

APPENDIX G: POWER REDUCTION VERIFICATION

Per the May 2017 TCBC Workshop Notes, demonstration of proper functioning of the power reduction mechanisms is required to support the corresponding SAR configurations. The verification process was divided into two parts: (1) evaluation of output power levels for individual or multiple triggering mechanisms and (2) evaluation of the triggering distances for proximity-based sensors.

G.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.

G.2 Distance Verification Procedure

The distance verification procedure was performed according to the following procedure:

1. A base station simulator was used to establish an RF connection and to monitor the power levels. The device being tested was placed below the relevant section of the phantom with the relevant side or edge of the device facing toward the phantom.
2. The device was moved toward and away from the phantom to determine the distance at which the mechanism triggers and the output power is reduced, per KDB Publication 616217 D04v01r02 and FCC Guidance. Each applicable test position was evaluated. The distances were confirmed to be the same or larger (more conservative) than the minimum distances provided by the manufacturer.
3. Steps 1 and 2 were repeated for low, mid, and high bands, as appropriate (see note below Table G-2 for more details).
4. Steps 1 through 3 were repeated for all distance-based power reduction mechanisms.

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G.3 Main Antenna Verification Summary

**Table G-1
Power Measurement Verification for Main Antenna**

Mechanism(s)			Mode/Band	Device State Index (DSI)			
1st	2nd	3rd		Free Space	Mechanism #1	Mechanism #2	Mechanism #3
Hotspot On			GPRS 850 1 Tx Slot	0	3		
Hotspot On			GPRS 1900 1 Tx Slot	0	3		
Grip			GPRS 1900 1 Tx Slot	0	1		
Hotspot On	Grip		GPRS 1900 1 Tx Slot	0	3	3	
Grip	Hotspot On		GPRS 1900 1 Tx Slot	0	1	3	
Hotspot On			UMTS 850	0	3		
Held-to-Ear			UMTS 850	0	2		
Hotspot On	Held-to-Ear		UMTS 850	0	3	2	
Held-to-Ear	Hotspot On		UMTS 850	0	2	2	
Hotspot On			UMTS 1750	0	3		
Grip			UMTS 1750	0	1		
Held-to-Ear			UMTS 1750	0	2		
Hotspot On	Grip		UMTS 1750	0	3	3	
Hotspot On	Held-to-Ear		UMTS 1750	0	3	2	
Hotspot On	Grip	Held-to-Ear	UMTS 1750	0	3	3	2
Hotspot On	Held-to-Ear	Grip	UMTS 1750	0	3	2	2
Grip	Hotspot On		UMTS 1750	0	1	3	
Grip	Held-to-Ear		UMTS 1750	0	1	2	
Grip	Hotspot On	Held-to-Ear	UMTS 1750	0	1	3	2
Grip	Held-to-Ear	Hotspot On	UMTS 1750	0	1	2	2
Held-to-Ear	Hotspot On		UMTS 1750	0	2	2	
Held-to-Ear	Grip		UMTS 1750	0	2	2	
Held-to-Ear	Hotspot On	Grip	UMTS 1750	0	2	2	2
Held-to-Ear	Grip	Hotspot On	UMTS 1750	0	2	2	2
Hotspot On			UMTS 1900	0	3		
Grip			UMTS 1900	0	1		
Held-to-Ear			UMTS 1900	0	2		
Hotspot On	Grip		UMTS 1900	0	3	3	
Hotspot On	Held-to-Ear		UMTS 1900	0	3	2	
Hotspot On	Grip	Held-to-Ear	UMTS 1900	0	3	3	2
Hotspot On	Held-to-Ear	Grip	UMTS 1900	0	3	2	2
Grip	Hotspot On		UMTS 1900	0	1	3	
Grip	Held-to-Ear		UMTS 1900	0	1	2	
Grip	Hotspot On	Held-to-Ear	UMTS 1900	0	1	3	2
Grip	Held-to-Ear	Hotspot On	UMTS 1900	0	1	2	2
Held-to-Ear	Hotspot On		UMTS 1900	0	2	2	
Held-to-Ear	Grip		UMTS 1900	0	2	2	
Held-to-Ear	Hotspot On	Grip	UMTS 1900	0	2	2	2
Held-to-Ear	Grip	Hotspot On	UMTS 1900	0	2	2	2
Hotspot On			LTE Band 71	0	3		
Hotspot On			LTE Band 12	0	3		
Hotspot On			LTE Band 13	0	3		
Hotspot On			LTE Band 14	0	3		
Hotspot On			LTE Band 26	0	3		
Hotspot On			LTE Band 5	0	3		
Hotspot On			LTE Band 66	0	3		
Grip			LTE Band 66	0	1		
Hotspot On	Grip		LTE Band 66	0	3	3	
Grip	Hotspot On		LTE Band 66	0	1	3	
Hotspot On			LTE Band 4	0	3		
Grip			LTE Band 4	0	1		
Hotspot On	Grip		LTE Band 4	0	3	3	
Grip	Hotspot On		LTE Band 4	0	1	3	
Hotspot On			LTE Band 25	0	3		
Grip			LTE Band 25	0	1		
Hotspot On	Grip		LTE Band 25	0	3	3	
Grip	Hotspot On		LTE Band 25	0	1	3	
Hotspot On			LTE Band 2	0	3		
Grip			LTE Band 2	0	1		
Hotspot On	Grip		LTE Band 2	0	3	3	
Grip	Hotspot On		LTE Band 2	0	1	3	
Hotspot On			LTE Band 30	0	3		
Grip			LTE Band 30	0	1		
Hotspot On	Grip		LTE Band 30	0	3	3	
Grip	Hotspot On		LTE Band 30	0	1	3	
Hotspot On			LTE Band 7	0	3		
Grip			LTE Band 7	0	1		
Hotspot On	Grip		LTE Band 7	0	3	3	
Grip	Hotspot On		LTE Band 7	0	1	3	
Hotspot On			LTE Band 41	0	3		
Hotspot On			LTE Band 41 PC2	0	3		
Hotspot On			LTE Band 38	0	3		
Hotspot On			LTE Band 48	0	3		
Held-to-Ear			LTE Band 48	0	2		
Hotspot On	Held-to-Ear		LTE Band 48	0	3	2	
Held-to-Ear	Hotspot On		LTE Band 48	0	2	2	

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Mechanism(s)		Mode/Band	Device State Index (DSI)		
1st	2nd		Free Space	Mechanism #1	Mechanism #2
Hotspot On		NR FDD Band n71	0	3	
Hotspot On		NR FDD Band n2	0	3	
Hotspot On		NR FDD Band n2	0	3	
Hotspot On		NR FDD Band n66 Ant A	0	3	
Grp		NR FDD Band n66 Ant A	0	1	
Hotspot On	Grp	NR FDD Band n66 Ant A	0	3	3
Grp	Hotspot On	NR FDD Band n66 Ant A	0	1	3
Hotspot On		NR FDD Band n66 Ant 1	0	3	
Held-to-Ear		NR FDD Band n66 Ant 1	0	2	
Hotspot On	Held-to-Ear	NR FDD Band n66 Ant 1	0	3	2
Held-to-Ear	Hotspot On	NR FDD Band n66 Ant 1	0	2	2
Hotspot On		NR FDD Band n25 Ant A	0	3	
Grp		NR FDD Band n25 Ant A	0	1	
Hotspot On	Grp	NR FDD Band n25 Ant A	0	3	3
Grp	Hotspot On	NR FDD Band n25 Ant A	0	1	3
Hotspot On		NR FDD Band n25 Ant 1	0	3	
Held-to-Ear		NR FDD Band n25 Ant 1	0	2	
Hotspot On	Held-to-Ear	NR FDD Band n25 Ant 1	0	3	2
Held-to-Ear	Hotspot On	NR FDD Band n25 Ant 1	0	2	2
Hotspot On		NR FDD Band n2 Ant A	0	3	
Grp		NR FDD Band n2 Ant A	0	1	
Hotspot On	Grp	NR FDD Band n2 Ant A	0	3	3
Grp	Hotspot On	NR FDD Band n2 Ant A	0	1	3
Hotspot On		NR FDD Band n2 Ant 1	0	3	
Held-to-Ear		NR FDD Band n2 Ant 1	0	2	
Hotspot On	Held-to-Ear	NR FDD Band n2 Ant 1	0	3	2
Held-to-Ear	Hotspot On	NR FDD Band n2 Ant 1	0	2	2
Hotspot On		NR FDD Band n7 Ant B	0	3	
Grp		NR FDD Band n7 Ant B	0	1	
Hotspot On	Grp	NR FDD Band n7 Ant B	0	3	3
Grp	Hotspot On	NR FDD Band n7 Ant B	0	1	3
Hotspot On		NR FDD Band 30 Ant B	0	3	
Grp		NR FDD Band 30 Ant B	0	1	
Hotspot On	Grp	NR FDD Band 30 Ant B	0	3	3
Grp	Hotspot On	NR FDD Band 30 Ant B	0	1	3
Hotspot On		NR FDD Band 30 Ant 1	0	3	
Held-to-Ear		NR FDD Band 30 Ant 1	0	2	
Hotspot On	Held-to-Ear	NR FDD Band 30 Ant 1	0	3	2
Held-to-Ear	Hotspot On	NR FDD Band 30 Ant 1	0	2	2
Hotspot On		NR TDD Band 38	0	3	
Held-to-Ear		NR TDD Band 38	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 38	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 38	0	2	2
Hotspot On		NR TDD Band 41 Ant 1	0	3	
Held-to-Ear		NR TDD Band 41 Ant 1	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 41 Ant 1	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 41 Ant 1	0	2	2
Hotspot On		NR TDD Band 41 (PC2) Ant 1	0	3	
Held-to-Ear		NR TDD Band 41 (PC2) Ant 1	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 41 (PC2) Ant 1	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 41 (PC2) Ant 1	0	2	2
Hotspot On		NR TDD Band 41 Ant F	0	3	
Held-to-Ear		NR TDD Band 41 Ant F	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 41 Ant F	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 41 Ant F	0	2	2
Hotspot On		NR TDD Band 41 (PC2) Ant F	0	3	
Held-to-Ear		NR TDD Band 41 (PC2) Ant F	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 41 (PC2) Ant F	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 41 (PC2) Ant F	0	2	2
Hotspot On		NR TDD Band 48 Ant F	0	3	
Held-to-Ear		NR TDD Band 48 Ant F	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 48 Ant F	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 48 Ant F	0	2	2
Hotspot On		NR TDD Band 48 Ant 1	0	3	
Held-to-Ear		NR TDD Band 48 Ant 1	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 48 Ant 1	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 48 Ant 1	0	2	2
Hotspot On		NR TDD Band 48 Ant E	0	3	
Held-to-Ear		NR TDD Band 48 Ant E	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 48 Ant E	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 48 Ant E	0	2	2
Hotspot On		NR TDD Band 77 DoD Ant F	0	3	
Held-to-Ear		NR TDD Band 77 DoD Ant F	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 77 DoD Ant F	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 77 DoD Ant F	0	2	2
Hotspot On		NR TDD Band 77 DoD (PC2) Ant F	0	3	
Held-to-Ear		NR TDD Band 77 DoD (PC2) Ant F	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 77 DoD (PC2) Ant F	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 77 DoD (PC2) Ant F	0	2	2
Hotspot On		NR TDD Band 77 DoD Ant 1	0	3	
Held-to-Ear		NR TDD Band 77 DoD Ant 1	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 77 DoD Ant 1	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 77 DoD Ant 1	0	2	2
Hotspot On		NR TDD Band 77 DoD Ant 1	0	3	
Held-to-Ear		NR TDD Band 77 DoD Ant 1	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 77 DoD Ant 1	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 77 DoD Ant 1	0	2	2
Hotspot On		NR TDD Band 77 DoD Ant E	0	3	
Held-to-Ear		NR TDD Band 77 DoD Ant E	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 77 DoD Ant E	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 77 DoD Ant E	0	2	2
Hotspot On		NR TDD Band 77 (PC2) Ant F	0	3	
Held-to-Ear		NR TDD Band 77 (PC2) Ant F	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 77 (PC2) Ant F	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 77 (PC2) Ant F	0	2	2
Hotspot On		NR TDD Band 77 Ant 1	0	3	
Held-to-Ear		NR TDD Band 77 Ant 1	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 77 Ant 1	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 77 Ant 1	0	2	2
Hotspot On		NR TDD Band 77 Ant E	0	3	
Held-to-Ear		NR TDD Band 77 Ant E	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 77 Ant E	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 77 Ant E	0	2	2
Hotspot On		NR TDD Band 77 (PC2) Ant E	0	3	
Held-to-Ear		NR TDD Band 77 (PC2) Ant E	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 77 (PC2) Ant E	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 77 (PC2) Ant E	0	2	2
Hotspot On		NR TDD Band 77 Ant 1	0	3	
Held-to-Ear		NR TDD Band 77 Ant 1	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 77 Ant 1	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 77 Ant 1	0	2	2
Hotspot On		NR TDD Band 77 Ant E	0	3	
Held-to-Ear		NR TDD Band 77 Ant E	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 77 Ant E	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 77 Ant E	0	2	2
Hotspot On		NR TDD Band 77 (PC2) Ant E	0	3	
Held-to-Ear		NR TDD Band 77 (PC2) Ant E	0	2	
Hotspot On	Held-to-Ear	NR TDD Band 77 (PC2) Ant E	0	3	2
Held-to-Ear	Hotspot On	NR TDD Band 77 (PC2) Ant E	0	2	2

*Note: This device uses different Device State Indices (DSI) to configure different time averaged power levels based on certain exposure scenarios. For this device, DSI = 1 represents the case when the grip sensor is active, DSI = 2 represents the case where the device is held to ear, and DSI = 3 represents the case when hotspot mode is active. DSI = 0 is configured at max power when the device cannot detect the use condition.

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**Table G-2
Distance Measurement Verification for Main Antenna**

Test Condition	Band	Distance Measurements (mm)		Minimum Distance per Manufacturer (mm)
		Moving Toward	Moving Away	
Phablet - Back Side	Mid	11	14	9
Phablet - Back Side	High	11	14	9
Phablet - Front Side	Mid	8	11	7
Phablet - Front Side	High	8	11	7
Phablet - Bottom Edge	Mid	13	16	13
Phablet - Bottom Edge	High	13	16	13

*Note: Mid band refers to: GSM1900, UMTS B2/4, LTE B2/4/25/66 Antenna A, NR Band n66/2/25 Antenna A;
High band refers to: LTE B7/30, NR Band n7/30 Antenna B

G.4 WIFI Verification Summary

**Table G-3
Power Measurement Verification WIFI Antenna 1**

Mechanism(s)	Mode/Band	Conducted Power (dBm)	
		Un-triggered (Max)	Mechanism #1 (Reduced)
1st			
Held-to-Ear	802.11b	18.40	11.40
Held-to-Ear	802.11g	16.50	10.60
Held-to-Ear	802.11n (2.4GHz)	16.13	10.20
Held-to-Ear	802.11a	16.26	9.63
Held-to-Ear	802.11n (5GHz, 20MHz BW)	16.11	9.58
Held-to-Ear	802.11ac (20MHz BW)	16.60	9.80
Held-to-Ear	802.11n (5GHz, 40MHz BW)	15.38	9.60
Held-to-Ear	802.11ac (40MHz BW)	15.84	9.27
Held-to-Ear	802.11ac (80MHz BW)	14.48	9.40
Held-to-Ear	802.11ac (160MHz BW)	15.00	9.47

*Note: IEEE 801.11 ax and MIMO WIFI modes were not evaluated due to equipment limitations.

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**Table G-4
Power Measurement Verification WIFI Antenna 2**

Mechanism(s)	Mode/Band	Conducted Power (dBm)	
		Un-triggered (Max)	Mechanism #1 (Reduced)
1st			
Held-to-Ear	802.11b	18.27	9.00
Held-to-Ear	802.11g	16.01	8.00
Held-to-Ear	802.11n (2.4GHz)	16.04	7.42
Held-to-Ear	802.11a	17.69	10.86
Held-to-Ear	802.11n (5GHz, 20MHz BW)	17.71	10.64
Held-to-Ear	802.11ac (20MHz BW)	17.69	10.54
Held-to-Ear	802.11n (5GHz, 40MHz BW)	16.22	10.22
Held-to-Ear	802.11ac (40MHz BW)	16.19	10.30
Held-to-Ear	802.11ac (80MHz BW)	15.56	10.27
Held-to-Ear	802.11ac (160MHz BW)	14.90	9.47

*Note: IEEE 801.11 ax and MIMO WIFI modes were not evaluated due to equipment limitations.

**Table G-5
Power Measurement Verification WIFI Antenna 1 with NR Active**

Mode/Band	Conducted Power (dBm)		
	Un-triggered (Max)	Mechanism #1 NR Active (Reduced)	Mechanism #2 RCV and Sub 6 Active (Reduced)
802.11b	17.70	11.90	11.80
802.11g	16.80	11.70	11.80
802.11n (2.4GHz)	16.70	11.50	11.40
802.11a	16.50	9.30	9.20
802.11n (5GHz, 20MHz BW)	16.60	9.20	9.30
802.11ac (20MHz BW)	16.40	9.30	9.20
802.11n (5GHz, 40MHz BW)	15.50	9.30	9.10
802.11ac (40MHz BW)	15.50	9.10	9.00
802.11ac (80MHz BW)	14.60	9.00	9.10

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**Table G-6
Power Measurement Verification WIFI Antenna 2 with NR Active**

Mode/Band	Conducted Power (dBm)		
	Un-triggered (Max)	Mechanism #1 NR Active (Reduced)	Mechanism #2 RCV and Sub 6 Active (Reduced)
802.11b	17.90	11.80	11.70
802.11g	16.30	11.40	11.30
802.11n (2.4GHz)	16.50	11.00	11.10
802.11a	16.60	9.50	9.40
802.11n (5GHz, 20MHz BW)	16.70	9.40	9.50
802.11ac (20MHz BW)	16.50	9.20	9.10
802.11n (5GHz, 40MHz BW)	15.70	9.40	9.00
802.11ac (40MHz BW)	15.50	9.30	9.10
802.11ac (80MHz BW)	14.60	9.10	9.20

G.5 Bluetooth Verification Summary

**Table G-7
Power Measurement Verification Bluetooth**

Mode/Band	Conducted Power (dBm)	
	Un-triggered (Max)	Mechanism #1 RCV Active (Reduced)
Bluetooth Ant 1	15.88	9.10
Bluetooth Ant 2	15.52	9.97

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