

RF Exposure Report

(Part 0: SAR and PD Char Evaluation)

FCC ID : IHDT56AX5
Equipment : Mobile Cellular Phone
Brand Name : Motorola
Model Name : XT2651V
Applicant : Motorola Mobility LLC
222 W,Merchandise Mart Plaza, Chicago IL 60654 USA
Manufacturer : Motorola Mobility LLC
222 W, Merchandise Mart Plaza, Chicago IL 60654 USA
Standard : FCC 47 CFR Part 2 (2.1093)

The product was received on Jun. 17, 2025 and testing was started from Jun. 30, 2026 and completed on Jul. 04, 2026. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.



Approved by: Cona Huang / Deputy Manager

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History of this test report

Report No.	Version	Description	Issued Date
FA660814C	01	Initial issue of report	Aug. 05, 2026

1. Introduction

The Qualcomm® Smart Transmit™ Plus of Smart Transmit (GEN2) Feature operates based on pre-defined sub6 antenna groups (AG). This Device is enabled with the Qualcomm® Smart Transmit Gen2 feature. The FCC RF exposure limit is defined based on time-averaged RF exposure. The product implements Qualcomm Smart Transmit feature which controls the instantaneous transmitting power for WWAN and WLAN/BT transmitter to ensure the product in compliance with FCC RF exposure limit over a defined time window, for SAR (transmit frequency $\leq 6\text{GHz}$) and power density (transmit frequency $> 6\text{GHz}$). to control and manage transmitting power in real time and to ensure at all times the time-averaged RF exposure is compliant to the regulation requirement. Cannot operate without SAR and PD characterization at the device level, beforehand.

This report describes the procedures for the SAR char and PD char generation, and the parameters obtained from SAR and PD characterization (referred to as SAR char and PD char, respectively) will be used as input for Smart Transmit. Both SAR char and PD char will be entered via the Embedded File System (EFS) version 24 to enable the Smart Transmit GEN2 Feature.

Terminologies in this report

P_{limit}	The time-averaged RF power which corresponds to SAR_design_target.
P_{max}	Maximum target power level
SAR_design_target:	The design target for SAR compliance. It should be less than regulatory power density limit to account for all device design related uncertainties.
SAR char	P_{limit} for all the technologies/bands for all applicable DSI
PD_design_target:	The design target for PD compliance. It should be less than regulatory power density limit to account for all device design related uncertainties.
input.power.limit	For a PD characterized wireless device, the input power level at antenna port(s) for each beam corresponding to PD_design_target.
PD char	The table that contains input.power.limit fed to antenna port(s) for all supported beams.



2. Product Description

Product Feature & Specification	
Equipment Name	Mobile Cellular Phone
FCC ID	IHDT56AX5
Wireless Technology and Frequency Range	GSM850: 824 MHz ~ 849 MHz GSM1900: 1850 MHz ~ 1910 MHz WCDMA Band II: 1850 MHz ~ 1910 MHz WCDMA Band IV: 1710 MHz ~ 1755 MHz WCDMA Band V: 824 MHz ~ 849 MHz LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 5: 824 MHz ~ 849 MHz LTE Band 7: 2500 MHz ~ 2570 MHz LTE Band 12: 699 MHz ~ 716 MHz LTE Band 13: 777 MHz ~ 787 MHz LTE Band 14: 788 MHz ~ 798 MHz LTE Band 17: 704 MHz ~ 716 MHz LTE Band 25: 1850 MHz ~ 1915 MHz LTE Band 26: 814 MHz ~ 849 MHz LTE Band 38: 2570 MHz ~ 2620 MHz LTE Band 41: 2496 MHz ~ 2690 MHz LTE Band 42: 3450 MHz ~ 3600 MHz LTE Band 43: 3600 MHz ~ 3700 MHz LTE Band 48: 3550 MHz ~ 3700 MHz LTE Band 66: 1710 MHz ~ 1780 MHz LTE Band 71: 663 MHz ~ 698 MHz 5G NR n2: 1850 MHz ~ 1910 MHz 5G NR n5: 824 MHz ~ 849 MHz 5G NR n7: 2500 MHz ~ 2570 MHz 5G NR n12: 699 MHz ~ 716 MHz 5G NR n13: 777 MHz ~ 787 MHz 5G NR n14: 788 MHz ~ 798 MHz 5G NR n25: 1850 MHz ~ 1915 MHz 5G NR n26: 814 MHz ~ 849 MHz 5G NR n38: 2570 MHz ~ 2620 MHz 5G NR n41: 2496 MHz ~ 2690 MHz 5G NR n48: 3550 MHz ~ 3700 MHz 5G NR n66: 1710 MHz ~ 1780 MHz 5G NR n71: 663 MHz ~ 698 MHz 5G NR n77: 3700 MHz ~ 3980 MHz, 3450MHz ~ 3550MHz 5G NR n78: 3700 MHz ~ 3800 MHz, 3450MHz ~ 3550MHz 5G NR n260: 37 GHz~40 GHz 5G NR n261: 27.5 GHz~28.35 GHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5720 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz WLAN 6GHz U-NII 5: 5925 MHz ~ 6425 MHz WLAN 6GHz U-NII 6: 6425 MHz ~ 6525 MHz WLAN 6GHz U-NII 7: 6525 MHz ~ 6875 MHz WLAN 6GHz U-NII 8: 6875 MHz ~ 7125 MHz Bluetooth: 2402 MHz ~ 2480 MHz NFC: 13.56 MHz WPT: 110 KHz ~ 145 KHz UWB: 6489.6 MHz & 7987.2 MHz
Mode	GSM/GPRS/EGPRS RMC/AMR 12.2Kbps HSDPA/HSUPA DC-HSDPA HSPA+ (16QAM uplink is not supported) LTE: QPSK, 16QAM, 64QAM, 256QAM 5G NR: DFT-s-OFDM/CP-OFDM, Pi/2 BPSK/QPSK/16QAM/64QAM/256QAM WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 2.4GHz 802.11ax/be HE20/HE40/EHT20/EHT40 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac VHT20/VHT40/VHT80/VHT160 WLAN 5GHz 802.11ax HE20/HE40/HE80/HE160 WLAN 5GHz 802.11be EHT20/EHT40/EHT80/EHT160

WLAN 6GHz 802.11a/ax HE20/HE40/HE80/HE160
WLAN 6GHz 802.11be EHT20/EHT40/EHT80/EHT160/EHT320
Bluetooth BR/EDR/LE / CS GFSK/ CS ASK
NFC: ASK
WPT: ASK
UWB: BPM-BPSK

Reviewed by: **Jason Wang**

Report Producer: **Carlie Tsai**

3. SAR Characterization

SAR char must be generated to cover all radio configurations and usage scenarios that the wireless device supports for operating at WWAN and WLAN/BT bands. It will then be used as input for Smart Transmit to control and manage RF exposure for WWAN and WLAN/BT bands.

3.1 SAR design target and uncertainty

Trigger condition

Exposure Condition	DSI	EUT Flip State	Trigger conditions
Head	DSI 2	Flip Close	Earpiece On
Body worn	DSI 3	Flip Close	Sensor On
Body	DSI 12	Flip Open	Sensor On
Extremity	DSI 6	Flip Close	Sensor On
Hotspot	DSI 7	Flip Close	Hotspot on
Body/ Body Worn / Extremity / Sensor Off	DSI 4	Flip Open/Flip Close	Sensor Off

SAR design target

Exposure Condition	Measure Distance	SAR (W/kg)
		WWAN
Body Worn (1g)	5 mm	1.03
Hotspot (1g)	5 mm	1.03
Head (1g)	touch&tilt 15deg	1.03
Extremity (10g)	0 mm	2.55
Body (1g)	0 mm	1.03

Exposure Condition	Measure Distance	SAR (W/kg)	
		WLAN 2.4GHz/BT	WLAN 5G/6GHz
Body Worn (1g)	5 mm	0.91	0.76
Hotspot (1g)	5 mm	0.91	0.76
Head (1g)	touch&tilt 15deg	0.91	0.76
Extremity (10g)	0 mm	2.27	2.02
Body (1g)	0 mm	0.91	0.76

	Uncertainty dB (k=2)
Device to device uncertainty	1.2
TXAGC uncertainty	1.0
Total uncertainty	1.5

To account for total uncertainty, SAR_design_target should be determined as:

$$SAR_{design_target} < SAR_{regulatory_limit} \times 10^{\frac{-total\ uncertainty}{10}}$$

3.2 SAR Char Table

SAR char must be generated to cover all radio configurations and usage scenarios that the wireless device supports for operating at WWAN and WLAN/BT bands. It will then be used as input for Smart Transmit to control and manage RF exposure for WWAN and WLAN/BT bands.

<P_{limit} for supported technologies and bands (P_{limit} in EFS file)>

Band	Antenna	Head DSI2	Body worn DSI3	Extremity DSI6	Hotspot DSI7	Body DSI12	Sensor off DSI4	Pmax*
GSM850	Ant 0	33.8	26.2	24.7	26.2	18.4	24.0	24.7
GSM850	Ant 1	31.9	21.6	21.6	21.6	21.6	21.6	24.7
GSM1900	Ant 3	22.1	18.4	24.3	18.1	15.0	21.2	21.2
GSM1900	Ant 4	24.8	23.4	19.7	19.7	15.0	19.7	19.7
WCDMA II	Ant 3	20.7	18.2	21.5	18.2	14.6	23.0	23.0
WCDMA II	Ant 4	25.6	21.7	23.8	21.7	15.0	23.0	23.0
WCDMA IV	Ant 3	19.0	19.9	20.0	19.0	14.1	23.0	23.0
WCDMA IV	Ant 4	24.1	21.2	23.0	21.2	15.0	23.0	23.0
WCDMA V	Ant 0	31.7	23.1	26.7	23.1	21.8	23.0	23.0
WCDMA V	Ant 1	29.1	20.5	20.5	20.5	20.5	20.5	23.0
LTE Band 7	Ant 3	16.7	17.1	20.7	16.2	12.6	23.0	23.0
LTE Band 7	Ant 2	33.8	20.9	22.1	20.9	13.6	23.0	23.0
LTE Band 7	Ant 4	25.1	19.0	21.0	18.7	12.9	22.0	22.0
LTE Band 7	Ant 0	31.4	23.3	23.4	20.8	13.9	23.0	23.0
LTE Band 12(17)	Ant 0	31.9	24.3	23.0	23.4	19.3	23.0	23.0
LTE Band 12(17)	Ant 1	30.0	20.7	20.7	20.7	20.7	20.7	23.0
LTE Band 13	Ant 0	32.4	24.0	23.0	23.6	19.8	23.0	23.0
LTE Band 13	Ant 1	30.3	20.4	20.4	20.4	20.4	20.4	23.0
LTE Band 14	Ant 0	32.4	23.9	23.0	23.9	21.2	23.0	23.0
LTE Band 14	Ant 1	29.8	20.6	20.6	20.6	20.6	20.6	23.0
LTE Band 25(2)	Ant 3	21.0	18.8	23.0	18.4	15.3	23.0	23.0
LTE Band 25(2)	Ant 2	34.3	19.8	21.8	19.1	14.9	23.0	23.0
LTE Band 25(2)	Ant 4	22.9	22.0	23.6	22.0	15.7	22.0	22.0
LTE Band 25(2)	Ant 0	45.1	21.7	21.9	20.8	16.5	22.0	22.0
LTE Band 26(5)	Ant 0	31.2	23.1	25.9	23.1	20.6	23.0	23.0
LTE Band 26(5)	Ant 1	29.5	20.4	20.4	23.3	20.4	20.4	23.0
LTE Band 66(4)	Ant 3	20.5	18.1	21.6	18.1	14.9	23.0	23.0
LTE Band 66(4)	Ant 2	34.8	20.0	21.8	18.7	14.6	23.0	23.0
LTE Band 66(4)	Ant 4	23.5	21.8	23.1	21.8	15.5	22.0	22.0
LTE Band 66(4)	Ant 0	42.7	19.8	22.7	18.6	17.1	22.0	22.0
LTE Band 71	Ant 0	32.7	25.4	23.0	23.8	20.2	23.0	23.0
LTE Band 71	Ant 1	31.1	19.8	19.8	19.8	19.8	19.8	23.0
LTE Band 41(38) PC3	Ant 3	15.6	17.3	20.7	15.6	12.3	21.0	21.0
LTE Band 41 PC2	Ant 3	15.6	17.3	20.7	15.6	12.3	22.4	22.4
LTE Band 41(38) PC3	Ant 2	33.4	19.4	21.0	19.0	12.7	22.4	21.0
LTE Band 41 PC2	Ant 2	33.4	19.4	21.0	19.0	12.7	22.4	22.4



LTE Band 41(38) PC3	Ant 4	24.1	18.5	20.8	18.5	13.1	20.0	20.0
LTE Band 41 PC2	Ant 4	24.1	18.5	20.8	18.5	13.1	21.4	21.4
LTE Band 41(38) PC3	Ant 0	32.9	20.9	25.2	20.6	13.2	22.4	21.0
LTE Band 41 PC2	Ant 0	32.9	20.9	25.2	20.6	13.2	22.4	22.4
LTE Band 42 Part 27Q	Ant 2	30.5	17.5	19.0	16.3	12.8	19.0	19.0
LTE Band 42 Part 96	Ant 2	30.5	17.5	19.0	16.3	12.8	19.0	19.0
LTE Band 42 Part 27Q	Ant 4	26.0	21.5	22.1	21.5	14.0	21.0	21.0
LTE Band 42 Part 96	Ant 4	26.0	21.5	22.1	21.5	14.0	21.0	21.0
LTE Band 42 Part 27Q	Ant 6	22.8	18.5	20.3	18.5	14.1	20.0	20.0
LTE Band 42 Part 96	Ant 6	22.8	18.5	20.3	18.5	14.1	20.0	20.0
LTE Band 42 Part 27Q	Ant 8	20.0	17.9	19.7	17.7	10.2	21.0	21.0
LTE Band 42 Part 96	Ant 8	20.0	17.9	19.7	17.7	10.2	21.0	21.0
LTE Band 43 Part 96	Ant 2	30.5	17.0	19.0	16.2	11.5	19.0	19.0
LTE Band 48_Part 96	Ant 2	30.5	17.7	19.0	17.0	12.4	19.0	19.0
LTE Band 48(43)_Part 96	Ant 4	26.0	21.5	22.1	21.5	15.7	21.0	21.0
LTE Band 48(43)_Part 96	Ant 6	22.8	18.5	20.3	18.5	14.1	20.0	20.0
LTE Band 48(43)_Part 96	Ant 8	20.0	18.1	19.9	18.1	10.2	21.0	21.0
FR1 n7	Ant 3	15.7	17.4	24.9	15.7	12.5	22.5	23.0
FR1 n7	Ant 2	34.8	18.9	21.2	18.9	13.3	23.0	23.0
FR1 n7	Ant 4	29.0	19.8	23.2	19.8	14.3	22.0	22.0
FR1 n7	Ant 0	32.4	23.3	23.7	21.1	14.9	23.0	23.0
FR1 n12	Ant 0	33.3	26.3	23.0	24.6	21.2	23.0	23.0
FR1 n12	Ant 1	31.7	19.6	19.6	19.6	19.6	19.6	23.0
FR1 n13	Ant 0	33.9	25.6	23.0	27.4	21.5	23.0	23.0
FR1 n13	Ant 1	35.4	20.8	20.8	20.8	20.8	20.8	23.0
FR1 n14	Ant 0	33.5	25.2	23.0	25.2	20.7	23.0	23.0
FR1 n14	Ant 1	31.5	20.4	20.4	20.4	20.4	20.4	23.0
FR1 n25(2)	Ant 3	20.4	18.5	22.4	17.9	15.0	23.0	23.0
FR1 n25(2)	Ant 2	36.3	19.2	21.6	18.9	13.8	23.0	23.0
FR1 n26(5)	Ant 0	32.7	24.6	23.0	24.6	20.4	23.0	23.0
FR1 n26(5)	Ant 1	31.4	19.8	19.8	19.8	19.8	19.8	23.0
FR1 n66	Ant 3	19.7	18.8	22.2	17.8	13.4	23.0	23.0
FR1 n66	Ant 2	36.1	19.9	22.2	19.1	14.1	23.0	23.0
FR1 n71	Ant 0	33.7	26.9	23.0	25.2	22.0	23.0	23.0
FR1 n71	Ant 1	32.2	20.0	20.0	20.0	20.0	20.0	23.0
FR1 n41(38) PC3	Ant 3	15.4	17.2	20.0	15.4	12.5	22.5	23.0
FR1 n41 PC2	Ant 3	15.4	17.2	20.0	15.4	12.5	22.5	23.0
FR1 n41(38) PC3	Ant 2	34.1	18.8	20.8	19.0	11.8	23.0	23.0
FR1 n41 PC2	Ant 2	34.1	18.8	20.8	19.0	11.8	23.0	23.0
FR1 n41(38) PC3	Ant 4	27.5	20.6	20.7	20.2	15.0	22.0	22.0
FR1 n41 PC2	Ant 4	27.5	20.6	20.7	20.2	15.0	22.0	22.0
FR1 n41(38) PC3	Ant 0	30.8	23.8	24.3	21.7	19.4	23.0	23.0
FR1 n41 PC2	Ant 0	30.8	23.8	24.3	21.7	19.4	23.0	23.0
FR1 n48_Part 96	Ant 2	35.3	18.5	21.5	18.4	10.1	23.0	23.0
FR1 n48_Part 96	Ant 4	27.3	20.8	22.0	20.7	13.5	23.0	23.0
FR1 n48_Part 96	Ant 6	27.4	23.0	25.7	21.7	16.5	23.0	23.0
FR1 n48_Part 96	Ant 8	21.5	17.6	19.2	17.2	9.5	23.0	23.0
FR1 n77(78) Part 27Q PC3	Ant 2	33.2	18.5	20.9	17.4	10.4	23.0	23.0
FR1 n77(78) Part 27Q PC2	Ant 2	33.2	18.5	20.9	17.4	10.4	23.0	23.0
FR1 n77(78) Part 27O PC3	Ant 2	33.2	18.5	20.9	17.4	10.4	23.0	23.0
FR1 n77(78) Part 27O PC2	Ant 2	33.2	18.5	20.9	17.4	10.4	23.0	23.0
FR1 n77(78) Part 27Q PC3	Ant 4	32.7	18.9	23.0	18.9	13.8	23.0	23.0
FR1 n77(78) Part 27Q PC2	Ant 4	32.7	18.9	23.0	18.9	13.8	23.0	23.0
FR1 n77(78) Part 27O PC3	Ant 4	32.7	18.9	23.0	18.9	13.8	23.0	23.0
FR1 n77(78) Part 27O PC2	Ant 4	32.7	18.9	23.0	18.9	13.8	23.0	23.0
FR1 n77(78) Part 27Q PC3	Ant 6	26.3	21.4	24.3	21.4	14.0	23.0	23.0



FR1 n77(78) Part 27Q PC2	Ant 6	26.3	21.4	24.3	21.4	14.0	23.0	23.0
FR1 n77(78) Part 27O PC3	Ant 6	26.3	21.4	24.3	21.4	14.0	23.0	23.0
FR1 n77(78) Part 27O PC2	Ant 6	26.3	21.4	24.3	21.4	14.0	23.0	23.0
FR1 n77(78) Part 27Q PC3	Ant 8	20.2	17.9	18.9	17.4	10.2	23.0	23.0
FR1 n77(78) Part 27Q PC2	Ant 8	20.2	17.9	18.9	17.4	10.2	23.0	23.0
FR1 n77(78) Part 27O PC3	Ant 8	20.2	17.9	18.9	17.4	10.2	23.0	23.0
FR1 n77(78) Part 27O PC2	Ant 8	20.2	17.9	18.9	17.4	10.2	23.0	23.0
Bluetooth	Ant 7	29.9	26.4	17.9	26.4	14.3	17.9	17.9
Bluetooth	Ant 11	35.2	24.9	18.3	24.9	15.8	18.3	18.3
WLAN2.4G	Ant7	21.0	19.8	21.0	21.0	14.0	21.0	21.0
WLAN2.4G	Ant11	21.0	19.8	21.0	21.0	14.0	21.0	21.0
WLAN2.4G	Ant7+11	21,21	19.8,19.8	21,21	21,21	14,14	21,21	24.0
WLAN5.2G	Ant6	23.0	16.0	16.5	17.5	8.0	16.5	19.0
WLAN5.2G	Ant1	23.0	16.0	16.5	18.0	8.0	16.5	19.5
WLAN5.2G	Ant6+1	23,23	16,16	16.5,16.5	17.5,17.5	8,8	16.5,16.5	22.3
WLAN5.3G	Ant6	23.0	16.0	17.0		8.0	17.0	20.0
WLAN5.3G	Ant1	23.0	16.0	16.5		8.0	16.5	19.5
WLAN5.3G	Ant6+1	23,23	16,16	16.5,16.5		8,8	16.5,16.5	22.8
WLAN5.5G	Ant6	23.0	16.5	17.5		8.5	17.5	20.0
WLAN5.5G	Ant1	23.0	16.5	17.5		8.5	17.5	19.5
WLAN5.5G	Ant6+1	23,23	16.5,16.5	17.5,17.5		8.5,8.5	17.5,17.5	22.8
WLAN5.8G	Ant6	23.0	17.5	17.5	17.5	9.5	17.5	20.5
WLAN5.8G	Ant1	23.0	17.5	17.5	17.5	9.5	17.5	20.5
WLAN5.8G	Ant6+1	23,23	17.5,17.5	17.5,17.5	17.5,17.5	9.5,9.5	17.5,17.5	23.5
WLAN6E B5	Ant6	21.2	13.8	11.8		10.0	15.0	15.0
WLAN6E B5	Ant1	21.2	13.8	11.8		10.0	15.5	15.5
WLAN6E B5	Ant6+1	21.2,21.2	13.8,13.8	11.8,11.8		10,10	15,15	18.3
WLAN6E B6	Ant6	20.2	13.8	11.8		9.5	15.5	15.5
WLAN6E B6	Ant1	20.2	13.8	11.8		9.5	15.5	15.5
WLAN6E B6	Ant6+1	20.2,20.2	13.8,13.8	11.8,11.8		9.5,9.5	15,15	18.5
WLAN6E B7	Ant6	18.6	13.3	11.3		9	15.5	15.5
WLAN6E B7	Ant1	18.6	13.3	11.3		9	15.5	15.5
WLAN6E B7	Ant6+1	18.6,18.6	13.3,13.3	11.3,11.3		9,9	15,15	18.5
WLAN6E B8	Ant6	18.1	13.8	11.8		9	17.5	17.5
WLAN6E B8	Ant1	18.1	13.8	11.8		9	17.5	17.5
WLAN6E B8	Ant6+1	18.1,18.1	13.8,13.8	11.8,11.8		9,9	17.5,17.5	20.5
FR1 n7 PC2	Ant3+2	15.4,15.4	16.3,16.3	20.2,20.2	15.8,15.8	10.6,10.6	22.5,22.5	26.0
FR1 n7 PC2	Ant4+2	26.8,26.8	18.9,18.9	21.2,21.2	18.9,18.9	13.3,13.3	22.5,22.5	25.5
FR1 n7 PC2	Ant3+0	15.4,15.4	16.3,16.3	20.2,20.2	15.8,15.8	10.6,10.6	23,23	26.0
FR1 n7 PC2	Ant4+0	26.8,26.8	20.8,20.8	23.3,23.3	20.8,20.8	14.3,14.3	22,22	25.5
FR1 n25(2) PC2	Ant3+2	20,20	18.3,18.3	20.7,20.7	17.4,17.4	13.8,13.8	23,23	26.0
FR1 n41 PC2	Ant3+2	15.4,15.4	16.5,16.5	20.3,20.3	15.7,15.7	11.8,11.8	22.5,22.5	23.0
FR1 N41 PC1.5	Ant3+2	15.4,15.4	16.5,16.5	20.3,20.3	15.7,15.7	11.8,11.8	22.5,22.5	23.0
FR1 n41 PC2	Ant4+2	27.7,27.7	18.8,18.8	20.8,20.8	19,19	11.8,11.8	22.5,22.5	22.5
FR1 N41 PC1.5	Ant4+2	27.7,27.7	18.8,18.8	20.8,20.8	19,19	11.8,11.8	22.5,22.5	22.5
FR1 n41 PC2	Ant3+0	15.4,15.4	16.5,16.5	20.3,20.3	15.7,15.7	12.6,12.6	22.5,22.5	23.0
FR1 n41 PC1.5	Ant3+0	15.4,15.4	16.5,16.5	20.3,20.3	15.7,15.7	12.6,12.6	22.5,22.5	23.0
FR1 n41 PC2	Ant4+0	27.7,27.7	20.6,20.6	22.5,22.5	20.6,20.6	14,14	22,22	22.5
FR1 N41 PC1.5	Ant4+0	27.7,27.7	20.6,20.6	22.5,22.5	20.6,20.6	14,14	22,22	22.5
FR1 n48	Ant8+4	22.8,22.8	19.3,19.3	19.8,19.8	19.3,19.3	10.2,10.2	23,23	23.0
FR1 n48	Ant2+4	29.7,29.7	18.5,18.5	21.5,21.5	18.4,18.4	10.1,10.1	23,23	23.0
FR1 n48	Ant8+6	22.8,22.8	19.3,19.3	19.8,19.8	19.3,19.3	10.2,10.2	23,23	23.0
FR1 n48	Ant2+6	26.4,26.4	18.5,18.5	21.5,21.5	18.4,18.4	10.1,10.1	23,23	23.0
FR1 n66 PC2	Ant3+2	22.2,22.2	19.9,19.9	22.2,22.2	19.1,19.1	14.1,14.1	23,23	26.0
FR1 n77(78) PC2	Ant8+4	20.7,20.7	17.9,17.9	18.9,18.9	17.9,17.9	9,9	20.9,20.9	23.0
FR1 n77(78) PC1.5	Ant8+4	20.7,20.7	17.9,17.9	18.9,18.9	17.9,17.9	9,9	20.9,20.9	23.0

FR1 n77(78) PC2	Ant2+4	26.9,26.9	18.5,18.5	20.9,20.9	17.4,17.4	10.4,10.4	23,23	23.0
FR1 n77(78) PC1.5	Ant2+4	26.9,26.9	18.5,18.5	20.9,20.9	17.4,17.4	10.4,10.4	23,23	23.0
FR1 n77(78) PC2	Ant8+6	20.7,20.7	17.9,17.9	18.9,18.9	17.9,17.9	9,9	20.9,20.9	23.0
FR1 n77(78) PC1.5	Ant8+6	20.7,20.7	17.9,17.9	18.9,18.9	17.9,17.9	9,9	20.9,20.9	23.0
FR1 n77(78) PC2	Ant2+6	23.2,23.2	18.4,18.4	20.9,20.9	17.4,17.4	10.4,10.4	23,23	23.0
FR1 n77(78) PC1.5	Ant2+6	23.2,23.2	18.4,18.4	20.9,20.9	17.4,17.4	10.4,10.4	23,23	23.0

1. Pmax is used for RF tune up procedure. The maximum allowed output power is equal to Pmax + TXAGC uncertainty.
2. All Plimit / Pmax power levels entered in the Table correspond to average power levels after accounting for duty cycle in the case TDD modulation schemes (for e.g., GSM & LTE TDD & NR TDD).
3. The Plimit values, corresponding to SAR_design_target.
4. Maximum target power, P_{max} , is configured in NV settings in EUT to limit maximum transmitting power. This power is converted into peak power in NV settings for TDD schemes. The EUT maximum allowed output power is equal to $P_{max} + 1.0\text{dB TXAGC}$ uncertainty.
5. The following table is duty cycle and factor used for calculating time average power.

GSM/FDD/TDD	Duty Cycle	Time average calculation factor(dB)
GSM 1TX	12.50%	-9.0
GSM 2TX	25%	-6.0
GSM 3TX	37.50%	-4.3
GSM 4TX	50%	-3.0
FDD LTE	100%	0.0
TDD LTE	63.30%	-2.0
TDD HPUE	43.30%	-3.6
NR FDD/TDD	100%	0.0
NR TDD HPUE	50%	-3.0

4. Power Density Characterization

The device with 5G mmW NR typically supports many beams and contains multiple mmW antenna arrays installed at different locations to achieve good coverage in the field. The power density (PD) measurement is a time-consuming test, and it is not practical to measure the power density for all the beams on all the surfaces of the device, thus a hybrid approach using electromagnetic (EM) simulation in combination with measurement is recommended for PD char generation

4.1 PD Char Table

The mmW device supports total N beams, where M out of N are single beams and the rest of (N-M) are beam pairs (where 2 single beams are excited at the same time).

The following figure outlines the PD char process.

Simulation modeling and validation

- Correlate the simulated PD distributions with measured PD distribution for the selected beams to validate simulation model



Uncertainty Budget

- Calculate the total device design uncertainty to include worst case RF tune-up accuracy and device-to-device variation



PD_design_target

Specify a power density design target, which should be less than power density regulatory limit to account for the total device design uncertainties



Worst-case housing material Influence Quantification

- Determine $\Delta_{\min} = \min\{\text{simulated PD@8dBm} - \text{measured PD@8dBm}\}$ to quantify the worst-case housing influence



PD Char Generation

- Use validated simulation approach to determine input power limit for all the beams after accounting for the worst-case housing influence

**4.2 Codebook for all beams**

All the beams that the device supports are specified in the pre-defined codebook, and the codebook is device design specific and generated after evaluating radiation coverage from this particular device. In the field, a smartphone manages the beam selection and utilization based on this pre-defined codebook that is loaded and stored in the device.

n260/n261

Beam ID 1	Beam ID 2	Antenna Module
0	-	0
1	-	0
2	-	0
3	-	0
4	-	0
5	-	0
6	-	0
7	-	0
8	-	0
9	-	0
10	-	0
11	-	0
12	-	0
13	-	0
14	-	0
15	-	0
16	-	0
17	-	0
18	-	0
19	-	0
20	-	0
-	256	0
-	257	0
-	258	0
-	259	0
-	260	0
-	261	0
-	262	0
-	263	0
-	264	0
-	265	0
-	266	0
-	267	0
-	268	0
-	269	0
-	270	0
-	271	0
-	272	0
-	273	0
-	274	0
-	275	0
-	276	0
0	256	0
1	257	0
2	258	0
3	259	0



4	260	0
5	261	0
6	262	0
7	263	0
8	264	0
9	265	0
10	266	0
11	267	0
12	268	0
13	269	0
14	270	0
15	271	0
16	272	0
17	273	0
18	274	0
19	275	0
20	276	0

4.3 PD design target determination

To account for total uncertainty, PD_design_target should meet the criteria:

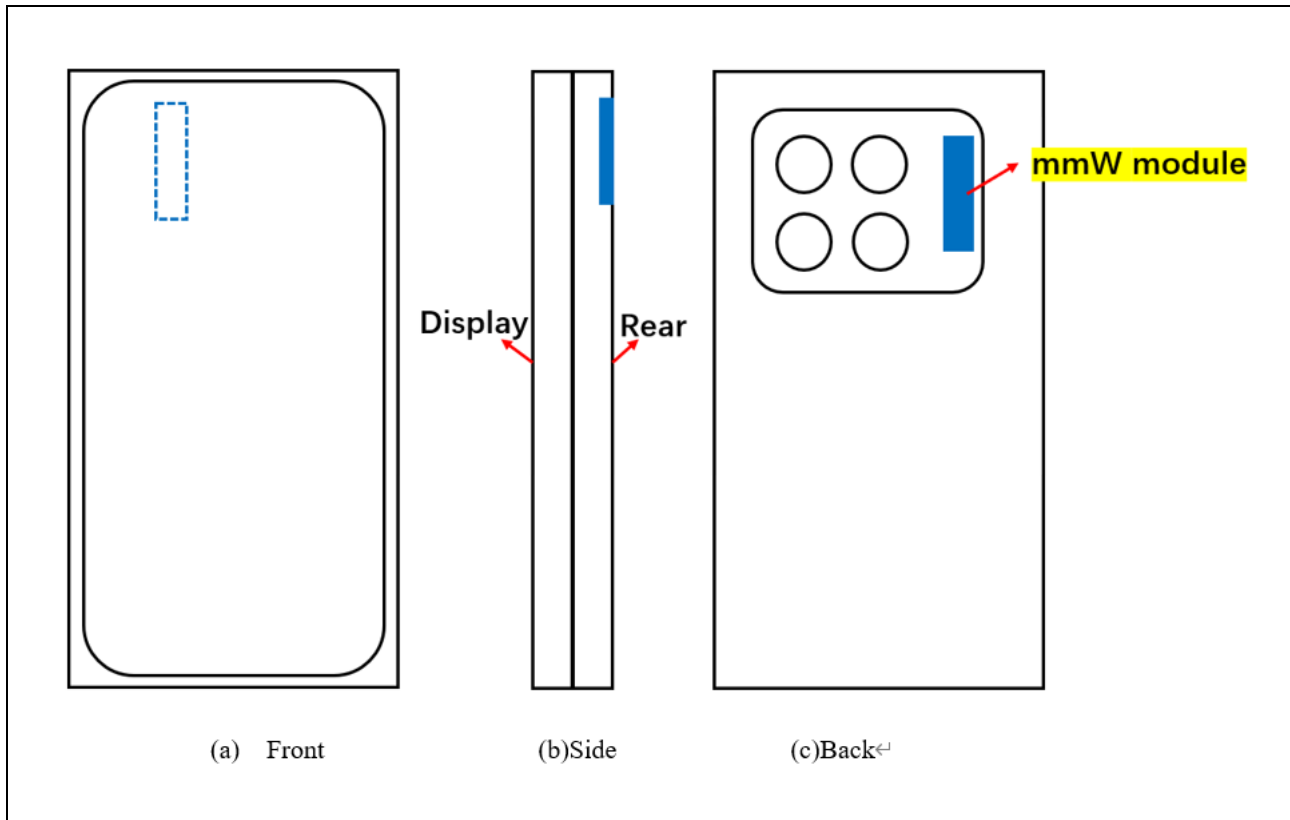
$$PD_design_target < PD_{regulatory_limit} \times 10^{\frac{-totaluncertainty}{10}}$$

For this EUT, the PD design target and the uncertainty value are listed below

n260/261	PD design target	Antenna Module	W/m ²
		Module 0	5.8

Item	Uncertainty dB (k=2)
Total uncertainty	1.4

4.4 Exposure positions for PD evaluation



Evaluation positions

Front view	Front	Back	Left side	Right side	Top side	Bottom side
	S1	S2	S3	S4	S5	S6
Module 0 (Fold Closed)	-	V	-	-	-	-
Module 0 (Fold Open)	-	V	-	-	-	-

Remark:

- Referring to the PD simulation report for the reason of selecting surfaces/edges.

4.5 Simulation and modeling validation

Power density simulations of all beams and surfaces were performed by the manufacturer. Details of these simulations and modeling validation can be found in the Power Density Simulation Report. Following Table includes a summary of the validation results to support worst-case housing influence quantification in power density characterization for this model With an input power of 6 dBm for n261 and n260 band, PD measurements are conducted for at least one single beam per antenna type and per antenna module (0) on worst-surface(s) . PD measurements are performed at mid channel of each mmW band and with CW modulation.
PD value will be used to determine worst-case housing influence for conservative assessment

Band	Antenna Module	Beam ID 1	Beam ID 2	Frequency (GHz)	EUT State	Exposure Surface	Input power level(dBm)	Test Separation	Modulation	Measured results Savg tot 4cm ² (W/m ²)	Simulated PD (W/m ²), averaged over 4 cm ²	Sim vs meas (dB)
n260	Module 0	15		38.5	Fold Closed	Back (S2)	6	2mm	CW	10.4	15.98	1.87
n260	Module 0		270	38.5	Fold Closed	Back (S2)	6	2mm	CW	9.17	12.62	1.39
n261	Module 0	14		27.925	Fold Closed	Back (S2)	6	2mm	CW	11.4	15.98	1.47
n261	Module 0		270	27.925	Fold Closed	Back (S2)	6	2mm	CW	15	15.7	0.20
n260	Module 0	15		38.5	Fold Open	Back (S2)	6	2mm	CW	11.6	16	1.40
n260	Module 0		270	38.5	Fold Open	Back (S2)	6	2mm	CW	9.36	12.48	1.25
n261	Module 0	14		27.925	Fold Open	Back (S2)	6	2mm	CW	11.2	16.19	1.60
n261	Module 0		270	27.925	Fold Open	Back (S2)	6	2mm	CW	15.1	15.65	0.16

4.6 PD Char

4.6.1 Simulated input power limit for single beams

Perform simulation at low, mid and high channel for each mmW band supported, with a given input power per active port, *sim.input.power.per.active.port* (6 dBm for this product):

1. Obtain $PD_{surface}$ value (the worst PD among all identified surfaces of the device) at all three channels for all single beams (1~M) specified in *codebook_sim*.
2. Adjust input power to determine a scaling factor at all three channels by:

$$s(i)_{low_or_mid_high} = \frac{PD\ design\ target}{sim.PD_{surface}(i)}, i = 1, 2, \dots, M \quad (4)$$

3. Determine the worst-case scaling factor among low, mid and high channels:

$$s(i) = \min\{s_{low}(i), s_{mid}(i), s_{high}(i)\}, i = 1, 2, \dots, M \quad (5)$$

Note: This scaling factor applies to the input power at each antenna port

4. Determine the simulated input power limit, *sim.powerlimit*, for single beam *i* by:

$$sim.\ powerlimit.(i)dBm = 10 * \log(s(i)) + sim.input.power.per.active.port, i = 1, 2, \dots, M \quad (6)$$

4.6.2 Simulated input power limit for beam pairs

The relative phase between single beams of a beam pair is swept to find the worst case PD for beam-pairs operation, and PD simulation data has taken this into consideration for beam-pair operations take consideration of the variation relative phase was reported

For beam pair, extract the E-fields and H-fields from the corresponding single beams at and high channel for each supported band and for all identified surfaces of the device.

For a given beam pair containing *beam_a* and *beam_b* with relative phase ϕ and for a given channel, determine the worst-case $\phi_{worstcase}$ which results in the highest total PD (ϕ) among all identified surfaces for this beam pair at this channel. When $\phi_{worstcase}$ is determined for all three channels, obtain the scaling factor given by the below equation for low, mid and high channels:

$$s(i)_{low_or_mid_high} = \frac{PD\ design\ target}{total.PD(\phi(i)_{worstcase})}, i = M+1, M+2, \dots N \quad (8)$$

The $\phi_{worstcase}$ varies with channel and beam pair, the lowest scaling factor among all three channels, $s(i)$, is determined for the beam pair i :

$$s(i) = \min\{s_{low}(i), s_{mid}(i), s_{high}(i)\}, i = M+1, M+2, \dots N \quad (9)$$

The simulated input power limit, *sim.power_{limit}*, for beam pair i can be determined by

$$sim.power_{limit}(i)dBm = 10 * \log(s(i)) + sim.input.power.per.active.port, i = M+1, M+2, \dots N \quad (10)$$

4.6.3 Worst-case housing influence determination

Referring to the PD simulation report for PD simulation data for all beams. For non-metal material, the material property cannot be accurately characterized at mmW frequencies. The estimated material property for the device housing is used in the simulation model, which could impact the accuracy in simulation for PD amplitude quantification. Since the housing influence on PD could vary from surface to surface where the EM field propagates through, the most underestimated surface is used to quantify the worst-case housing influence for conservative assessment.

Referring to the PD simulation report for PD simulation data for all beams, and the worst beams are selected to be tested Power density simulation for all

The mmW antenna modules are placed at different locations and only surrounding material/housing has impact on EM field propagation and in turn power density, and depending on the type of antenna array the nature of EM field propagation in the near field is different. Therefore, the worst-case housing influence is determined per antenna module and per antenna type.

For this DUT, the procedure to determine worst-case housing influence, denoted as Δ_{min} :

1. Based on PD simulation, determine one or more worst-surface(s) that contains all the highest 4cm²-averaged PD for each of the beams, per antenna module and per antenna type in the mid channel of each band.
2. For identified worst surface(s) per antenna module and per antenna type group,
 - a. First determine Δ_{min} based on identified worst surface(s) in Step 1, and then follow the procedures described in Section 4.6 to derive *input.power.limit* corresponding to *PD_design_target* for all the beams
 - b. Then prove all other surface(s) near-by the mmW module, i.e., surface(s) not selected in Step 1, is not required for housing material loss quantification (in other words, these nonevaluated surfaces have no influence on the determined *input.power.limit*) by:
 - i. Scale the simulated 4cm²-averaged PD values for all single beams to correspond to their *sim.power.limit*, and identify the worst-PD beam per each non-selected surface.
 - ii. Measure 4cm²-averaged PD at *input.power.limit* for the identified worst-PD beam at each non-selected surface
 - iii. Demonstrate all measured 4cm²-averaged PD values are below *PD_design_target*.
3. If any of the above surface(s) in Step (2.b.iii) have measured 4cm²-averaged PD $\geq$ *PD_design_target*, then those surfaces must be included in the Δ_{min} determination in Step (2.a), and follow the procedures in Section 4.6 to re-evaluate *input.power.limit* with these added surfaces.

Therefore, when comparing a simulated 4cm²-averaged PD and measured 4cm²-averaged PD for the above identified surfaces, the worst errors introduced when using the estimated material property in the simulation per module and per antenna type (worst out of both polarizations) is highlighted in bolded numbers in section 4.5. Thus, the worst-case housing influence, denoted as Δ_{min} (= minimum of (sim.PD – meas.PD) for the same antenna type of each module), is determined as:

Band	Antenna Module	$\Delta_{min}(\text{dB})$	
		Fold Closed Polarization	Fold Open Polarization
n260	0	1.40	1.25
n261	0	1.47	0.16

Δ_{min} represents the worst case where RF exposure is underestimated the most by simulation upon using the estimated material property for glass/plastics of the housing. For conservative assessment, the Δ_{min} is used as the worst case correction and applied to each corresponding beam group to determine power limits in PD char for compliance. To ensure that condition described in Step (2.b.iii) is met, apply the correct input.power.limit to derive the PD simulated results for all beams, and select the worst beams (yellow highlighted in the PD table) for each of non-selected applicable surface(s).

The PD test results for non-selected surfaces are less than PD_design_target, and meets condition in Step (2.b.iii), thus performing Step (3) is not needed

4.7 PD Char

This section describes the PD char generation that complies with the *PD_design_target* and is in compliance with the regulatory power density limit.

4.7.1 PD char generation

Ideally, if there is no uncertainty associated with hardware as described in Section 4.4, after accounting for the housing influence (Δ_{min}), *input.power.limit(i)*, for beam *i* can be obtained:

$$input.power.limit(i) = 6 \text{ dBm} + 10 * \log(s(i)) + \Delta_{min}, i \in \text{all beams} \quad (11)$$

If simulation overestimates the housing influence, then Δ_{min} (= minimum {simulated PD – measured PD}) is negative, which means that the measured PD would be higher than the simulated PD. The input power to antenna elements determined via simulation must be decreased for compliance.

Similarly, if simulation underestimates loss, then Δ_{min} is positive (measured PD would be lower than the simulated value). Input power to antenna elements determined via simulation can be increased and still be PD compliant.

In reality, the hardware design has uncertainty which must be properly considered in equation (11). In Section 4.7, the TxAGC uncertainty at reference power level (6dBm in report) is embedded in the process of Δ_{min} determination and should be removed to avoid double counting this uncertainty.

If -TxAGC uncertainty at reference power level < Δ_{min} < TxAGC uncertainty at reference power level,

$$Input.power.limit(i) = sim.power.limit(i), i = 1, 2, \dots, N \quad (12)$$

else if Δ_{min} < -TxAGC uncertainty at reference power level,

$$Input.power.limit(i) = sim.power.limit(i) + (\Delta_{min} + TxAGC \text{ uncertainty}), i = 1, 2, \dots, N \quad (13)$$

else if Δ_{min} > TxAGC uncertainty at reference power level,

$$Input.power.limit(i) = sim.power.limit(i) + (\Delta_{min} - TxAGC \text{ uncertainty}), i = 1, 2, \dots, N \quad (14)$$

The input power limit is derived and listed in the table below

Fold Closed Polarization					
Band	Antenna Module	Δ_{min} (dB)	TxAGC uncertainty (dB)	Input.power.limit (dBm)	Input.power.limit (dBm)
n260	0	1.40	0.47	$6 + 10 * \log(s(i)) + K$	sim.power_limit +0.93
n261	0	1.47	0.47	$6 + 10 * \log(s(i)) + K$	sim.power_limit +1.00
Fold Open Polarization					
Band	Antenna Module	Δ_{min} (dB)	TxAGC uncertainty (dB)	Input.power.limit (dBm)	Input.power.limit (dBm)
n260	0	1.25	0.47	$6 + 10 * \log(s(i)) + K$	sim.power_limit +0.78
n261	0	0.16	0.47	$6 + 10 * \log(s(i)) + K$	sim.power_limit +0.00



4.7.2 PD char Table

Combining the information in previous sections, PD char is derived and listed below

Beam ID 1	Beam ID 2	Antenna Module	Input power limit (dBm)	Input power limit (dBm)
			n260	n261
0	-	0	10.91	11.94
1	-	0	9.98	10.63
2	-	0	9.05	10.24
3	-	0	9.44	10.44
4	-	0	10.49	11.16
5	-	0	6.40	8.86
6	-	0	8.21	6.48
7	-	0	7.19	7.55
8	-	0	7.03	8.91
9	-	0	6.78	8.45
10	-	0	7.64	6.00
11	-	0	5.89	8.07
12	-	0	2.60	4.90
13	-	0	3.30	3.34
14	-	0	3.97	2.49
15	-	0	2.52	2.98
16	-	0	2.59	6.18
17	-	0	4.10	3.97
18	-	0	4.08	2.65
19	-	0	2.69	2.64
20	-	0	2.97	3.81
-	256	0	10.71	8.62
-	257	0	10.45	8.83
-	258	0	9.65	9.07
-	259	0	9.70	8.81
-	260	0	10.41	9.55
-	261	0	7.07	6.26
-	262	0	6.83	5.67
-	263	0	7.62	4.86
-	264	0	8.52	5.51
-	265	0	7.31	6.49
-	266	0	6.62	5.07
-	267	0	7.55	5.97
-	268	0	4.04	2.94
-	269	0	3.49	1.46
-	270	0	2.59	1.36
-	271	0	3.93	1.51
-	272	0	3.75	1.52
-	273	0	3.64	1.86
-	274	0	2.99	1.44
-	275	0	3.00	1.66
-	276	0	3.93	1.36
0	256	0	5.94	5.78
1	257	0	5.77	5.72
2	258	0	4.81	5.58
3	259	0	4.65	5.57
4	260	0	5.79	6.37
5	261	0	2.14	2.88
6	262	0	2.74	1.93
7	263	0	2.66	2.17
8	264	0	2.92	3.40



9	265	0	2.72	2.83
10	266	0	2.46	1.40
11	267	0	1.88	3.11
12	268	0	-1.34	-1.31
13	269	0	-1.15	-2.26
14	270	0	-1.59	-2.00
15	271	0	-1.58	-1.76
16	272	0	-1.88	-1.14
17	273	0	-0.96	-1.97
18	274	0	-1.34	-2.06
19	275	0	-1.83	-1.72
20	276	0	-1.54	-1.95

-----THE END-----