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COMPLIANCE SUMMARY REPORT

Applicant Name: **SAMSUNG Electronics Co., Ltd.** 129, Samsung-ro, Yeongtong-gu, Suwon-Si, Gyeonggi-do, 16677 Rep. of Korea	**Date of Issue:** Jun. 26, 2020 **Test Report No.:** HCT-SR-2006-FC011-R1 **Test Site: HCT CO., LTD.**

FCC ID: A3LSMA516V

Report Type:	**Compliance Summary Characterization**
Equipment Type:	**Mobile Phone**
Model Name:	**SM-A516V**

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REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	Jun. 22, 2020	Initial Release
R1	Jun. 25, 2020	Revised

This test results were applied only to the test methods required by the standard.

The above Test Report is not related to the accredited test result by (KS Q) ISO/IEC 17025 and KOLAS(Korea Laboratory Accreditation Scheme), which signed the ILAC-MRA.

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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 2G/3G/4G/5G NR operations. Additionally, this device supports WLAN/BT/NFC/ANT+/MST 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, denoted as SAR Char and PD Char, determines the power limit that meets FCC exposure requirement after accounting for device design 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 2G/3G/4G/5G Sub6, SAR Char is derived from SAR test measurements and conducted power measurements to determine PLimit 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 PLimit 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 demonstrates that DUT meets FCC SAR and PD limits when transmitting at pre-determined maximum time-averaged power level: PLimit for 2G/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.

Applicable Technologies	Term	Description
2G/3G/4G/5G Sub6	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 *Plimit* 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 Sub6/5G 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}

1.2 Report Serial Number

Frequency	Report description	Report Number
Freq. > 6 GHz.	Part 0 SAR Test Report	HCT-SR-2006-FC008-R1
	Part 1 SAR Test Report	HCT-SR-2006-FC007- R1
Freq.< 6 GHz.	Power Density Simulation Report	Power Density Simulation Report Revision A
	Part 0 Power Density Test Report	HCT-SR-2006-FC009-R1
	Part 1 Power Density Test Report	HCT-SR-2006-FC010-R1
Freq. > 6 GHz.& Freq.< 6 GHz.	Part 2 RF Exposure Report	HCT-SR-2006-FC012-R1

2. Time Averaging Algorithm

2.1 General Information

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 TSAR and TPD 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 PLimit 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 PLimit 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.

2.2 Basic concept of the feature

The Smart Transmit feature is configured to manage the instantaneous transmit power (Tx) to keep the time-averaged power and not exceed *Plimit*.

If time-averaged transmit power approaches the *Plimit*, then the modem needs to limit instantaneous transmit power to ensure the time-averaged transmit power does not exceed the *Plimit* in any T_{SAR} and T_{PD} time windows (i.e., the time-averaged RF exposure complies with the FCC RF exposure limit in any time window).

The wireless device can instantaneously transmit at high transmit powers and exceed the *Plimit* for a short duration before limiting the power to maintain the time-averaged transmit power under the *Plimit*.
If the wireless device transmits at high power for a long duration, 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 feature starts the power limiting enforcement earlier in time to back off the Tx power to a reserve level (denoted as *Preserve*), 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 predefined time window is less than *Plimit* at all times (see Figure 2-2). At all times, Smart Transmit meets the below equation (1):

$$time\ avg.Tx\ power = \frac{1}{T}\int_{t}^{t+T} inst.Tx\ power(t)\,dt \le P_{limit} \qquad (1)$$

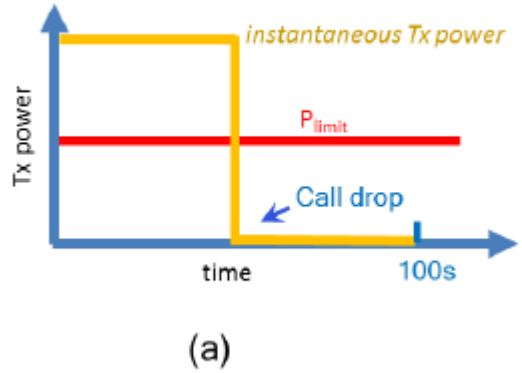

Figure 2-1 Transmit at high power when needed and permitted

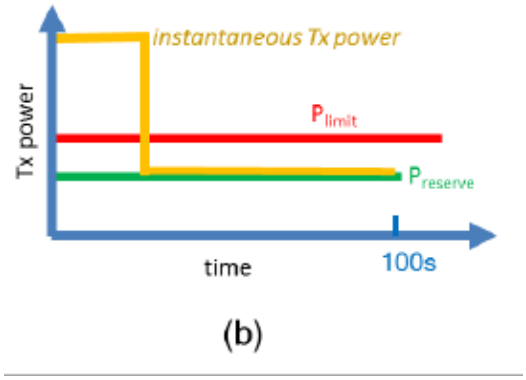

Figure 2-2 Transmit with reserve power to support continuous transmission at a minimum power level (Preserve)

3. DEVICE UNDER TEST

3.1 General Information of the EUT

Device Wireless specification overview		
Band & Mode	**Operating Mode**	**Tx Frequency**
GSM850	Voice / Data	824.2 MHz ~ 848.8 MHz
GSM1900	Voice / Data	1 850.2 MHz ~ 1 909.8 MHz
WCDMA 850	Voice / Data	826.4 MHz ~ 846.6 MHz
WCDMA 1900	Voice / Data	1 852.4 MHz ~ 1 907.6 MHz
LTE Band 2 (PCS)	Voice / Data	1 850.7 MHz ~ 1 909.3 MHz
LTE Band 4 (AWS)	Voice / Data	1 710.7 MHz ~ 1 754.3 MHz
LTE Band 5 (Cell)	Voice / Data	824.7 MHz ~ 848.3 MHz
LTE Band 7	Voice / Data	2 502.5 MHz ~ 2 567.5 MHz
LTE Band 12	Voice / Data	699.7 MHz ~ 715.3 MHz
LTE Band 13	Voice / Data	779.5 MHz ~ 784.5 MHz
LTE Band 66 (AWS)	Voice / Data	1 710.7 MHz ~ 1 779.3 MHz
NR Band n2 (PCS)	Data	1 852.5 MHz ~ 1 907.5 MHz
NR Band n5 (Cell)	Data	826.5 MHz ~ 846.5 MHz
NR Band n66	Data	1 712.5 MHz ~ 1 777.5 MHz
NR band n260	Data	37000 ~ 40000 MHz
NR band n261	Data	27500 ~ 28350 MHz
U-NII-1	Voice / Data	5 180 MHz ~ 5 240 MHz
U-NII-2A	Voice / Data	5 260 MHz ~ 5 320 MHz
U-NII-2C	Voice / Data	5 500 MHz ~ 5 720 MHz
U-NII-3	Voice / Data	5 745 MHz ~ 5 825 MHz
2.4 GHz WLAN	Voice / Data	2 412 MHz ~ 2 462 MHz
Bluetooth / LE 5.0	Data	2 402 MHz ~ 2 480 MHz
NFC	Data	13.56 MHz
MST	Data	555 Hz ~ 8.33 kHz
ANT+	Data	2402 ~ 2480 MHz

This device uses the Qualcomm® Smart Transmit feature to control and manage transmitting power in real time and to ensure the time-averaged RF exposure is in compliance with the FCC requirement at all times for 2G/3G/4G/5G WWAN operations. Additionally, this device supports WLAN/BT/NFC /MST technologies, but the output power of these modems is not controlled by the Smart Transmit algorithm

4. RF Exposure Compliance Summary

	RFx Evaluation	Power Level	FCC Limit	*Reported* RF Exposure Level	Test Report
SAR (W/kg)	Standalone 1g SAR	P_{limit}	1.6	1.37	Part 1 SAR_ Report
	Standalone 10g SAR	P_{limit}	4.0	3.01	
	Simultaneous Tx 1g SAR	P_{limit}	1.6	1.58	
	Simultaneous Tx 10g SAR	P_{limit}	4.0	3.91	
psPD [mW/cm	4cm² psPD	*input.power.limit*	1.0	0.75	Part 1 Power Density_Report
TER	Total Exposure Ratio	P_{limit} for SAR, *input.power.limit* for psPD	1.0	0.997	Part 1 Power Density_Report