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COMPLIANCE SUMMARY REPORT

Applicant Name:

Apple, Inc.
One Apple Park Way
Cupertino, CA 95014 USA

Test Site/Location:

Element, Morgan Hill, CA, USA

Document Serial No.:

1C2503270029-30.BCG

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FCC ID:**BCG-A3281****APPLICANT:****APPLE, INC.****Report Type:**

Compliance Summary

DUT Type:

Watch

Model:

A3281, A3282



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1 STRATEGY FOR COMPLIANCE DEMONSTRATION

1.1 RF Exposure Evaluation Strategy

The FCC RF exposure limits defined based on time-averaged RF exposure. The device under test (DUT) uses the MediaTek Time-averaged SAR algorithm 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 4G/5G NR operations. Additionally, this device supports WLAN/BT/NTN/NFC/802.15.4 AB-NB technologies, but the output power of these modems is not controlled by the Time-averaged SAR algorithm.

Demonstrating compliance of DUT enabled with MediaTek Time-averaged SAR algorithm feature is completed in three parts:

0. RF Exposure Compliance Test Report Part 0: SAR Characterization

The SAR Characterization, denoted as SAR 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 Time-averaged SAR to operate.

For 4G/5G Sub6, SAR Char is derived from SAR test measurements and conducted power measurements to determine P_{Limit} for each technology/band. The P_{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 limits when transmitting at pre-determined maximum time-averaged power level: P_{Limit} for 4G/5G Sub6 NR. The SAR measurement in Part 1 is under static transmission condition.

The compliance for WLAN/BT/NTN/NFC/802.15.4 AB-NB 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 WLAN/BT/NTN/NFC/802.15.4 AB-NB 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 MediaTek algorithm. The test results reported in Part 2 demonstrate that DUT complies with FCC RF exposure requirement under Tx varying transmission scenarios, thereby validity MediaTek Time-averaged SAR.

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1.2 Nomenclature

Applicable Technologies	Term	Description
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 P_{Limit} for all technologies

1.3 Bibliography

Report Type	Report Serial Number
SAR Part 0 Test Report	1C2503270029-27.BCG
SAR Part 1 Test Report	1C2503270029-28.BCG
RF Exposure Part 2 Test Report	1C2503270029-29.BCG

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2 TIME AVERAGING ALGORITHM

2.1 Algorithm Description

The FCC RF exposure limit is defined based on time-averaged RF exposure. When running in a wireless device, MediaTek's Time-averaged SAR 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} for specific absorption rate (SAR for transmit frequency < 6 GHz).

The Time-averaged SAR 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 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 MediaTek's Time-averaged SAR algorithm embedded in MediaTek's 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) in this report.
- The wireless device continuously transmitting at P_{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.

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2.2 Basic concept of the algorithm

The Time-averaged SAR 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} , then the modem needs to limit instantaneous transmit power to ensure the time-averaged transmit power does not exceed P_{Limit} in any T_{SAR} time windows since the time-averaged RF exposure is required to comply with the FCC RF exposure limit in any T_{SAR} time window.
- The wireless device can instantaneously transmit at high transmit powers and exceed the P_{Limit} or level for a short duration before limiting the power to maintain the time-averaged transmit power under P_{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, Time-averaged SAR algorithm starts the power limiting enforcement earlier in time to back off the Tx power to a reserve level (denoted as $P_{UE_backoff}$), so the wireless device can maintain the radio link at a minimum backoff 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, Time-averaged SAR algorithm 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.

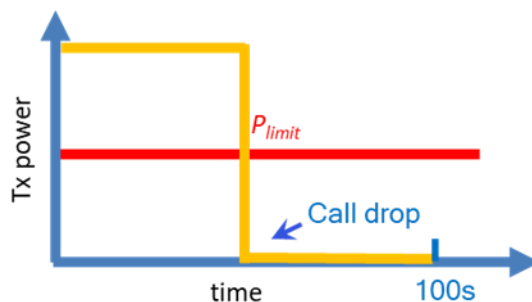


Figure 2-1
Transmit at high power when needed and permitted

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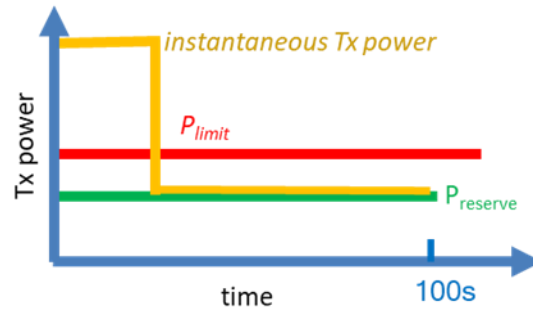


Figure 2-2

Transmit with backoff power to support continuous transmission at a minimum power level ($P_{UE_backoff}$)

- In the case of simultaneous transmission, MediaTek's time-averaged SAR algorithm manages all active transmitters and make sure the total exposure ratio is less than 1

$$\sum \frac{\frac{1}{T_{SAR}} \int_{t-T_{SAR}}^t SAR(t) dt}{FCC\ SAR\ limit} \leq 1$$

Equation 2-2

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DUT DESCRIPTION

3.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
LTE Band 71	Voice/Data	665.5 - 695.5 MHz
LTE Band 12	Voice/Data	699.7 - 715.3 MHz
LTE Band 17	Voice/Data	706.5 - 713.5 MHz
LTE Band 13	Voice/Data	779.5 - 784.5 MHz
LTE Band 14	Voice/Data	790.5 - 795.5 MHz
LTE Band 26 (Cell)	Voice/Data	814.7 - 848.3 MHz
LTE Band 5 (Cell)	Voice/Data	824.7 - 848.3 MHz
LTE Band 66 (AWS)	Voice/Data	1710.7 - 1779.3 MHz
LTE Band 4 (AWS)	Voice/Data	1710.7 - 1754.3 MHz
LTE Band 25 (PCS)	Voice/Data	1850.7 - 1914.3 MHz
LTE Band 2 (PCS)	Voice/Data	1850.7 - 1909.3 MHz
LTE Band 7	Voice/Data	2502.5 - 2567.5 MHz
LTE Band 41	Voice/Data	2498.5 - 2687.5 MHz
LTE Band 53	Voice/Data	2488.5 - 2490 MHz
NR Band n71	Voice/Data	665.5 - 695.5 MHz
NR Band n12	Voice/Data	701.5 - 713.5 MHz
NR Band n14	Voice/Data	790.5 - 795.5 MHz
NR Band n26 (Cell)	Voice/Data	816.5 - 846.5 MHz
NR Band n5 (Cell)	Voice/Data	826.5 - 846.5 MHz
NR Band n66 (AWS)	Voice/Data	1712.5 - 1777.5 MHz
NR Band n25 (PCS)	Voice/Data	1852.5 - 1912.5 MHz
NR Band n2 (PCS)	Voice/Data	1852.5 - 1907.5 MHz
NR Band n7	Voice/Data	2502.5 - 2567.5 MHz
NR Band n41	Voice/Data	2501.01 - 2685.0 MHz
NR Band n53	Voice/Data	2488.5 - 2490MHz
NTN Band 254	Data	1610.2 - 1626 MHz
2.4 GHz WLAN	Voice/Data	2412 - 2472 MHz
5 GHz WIFI	Voice/Data	U-NII-1: 5180 - 5240 MHz U-NII-2A: 5260 - 5320 MHz U-NII-2C: 5500 - 5720 MHz U-NII-3: 5745 - 5825 MHz
Bluetooth	Data	2402 - 2480 MHz
802.15.4 ab-NB	Data	5728.75 - 5846.25 MHz
NFC	Data	13.56 MHz
UWB	Data	6489.6 - 7987.2 MHz

This device uses the MediaTek's Time-averaged SAR algorithm 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 4G/5G operations. Additionally, this device supports WLAN/BT/NTN/NFC/802.15.4 AB-NB technologies, but the output power of these modems is not controlled by the time-averaged SAR algorithm.

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4 COMPLIANCE SUMMARY

4.1 RF Exposure Compliance Summary

All transmission scenarios that the DUT supports comply with FCC time-averaged RF exposure requirements, as shown in Table 4-1.

Table 4-1
Reported RF Exposure Levels

	RFx Evaluation	Power Level	FCC Limit	<i>Reported</i> RF Exposure Level	Test Report
SAR (W/kg)	Standalone 1g SAR	P_{limit}	1.6	1.16	FCC SAR Evaluation Report (Part 1)
	Standalone 10g SAR	P_{limit}	4.0	0.81	
	Simultaneous Tx 1g SAR	P_{limit}	1.6	1.34	
	Simultaneous Tx 10g SAR	P_{limit}	4.0	0.89	

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