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Innovative Radio Frequency Solutions

Maximum Permitted Exposure

Revision – Draft

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Table of Contents

1	REVISION HISTORY	2
2	ABBREVIATIONS.....	2
3	REFERENCE DOCUMENTS.....	3
4	INTRODUCTION.....	3
5	GENERAL INFORMATION	3
6	ANTENNA.....	3
6.1	INTEGRAL ANTENNA.....	3
6.2	EXTERNAL YAGI ANTENNA	4
7	OPERATING CONFIGURATION AND EXPOSURE CONDITIONS.....	4
8	MPE CALCULATION.....	4
9	CONCLUSION	5
10	REVISIONS	5

1 Revision History

Revision	Date	Description
Draft	Feb 24, 2014	Initial release

The details of each revision are captured in Revision Details Section 6.

2 Abbreviations

Abbreviation	Description
Attn	attenuator
BW	bandwidth
dB	decibel
dBc	decibel relative to carrier power
dB _i	decibel relative to an isotropic antenna
dBm	decibel relative to 1 milliwatt
FCC	federal communications commission
GPS	global positioning system
IC	Industry Canada
ISM	industrial, scientific and medical
ISR	interrupt service routine
kHz	kilohertz
LCD	liquid crystal display
LED	light emitting diode
LNA	low noise amplifier
mA	milliampere
mcd	millicandle
MHz	mega-hertz

Abbreviation	Description
mm	millimeter
msec	millisecond
mV	millivolt
PA	power amplifier
PLL	phase locked loop
ppm	parts per million
RBW	resolution bandwidth
RF	radio frequency
RTC	Real time clock
TBC	to be confirmed
TBD	to be determined
TRP	total radiated power
µA	microampere
TDD	Time division duplex
UART	universal asynchronous receiver/transmitter
V	volts
W	width

3 Reference Documents

1. MLink Antenna Specification – Draft, Feb 10, 2014
2. A09-Y8NF Yagi Antenna datasheet – May 2003 (A09-Y8NF.pdf)
3. MLink Circuit Description – Draft, Feb 10, 2014

4 Introduction

This document shows how compliance with maximum RF exposure is met by the MLink module operating under FCC 15.247 and RSS 210 with integral and external Yagi antennas.

5 General Information

Device category: Mobile with Integral antenna
Fixed with external Yagi antenna

Environment: Uncontrolled exposure in general public (uncontrolled environment) for Integral and external Yagi antenna

6 Antenna

The MLink module is design for used with two antennas types – an Integral Antenna and an External Yagi Antenna.

6.1 Integral Antenna

The integral antenna is a custom design specifically for use with MLink 900 module with a measured peak gain of 2.1 dBi (Ref 1).

Configuration	Antenna Polarization	Type	Freq. Band	Max. Gain (dBi)
Mobile or Fixed	Vertical	Omni	900 MHz	2.1

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6.2 External Yagi Antenna

The external Yagi Antenna is made by several manufacturers (MaxStream Inc (A08-Y8NF) and Laird Technologies (PC904)) with a gain of 4.8 dBd (7 dBi) including a 1.2 dB min cable loss.

Configuration	Antenna Polarization	Type	Freq. Band	Max. Gain (dBi)
Fixed	Vertical	Yagi	900 MHz	7

7 Operating Configuration and Exposure Conditions

The max conducted power for the MLink 900 module is 29 dBm with a 50% max duty cycle (max TX of 100 ms followed by 100 ms RX). The integral antenna is directly connected to the MLink 900 module, while the external Yagi antenna is connected through an RF cable.

8 MPE Calculation

From FCC 1.1311 Table 1(B) and RSS-102 section 4.2 the MPE is 0.6 mW/cm² max @ 900 MHz.

The MPE at 20 cm separation is calculated as follows:

MLink 900 module conducted TX power

$$29 \text{ dBm} = 800 \text{ mW}$$

With 50% duty cycle

$$800 \text{ mW} \times 50\% = 400 \text{ mW}$$

Spherical surface area with a 20 cm radius

$$4\pi r^2 = 5000 \text{ cm}^2$$

For an isotropic antenna the RF intensity at 20 cm is

$$400 \text{ mW} / 5000 \text{ cm}^2 = 0.08 \text{ mW/cm}^2$$

For the Integral Antenna with max 2.1 dBi gain (1.62 linear gain) the max RF intensity at 20 cm is

$$0.08 \text{ mW/cm}^2 \times 1.62 = 0.13 \text{ mW/cm}^2 @ 20 \text{ cm separation}$$

which is less than the 0.6 mW/cm² max @ 20 cm specification

Similarly for the External Yagi Antenna with max 7 dBi gain (5 linear gain) the max RF intensity at 20 cm is

$$0.08 \text{ mW/cm}^2 \times 6 = 0.4 \text{ mW/cm}^2 @ 20 \text{ cm separation}$$

which is less than the 0.6 mW/cm² max @ 20 cm specification

9 Conclusion

The MLink 900 module complies with the MPE requirements for both the integral antenna (section 6.1) and the external Yagi antenna (section 6.2) with a minimum 20 cm separation between the antenna and the user in normal operation.

10 Revisions