

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. For licensed modes, the device state index as displayed on the device UI was recorded before and after the 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. For licensed modes, the device state index on the device UI was monitored to determine the triggering state.
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-3 and G-4 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		Un-triggered (Max)	Mechanism #1 (Reduced)	Mechanism #2 (Reduced)
Hotspot On		GPRS 850	0	3	
Hotspot On		GPRS 1900	0	3	
Grip		GPRS 1900	0	1	
Hotspot On	Grip	GPRS 1900	0	3	3
Grip	Hotspot On	GPRS 1900	0	1	3
Hotspot On		UMTS 850	0	3	
Hotspot On		UMTS 1750	0	3	
Grip		UMTS 1750	0	1	
Hotspot On	Grip	UMTS 1750	0	3	3
Grip	Hotspot On	UMTS 1750	0	1	3
Hotspot On		UMTS 1900	0	3	
Grip		UMTS 1900	0	1	
Hotspot On	Grip	UMTS 1900	0	3	3
Grip	Hotspot On	UMTS 1900	0	1	3
Hotspot On		Cell. CDMA/EVDO	0	3	
Hotspot On		PCS EVDO	0	3	
Grip		PCS EVDO	0	1	
Hotspot On	Grip	PCS EVDO	0	3	3
Grip	Hotspot On	PCS EVDO	0	1	3
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	
Grip		LTE Band 41	0	1	
Hotspot On	Grip	LTE Band 41	0	3	3
Grip	Hotspot On	LTE Band 41	0	1	3
Hotspot On		LTE Band 41 (PC2)	0	3	
Grip		LTE Band 41 (PC2)	0	1	
Hotspot On	Grip	LTE Band 41 (PC2)	0	3	3
Grip	Hotspot On	LTE Band 41 (PC2)	0	1	3
Hotspot On		LTE Band 38	0	3	
Grip		LTE Band 38	0	1	
Hotspot On	Grip	LTE Band 38	0	3	3
Grip	Hotspot On	LTE Band 38	0	1	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		Un-triggered (Max)	Mechanism #1 (Reduced)	Mechanism #2 (Reduced)
Hotspot On		NR Band n71	0	3	
Hotspot On		NR Band n12	0	3	
Hotspot On		NR Band n5	0	3	
Hotspot On		NR Band n66 Antenna A	0	3	
Grip		NR Band n66 Antenna A	0	1	
Hotspot On	Grip	NR Band n66 Antenna A	0	3	3
Grip	Hotspot On	NR Band n66 Antenna A	0	1	3
Hotspot On		NR Band n66 Antenna I	0	3	
Held-to-Ear		NR Band n66 Antenna I	0	2	
Hotspot On	Held-to-Ear	NR Band n66 Antenna I	0	3	2
Held-to-Ear	Hotspot On	NR Band n66 Antenna I	0	2	2
Hotspot On		NR Band n25 Antenna A	0	3	
Grip		NR Band n25 Antenna A	0	1	
Hotspot On	Grip	NR Band n25 Antenna A	0	3	3
Grip	Hotspot On	NR Band n25 Antenna A	0	1	3
Hotspot On		NR Band n25 Antenna I	0	3	
Held-to-Ear		NR Band n25 Antenna I	0	2	
Hotspot On	Held-to-Ear	NR Band n25 Antenna I	0	3	2
Held-to-Ear	Hotspot On	NR Band n25 Antenna I	0	2	2
Hotspot On		NR Band n2 Antenna A	0	3	
Grip		NR Band n2 Antenna A	0	1	
Hotspot On	Grip	NR Band n2 Antenna A	0	3	3
Grip	Hotspot On	NR Band n2 Antenna A	0	1	3
Hotspot On		NR Band n2 Antenna I	0	3	
Held-to-Ear		NR Band n2 Antenna I	0	2	
Hotspot On	Held-to-Ear	NR Band n2 Antenna I	0	3	2
Held-to-Ear	Hotspot On	NR Band n2 Antenna I	0	2	2
Hotspot On		NR Band n30	0	3	
Grip		NR Band n30	0	1	
Hotspot On	Grip	NR Band n30	0	3	3
Grip	Hotspot On	NR Band n30	0	1	3
Hotspot On		NR Band n41 (PC3)	0	3	
Held-to-Ear		NR Band n41 (PC3)	0	2	
Hotspot On	Held-to-Ear	NR Band n41 (PC3)	0	3	2
Held-to-Ear	Hotspot On	NR Band n41 (PC3)	0	2	2
Hotspot On		NR Band n41 (PC2)	0	3	
Held-to-Ear		NR Band n41 (PC2)	0	2	
Hotspot On	Held-to-Ear	NR Band n41 (PC2)	0	3	2
Held-to-Ear	Hotspot On	NR Band n41 (PC2)	0	2	2
Hotspot On		NR Band n77 Ant F (PC3)	0	3	
Held-to-Ear		NR Band n77 Ant F (PC3)	0	3	
Hotspot On	Held-to-Ear	NR Band n77 Ant F (PC3)	0	3	2
Held-to-Ear	Hotspot On	NR Band n77 Ant F (PC3)	0	2	2
Hotspot On		NR Band n77 Ant F (PC2)	0	3	
Held-to-Ear		NR Band n77 Ant F (PC2)	0	2	
Hotspot On	Held-to-Ear	NR Band n77 Ant F (PC2)	0	3	2
Held-to-Ear	Hotspot On	NR Band n77 Ant F (PC2)	0	2	2
Hotspot On		NR Band n77 Ant I (PC3)	0	3	
Held-to-Ear		NR Band n77 Ant I (PC3)	0	2	
Hotspot On	Held-to-Ear	NR Band n77 Ant I (PC3)	0	3	2
Held-to-Ear	Hotspot On	NR Band n77 Ant I (PC3)	0	2	2
Hotspot On		NR Band n77 Ant I (PC2)	0	3	
Held-to-Ear		NR Band n77 Ant I (PC2)	0	2	
Hotspot On	Held-to-Ear	NR Band n77 Ant I (PC2)	0	3	2
Held-to-Ear	Hotspot On	NR Band n77 Ant I (PC2)	0	2	2
Hotspot On		NR Band n77 Ant E (PC3)	0	3	
Held-to-Ear		NR Band n77 Ant E (PC3)	0	2	
Hotspot On	Held-to-Ear	NR Band n77 Ant E (PC3)	0	3	2
Held-to-Ear	Hotspot On	NR Band n77 Ant E (PC3)	0	2	2
Hotspot On		NR Band n77 Ant E (PC2)	0	3	
Held-to-Ear		NR Band n77 Ant E (PC2)	0	2	
Hotspot On	Held-to-Ear	NR Band n77 Ant E (PC2)	0	3	2
Held-to-Ear	Hotspot On	NR Band n77 Ant E (PC2)	0	2	2
Hotspot On		NR Band n77 Ant C (PC3)	0	3	
Held-to-Ear		NR Band n77 Ant C (PC3)	0	2	
Hotspot On	Held-to-Ear	NR Band n77 Ant C (PC3)	0	3	2
Held-to-Ear	Hotspot On	NR Band n77 Ant C (PC3)	0	2	2
Hotspot On		NR Band n77 Ant C (PC2)	0	3	
Held-to-Ear		NR Band n77 Ant C (PC2)	0	2	
Hotspot On	Held-to-Ear	NR Band n77 Ant C (PC2)	0	3	2
Held-to-Ear	Hotspot On	NR Band n77 Ant C (PC2)	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 in the open configuration, 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 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	12	9
Phablet - Back Side	High	12	13	9
Phablet - Front Side	Mid	9	10	7
Phablet - Front Side	High	9	11	7
Phablet - Bottom Edge	Mid	13	16	12
Phablet - Bottom Edge	High	15	18	12

*Note: Mid band refers to: CDMA BC1, GSM1900, UMTS B2/4, LTE B2/4/25/66, NR Band n66/2/25
Ant A; High band refers to: LTE B7/30/38/41/48, NR Band n30

G.4 WIFI Verification Summary

Table G-3
Power Measurement Verification WIFI Antenna 1 Held to Ear - Q

Mechanism(s)	Mode/Band	Conducted Power (dBm)	
1st		Un-triggered (Max)	Mechanism #1 (Reduced)
Held-to-Ear	802.11b	17.64	11.59
Held-to-Ear	802.11g	17.96	12.90
Held-to-Ear	802.11n (2.4GHz)	17.01	11.68
Held-to-Ear	802.11a	16.46	9.95
Held-to-Ear	802.11n (5GHz, 20MHz BW)	16.77	10.19
Held-to-Ear	802.11ac (20MHz BW)	16.73	10.13
Held-to-Ear	802.11n (5GHz, 40MHz BW)	16.09	9.70
Held-to-Ear	802.11ac (40MHz BW)	15.98	9.02
Held-to-Ear	802.11ac (80MHz BW)	15.48	9.15

*Note: IEEE801.11ax and MIMO WIFI modes were not evaluated due to equipment limitations.

Table G-4
Power Measurement Verification WIFI Antenna 2 Held to Ear - Q

Mechanism(s)	Mode/Band	Conducted Power (dBm)	
1st		Un-triggered (Max)	Mechanism #1 (Reduced)
Held-to-Ear	802.11b	17.89	11.76
Held-to-Ear	802.11g	17.28	12.25
Held-to-Ear	802.11n (2.4GHz)	17.30	12.43
Held-to-Ear	802.11a	16.90	10.79
Held-to-Ear	802.11n (5GHz, 20MHz BW)	17.63	10.86
Held-to-Ear	802.11ac (20MHz BW)	17.21	10.12
Held-to-Ear	802.11n (5GHz, 40MHz BW)	16.75	10.46
Held-to-Ear	802.11ac (40MHz BW)	15.70	10.53
Held-to-Ear	802.11ac (80MHz BW)	14.98	9.15

*Note: IEEE801.11ax and MIMO WIFI modes were not evaluated due to equipment limitations.

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Table G-5
Power Measurement Verification WIFI Antenna 1 Held to Ear - N

Mechanism(s)	Mode/Band	Conducted Power (dBm)	
1st		Un-triggered (Max)	Mechanism #1 (Reduced)
Held-to-Ear	802.11b	17.60	11.42
Held-to-Ear	802.11g	16.39	11.39
Held-to-Ear	802.11n (2.4GHz)	16.48	11.05
Held-to-Ear	802.11a	16.34	9.12
Held-to-Ear	802.11n (5GHz, 20MHz BW)	16.28	9.87
Held-to-Ear	802.11ac (20MHz BW)	16.22	9.86
Held-to-Ear	802.11n (5GHz, 40MHz BW)	15.97	9.34
Held-to-Ear	802.11ac (40MHz BW)	16.00	9.33
Held-to-Ear	802.11ac (80MHz BW)	15.79	10.22

*Note: IEEE801.11ax and MIMO WIFI modes were not evaluated due to equipment limitations.

Table G-6
Power Measurement Verification WIFI Antenna 2 Held to Ear - N

Mechanism(s)	Mode/Band	Conducted Power (dBm)	
1st		Un-triggered (Max)	Mechanism #1 (Reduced)
Held-to-Ear	802.11b	17.64	12.71
Held-to-Ear	802.11g	16.92	11.74
Held-to-Ear	802.11n (2.4GHz)	16.47	11.63
Held-to-Ear	802.11a	16.92	9.35
Held-to-Ear	802.11n (5GHz, 20MHz BW)	17.44	10.06
Held-to-Ear	802.11ac (20MHz BW)	17.25	10.15
Held-to-Ear	802.11n (5GHz, 40MHz BW)	15.89	9.72
Held-to-Ear	802.11ac (40MHz BW)	15.67	9.34
Held-to-Ear	802.11ac (80MHz BW)	15.73	9.35

*Note: IEEE801.11ax and MIMO WIFI modes were not evaluated due to equipment limitations.

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Table G-7
Power Measurement Verification WIFI Antenna 1 with NR Active - Q

Mode/Band	Conducted Power (dBm)			
	Un-triggered (Max)	Mechanism #1 NR Active (Reduced)	Mechanism #2 RCV and Sub6 Active (Reduced)	Mechanism #3 RCV and mmW Active (Reduced)
802.11b	17.30	12.90	11.10	9.20
802.11g	15.70	12.50	10.60	8.60
802.11n (2.4GHz)	15.60	12.40	10.30	8.40
802.11a	16.50	12.90	9.40	9.40
802.11n (5GHz, 20MHz BW)	15.40	12.70	9.20	9.10
802.11ac (20MHz BW)	15.30	12.80	9.10	9.10
802.11n (5GHz, 40MHz BW)	13.90	12.30	8.70	8.70
802.11ac (40MHz BW)	14.00	12.40	8.80	8.70
802.11ac (80MHz BW)	13.60	13.00	9.40	9.30

*Note: IEEE801.11ax and MIMO WIFI modes were not evaluated due to equipment limitations.

Table G-8
Power Measurement Verification WIFI Antenna 2 with NR Active - Q

Mode/Band	Conducted Power (dBm)			
	Un-triggered (Max)	Mechanism #1 NR Active (Reduced)	Mechanism #2 RCV and Sub6 Active (Reduced)	Mechanism #3 RCV and mmW Active (Reduced)
802.11b	18.00	14.10	12.27	10.30
802.11g	16.10	13.40	11.40	9.40
802.11n (2.4GHz)	16.00	13.20	11.20	9.20
802.11a	17.20	13.40	9.40	9.30
802.11n (5GHz, 20MHz BW)	16.10	13.10	9.20	9.20
802.11ac (20MHz BW)	16.00	13.10	9.20	9.20
802.11n (5GHz, 40MHz BW)	14.90	12.80	8.90	8.80
802.11ac (40MHz BW)	15.00	12.80	9.40	9.20
802.11ac (80MHz BW)	14.50	13.40	9.40	9.40

*Note: IEEE801.11ax and MIMO WIFI modes were not evaluated due to equipment limitations.

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Table G-9
Power Measurement Verification WIFI Antenna 1 with NR Active - N

Mode/Band	Conducted Power (dBm)			
	Un-triggered (Max)	Mechanism #1 NR Active (Reduced)	Mechanism #2 RCV and Sub6 Active (Reduced)	Mechanism #3 RCV and mmW Active (Reduced)
802.11b	18.00	13.70	11.80	9.80
802.11g	16.10	13.50	11.70	9.60
802.11n (2.4GHz)	16.20	13.40	11.60	9.50
802.11a	16.90	13.80	9.70	9.90
802.11n (5GHz, 20MHz BW)	16.20	13.60	9.60	9.70
802.11ac (20MHz BW)	16.00	13.50	9.60	9.60
802.11n (5GHz, 40MHz BW)	14.70	13.70	9.70	9.60
802.11ac (40MHz BW)	14.50	13.50	9.80	9.40
802.11ac (80MHz BW)	14.10	13.40	9.50	9.50

*Note: IEEE801.11ax and MIMO WIFI modes were not evaluated due to equipment limitations.

Table G-10
Power Measurement Verification WIFI Antenna 2 with NR Active – N

Mode/Band	Conducted Power (dBm)			
	Un-triggered (Max)	Mechanism #1 NR Active (Reduced)	Mechanism #2 RCV and Sub6 Active (Reduced)	Mechanism #3 RCV and mmW Active (Reduced)
802.11b	18.20	13.90	11.80	9.90
802.11g	16.70	13.80	11.70	9.60
802.11n (2.4GHz)	16.60	13.70	11.80	9.50
802.11a	16.80	13.90	9.60	9.70
802.11n (5GHz, 20MHz BW)	16.30	13.70	9.70	9.50
802.11ac (20MHz BW)	16.40	13.60	9.50	9.40
802.11n (5GHz, 40MHz BW)	15.00	13.40	9.40	9.60
802.11ac (40MHz BW)	15.10	13.50	9.60	9.50
802.11ac (80MHz BW)	14.60	13.50	9.40	9.50

*Note: IEEE801.11ax and MIMO WIFI modes were not evaluated due to equipment limitations.

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G.5 Bluetooth Verification Summary

Table G-11
Power Measurement Verification Bluetooth Antenna 1 with NR Active - Q

Mode/Band	Conducted Power (dBm)		
	Un-triggered (Max)	Mechanism #1 NR Active (Reduced)	Mechanism #2 RCV Active (Reduced)
Bluetooth Ant 1	15.10		8.60
Bluetooth Ant 2	15.80		9.40
Bluetooth Ant 1	15.10	13.10	
Bluetooth Ant 2	15.80	13.60	

Table G-12
Power Measurement Verification Bluetooth Antenna 1 with NR Active - N

Mode/Band	Conducted Power (dBm)		
	Un-triggered (Max)	Mechanism #1 NR Active (Reduced)	Mechanism #2 RCV Active (Reduced)
Bluetooth Ant 1	15.20		8.70
Bluetooth Ant 2	15.70		9.60
Bluetooth Ant 1	15.20	13.00	
Bluetooth Ant 2	15.70	13.40	

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