

# Avoiding Ground Loops in Vision Systems

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## 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. Do the following to avoid damage the camera and the connected devices or causing malfunctions.

- Avoid potential differences between the camera housing and ground.
- 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.

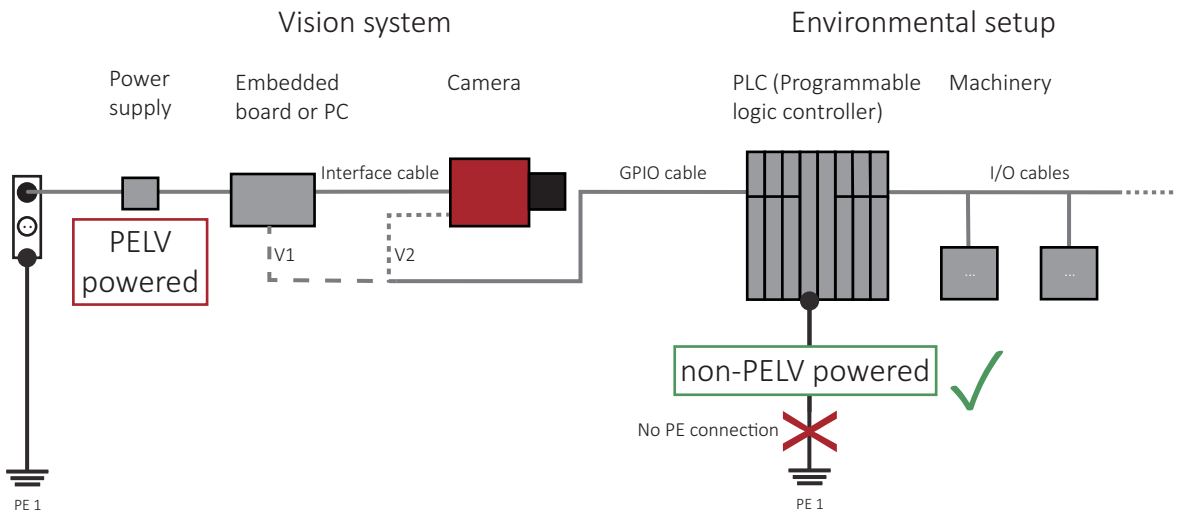


Figure 1: No ground loop in an environmental setup **without** PELV-powering

| Gray line  | Cable connection                                      |
|------------|---|
| V1         | I/Os connect through the embedded board to the camera |
| V2         | I/Os connect directly to the camera                   |
| Black line | PE (protective earth) ground                          |

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.

## Acronyms

| Acronym | Meaning  |
|---------|--|
| PE      | Protective earth                                       |
| PELV    | Protected extra low voltage                            |
| PLC     | Programmable logic controller, such as Siemens SIMATIC |

Table 7: Acronyms

## Ground loop factors

| Acronym       | Meaning   |
|---------------|---|
| 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: <ul style="list-style-type: none"> <li>• Camera chassis ground</li> <li>• PE of the embedded board or PC that connects to PELV power supply.</li> </ul>  |
| PELV devices  | PELV-powered devices in the machine application environment 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 Volts can occur, caused by, for example: <ul style="list-style-type: none"> <li>• Machine defects in the environmental setup</li> <li>• Friction from ground movements or moving machine parts</li> <li>• Chemical processes in the ground.</li> </ul> |

Table 8: Ground loop factors

## Ground loop risks

| Acronym         | Meaning   |
|-----------------|---|
| 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, creating a ground loop. |
| Material damage | High voltage can destroy the camera or connected devices, such as the embedded board or PC, or peripherals  |

Table 9: Ground loop risks

## Setup causing a ground loop

### Ground loop: GPIOs and PELV devices



#### NOTICE

##### Damage to the camera and connected devices

Ground loops can damage cameras and connected devices or cause malfunctions.

- Avoid setups causing ground loops as shown in [Figure 2](#).
- See [Figure Setup to avoid ground loops](#) on page 4.

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.

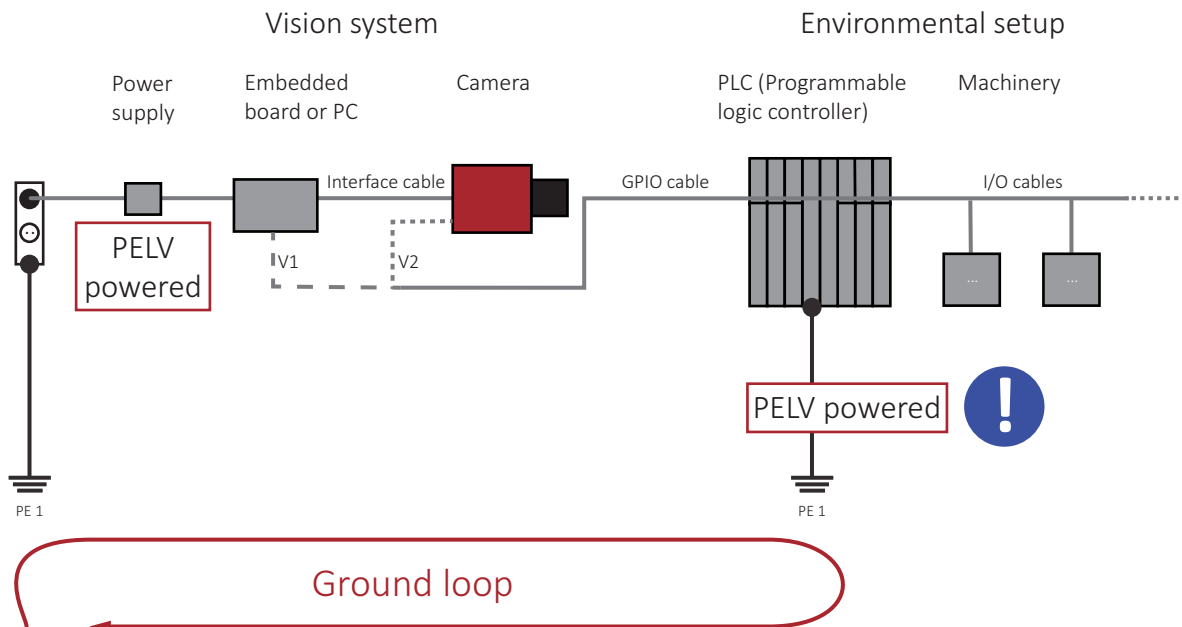


Figure 2: Ground loop when using GPIOs

|                   |   |
|-------------------|---|
| <b>Gray line</b>  | Cable connection                                      |
| V1                | I/Os connect through the embedded board to the camera |
| V2                | I/Os connect directly to the camera                   |
| <b>Black line</b> | PE ground   |
| <b>Red line</b>   | Ground loop   |

## Setup to avoid ground loops

### No ground loop: GPIOs and barrier isolator



#### NOTICE

##### Damage to the camera and connected devices

Ground loops can damage cameras and connected devices or cause malfunctions. For example, use a barrier isolator, as shown in [Figure 2](#).

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.

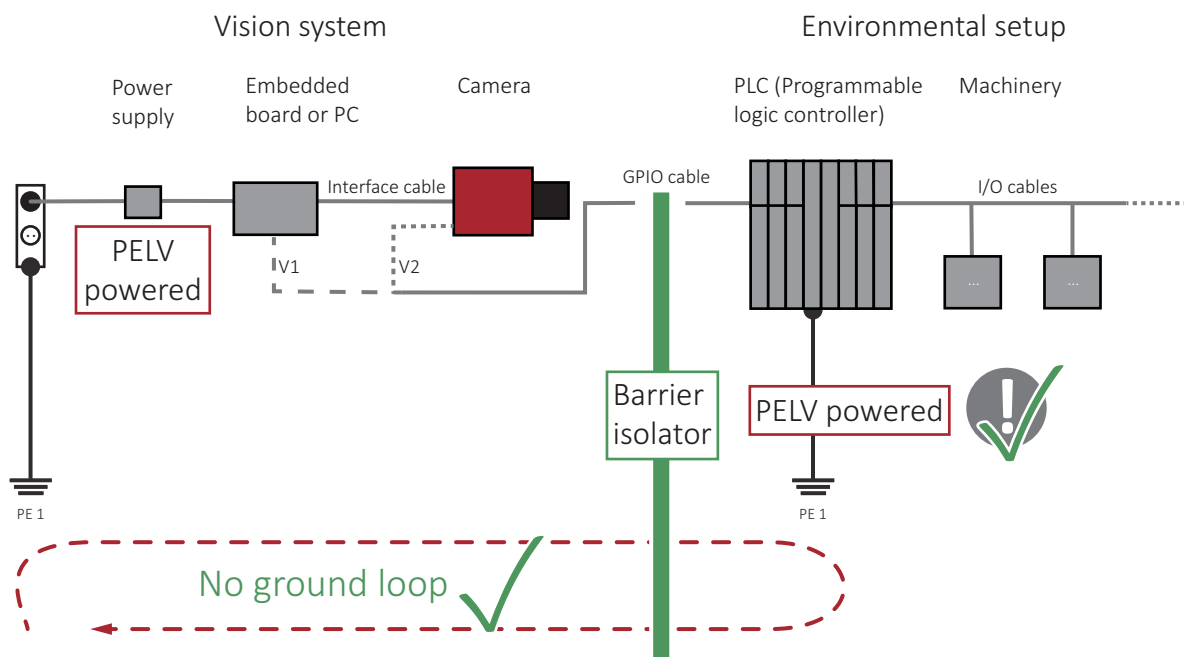


Figure 3: No ground loop when using GPIOs and a barrier isolator

|                        |   |
|------------------------|---|
| <b>Gray line</b>       | Cable connection                                      |
| V1                     | I/Os connect through the embedded board to the camera |
| V2                     | I/Os connect directly to the camera                   |
| <b>Black line</b>      | PE ground   |
| <b>Red line</b>        | Ground loop   |
| <b>Green rectangle</b> | Isolator avoiding ground loops                        |

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| Europe, Middle East, and Africa | T// +49 36428 677-230  |
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| China                           | T// +86 21 64861133  |

## Headquarters

Allied Vision Technologies GmbH  
Taschenweg 2a  
07646 Stadtroda, Germany  
T// +49 36428 677-0  
F// +49 36428 677-28

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