

APPLICATION NOTE

Avoiding Ground Loops in Vision Systems

V1.1.0
2025-Jul-22

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.

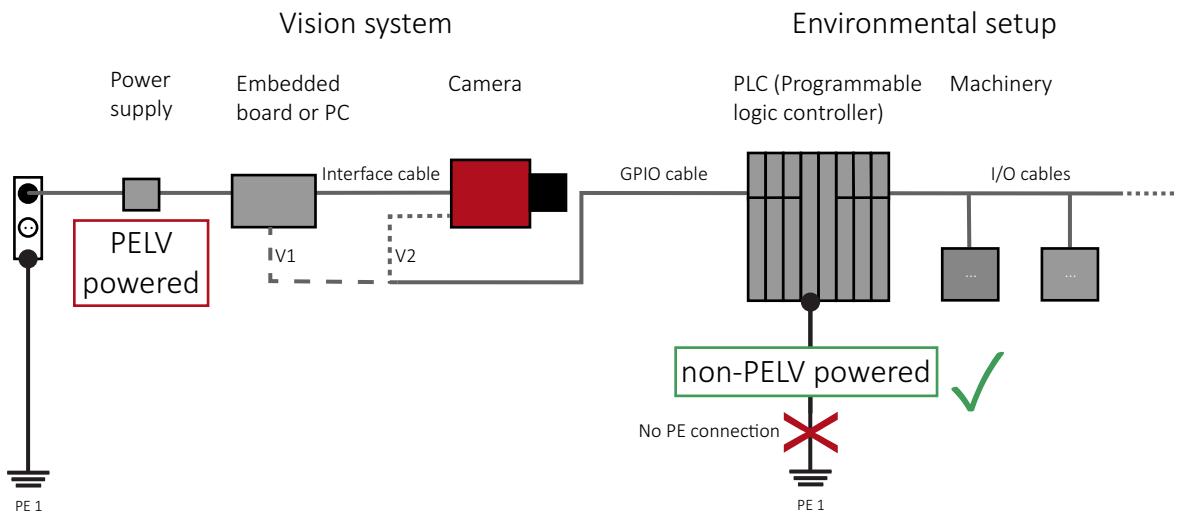


Figure 1: No ground loop in an environmental setup **without** PELV-powering

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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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.

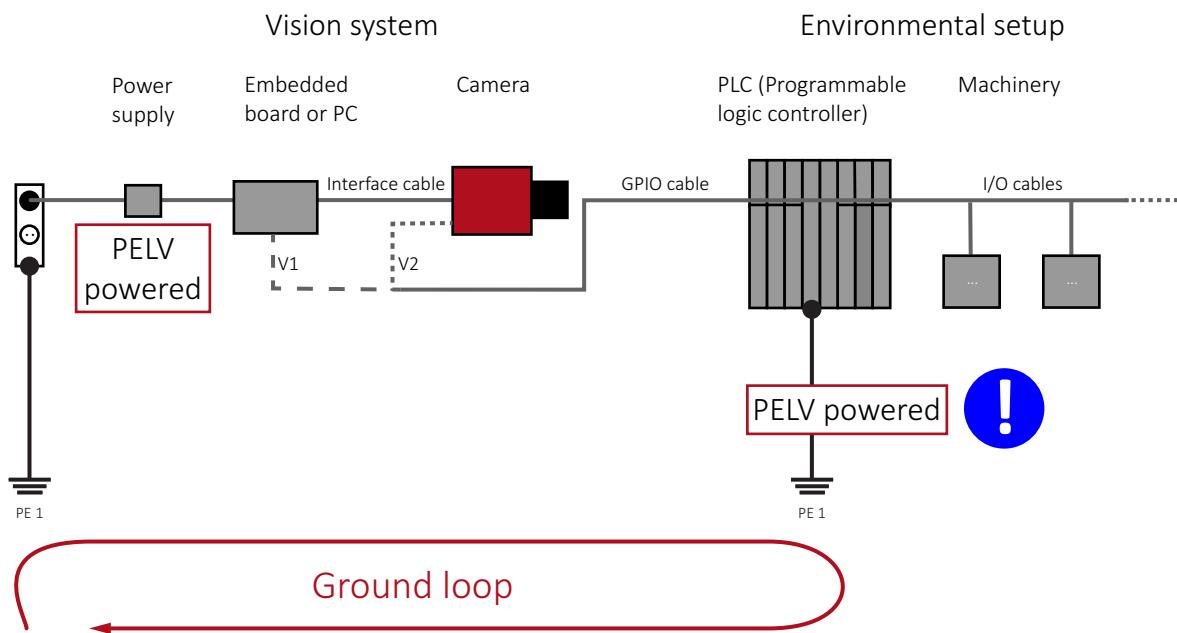


Figure 2: Ground loop when using GPIOs

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-isolated GPIOs of the camera and the environmental setup avoids ground loops.

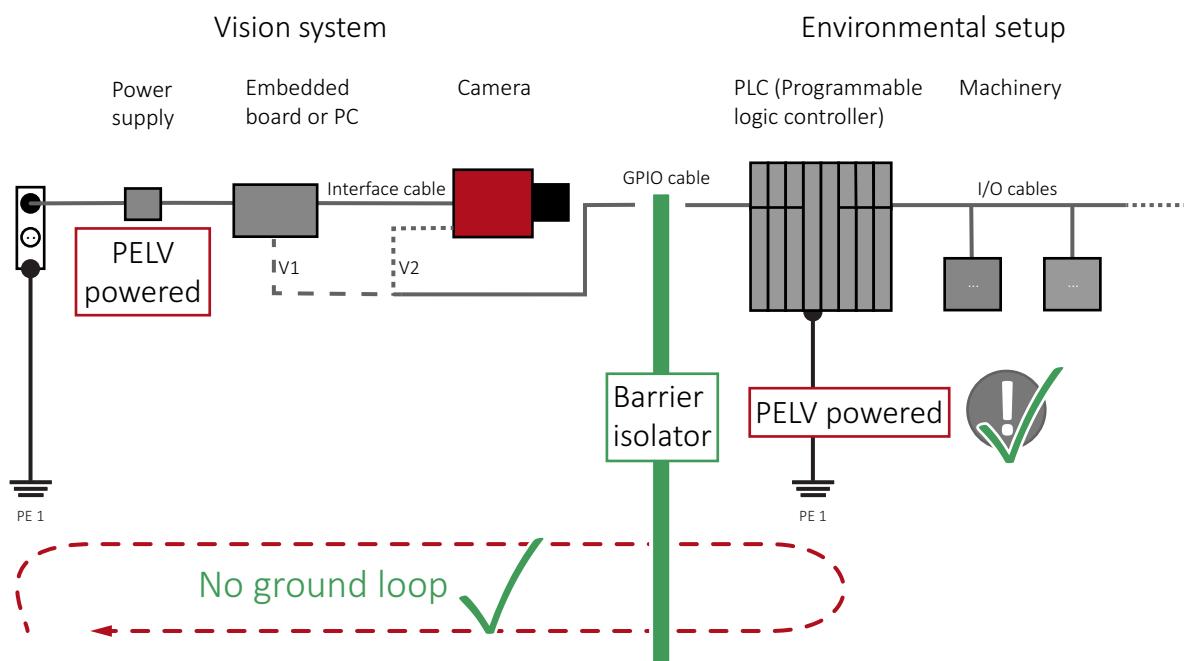


Figure 3: No ground loop when using GPIOs and a barrier isolator

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

Contact us

Website, email

General

www.alliedvision.com/en/contact

info@alliedvision.com

Distribution partners

www.alliedvision.com/en/avt-locations/avt-distributors

Support

www.alliedvision.com/en/support

www.alliedvision.com/en/about-us/contact-us/technical-support-repair-/rma

Offices

Europe, Middle East, and Africa (Headquarters)

Allied Vision Technologies GmbH

Taschenweg 2a

07646 Stadtdroda, Germany

T// +49 36428 677-0 (Reception)

T// +49 36428 677-230 (Sales)

F// +49 36428 677-28

North, Central, and South America, Canada

Allied Vision Technologies Canada Inc.

300 – 4621 Canada Way

Burnaby, BC V5G 4X8, Canada

T// +1 604 875 8855

USA

Allied Vision Technologies, Inc.

102 Pickering Way- Suite 502

Exton, PA 19341, USA

Toll-free// +1-877-USA-1394

T// +1 978 225 2030

Asia-Pacific

China

Allied Vision Technologies Shanghai Co Ltd.

B-510, Venture International Business Park

2679 Hechuan Road

Minhang District, Shanghai 201103

People's Republic of China

T// +86 21 64861133

Japan

Allied Vision Technologies

Yokohama Portside Bldg. 10F

8-1 Sakae-cho, Kanagawa-ku

Yokohama-shi, Kanagawa, 221-0052

T// +81 (0) 45 577 9527

Singapore

Allied Vision Technologies Asia Pte. Ltd

82 Playfair Rd, #07-01 D'Lithium

Singapore 368001

T// +65 6634 9027

Liability, trademarks, and copyright

Allied Vision has tested the product under the described conditions. The customer assumes all risk of product damage, application compromise or potential failure, and Sales Warranty loss related to deviation from the described conditions. Allied Vision's acknowledgement of such deviations in the customer's modified product or applications does not constitute advice for use. No Warranty is offered or implied by Allied Vision regarding the customer's assumed risk or legal responsibilities with such modified products or applications.

All text, pictures, and graphics are protected by copyright and other laws protecting intellectual property. All content is subject to change without notice. All trademarks, logos, and brands cited in this document are property and/or copyright material of their respective owners. Use of these trademarks, logos, and brands does not imply endorsement.

Copyright © 2025 Allied Vision Technologies GmbH. All rights reserved.