

Appendix E. Supplemental RF Exposure Tests Results

SAR test result

1. The test data is selected according to the worst case SAR configuration per cellular technology.
2. The test data is to demonstrate the device is in compliance with FCC requirements at 25mm when all power reduction mechanisms are OFF. The worst case body SAR at 10mm was used for simultaneous transmission SAR analysis since they are more conservative than the 25mm SAR.

Band	Mode	Test Position	Gap (mm)	Brick/ Gun Type	Power State	Ch.	Freq. (MHz)	SKU	Battery	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)
WCDMA IV_Ant 1	RMC 12.2Kbps	Left Side	25mm	Brick	DSI 0	1513	1752.6	SKU12	Battery1	24.96	25.00	1.009			0.02	0.382	0.386
LTE Band 43_Ant 8	20M_QPSK_1_0	Right Side	25mm	Brick	DSI 0	44690	3710	SKU12	Battery1	24.10	25.00	1.230	62.9	1.006	-0.09	0.398	0.493
FR1 n77_Ant 8	100M_BPSK_1_1	Right Side	25mm	Brick	DSI 0	656000	3840	SKU4+1	SKU4+1	24.61	25.00	1.094			0.18	0.337	0.369

Band	Mode	Test Position	Gap (mm)	Antenna	Brick / Gun Type	Power State	Ch.	Freq. (MHz)	SKU	Battery	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
WLAN2.4GHz	802.11b 1Mbps	Right Side	25mm	Ant 6+7(6)	Brick	CTL	11	2462	SKU 12	Battery1	19.71	20.50	1.199	98.05	1.020	0.04	0.134	0.164
WLAN2.4GHz	802.11b 1Mbps	Right Side	25mm	Ant 6+7(6)	Gun	CTL	11	2462	SKU 7	Battery1	19.71	20.50	1.199	98.05	1.020	0.02	0.166	0.203
WLAN5GHz	802.11n-HT20 MCS0	Left Side	25mm	Ant 6+7(6)	Brick	CTL	132	5660	SKU 12	Battery1	19.63	20.50	1.222	99.2	1.008	-0.07	0.854	1.052
WLAN5GHz	802.11n-HT20 MCS0	Left Side	25mm	Ant 6+7(6)	Gun	CTL	132	5660	SKU 7	Battery1	19.63	20.50	1.222	99.2	1.008	-0.03	0.718	0.884
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(7)	Brick	CTL	47	6185	SKU 12	Battery1	18.49	18.50	1.002	99.37	1.006	0.09	0.304	0.307
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(7)	Gun	CTL	47	6185	SKU 7	Battery1	18.49	18.50	1.002	99.37	1.006	-0.19	0.354	0.357

Band	Mode	Test Position	Gap (mm)	Antenna	SKU	Battery	Brick / Gun Type	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Duty Cycle %	Grid Step (A)	Scaling Factor for Measurement Uncertainty	Power Drift (dB)	Normal psPD (W/m^2)	Scaled Normal psPD (W/m^2)	Total psPD (W/m^2)	Scaled Total psPD (W/m^2)
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(6)	SKU12	Battery1	Brick	15	6025	18.08	18.50	99.42	0.25	1.5535	0.05	1.89	3.25	2.1	3.62
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(7)	SKU12	Battery1	Brick	47	6185	18.49	18.50	99.42	0.25	1.5535	-0.01	3.05	4.78	3.15	4.93
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(6)	SKU12	Battery1	Brick	111	6505	15.15	16.50	99.42	0.25	1.5535	0.07	3.3	7.04	3.42	7.29
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(6)	SKU12	Battery1	Brick	143	6665	15.60	16.50	99.42	0.25	1.5535	-0.06	3.53	6.79	3.61	6.94
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(7)	SKU12	Battery1	Brick	207	6985	15.80	16.00	99.42	0.25	1.5535	-0.06	2.93	4.79	3.01	4.93
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(6)	SKU12	Battery2	Brick	111	6505	15.15	16.50	99.42	0.25	1.5535	-0.08	3.22	6.87	3.33	7.10
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(6)	SKU12	Battery3	Brick	111	6505	15.15	16.50	99.42	0.25	1.5535	-0.08	3.25	6.93	3.38	7.21
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(6)	SKU4	Battery4	Brick	111	6505	15.15	16.50	99.42	0.25	1.5535	0.1	3.2	6.82	3.31	7.06
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(6)	SKU7	Battery1	Gun	15	6025	18.06	18.50	99.42	0.25	1.5535	0.05	1.93	3.34	2.12	3.67
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(7)	SKU7	Battery1	Gun	47	6185	18.49	18.50	99.42	0.25	1.5535	-0.01	3.31	5.18	3.41	5.34
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(6)	SKU7	Battery1	Gun	111	6505	15.15	16.50	99.42	0.25	1.5535	-0.01	3.02	6.44	3.12	6.65
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(6)	SKU7	Battery1	Gun	143	6665	15.60	16.50	99.42	0.25	1.5535	-0.05	3.37	6.48	3.46	6.65
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(7)	SKU7	Battery1	Gun	207	6985	15.80	16.00	99.42	0.25	1.5535	0.02	2.93	4.79	3.02	4.94
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(7)	SKU7	Battery2	Gun	47	6185	18.49	18.50	99.42	0.25	1.5535	-0.18	3.23	5.06	3.35	5.25
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(7)	SKU7	Battery3	Gun	47	6185	18.49	18.50	99.42	0.25	1.5535	0.1	3.25	5.09	3.36	5.26
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(7)	SKU7	Battery4	Gun	47	6185	18.49	18.50	99.42	0.25	1.5535	0.12	3.21	5.03	3.28	5.14

Appendix E. Power reduction mechanism verification

According to the May 2017 TCBC Workshop, Demonstration of proper functioning of the detection and triggering mechanisms to support the corresponding RF exposure conditions. The verification is through a base station simulator is used to establish a conducted RF connection and monitor output power under different operating conditions related to the power reduction mechanisms. Detail of power reduction mechanisms referring to Operational Description

1. Power verification procedure

- Establish data connection monitor hotspot power state for GSM/UMST/LTE/FR1/WiFi
- Establish data connection monitor body worn power state for GSM/UMST/LTE/FR1/WiFi, Body Detect mechanism was performed for the in-hand and on a stationary object (placed on a table)
- This device incorporates the Smart Transmit algorithm feature and through under varying Tx power transmission scenarios in real-time to maintain the time-averaged Tx power compliant with RF exposure requirement.
- In this power validation purpose is to demonstrate of proper functioning of the detection and triggering mechanisms to support the corresponding RF exposure conditions. In order to avoid real-time TX power varying may affect monitor output power related to the power reduction mechanisms, therefore power reduction verification would be disabled WWAN time average SAR feature.
- Verification performed for each technology to demonstrate that the power reduction applies for both technology and call origination.

2. Test setup for measuring power



Figure 1

3. Verification output Power Results

Hotspot exposure condition

Hotspot exposure condition		Output Power for data connection	
Wifi Status		ON	
Power state		WWAN DSI 3 WIFI status 3	
Wireless Technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)
WCDMA II	Ant 1	19.3	21.0
LTE Band 7	Ant 5	20.0	22.5
NR SA n2	Ant 1	19.6	21.5

Hotspot exposure condition		Output Power (data connection)			
		G-Sensor status			
Power state		WWAN Off (NoDBS,Set1)		WWAN On(NoDBS,Set5)	
Wireless technology	Antenna	Measured (dBm)	Target power(dBm)	Measured (dBm)	Target power(dBm)
802.11g 1Mbps CH6	(Ant6+7)Ant 6	17.4	18.0 ±1.5db	15.0	16.0 ±1.5db
	(Ant6+7)Ant 7	18.5	18.0 ±1.5db	16.3	16.0 ±1.5db
802.11a 6Mbps ,CH157	(Ant6+7)Ant 6	15.5	16.0 ±1.5db	12.5	14.0 ±1.5db
	(Ant6+7)Ant 7	17.0	16.0 ±1.5db	13.3	14.0 ±1.5db

Body worn exposure condition

Body worn exposure condition		Output Power for data connection			
Wifi Status		OFF		ON	
Power state		WWAN DSI 1 WIFI status 1		WWAN DSI 1 WIFI status 3	
Wireless Technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
WCDMA II	Ant 1	22.5	23.9	19.6	21.0
LTE Band 2	Ant 5	22.4	24.7	19.5	22.0
NR SA n2	Ant 1	21.6	23.9	19.6	21.6

Body worm exposure condition		Output Power (data connection)			
		G-Sensor status (No-DBS,Set2)			
Power state		WWAN Off		WWAN On	
Wireless technology	Antenna	Measured (dBm)	Target power(dBm)	Measured (dBm)	Target power(dBm)
802.11b 1Mbps CH6	(Ant6+7)Ant 6	17.5	17.5 ±1.5db	17.5	17.5 ±1.5db
	(Ant6+7)Ant 7	18.7	17.5 ±1.5db	18.6	17.5 ±1.5db
802.11a 6Mbps ,CH157	(Ant6+7)Ant 6	15.5	15.0±1.5db	15.4	15.0±1.5db
	(Ant6+7)Ant 7	15.8	15.0±1.5db	15.7	15.0±1.5db

Free Space exposure condition

Free Space exposure condition		Output Power for data connection			
Wifi Status		OFF		ON	
Power state		WWAN DSI 0 WIFI status 1		WWAN DSI 0 WIFI status 3	
Wireless Technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
LTE Band 2	Ant 1	24.0	25.7	24.1	25.7

4. Motion Time vs Power verification

- a) Body Detect mechanism will be performed for the in-hand and on a stationary object (placed on a table).
- b) Verify the functionality of the motion sensor by measuring the output power in the following steps.

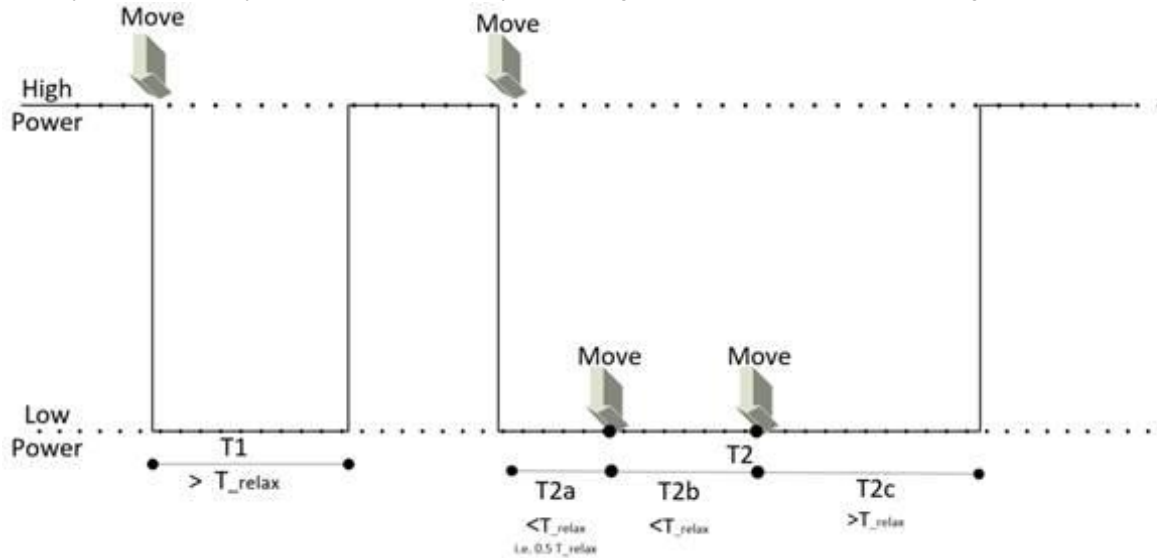


Figure 1 Illustration of the procedure for the validation of the power reduction

The device is embedded with motion sensors only, no proximity sensors are installed.

1. **Placed on a table:** Make the DUT transmit with the maximum output power by using a base station simulator.
 - a) Confirm that motion sensor is not triggered by letting the DUT remain stationary with no movements for the period T_{relax} for the motion sensor to reach stationary state.
 - b) Record P_{step1} (high power)
2. **In-hand:** Move the DUT to trigger the motion sensor. Apply the motion of the DUT with respect to movements in intended and reasonably foreseeable use conditions of the DUT.
 - c) Record P_{step2} (low power)
3. For the validation of T_{relax} , wait a time period $T_1 > T_{relax}$ and confirm DUT restores to high power (P_{step1}).
4. Move the DUT to trigger the motion sensor.
5. Move DUT within T_{relax} to ensure T_{relax} resets when DUT is in motion.
 DUT can be moved once or twice within T_{relax} , (after time periods T_{2a} and T_{2b} in Figure 1.) followed by waiting for a time period greater than T_{relax} (time period T_{2c} in Figure 1.) for DUT to restore high power. The total time duration of this step is T_2 , and the power during the whole period T_2 shall be reduced (low power – P_{step2}).

WLAN OFF

Exposure Condition		Output Power (data connection) (dBm)											
		Stationary Placed on a table		In hand		Stationary Placed on a table		In hand				Stationary Placed on a table	
Power state		Full Power P_{step1}		Low Power P_{step2}		Full Power $P_{\text{step1}} \& T_1 >$ T_{relax}		Low Power $P_{\text{step2}} \& T_{2a} <$ T_{relax}		Low Power $P_{\text{step2}} \& T_{2b} <$ T_{relax}		Full Power $P_{\text{step1}} \& T_{2c} >$ T_{relax}	
Wireless technology	Antenna	Measured	Max. Tune-up	Measured	Max. Tune-up	Measured	Max. Tune-up	Measured	Max. Tune-up	Measured	Max. Tune-up	Measured	Max. Tune-up
LTE Band 2	Ant 1	24.0	25.7	22.5	24.7	24.0	25.7	22.4	24.7	22.5	24.7	24.1	25.7

WLAN ON

Exposure Condition		Output Power (data connection) (dBm)											
		Stationary Placed on a table		In hand		Stationary Placed on a table		In hand				Stationary Placed on a table	
Power state		Full Power P_{step1}		Low Power P_{step2}		Full Power $P_{\text{step1}} \& T_1 >$ T_{relax}		Low Power $P_{\text{step2}} \& T_{2a} <$ T_{relax}		Low Power $P_{\text{step2}} \& T_{2b} <$ T_{relax}		Full Power $P_{\text{step1}} \& T_{2c} >$ T_{relax}	
Wireless technology	Antenna	Measured	Max. Tune-up	Measured	Max. Tune-up	Measured	Max. Tune-up	Measured	Max. Tune-up	Measured	Max. Tune-up	Measured	Max. Tune-up
LTE Band 2	Ant 1	24.2	25.7	19.5	22.0	24.1	25.7	19.6	22.0	19.5	22.0	24.1	25.7

Exposure Condition		Output Power (data connection) (dBm)											
		Stationary Placed on a table		In hand		Stationary Placed on a table		In hand				Stationary Placed on a table	
Power state		Full Power P_{step1}		Low Power P_{step2}		Full Power $P_{\text{step1}} \& T_1 >$ T_{relax}		Low Power $P_{\text{step2}} \& T_{2a} <$ T_{relax}		Low Power $P_{\text{step2}} \& T_{2b} <$ T_{relax}		Full Power $P_{\text{step1}} \& T_{2c} >$ T_{relax}	
Wireless technology	Antenna	Measured	Max. Tune-up	Measured	Max. Tune-up	Measured	Max. Tune-up	Measured	Max. Tune-up	Measured	Max. Tune-up	Measured	Max. Tune-up
802.11g 6Mbps ,CH6	(Ant6+7) Ant 6	18.9	19±1.5db	18.1	17.5±1.5db	19.1	19±1.5db	18.0	17.5±1.5db	18.0	17.5±1.5db	19.2	19±1.5db
	(Ant6+7) Ant 7	20.2	19±1.5db	18.0	17.5±1.5db	20.0	19±1.5db	19.0	17.5±1.5db	19.1	17.5±1.5db	20.0	19±1.5db

Exposure Condition		Output Power (data connection) (dBm)			
		Stationary Placed on a table (Display on and Hotspot off)		Stationary Placed on a table (Display off and Hotspot off)	
Power state		Full Power P_{step1}		Low Power P_{step1}	
Wireless technology	Antenna	Measured	Max. Tune-up	Measured	Max. Tune-up
802.11g 6Mbps ,CH6	(Ant6+7)Ant 6	19.0	19±1.5db	18.2	17.5±1.5db
	(Ant6+7)Ant 7	20.0	19±1.5db	18.8	17.5±1.5db
LTE Band 25	Ant 1	24.0	25.7	22.3	24.7