



FCC 47 CFR § 2.1093  
IEEE Std 1528-2013

**RF EXPOSURE SUMMARY REPORT**

**FOR**

**WCDMA/LTE/5G NR Tablet + BT/BLE, DTS/UNII a/b/g/n/ac**

**MODEL NUMBER: SM-T738U**

**FCC ID: A3LSMT738U**

**REPORT NUMBER: 4789867826-S1V1**

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# 1. Attestation of Test Results

Applicant Name	SAMSUNG ELECTRONICS CO.,LTD.		
FCC ID	A3LSMT738U		
Model Number	SM-T738U		
Applicable Standards	FCC 47 CFR § 2.1093 IEEE Std 1528-2013 IEC TR 63170-2018 Published RF exposure KDB procedures		
Exposure Category	SAR Limits (W/Kg)	Power Density Limits (mW/cm <sup>2</sup> )	TER limits (Total Exposure Ratio)
	Peak spatial-average (1g of tissue)	4cm <sup>2</sup> psPD	
General population / Uncontrolled exposure	1.6	1.0	1.0
RF Exposure Conditions	The Highest Reported RF Exposure Level		
Standalone - 1g (W/kg)	1.25		
Standalone – 4cm <sup>2</sup> psPD (mW/cm <sup>2</sup> )	0.56		
Simultaneous Tx – 1g (W/kg)	1.59		
Simultaneous Tx TER (Total Exposure Ratio)	0.99		
Test Results	Pass		
<p>UL Korea, Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Korea, Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.</p> <p><b>Note:</b> The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by IAS, any agency of the Federal Government, or any agency of any government.</p> <p>This test report contains SAR measurements to support a Permissive Change application that only affect specific exposure conditions for the GSM 1900 cellular operations. The tables in sections 1 and 1.1 below, and data used for the simultaneous analysis in section 13, for the operating bands and modes not detailed in this report have been taken directly from the test report submitted to support the original filing for device certification.</p>			
Approved & Released By:	Prepared By:		
			
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## 2. Strategy for Compliance Demonstration

### 2.1. RF Exposure Evaluation Strategy

The FCC RF exposure limits defined based on time-averaged RF exposure. The device under test (DUT) uses the Qualcomm Smart Transmit feature to control and manage transmitting power in real time and to ensure at all times the time-averaged RF exposure is in compliance with the FCC requirement for 3G/4G/5G NR operations. Additionally, this device supports WLAN/BT technologies but the output power of these modems is not controlled by the smart transmit algorithm.

Demonstrating compliance of DUT enabled with Qualcomm Smart Transmit feature is completed in three parts:

#### **0. RF Exposure Compliance Test Report Part.0: SAR Characterization and PD Characterization**

The SAR and PD Characterization, denote as SAR Char and PD Char, determines the power limit that meets FCC exposure requirement after accounting for device related uncertainties for each supported radio configuration and RF exposure usage scenario. The determined power limits will be loaded and stored in the EUT via the Embedded File System (EFS), and then used as inputs for Smart Transmit to operate.

For 3G/4G/5G Sub6 NR, SAR Char is derived from SAR test measurements and conducted power measurements to determine  $P_{limit}$  for each technology/band. For 5G mmW NR, PD Char is derived using simulation in combination with measurement as validation to determine the *input.power.limit* for each radio/antenna configuration (each beam). The  $P_{limit}$  and *input.power.limit* represents the maximum time-averaged power level for the corresponding radio/antenna configuration.

#### **1. RF Exposure Compliance Test Report Part 1: Test in Static Transmission Condition**

Part 1 demonstrate that DUT meets FCC SAR and PD limits when transmitting at pre-determined maximum time-averaged power level:  $P_{limit}$  for 3G/4G/5G Sub6 NR and *input.power.limit* for 5G mmW NR. The SAR and PD measurement in Part 1 is under static transmission condition.

The compliance for WLAN/BT radio is demonstrated at a fixed power level (fixed = maximum RF tune-up level or power-back off level).

The exposure from the simultaneous transmission of WWAN and WLAN/BT is evaluated in Part 1 report.

#### **2. RF Exposure Compliance Test Report Part 2: Test in Dynamic Transmission Condition**

Part 2 demonstrates compliance in Tx varying transmission conditions and validates Qualcomm Smart Transmit algorithm. The test results reported in Part 2 demonstrates that DUT complies with FCC RF exposure requirement under Tx varying transmission scenarios, thereby validity of Qualcomm Smart Transmit algorithm.

## 2.2. Nomenclature

Supported Technologies	Term	Description
2G/3G/4G/5G Sub6 NR	$P_{Limit}$	Power level that corresponds to the exposure design target ( $SAR_{design\_target}$ ) after accounting for all device design related uncertainties
	$P_{Max}$	Maximum tune up output power
	$T_{SAR}$	Defined time averaging window for $f < 6$ GHz
	$SAR_{design\_target}$	Target SAR level resulting in maximum time-averaged exposure optimized from total uncertainty
	$SAR Char$	Table containing $P_{limit}$ for all technologies
5G mmW NR	$input.power.limit$	Power level at antenna element for each beam corresponding to the exposure design target ( $PD_{design\_target}$ )
	$T_{PD}$	Defined time averaging window for $f > 6$ GHz
	$PD_{design\_target}$	Target PD level resulting in maximum time-averaged exposure optimized from total uncertainty
	$PD Char$	Table containing $input.power.limit$ for all beams
2G/3G/4G/5G Sub6 NR & 5G mmW NR	$regulatory\_body$	Regulatory body that the algorithm is designed to comply. Algorithm's time averaging window is dependent on either FCC or ICNIRP requirements
	$reserve\_power\_margin$	Margin below $P_{Limit}$ reserved for future transmission
	$P_{reserve}$	Minimum transmit power with a designated margin below $P_{Limit}$

## 2.3. Report Compositions

Report Type	Report name
RF Exposure Summary	4789867826-S1 FCC Report_RF exposure Summary
SAR Report_Part.0	4789867826-S1 FCC Report SAR_Part 0
SAR Report_Part.1	4789867826-S1 FCC Report SAR_Part 1
Power Density Report_Part.0	SM-T738U Part 0_Power Density Report
Power Density Report_Part.1	4789867826-S2 FCC Report PD_Part 1
Power Density Simulation Report	Power Density Simulation Report (Part_0)_Rev A
RF exposure Report_Part.2	4789867826-S1 FCC Report RF exposure_Part 2

### 3. Time Averaging Algorithm

#### 3.1. Algorithm Description

The FCC RF exposure limit is defined based on time-averaged RF exposure. When running in a wireless device, Qualcomm Smart Transmit algorithm enables more elegant power control mechanisms for RF exposure management. It ensures at all times the wireless device is in compliance with the FCC limit of RF exposure time- averaged over a defined time window, denoted as  $T_{SAR}$  and  $T_{PD}$  for specific absorption rate (SAR for transmit frequency < 6 GHz) and power density (PD for transmit frequency > 6 GHz) time windows, respectively.

The Smart Transmit algorithm not only ensures the wireless device complies with RF exposure requirement, but also improves the user experience and network performance.

For a given wireless device, RF exposure is proportional to the transmitting power.

- Once the SAR and PD of the wireless device is characterized at a transmit power level, RF exposure at a different power level for the characterized configurations can be scaled by the change in the corresponding power level.
- Therefore, for a characterized device, RF exposure compliance can be achieved through transmit power control and management.

The Smart Transmit algorithm embedded in Qualcomm modems reliably controls the transmit power of the Wireless device in real time to maintain the time-averaged transmit power, in turn, time-averaged RF exposure, below the predefined time-averaged power limit for each characterized technology and band.

- This predefined time-averaged power limit is denoted as  $P_{Limit}$  corresponding SAR limit (frequency < 6 GHz) and *input.power.limit* corresponding PD limit (frequency > 6 GHz) in this report.
- The wireless device continuously transmitting at  $P_{Limit}$  level or *input.power.limit* level complies with the FCC RF exposure requirement.

In a simultaneous transmission scenario, the algorithm manages all active transmitters and make sure the total exposure ratio from each transmitter not exceeding to 1.

### 3.2. Basic concept of the algorithm

The Smart Transmit algorithm controls and manages the instantaneous transmit power (Tx) to maintain the time-averaged Tx power and therefore, time-averaged RF exposure in compliance with FCC limits.

- If time-averaged transmit power approaches  $P_{Limit}$  or  $input.power.limit$ , then the modem needs to limit instantaneous transmit power to ensure the time-averaged transmit power does not exceed  $P_{Limit}$  or  $input.power.limit$  in any  $T_{SAR}$  and  $T_{PD}$  time windows since the time-averaged RF exposure is required to comply with the FCC RF exposure limit in any  $T_{SAR}$  or  $T_{PD}$  time window.
- The wireless device can instantaneously transmit at high transmit powers and exceed the  $P_{Limit}$  or  $input.power.limit$  level for a short duration before limiting the power to maintain the time-averaged transmit power under  $P_{Limit}$  or  $input.power.limit$ .
- If the wireless device transmits at high power for a long time, then the radio link needs to be dropped to be compliant with time-averaged Tx power requirement (see Figure 2-1).
- To avoid dropping the radio link, Smart Transmit algorithm starts the power limiting enforcement earlier in time to back off the Tx power to a reserve level (denoted as  $P_{reserve}$ ), so the wireless device can maintain the radio link at a minimum reserve power level for as long as needed, and at the same time ensure the time-averaged Tx power over any defined time window is less than  $P_{Limit}$  at all times (see Figure 2-2). At all times, Smart Transmit meets the below equation:

$$time.avg.Tx\ power = \frac{1}{T_{SAR}} \int_{t-T_{SAR}}^t inst.Tx\ power(t) dt \leq P_{limit}$$

**Equation 2-1**

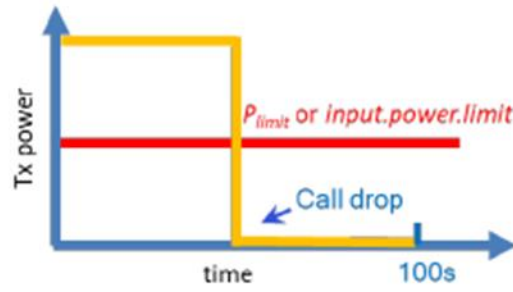
where,  $time.avg.Tx\ power$  is the transmit power averaged between  $t-T_{SAR}$  and  $t$  time period;  $T_{SAR}$  is the time window defined by FCC for time-averaging RF exposure for Tx frequency less than 6GHz (sub6);  $inst. Tx\ power(t)$  is the instantaneous transmit power at  $t$  time instant;  $P_{Limit}$  is the predefined time-averaged power limit. Similarly, Smart Transmit meets the below equation for mmW transmission:

$$mmW\_time.avg.Tx\ power = \frac{1}{T_{PD}} \int_{t-T_{PD}}^t mmW\_Tx\ power(t) dt \leq input.power.limit$$

**Equation 2-2**

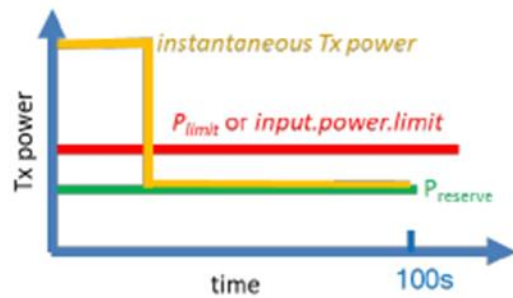
where,  $mmW\_time.avg.Tx\ power$  is the mmW transmit power averaged between  $t-T_{PD}$  and  $t$  time period;  $T_{PD}$  is the time window defined by FCC for time-averaging RF exposure for mmW bands;  $mmW\_Tx\ power(t)$  is the instantaneous mmW transmit power at  $t$  time instant;  $input.power.limit$  is the predefined time-averaged power limit for the beam under test.





(a)

**Figure 2-1**  
**Transmit at high power when needed and permitted**



(b)

**Figure 2-2**  
**Transmit with reserve power to support continuous transmission at a minimum power level ( $P_{reserve}$ )**

- In the case of simultaneous transmission, Smart Transmit manages all active transmitters and make sure the total exposure ratio is less than 1.

$$\sum \frac{1}{T_{SAR}} \int_{t-T_{SAR}}^t \frac{SAR(t) dt}{FCC SAR limit} + \sum \frac{1}{T_{PD}} \int_{t-T_{psPD}}^t \frac{4cm^2 psPD(t) dt}{FCC psPD limit} \leq 1$$

**Equation 2-3**

### 3.3. Configurable Parameters

The following input parameters are required for functionality of Qualcomm Smart Transmit algorithm. These parameters cannot be accessed by the end user, because at the factory they are entered through the embedded file system (EFS) entries by the OEM

Input Parameter	Description
Regulatory body	<ul style="list-style-type: none"> <li>■ Inputs of “0” and “1” corresponding to FCC and ICNIRP requirements for the averaging time windows.</li> <li>■ For FCC, algorithm uses an averaging window of 100 seconds for <math>f &lt; 3</math> GHz, 60 seconds for <math>3 \text{ GHz} &lt; f &lt; 6 \text{ GHz}</math>, and 4 seconds for <math>24 \text{ GHz} &lt; f &lt; 42 \text{ GHz}</math>.</li> </ul>
<i>Tx_power_at_SAR_design_target</i> <i>(P<sub>Limit</sub> in dBm)</i> <i>f &lt; 6 GHz</i>	<p>The maximum time-averaged transmit power, in dBm, corresponding to the <i>SAR_design_target</i>.</p> <p><i>SAR_design_target</i> is pre-determined for this DUT and it is less than regulatory SAR limit after accounting for all design related tolerances. The time-averaged SAR is assessed against this <i>SAR_design_target</i> in real time to determine the compliance.</p> <p><i>P<sub>Limit</sub></i> could vary with technology, band and Device State Index (DSI) and therefore, it has the unique value for each technology, band and DSI.</p>
<i>reserve_power_margin</i> <i>(P<sub>reserve</sub> in dBm)</i>	<p>The margin below <i>P<sub>Limit</sub></i> reserved for future transmission with a minimum transmit power <i>P<sub>reserve</sub></i></p> $P_{reserve} \text{ (dBm)} = P_{limit} \text{ (dBm)} - Reserve\_power\_margin \text{ (dB)}$ <p>When the <i>Reserve_power_margin</i> is set to 0 dB, Smart Transmit effectively limits the upper bound of the transmit power to <i>P<sub>limit</sub></i> and the DUT transmits continuously at <i>P<sub>limit</sub></i> without utilizing Smart Transmit dynamic control feature.</p>
<i>input.power.limit</i> in dBm <i>f ≥ 6 GHz</i>	<p>Maximum time-averaged power at the input of antenna element port at which each antenna configuration/beam meets <i>PD_design_target</i>.</p>

## 4. DUT Description

Wireless technologies	Frequency bands	Operating mode
W-CDMA (UMTS)	Band II Band IV Band V	UMTS Rel. 99 (Voice & Data) HSDPA (Category 24) HSUPA (Category 6) DC-HSDPA (Category 24) HSPA+ (DL only)
LTE	FDD Band 2 FDD Band 4 FDD Band 5 FDD Band 7 FDD Band 12 FDD Band 13 FDD Band 14 FDD Band 25 FDD Band 26 FDD Band 30 TDD Band 41 Power Class 3 TDD Band 41 Power Class 2 TDD Band 48 FDD Band 66 FDD Band 71  FDD Band 5 (2CC) FDD Band 66 (2CC) TDD Band 41 (2CC)	QPSK 16QAM 64QAM  Rel. 15 Carrier Aggregation (2 Uplink and 4 Downlinks)
Does this device support SV-LTE (1xRTT-LTE)? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
5G NR (Sub 6)	NR Band n2 NR Band n5 NR Band n25 NR Band n41 NR Band n66 NR Band n71 NR Band n77	DFT-s-OFDM: ■ $\pi/2$ BPSK, QPSK, 16QAM, 64QAM, 256QAM CP-OFDM: ■ QPSK, 16QAM, 64QAM, 256QAM
5G NR (mmW)	NR Band n261 NR Band n260	DFT-s-OFDM & CP-OFDM: ■ QPSK, 16QAM, 64QAM
Wi-Fi	2.4 GHz	802.11b 802.11g 802.11n (HT20)
	5 GHz	802.11a 802.11n (HT20) 802.11n (HT40) 802.11ac (VHT20) 802.11ac (VHT40) 802.11ac (VHT80)
	Does this device support bands 5.60 ~ 5.65 GHz? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Does this device support Band gap channel(s)? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
Bluetooth	2.4 GHz	Version 5.0 LE

### Notes:

This device uses the Qualcomm Smart Transmit feature to control and manage transmitting power in real time and to ensure at all times the time-averaged RF exposure is in compliance with the FCC requirement for 3G/4G/5G NR operations. Additionally, this device supports WLAN/BT technologies but the output power of these modem is not controlled by the smart transmit algorithm.

## 5. RF Exposure Compliance Summary

All transmission scenarios that the DUT supports comply with FCC time-averaged RF exposure requirements, as shown in table.

	RF exposure Evaluation	Power Level	FCC Limit	Highest RF exposure Level	Reference Report
SAR (W/kg)	Standalone 1g	$P_{Limit}$	1.6	1.25	FCC Report SAR_Part.1
	Simultaneous Tx-1g	$P_{Limit}$	1.6	1.59	
psPD (mW/cm <sup>2</sup> )	4cm <sup>2</sup> psPD	<i>input.power.limit</i>	1.0	0.56	FCC Report PD_Part.1
TER	Total Exposure Ratio	$P_{Limit}$ & <i>input.power.limit</i>	1.0	0.99	

**END OF REPORT**