Appendix E. Power reduction mechanism verification

1. Power verification introduction

- This device supports the manufacturer's proprietary power reduction mechanisms for cellular and Wi-Fi transmitters. Further details of the specific mechanisms for the power reduction mechanism can be found in the Operational Description
- Demonstration of proper functioning of the detection and triggering mechanisms to support the corresponding RF exposure conditions, the verification plan consists of measuring the power levels of the cellular and Wi-Fi transmitters at each wireless technology under different operating conditions related to the power reduction mechanisms.
- This device incorporates the WWAN TAS algorithm feature and through under varying Tx power transmission scenarios in real-time to maintain the time-averaged Tx power compliant with FCC 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 WWAN real-time TX power varying was disabled and keep in static output power for power reduction mechanism validation.
- For testing purposes, the device was measured against each Index supported for the cellular and Wi-Fi technologies. The target power level and measured power levels are detailed in the following table and clearly shows that each power reduction mechanism operates as expected.

2. Power verification procedure

- The verification is through a base station simulator is used to establish a conducted RF connection and record output power under different operating conditions related to the power reduction mechanisms.
- Verification of power reduction levels for Wi-Fi is performed with cellular transmitters on and off, for cellular is performed with Wi-Fi transmitters on and off.
- Verification of RCV mechanism is via establish voice call and audio routed through the earpiece to record output power under head power states.
- Verification of Hotspot power reduction is via establish data connection and enable hotspot feature to record output power under hotspot power state.
- Verification of Body Detector mechanism is via establish data connection to record output power under body worn power state.
 - > On a stationary object (placed on a table)
 - In-hand or on knee
 - > Body detect and monitor period validation



3. Test setup for conducted power measurement



Figure 1



4. Verification output Power Results

Head exposure conditions

Head Exposure condition		Output Power for Voice Call							
Ear acoustic output Status:		C	N	ON					
WiFi Status:		0	FF	ON					
Power state		WWAN	I Index 2	WWAN Index 3					
Wireless technology	Antenna	Measured (dBm) Max. Tune-up (dBm)		Measured (dBm)	Max. Tune-up (dBm)				
	Ant 2	23.80	25.70	22.80	24.70				
UNITS Dallu 4	Ant 0	23.90	25.20	23.92	25.20				
LTE Band 2 (FDD)	Ant 2	23.05	25.00	22.93	24.90				
	Ant 0	23.16	24.50	23.15	24.50				
LTE Band 66 (FDD)	Ant 2	24.44	25.70	24.09	25.30				
	Ant 0	24.04	25.20	24.03	25.20				
NR SA n66	Ant 2	24.66	25.70	24.49	25.50				
	Ant 0	24.18	25.20	24.18	25.20				

Head Exposure co	ondition	Output Power for Voice Call						
Ear acoustic output	t Status:	ON		ON				
WWAN Statu	IS:	OFF	:	ON				
Power state	;	WIFI Ind	ex 1	WIFI Index 3				
Wireless technology	Antenna	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)			
	(Ant4+3)Ant 4	13.44	15.00	9.51	10.00			
CH6	(Ant4+3)Ant 3	14.30	15.00	9.55	10.00			
WiFi 802.11a 6Mbps	(Ant4+3)Ant 4	11.82	13.50	6.45	9.00			
CH157	(Ant4+3)Ant 3	11.54	13.50	6.61	9.00			

Hotspot exposure condition

Hotspot exposure	Output Power for data connection						
Wifi Hotspot		ON	OFF				
BT Hotspot S	Status	(DFF	ON			
Power state		WWAI WIFI	N Index 4 Index 7	WWAN Index 4 WIFI Index 7			
Wireless	Antonno	Measured	Max Tupo up (dBm)	Measured	Max. Tune-up		
Technology	Antenna	(dBm)	Max. Tune-up (ubin)	(dBm)	(dBm)		
LIMTS Pond 2	Ant 2	19.85	21.70	19.86	21.70		
UNITS Dariu Z	Ant 0	21.30	23.10	21.30	23.10		
	Ant 2	20.22	21.90	20.23	21.90		
LIE Band 2 (FDD)	Ant 0	21.04	22.00	21.02	22.00		
	Ant 2	20.97	22.40	20.98	22.40		
LIE Band 66 (FDD)	Ant 0	23.01	23.40	22.99	23.40		
	Ant 2	20.61	21.80	20.62	21.80		
NR SA IIZ	Ant 0	20.68	22.00	20.66	22.00		
	(Ant4+3)Ant 4	13.61	15.00				
WIFI 802. TIG CH6	(Ant4+3)Ant 3	14.50	15.00				
WiFi 802.11a	(Ant4+3)Ant 4	16.25	18.00				
UNII ,CH157	(Ant4+3)Ant 3	15.57	18.00				



Body worn exposure condition

Rody Worn expensive condition		Output Power (data connection)									
Body worn expos	Sure condition	Statio	onary		Body Worr	m (In hand)					
WIFI/BT Status		OI	FF	O	FF	ON					
Power state		WWAN	Index 1	WWAN	Index 5	WWAN	WWAN Index 6				
Wireless Technology	Antenna Measured Max. Tune-up (dBm) (dBm)		Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)	Measured (dBm)	Max. Tune-up (dBm)				
	Ant 2	23.79	25.00	19.89	21.70	19.88	21.70				
UMIS Dand 2	Ant 0	22.81	24.50	22.37	23.80	21.75	23.10				
	Ant 2	23.46	25.00	20.29	21.90	20.27	21.90				
LIE Dallu Z (FDD)	Ant 0	23.17	24.50	22.50	23.50	20.93	22.00				
LTE Band 66	Ant 2	24.23	25.70	20.95	22.40	20.98	22.40				
(FDD)	Ant 0	24.11	25.20	23.89	24.70	22.85	23.40				
	Ant 2	23.73	25.00	21.23	22.50	20.58	21.80				
NR SA n2	Ant 0	23.15	24.50	22.39	23.70	20.66	22.00				

Body Worn exposure condition		Output Power (data connection)									
		Statio	onary	In hand							
WWAN Status:		OI	F	OFF		ON					
Power state		WIFI II	ndex 0	WIFI I	ndex 5	WIFI Ir	ndex 7				
Wireless technology	Antenna	Measured	Max. Tune-up	Measured	Max. Tune-up	Measured	Max. Tune-up (dBm)				
		(dBm)	(dBm)	(dBm)	(dBm)	(dBm)					
WiFi 802.11g CH6	(Ant4+3)Ant 4	18.51	21.50	18.33	20.50	14.45	15.00				
	(Ant4+3)Ant 3	18.73	21.50	18.68	20.50	14.74	15.00				
WiFi 802.11a UNII ,CH157	(Ant4+3)Ant 4	17.52	20.00	17.48	20.00	16.21	18.00				
	(Ant4+3)Ant 3	16.89	20.00	16.88	20.00	15.15	18.00				
WiFi 802.11a UNII ,CH173	(Ant4+3)Ant 4	17.32	20.00	17.29	19.50	17.10	19.50				
	(Ant4+3)Ant 3	16.57	20.00	16.56	19.50	16.42	19.50				



- Body Detect mechanism will be performed for the in-hand and on a stationary object (placed on a table). a) 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

- Placed on a table: Make the DUT transmit with the maximum output power by using a base station simulator. 1. Confirm that motion sensor is not triggered by letting the DUT remain stationary with no movements for a) the period T_{relax} for the motion sensor to reach stationary state.
 - Record Pstep1 (high power) b)
- In-hand: Move the DUT to trigger the motion sensor. Apply the motion of the DUT with respect to movements in 2. intended and reasonably foreseeable use conditions of the DUT.
 - c) Record P_{step2} (low power)
- For the validation of T_{relax} , wait a time period $T_1 > T_{relax}$ and confirm DUT restores to high power (P_{step1}). 3.
- 4. Move the DUT to trigger the motion sensor.
- Move DUT within T_{relax} to ensure T_{relax} resets when DUT is in motion. 5.

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}). Trelax: 20 sec

Monitor period, T₁: 25 sec, T_{2a}: 15 sec, T_{2b}:15 sec, T_{2c}: 25 sec

Exposure Condition		Output Power (data connection) (dBm)											
		Station Placed on	ary a table	e In hand		Stationary Placed on a table		In hand				Statior Placed on	nary a table
Power state		Full Po P _{step}	wer o1	Low Power P _{step2}		Full Power P _{step1} & T ₁ > P _s 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
LTE Band 2	Ant 2	23.39	25.00	20.25	21.90	23.37	25.00	20.28	21.90	20.27	21.90	23.38	25.00
WLAN2.4GHz	Ant 4+3 (4)	18.51	21.50	14.45	15.00	18.51	21.50	14.45	15.00	14.45	15.00	18.51	21.50
	Ant 4+3 (3)	18.73	21.50	14.74	15.00	18.73	21.50	14.74	15.00	14.74	15.00	18.73	21.50