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Test Report No.

14017634 001

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Maximum Permissible Exposure Requirement:

Section 47 CFR §1.1307

Three different categories of transmitters are defined by the FCC in OET Bulletin 65. 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:

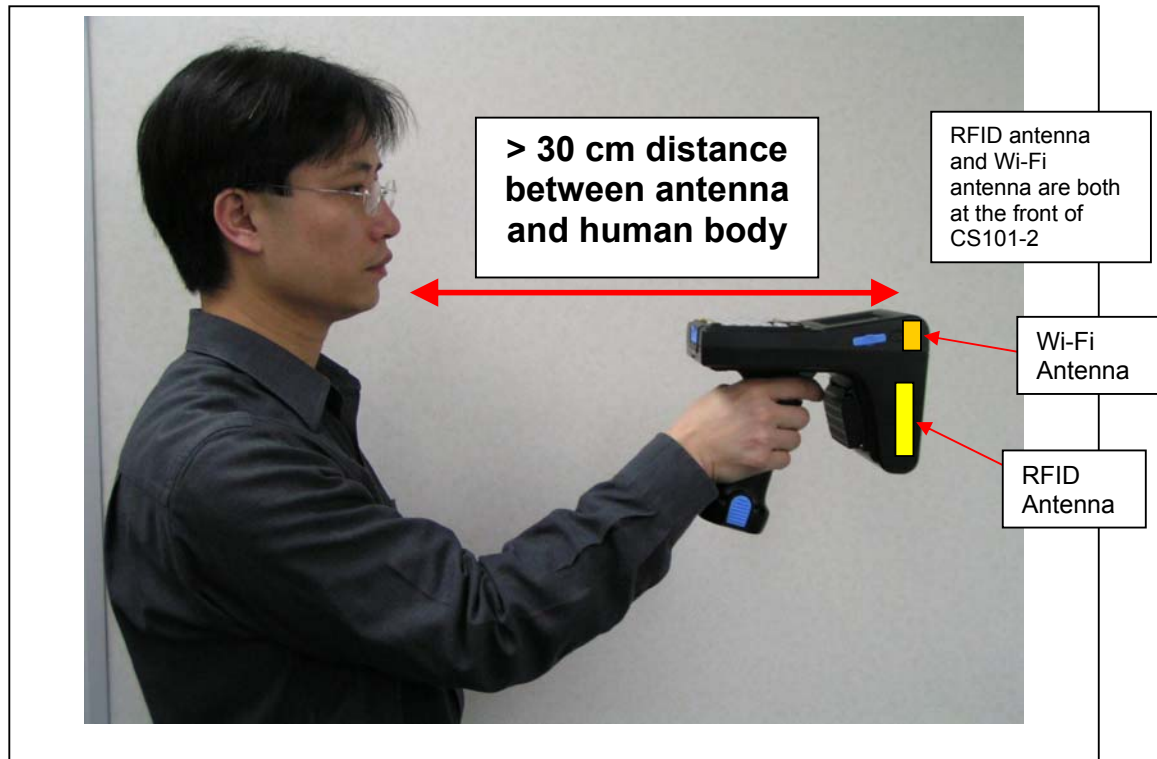
- **Occupational/Controlled Exposure:** In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure 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.

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The CS-101-2 RFID reader is a handheld reader that is used in a handheld operation manner:



The user takes the handheld reader and moves around the work space and read tags. Since it is not used in a fixed place, it falls into the category of mobile or portable devices. Since the antenna is actually > 30 cm away from the user body torso, it can be categorized as mobile devices. Since the distance between antenna and body is generally > 30 cm, the **simplified method of power density compliance is used in this report to show CS101-2 complies with FCC MPE limit of General Population / Uncontrolled Exposure.**

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Radio Frequency Radiation Exposure Evaluation – RFID Mode:

The measured highest RF output power of the EUT feeding to the embedded antenna was 28.6dBm at 927.25MHz. According to §1.1310 of the FCC rules, the power density limit for **General Population/Uncontrolled Exposure** at 927.25 MHz is $f_{(\text{MHz})}/1500 = 0.6182\text{mW}/\text{cm}^2$. The maximum permissible exposure (MPE) is calculated to show the required separation distance that must be maintained during installation to maintain 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 = Power feeding to the embedded patch antenna

G = Tx gain of the antenna (linear gain)

R = Distance from the antenna

For the EUT, the calculation is as follows:

$$P = 28.6\text{dBm} = 724.4\text{mW}$$

$$G = \text{Maximum Antenna Gain} = 5.5\text{dBi} = \text{anti-log}(5.5/10) = 3.55$$

At 20cm separation,

$$S = \frac{724.4 \times 3.55}{4\pi(20)^2} = 0.5116\text{mW}/\text{cm}^2$$

Based on the above calculation for 20cm separation, the power density does not exceed FCC limit of $0.6182\text{mW}/\text{cm}^2$.

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Radio Frequency Radiation Exposure Evaluation – WiFi Mode:

The measured highest RF output power of the EUT feeding to the embedded antenna was 11.5dBm at 2412MHz. According to §1.1310 of the FCC rules, the power density limit for **General Population/Uncontrolled Exposure** at 2412MHz is = 1.0 mW/cm². The maximum permissible exposure (MPE) is calculated to show the required separation distance that must be maintained during installation to maintain 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 = Power feeding to the embedded patch antenna

G = Tx gain of antenna (linear gain)

R = Distance from the antenna

For the EUT, the calculation is as follows:

$$P = 11.5\text{dBm} = 14.13\text{mW}$$

$$G = \text{Maximum Antenna Gain} = 2.0\text{dBi} = \text{anti-log}(2.0/10) = 1.585$$

At 20cm separation,

$$S = \frac{14.13 \times 1.585}{4\pi(20)^2} = 0.004456\text{mW/cm}^2$$

Based on the above calculation for 20cm separation, the power density does not exceed FCC limit of 1.0mW/cm².