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Maximum Permissible Exposure Evaluation

For the

Applied Micro Design

Head End System

FCC ID: 2AES2-1465

WLL Report: 13947-MPE

June 16, 2015

Re-issued August 13, 2015

Prepared for:

APPLIED MICRO DESIGN

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Testing Certificate AT-1448

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Abstract

This report has been prepared on behalf of Applied Micro Design Head End System to document the findings of the maximum permissible exposure evaluation on the Applied Micro Design Head End System. The purpose of this evaluation is to establish a minimum safe distance as per the RF exposure requirements as defined in FCC §1.1307 & §1.1310.

This report documents the results of testing to the requirements of:

- CFR Title 47 Volume 1 Practice and Procedure; (1.1307) Environmental Assessments

The Evaluation was performed by Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Washington Laboratories, Ltd. has been accepted as an EMC Conformity Assessment Body (CAB) under the United States/European Union Memorandum of Agreement. Washington Laboratories, Ltd. is accredited by ACLASS under Testing Certificate AT-1448.

Revision History	Reason	Date
Rev 0	Initial Release	June 16, 2015
Rev 1	Updated due to power levels	August 13, 2015

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1 Introduction

This report has been prepared on behalf of Applied Micro Design Head End System Transmitter to show compliance with the RF exposure requirements as defined in FCC §1.1307.

Testing supporting this evaluation was performed at Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Washington Laboratories, Ltd. has been accepted as an EMC Conformity Assessment Body (CAB) under the United States/European Union Memorandum of Agreement. Washington Laboratories, Ltd. is accredited with ACLASS under Testing Certificate AT-1448.

2 Requirements

Three different categories of transmitters are defined by the FCC in OET Bulletin 65. These categories are fixed installation, mobile, and portable. Additionally, the FCC categorizes the use of the devices based on the user's awareness and the ability to exercise control over his or her exposure. The two categories are defined as Occupational/Controlled Exposure and General Population/Uncontrolled Exposure.

2.1 Transmitter Categories

2.1.1 Fixed Installations

A 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.

2.1.2 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.

2.1.3 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).

2.2 Exposure Categories

The limits for exposure are determined by the type of situation the individual is exposed to. Table 1 lists the limits for the particular environment.

2.2.1 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.

2.2.2 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.

Table 1: MPE Limits

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f2)	6
30–300	61.4	0.163	1	6
300–1500	N/A	N/A	f/300	6
1500–100,000	N/A	N/A	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f2)	30
30–300	27.5	0.073	0.2	30
300–1500	N/A	N/A	f/1500	30
1500–100,000	N/A	N/A	1	30

3 Device Summary

Table 1 below summarizes the criteria used to evaluate the Head End System.

Table 2: Device Summary of the Head End System

Model Evaluated:	1465 DL
Transmitter Category:	Booster
Exposure Category:	General Population/Uncontrolled Exposure
Antenna Gain:	-70dBi (see note 1)
Power Output (dBm):	Multiple Bands – maximum 22.53dBm
Evaluation Distance:	20cm
Frequency Range:	453 - 485MHz & 851-853MHz
Limit:	453 – 485MHz = 0.323mW/cm^2, 851 – 853MHz = 0.568mW/cm^2

Note 1: the system is designed to work with a DAS (Distributed Antenna System) of a building, therefore the gain of -70dBi is correct.

4 Radio Frequency Radiation Exposure Evaluation

The highest RF output power of the unit was measured and recorded. According to §1.1310 of the FCC rules, the power density limit for General Population/Uncontrolled Exposure is 1mW/cm^2. According to §1.1310 of the FCC rules, the power density limit for Occupational/Controlled Exposure is 5mW/cm^2.

The MPE shall be calculated at 20cm to show compliance with the power density limit. The following formula was used to calculate the Power Density:

$$S = \frac{PG}{4\pi R^2}$$

Where:
S = Power Density
P = Output Power at the Antenna Terminals
G = Gain of Transmit Antenna (linear gain-isotropic)
R = Distance from Transmitting Antenna

One Transmitter			
Frequency	483.88	MHz	
Limit	0.323	mW/cm^2	
Distance (cm), R =	20	cm	
Power (dBm), P =	20.03	dBm	
TX Ant Gain (dBi), G =	-70	dB	
Power Density:	0.00	mW/cm^2	**Separation<20 cm**
Minimum Distance:	**0.0**	cm	
Second Transmitter			
Frequency	486.26	MHz	
Limit	0.324	mW/cm^2	
Distance (cm), R =	20	cm	
Power (dBm), P =	19.69	dBm	
TX Ant Gain (dB), G =	-70	dB	
Power Density:	0.00	mW/cm^2	**Separation<20 cm**
Minimum Distance:	**0.0**	cm	
Third Transmitter			
Frequency	482.7	MHz	
Limit	0.322	mW/cm^2	
Distance (cm), R =	20	cm	
Power (dBm), P =	19.887	dBm	
TX Ant Gain (dBi), G =	-70	dB	
Power Density:	0.00	mW/cm^2	**Separation<20 cm**
Minimum Distance:	**0.0**	cm	
Forth Transmitter			
Frequency	461.8	MHz	
Limit	0.308	mW/cm^2	
Distance (cm), R =	20	cm	
Power (dBm), P =	21.212	dBm	
TX Ant Gain (dB), G =	-70	dB	
Power Density:	0.00	mW/cm^2	**Separation<20 cm**
Minimum Distance:	**0.0**	cm	
Fifth Transmitter			

Frequency	453.53	MHz	
Limit	0.302	mW/cm^2	
Distance (cm), R =	20	cm	
Power (dBm), P =	19.987	dBm	
TX Ant Gain (dBi), G =	-70	dB	
Power Density:	0.00	mW/cm^2	**Separation<20 cm**
Minimum Distance:	**0.0**	cm	

Sixth Transmitter

Frequency	478.02	MHz	
Limit	0.319	mW/cm^2	
Distance (cm), R =	20	cm	
Power (dBm), P =	19.687	dBm	
TX Ant Gain (dB), G =	-70	dB	
Power Density:	0.00	mW/cm^2	**Separation<20 cm**
Minimum Distance:	**0.0**	cm	

Seventh Transmitter

Frequency	453.65	MHz	
Limit	0.302	mW/cm^2	
Distance (cm), R =	20	cm	
Power (dBm), P =	20.015	dBm	
TX Ant Gain (dBi), G =	-70	dB	
Power Density:	0.00	mW/cm^2	**Separation<20 cm**
Minimum Distance:	**0.0**	cm	

Eighth Transmitter

Frequency	852	MHz	
Limit	0.568	mW/cm^2	
Distance (cm), R =	20	cm	
Power (dBm), P =	20.009	dBm	
TX Ant Gain (dB), G =	-70	dB	
Power Density:	0.00	mW/cm^2	**Separation<20 cm**
Minimum Distance:	**0.0**	cm	

Ninth Transmitter

Frequency	852	MHz	
Limit	0.568	mW/cm^2	
Distance (cm), R =	20	cm	
Power (dBm), P =	20.009	dBm	
TX Ant Gain (dBi), G =	-70	dB	
Power Density:	0.00	mW/cm^2	**Separation<20 cm**
Minimum Distance:	**0.0**	cm	

Tenth Transmitter

Frequency	852	MHz	
Limit	0.568	mW/cm^2	
Distance (cm), R =	20	cm	
Power (dBm), P =	20.009	dBm	
TX Ant Gain (dB), G =	-70	dB	
Power Density:	0.00	mW/cm^2	**Separation<20 cm**
Minimum Distance:	**0.0**	cm	

Eleventh Transmitter

Frequency	852.54	MHz	
Limit	0.568	mW/cm^2	
Distance (cm), R =	20	cm	
Power (dBm), P =	19.296	dBm	
TX Ant Gain (dBi), G =	-70	dB	
Power Density:	0.00	mW/cm^2	**Separation<20 cm**
Minimum Distance:	**0.0**	cm	

Multiple Transmitter Summary

Power Density:	0.00	mW/cm^2	**Separation<20 cm**
Minimum Distance:	**0.0**	cm	