 1	Ant 5	Ant 0	Ant 2	Ant 6	Ant 1	Ant 5	Ant 0	Ant 2	Ant 1	Ant 6
	Band		GSM 850	GSM 1900	GSM 1900	B5	B2	B2	B25	B25	B25	B48	B25	N25	N25	N25	N25	N48
	Close mode to open mode	0	28.12	25.6	21.14	24.79	19.03	22.72	23.42	19.36	18.45	23.84	22.75	23.56	19.09	17.66	23.34	20.58
		6	28.12	25.6	21.14	24.79	19.03	22.72	23.42	19.36	18.45	23.84	22.75	23.56	19.09	17.66	23.34	20.58
		7	28.12	25.6	21.14	24.79	19.03	22.72	23.42	19.36	18.45	23.84	22.75	23.56	19.09	17.66	23.34	20.58
		8	28.12	25.6	21.14	24.79	19.03	22.72	23.42	19.36	18.45	23.84	22.75	23.56	19.09	17.66	23.34	20.58
		9	28.12	25.6	21.14	24.79	19.03	22.72	23.42	19.36	18.45	23.84	22.75	23.56	19.09	17.66	23.34	20.58
		10	28.12	25.6	21.14	24.79	19.03	22.72	23.42	19.36	18.45	23.84	22.75	23.56	19.09	17.66	23.34	20.58
		11	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		12	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		13	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		14	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		15	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		20	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		30	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		40	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		50	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		60	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		70	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		80	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		90	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		100	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		110	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		120	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		130	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		140	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		150	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		160	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		170	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		180	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
	Open mode to close mode	180	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		170	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		160	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		150	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		140	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		130	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52

		120	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		110	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		100	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		90	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		80	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		70	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		60	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		50	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		40	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		30	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		20	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		10	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		9	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		8	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		7	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		6	29.35	23.6	20.46	24.79	18.22	21.25	22.88	19.68	17.23	21.93	20.41	22.85	18.76	17.42	21.27	19.52
		5	28.12	25.6	21.14	24.79	19.03	22.72	23.42	19.36	18.45	23.84	22.75	23.56	19.09	17.66	23.34	20.58
		4	28.12	25.6	21.14	24.79	19.03	22.72	23.42	19.36	18.45	23.84	22.75	23.56	19.09	17.66	23.34	20.58
		3	28.12	25.6	21.14	24.79	19.03	22.72	23.42	19.36	18.45	23.84	22.75	23.56	19.09	17.66	23.34	20.58
		2	28.12	25.6	21.14	24.79	19.03	22.72	23.42	19.36	18.45	23.84	22.75	23.56	19.09	17.66	23.34	20.58
		1	28.12	25.6	21.14	24.79	19.03	22.72	23.42	19.36	18.45	23.84	22.75	23.56	19.09	17.66	23.34	20.58
		0	28.12	25.6	21.14	24.79	19.03	22.72	23.42	19.36	18.45	23.84	22.75	23.56	19.09	17.66	23.34	20.58

Lid angle verification between close mode an open mode						
	Wireless		WLAN Ant 3		WLAN Ant 4	
	Band		2.4GHz WLAN	5.2GHz WLAN	2.4GHz WLAN	5.2GHz WLAN
Screen angle (degree) v.s. power	Close mode to open mode	0	17.95	17.06	18.25	17.04
		6	17.95	17.06	18.25	17.04
		7	17.95	17.06	18.25	17.04
		8	17.95	17.06	18.25	17.04
		9	17.95	17.06	18.25	17.04
		10	17.95	17.06	18.25	17.04
		11	20.00	17.06	19.98	17.04
		12	20.00	17.06	19.98	17.04
		13	20.00	17.06	19.98	17.04
		14	20.00	17.06	19.98	17.04
		15	20.00	17.06	19.98	17.04
		20	20.00	17.06	19.98	17.04
		30	20.00	17.06	19.98	17.04
		40	20.00	17.06	19.98	17.04
		50	20.00	17.06	19.98	17.04
		60	20.00	17.06	19.98	17.04
		70	20.00	17.06	19.98	17.04
		80	20.00	17.06	19.98	17.04
		90	20.00	17.06	19.98	17.04
		100	20.00	17.06	19.98	17.04
		110	20.00	17.06	19.98	17.04
		120	20.00	17.06	19.98	17.04
		130	20.00	17.06	19.98	17.04
		140	20.00	17.06	19.98	17.04
		150	20.00	17.06	19.98	17.04
		160	20.00	17.06	19.98	17.04
		170	20.00	17.06	19.98	17.04
		180	20.00	17.06	19.98	17.04
	Open mode to close mode	180	20.00	17.06	19.98	17.04
		170	20.00	17.06	19.98	17.04
		160	20.00	17.06	19.98	17.04
		150	20.00	17.06	19.98	17.04
		140	20.00	17.06	19.98	17.04
		130	20.00	17.06	19.98	17.04
		120	20.00	17.06	19.98	17.04
		110	20.00	17.06	19.98	17.04
		100	20.00	17.06	19.98	17.04
		90	20.00	17.06	19.98	17.04
		80	20.00	17.06	19.98	17.04
		70	20.00	17.06	19.98	17.04
		60	20.00	17.06	19.98	17.04
		50	20.00	17.06	19.98	17.04
		40	20.00	17.06	19.98	17.04
		30	20.00	17.06	19.98	17.04
		20	20.00	17.06	19.98	17.04
		10	20.00	17.06	19.98	17.04
		9	20.00	17.06	19.98	17.04
		8	20.00	17.06	19.98	17.04
		7	20.00	17.06	19.98	17.04
		6	20.00	17.06	19.98	17.04
		5	17.95	17.06	18.25	17.04
		4	17.95	17.06	18.25	17.04
		3	17.95	17.06	18.25	17.04
		2	17.95	17.06	18.25	17.04
		1	17.95	17.06	18.25	17.04
		0	17.95	17.06	18.25	17.04

Appendix E. Power reduction mechanism verification

According to the May 2017 TCBC Workshop, 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 introduction

- This device supports the manufacturer's proprietary power reduction mechanisms for cellular and Wi-Fi transmitters. Further details of the specific mechanisms for the power reduction mechanism can be found in the Operational Description
- To demonstrate the proper functioning of the detection and triggering mechanisms under corresponding RF exposure conditions, the verification plan includes measuring the output power levels of both the cellular and Wi-Fi transmitters across different operating scenarios related to the power reduction mechanisms.
- The device integrates WWAN and WLAN Transmit Antenna Selection (TAS) algorithms, which dynamically adjust transmission power in real-time to comply with ISED time-averaged RF exposure limits. However, for power reduction mechanism validation, real-time TX power variation was disabled to ensure consistent monitoring of output power. A fixed output power level was used to accurately assess the effectiveness of the power reduction mechanisms.
- For testing purposes, the device was measured against each Index supported for the cellular and Wi-Fi technologies. The target power level and measured power levels are detailed in the following table and clearly shows that each power reduction mechanism operates as expected.

2. Power verification procedure

- Verification is performed using a base station simulator to establish a conducted RF connection and record output power under various operating conditions associated with the power reduction mechanisms.
- Power reduction verification for Wi-Fi is conducted with cellular transmitters both active and inactive. Similarly, verification for cellular transmitters is performed with Wi-Fi transmitters both active and inactive.
- Verification of the RCV mechanism is performed by establishing a voice call and routing audio through the earpiece to measure output power under head SAR conditions.
- Hotspot power reduction is verified by establishing a data connection and enabling the hotspot feature, during which output power is recorded under the hotspot operating condition.
- Verification of the Body Detector mechanism is conducted by establishing a data connection and recording output power under the body-worn operating condition.
  - On a stationary object (placed on a table)
  - In-hand or on knee
  - Body detect and monitor period validation
  - Proximity sensor detect mechanism only for Ant 1 and Ant 4
  - Proximity sensor Detect mechanism was performed for the in-hand to trigger body detection and hand close to the Ant 1 and Ant 4 within proximity sensor detect range, to trigger power reduction is when body detect and proximity sensor detect are triggered simultaneously.

3. Test setup for conducted power measurement

Figure 1

4. Verification output Power Results

Head exposure conditions

Close Mode		Output Power for Voice Call			
Ear acoustic output Status:		ON		ON	
WiFi Status:		OFF		ON	
Power state		WWAN Index 2		WWAN Index 3	
Wireless technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
GSM850 (Voice)	Ant 0	32.60	33.50	32.56	33.50
	Ant 1	31.12	32.70	31.01	32.00
UMTS Band 5	Ant 0	24.75	25.00	24.68	25.00
	Ant 1	20.19	21.70	20.11	21.00
LTE Band 66 (FDD)	Ant 2	23.50	25.00	23.52	25.00
	Ant 1	21.45	21.70	20.71	21.00
LTE Band 26 (FDD)	Ant 0	23.80	25.30	23.79	25.30
	Ant 1	22.87	24.00	22.15	23.30
LTE Band 48 (TDD)	Ant 6	23.70	24.50	23.60	24.50
	Ant 1	16.21	18.20	15.60	17.50
NR SA n66	Ant 2	23.50	25.00	23.50	25.00
	Ant 1	20.63	21.30	19.89	20.60

Close Mode		Output Power for Voice Call			
Ear acoustic output Status:		ON		ON	
WWAN Status:		OFF		ON	
Power state		WIFI Index 1		WIFI Index 2	
Wireless technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
WiFi 802.11g CH6	(Ant4+3)Ant 3	21.63	22.00	16.04	17.00
	(Ant4+3)Ant 4	21.31	22.00	16.05	17.00
WiFi 802.11a 6Mbps CH40	(Ant4+3)Ant 3	13.53	15.50	11.51	13.50
	(Ant4+3)Ant 4	13.51	15.50	11.50	13.50

Hotspot exposure condition

Close Mode		Output Power for data connection			
Wifi Hotspot Status		ON		OFF	
BT Hotspot Status		OFF		ON	
Power state		WWAN Index 4 WIFI Index 4		WWAN Index 4 WIFI Index 4	
Wireless Technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
GSM850 (4TX)	Ant 0	27.24	28.20	27.22	28.20
	Ant 1	29.34	30.50	29.29	30.50
UMTS Band 2	Ant 2	17.52	18.50	17.55	18.50
	Ant 1	21.22	22.20	21.19	22.20
LTE Band 25 (FDD)	Ant 2	16.79	18.10	16.77	18.10
	Ant 1	21.80	23.60	21.70	23.60
LTE Band 7 (FDD)	Ant 2	16.98	17.80	16.95	17.80
	Ant 1	21.90	23.30	21.90	23.30
LTE Band 38 (TDD)	Ant 2	18.91	19.60	18.92	19.60
	Ant 1	23.92	25.00	23.92	25.00
NR SA n7	Ant 2	17.32	18.10	17.32	18.10
	Ant 1	22.01	22.90	21.87	22.90
WiFi 802.11b CH6	(Ant4+3)Ant 3	13.01	14.50		
	(Ant4+3)Ant 4	13.04	14.50		
WiFi 802.11a UNII ,CH40	(Ant4+3)Ant 3	17.07	19.50		
	(Ant4+3)Ant 4	17.08	19.50		

Body worn exposure condition

Close Mode		Output Power (data connection)					
		Stationary		Body Worn (In hand)			
WIFI/BT Status		OFF		OFF		ON	
Power state		WWAN Index 1		WWAN Index 5		WWAN Index 6	
Wireless Technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
GSM1900 (4TX)	Ant 2	25.85	27.50	20.16	21.60	19.43	20.90
	Ant 1	25.50	27.50	25.50	27.50	25.50	27.50
UMTS Band 4	Ant 2	24.10	25.00	18.18	19.20	17.48	18.50
	Ant 1	23.98	25.00	23.96	25.00	23.97	25.00
LTE Band 66 (FDD)	Ant 2	24.00	25.00	18.11	19.10	17.41	18.40
	Ant 1	23.51	25.00	23.51	25.00	23.51	25.00
LTE Band 7 (FDD)	Ant 2	24.15	25.00	17.66	18.50	17.01	17.80
	Ant 1	23.58	25.00	22.59	24.00	21.90	23.30
LTE Band 38(TDD)	Ant 2	24.34	25.00	20.19	20.90	19.50	20.20
	Ant 1	23.92	25.00	23.92	25.00	23.92	25.00
NR SA n7	Ant 2	24.32	25.10	18.31	19.10	17.55	18.40
	Ant 1	24.31	25.10	22.78	23.60	22.07	22.90

Close Mode		Output Power (data connection)					
		Stationary		In hand			
WWAN Status:		OFF		OFF		ON	
Power state		WIFI Index 0		WIFI Index 3		WIFI Index 4	
Wireless technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
WiFi 802.11g CH6	(Ant4+3)Ant 3	21.92	22.00	15.95	17.00	14.49	14.50
	(Ant4+3)Ant 4	21.13	22.00	16.25	17.00	14.50	14.50
WiFi 802.11a UNII ,CH56	(Ant4+3)Ant 3	17.06	19.00	17.06	19.00	17.06	19.00
	(Ant4+3)Ant 4	17.04	19.00	17.04	19.00	17.04	19.00

Head exposure conditions

Open Mode		Output Power for Voice Call			
Ear acoustic output Status:		ON		ON	
WiFi Status:		OFF		ON	
Power state		WWAN Index 7/8		WWAN Index 7/8	
Wireless technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
GSM1900 (1TX)	Ant 2	29.75	30.50	29.73	30.50
	Ant 1	25.40	27.40	25.24	26.70
UMTS Band 2	Ant 2	24.06	25.00	24.11	25.00
	Ant 1	15.86	17.50	15.89	16.80
LTE Band 25 (FDD)	Ant 2	24.28	25.00	24.15	25.00
	Ant 1	15.21	17.20	15.21	16.50
LTE Band 7 (FDD)	Ant 2	24.80	25.00	24.77	25.00
	Ant 1	16.80	18.40	16.77	17.70
LTE Band 38 (TDD)	Ant 2	24.72	25.00	24.64	25.00
	Ant 1	19.21	20.50	19.10	19.80
NR SA n7	Ant 2	24.48	25.10	24.30	25.10
	Ant 1	16.66	17.70	16.50	17.00

Open Mode		Output Power for Voice Call			
Ear acoustic output Status:		ON		ON	
WWAN Status:		OFF		ON	
Power state		WIFI Index 5		WIFI Index 5	
Wireless technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
WiFi 802.11g CH6	(Ant4+3)Ant 3	6.02	6.50	6.35	6.50
	(Ant4+3)Ant 4	6.01	6.50	6.33	6.50
WiFi 802.11a 6Mbps UNII CH44	(Ant4+3)Ant 3	6.03	8.00	6.13	8.00
	(Ant4+3)Ant 4	6.04	8.00	6.02	8.00

Hotspot exposure condition

Open Mode		Output Power for data connection			
Wifi Hotspot Status		ON		OFF	
BT Hotspot Status		OFF		ON	
Power state		WWAN Index 9 WIFI Index 9		WWAN Index 9 WIFI Index 9	
Wireless Technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
GSM1900 (4TX)	Ant 2	18.37	20.30	18.37	20.30
	Ant 1	21.21	23.20	21.21	23.20
UMTS Band 2	Ant 2	16.36	17.30	16.33	17.30
	Ant 1	19.18	20.10	19.13	20.10
LTE Band 25 (FDD)	Ant 2	16.16	17.50	16.18	17.50
	Ant 1	17.94	19.80	17.95	19.80
LTE Band 7 (FDD)	Ant 2	18.04	18.90	18.04	18.90
	Ant 1	20.00	21.30	20.00	21.30
LTE Band 38 (TDD)	Ant 2	19.20	19.90	19.20	19.90
	Ant 1	23.33	24.40	23.33	24.40
NR SA n25	Ant 2	16.81	18.10	16.81	18.10
	Ant 1	20.09	21.50	20.09	21.50
WiFi 802.11b CH6	(Ant4+3)Ant 3	12.39	14.00		
	(Ant4+3)Ant 4	12.42	14.00		
WiFi 802.11a CH44	(Ant4+3)Ant 3	17.06	19.00		
	(Ant4+3)Ant 4	17.04	19.00		

Body worn exposure condition

Open Mode		Output Power (data connection)					
		Stationary		Body Worn (In hand)			
WIFI/BT Status		OFF		OFF		ON	
Power state		WWAN Index 1		WWAN Index 10		WWAN Index 11	
Wireless Technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
GSM1900 (4TX)	Ant 2	25.96	27.50	19.87	21.20	19.17	20.50
UMTS Band 2	Ant 2	24.11	25.00	17.91	18.90	17.24	18.20
LTE Band 25(FDD)	Ant 2	23.63	25.00	17.07	18.40	16.32	17.70
LTE Band 7 (FDD)	Ant 2	24.19	25.00	19.35	20.20	18.62	19.50
LTE Band 38(TDD)	Ant 2	24.12	25.00	17.93	20.70	17.22	20.00
NR SA n25	Ant 2	23.61	25.00	17.55	18.90	16.88	18.20

Open Mode		Output Power (data connection)					
		Stationary		Body Worn (In hand)			
WIFI/BT Status		OFF		OFF		ON	
Proximity Sensor		OFF		ON		ON	
Power state		WWAN Index 1		WWAN Index 10		WWAN Index 11	
Wireless Technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
GSM1900 (4TX)	Ant 1	25.52	27.50	23.54	25.50	22.87	24.80
UMTS Band 2	Ant 1	24.12	25.00	21.49	22.40	20.78	21.70
LTE Band 25(FDD)	Ant 1	23.35	25.00	20.16	22.00	19.40	21.30
LTE Band 7 (FDD)	Ant 1	23.74	25.00	21.34	22.60	20.60	21.90
LTE Band 38(TDD)	Ant 1	23.98	25.00	24.00	25.00	23.30	24.40
NR SA n25	Ant 1	23.56	25.00	21.34	22.90	20.71	22.20

Open Mode		Output Power (data connection)					
		Stationary		Body Worn (In hand)			
WIFI/BT Status		OFF		OFF		ON	
Proximity Sensor		OFF		OFF		OFF	
Power state		WWAN Index 1		WWAN Index 10		WWAN Index 11	
Wireless Technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
GSM1900 (4TX)	Ant 1	25.52	27.50	25.52	27.50	25.52	27.50
UMTS Band 2	Ant 1	24.12	25.00	24.14	25.00	24.09	25.00
LTE Band 25(FDD)	Ant 1	23.35	25.00	23.35	25.00	23.35	25.00
LTE Band 7 (FDD)	Ant 1	23.74	25.00	23.74	25.00	23.74	25.00
LTE Band 38(TDD)	Ant 1	23.98	25.00	23.98	25.00	23.98	25.00
NR SA n25	Ant 1	23.56	25.00	23.56	25.00	23.56	25.00

Open Mode		Output Power (data connection)					
		Stationary		In hand			
WWAN Status:		OFF		OFF		ON	
Proximity Sensor		OFF		ON		ON	
Power state		WIFI Index 0		WIFI Index 8		WIFI Index 9	
Wireless technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
WiFi 802.11g CH6	(Ant4+3)Ant 3	21.99	22.00	20.00	20.00	14.00	14.00
	(Ant4+3)Ant 4	22.00	22.00	19.98	20.00	13.99	14.00
WiFi 802.11a UNII ,CH56	(Ant4+3)Ant 3	17.06	19.00	17.06	19.00	17.06	19.00
	(Ant4+3)Ant 4	17.04	19.00	17.04	19.00	17.04	19.00

Open Mode		Output Power (data connection)					
		Stationary		In hand			
WWAN Status:		OFF		OFF		ON	
Proximity Sensor		OFF		OFF		OFF	
Power state		WIFI Index 0		WIFI Index 6		WIFI Index 7	
Wireless technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
WiFi 802.11g CH6	(Ant4+3)Ant 3	21.99	22.00	20.00	20.00	14.00	14.00
	(Ant4+3)Ant 4	22.00	22.00	22.00	22.00	21.05	22.00
WiFi 802.11a UNII ,CH56	(Ant4+3)Ant 3	17.06	19.00	17.06	19.00	17.06	19.00
	(Ant4+3)Ant 4	17.04	19.00	17.04	19.00	17.04	19.00

Body detect and monitor period validation

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.

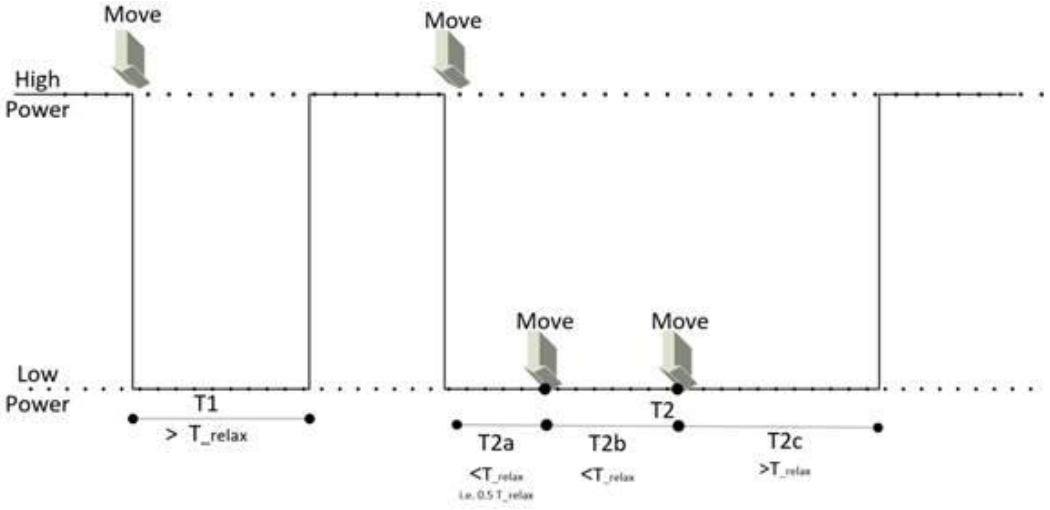


Figure 1 Illustration of the procedure for the validation of the power reduction

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.
   c) 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}: *15 sec*
   Monitor period, T_1: 20 *sec*, T_{2a}: 10 sec, T_{2b}:10 sec, T_{2c}: 20 sec

Close Mode		Output Power (data connection) (dBm)											
		Stationary Placed on a table		In hand		Stationary Placed on a table		In hand				Stationary Placed on a table	
WWAN Index 5 WLAN Index 3		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
GSM_1900	Ant 2	25.85	27.50	20.16	21.60	25.85	27.50	20.16	21.60	20.16	21.60	25.85	27.50
WCDMA IV	Ant 2	24.10	25.00	18.18	19.20	24.10	25.00	18.18	19.20	18.18	19.20	24.10	25.00
LTE Band 66	Ant 2	24.00	25.00	18.11	19.10	24.00	25.00	18.11	19.10	18.11	19.10	24.00	25.00
NR SA n7	Ant 2	24.32	25.10	18.31	19.10	24.32	25.10	18.31	19.10	18.31	19.10	24.32	25.10
WLAN2.4G	Ant 3+4 (3)	21.92	22.00	15.95	17.00	21.92	22.00	15.95	17.00	15.95	17.00	21.92	22.00
	Ant 3+4 (4)	21.13	22.00	16.25	17.00	21.13	22.00	16.25	17.00	16.25	17.00	21.13	22.00

Open Mode		Output Power (data connection) (dBm)											
		Stationary Placed on a table		In hand		Stationary Placed on a table		In hand				Stationary Placed on a table	
WWAN Index 10 WLAN Index 8		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
GSM_1900	Ant 2	25.96	27.50	19.87	21.20	25.96	27.50	19.87	21.20	19.87	21.20	25.96	27.50
WCDMA II	Ant 2	24.11	25.00	17.91	18.90	24.11	25.00	17.91	18.90	17.91	18.90	24.11	25.00
LTE Band 25	Ant 2	23.63	25.00	17.07	18.40	23.63	25.00	17.07	18.40	17.07	18.40	23.63	25.00
NR SA n7	Ant 2	24.19	25.00	19.35	20.20	24.19	25.00	19.35	20.20	19.35	20.20	24.19	25.00
WLAN5G	Ant 3+4 (3)	17.06	19.00	17.06	19.00	17.06	19.00	17.06	19.00	17.06	19.00	17.06	19.00
	Ant 3+4 (4)	17.04	19.00	17.04	19.00	17.04	19.00	17.04	19.00	17.04	19.00	17.04	19.00