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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.:**

1C2205090026-28.BCG

**FCC ID:**

BCGA2761

**APPLICANT:**

APPLE, INC.

**Report Type:**

Compliance Summary

**DUT Type:**

Tablet Device

**Model (s):**

A2761,A2762



|                                      |                            |                                   |
|--------------------------------------|----------------------------|-----------------------------------|
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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 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 two parts:

### 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 3G/4G/5G Sub6 NR and *input.power.limit* for 5G mmW NR. The SAR 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 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.

|                                      |                            |                                   |
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## 1.2 Nomenclature

| Applicable Technologies | Term                        | Description                                                                                                                                          |
|-------------------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3G/4G/5G Sub6           | $P_{Limit}$                 | Power level that corresponds to the exposure design target ( <i>SAR design target</i> ) 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                                                                                                        |
|                         | <i>SAR design target</i>    | Target SAR level resulting in maximum time-averaged exposure optimized from total uncertainty                                                        |
|                         | <i>SAR Char</i>             | Table containing $P_{Limit}$ for all technologies                                                                                                    |
|                         | <i>regulatory body</i>      | Regulatory body that the algorithm is designed to comply. Algorithm's time averaging window is dependent on either FCC or ICNIRP requirements.       |
|                         | <i>reserve power margin</i> | Margin below $P_{Limit}$ reserved for future transmission                                                                                            |
|                         | $P_{reserve}$               | Minimum transmit power with a designated margin below $P_{Limit}$                                                                                    |

## 1.3 Bibliography

| Report Type                    | Report Serial Number |
|--------------------------------|----------------------|
| SAR Part 1 Test Report         | 1C2205090026-25.BCG  |
| RF Exposure Part 2 Test Report | 1C2205090026-26.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, 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  $T_{SAR}$  for specific absorption rate (SAR for transmit frequency < 6 GHz).

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 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) 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

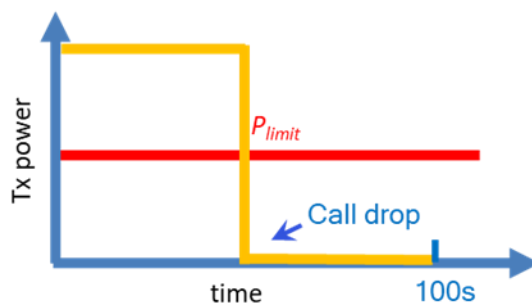
The Smart Transmit algorithm controls and manages the instantaneous transmit power (Tx) to maintain the time-averaged Tx power and therefore, time-averaged RF exposure in compliance with FCC limits.

- If time-averaged transmit power approaches  $P_{Limit}$ , 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, 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:

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

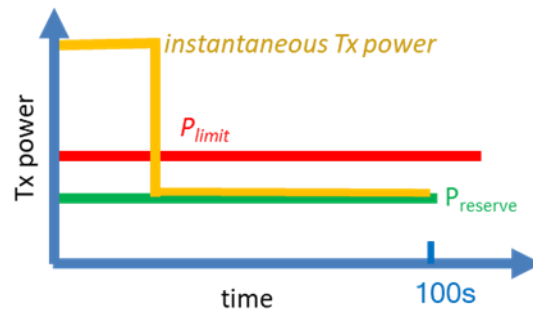
**Equation 2-1**

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.



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

|                                      |                            |                                   |
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**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

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

**Equation 2-2**

|                                      |                            |                                   |
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## 2.3 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>regulatory body</i>                                                       | <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</math> GHz, and 4 seconds for <math>6 \text{ GHz} &lt; f &lt; 42</math> GHz.</li> </ul>                                                                                                                                                                       |
| <i>Tx_power_at_SAR_design_target</i><br>( $P_{Limit}$ in dBm)<br>$f < 6$ GHz | <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><math>P_{Limit}</math> 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> (dB)                                             | The margin below $P_{Limit}$ reserved for future transmission with a minimum transmit power $P_{reserve}$                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <i>Reserve_Power_Margin_db_2g_3g_wwan</i><br>( $P_{reserve}$ in dBm)         | <p>For 2G/3G technology, <i>Reserve_power_margin</i> (dB) = <i>Reserve_Power_Margin_db_2g_3g_wwan</i></p> $P_{reserve} \text{ (dBm)} = P_{limit} \text{ (dBm)} - \text{Reserve\_power\_margin (dB)}$ <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 <math>P_{limit}</math> and the DUT transmits continuously at <math>P_{limit}</math> without utilizing Smart Transmit dynamic control feature.</p>                                                                   |
| <i>total_min_exp_budget_linear_4g_5g_wwan</i>                                | <p>For 4G/5G technology, <i>Reserve_power_margin</i> (dB) = <math>-10 \cdot \log_{10}(\text{total\_min\_exp\_budget\_linear\_4g\_5g\_wwan})</math></p> $P_{reserve} \text{ (dBm)} = P_{limit} \text{ (dBm)} - \text{Reserve\_power\_margin (dB)}$ <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 <math>P_{limit}</math> and the DUT transmits continuously at <math>P_{limit}</math> without utilizing Smart Transmit dynamic control feature.</p>                      |

|                                      |                            |                                   |
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|                              |                                                                                                                                                                                                                                                                                                                                             |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>secondary_split_ratio</i> | For 4G/5G WWAN Technologies, in a two WWAN radio transmission scenario, the minimum reserve margin for the secondary WWAN radio is <i>secondary_split_ratio* total_min_exp_budget_linear_4g_5g_wwan</i> , while the primary radio has a minimum reserve margin of <i>(1-secondary_split_ratio)*total_min_exp_budget_linear_4g_5g_wwan</i> . |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                             |                                   |                                          |
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## 3 DUT DESCRIPTION

### 3.1 Device Overview

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 operations. Additionally, this device supports WLAN/BT technologies, but the output power of these modems is not controlled by the smart transmit algorithm.

| Band & Mode        | Operating Modes | Tx Frequency          |
|--------------------|-----------------|-----------------------|
| UMTS 850           | Data            | 826.40 - 846.60 MHz   |
| UMTS 1750          | Data            | 1712.4 - 1752.6 MHz   |
| UMTS 1900          | Data            | 1852.4 - 1907.6 MHz   |
| 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 30        | Voice/Data      | 2307.5 - 2312.5 MHz   |
| LTE Band 7         | Voice/Data      | 2502.5 - 2567.5 MHz   |
| LTE Band 41        | Voice/Data      | 2498.5 - 2687.5 MHz   |
| LTE Band 48        | Voice/Data      | 3552.5 - 3697.5 MHz   |
| NR Band n71        | Data            | 665.5 - 695.5 MHz     |
| NR Band n12        | Data            | 701.5 - 713.5 MHz     |
| NR Band n14        | Data            | 790.5 - 795.5 MHz     |
| NR Band n5 (Cell)  | Data            | 826.5 - 846.5 MHz     |
| NR Band n26 (Cell) | Data            | 816.5 - 846.5 MHz     |
| NR Band n70        | Data            | 1697.5 - 1707.5 MHz   |
| NR Band n66 (AWS)  | Data            | 1712.5 - 1777.5 MHz   |
| NR Band n25 (PCS)  | Data            | 1852.5 - 1912.5 MHz   |
| NR Band n2 (PCS)   | Data            | 1852.5 - 1907.5 MHz   |
| NR Band n30        | Data            | 2307.5 - 2312.5 MHz   |
| NR Band n7         | Data            | 2502.5 - 2567.5 MHz   |
| NR Band n41        | Data            | 2506.02 - 2679.99 MHz |
| NR Band n77 DoD    | Data            | 3455.01 - 3544.98 MHz |
| NR Band n77 C      | Data            | 3705.0 - 3975.0 MHz   |
| 2.4 GHz WLAN       | Voice/Data      | 2412 - 2472 MHz       |
| U-NII-1            | Voice/Data      | 5180 - 5240 MHz       |
| U-NII-2A           | Voice/Data      | 5260 - 5320 MHz       |
| U-NII-2C           | Voice/Data      | 5500 - 5720 MHz       |
| U-NII-3            | Voice/Data      | 5745 - 5825 MHz       |
| U-NII-5            | Voice/Data      | 5955 - 6415 MHz       |
| U-NII-6            | Voice/Data      | 6435 - 6515 MHz       |
| U-NII-7            | Voice/Data      | 6535 - 6875 MHz       |
| U-NII-8            | Voice/Data      | 6895 - 7115 MHz       |
| Bluetooth          | Data            | 2402 - 2480 MHz       |
| NB UNII-1          | Data            | 5162 - 5245 MHz       |
| NB UNII-3          | Data            | 5733 - 5844 MHz       |

|                                      |                            |                                   |
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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><br>RF Exposure<br>Level | Test Report                              |
|-----------------------|---------------------------|-------------|-----------|-----------------------------------------|------------------------------------------|
| <b>SAR<br/>(W/kg)</b> | Standalone<br>1g SAR      | $P_{limit}$ | 1.6       | 1.175                                   | FCC SAR<br>Evaluation Report<br>(Part 1) |
|                       | Simultaneous Tx<br>1g SAR | $P_{limit}$ | 1.6       | 1.587                                   |                                          |

|                                             |                                   |                                          |
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