



FCC ID: A3LSMM127G

**PROXIMITY SENSOR CONSIDERATIONS
(PER FCC KDB 616217 D04 V01r02)**

Last Revised: Dec 9th, 2020

Confidential

Note:

Sensor Triggering and reliability data in this document is provided by Samsung R&D Lab

INTRODUCTION



Confidential

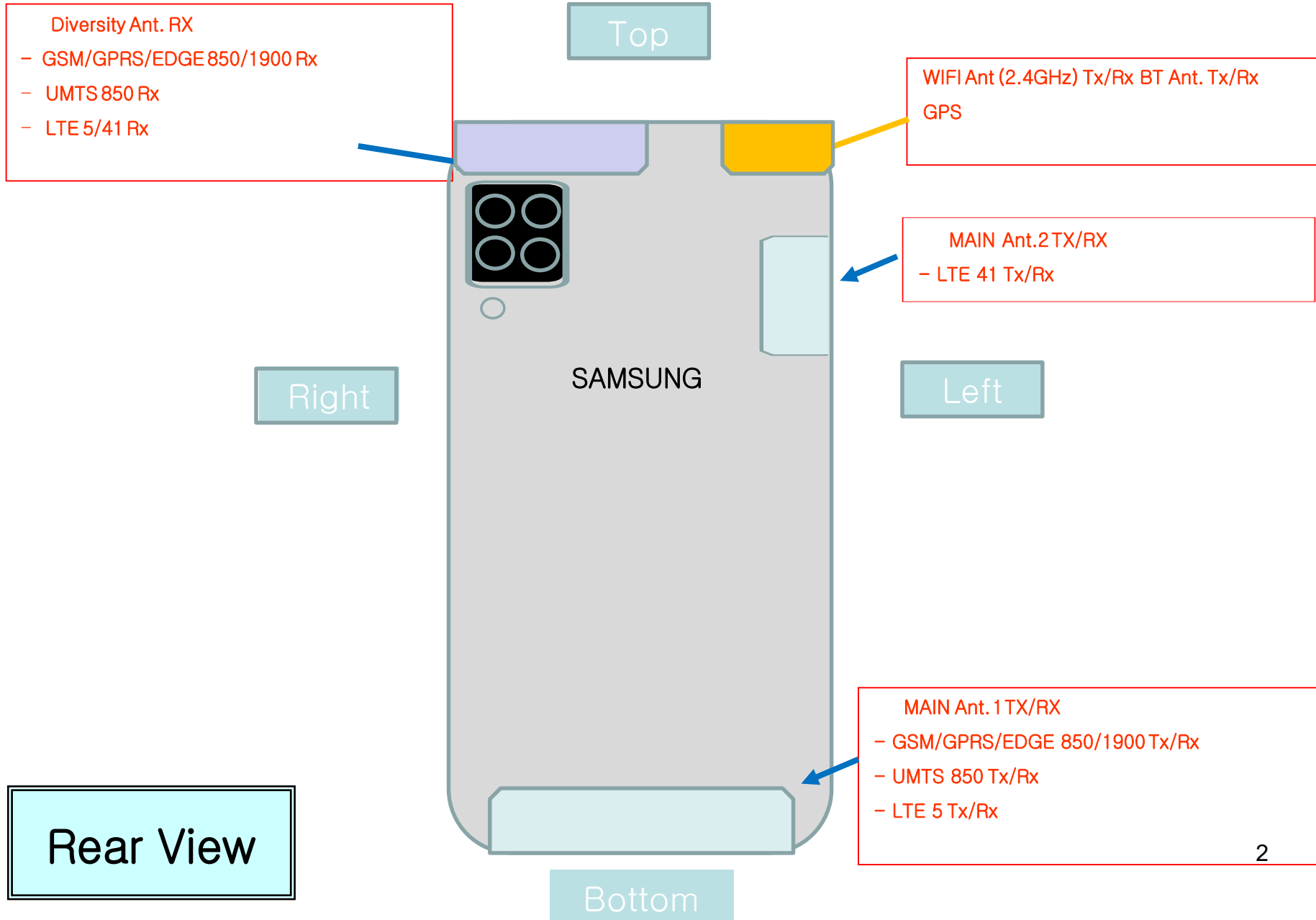
Due to the operating configurations and exposure conditions required by Mobiles, proximity sensors are used in this device to reduce the maximum output power in specific wireless and operating modes to ensure SAR compliance.

This device uses a capacitive proximity sensor that is same metallic component as the transmitting antenna to facilitate triggering in typical user interactivity with the device.

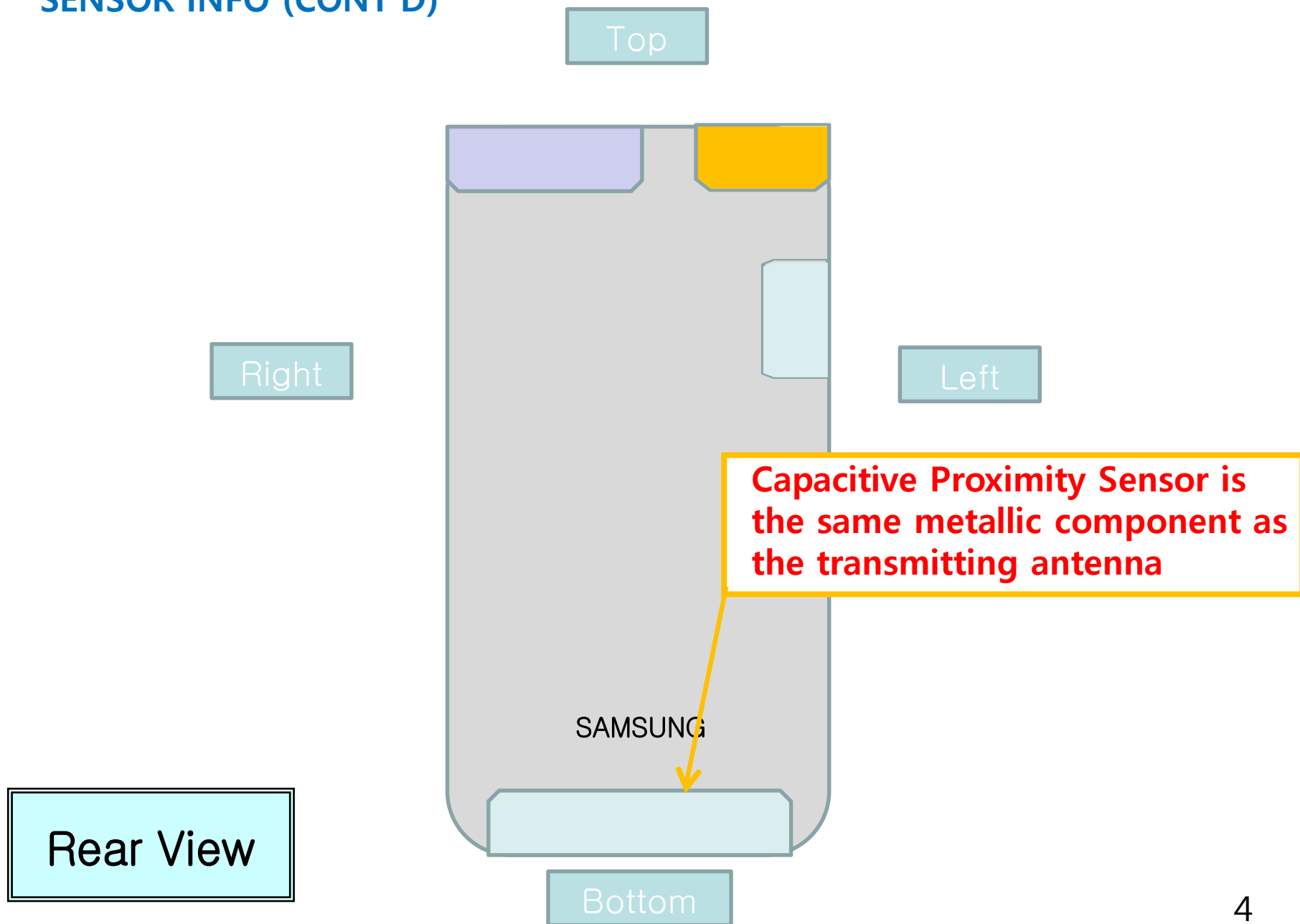
This document discloses the procedures and data obtained to determine triggering distances for each sensor. An assessment of the antenna and sensor coverage of this device was also not required since the proximity sensor is the same metallic component as the transmitting antenna.

* Placement of each antenna

Confidential



SENSOR INFO (CONT'D)



**I. TRIGGERING DISTANCE DETERMINATION
FOR SENSOR SENSING BACK SIDE**

I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING BACK SIDE (Cont'd)

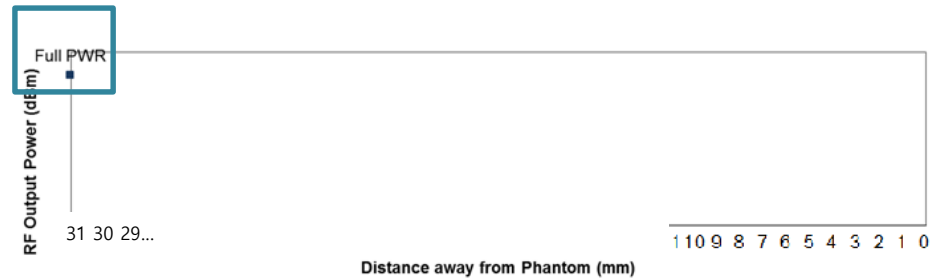
Steps:

1. Mobile is set to operate at its normal maximum output power (KDB616217 6.2.a)
2. Entire rear of the Mobile was positioned below a flat phantom filled with tissue-equivalent medium required for the test frequency range, positioned at least 20 mm further than the distance that triggers power reduction (KDB616217 6.2.b)

We positioned the device 31mm away from the Phantom for this test

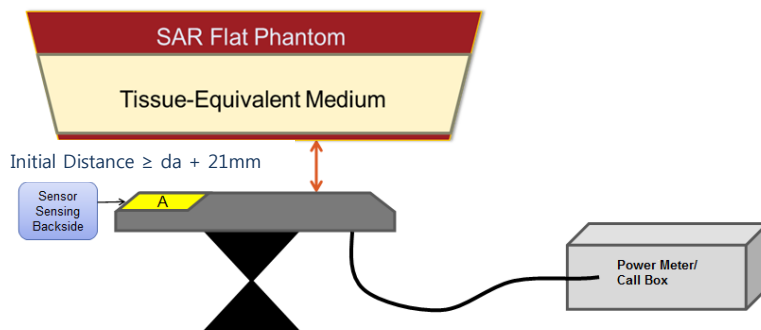
Initial dist = 10mm (triggering dist) + 21 mm

3. Cable used for power measurement does not interfere with proximity sensor. Cable losses were properly compensated to report the measured power results per KDB616217 6.2.c



KDB 616217 D04 6.2.b	
Measured Power [dBm]	
Distance[mm]	31
LTE B5	24.03

Full Power

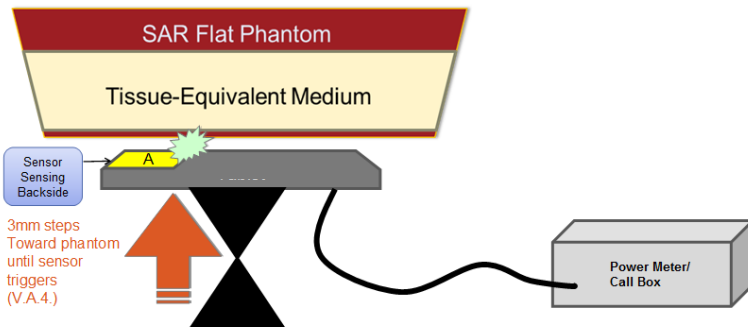
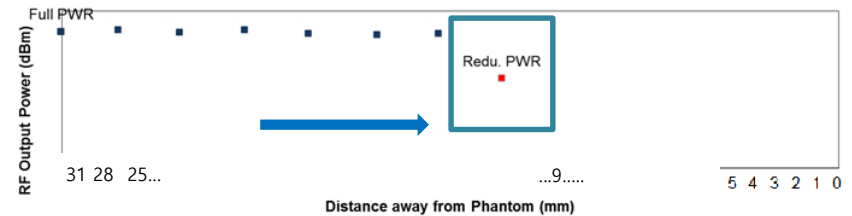


I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING BACK SIDE (Cont'd)

4. Mobile is moved in 3mm steps toward the SAR Flat Phantom until the sensor activated per FCC KDB 616217 6.2.d

$d_{A1} = 10\text{mm}$

RF Output Power Over Distance toward Phantom KDB616217 6.2.4(3mm Steps toward Phantom)



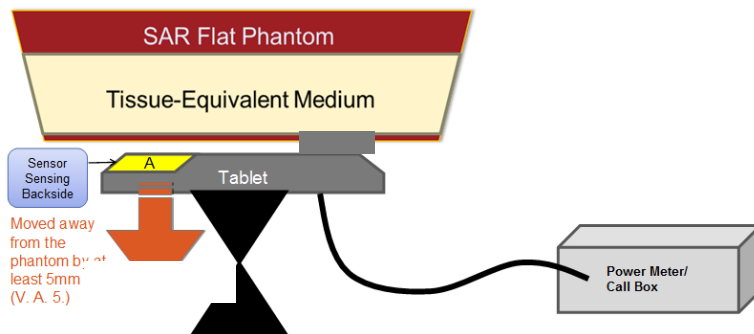
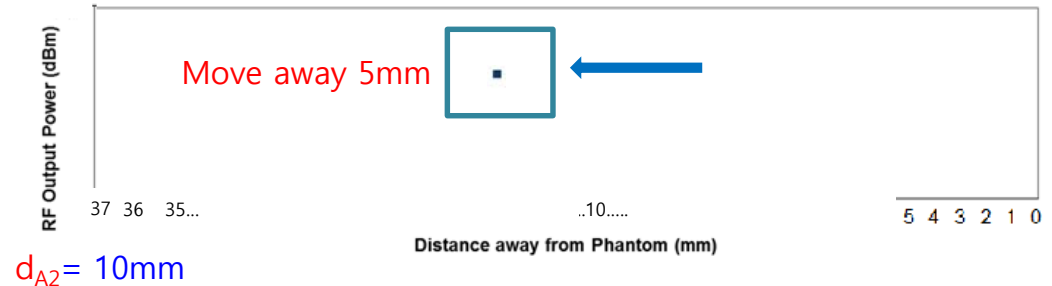
KDB 616217 D04 6.2.d								
Measured Power [dBm]								
Distance[mm]	30	27	24	21	19	16	13	10
LTE B5	24.02	24.00	24.01	24.01	24.00	24.03	24.01	22.05

Reduced Power

I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING BACK SIDE (Cont'd)

5. While the Mobile has a triggered sensor state, the Mobile was moved away from the SAR Flat phantom by at least 5mm per FCC KDB 616217 6.2.e.
6. The sensor was confirmed to de-activate when it moved at least 5mm from the last triggered position from Step 4.

RF Output Power Over Distance away from Phantom KDB616217 6.2.5(Moved away from the phantom by at least 5mm)

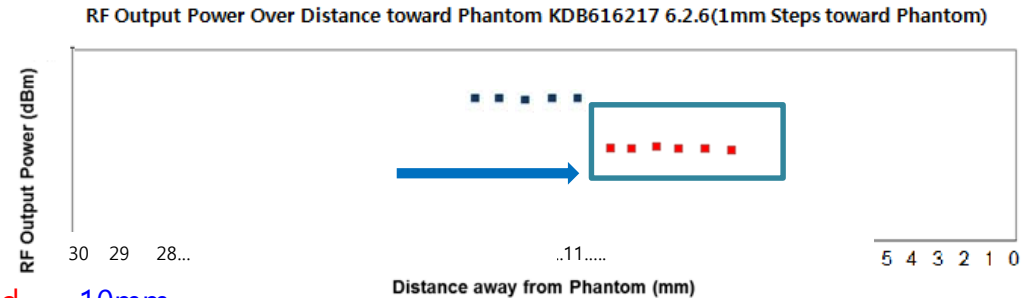


KDB 616217 D04 6.2.e		
Measured Power [dBm]		
Distance[mm]	15	10
LTE B5	24.03	22.01

Full Power

I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING BACK SIDE (Cont'd)

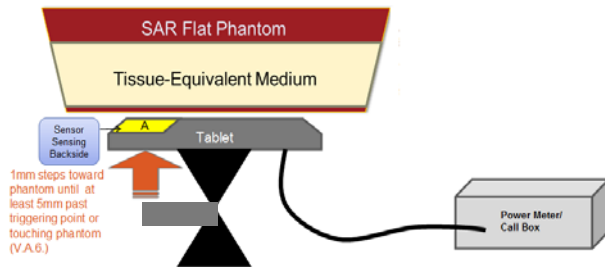
7. Mobile is moved again toward the SAR Flat Phantom, but now in 1mm steps until at least 5mm past the sensor triggering point (or when the Mobile touched the phantom) per FCC KDB 616217 6.2.f



$d_{A3} = 10\text{mm}$

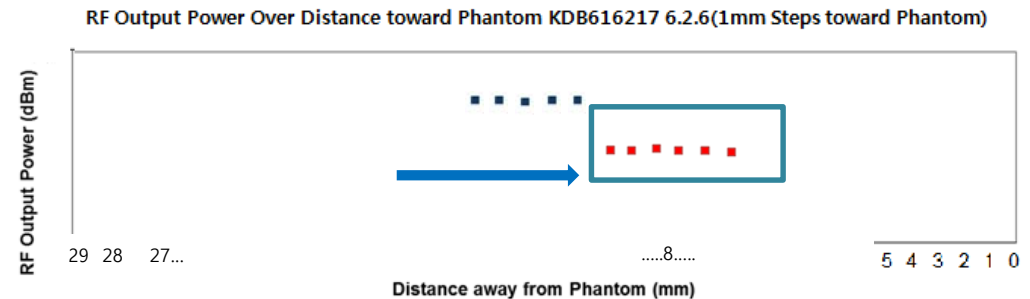
KDB 616217 D04 6.2.f									
Measured Power [dBm]									
Distance[mm]	15	14	13	12	11	10	9	8	7
LTE B5	24.03	24.03	24.05	24.01	24.00	22.04	22.05	22.01	22.00

Reduced Power



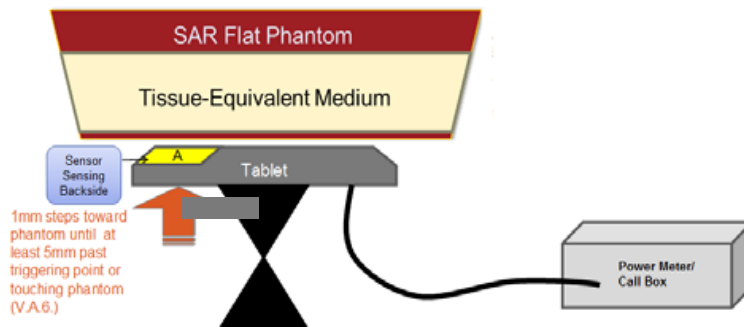
I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING BACK SIDE (Cont'd)

8. Since the Device was not touching the phantom 5mm beyond the triggering distance determined from Step 7, it was moved in 3mm steps toward the SAR phantom until the Device touched the phantom to confirm that the sensor remained triggered through out and thus the maximum power staying reduced per FCC KDB 616217 6.2.g.



$d_{A3} = 10\text{mm}$

Confirmed Sensor remained
Reduced Power.

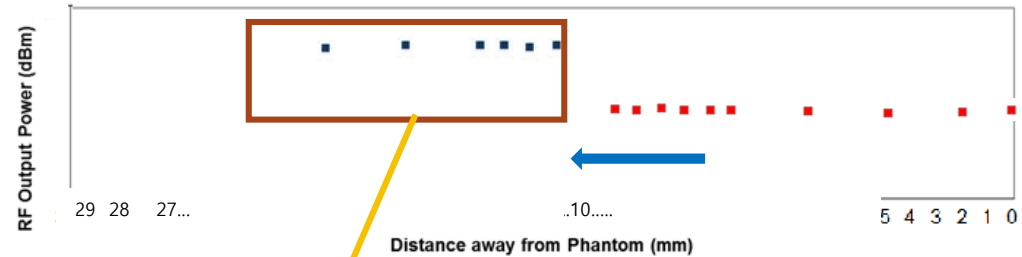


KDB 616217 D04 6.2.g				
Measured Power [dBm]				
Distance[mm]	10	7	4	1
LTE B5	22.04	22.05	22.00	22.02

I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING BACK SIDE (Cont'd)

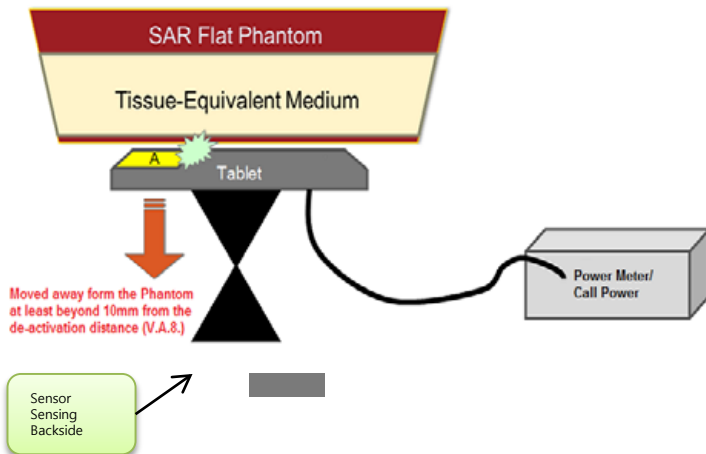
9. The process is then reversed by moving the Mobile away from the phantom according to steps KDB 616217 6.2.d to 6.2.g, to determine triggering release, until it is at least 10 mm beyond the point that triggers the return of normal maximum power per KDB 616217 6.2.h

$$d_{A4} = 10\text{mm}$$



KDB 616217 D04 6.2.h											
Measured Power [dBm]											
Distance[mm]	15	14	13	12	11	10	9	8	7	6	5
LTE B5	24.03	24.03	24.00	24.01	24.05	22.05	22.00	22.05	22.06	22.02	22.00

Full Power



I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING BACK SIDE (Cont'd)

Conclusion:

According to FCC KDB 616217 6.2.k., to ensure all production units are compliant, SAR testing should be performed 1mm closer than the smallest distance determined from the triggering tests $\{d_{A1}, d_{A2}, d_{A3}, d_{A4}\}$ at the reduced and maximum power.

SAR Test Distance from the **Back** of the mobile for Sensor sensing back side

= **minimum** $\{d_{A1}, d_{A2}, d_{A3}, d_{A4}\} - 1\text{mm}$

= **minimum** $\{10, 10, 10, 10\} - 1\text{ mm}$

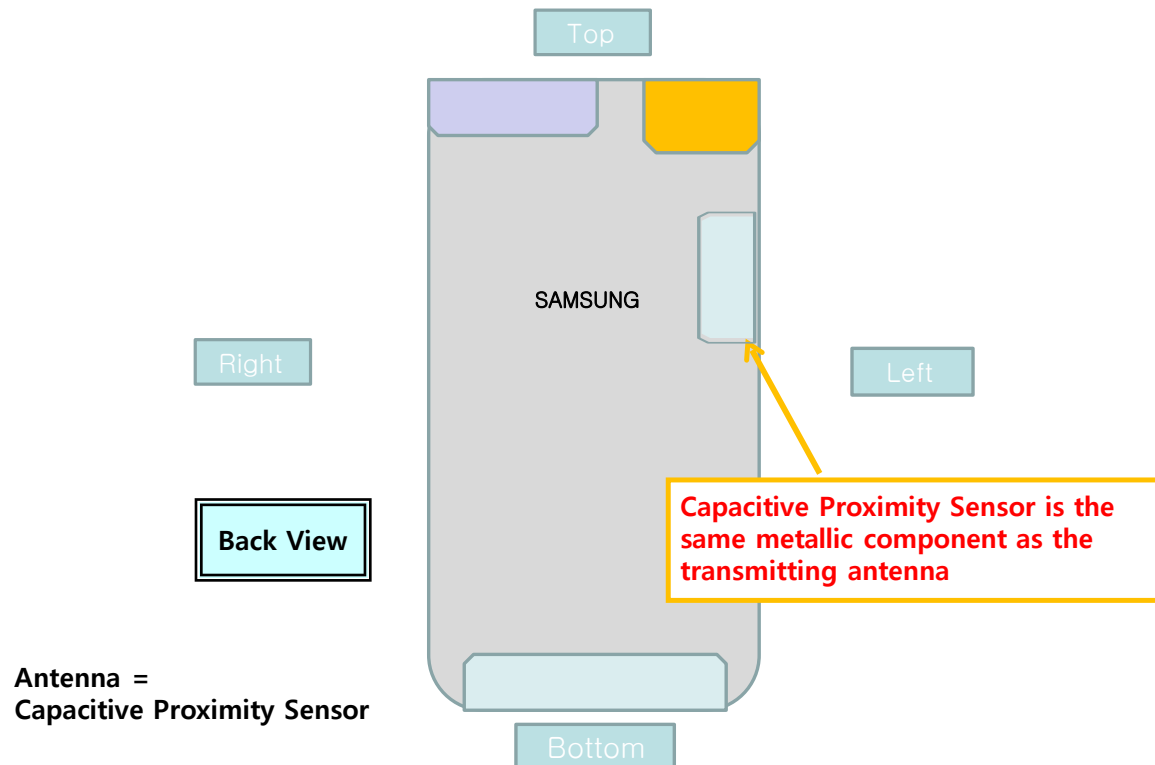
= **9 mm**

IV. Antenna & Sensor Coverage

According to FCC KDB 616217 6.3, if the proximity sensors are not designed to cover the entire rear surface of the Mobile, the sensing regions are limited and are spatially offset from the antenna.

However, this device uses a capacitive proximity sensor that is same metallic component as the transmitting antenna to facilitate triggering in any conditions the user may use the device in proximity of the antenna in the device.

Therefore, no further sensor coverage assessments were required according to KDB 616217 D04 v01 r02.

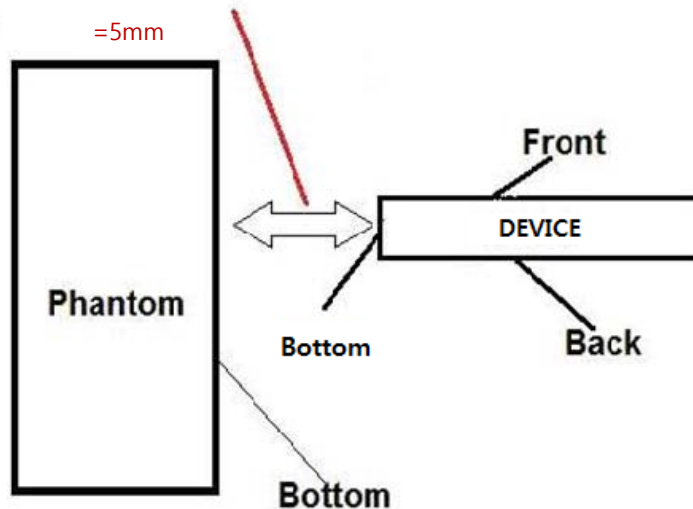


V. Procedure for determining device Tilt Angle Influences to Proximity Sensor triggering Left Edge

1. The influence of table tilt angles to proximity sensor triggering is determined by positioning each tablet edge that contains a transmitting antenna, perpendicular to the flat phantom, at the smallest sensor triggering test distance determined in sections 6.2 and 6.3 by rotating the tablet around the edge in $\leq 10^\circ$ increments until the tablet is $\pm 45^\circ$ or more from the vertical position at 0° per KDB 616217 6.4.a

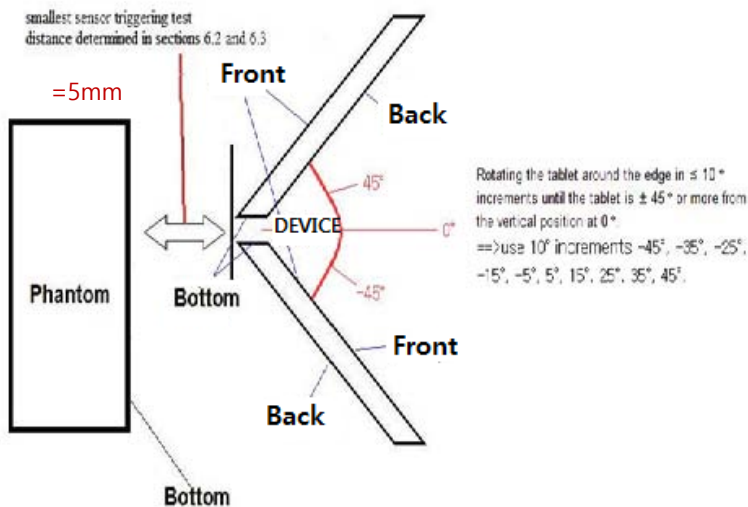
KDB 616217 6.4.a Measured Power [dBm]	
Tilt Angle[°]	0
LTE B5	24.03

smallest sensor triggering test
distance determined in sections 6.2 and 6.3



V. Procedure for determining device Tilt Angle Influences to Proximity Sensor triggering Left Edge(CONT'D)

1. The influence of table tilt angles to proximity sensor triggering is determined by positioning each tablet edge that contains a transmitting antenna, perpendicular to the flat phantom, at the smallest sensor triggering test distance determined in sections 6.2 and 6.3 by rotating the tablet around the edge in $\leq 10^\circ$ increments until the tablet is $\pm 45^\circ$ or more from the vertical position at 0° per KDB 616217 6.4.a



KDB 616217 6.4.a										
Measured Power [dBm]										
Tilt Angle[°]	-45	-35	-25	-15	-5	5	15	25	35	45
LTE B5	24.03	24.01	24.01	24.03	24.05	24.02	24.00	24.04	24.01	24.04



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Last Revised: Nov 3rd, 2020

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Note:

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INTRODUCTION



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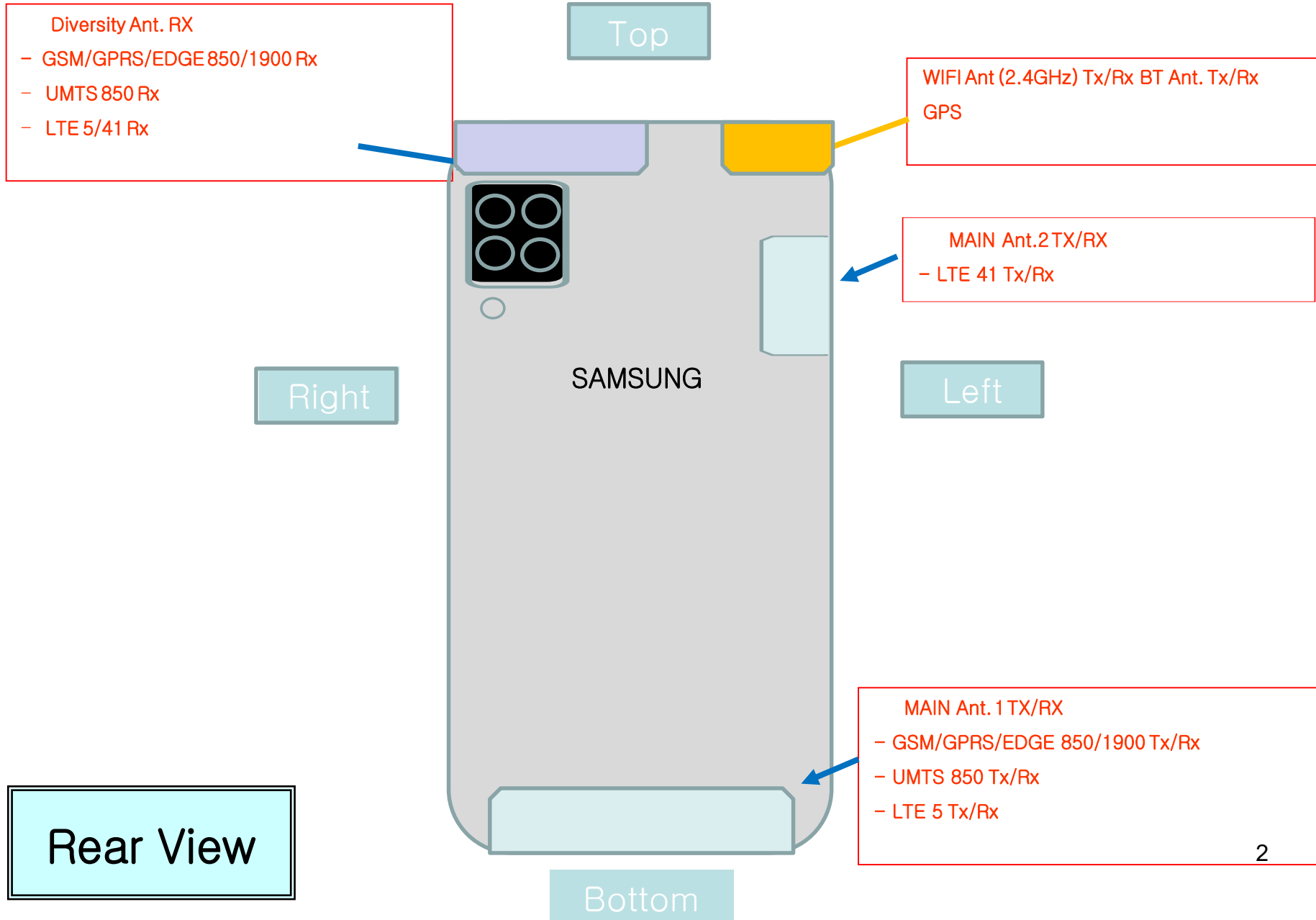
Due to the operating configurations and exposure conditions required by Mobiles, proximity sensors are used in this device to reduce the maximum output power in specific wireless and operating modes to ensure SAR compliance.

This device uses a capacitive proximity sensor that is same metallic component as the transmitting antenna to facilitate triggering in typical user interactivity with the device.

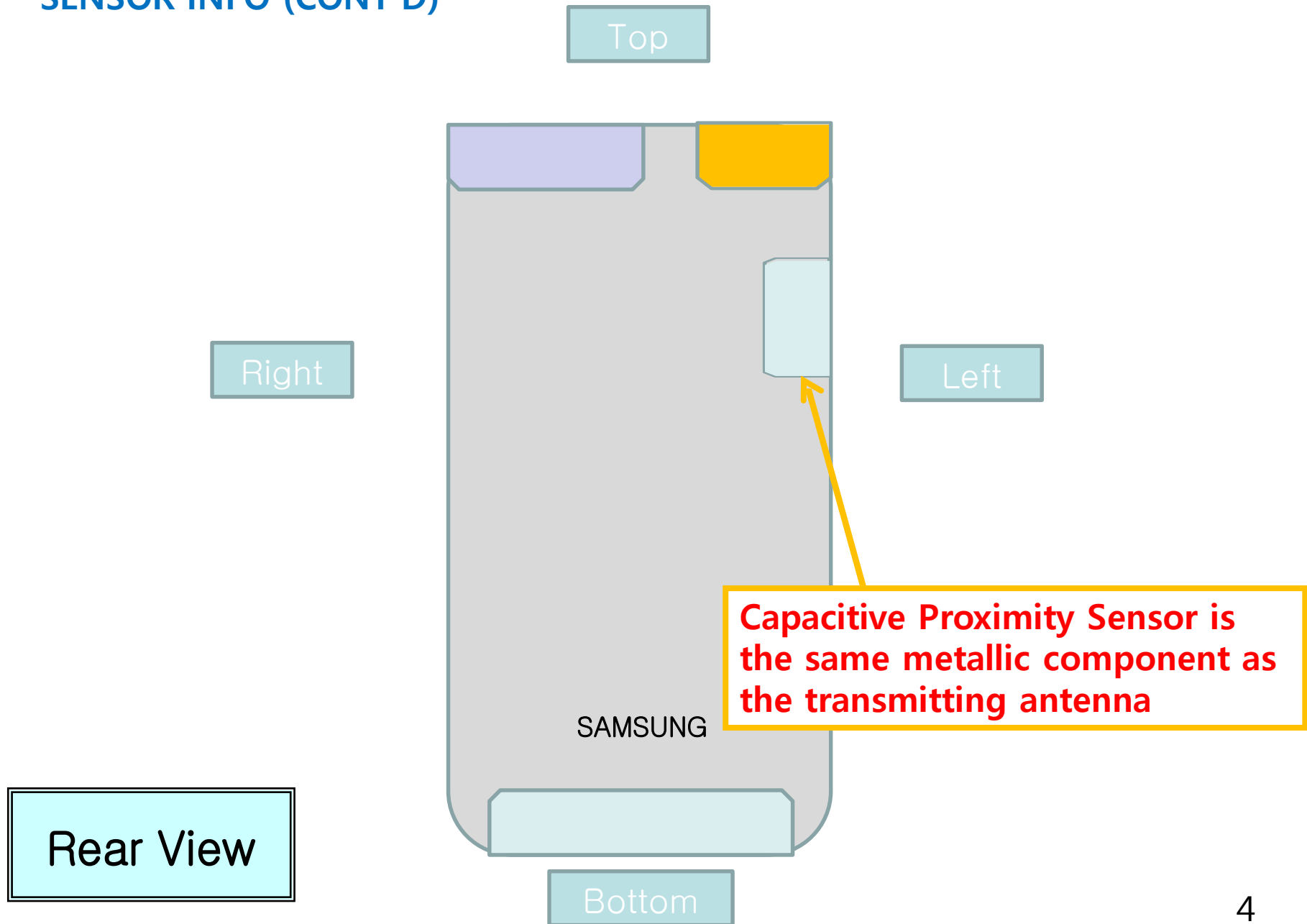
This document discloses the procedures and data obtained to determine triggering distances for each sensor. An assessment of the antenna and sensor coverage of this device was also not required since the proximity sensor is the same metallic component as the transmitting antenna.

* Placement of each antenna

Confidential



SENSOR INFO (CONT'D)



**I. TRIGGERING DISTANCE DETERMINATION
FOR SENSOR SENSING BACK SIDE**

I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING BACK SIDE (Cont'd)

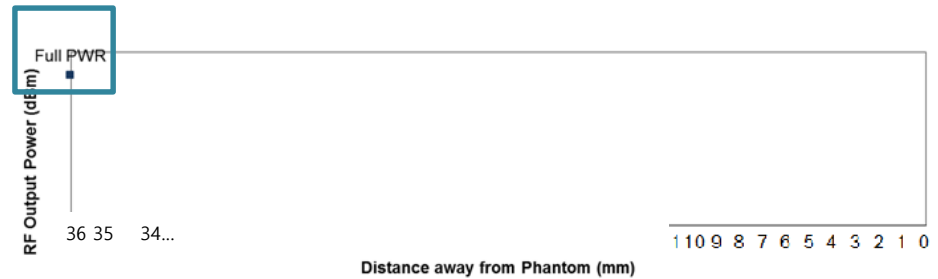
Steps:

1. Mobile is set to operate at its normal maximum output power (KDB616217 6.2.a)
2. Entire rear of the Mobile was positioned below a flat phantom filled with tissue-equivalent medium required for the test frequency range, positioned at least 20 mm further than the distance that triggers power reduction (KDB616217 6.2.b)

We positioned the device 34mm away from the Phantom for this test

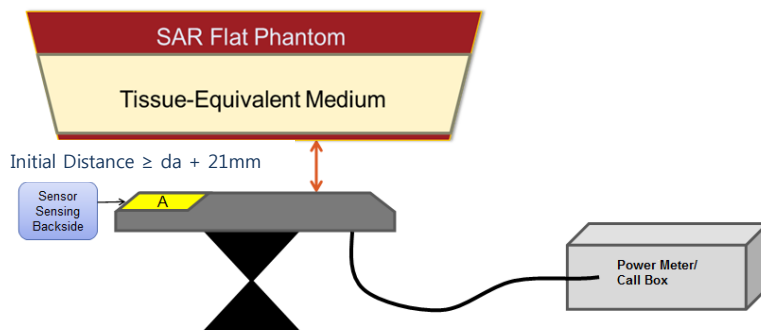
Initial dist = 13mm (triggering dist) + 21 mm

3. Cable used for power measurement does not interfere with proximity sensor. Cable losses were properly compensated to report the measured power results per KDB616217 6.2.c



KDB 616217 D04 6.2.b	
Measured Power [dBm]	
Distance[mm]	34
LTE B41	22.50

Full Power

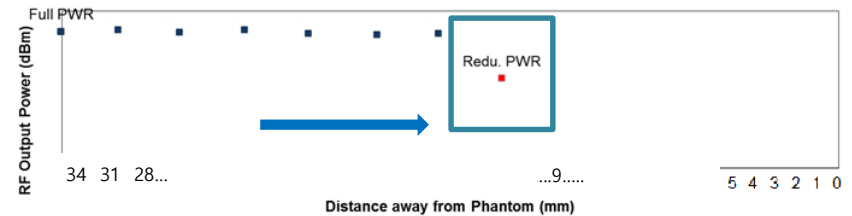


I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING BACK SIDE (Cont'd)

4. Mobile is moved in 3mm steps toward the SAR Flat Phantom until the sensor activated per FCC KDB 616217 6.2.d

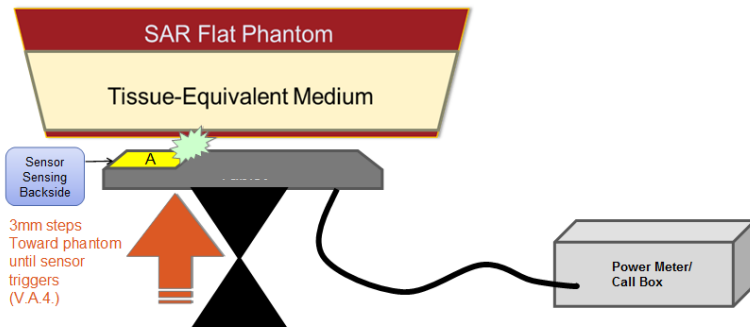
$d_{A1} = 13\text{mm}$

RF Output Power Over Distance toward Phantom KDB616217 6.2.4(3mm Steps toward Phantom)



KDB 616217 D04 6.2.d								
Measured Power [dBm]								
Distance[mm]	34	31	28	25	22	19	16	13
LTE B41	22.50	22.52	22.51	22.52	22.53	22.51	22.50	18.50

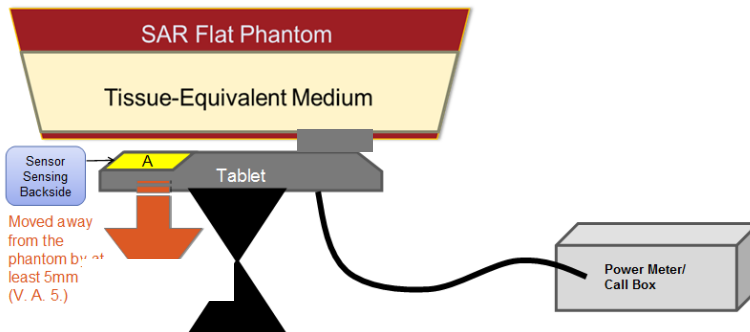
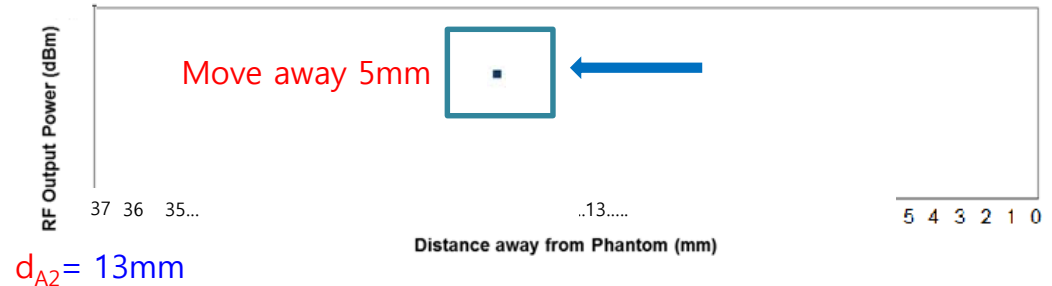
Reduced
Power



I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING BACK SIDE (Cont'd)

5. While the Mobile has a triggered sensor state, the Mobile was moved away from the SAR Flat phantom by at least 5mm per FCC KDB 616217 6.2.e.
6. The sensor was confirmed to de-activate when it moved at least 5mm from the last triggered position from Step 4.

RF Output Power Over Distance away from Phantom KDB616217 6.2.5(Moved away from the phantom by at least 5mm)

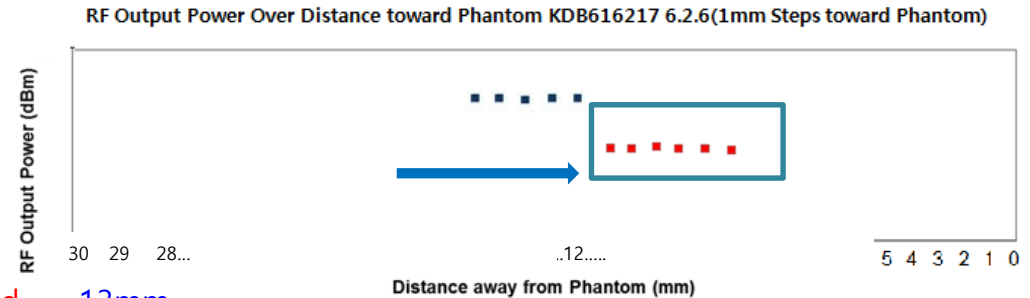


KDB 616217 D04 6.2.e		
Measured Power [dBm]		
Distance[mm]	18	13
LTE B41	22.51	18.52

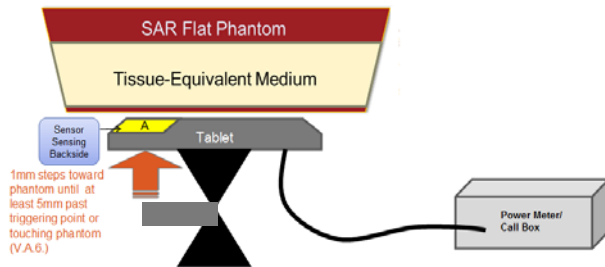
Full Power

I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING BACK SIDE (Cont'd)

7. Mobile is moved again toward the SAR Flat Phantom, but now in 1mm steps until at least 5mm past the sensor triggering point (or when the Mobile touched the phantom) per FCC KDB 616217 6.2.f



$$d_{A3} = 13\text{mm}$$

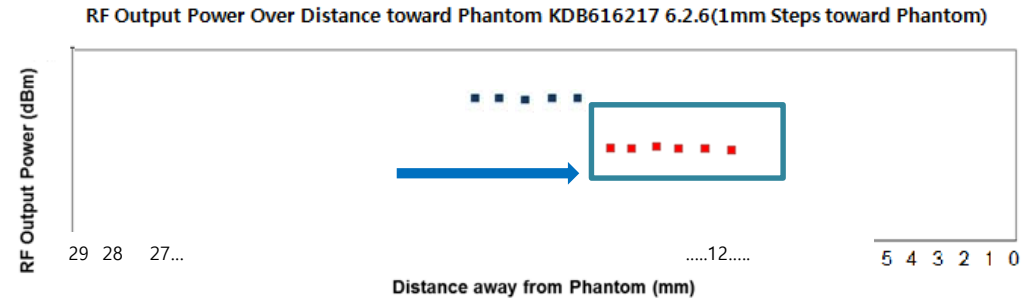


KDB 616217 D04 6.2.f									
Measured Power [dBm]									
Distance[mm]	18	17	16	15	14	13	12	11	10
GSM 1900 Voice	22.53	22.52	22.52	22.51	22.50	18.52	18.53	18.52	18.51

Reduced Power

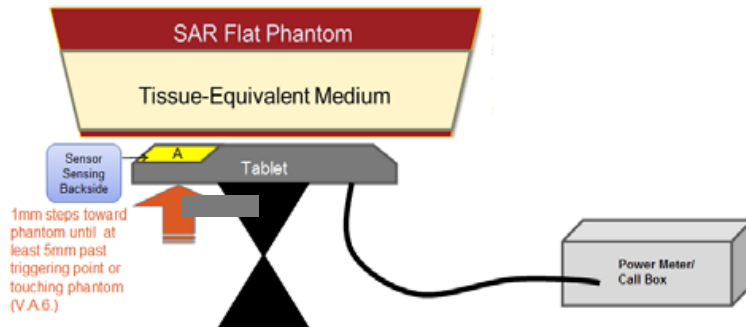
I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING BACK SIDE (Cont'd)

8. Since the Device was not touching the phantom 5mm beyond the triggering distance determined from Step 7, it was moved in 3mm steps toward the SAR phantom until the Device touched the phantom to confirm that the sensor remained triggered through out and thus the maximum power staying reduced per FCC KDB 616217 6.2.g.



$d_{A3} = 13\text{mm}$

Confirmed Sensor remained
Reduced Power.

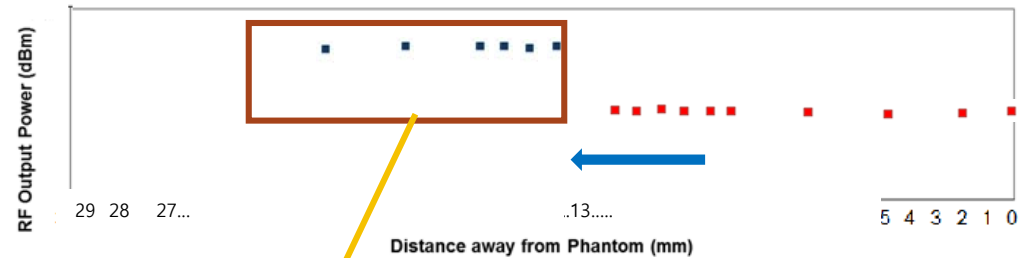


KDB 616217 D04 6.2.g				
Measured Power [dBm]				
Distance[mm]	13	10	7	4
LTE B41	18.51	18.53	18.52	18.50

I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING BACK SIDE (Cont'd)

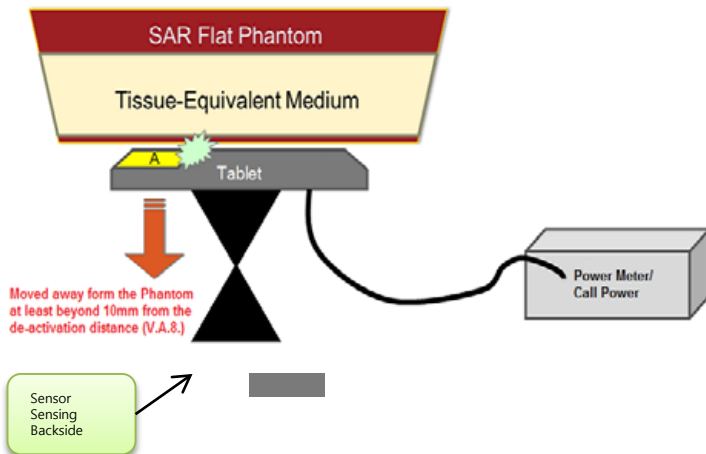
9. The process is then reversed by moving the Mobile away from the phantom according to steps KDB 616217 6.2.d to 6.2.g, to determine triggering release, until it is at least 10 mm beyond the point that triggers the return of normal maximum power per KDB 616217 6.2.h

$$d_{A4} = 13\text{mm}$$



KDB 616217 D04 6.2.h											
Measured Power [dBm]											
Distance[mm]	18	17	16	15	14	13	12	11	10	9	8
GSM 1900 Voice	22.51	22.50	22.52	22.52	22.50	18.50	18.52	18.51	18.51	18.50	18.53

Full Power



I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING BACK SIDE (Cont'd)

Conclusion:

According to FCC KDB 616217 6.2.k., to ensure all production units are compliant, SAR testing should be performed 1mm closer than the smallest distance determined from the triggering tests $\{d_{A1}, d_{A2}, d_{A3}, d_{A4}\}$ at the reduced and maximum power.

SAR Test Distance from the **Back** of the mobile for Sensor sensing back side

= **minimum** $\{d_{A1}, d_{A2}, d_{A3}, d_{A4}\} - 1\text{mm}$

= **minimum** $\{13, 13, 13, 13\} - 1\text{ mm}$

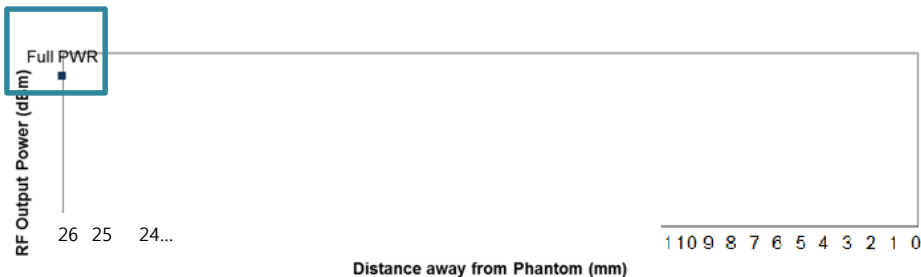
= **12 mm**

II. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING LEFT SIDE

I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING LEFT SIDE

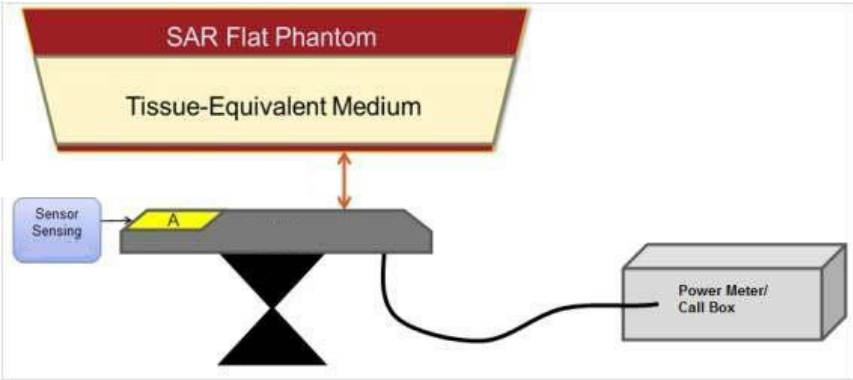
Steps:

1. Device is set to operate at its normal maximum output power (KDB616217 6.2.a)
2. Entire rear of the Device was positioned below flat phantom filled with tissue-equivalent medium required for the test frequency range, positioned at least 20 mm further than the distance that triggers power reduction (KDB616217 6.2.b)
We positioned the device 34 mm away from the Phantom for this test
Initial dist = 13mm (triggering dist) + 21 mm
3. Cable used for power measurement does not interfere with proximity sensor. Cable losses were properly compensated to report the measured power results per KDB616217 6.2.c



KDB 616217 D04 6.2.b	
Measured Power [dBm]	
Distance[mm]	34
LTE B41	22.50

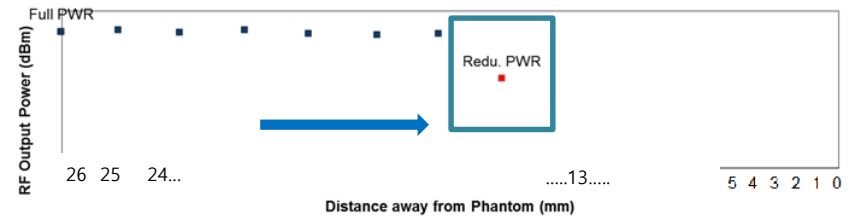
Full Power



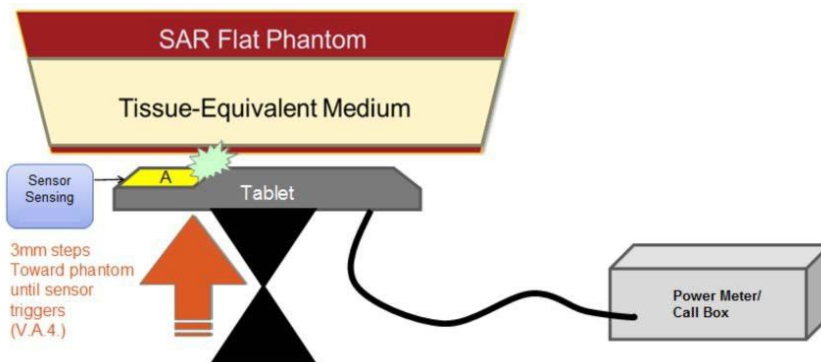
I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING LEFT SIDE

- Device is moved in 3mm steps toward the SAR Flat Phantom until the sensor activated per FCC KDB 616217 6.2.d

RF Output Power Over Distance toward Phantom KDB616217 6.2.4(3mm Steps toward Phantom)



$d_{A1} = 13 \text{ mm}$



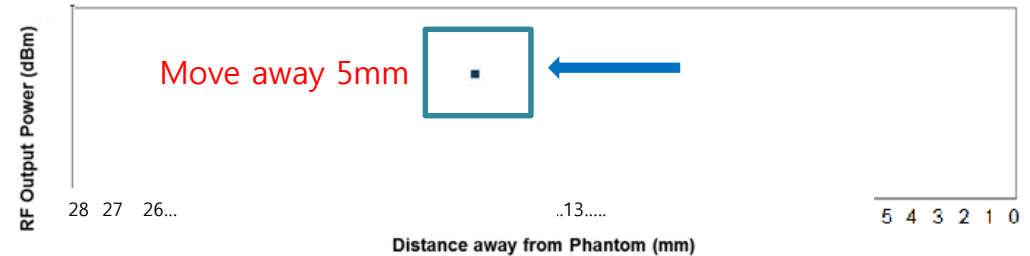
KDB 616217 D04 6.2.d								
Measured Power [dBm]								
Distance[mm]	34	31	28	25	22	19	16	13
LTE B41	22.50	22.51	22.51	22.53	22.50	22.51	22.50	18.50

Reduced
Power

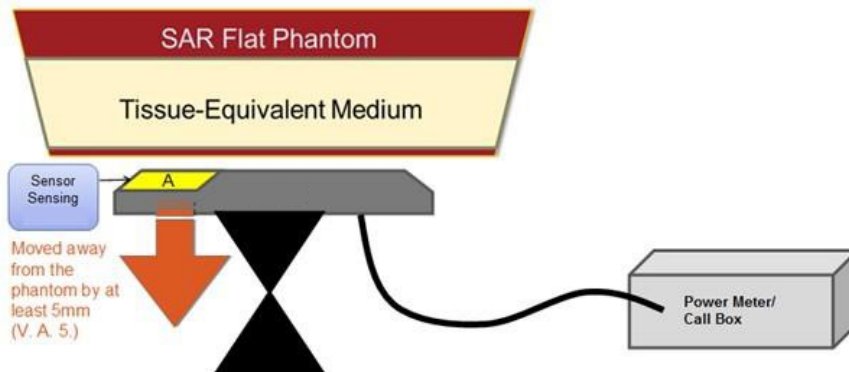
I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING LEFT SIDE

5. While the Device has a triggered sensor state, the Device was moved away from the SAR Flat phantom by at least 5mm per FCC KDB 616217 6.2.e.
6. The sensor was confirmed to de-activate when it moved at least 5mm from the last triggered position from Step 4.

RF Output Power Over Distance away from Phantom KDB616217 6.2.5(Moved away from the phantom by at least 5mm)



$d_{A2} = 13 \text{ mm}$



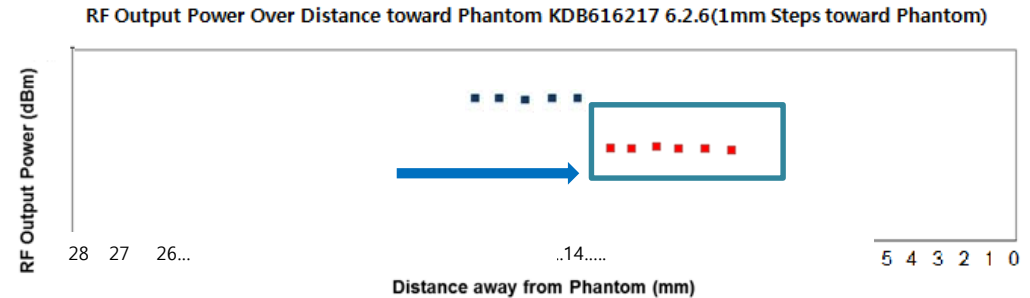
KDB 616217 D04 6.2.e		
Measured Power [dBm]		
Distance[mm]	18	13
LTE B41	22.50	18.50

Full Power

I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING LEFT SIDE

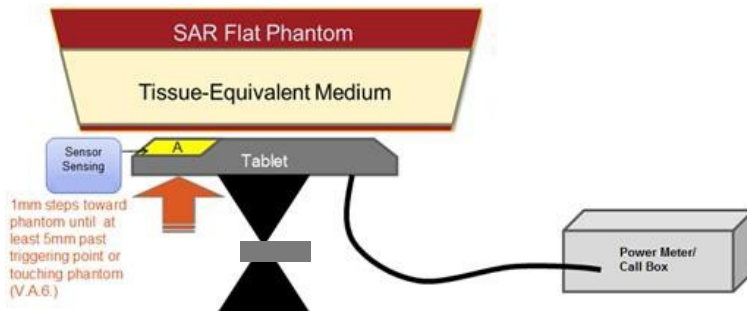
- Device is moved again toward the SAR Flat Phantom, but now in 1mm steps until at least 5mm past the sensor triggering point (or when the Device touched the phantom) per FCC KDB 616217 6.2.f.

$d_{A3} = 13 \text{ mm}$



KDB 616217 D04 6.2.f									
Measured Power [dBm]									
Distance[mm]	18	17	16	15	14	13	12	11	10
LTE B41	22.50	22.51	22.52	22.50	22.51	18.50	18.52	18.51	18.50

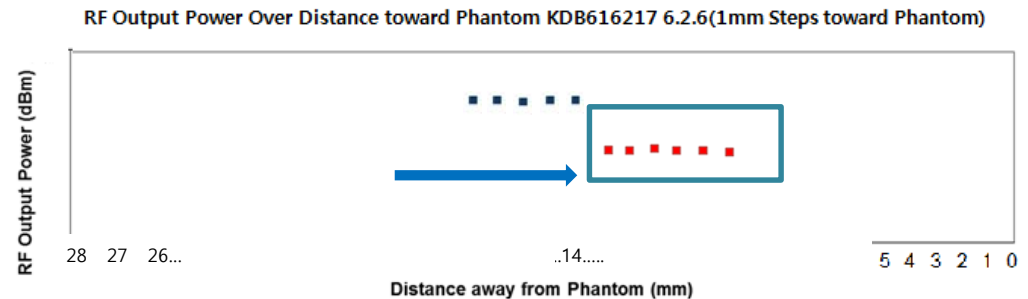
Reduced Power



I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING LEFT SIDE

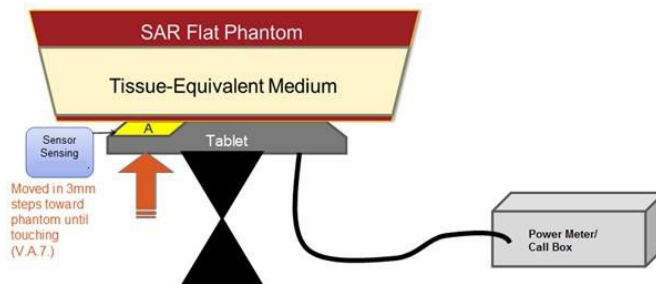
8. Since the Device was not touching the phantom 5mm beyond the triggering distance determined from Step 7, it was moved in 3 mm steps toward the SAR phantom until the Device touched the phantom to confirm that the sensor remained triggered throughout and thus the maximum power staying reduced per FCC KDB 616217 6.2.g.

$$d_{A3} = 13\text{mm}$$



Confirmed Sensor remained
Reduced Power.

Confirmed Sensor remained
Reduced Power

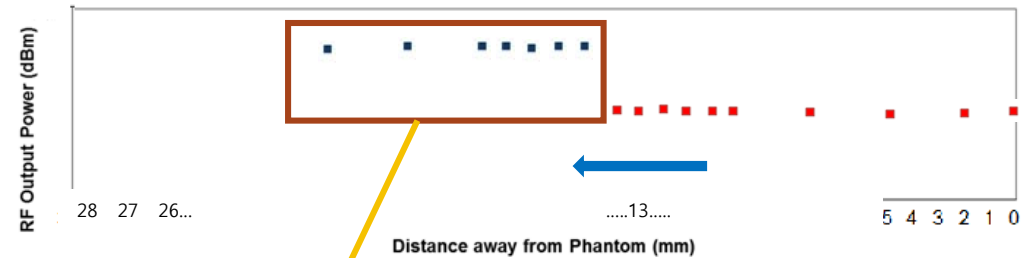


KDB 616217 D04 6.2.g			
Measured Power [dBm]			
Distance[mm]	13	10	7
LTE B41	18.50	18.52	18.51

I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING LEFT SIDE

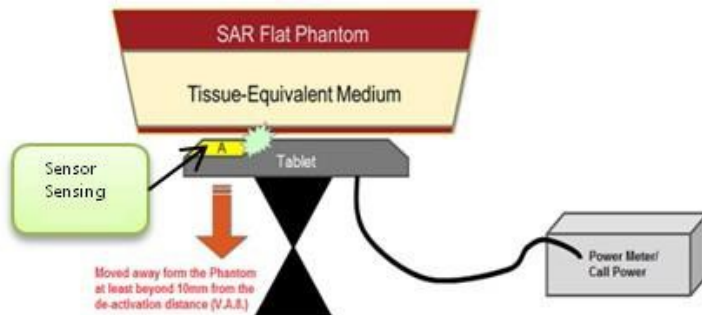
9. The process is then reversed by moving the Device away from the phantom according to steps KDB 616217 6.2.d to 6.2.g, to determine triggering release, until it is at least 10 mm beyond the point that triggers the return of normal maximum power per KDB 616217 6.2.h

$d_{A4} = 13 \text{ mm}$



KDB 616217 D04 6.2.h											
Measured Power [dBm]											
Distance[mm]	18	17	16	15	14	13	12	11	10	9	8
LTE B41	22.51	22.50	22.52	22.50	22.53	18.50	18.52	18.51	18.50	18.53	18.51

Full Power



I. TRIGGERING DISTANCE DETERMINATION FOR SENSOR SENSING LEFT SIDE

Conclusion:

According to FCC KDB 616217 6.2.k., to ensure all production units are compliant, SAR testing was performed 1mm closer than the smallest distance determined from the triggering tests $\{d_{A1}, d_{A2}, d_{A3}, d_{A4}\}$ at the reduced and maximum power.

SAR Test Distance from the **LEFT SIDE**

= minimum $\{d_{A1}, d_{A2}, d_{A3}, d_{A4}\} - 1\text{mm}$

= minimum $\{13, 13, 13, 13\} - 1$

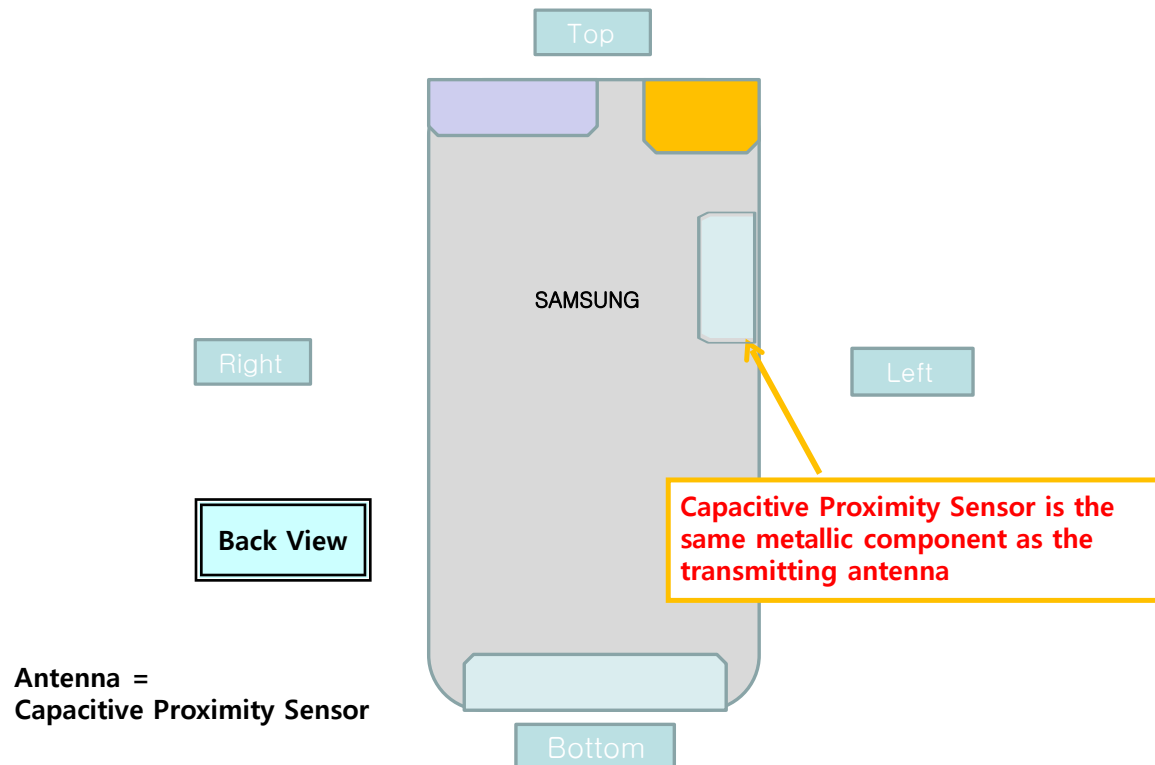
= mm 12 mm

IV. Antenna & Sensor Coverage

According to FCC KDB 616217 6.3, if the proximity sensors are not designed to cover the entire rear surface of the Mobile, the sensing regions are limited and are spatially offset from the antenna.

However, this device uses a capacitive proximity sensor that is same metallic component as the transmitting antenna to facilitate triggering in any conditions the user may use the device in proximity of the antenna in the device.

Therefore, no further sensor coverage assessments were required according to KDB 616217 D04 v01 r02.

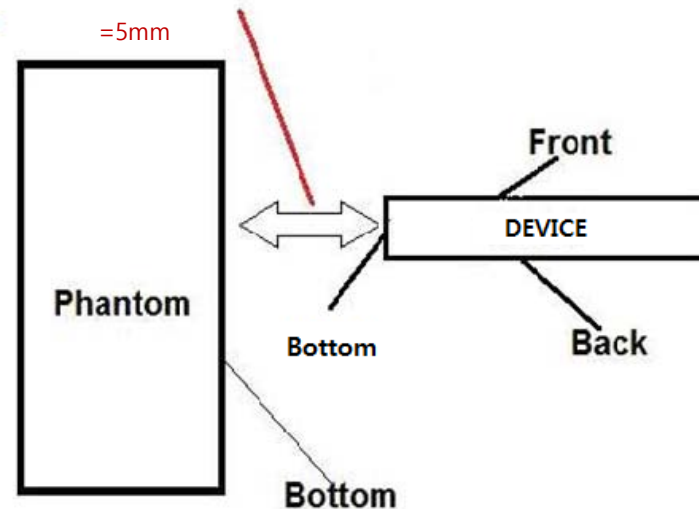


V. Procedure for determining device Tilt Angle Influences to Proximity Sensor triggering Left Edge

1. The influence of table tilt angles to proximity sensor triggering is determined by positioning each tablet edge that contains a transmitting antenna, perpendicular to the flat phantom, at the smallest sensor triggering test distance determined in sections 6.2 and 6.3 by rotating the tablet around the edge in $\leq 10^\circ$ increments until the tablet is $\pm 45^\circ$ or more from the vertical position at 0° per KDB 616217 6.4.a

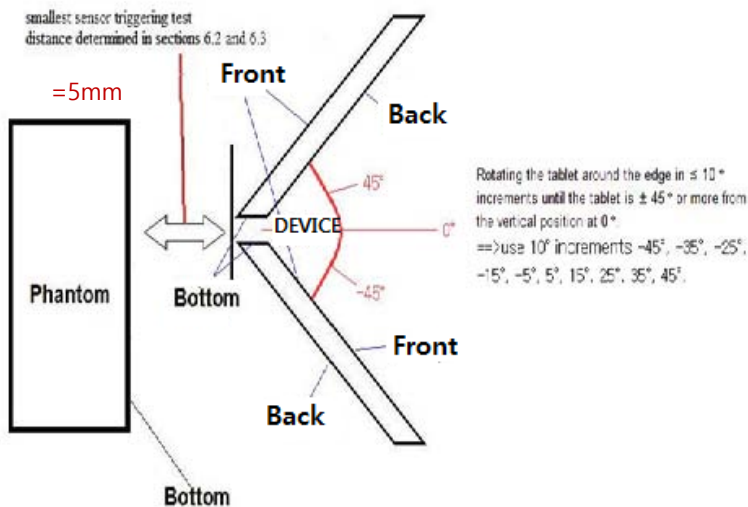
KDB 616217 6.4.a Measured Power [dBm]	
Tilt Angle[°]	0
LTE B41	22.50

smallest sensor triggering test
distance determined in sections 6.2 and 6.3



V. Procedure for determining device Tilt Angle Influences to Proximity Sensor triggering Left Edge(CONT'D)

1. The influence of table tilt angles to proximity sensor triggering is determined by positioning each tablet edge that contains a transmitting antenna, perpendicular to the flat phantom, at the smallest sensor triggering test distance determined in sections 6.2 and 6.3 by rotating the tablet around the edge in $\leq 10^\circ$ increments until the tablet is $\pm 45^\circ$ or more from the vertical position at 0° per KDB 616217 6.4.a



KDB 616217 6.4.a Measured Power [dBm]										
Tilt Angle[°]	-45	-35	-25	-15	-5	5	15	25	35	45
LTE B41	22.50	22.51	22.51	22.50	22.53	22.51	22.50	22.51	22.52	22.50