Appendix G. Supplemental SAR 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)	Antenna	Sample	Battery	Power State	Non-DBS / DBS	Ch.	Freq. (MHz)	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)
GSM1900_Ant 1	GPRS (4 Tx slots)	Back	25mm	-	Sample 1	Battery 1	DSI 0	-	661	1880	28.12	29.00	1.225	-	-	-0.04	0.136	0.167
WCDMA IV_Ant 1	RMC 12.2Kbps	Back	25mm	-	Sample 1	Battery 1	DSI 0	-	1513	1752.6	24.43	25.20	1.194	-	-	0.04	0.196	0.234
LTE Band 66_Ant 1	20M_QPSK_1_0	Back	25mm	-	Sample 1	Battery 1	DSI 0	-	132322	1745	24.21	25.20	1.256	-	-	0.17	0.181	0.227
FR1 n66_Ant 1	20M_BPSK_1_0	Back	25mm	-	Sample 1	Battery 1	DSI 0	-	344000	1720	24.16	25.20	1.271	-	-	-0.04	0.152	0.193
WLAN2.4GHz	802.11b 1Mbps	Back	25mm	Ant 6+7(6)	Sample 1	Battery 1	Power table 0	Non-DBS	1	2412	20.50	21.00	1.122	85.71	1.167	-0.04	0.271	0.355
WLAN5GHz	802.11ac-VHT80 MCS0	Right Side	25mm	Ant 6+7(7)	Sample 1	Battery 1	Power table 0	Non-DBS	155	5775	20.60	21.00	1.096	85.39	1.171	-0.12	0.654	0.840
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(7)	Sample 1	Battery 1	Power table 0	Non-DBS	111	6505	12.29	12.50	1.050	85.71	1.167	0.17	0.089	0.109

Appendix E. Supplemental SAR Tests Results

SAR test result

3. The test data is selected according to the worst case SAR configuration per cellular technology.
4. 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)	Sample	Battery	Power State	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
WCDMA IV_Ant 1	RMC 12.2Kbps	Back	25mm	Sample 1	Battery 1	DSI 0	1513	1752.6	24.44	25.20	1.191	-0.17	0.210	0.250

Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Gap (mm)	Sample	Battery	Power State	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
LTE Band 66_Ant 1	20M	QPSK	1	0	Back	25mm	Sample 1	Battery 1	DSI 0	132322	1745	24.10	25.20	1.288	-0.17	0.189	0.243
FR1 n66_Ant 1	20M	BPSK	50	28	Back	25mm	Sample 1	Battery 1	DSI 0	354000	1770	23.82	25.20	1.374	-0.08	0.181	0.249

Band	Mode	Test Position	Gap (mm)	Antenna	Sample	Buttery	Power Status	Non-DBS / DBS	Ch.	Freq. (MHz)	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	Back	25mm	Ant 6+7(6)	Sample 1	Battery 1	Power table 0	Non-DBS	1	2412	20.20	21.00	1.202	85.84	1.165	-0.08	0.262	0.367
WLAN5GHz	802.11ac-VHT80 MCS0	Right Side	25mm	Ant 6+7(6)	Sample 1	Battery 1	Power table 0	Non-DBS	155	5775	20.40	21.00	1.148	86.15	1.161	-0.08	1.030	1.373
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(7)	Sample 1	Battery 1	Power table 0	Non-DBS	111	6505	12.10	12.50	1.096	85.76	1.166	-0.01	0.079	0.101
WLAN6GHz	802.11ax-HE160 MCS0	Right Side	25mm	Ant 6+7(6)	Sample 1	Battery 1	Power table 0	Non-DBS	15	6025	15.10	15.50	1.096	85.76	1.166	0.19	0.071	0.091

Appendix G. 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 voice call and audio routed through the earpiece to monitor output power under head with simultaneous transmitting power states for GSM/UMST/LTE/FR1/WiFi
- 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

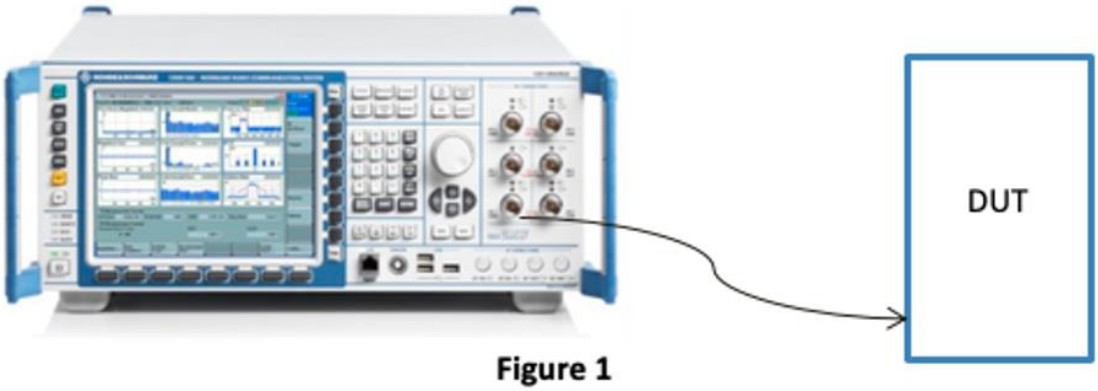

Figure 1

3. Verification output Power Results

Head exposure condition

Head exposure condition		Output Power for data connection			
Wifi Status		OFF		ON	
Power state		WWAN DSI 2 WIFI status 1		WWAN DSI 2 WIFI status 3	
Wireless Technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
GSM	Ant 1	27.38	27.7	25.54	25.9
NR SA n77	Ant 8	22.7	23.6	21.66	21.8

Head exposure condition		Output Power (data connection)			
		G-Sensor status			
Power state		WWAN Off		WWAN On	
Wireless technology	Antenna	Measured (dBm)	Target power(dBm)	Measured (dBm)	Target power(dBm)
802.11n-HT40 ,CH110	(Ant6+7)Ant 6	17.1	17 ±1.5db	17.2	17 ±1.5db
	(Ant6+7)Ant 7	17.0	17 ±1.5db	17.1	17 ±1.5db

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)
GSM	Ant 1	23.44	24.7
WCDMA IV	Ant 1	20.25	21.7
LTE Band Band66	Ant 1	21.28	21.7
NR SA n66	Ant 1	21.14	21.6
NR SA n77	Ant 8	20.21	21.5

Hotspot exposure condition		Output Power (data connection)			
		G-Sensor status			
Power state		WWAN Off		WWAN On	
Wireless technology	Antenna	Measured (dBm)	Target power(dBm)	Measured (dBm)	Target power(dBm)
802.11n-HT40 ,CH159	(Ant6+7)Ant 6	13.9	14.5 ±1.5db	13.9	14.5 ±1.5db
	(Ant6+7)Ant 7	13.8	14.5 ±1.5db	13.7	14.5 ±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)
GSM	Ant 1	26.12	27.8	26.12	27.8
WCDMA IV	Ant 1	24.32	25	22.27	23.2
LTE Band Band 7	Ant 5	21.99	22.5	21.98	22.5
NR SA n66	Ant 1	23.38	24	21.75	22.3
NR SA n77	Ant 8	21.62	22.9	21.6	22.9

Body worm exposure condition		Output Power (data connection)			
		G-Sensor status			
Power state		WWAN Off		WWAN On	
Wireless technology	Antenna	Measured (dBm)	Target power(dBm)	Measured (dBm)	Target power(dBm)
802.11n-HT40 ,CH110	(Ant6+7)Ant 6	16.9	17±1.5db	17.1	17±1.5db
	(Ant6+7)Ant 7	16.5	17±1.5db	17.2	17±1.5db
802.11ax-HE160 UNII5 ,CH47	(Ant6+7)Ant 6	7.18	8±1.5db	7.15	8±1.5db
	(Ant6+7)Ant 7	7.15	8±1.5db	7.16	8±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 CTL		WWAN DSI 0 WIFI status CTL	
Wireless Technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)
NR SA n77	Ant 8	22.82	24	22.81	24

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.

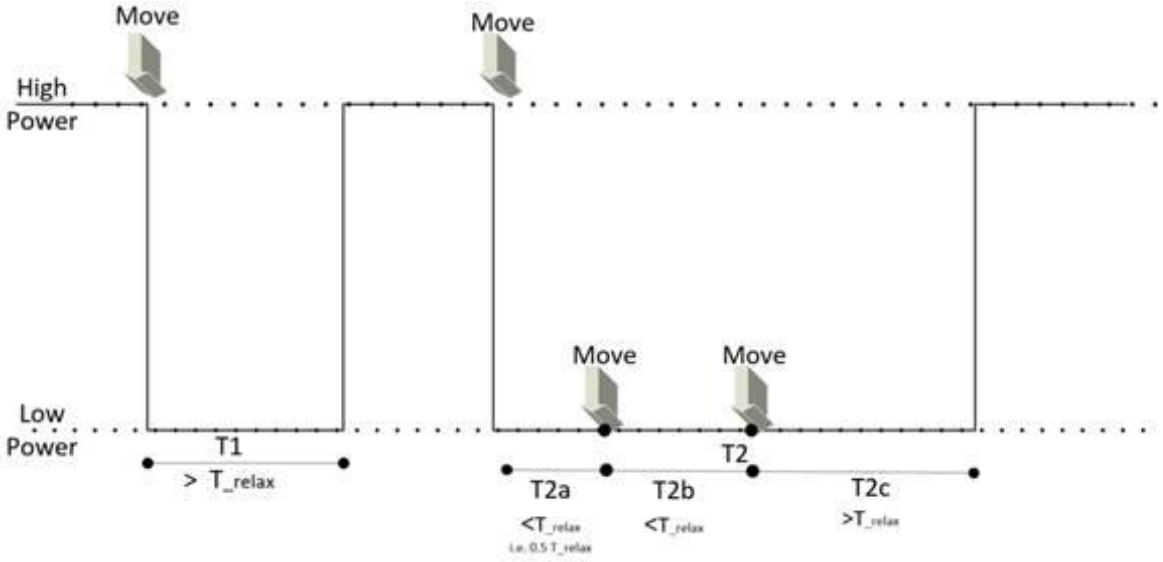

Figure 1 Illustration of the procedure for the validation of the power reduction

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.

a) 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_{step1} & $T_1 > T_{relax}$		Low Power P_{step2} & $T_{2a} < T_{relax}$		Low Power P_{step2} & $T_{2b} < T_{relax}$		Full Power P_{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
GSM	Ant 1	28.01	29.0	26.18	27.8	27.98	29.0	26.15	27.8	26.11	27.8	28.01	29.0
WCDMA IV	Ant 1	24.23	25.2	24.16	25	24.13	25.2	24.23	25	24.06	25	24.18	25.2
LTE Band Band 7	Ant 5	23.99	25.2	21.91	22.5	24.01	25.2	21.89	22.5	21.92	22.5	24.02	25.2
FR1 n77	Ant 8	22.86	24.0	21.68	22.9	22.89	24.0	21.64	22.9	21.65	22.9	22.84	24.0

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_{step1} & $T_1 > T_{relax}$		Low Power P_{step2} & $T_{2a} < T_{relax}$		Low Power P_{step2} & $T_{2b} < T_{relax}$		Full Power P_{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
GSM	Ant 1	28.01	29.0	26.15	27.8	27.99	29.0	26.14	27.8	26.18	27.8	28.03	29.0
WCDMA IV	Ant 1	24.23	25.2	22.29	23.2	24.21	25.2	21.3	23.2	21.35	23.2	24.2	25.2
LTE Band Band 7	Ant 5	23.98	25.2	21.95	22.5	24.02	25.2	21.94	22.5	21.9	22.5	24.01	25.2
FR1 n77	Ant 8	22.88	24.0	21.61	22.9	22.85	24.0	21.64	22.9	21.66	22.9	22.89	24.0

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_{step1} & $T_1 > T_{relax}$		Low Power P_{step2} & $T_{2a} < T_{relax}$		Low Power P_{step2} & $T_{2b} < T_{relax}$		Full Power P_{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
WLAN5G AC80_CH159	(Ant6+7)Ant 6	19.1	19.5± 1.5db	17.02	17.5± 1.5db	18.95	19.5± 1.5db	17.11	17.5± 1.5db	17.14	17.5± 1.5db	19.0	19.5± 1.5db
	(Ant6+7)Ant 7	19.2	19.5± 1.5db	17.1	17.5± 1.5db	18.96	19.5± 1.5db	17.16	17.5± 1.5db	17.13	17.5± 1.5db	19.03	19.5± 1.5db