
Optimizing Read-Range of the 13.56 MHz Demonstration Reader

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INTRODUCTION

The 13.56 MHz Anticollision Reader in the DV103003 microID™ Developer's Kit is designed to demonstrate basic operation of the MCRF355, but not to show the limits of its performance. The MCRF355 is a very advanced, carrier-independent tagging IC with the lowest power consumption and highest speed in the industry as of this writing. Designing a reader that takes advantage of the inherent performance of the MCRF355 involves two primary optimizations:

- a) Increasing the speed of the digital processing by using a high-end PICmicro® microcontroller (MCU) to sample the data and calculate the checksums. This will help take advantage of the 2.2 msec data burst time and high-speed anti-collision capabilities of the MCRF355.
- b) Increasing the reader's carrier field volume and/or power output in order to provide power to the tag at longer distance from the reader. This application note describes one method of accomplishing this improvement.

Following are the steps to achieve a read-range of 12 inches to 18 inches using a 2-inch x 2-inch sample tag based on MCRF355, properly tuned to the carrier frequency.

1. Disconnect the power cable and RS-232 cable from the reader, and remove the six screws from the back of the case.
2. Make an antenna with the following parameters:
 - a) Use AWG #18 ~ #20 wire.
 - b) Make one turn: a rectangular loop with 7.85-inches x 7.75-inches as shown in Figure 1. This antenna will fit in PAC TEC's CF-125 enclosure. The enclosure is available from PAC TEC or its distributors. This will result in about 800 nH ~ 1 µH of inductance.
 - c) This inductance requires 172 pF ~ 138 pF of capacitance to tune the antenna circuit to 13.56 MHz.

3. Connect the new inductor (antenna) and capacitor to the demo reader board by following these steps:
 - a) Disconnect the C31, C9, and C10 from the circuit board.
 - b) Disconnect L3 (printed antenna) from the circuit. This can be accomplished by cutting off the metallic trace on the board.
 - c) Connect the new resonant capacitance (172 pF ~ 138 pF) at C31, C9, C10.
 - d) Connect the new antenna at L3. Connect one side of the antenna to the resonant capacitor and the other side to ground.

4. Tuning the antenna circuit:

The benefit of this modification will be realized only if the antenna circuit is tuned precisely to the 13.56 MHz carrier. Here is one method for tuning the circuit:

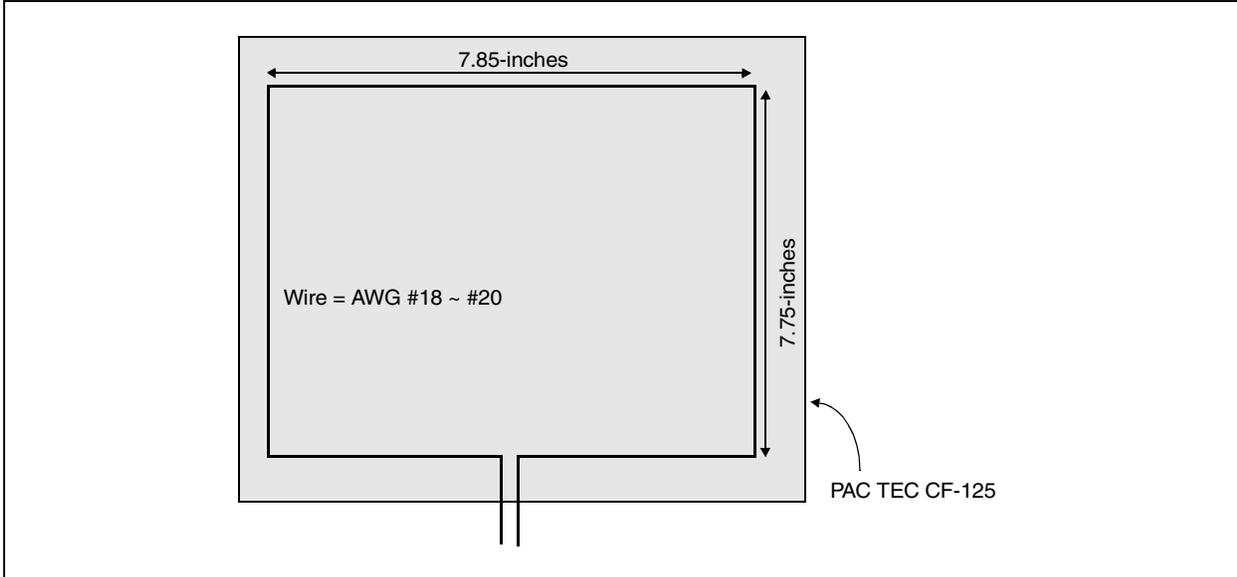
- a) Connect an oscilloscope across the new antenna (L3).
- b) Observe the voltage while adjusting the capacitance (C31, C9, C10).
- c) Adjust the cap to + and - direction and stop at the maximum voltage.
- d) Bring the voltage to above 200 VPP.

5. Read-Range Measurement:

Reconnect the power and RS-232 cables to the reader. The reader should now provide between 12 ~ 18 inches of read range. If it does not exhibit this performance, check the following:

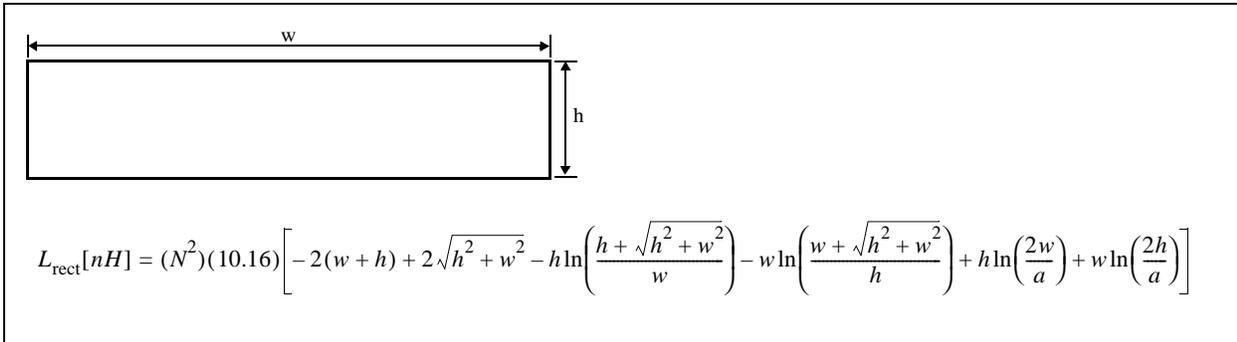
- a) Check the antenna voltage again, bringing it to above 200 VPP.
- b) Adjust VR1 in the reader circuit; VR1 is very sensitive to voltage. Connect a 1 MΩ resistor across C17 permanently. Then, connect a Digital Volt Meter across the resistor, and adjust the VR1 between 4.7-volts to 4.87-volts while measuring the read range. Set the VR1 for maximum range.

FIGURE 1: ANTENNA GEOMETRY



1.1 Formula for Inductance Calculation

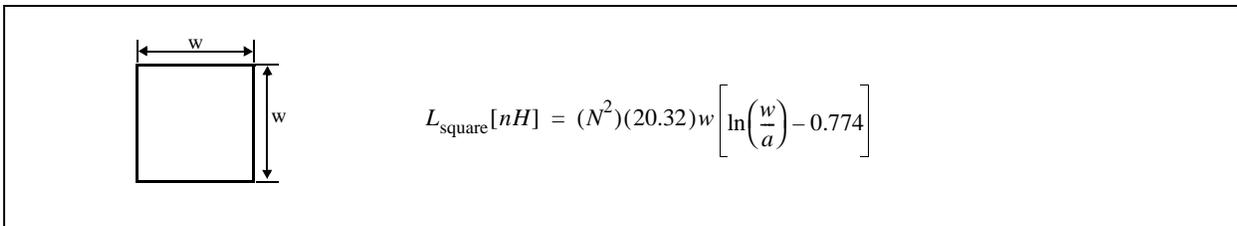
EQUATION 1: RECTANGULAR LOOP



where:

- N = number of turns
- w = width of the rectangle (inches)
- h = height of the rectangle (inches)
- a = wire radius (inches)

EQUATION 2: SQUARE LOOP



where:

- N = number of turns
- w = length of one side (inches)
- a = wire radius (inches)

NOTES:



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