

# RF Exposure Evaluation

## of

E.U.T. : Radio Box

FCC ID. : PQMCRM01

MODEL : 487-7442, 487-7440

## for

APPLICANT : Caterpillar, Inc.

ADDRESS : 100, North East Adams Street, Peoria, Illinois,  
61629, United States

Prepared by

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Report Number : 16-07-RBF-037-MPE

# TEST REPORT CERTIFICATION

Applicant : Caterpillar, Inc.  
100, North East Adams Street, Peoria, Illinois, 61629, United States

Manufacturer : Panasonic Taiwan Co.,Ltd  
579, Yuan Shan Road, Chung-Ho District, New Taipei City, Taiwan

## Description of EUT

- a) Type of EUT : Radio Box
- b) Trade Name : Caterpillar
- c) Model No. : 487-7442, 487-7440
- d) Power Supply : DC 24V

Regulation Applied : FCC KDB447498 D03. The equipment fulfills the requirements on power density for general population/uncontrolled exposure and therefore fulfills the requirements of 47 CFR Part 15.247 (b)(5).

Note: 1. The result of the testing report relate only to the item tested.

- 2. The testing report shall not be reproduced expect in full, without the written approval of ETC

Date Test Item Received : Jul. 22, 2016  
Date Test Campaign Completed : Oct. 05, 2016  
Date of Issue : Oct. 218, 2016

Test Engineer : Brian Huang  
(Brian Huang, Engineer )

Approve & Authorized Signer : S. S. Liou  
S. S. Liou, Section Manager  
EMC Dept. II of ELECTRONICS  
TESTING CENTER, TAIWAN

**Product Information:**

Type of EUT: Radio Box

FCC ID: PQMCRM01

Model: 487-7442, 487-7440

Description: Radio Box with Bluetooth.

Maximum conducted output power (measured):

BR: **3.48** dBm or **2.228**mWEDR: **3.04** dBm or **2.014**mW

The following table lists the provided authorized antennas:

Model	Antenna Type	Antenna Gain	
		(dBi)	Numeric
RFANT5220110A0T	Chip Antenna	2.0	1.58

Below is an example of the RF Exposure Statement:

**IMPORTANT NOTE:** To comply with the FCC RF exposure compliance requirements, the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. No change to the antenna or the device is permitted. Any change to the antenna or the device could result in the device exceeding the RF exposure requirements and void user's authority to operate the device.

## Relative Requirement for Compliance

According to section 1.1310 of FCC 47 CFR Part 1, limits for maximum permissible exposure (MPE) are as following:

TABLE 1 – LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Averaging Time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0 .....	614	1.63	*(100)	6
3-30 .....	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30-300 .....	61.4	0.163	1.0	6
300-1500 .....	.....	.....	f/300	6
1500-100,000 .....	.....	.....	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/f <sup>2</sup> )	30
30-300 .....	27.5	0.073	0.2	30
300-1500 .....	.....	.....	f/1500	30
1500-100,000 .....	.....	.....	1.0	30

f = frequency in MHz

\* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational / controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

## RF Exposure Calculations:

The following information provides the minimum separation distance for the highest gain antenna provided. This calculation is based on the highest EIRP possible from the system, considering maximum power and antenna gain, and considering a 1.0 mW/cm<sup>2</sup> uncontrolled exposure limit. The formula shown in OET Bulletin 65 is used in the calculation.

Equation from page 19 of OET Bulletin 65, Edition 97-01 is:

$$S = PG / 4 \pi R^2$$

- where: S = power density (in appropriate units, e.g. mW/cm<sup>2</sup>)  
 P = power input to the antenna (in appropriate units, e.g., mW)  
 G = power gain of the antenna in the direction of interest relative to an isotropic radiator  
 R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

hence

$$R = (PG / 4 \pi S)^{1/2}$$

For our device

$$P = 2.228\text{mW}$$

$$G = 1.58$$

$$R = 20 \text{ cm}$$

$$S = (2.228 * 1.58) / (4 * \pi * 20^2) = \underline{\underline{0.0007}} \text{ mW/cm}^2 < 1.0 \text{ mW/cm}^2$$

For complying the FCC limits for general population/uncontrolled exposure, the power density limit is 1.0 mW/cm<sup>2</sup>. The calculation result of the power density at a distance of 20 cm of our device is less than the limit.

This means that according to FCC KDB447498 D03, the equipment fulfills the requirements on power density for general population/uncontrolled exposure and therefore fulfills the requirements of 47 CFR Part 15.247 (b)(5).