

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 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	Conducted Power (dBm)		
1st	2nd		Un-triggered (Max)	Mechanism #1 (Reduced)	Mechanism #2 (Reduced)
Hotspot On		GPRS 850 3 Tx Slot	29.50	27.32	
Hotspot On		GPRS 1900 3 Tx Slot	26.81	22.30	
Grip		GPRS 1900 3 Tx Slot	26.85	25.15	
Hotspot On	Grip	GPRS 1900 3 Tx Slot	26.83	22.35	22.31
Grip	Hotspot On	GPRS 1900 3 Tx Slot	26.84	25.11	22.34
Hotspot On		UMTS 850	24.67	22.55	
Hotspot On		UMTS 1750	23.15	16.18	
Grip		UMTS 1750	23.11	20.05	
Hotspot On	Grip	UMTS 1750	23.17	16.22	16.21
Grip	Hotspot On	UMTS 1750	23.05	20.17	16.15
Hotspot On		UMTS 1900	23.22	18.25	
Grip		UMTS 1900	23.16	21.19	
Hotspot On	Grip	UMTS 1900	23.13	18.27	18.25
Grip	Hotspot On	UMTS 1900	23.25	21.22	18.29
Hotspot On		LTE Band 12	23.51	22.28	
Hotspot On		LTE Band 17	23.51	22.08	
Hotspot On		LTE Band 13	23.73	22.27	
Hotspot On		LTE Band 26	23.52	22.13	
Hotspot On		LTE Band 5	23.50	22.19	
Hotspot On		LTE Band 66	22.35	15.22	
Grip		LTE Band 66	22.31	19.30	
Hotspot On	Grip	LTE Band 66	22.33	15.26	15.24
Grip	Hotspot On	LTE Band 66	22.34	19.32	15.29
Hotspot On		LTE Band 4	22.42	15.15	
Grip		LTE Band 4	22.45	19.46	
Hotspot On	Grip	LTE Band 4	22.48	15.18	15.11
Grip	Hotspot On	LTE Band 4	22.45	19.45	15.14
Hotspot On		LTE Band 25	22.80	17.44	
Grip		LTE Band 25	22.79	19.80	
Hotspot On	Grip	LTE Band 25	22.81	17.51	17.53
Grip	Hotspot On	LTE Band 25	22.82	19.84	17.55
Hotspot On		LTE Band 2	22.71	17.49	
Grip		LTE Band 2	22.72	19.75	
Hotspot On	Grip	LTE Band 2	22.71	17.65	17.61
Grip	Hotspot On	LTE Band 2	22.74	19.71	17.59
Hotspot On		LTE Band 41 PC3	23.43	17.89	
Grip		LTE Band 41 PC3	23.42	21.95	
Hotspot On	Grip	LTE Band 41 PC3	23.40	17.91	17.91
Grip	Hotspot On	LTE Band 41 PC3	23.40	21.94	17.92
Hotspot On		LTE Band 41 PC2	25.88	17.94	
Grip		LTE Band 41 PC2	25.86	21.95	
Hotspot On	Grip	LTE Band 41 PC2	25.85	17.92	17.95
Grip	Hotspot On	LTE Band 41 PC2	25.86	21.93	17.93

Mechanism(s)		Mode/Band	Conducted Power (dBm)		
1st	2nd		Un-triggered (Max)	Mechanism #1 (Reduced)	Mechanism #2 (Reduced)
Hotspot On		NR Band n5	24.07	22.51	
Hotspot On		NR Band n66	23.04	15.56	
Grip		NR Band n66	23.12	20.20	
Hotspot On	Grip	NR Band n66	23.01	15.52	15.59
Grip	Hotspot On	NR Band n66	23.25	20.10	15.57



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Table G-2
Distance Measurement Verification for Main Antenna

Mechanism(s)	Test Condition	Band	Distance Measurements (mm)		Minimum Distance per Manufacturer (mm)
			Moving Toward	Moving Away	
Grip	Phablet - Back Side	Mid	11	14	9
Grip	Phablet - Back Side	High	11	13	9
Grip	Phablet - Front Side	Mid	8	11	7
Grip	Phablet - Front Side	High	8	10	7
Grip	Phablet - Bottom Edge	Mid	13	16	12
Grip	Phablet - Bottom Edge	High	12	15	12

*Note: Mid band refers to: GSM1900, UMTS B2/4, LTE B2/4/25/66, NR Band n66; High band refers to: LTE B41.

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)	
		Un-triggered (Max)	Mechanism #1 (Reduced)
1st			
Held-to-Ear	802.11b	17.62	11.25
Held-to-Ear	802.11g	16.12	11.09
Held-to-Ear	802.11n (2.4GHz)	16.05	11.01
Held-to-Ear	802.11a	16.11	9.82
Held-to-Ear	802.11n (5GHz, 20MHz BW)	16.03	9.78
Held-to-Ear	802.11ac (20MHz BW)	16.03	9.54
Held-to-Ear	802.11n (5GHz, 40MHz BW)	15.27	9.04
Held-to-Ear	802.11ac (40MHz BW)	15.93	9.57
Held-to-Ear	802.11ac (80MHz BW)	14.53	9.74

*Note: IEEE 801.11ax 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)	
		Un-triggered (Max)	Mechanism #1 (Reduced)
1st			
Held-to-Ear	802.11b	18.24	12.69
Held-to-Ear	802.11g	16.81	11.90
Held-to-Ear	802.11n (2.4GHz)	16.70	11.79
Held-to-Ear	802.11a	16.01	9.46
Held-to-Ear	802.11n (5GHz, 20MHz BW)	16.16	9.63
Held-to-Ear	802.11ac (20MHz BW)	16.04	9.28
Held-to-Ear	802.11n (5GHz, 40MHz BW)	15.15	9.94
Held-to-Ear	802.11ac (40MHz BW)	15.20	9.08
Held-to-Ear	802.11ac (80MHz BW)	15.12	9.04

*Note: IEEE 801.11ax 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	18.48	12.44
Held-to-Ear	802.11g	16.95	11.50
Held-to-Ear	802.11n (2.4GHz)	16.55	11.06
Held-to-Ear	802.11a	15.11	8.21
Held-to-Ear	802.11n (5GHz, 20MHz BW)	15.25	8.27
Held-to-Ear	802.11ac (20MHz BW)	14.74	7.69
Held-to-Ear	802.11n (5GHz, 40MHz BW)	14.57	7.40
Held-to-Ear	802.11ac (40MHz BW)	14.08	7.76
Held-to-Ear	802.11ac (80MHz BW)	13.87	8.46

*Note: IEEE 801.11ax 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	18.48	12.79
Held-to-Ear	802.11g	16.75	11.75
Held-to-Ear	802.11n (2.4GHz)	16.67	11.41
Held-to-Ear	802.11a	15.41	8.80
Held-to-Ear	802.11n (5GHz, 20MHz BW)	15.49	8.95
Held-to-Ear	802.11ac (20MHz BW)	15.35	8.69
Held-to-Ear	802.11n (5GHz, 40MHz BW)	14.23	8.15
Held-to-Ear	802.11ac (40MHz BW)	14.66	8.75
Held-to-Ear	802.11ac (80MHz BW)	13.90	8.74

*Note: IEEE 801.11ax 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 NR Active (Reduced)
802.11b	17.89	13.35	11.86
802.11g	16.78	13.25	11.32
802.11n (2.4GHz)	16.62	13.45	11.43
802.11a	16.83	13.45	9.81
802.11n (5GHz, 20MHz BW)	16.73	13.21	9.32
802.11ac (20MHz BW)	16.69	13.15	9.45
802.11n (5GHz, 40MHz BW)	15.56	13.00	9.85
802.11ac (40MHz BW)	15.58	13.21	9.25
802.11ac (80MHz BW)	14.82	13.05	9.15

*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 NR Active (Reduced)
802.11b	17.68	13.32	11.21
802.11g	16.54	13.43	11.23
802.11n (2.4GHz)	16.35	13.25	11.25
802.11a	16.98	13.42	9.32
802.11n (5GHz, 20MHz BW)	16.54	13.52	9.45
802.11ac (20MHz BW)	16.63	13.75	9.38
802.11n (5GHz, 40MHz BW)	15.32	13.26	9.28
802.11ac (40MHz BW)	15.43	13.52	9.30
802.11ac (80MHz BW)	14.75	13.17	9.15

*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 NR Active (Reduced)
802.11b	18.01	14.03	11.98
802.11g	16.34	13.98	11.26
802.11n (2.4GHz)	16.48	13.84	11.44
802.11a	16.10	13.56	9.83
802.11n (5GHz, 20MHz BW)	16.21	13.82	9.26
802.11ac (20MHz BW)	16.32	13.45	9.44
802.11n (5GHz, 40MHz BW)	14.98	13.65	9.65
802.11ac (40MHz BW)	15.23	13.65	9.58
802.11ac (80MHz BW)	14.21	13.25	9.78

*Note: IEEE 801.11ax 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 NR Active (Reduced)
802.11b	17.89	13.21	12.22
802.11g	16.84	12.98	11.89
802.11n (2.4GHz)	16.83	13.23	11.93
802.11a	16.26	13.45	10.21
802.11n (5GHz, 20MHz BW)	16.33	13.10	9.83
802.11ac (20MHz BW)	16.42	13.08	9.22
802.11n (5GHz, 40MHz BW)	15.65	13.06	9.12
802.11ac (40MHz BW)	15.44	13.21	9.53
802.11ac (80MHz BW)	14.98	12.99	9.48

*Note: IEEE 801.11ax 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 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	15.20		8.90
Bluetooth Ant 2	15.90		9.10
Bluetooth Ant 1	15.20	12.90	
Bluetooth Ant 2	15.90	12.90	

Table G-12
Power Measurement Verification Bluetooth 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		9.30
Bluetooth Ant 2	15.60		9.30
Bluetooth Ant 1	15.20	13.20	
Bluetooth Ant 2	15.60	13.30	

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