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MIFARE Plus Card Coil Design

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Document information

Info	Content
Keywords	Contactless, MIFARE Plus, ISO/IEC 14443, Resonance, Coil, Inlay
Abstract	This document provides guidance for engineers designing magnetic loop antenna coils for the MIFARE Plus.

NXP
founded by Philips

Revision history

Rev	Date	Description
01	20090626	Initial version

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1. Introduction

This document describes the details of the antenna coil design for the MIFARE Plus. It does not replace but extend the details as explained in [1]. Although such antennas are relatively straightforward in principle and look very similar when comparing various contactless smartcards, experience proves that their parameters do have a noticeable impact on performance.

1.1 How to use this document

In this document only the hints and notes specific to MIFARE Plus are explained. All the basics and common design details are explained in the base document [1]. Use the base document and apply wherever required the notes mentioned here.

1.2 Reference documents

[1]   AN 011732 "MIFARE Card Coil Design Guide"

1.3 Abbreviations and terms

Table 1 lists the abbreviations as used in this document.

Table 1.   Table of abbreviations

Abbreviation	
PICC	Proximity Chip Card or object (ISO/IEC 14443), tag
PCD	Proximity Coupling Device (ISO/IEC 14443), "reader"
Reader IC	NXP MIFARE Reader IC (MF RC500, MF RC530, MF RC531, CL RC632, MF RC522, MF RC523, MF RC170, MF RC171)
Reader module	MIFARE Reader Core Module (MF CM200, MF CM500, MF CM520)
MIFARE Reader	Mikron or Philips MIFARE Reader (MF RD260, MF RD560)
Contactless Interface	Proximity Contactless interface acc. to ISO/IEC 14443A
MIFARE Interface	Proximity Contactless interface acc. to MIFARE
SAM	Secure Application Module
UID	Unique Identifier (ISO/IEC 14443), unique per card IC
RID	Random ID (ISO/IEC 14443), dynamically generated during power on of the card IC, used to protect privacy
B	Byte (= 8 bit)
b	bit
GPB	General Purpose Byte (byte 9 in the sector trailer of a MIFARE Classic memory)

Abbreviation	
RFU	Reserved for Future Use

2. Design notes for MIFARE Plus

2.1 Threshold Resonance Frequency

The appropriate resonance frequency of the antenna coil depends on the card IC and application. To cover manufacturing tolerances and optimum performance, for MIFARE Plus, NXP recommends a resonance frequency of

$$14.50 \text{ MHz} < f_{RT} < 15.00 \text{ MHz}$$

2.2 Practical design hints and recommendations

2.2.1 ID1-sized antennas

Hints for antenna design

- Within the confines of the application and the card manufacturing processes used, try to maximize the antenna size. The outermost turn of the antenna coil should be placed as close as possible to the edge of the card (represented by an 81 x 49 mm rectangle).
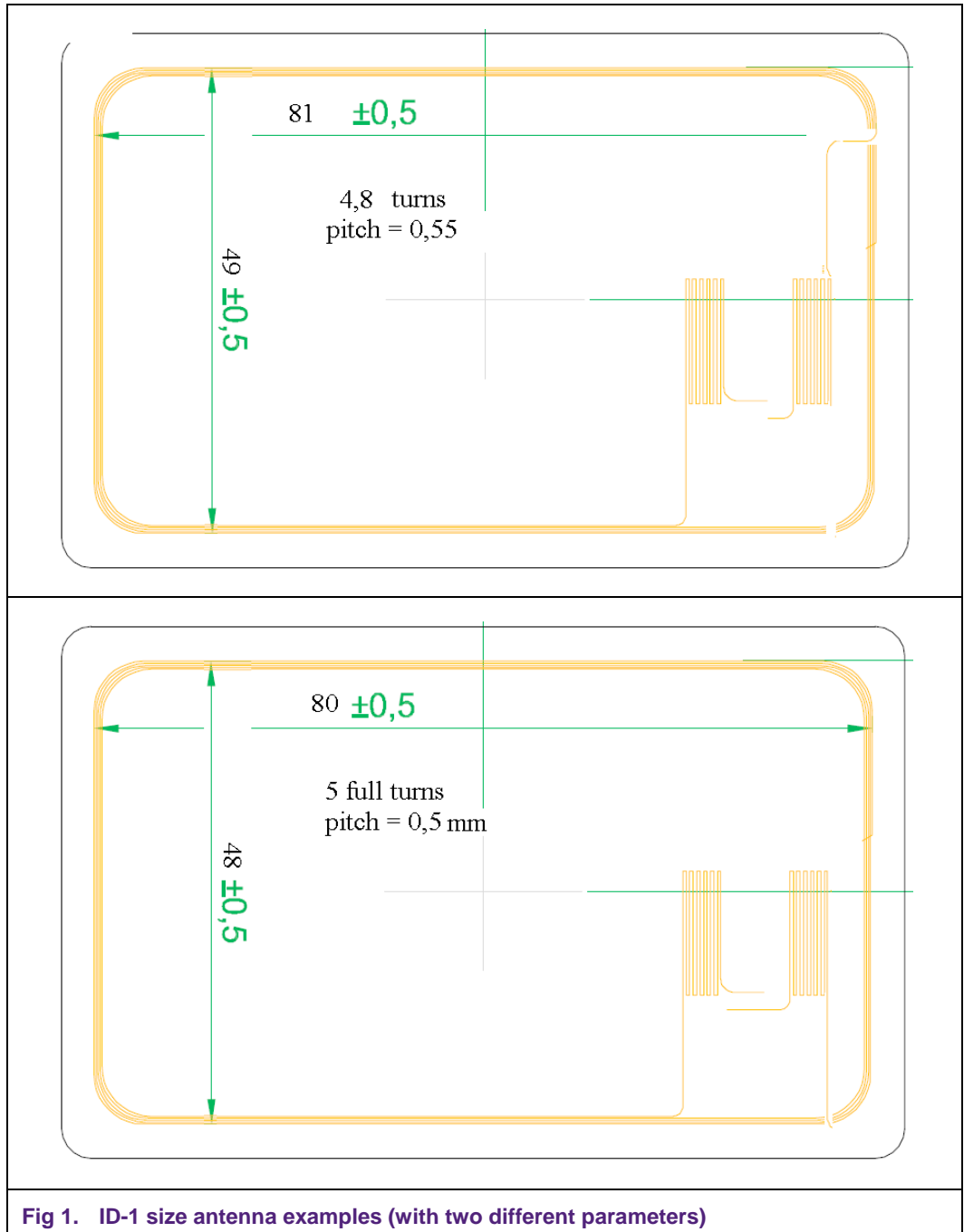 **Note:** international standards and industry specifications may restrict the choice.

Fig 1.   ID-1 size antenna examples (with two different parameters)

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