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## REPORT

# RF Exposure Report for RFID Reader XT-1

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### Summary

This document reports the results from the Maximum Permissible Exposure analysis performed for RFID Reader XT-1.

ORG. FUNCTION

### Revision History

Revision	Date	Issued by	Comment
01	2014-01-29	Marcus Dahl	First release

*This document follows the TagMaster documentation version numbering standard to identify the document version. This standard use the form P01A, P01B to P01n for draft versions (not for customer issue) then 01 for a released version (reviewed; can be given to the customer). Subsequent issues use 02, 03, 04 etc and are changed via the formal change control process*

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DOCUMENT CLASS

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## 1. Introduction

The RFID Reader XT-1 is evaluated according to FCC guidelines for human exposure to radio frequency electromagnetic fields. The evaluation results are used as part of the FCC-application.

The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached. Although the Friis transmission formula is a far field assumption, the calculated result of that is an over-prediction for near field power density. We will take that as the worst case to specify the safety range.

### 1.1. References

- [1] Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, (<http://transition.fcc.gov>)
- [2] 13-111 XT-1 Installation Manual

### 1.2. Definitions and abbreviations

Abbreviation	Description
DUT	Device Under Test
EIRP	Effective Isotropic Radiated Power
FCC	Federal Communications Commission
MPE	Maximum Permissible Exposure
RFID	Radio-frequency identification

Table 1. List of abbreviations

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## 2. System Description

### 2.1. Assessed Object

Name of test object (DUT)	XT-1 US
Model / Type	XT-1
Part No.	152600
Serial No.	-
FCC ID	-
Manufacturer	TagMaster AB
Supply Voltage	12V - 24V
Software version	-
Comments	-



Figure 1: Photo of assessed object.

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## 2.2. Characteristics and parameters of the assessed object

### RFID Reader XT-1:

Antenna	:	Integral antenna
Operating frequency	:	902.75MHz – 927.25MHz
Transmit power	:	1W
Max Duty Cycle	:	100% during normal use
Power Supply	:	12V – 24V

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### 3. RF Exposure Evaluation

#### 3.1. RF Exposure Limits

According to FCC 1.1310: The criteria listed in the table 2 below shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation.

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Average Time (minutes)
<b>(A)Limits For Occupational / Control Exposures</b>				
300-1500	...	...	F/300	6
1500-100,000	...	...	5	6
<b>(B)Limits For General Population / Uncontrolled Exposure</b>				
300-1500	...	...	F/1500	6
1500-100,000	...	...	1.0	30

Table 2. Limits for maximum permissible exposure (MPE), F = Frequency in MHz.

#### 3.2. Exposure classification for XT-1

The FCC rules define two types of permissible exposure differentiated by the situation in which the exposure takes place and/or the status of the individuals who are subject to exposure.

##### **General Population/uncontrolled exposure**

The limits apply to those situations in which persons may not be aware of the presence of electromagnetic energy, where exposure is not employment-related, or where persons cannot exercise control over their exposure.

##### **Occupational/controlled exposure**

The limits apply to situations in which persons are exposed as a consequence of their employment, have been made fully aware of the potential for exposure, and can exercise control over their exposure.

The classification of XT-1 is Occupational/controlled exposure.

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### 3.3. Friis Formula

The Friis transmission formula:

$$P_d = \frac{P_{out}G}{4\pi R^2}$$

where;

Pd = power density in mW/cm<sup>2</sup>

Pout = output power to antenna in mW

G = gain of antenna in linear scale

Pi = 3.1416

R = distance between observation point and center of the radiator in cm

If we know the maximum Gain of the antenna and the total power input to the antenna the MPE value at distance R can be calculated.

*Ref. : David K. Cheng, Field and Wave Electromagnetics, Second Edition, Page 640, Eq. (11-133).*

### 3.4. EUT operating condition

The antenna of the product, under normal use condition, is at least 25cm away from the body of the user. Warning statement to the user for keeping at least 25cm or more separation distance with the antenna is included in the XT-1 installation manual, see ref [1].

### 3.5. Calculations

#### RF Exposure Limit and the calculated value at distance 25cm:

Limit for MPE (from FCC part 1.1310 table 2) for frequency f = 902.75MHz is:

$$\text{Limit MPE} = f(\text{Mhz}) / 1500 = 902.75 / 1500 = 0.60 \text{ mW/cm}^2$$

Highest allowed Pout is 1W which together with the antenna gain of 6dBi gives an Effective Isotropic Radiated Power of 4W.

$$P_d = \frac{P_{out}G}{4\pi R^2} = \frac{4000mW}{1600\pi} = 0.509mW/cm^2$$

Pd = **0.509 mW/cm<sup>2</sup>**, which is at least 0.09 mW/cm<sup>2</sup> below to the limit.

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## 4. Conclusions

The XT-1 is found to be compliant to the Maximum Permissible Exposure limits specified in the standard FCC 1.1310.