

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 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 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 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 | | 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 FDD Band 4 | 0 | 3 | |
| Grip | | LTE FDD Band 4 | 0 | 1 | |
| Hotspot On | Grip | LTE FDD Band 4 | 0 | 3 | 3 |
| Grip | Hotspot On | LTE FDD Band 4 | 0 | 1 | 3 |
| Hotspot On | | LTE FDD Band 66 | 0 | 3 | |
| Grip | | LTE FDD Band 66 | 0 | 1 | |
| Hotspot On | Grip | LTE FDD Band 66 | 0 | 3 | 3 |
| Grip | Hotspot On | LTE FDD Band 66 | 0 | 1 | 3 |
| Hotspot On | | LTE FDD Band 2 | 0 | 3 | |
| Grip | | LTE FDD Band 2 | 0 | 1 | |
| Hotspot On | Grip | LTE FDD Band 2 | 0 | 3 | 3 |
| Grip | Hotspot On | LTE FDD Band 2 | 0 | 1 | 3 |
| Hotspot On | | LTE FDD Band 25 | 0 | 3 | |
| Grip | | LTE FDD Band 25 | 0 | 1 | |
| Hotspot On | Grip | LTE FDD Band 25 | 0 | 3 | 3 |
| Grip | Hotspot On | LTE FDD Band 25 | 0 | 1 | 3 |
| Hotspot On | | LTE FDD Band 30 | 0 | 3 | |
| Grip | | LTE FDD Band 30 | 0 | 1 | |
| Hotspot On | Grip | LTE FDD Band 30 | 0 | 3 | 3 |
| Grip | Hotspot On | LTE FDD Band 30 | 0 | 1 | 3 |
| Hotspot On | | LTE FDD Band 7 | 0 | 3 | |
| Grip | | LTE FDD Band 7 | 0 | 1 | |
| Hotspot On | Grip | LTE FDD Band 7 | 0 | 3 | 3 |
| Grip | Hotspot On | LTE FDD Band 7 | 0 | 1 | 3 |
| Hotspot On | | LTE TDD Band 38 | 0 | 3 | |
| Grip | | LTE TDD Band 38 | 0 | 1 | |
| Hotspot On | Grip | LTE TDD Band 38 | 0 | 3 | 3 |
| Grip | Hotspot On | LTE TDD Band 38 | 0 | 1 | 3 |
| Hotspot On | | LTE TDD Band 41 (PC3) | 0 | 3 | |
| Grip | | LTE TDD Band 41 (PC3) | 0 | 1 | |
| Hotspot On | Grip | LTE TDD Band 41 (PC3) | 0 | 3 | 3 |
| Grip | Hotspot On | LTE TDD Band 41 (PC3) | 0 | 1 | 3 |
| Hotspot On | | LTE TDD Band 41 (PC2) | 0 | 3 | |
| Grip | | LTE TDD Band 41 (PC2) | 0 | 1 | |
| Hotspot On | Grip | LTE TDD Band 41 (PC2) | 0 | 3 | 3 |
| Grip | Hotspot On | LTE TDD Band 41 (PC2) | 0 | 1 | 3 |
| Held-to-Ear | | LTE TDD Band 48 | 0 | 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
Power Measurement Verification for Main Antenna Continued**

| Mechanism(s) | | Mode/Band | Device State Index (DSI) | | |
|--------------|-------------|-----------------------------|--------------------------|------------------------|------------------------|
| 1st | 2nd | | Un-triggered (Max) | Mechanism #1 (Reduced) | Mechanism #2 (Reduced) |
| 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 E | 0 | 3 | |
| Held-to-Ear | | NR Band n66 Antenna E | 0 | 2 | |
| Hotspot On | Held-to-Ear | NR Band n66 Antenna E | 0 | 3 | 2 |
| Held-to-Ear | Hotspot On | NR Band n66 Antenna E | 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 E | 0 | 3 | |
| Held-to-Ear | | NR Band n25 Antenna E | 0 | 2 | |
| Hotspot On | Held-to-Ear | NR Band n25 Antenna E | 0 | 3 | 2 |
| Held-to-Ear | Hotspot On | NR Band n25 Antenna E | 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 E | 0 | 3 | |
| Held-to-Ear | | NR Band n2 Antenna E | 0 | 2 | |
| Hotspot On | Held-to-Ear | NR Band n2 Antenna E | 0 | 3 | 2 |
| Held-to-Ear | Hotspot On | NR Band n2 Antenna E | 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) Antenna B | 0 | 3 | |
| Grip | | NR Band n41 (PC3) Antenna B | 0 | 1 | |
| Hotspot On | Grip | NR Band n41 (PC3) Antenna B | 0 | 3 | 3 |
| Grip | Hotspot On | NR Band n41 (PC3) Antenna B | 0 | 1 | 3 |
| Hotspot On | | NR Band n41 (PC3) Antenna E | 0 | 3 | |
| Held-to-Ear | | NR Band n41 (PC3) Antenna E | 0 | 2 | |
| Hotspot On | Held-to-Ear | NR Band n41 (PC3) Antenna E | 0 | 3 | 2 |
| Held-to-Ear | Hotspot On | NR Band n41 (PC3) Antenna E | 0 | 2 | 2 |
| Hotspot On | | NR Band n41 (PC2) Antenna E | 0 | 3 | |
| Held-to-Ear | | NR Band n41 (PC2) Antenna E | 0 | 2 | |
| Hotspot On | Held-to-Ear | NR Band n41 (PC2) Antenna E | 0 | 3 | 2 |
| Held-to-Ear | Hotspot On | NR Band n41 (PC2) Antenna E | 0 | 2 | 2 |
| Hotspot On | | NR Band n77 (PC3) | 0 | 3 | |
| Held-to-Ear | | NR Band n77 (PC3) | 0 | 2 | |
| Hotspot On | Held-to-Ear | NR Band n77 (PC3) | 0 | 3 | 2 |
| Held-to-Ear | Hotspot On | NR Band n77 (PC3) | 0 | 2 | 2 |
| Hotspot On | | NR Band n77 (PC2) | 0 | 3 | |
| Held-to-Ear | | NR Band n77 (PC2) | 0 | 2 | |
| Hotspot On | Held-to-Ear | NR Band n77 (PC2) | 0 | 3 | 2 |
| Held-to-Ear | Hotspot On | NR Band n77 (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, 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-3
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 | 14 | 19 | 9 |
| Grip | Phablet - Back Side | High | 14 | 19 | 9 |
| Grip | Phablet - Front Side | Mid | 11 | 13 | 7 |
| Grip | Phablet - Front Side | High | 11 | 13 | 7 |
| Grip | Phablet - Bottom Edge | Mid | 15 | 18 | 12 |
| Grip | Phablet - Bottom Edge | High | 15 | 18 | 12 |

*Note: Mid band refers to: PCS EVDO, GSM1900, UMTS B2/4, LTE B2/4/25/66, NR Band n66 Ant A /n25 Ant A /n2 Ant A; High band refers to: LTE B30/7/41 PC3/41 PC2/38, NR Band n30/n41 PC3 Ant B.

G.4 WIFI Verification Summary

Table G-4
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 | 18.88 | 15.15 |
| Held-to-Ear | 802.11g | 17.74 | 15.91 |
| Held-to-Ear | 802.11n (2.4GHz) | 17.75 | 15.75 |
| Held-to-Ear | 802.11a | 16.12 | 12.59 |
| Held-to-Ear | 802.11n (5GHz, 20MHz BW) | 16.23 | 12.68 |
| Held-to-Ear | 802.11ac (20MHz BW) | 16.22 | 12.69 |
| Held-to-Ear | 802.11n (5GHz, 40MHz BW) | 15.58 | 12.56 |
| Held-to-Ear | 802.11ac (40MHz BW) | 15.62 | 12.59 |
| Held-to-Ear | 802.11ac (80MHz BW) | 14.76 | 12.28 |
| Held-to-Ear | 802.11ac (160 MHz BW) | 12.58 | 12.21 |

Note:




1. MIMO and 802.11ax WIFI modes were not evaluated due to equipment limitations.
2. 802.11g, 802.11n, 802.11a, and 802.11ac WIFI only operate in MIMO, and these SISO powers were taken during MIMO conditions

Table G-5
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 | 19.08 | 15.10 |
| Held-to-Ear | 802.11g | 17.52 | 15.86 |
| Held-to-Ear | 802.11n (2.4GHz) | 17.51 | 15.84 |
| Held-to-Ear | 802.11a | 15.89 | 12.08 |
| Held-to-Ear | 802.11n (5GHz, 20MHz BW) | 15.84 | 12.16 |
| Held-to-Ear | 802.11ac (20MHz BW) | 15.82 | 12.19 |
| Held-to-Ear | 802.11n (5GHz, 40MHz BW) | 15.32 | 12.17 |
| Held-to-Ear | 802.11ac (40 MHz BW) | 15.35 | 12.17 |
| Held-to-Ear | 802.11ac (80 MHz BW) | 14.70 | 12.05 |
| Held-to-Ear | 802.11ac (160 MHz BW) | 12.69 | 12.09 |

Note:

1. MIMO and 802.11ax WIFI modes were not evaluated due to equipment limitations.
2. 802.11g, 802.11n, 802.11a, and 802.11ac WIFI only operate in MIMO, and these SISO powers were taken during MIMO conditions

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**Table G-6
Power Measurement Verification WIFI with NR Active – Antenna 1**

| Mode/Band | Conducted Power (dBm) | | |
|--------------------------|-----------------------|----------------------------------|--|
| | Un-triggered (Max) | Mechanism #1 NR Active (Reduced) | Mechanism #2 RCV and NR Active (Reduced) |
| 802.11b | 18.94 | 15.27 | 13.84 |
| 802.11g | 17.54 | 15.65 | 13.71 |
| 802.11n (2.4GHz) | 17.44 | 15.70 | 13.87 |
| 802.11a | 16.64 | 13.02 | 12.99 |
| 802.11n (5GHz, 20MHz BW) | 16.65 | 13.04 | 13.03 |
| 802.11ac (20MHz BW) | 16.62 | 13.01 | 13.02 |
| 802.11n (5GHz, 40MHz BW) | 15.86 | 12.64 | 12.87 |
| 802.11ac (40MHz BW) | 15.69 | 12.62 | 12.64 |
| 802.11ac (80MHz BW) | 15.12 | 12.33 | 12.51 |
| 802.11ac (160MHz BW) | 12.66 | 12.15 | 12.08 |

Note:



1. MIMO and 802.11ax WIFI modes were not evaluated due to equipment limitations.
2. 802.11g, 802.11n, 802.11a, and 802.11ac WIFI only operate in MIMO, and these SISO powers were taken during MIMO conditions

**Table G-7
Power Measurement Verification WIFI with NR Active – Antenna 2**

| Mode/Band | Conducted Power (dBm) | | |
|--------------------------|-----------------------|----------------------------------|--|
| | Un-triggered (Max) | Mechanism #1 NR Active (Reduced) | Mechanism #2 RCV and NR Active (Reduced) |
| 802.11b | 19.56 | 15.76 | 13.76 |
| 802.11g | 17.64 | 15.62 | 13.80 |
| 802.11n (2.4GHz) | 17.70 | 15.70 | 13.72 |
| 802.11a | 16.43 | 12.67 | 12.54 |
| 802.11n (5GHz, 20MHz BW) | 16.40 | 12.37 | 12.35 |
| 802.11ac (20MHz BW) | 16.41 | 12.36 | 12.27 |
| 802.11n (5GHz, 40MHz BW) | 15.61 | 12.13 | 12.14 |
| 802.11ac (40MHz BW) | 15.66 | 12.12 | 12.13 |
| 802.11ac (80MHz BW) | 14.54 | 11.79 | 11.75 |
| 802.11ac (160MHz BW) | 12.51 | 11.96 | 11.84 |

Note:

1. MIMO and 802.11ax WIFI modes were not evaluated due to equipment limitations.
2. 802.11g, 802.11n, 802.11a, and 802.11ac WIFI only operate in MIMO, and these SISO powers were taken during MIMO conditions

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G.5 Bluetooth Verification Summary

Table G-8
Power Measurement Verification Bluetooth Antenna 1 Held to Ear



| Mechanism(s) | Mode/Band | Conducted Power (dBm) | |
|--------------|-----------|-----------------------|------------------------|
| | | Un-triggered (Max) | Mechanism #1 (Reduced) |
| 1st | | | |
| Held-to-Ear | Bluetooth | 16.30 | 12.00 |

Note: Bluetooth Dual mode was not evaluated due to equipment limitations.

Table G-9
Power Measurement Verification Bluetooth Antenna 2 Held to Ear

| Mechanism(s) | Mode/Band | Conducted Power (dBm) | |
|--------------|-----------|-----------------------|------------------------|
| | | Un-triggered (Max) | Mechanism #1 (Reduced) |
| 1st | | | |
| Held-to-Ear | Bluetooth | 16.10 | 11.80 |

Note: Bluetooth Dual mode was not evaluated due to equipment limitations.

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