Avoiding Ground Loops in Vision Systems

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Scope

This application note applies only if cameras are connected to host computers that are PELV powered. Laptops and embedded boards use different power supplies. In this case and when non-PELV power supplies are used, you do not have to worry about this.

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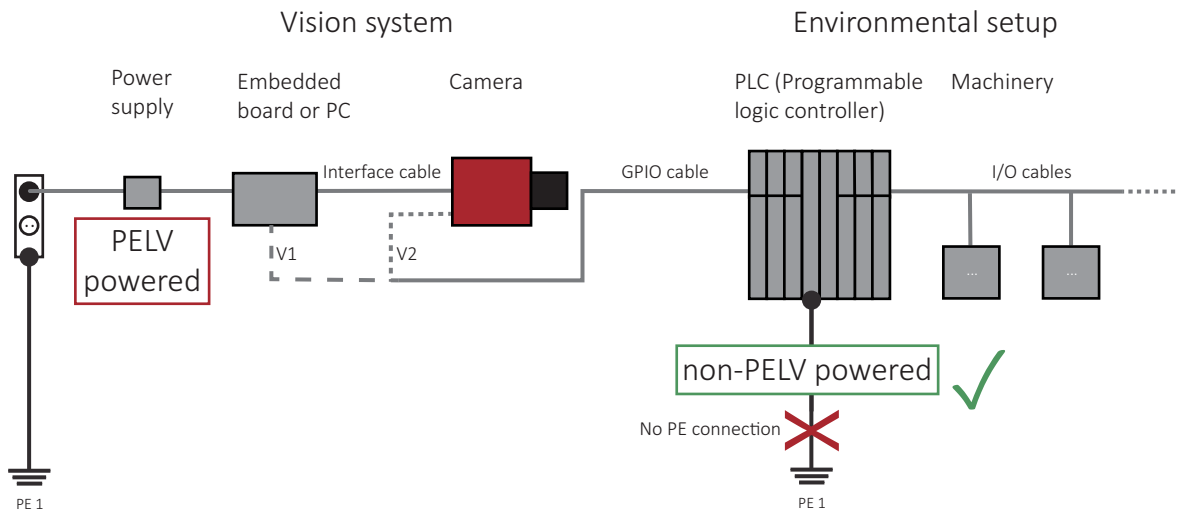
Figure 1: No ground loop in an environmental setup **without** PELV-powering

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: • Camera chassis ground • PE of the embedded board or PC that connects to PELV power supply.
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: • Machine defects in the environmental setup • Friction from ground movements or moving machine parts • Chemical processes in the ground.

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 5.

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 5.

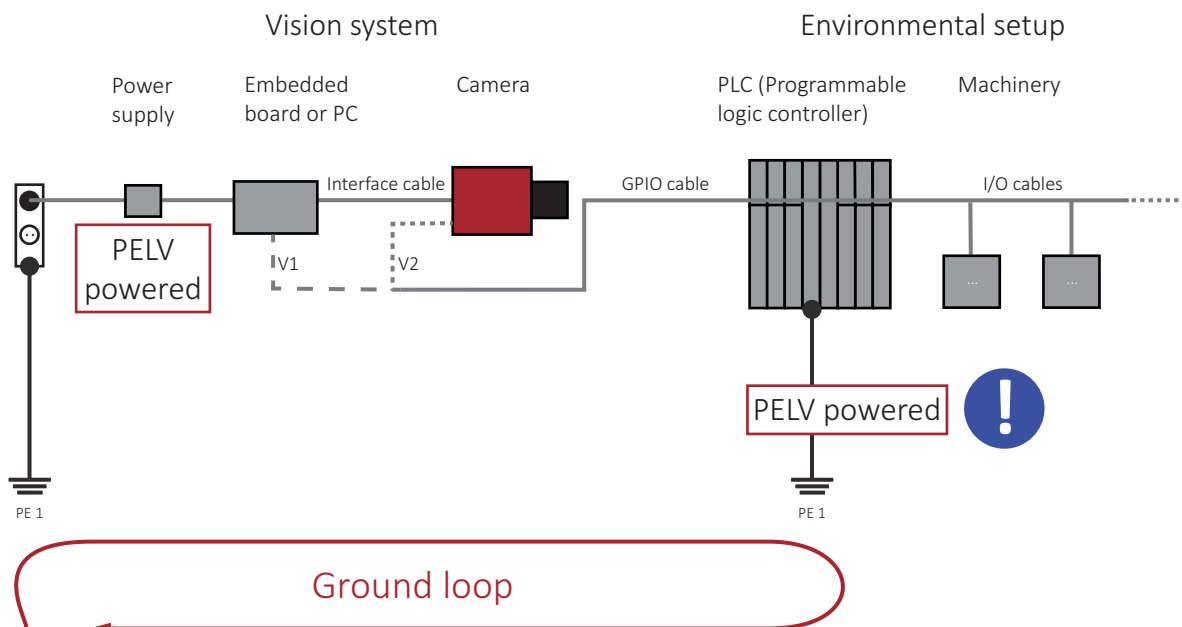Figure 2: Ground loop when using GPIOs

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 ground
Red line	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-islolated GPIOs of the camera and the environmental setup avoids ground loops.
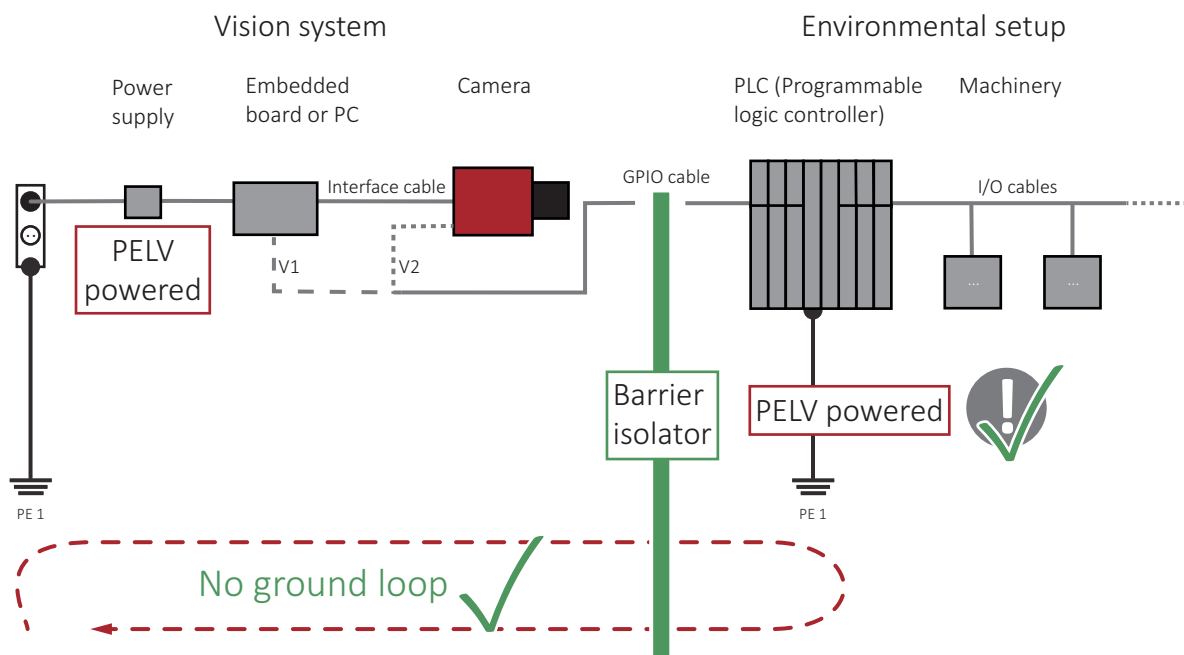

Figure 3: No ground loop when using GPIOs and a barrier isolator

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 ground
Red line	Ground loop
Green rectangle	Isolator avoiding ground loops

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