

RF Exposure Report

(Part 0: SAR Char Evaluation)

APPLICANT : Motorola Mobility LLC
EQUIPMENT : Mobile Cellular Phone
BRAND NAME : Motorola
MODEL NAME : XT2301-1
FCC ID : IHDT56AH1
STANDARD : FCC 47 CFR PART 2 (2.1093)

We, Sporton International Inc. (Shenzhen), would like to declare that the tested sample has been evaluated in accordance with the test procedures given in 47 CFR Part 2.1093 and FCC KDB 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. (Shenzhen), the test report shall not be reproduced except in full.



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History of this test report

Report No.	Version	Description	Issued Date
FA292622E	01	Initial issue of report	Dec. 12, 2022

1. Introduction

The 2nd generation of Smart Transmit (GEN2) operates based on pre-defined sub6 antenna groups (AG). This Device is enabled with the Qualcomm® Smart Transmit Gen2 feature. The 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 transmitter to ensure the product in compliance with RF exposure limit over a defined time window, for SAR (transmit frequency $\leq 6\text{GHz}$) 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. Smart Transmit cannot operate without SAR characterization at the device level, beforehand.

This report describes the procedures for the SAR char generation, and the parameters obtained from SAR characterization (referred to as SAR char, respectively) will be used as input for Smart Transmit. Both SAR char will be entered via the Embedded File System (EFS) 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 uncertainty.
SAR char	P_{limit} for all the technologies/bands for all applicable DSI



2. Product Description

Product Feature & Specification	
Equipment Name	Mobile Cellular Phone
Brand Name	Motorola
Model Name	XT2301-1
FCC ID	IHDT56AH1
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 30: 2305 MHz ~ 2315 MHz LTE Band 38: 2570 MHz ~ 2620 MHz LTE Band 41: 2496 MHz ~ 2690 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 n14 : 788 MHz ~ 798 MHz 5G NR n25 : 1850 MHz ~ 1915 MHz 5G NR n26 : 814 MHz ~ 849 MHz 5G NR n30 : 2305 MHz ~ 2315 MHz 5G NR n66: 1710 MHz ~ 1780 MHz 5G NR n70 : 1695 MHz ~ 1710 MHz 5G NR n71 : 663 MHz ~ 698 MHz 5G NR n38 : 2570 MHz ~ 2620 MHz 5G NR n41 : 2496 MHz ~ 2690 MHz 5G NR n48 : 3550 MHz ~ 3700 MHz 5G NR n77: 3450 MHz ~ 3550 MHz, 3700 MHz ~ 3980 MHz 5G NR n78: 3450 MHz ~ 3550 MHz, 3700 MHz ~ 3800 MHz 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 6E U-NII-5: 5925 MHz ~ 6425 MHz WLAN 6E U-NII-6: 6425 MHz ~ 6525 MHz WLAN 6E U-NII-7: 6525 MHz ~ 6875 MHz WLAN 6E U-NII-8: 6875 MHz ~ 7125 MHz Bluetooth: 2402 MHz ~ 2480 MHz WPT: 111 kHz ~ 148 kHz NFC: 13.56 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 : CP-OFDM / DFT-s-OFDM, PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 2.4GHz 802.11ax HE20/HE40 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac/ax VHT20/VHT40/VHT80/VHT160/HE20/HE40/HE80/HE160 WLAN 6GHz 802.11a WLAN 6GHz 802.11ax HE20/HE40/HE80/HE160 Bluetooth BR/EDR/LE WPT: ASK NFC: ASK

3. SAR Characterization

SAR char must be generated to cover all radio configurations and usage scenarios that the wireless device supports for operating at 6 GHz or below. It will then be used as input for Smart Transmit to control and manage RF exposure for $f < 6$ GHz.

3.1 SAR design target and uncertainty

SAR design Target :

FCC SAR	Measure Distance	WWAN 2/3/4/5G AG0(Ant 1/3/4/7/8)	WWAN 2/3/4/5G AG1(Ant 0/2/9)
Body Worn (1g)	5 mm	0.80	0.99
Hotspot (1g)	5 mm	0.80	0.99
Head (1g)	touch&tilt 15deg	0.75	0.99
Extremity (10g)	0 mm	1.59	2.07

Antenna Group:

Antenna Group 0 (AG0)	ANT1 & ANT3 & ANT4 & ANT7 & ANT8
Antenna Group 1 (AG1)	ANT0 & ANT2 & ANT9

Uncertainty:

Item	Uncertainty dB (k=2)
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 6 GHz or below. It will then be used as input for Smart Transmit to control and manage RF exposure for $f < 6$ GHz.

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

Band	Antenna	Head	Body-worn Hotspot	Extremity	Sensor off	P _{max} *
		(DSI2)	(DSI3)	(DSI6)	(DSI4)	
GSM850	0	32.5	24.2	23.7	23.7	23.7
GSM850	1	20.3	24.6	23.7	23.7	23.7
GSM1900	1	15.7	17.2	20.0	21.2	21.2
GSM1900	2	33.8	22.4	21.2	21.2	21.2
WCDMA II	1	15.3	17.4	18.7	24.0	24.0
WCDMA II	2	32.1	20.2	21.9	24.0	24.0
WCDMA IV	1	16.1	17.6	19.7	24.0	24.0
WCDMA IV	2	31.7	20.5	21.8	24.0	24.0
WCDMA V	0	33.0	24.9	24.0	24.0	24.0
WCDMA V	1	22.5	24.1	24.0	24.0	24.0
LTE B2/25	1	15.6	17.7	20.1	22.0	22.0
LTE B2/25	2	32.1	20.9	22.4	23.0	23.0
LTE B4/66	1	16.6	17.4	19.2	22.0	22.0
LTE B4/66	2	31.7	20.9	22.2	23.0	23.0
LTE B5/26	0	32.3	23.7	23.0	23.0	23.0
LTE B5/26	1	22.1	23.3	23.0	23.0	23.0
LTE B7	1	15.1	16.0	19.0	22.0	22.0
LTE B7	2	27.7	21.8	21.6	23.0	23.0
LTE B12/B17	0	33.4	25.1	23.0	23.0	23.0
LTE B12/B17	1	22.4	24.6	23.0	23.0	23.0
LTE B13	0	32.2	24.6	23.0	23.0	23.0
LTE B13	1	22.0	25.0	23.0	23.0	23.0
LTE B14	0	32.0	23.5	23.0	23.0	23.0
LTE B14	1	22.5	23.7	23.0	23.0	23.0
LTE B30	1	16.3	17.9	21.6	23.0	23.0
LTE B30	2	32.0	22.0	23.0	23.0	23.0
LTE B41/38(PC3)**	1	15.5	14.8	19.2	20.0	20.0
LTE B41 (PC2)**						19.9
LTE B41/38(PC3)**	2	26.2	21.0	21.0	21.0	21.0
LTE B41 (PC2)**						20.9
LTE B48**	3	19.0	16.4	18.0	18.0	19.0
LTE B48**	8	23.0	12.5	16.3	17.0	17.0
LTE B71	0	32.5	26.0	23.0	23.0	23.0
LTE B71	1	23.5	26.6	23.0	23.0	23.0
FR1 n2/25	1	15.5	16.5	19.0	23.0	23.0
FR1 n2/25	2	32.2	21.0	23.0	23.0	23.0
FR1 n5/26	0	33.0	24.2	23.0	23.0	23.0
FR1 n5/26	1	24.0	24.0	23.0	23.0	23.0
FR1 n7	1	14.5	14.5	18.0	23.0	23.0
FR1 n12	0	32.7	25.3	23.0	23.0	23.0
FR1 n14	0	32.3	24.5	23.0	23.0	23.0
FR1 n30	1	16.0	16.5	19.5	23.0	23.0
FR1 n30	2	31.8	23.2	22.0	22.0	22.0
FR1 n66	1	16.5	16.5	19.5	23.0	23.0
FR1 n66	2	31.5	20.5	21.5	23.0	23.0
FR1 n70	1	18.0	18.0	19.5	23.0	23.0
FR1 n70	2	33.2	21.5	22.5	23.0	23.0

FR1 n71	0	32.5	25.3	23.0	23.0	23.0
FR1 n71	1	25.7	24.8	23.0	23.0	23.0
FR1 n41(PC3)**	0	19.0	15.5	18.0	23.0	23.0
FR1 n41(PC2)**	0	19.0	15.5	18.0	23.0	23.0
FR1 n38/41(PC3)**	1	15.0	14.5	18.5	23.0	23.0
FR1 n41(PC2)**	1	15.0	14.5	18.5	23.0	23.0
FR1 n41(PC3)**	2	29.0	21.5	21.0	23.0	23.0
FR1 n41(PC2)**	2	29.0	21.5	21.0	23.0	23.0
FR1 n41(PC3)**	4	17.0	16.5	20.0	20.0	20.0
FR1 n41(PC2)**	4	17.0	16.5	20.0	20.0	20.0
FR1 n48	3	18.5	17.0	18.0	18.5	23.0
FR1 n48	8	23.0	13.0	17.0	23.0	23.0
FR1 n77/78(PC3)**	3	17.0	15.0	16.0	17.5	23.0
FR1 n77(PC2)**	3	17.0	15.0	16.0	17.5	23.0
FR1 n77/78(PC3)**	7	18.0	14.5	17.5	23.0	23.0
FR1 n77(PC2)**	7	18.0	14.5	17.5	23.0	23.0
FR1 n77/78(PC3)**	8	24.8	12.0	16.0	23.0	23.0
FR1 n77(PC2)**	8	24.8	12.0	16.0	23.0	23.0
FR1 n77/78(PC3)**	9	18.5	14.0	16.5	16.5	23.0
FR1 n77(PC2)**	9	18.5	14.0	16.5	16.5	23.0

Note: 1) *P_{max} is used for RF tune up procedure. The maximum allowed output power is equal to P_{max} + uncertainty.

2) **All P_{limit} 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 max allowed output power is the P_{limit} + device uncertainty, and if P_{limit} is higher than P_{max}, the device output power will be P_{max} instead.

4) For 5G NR n41/n77 HPUE, 5G NR n41/n77 PC2 Maximum Duty Cycle is 50%, using FTM (Factory Test Mode) with 50% duty cycle is considered during SAR testing. For 5G NR other bands test, using FTM (Factory Test Mode) with default 100% duty cycle transmission to perform SAR testing.

5) The device supports HPUE (power class 2) under SISO mode and HPUE (power class 1.5) under UL MIMO mode for 5G NR n41/n77.

6) 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 only for n41/n77	50%	-3.0