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RF EXPOSURE EVALUATION Maximum Permissible Exposure (MPE)

Applicant Name:

Qualcomm Technologies, Inc.
5775 Morehouse Drive
San Diego, CA 92121
United States

Date of Testing:

12/23/2015-3/5/2016

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Test Report Serial No.:

0Y1607131260-R2.J9C

FCC ID: J9CMTP9900LAA

APPLICANT: Qualcomm Technologies, Inc.

EUT Type: LAA Release 13 Small Cell

FCC Rule Part(s): FCC Part 1 (§1.1310) and Part 2 (§2.1091)

FCC Classifications: PCS Licensed Transmitter (PCB),
Unlicensed National Information Infrastructure (NII)

Test Procedure: KDB 447498 D01 v06

The device bearing the FCC Identifier specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and has been tested in accordance with the measurement procedures specified in FCC KDB 447498 D01 v06. These measurements were performed with no deviation from the standards. Test results reported herein relate only to the item(s) tested.

This revised Test Report (S/N: 0Y1607131260-R2.J9C) supersedes and replaces the previously issued test report (S/N: 0Y1607131260-R1.J9C) on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

I authorize and attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.


Randy Ortanez
President



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1.0 RF EXPOSURE EVALUATION – MAXIMUM PERMISSIBLE EXPOSURE (MPE)

1.1 Introduction

This document is prepared on behalf of Qualcomm Technologies, Inc. to show compliance with the RF Exposure requirements as required in §1.1310 of the FCC Rules and Regulations.

The limit for Maximum Permissible Exposure (MPE), specified in FCC §1.1310, is listed in Table 1-1 below. According to FCC §1.1310: the criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b).

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (Minutes)
(A) Limits For Occupational / Control Exposures (f = frequency)				
30-300	61.4	0.163	1.0	6
300-1500	...	...	f/300	6
1500-100,000	...	...	5.0	6
(B) Limits For General Population / Uncontrolled Exposure (f = frequency)				
30-300	27.5	0.073	0.2	30
300-1500	...	...	f/1500	30
1500-100,000	...	...	1.0	30

Table 1-1. Limits for Maximum Permissible Exposure (MPE)

1.2 EUT Description

The Qualcomm LAA Release 13 Small Cell Model: MTP9900 is a 2x2 Tx system that uses two LTE carriers to transmit simultaneously in a licensed band and an unlicensed band. It is also possible to transmit on a 40MHz channel by using both LTE carriers in the unlicensed band at the same time. The test hardware SKU identification number is 65-F5230-910. For this MPE evaluation, the power density is determined from the highest measured conducted power in LTE and LAA modes along with the addition of a 6dBi max antenna gain.

EUT:

Model: MTP9900LAA
SKU NUMBER: 65-F5230-910
MCN NUMBER: 10-F5230-006
Grantee: Qualcomm Technologies, Inc.
FCC ID: J9CMTP9900LAA
Antenna(s): The maximum antenna gain that will be used with this device is 6dBi

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1.3 MPE Requirements Overview

Three different categories of transmitters are defined by the FCC KDB 447498 D01 v06. These categories are fixed installation, mobile, and portable and are defined as follows:

- **Fixed Installations:** fixed location means that the device, including its antenna, is physically secured at a permanent location and is not able to be easily moved to another location. Additionally, distance to humans from the antenna is maintained to at least 2 meters.
- **Mobile Devices:** a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to be generally used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structures and the body of the user or nearby persons. Transmitters designed to be used by consumers or workers that can be easily re-located, such as a wireless modem operating in a laptop computer, are considered mobile devices if they meet the 20 centimeter separation requirement. The FCC rules for evaluating mobile devices for RF compliance are found in 47 CFR §2.1091.
- **Portable Devices:** a portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user. Portable device requirements are found in Section 2.1093 of the FCC's Rules (47 CFR§2.1093).

The FCC also categorizes the use of the device as based upon the user's awareness and ability to exercise control over his or her exposure. The two categories defined are Occupational/ Controlled Exposure and General Population/Uncontrolled Exposure. These two categories are defined as follows:

- **Occupational/Controlled Exposure:** In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means. Awareness of the potential for RF exposure in a workplace or similar environment can be provided through specific training as part of a RF safety program. If appropriate, warning signs and labels can also be used to establish such awareness by providing prominent information on the risk of potential exposure and instructions on methods to minimize such exposure risks.
- **General Population/Uncontrolled Exposure:** The general population / uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity. Warning labels placed on low-power consumer devices such as cellular telephones are not considered sufficient to allow the device to be considered under the occupational/controlled category, and the general population/uncontrolled exposure limits apply to these devices.

The Qualcomm LAA Release 13 Small Cell FCC ID: J9CMTP9900LAA is evaluated to the Mobile Device requirements and is considered a device to be used by the General Population/Uncontrolled Exposure.

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1.4 Procedure

The procedure used to determine the RF power density was based upon a calculation for determining compliance with the MPE requirements. The power generated by each antenna output used in this product was initially measured by a spectrum analyzer and the powers were recorded. Through use of the Friis transmission formula and knowledge of the maximum 6dBi antenna gain to be used, the power density level is calculated at a distance of 20cm.

Friis Transmission Formula

Friis transmission formula: $P_d = (P_{out} * G) / (4\pi r^2)$

Where,

P_d = Power Density (mW/cm²)

π = 3.1416

P_{out} = output power to antenna (mW)

r = distance between observation point and center of the radiator (cm)

G = gain of antenna in linear scale

Calculated MPE

The power density limit for General Population/Uncontrolled Exposure at each frequency is determined based on the information in Table 1-1.

There is no co-location between the electric fields of any two transmitters therefore following power densities are calculated for each individual transmitter by frequency at 20cm spacing:

Frequency	1940 MHz		
Limit	1.000 mW/cm ²		
Distance (cm), R =	20 cm		
Power (dBm), P =	24.47 dBm	279.90 mW	
TX Ant Gain (dBi), G =	6 dBi		
Power Density (S) =	0.222 mW/cm ²	(at 20cm)	
Minimum Distance =	9.4 cm		

Table 1-2. Calculated MPE Data for LTE Band 4 (Chain0)

Frequency:	2115 MHz		
Limit:	1.000 mW/cm ²		
Distance (cm), R =	20 cm		
Power (dBm), P =	24.39 dBm	274.79 mW	
TX Ant Gain (dBi), G =	6 dBi		
Power Density (S) =	0.218 mW/cm ²	(at 20cm)	
Minimum Distance =	9.3 cm		

Table 1-3. Calculated MPE Data for LTE Band 2 (Chain0)

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Frequency	5795 MHz		
Limit	1.000 mW/cm ²		
Distance (cm), R =	20 cm		
Power (dBm), P =	24.22 dBm	264.24 mW	
TX Ant Gain (dBi), G =	6 dBi		
Power Density (S) =	0.209 mW/cm ²	(at 20cm)	
Minimum Distance =	9.1 cm		

Table 1-4. Calculated MPE Data for LAA 5GHz Band (Chain0)

Frequency	2117.5 MHz		
Limit	1.000 mW/cm ²		
Distance (cm), R =	20 cm		
Power (dBm), P =	24.42 dBm	276.69 mW	
TX Ant Gain (dBi), G =	6 dBi		
Power Density (S) =	0.219 mW/cm ²	(at 20cm)	
Minimum Distance =	9.4 cm		

Table 1-5. Calculated MPE Data for LTE Band 4 (Chain1)

Frequency:	1937.5 MHz		
Limit:	1.000 mW/cm ²		
Distance (cm), R =	20 cm		
Power (dBm), P =	24.47 dBm	279.90 mW	
TX Ant Gain (dBi), G =	6 dBi		
Power Density (S) =	0.222 mW/cm ²	(at 20cm)	
Minimum Distance =	9.4 cm		

Table 1-6. Calculated MPE Data for LTE Band 2 (Chain1)

Frequency	5825 MHz		
Limit	1.000 mW/cm ²		
Distance (cm), R =	20 cm		
Power (dBm), P =	24.21 dBm	263.63 mW	
TX Ant Gain (dB), G =	6 dBi		
Power Density (S) =	0.209 mW/cm ²	(at 20cm)	
Minimum Distance =	9.1 cm		

Table 1-7. Calculated MPE Data for LAA 5GHz Band (Chain1)

Frequency	5745 MHz		
Limit	1.000 mW/cm ²		
Distance (cm), R =	20 cm		
Power (dBm), P =	15.58 dBm	36.14 mW	
TX Ant Gain (dB), G =	6 dBi		
Power Density (S) =	0.029 mW/cm ²	(at 20cm)	
Minimum Distance =	3.4 cm		

Table 1-8. Calculated MPE for 802.11a WiFi

1.5 Simultaneous Transmission

Simultaneous transmission results are calculated by adding the highest EIRP in LTE Band 2 or Band 4 and adding it to the highest 5GHz EIRP to compare with its respective power density limits. This is performed for both chains such that a total of 4 transmitters are active.

	Power Density (mW/cm ²)	Limit (mW/cm ²)	Percent MPE Used (%)
Transmitter #1 (LTE Ch0)	0.222	1.000	22.17
Transmitter #2 (LTE Ch1)	0.222	1.000	22.17
Transmitter #3 (LAA Ch0)	0.209	1.000	20.93
Transmitter #4 (LAA Ch1)	0.209	1.000	20.88
Total			86.14

Table 1-9. Calculated MPE Data for Simultaneous Tx

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2.0 CONCLUSION

The device meets the mobile RF exposure limit at a 20cm separation distance as specified in §2.1091 of the FCC Rules and Regulations.

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