

APPENDIX F: 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.

F.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. The device state index as displayed on the device UI was recorded before and after the mechanism was triggered.

F.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 in section F.3 for more details).
4. Steps 1 through 3 were repeated for all distance-based power reduction mechanisms.
5. The device state index on the device UI was monitored to determine the triggering state.

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F.3 Main Antenna Verification Summary

- Low band refers to: GSM850, UMTS B5, LTE B5/12/13/14/26/71, NR n71/12/14/26/5; Mid band refers to: GSM1900, UMTS B2/4, LTE B2/4/25/66, NR n66/70/25/2; High band refers to: LTE B7/30/38/41, NR n30/7/38/41; Ultra High band refers to: LTE B48, NR n48/77/78.
- This device uses different Device State Indices (DSI) to configure different time averaged power levels based on certain exposure scenarios. For Folder Closed states, DSI = 3 represents the case where the device is held-to-ear. DSI = 5 represents the case where the grip sensor is triggered. DSI = 1 is configured when the device cannot detect the held-to-ear or grip use conditions. For Folder Open states, DSI = 4 represents the case where the grip sensor is triggered. DSI = 0 is configured when the device cannot detect the held-to-ear or grip use conditions

Table F-1
Power Measurement Verification for WWAN Antennas – Folder Closed

Mechanism(s)	Mode/Band	Device State Index (DSI)	
1st		Free Space	Mechanism #1
Held-to-Ear	Mid Band Ant B	1	3
Held-to-Ear	Mid Band Ant G	1	3
Held-to-Ear	High band Ant B	1	3
Held-to-Ear	High Band Ant G	1	3
Held-to-Ear	Ultra High Band Ant F	1	3
Held-to-Ear	Ultra High Band Ant C	1	3

Table F-2
Power Measurement Verification for NTN – Folder Closed

Mechanism(s)	Mode/Band	Conducted Power (dBm)	
1st		Free Space	Mechanism #1
Grip	NTN Band 255	24.00	20.00

Table F-3
Power Measurement Verification for WWAN Antennas – Folder Open

Mechanism(s)	Mode/Band	Device State Index (DSI)	
1st		Free Space	Mechanism #1
Grip	Mid Band Ant G	0	4
Grip	High Band Ant G	0	4

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Table F-4
Power Measurement Verification for NTN – Folder Open

Mechanism(s)	Mode/Band	Conducted Power (dBm)	
1st		Free Space	Mechanism #1
Grip	NTN Band 255	24.00	13.00

Table F-5
Power Measurement Verification for WWAN Antennas – Folder Open and Closed

Mechanism(s)	Mode/Band	Device State Index (DSI)	
1st		Free Space	Mechanism #1
Open	Low Band Ant A+C	0	1
Open	Low Band Ant E	0	1
Open	Mid Band Ant B	0	1
Open	Mid Band Ant G	0	1
Open	High Band Ant B	0	1
Open	High Band Ant G	0	1
Open	High Band Ant H	0	1
Open	High Band Ant D	0	1
Open	Ultra High Band Ant F	0	1
Open	Ultra High Band Ant C	0	1
Open	Ultra High Band Ant A	0	1
Open	Ultra High Band Ant G	0	1
Closed	Low Band Ant A+C	1	0
Closed	Low Band Ant E	1	0
Closed	Mid Band Ant B	1	0
Closed	Mid Band Ant G	1	0
Closed	High Band Ant B	1	0
Closed	High Band Ant G	1	0
Closed	High Band Ant H	1	0
Closed	High Band Ant D	1	0
Closed	Ultra High Band Ant F	1	0
Closed	Ultra High Band Ant C	1	0
Closed	Ultra High Band Ant A	1	0
Closed	Ultra High Band Ant G	1	0

F.4 WIFI Verification Summary

Table F-6
Power Measurement Verification WIFI – Folder Closed

Mechanism(s)	Mode/Band	Device State Index (DSI)	
1st		Free Space	Mechanism #1
Held-to-Ear	2.4 GHz WLAN Ant H	1	3
Held-to-Ear	2.4 GHz WLAN Ant F	1	3
Held-to-Ear	5 GHz WLAN Ant F	1	3
Held-to-Ear	5 GHz WLAN Ant E	1	3
Held-to-Ear	6 GHz WLAN Ant F	1	3
Held-to-Ear	6 GHz WLAN Ant E	1	3

Table F-7
Power Measurement Verification WIFI – Folder Open and Closed

Mechanism(s)	Mode/Band	Device State Index (DSI)	
1st		Free Space	Mechanism #1
Open	2.4 GHz WLAN Ant H	1	0
Open	2.4 GHz WLAN Ant F	1	0
Open	5 GHz WLAN Ant F	1	0
Open	5 GHz WLAN Ant E	1	0
Open	6 GHz WLAN Ant F	1	0
Open	6 GHz WLAN Ant E	1	0
Closed	2.4 GHz WLAN Ant H	0	1
Closed	2.4 GHz WLAN Ant F	0	1
Closed	5 GHz WLAN Ant F	0	1
Closed	5 GHz WLAN Ant E	0	1
Closed	6 GHz WLAN Ant F	0	1
Closed	6 GHz WLAN Ant E	0	1

*Note: MIMO WIFI modes were not evaluated due to equipment limitations.

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Table F-8
Power Measurement Verification Bluetooth – Folder Open and Closed

Mechanism(s)	Mode/Band	Device State Index (DSI)	
1st		Free Space	Mechanism #1
Open	2.4 GHz Bluetooth Ant H	1	0
Open	2.4 GHz Bluetooth Ant F	1	0
Open	2.4 GHz Bluetooth MIMO	1	0
Closed	2.4 GHz Bluetooth Ant H	0	1
Closed	2.4 GHz Bluetooth Ant F	0	1
Closed	2.4 GHz Bluetooth MIMO	0	1

F.5 Distance Verification Summary

Table F-9
Distance Measurement Verification for Closed

Mechanism(s)	Test Condition	Band	Distance Measurements (mm)		Minimum Distance per Manufacturer (mm)
			Moving Toward	Moving Away	
Grip	Phablet - Back Side	NTN	11	12	10
Grip	Phablet - Top Edge	NTN	13	14	12

Table F-10
Distance Measurement Verification for Open

Mechanism(s)	Test Condition	Band	Distance Measurements (mm)		Minimum Distance per Manufacturer (mm)
			Moving Toward	Moving Away	
Grip	Body - Back Side	NTN	12	13	11
Grip	Body - Back Side	Mid	11	15	11
Grip	Body - Back Side	High	11	15	11
Grip	Body - Top Edge	NTN	15	16	14
Grip	Body - Top Edge	Mid	17	21	14
Grip	Body - Top Edge	High	17	21	14

Table F-11
Open Back Side, Moving Toward Phantom

KDB 616217 Section 6.2 Measured Power Moving Toward Phantom [dBm]											
Distance [mm]	16	15	14	13	12	11	10	9	8	7	6
Ant G	Max	Max	Max	Max	Max	Red	Red	Red	Red	Red	Red
KDB 616217 Section 6.2 Measured Power Moving Toward Phantom [dBm]											
Distance [mm]	17	16	15	14	13	12	11	10	9	8	7
NTN	Max	Max	Max	Max	Max	Red	Red	Red	Red	Red	Red

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Table F-12
Open Back Side, Moving Away Phantom

KDB 616217 Section 6.2 Measured Power Moving Away from Phantom [dBm]											
Distance [mm]	10	11	12	13	14	15	16	17	18	19	20
Ant G	Red	Red	Red	Red	Red	Max	Max	Max	Max	Max	Max
KDB 616217 Section 6.2 Measured Power Moving Away from Phantom [dBm]											
Distance [mm]	8	9	10	11	12	13	14	15	16	17	18
NTN	Red	Red	Red	Red	Red	Max	Max	Max	Max	Max	Max

Table F-13
Open Top Edge, Moving Toward Phantom

KDB 616217 Section 6.2 Measured Power Moving Toward Phantom [dBm]											
Distance [mm]	22	21	20	19	18	17	16	15	14	13	12
Ant G	Max	Max	Max	Max	Max	Red	Red	Red	Red	Red	Red
KDB 616217 Section 6.2 Measured Power Moving Toward Phantom [dBm]											
Distance [mm]	20	19	18	17	16	15	14	13	12	11	10
NTN	Max	Max	Max	Max	Max	Red	Red	Red	Red	Red	Red

Table F-14
Open Top Edge, Moving Away From Phantom

KDB 616217 Section 6.2 Measured Power Moving Away from Phantom [dBm]											
Distance [mm]	16	17	18	19	20	21	22	23	24	25	26
Ant G	Red	Red	Red	Red	Red	Max	Max	Max	Max	Max	Max
KDB 616217 Section 6.2 Measured Power Moving Away from Phantom [dBm]											
Distance [mm]	11	12	13	14	15	16	17	18	19	20	21
NTN	Red	Red	Red	Red	Red	Max	Max	Max	Max	Max	Max

Table F-15
Triggering States by Tilt Angle for each Sensor per KDB 616217 Section 6.4 – Open Back Side

KDB 616217 Section 6.4 Measured Tilt Angle											
Tilt Angle	-45	-35	-25	-15	-5	0	5	15	25	35	45
Ant G	11	11	11	11	11	11	11	11	11	11	11
KDB 616217 Section 6.4 Measured Tilt Angle											
Tilt Angle	-45	-35	-25	-15	-5	0	5	15	25	35	45
NTN	11	11	11	11	11	11	11	11	11	11	11

Table F-16
Triggering States by Tilt Angle for each Sensor per KDB 616217 Section 6.4 – Open Top Edge

KDB 616217 Section 6.4 Measured Tilt Angle											
Tilt Angle	-45	-35	-25	-15	-5	0	5	15	25	35	45
Ant G	17	17	17	17	17	17	17	17	17	17	17
KDB 616217 Section 6.4 Measured Tilt Angle											
Tilt Angle	-45	-35	-25	-15	-5	0	5	15	25	35	45
NTN	13	13	13	13	13	13	13	13	13	13	13

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Table F-17
Open Angle Detection

Mechanism(s)	Angle Measurements (°)		Angle (°) Range per Manufacturer
	Opening (0 to 180)	Opening Posture Readout (DSI)	
Folder Angle	0	1	10
	1	1	
	2	1	
	3	1	
	4	1	
	5	1	
	6	1	
	7	1	
	8	1	
	9	1	
	10	0	
	11	0	
	12	0	
	13	0	
	14	0	
	15	0	
	16	0	
	17	0	
	18	0	
	19	0	
	20	0	
	30	0	
	40	0	
	50	0	
	60	0	
	70	0	
	80	0	
	90	0	
	100	0	
	110	0	
	120	0	
	130	0	
	140	0	
	150	0	
	160	0	
	170	0	
	180	0	

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Table F-18
Closed Angle Detection

Mechanism(s)	Angle Measurements (°)		Angle (°) Range per Manufacturer
	Close (180 to 0)	Closing Posture Readout	
Folder Angle	180	0	5
	170	0	
	160	0	
	150	0	
	140	0	
	130	0	
	120	0	
	110	0	
	100	0	
	90	0	
	80	0	
	70	0	
	60	0	
	50	0	
	40	0	
	30	0	
	20	0	
	15	0	
	14	0	
	13	0	
	12	0	
	11	0	
	10	0	
	9	0	
	8	0	
	7	0	
	6	0	
	5	1	
	4	1	
	3	1	
	2	1	
	1	1	
	0	1	

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