## Abstract

Provides guidelines for the design of a tamper loop for the ICODE 3 TagTamper product.
1 Introduction

ICODE 3 TagTamper features a tamper evidence function. The TagTamper feature is used to identify an unauthorized access, or the manipulation of a product, package or system. Tampering attempts are detected and permanently stored in the memory of ICODE 3 TagTamper. The information can optionally be reported to the cloud. If the TagTamper feature is enabled, the opened or closed status is mirrored in the tag’s response (NDEF Message).

The ICODE 3 TagTamper IC includes four connection pads (Figure 1). The antenna is connected to the LA and LB pads of the IC. The TagTamper detection wire (Tamper loop) is connected to the tamper pads DP and GND. The connection of the TagTamper detection wire is checked at each startup of ICODE 3 TagTamper.

A command can be used to read the status of the TagTamper wire. The response of ICODE 3 TagTamper to the command is based on the open/close status of the Tamper loop. For more details on the command, refer to [1].
2 Design guidelines

This section provides some guidelines for the design of a tamper loop.

Note: To verify the functionality of your application, run the final characterization of your samples.

2.1 Requirements and conditions

When designing a Tamper loop, consider the following:

1. Requirement 1 - ON/OFF resistance value:
   • To detect the Tamper loop as closed, keep R<50 Ω.
   • To detect the Tamper loop as opened, keep R>1 MΩ.

2. Requirement 2 - The induced voltage on the Tamper loop must not exceed 0.5 V (peak).
2.2 Other considerations

2.2.1 Tamper loop material

The Tamper loop is made of a conductive material. The material and length of the loop must comply with requirement 1 (Section 2.1).

2.2.2 Overlapping area

The overlapping area is at the intersection of the Tamper loop conductors and the outer track of the vicinity coupling device (VCD) antenna. Figure 2 illustrates the overlapping area.

![Figure 2. Illustration of the overlapping area](image-url)
Figure 3 shows a different design with a long Tamper wire. The overlapping area is calculated by adding the lengths of the Tamper loop conductors that intersect with the VCD antenna track.

If using a VCD antenna size Class 6, the sum of all the overlapping areas must not exceed 2.5 cm$^2$. See Table 1 for other VCD antenna sizes.

### 2.2.3 VCD antenna sizes and mapped field strengths

Table 1 provides the values of the VCD field strengths and allowed overlapping areas for various antenna sizes.

<table>
<thead>
<tr>
<th>Antenna size</th>
<th>$H_{\text{MAX}}$ [A/m (rms)]</th>
<th>Allowed overlapping area [cm$^2$]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile devices’ average/estimated antenna size</td>
<td>1.5</td>
<td>15</td>
</tr>
<tr>
<td>Class 1</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Class 2</td>
<td>8.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Class 3</td>
<td>8.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Class 4</td>
<td>12</td>
<td>3.8</td>
</tr>
<tr>
<td>Class 5</td>
<td>14</td>
<td>3.3</td>
</tr>
<tr>
<td>Class 6</td>
<td>18</td>
<td>2.5</td>
</tr>
</tbody>
</table>
2.2.4 Layout considerations

- Avoid Tamper loops with large open areas (Figure 4).

Figure 4. Tamper loop with large open area
• Avoid placing the Tamper loop around the tag antenna.

Figure 5. Tamper loop around the tag antenna
• Keep the Tamper loop conductors close to each other (Figure 6).

Figure 6. Tamper loop conductors in proximity
3 References

4 Revision history

Table 2. Revision history

<table>
<thead>
<tr>
<th>Document ID</th>
<th>Release date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AN13646 v.1.0</td>
<td>29 March 2024</td>
<td>Initial version</td>
</tr>
</tbody>
</table>

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