About ground loops
Unsuitable connections can lead to different potentials between the camera system GND and the environmental shield/chassis GND caused by ground loops. This can damage the camera and the connected devices or cause malfunctions.

- Avoid potential differences between the camera housing and GND.
- All wiring must be done by authorized personnel, according to the corresponding technical standards.
- You may mount the camera electrically isolated.
- Read the description in this document carefully.

Uncritical setup
Ground loops are a general risk of setups with any camera that is connected using non-isolated I/Os, such as GPIOs. However, an environmental setup is uncritical if no devices powered by PELV (Protective extra low voltage) are involved.

In Figure 1, only the power supply for the embedded board or the PC is PELV-powered. Therefore, no ground loop is possible. The following section is about ground loops between PELV-powered devices and how to avoid them.
Ground loop explanation

Ground loops can occur only for camera applications including both

- PELV-powered devices in the vision application
- Use of camera GPIOs

With the figures on the following pages, you can easily recognize if ground loops may occur for your application.

Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE</td>
<td>Protective earth</td>
</tr>
<tr>
<td>PELV</td>
<td>Protective extra low voltage</td>
</tr>
<tr>
<td>PLC</td>
<td>Programmable logic controller, such as Siemens SIMATIC</td>
</tr>
</tbody>
</table>

Ground loop factors

**PELV power**  
PELV power supplies are used to better protect the user from injuries and death. Power supplies used for embedded boards and PCs are PELV type.

**Camera ground**  
Camera ground connects to
- Camera chassis ground
- PE of the embedded board or PC that connects to
  - PELV power supply.

**PELV devices**  
PELV-powered devices in the environment of the machine application bear the risk of a ground loop.

**PELV ground**  
The PELV power supply’s output zero conductor is connected to the ground of the device. Through the line power supply, this PE conductor is connected to earth.

**High voltage**  
On PE, high voltage up to 2500 V can occur, caused by, for example:
- Machine defects in the environmental setup
- Friction from ground movements or moving machine parts
- Chemical processes in the ground.

Ground loop risks

**Critical setup**  
If a device of the environmental setup has a PELV power supply, it is connected to PE as is the power supply of the embedded board or PC; a ground loop is created.

**Material damage**  
High voltage can destroy the camera or connected devices, such as the embedded board or PC, or peripherals.
Setup causing a ground loop

Ground loop: GPIOs and PELV devices

In Figure 2, a camera uses non-isolated GPIOs, while PELV-powered devices are part of the environmental setup. In this case, avoid ground loops with a barrier isolator. See Setup to avoid ground loops on page 4.

Figure 2: Ground loop when using GPIOs

<table>
<thead>
<tr>
<th>Gray line</th>
<th>Cable connection</th>
</tr>
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<tbody>
<tr>
<td>V1</td>
<td>I/Os connect through the embedded board to the camera</td>
</tr>
<tr>
<td>V2</td>
<td>I/Os connect directly to the camera</td>
</tr>
<tr>
<td><strong>Black line</strong></td>
<td>PE ground</td>
</tr>
<tr>
<td><strong>Red line</strong></td>
<td>Ground loop</td>
</tr>
</tbody>
</table>
Setup to avoid ground loops

No ground loop: GPIOs and barrier isolator

Using a **barrier isolator** is one solution among several solutions to avoid ground loops. In Figure 3, a barrier isolator between non-isolated GPIOs of the camera and the environmental setup avoids ground loops.

![Diagram showing setup to avoid ground loops](Image)

**Figure 3: No ground loop when using GPIOs and a barrier isolator**

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<td><strong>Red line</strong></td>
<td>Ground loop</td>
</tr>
<tr>
<td><strong>Green rectangle</strong></td>
<td>Isolator avoiding ground loops</td>
</tr>
</tbody>
</table>