Maximum Permitted Exposure

Revision – Draft

Mar 29, 2021

Table of Contents

1 Revision History

Revision	Date	Description
Draft	Mar 29, 2021	Initial release

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

2 Abbreviations

Abbreviation	Description
ATTN	**Atten**uator
FCC	**F**ederal **C**ommunications **C**ommissions
IC	**I**ndustry **C**anada
LNA	**L**ow **N**oise **A**mplifier
PA	**P**ower **A**mplifier
RBW	**R**esolution **B**and**w**idth
RF	**R**adio **F**requency
Rx	**R**eceive
SW	**S**oft**w**are
TBC	**T**o **B**e **C**onfirmed
TBD	**T**o **B**e **D**etermined
TRP	**T**otal **R**adiated **P**ower
Tx	**T**ransmit
TDD	**T**ime **D**ivision **D**uplex

3 Reference Documents

1. MLink PCB Antenna Specification – Draft, Mar 29, 2021
2. A09-Y8NF Yagi Antenna datasheet – May 2003 (A09-Y8NF.pdf)
3. MLink Ultra Functional Circuit Description – Draft, Mar 29, 2021

4 Introduction

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

5 General Information

Device category: Mobile with integral PCB antenna
Fixed with external Yagi antenna

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

6 Antenna

The MLink module is design for used with two antenna types - an integral PCB antenna and an external Yagi antenna.

6.1 Integral PCB Antenna

The integral PCB antenna is a custom design specifically for use with the MLink Ultra module with a measured peak gain of 2 dBi (Ref 1).

Configuration	Antenna Polarization	Type	Freq. Band	Max. Gain (dBi)
Mobile or Fixed	Vertical	Omni	900 MHz	2

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 Ultra module is 29 dBm with a 50% max duty cycle (max TX of 100 ms followed by 100 ms RX). The integral PCB antenna is directly connected to the MLink Ultra module through 50 Ω microstrip track, while the external Yagi antenna is connected through a 50 Ω RF cable.

8 MPE Calculation

From FCC 1.1311 Table 1(B) and RSS-102 section 4.2 the MPE is 0.6 mW/cm^2 max @ 900 MHz.

The MPE at 20 cm is separation is calculated as follows:

MLink 900 module conducted TX power

29 dBm = 800 mW

With 50% duty cycle

800 mW x 50% = 400 mW

Spherical surface area with a 20 cm radius

$4\pi r^2$ = 5000 cm^2

For an isotropic antenna the RF intensity at 20 cm is

400 mW / 5000 cm^2 = 0.08 mW/cm^2

For the Integral Antenna with max 2 dBi gain (1.58 linear gain) the max RF intensity at 20 cm is

0.08 mW/cm^2 x 1.58 = 0.13 mW/cm^2 @ 20 cm separation

which is less than the 0.6 mW/cm^2 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 mW/cm^2 x 6 = 0.4 mW/cm^2 @ 20 cm separation

which is less than the 0.6 mW/cm^2 max @ 20 cm specification

9 Conclusion

The MLink Ultra module complies with the MPE requirements for both the integral PCB 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