



# MASTERING GALVANIC ISOLATION: ENSURING SAFETY IN POWER ELECTRONICS WITH WÜRTH ELEKTRONIK PRODUCTS.

Timur Uludag

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

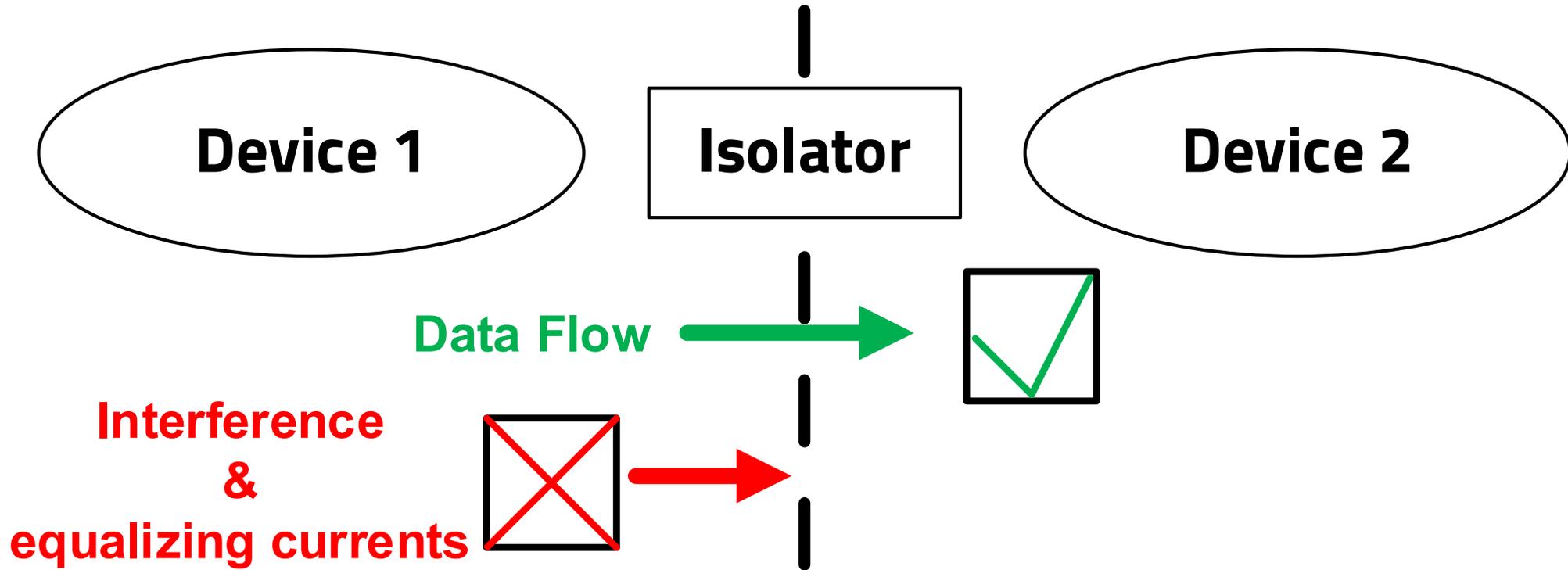
# WHAT IS GALVANIC ISOLATION!

Sort of Definition

**Different sections of electrical systems**  
**to prevent**  
**current flow between them**  
**while allowing data and power transfer.**

# WHAT IS GALVANIC ISOLATION!

Sort of Definition





# APPLICATIONS

# APPLICATIONS FOR GALVANIC ISOLATION!

Broad variety usecases



## Industrial Automation

- Communication Interfaces:
  - ✓ Field Bus
  - ✓ Industrial Ethernet
  - ✓ RS-232 and RS-485
  - ✓ CAN-BUS
  - ✓ Serial Peripheral Interface (SPI)
- Programmable Logic Controllers (PLC)
- Sensors and Modules
- Motor control



## Solar and Industrial Power Supplies

- Server SMPS
- Cloud Power Supplies
- Uninterruptible Power Supplies (UPS)
- Solar Inverters
- Telecom DC-DC brick
- Telecom SMPS
- Lighting



## Electric Vehicles Charging and Electric Meters

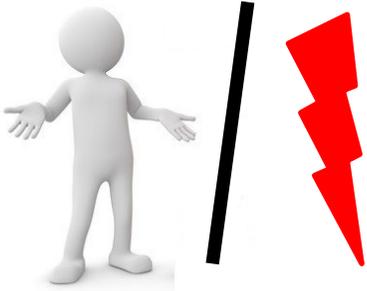
- Battery Management Systems (BMS)
- On Board Chargers
- Charging Stations
- DC/DC converters
- Smart Electric Meters
- Protection relays and grid
- Healthcare



# THE NEED FOR ISOLATION!

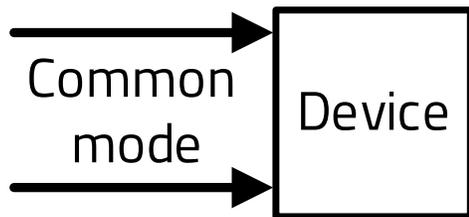
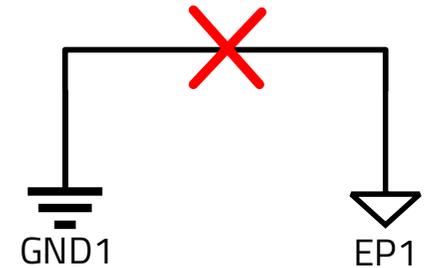
# NEED FOR ISOLATION

Main reasons



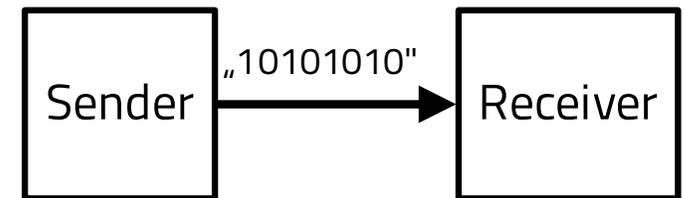
**“Safety barrier between hazardous voltages and a user”**

**“Separation of ground loops between spatial circuits”**



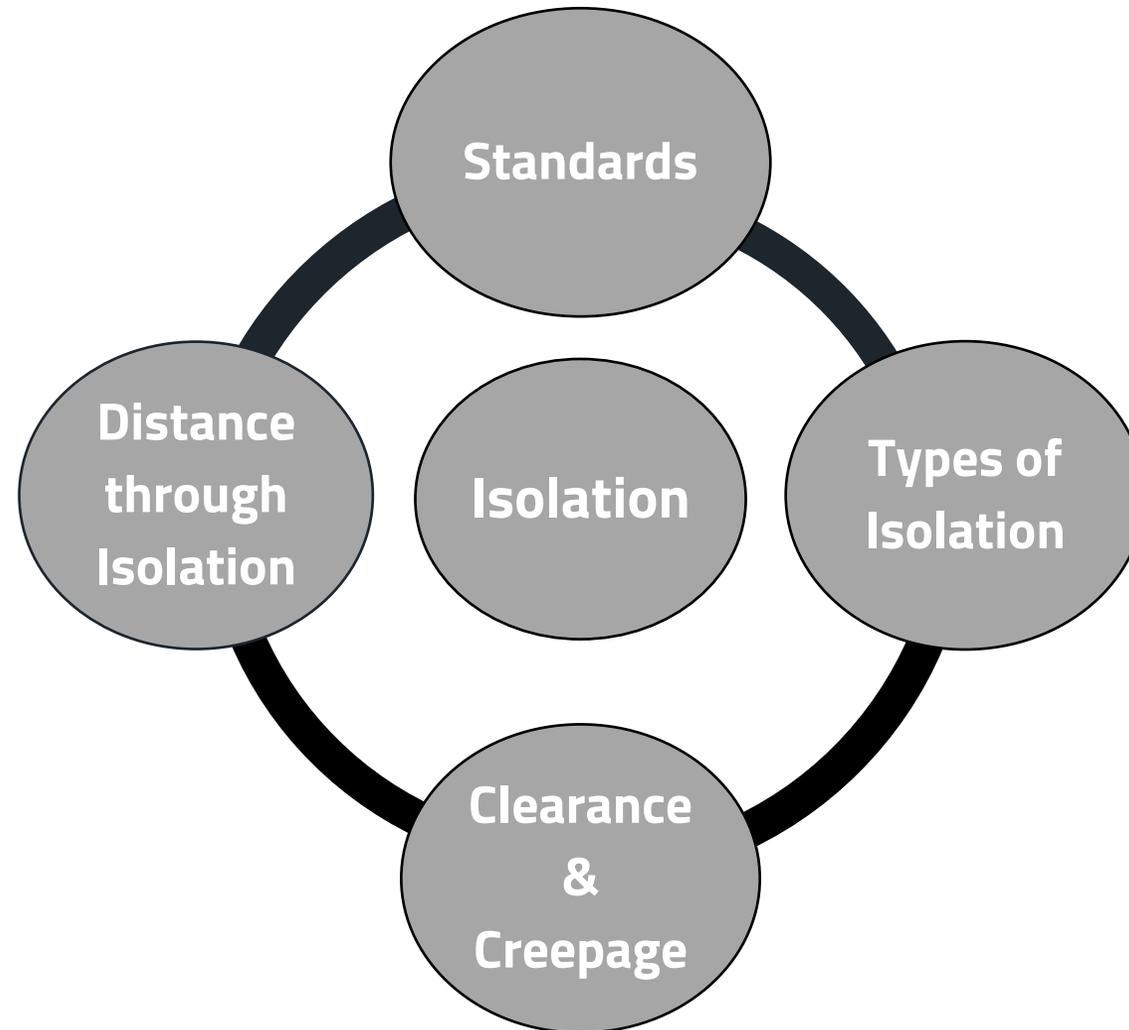
**“Minimization of common mode interference”**

**“Interference-free data transmission”**



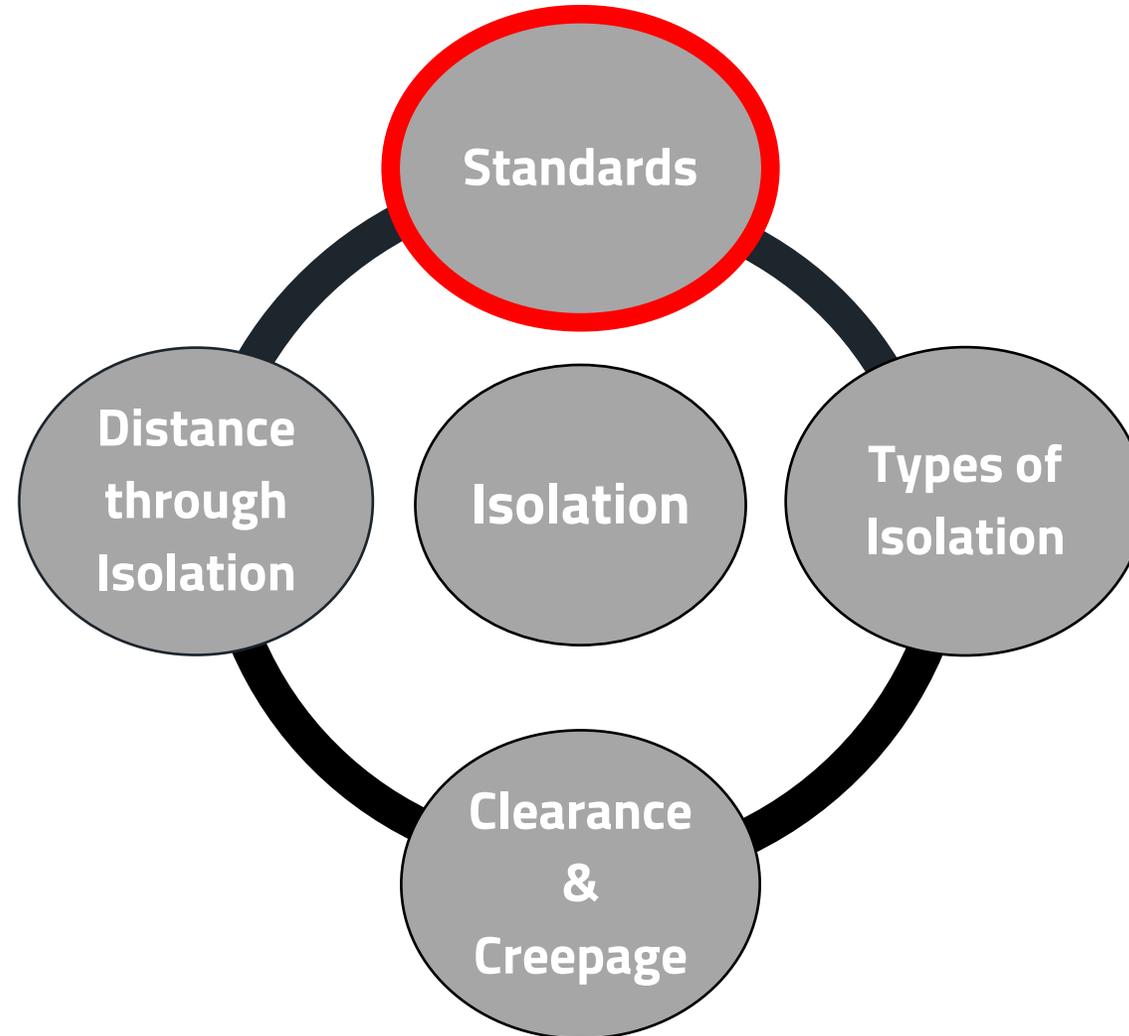
# ISOLATION

Buzzwords around



# ISOLATION

Buzzwords around - Standards



# ISOLATION

## Categories of Standards



# ISOLATION

## Categories of Standards

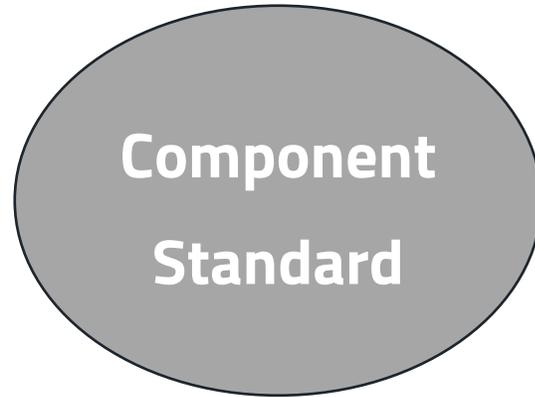


### **Description:**

- A basic safety standard is a type that provides fundamental safety principles and guidelines applicable across a wide range of products, systems, or industries.
- The purpose of a basic safety standard is to establish a common understanding of safety requirements and to promote consistency in safety practices.

# ISOLATION

## Categories of Standards

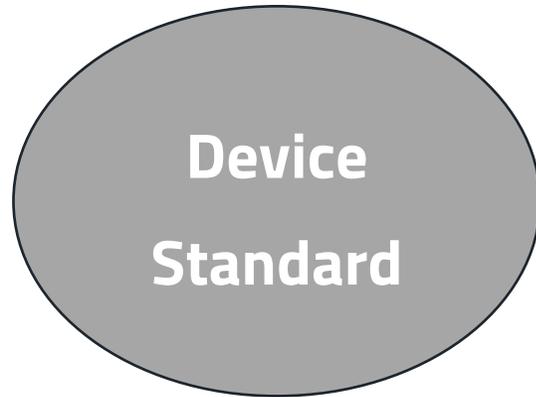


### **Description:**

- Component standards are specifications that apply to individual electronic components, such as resistors, capacitors, inductors, optocouplers.

# ISOLATION

## Categories of Standards

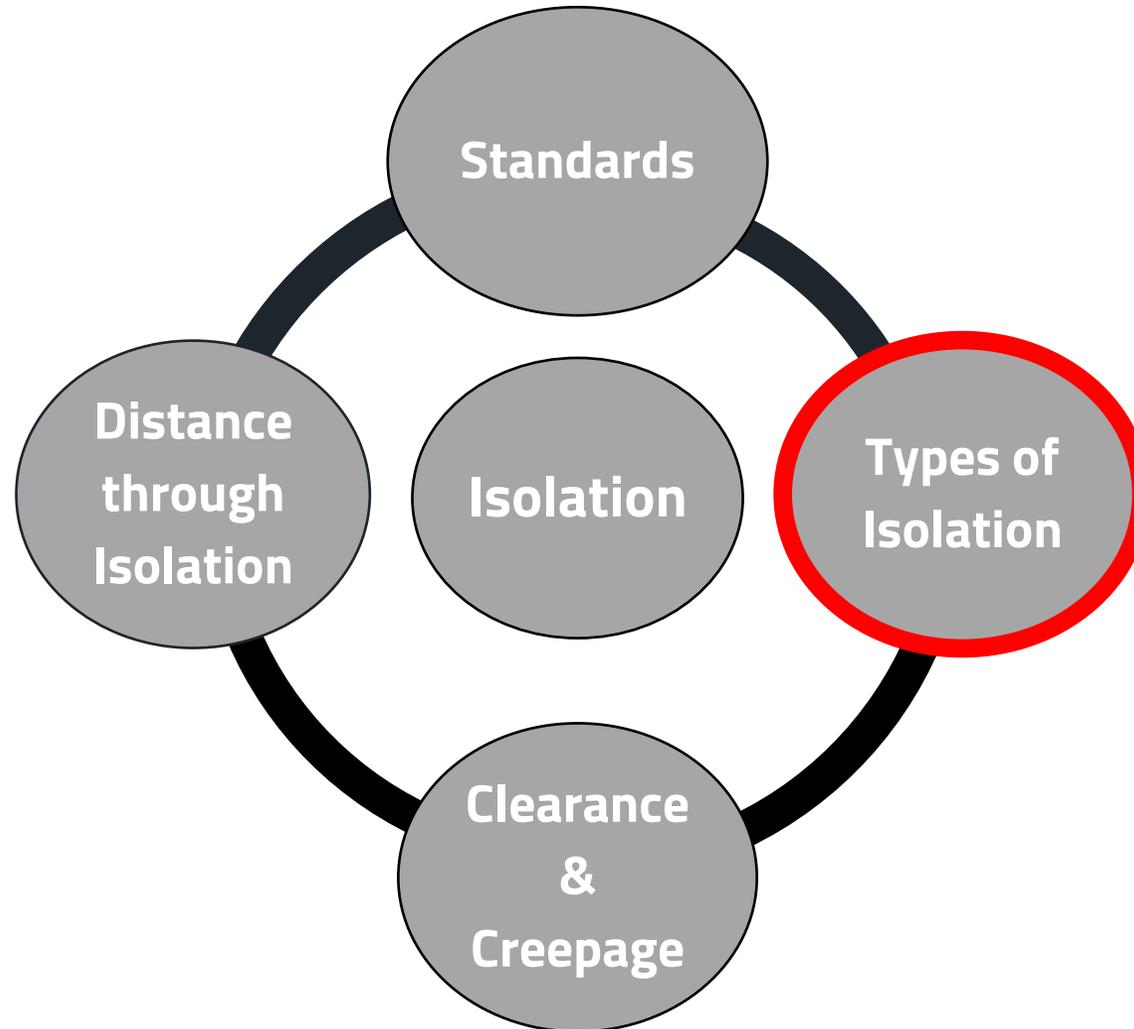


### **Description:**

- Device standards apply to complete electronic devices or systems, such as switch mode power supplies or industrial machinery.

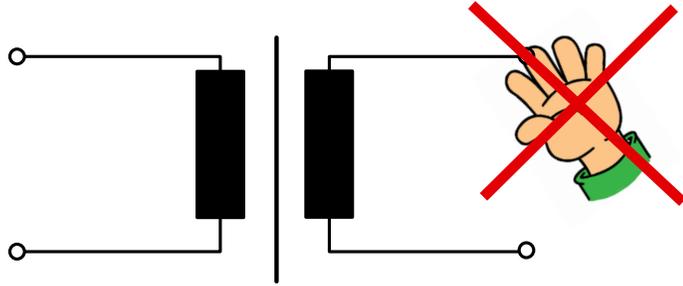
# ISOLATION

Buzzwords around – Types of Isolation



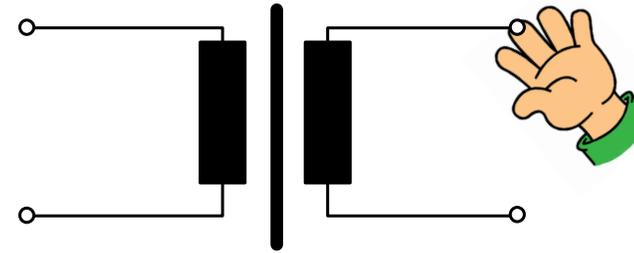
# ISOLATION

Types of Isolation – General definition



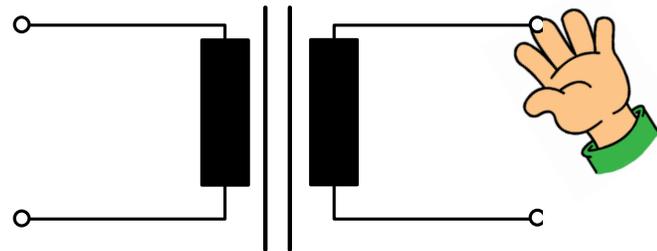
## Functional Isolation

No protection against electrical shock



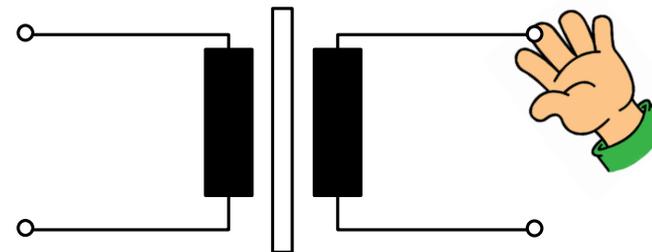
## Basic Isolation

Basic protection against electrical shock



## Double Isolation

Basic isolation & supplementary isolation protection against electrical shock

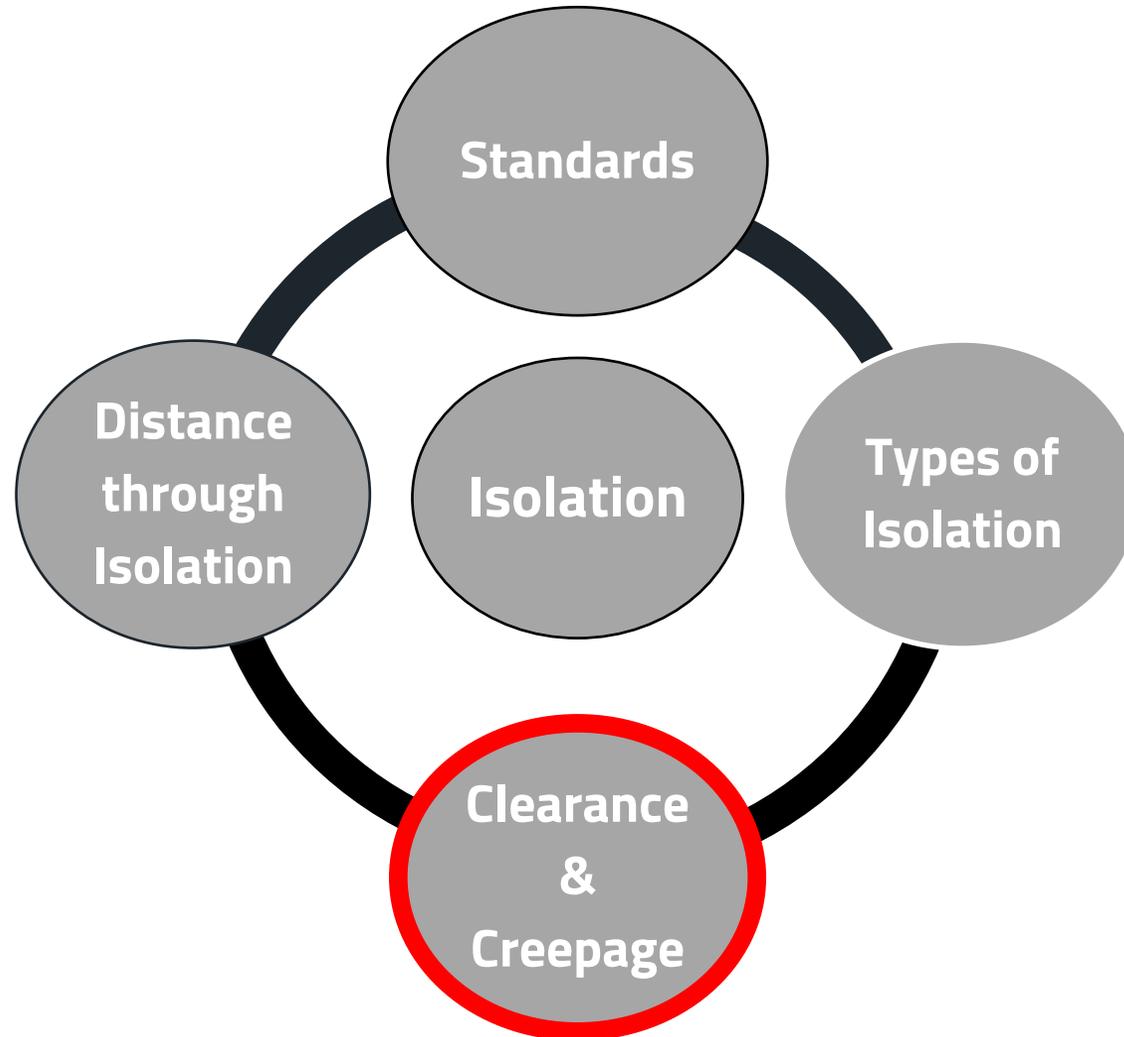


## Reinforced Isolation

Single isolation system that provides a degree of protection against electrical shock

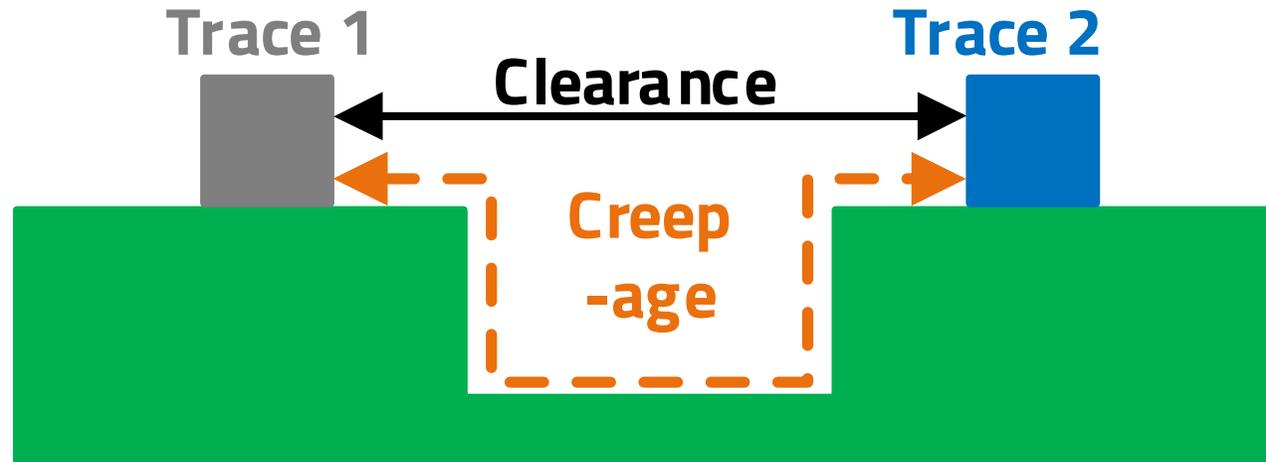
# ISOLATION

Buzzwords around – Clearance & Creepage



# ISOLATION

## Clearance & Creepage

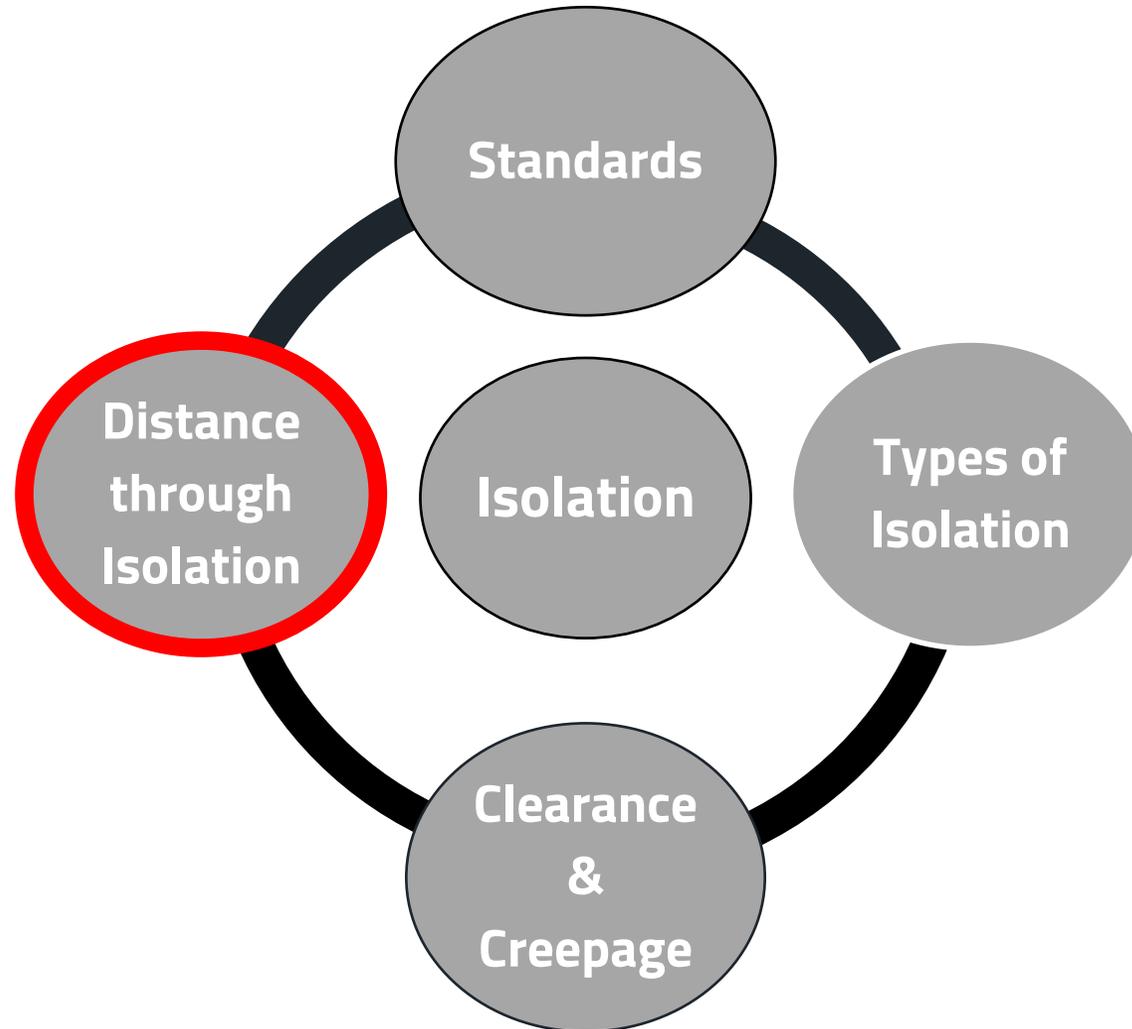


**Creepage** is the shortest path along the surface of an insulating material between two conductive parts.

**Clearance** is the shortest distance through air between two conductive elements.

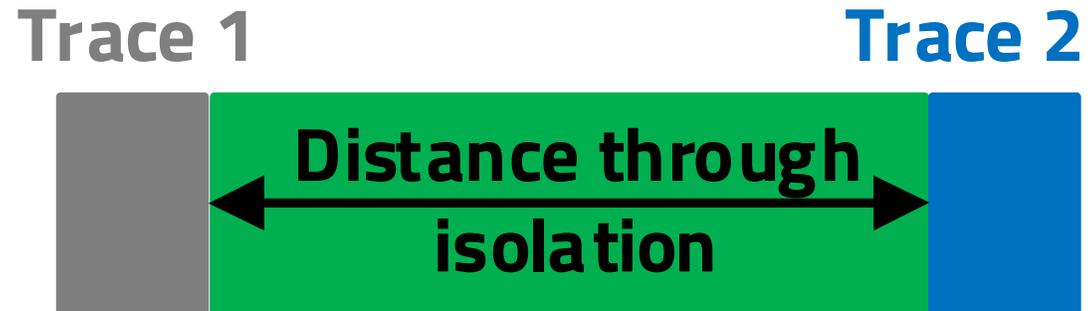
# ISOLATION

Buzzwords around – Distance Through Isolation



# ISOLATION

Distance Through Isolation



**Distance through isolation** is the shortest path through an insulating material between two conductors, ensuring electrical separation.



# METHODS FOR ISOLATION

# ISOLATION

Methods to realize

Optical

- Optocouplers

Capacitive

- Digital isolators
- Capacitors

Inductive

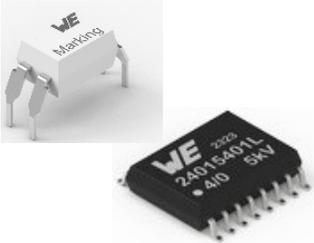
- Isolated power modules
- Transformers

# EISOS SOLUTIONS FOR ISOLATION

A hallway with a row of white doors and blue patterned wallpaper. The floor is made of light-colored wood. The text 'EISOS SOLUTIONS FOR ISOLATION' is overlaid in white, with horizontal lines underlining the words 'SOLUTIONS' and 'ISOLATION'.

# EISOS SOLUTIONS FOR ISOLATION

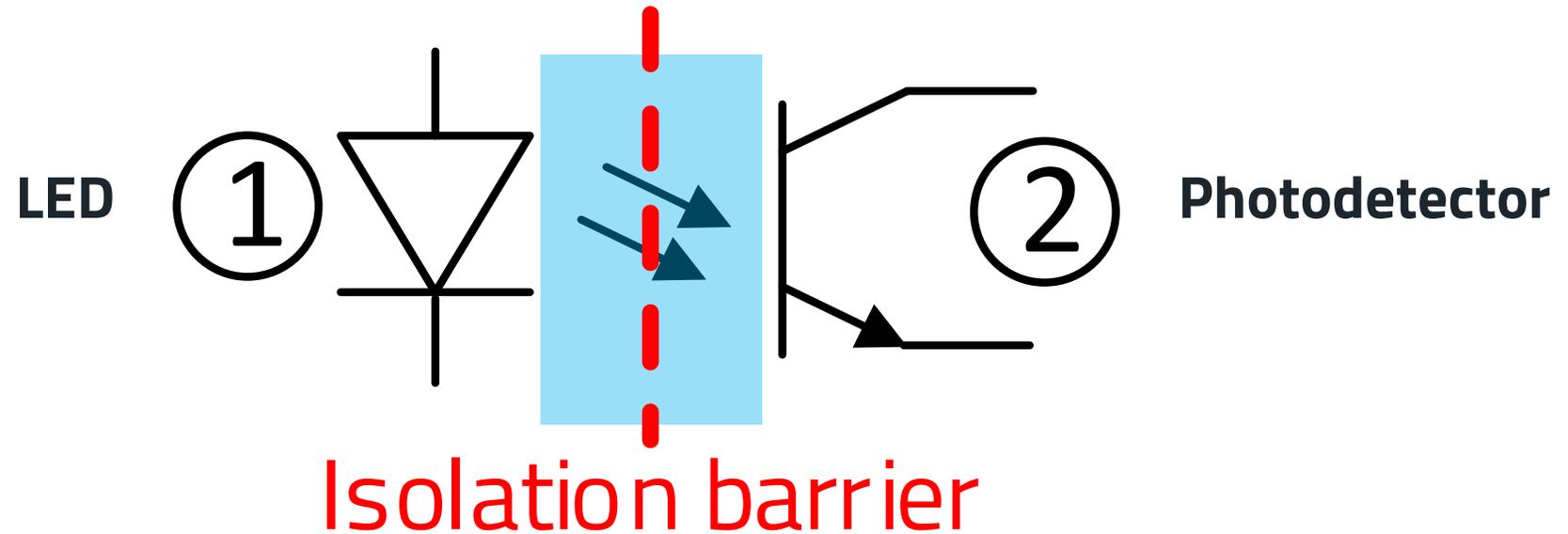
Standards vs. eiSos Solutions

Component standard					Device standard
IEC60747-5-5	IEC60747-17	IEC61558-2-16	IEC60384-14	UL1577	IEC62368-1
Opto-couplers	Digital Isolators	Transformers	Capacitors	Optocouplers / Digital Isolators	Power Modules
					

Basic Safety Publication IEC60664-1

# EISOS SOLUTIONS FOR ISOLATION

Optocouplers

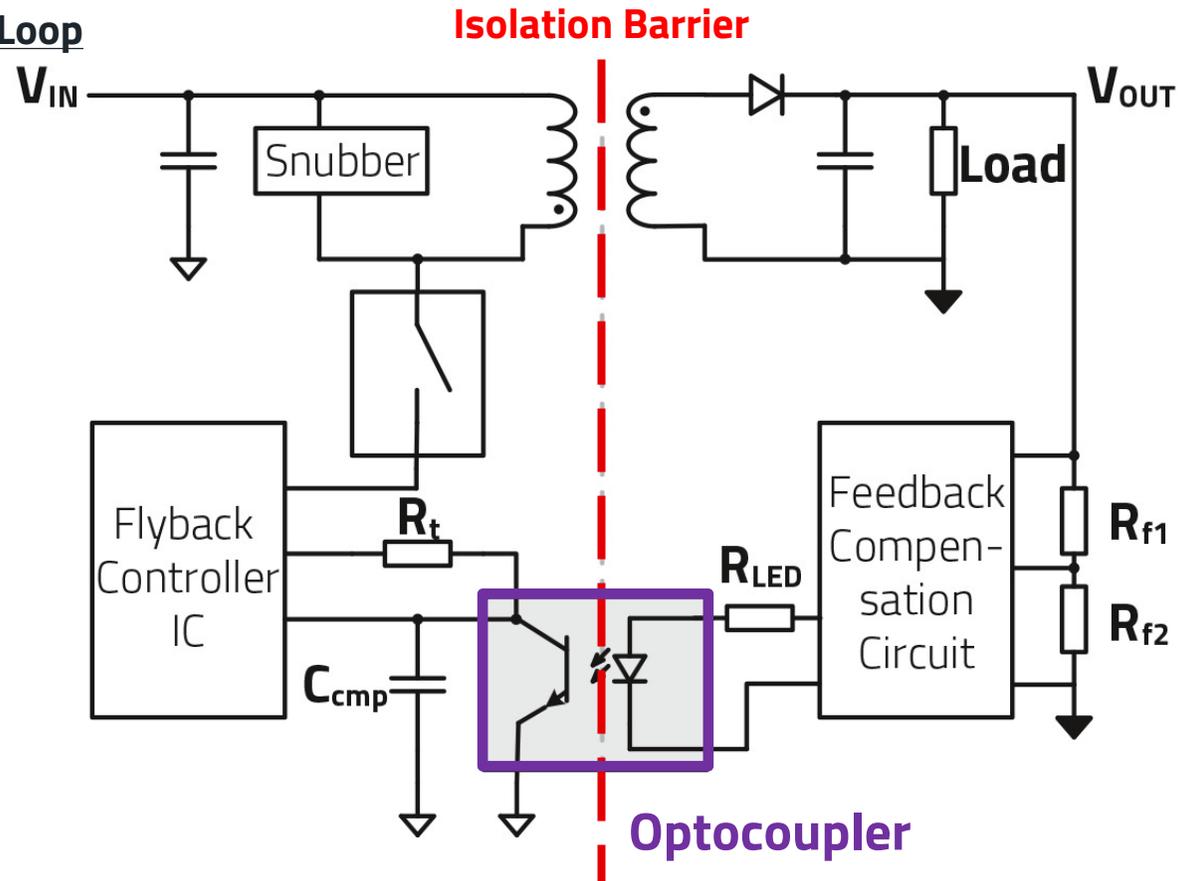


# EISOS SOLUTIONS FOR ISOLATION

Optocouplers – Isolated Power Supply Isolation Barrier



## Flyback Converter Feedback Loop



[ANP113 | Feedback loop compensation of a current-mode Flyback converter with optocoupler](#)

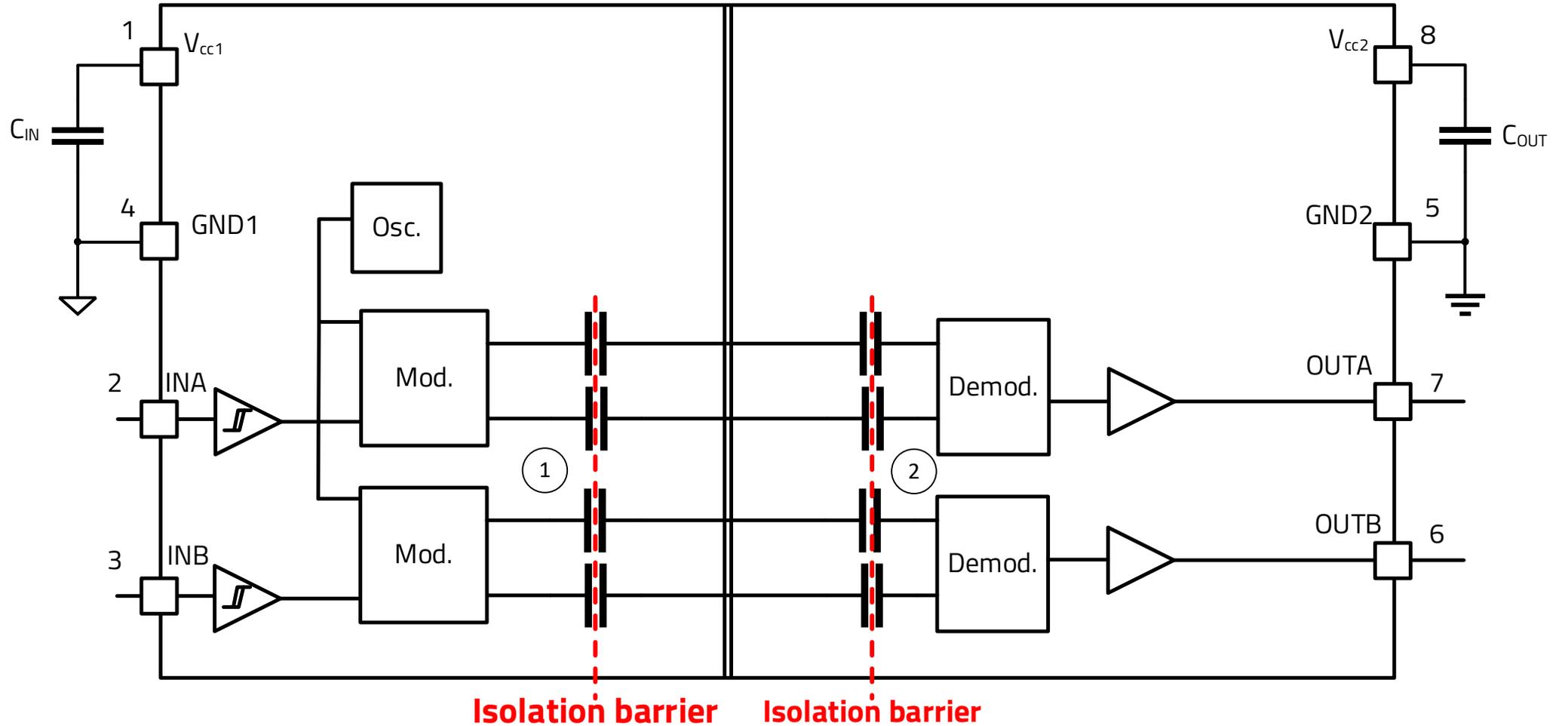
# EISOS SOLUTIONS FOR ISOLATION

## Optocouplers



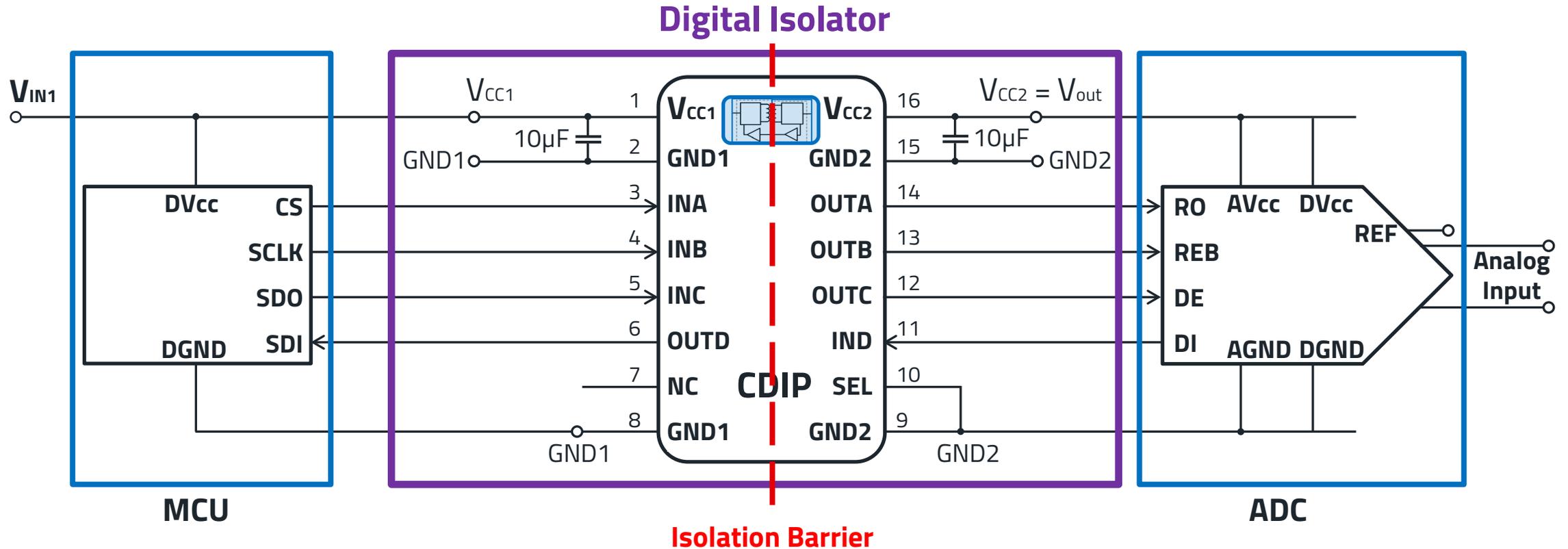

# EISOS SOLUTIONS FOR ISOLATION

## Digital Isolators



# EISOS SOLUTIONS FOR ISOLATION

Optocouplers - Isolated SPI interface



# EISOS SOLUTIONS FOR ISOLATION

## Digital Isolators



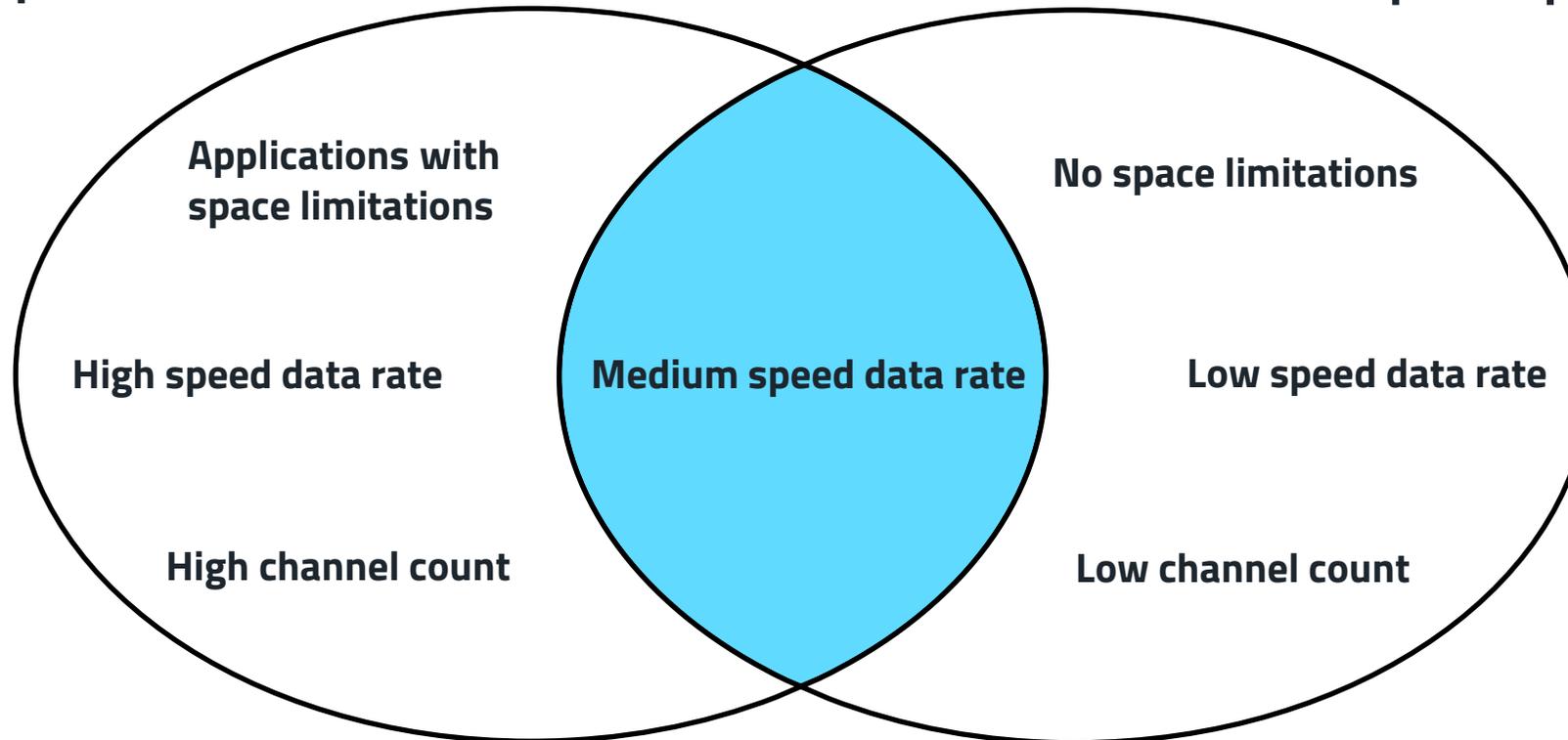

# EISOS SOLUTIONS FOR ISOLATION

Digital Isolators



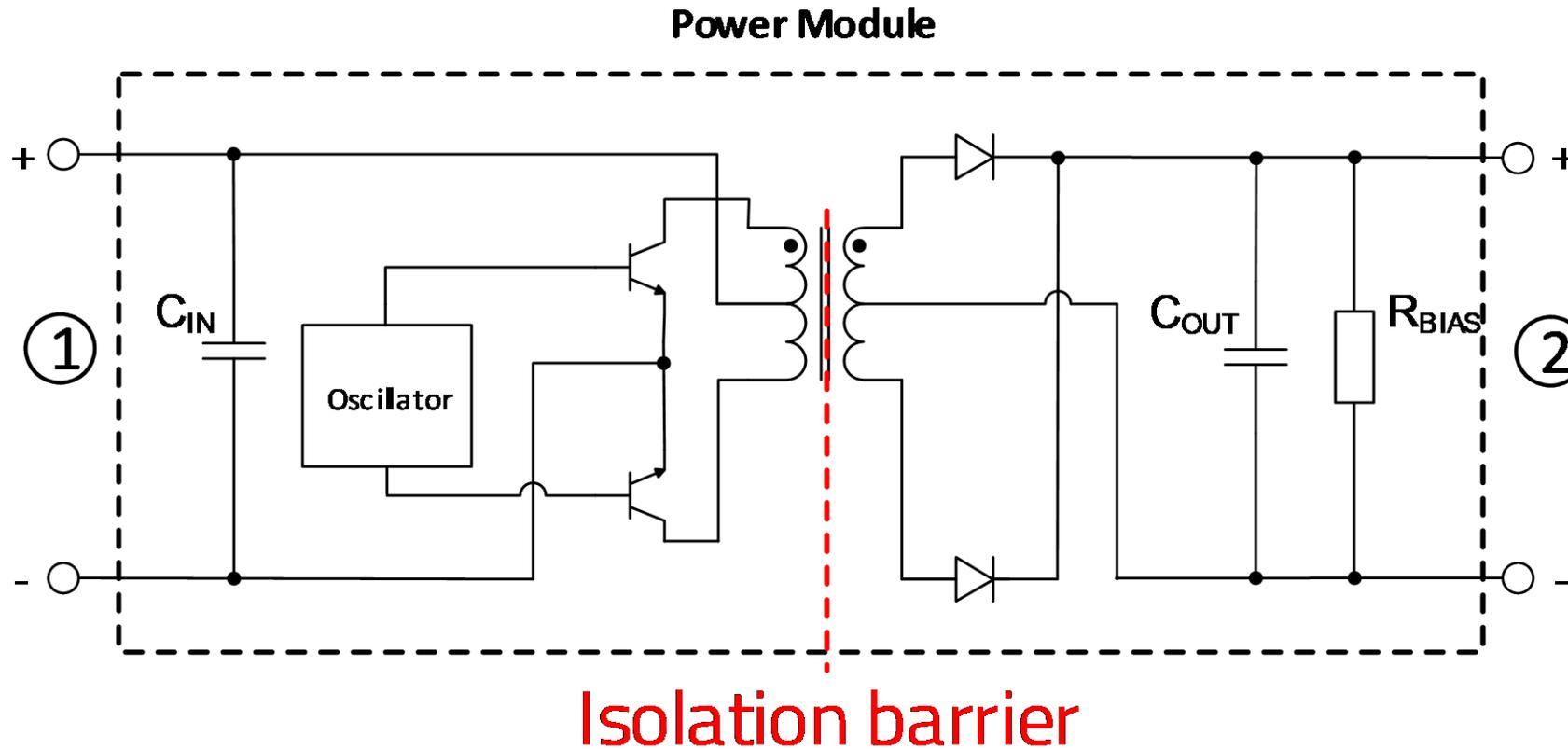
**Digital isolator preferred**

**Optocoupler preferred**



# EISOS SOLUTIONS FOR ISOLATION

Isolated Power Modules

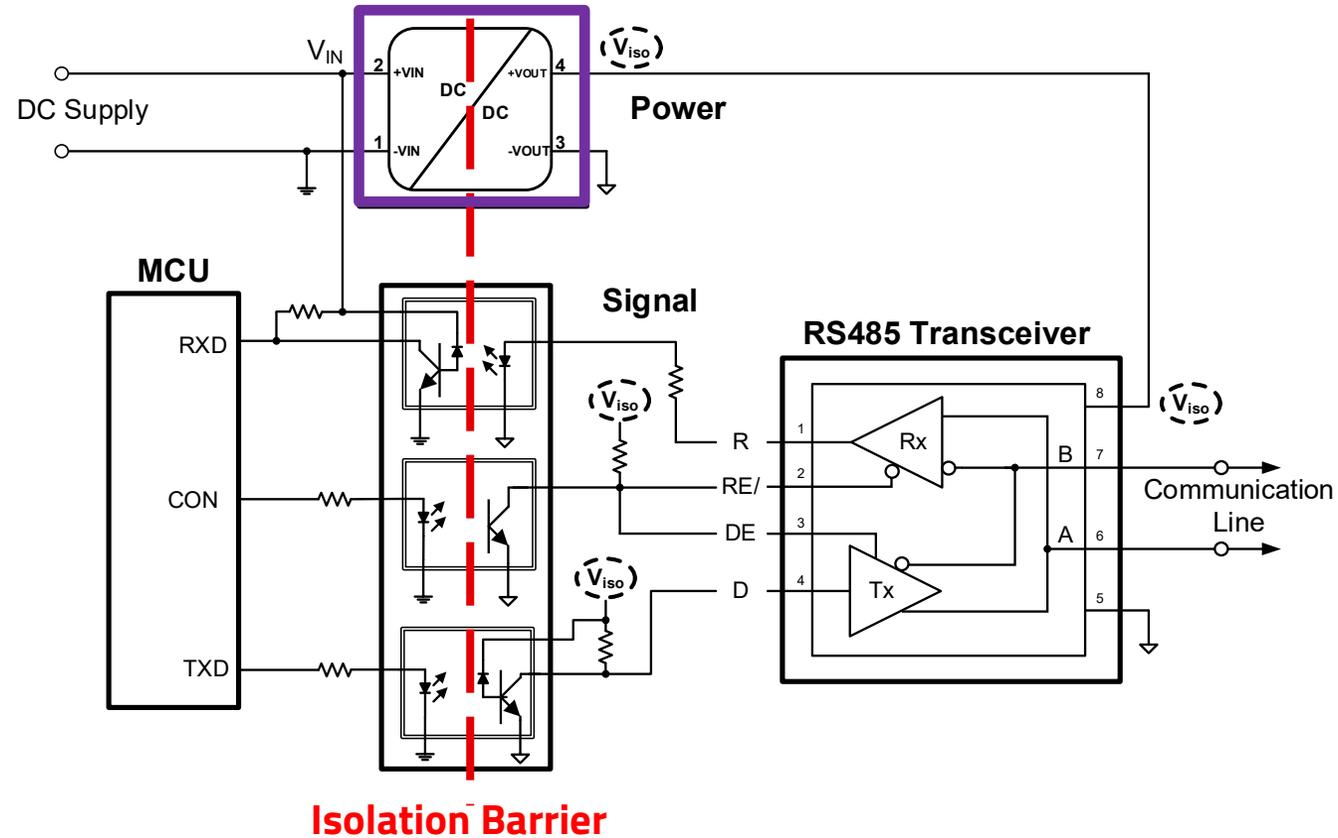


# EISOS SOLUTIONS FOR ISOLATION

## Isolated Power Modules



### Isolated Power Module



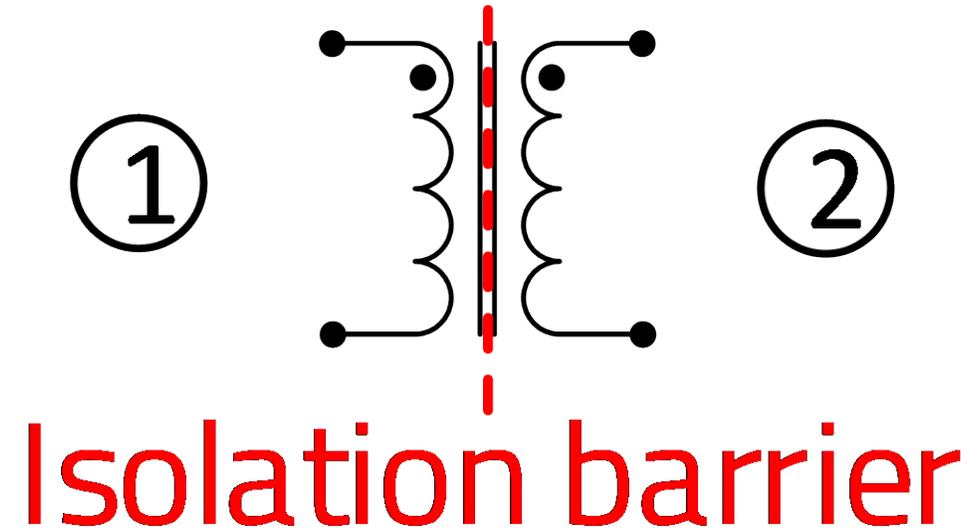
# EISOS SOLUTIONS FOR ISOLATION

## Isolated Power Modules




# EISOS SOLUTIONS FOR ISOLATION

Transformers

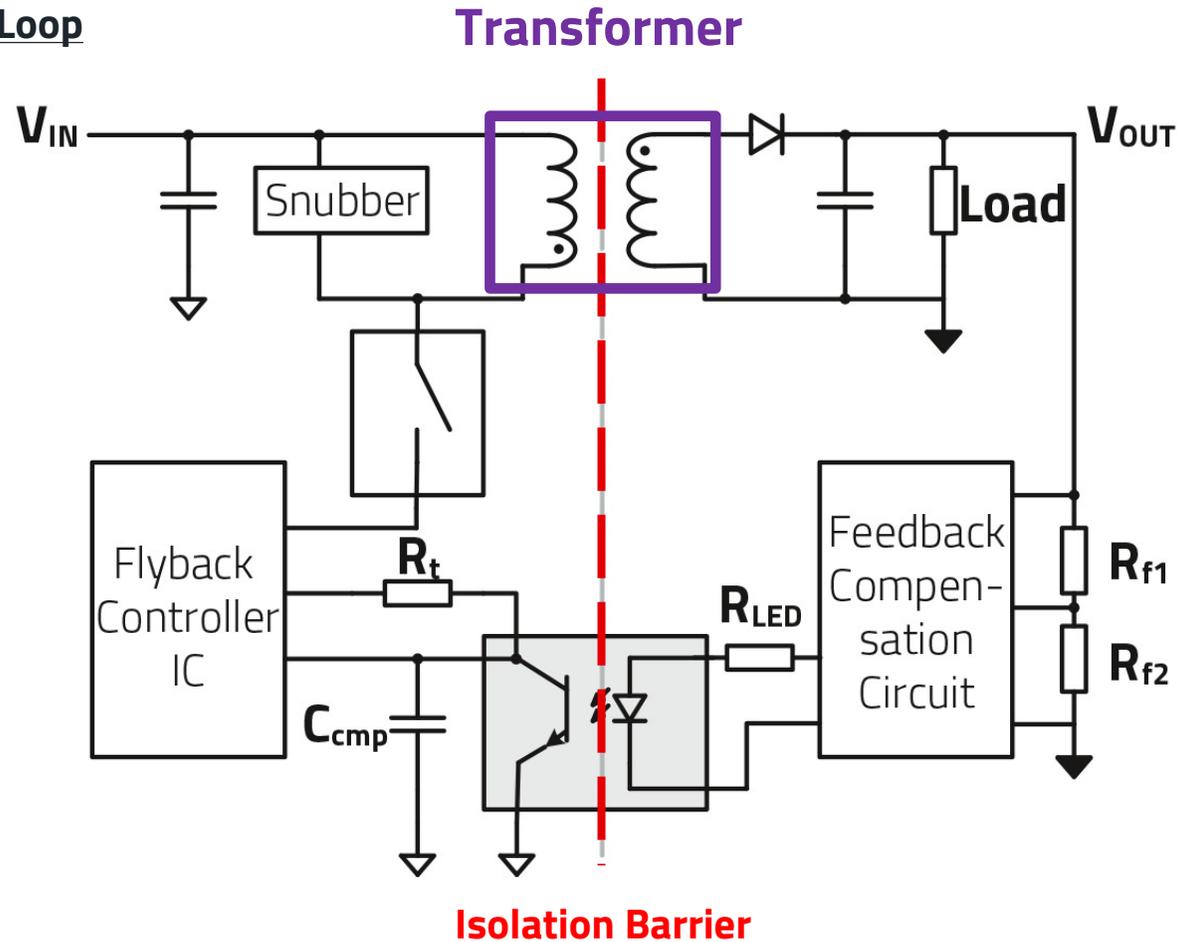


# EISOS SOLUTIONS FOR ISOLATION

Transformers



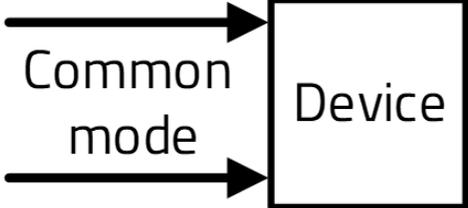
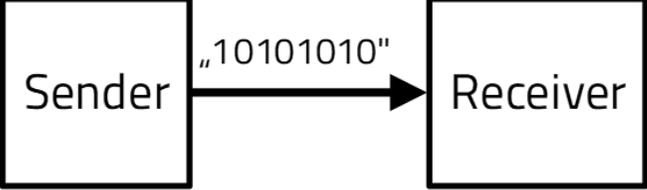
## Flyback Converter Feedback Loop



# EISOS SOLUTIONS FOR ISOLATION

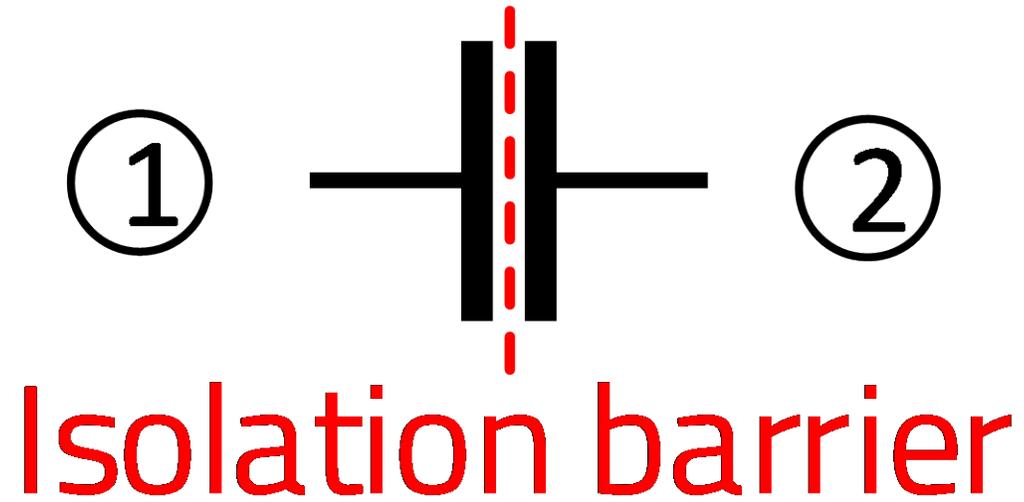
## Digital Isolators



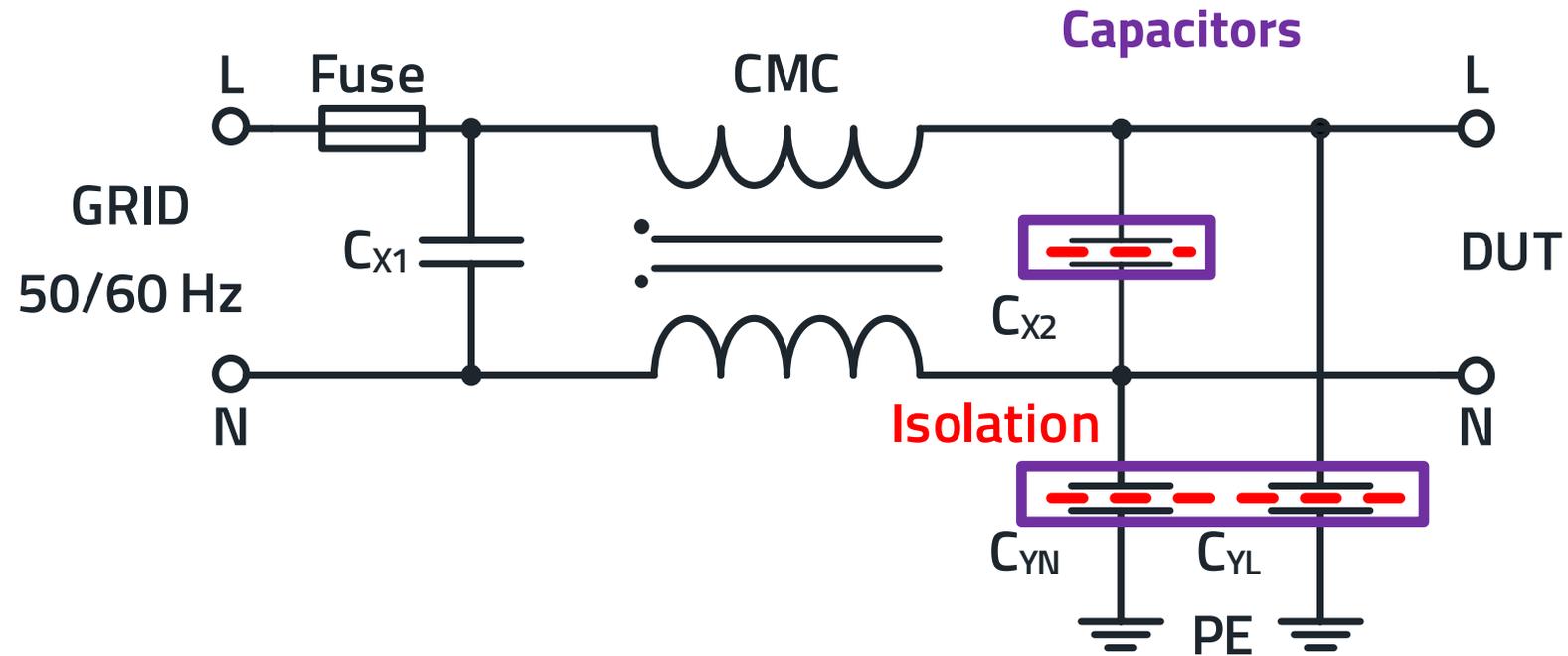
# EISOS SOLUTIONS FOR ISOLATION

Capacitors



# EISOS SOLUTIONS FOR ISOLATION

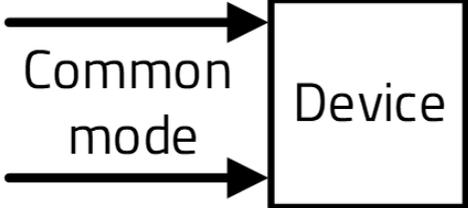
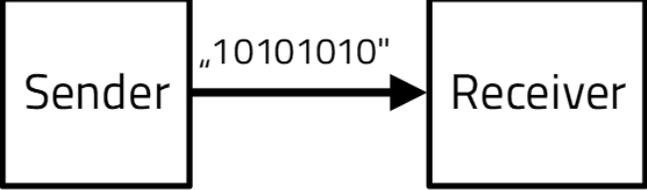
Transformers



# EISOS SOLUTIONS FOR ISOLATION

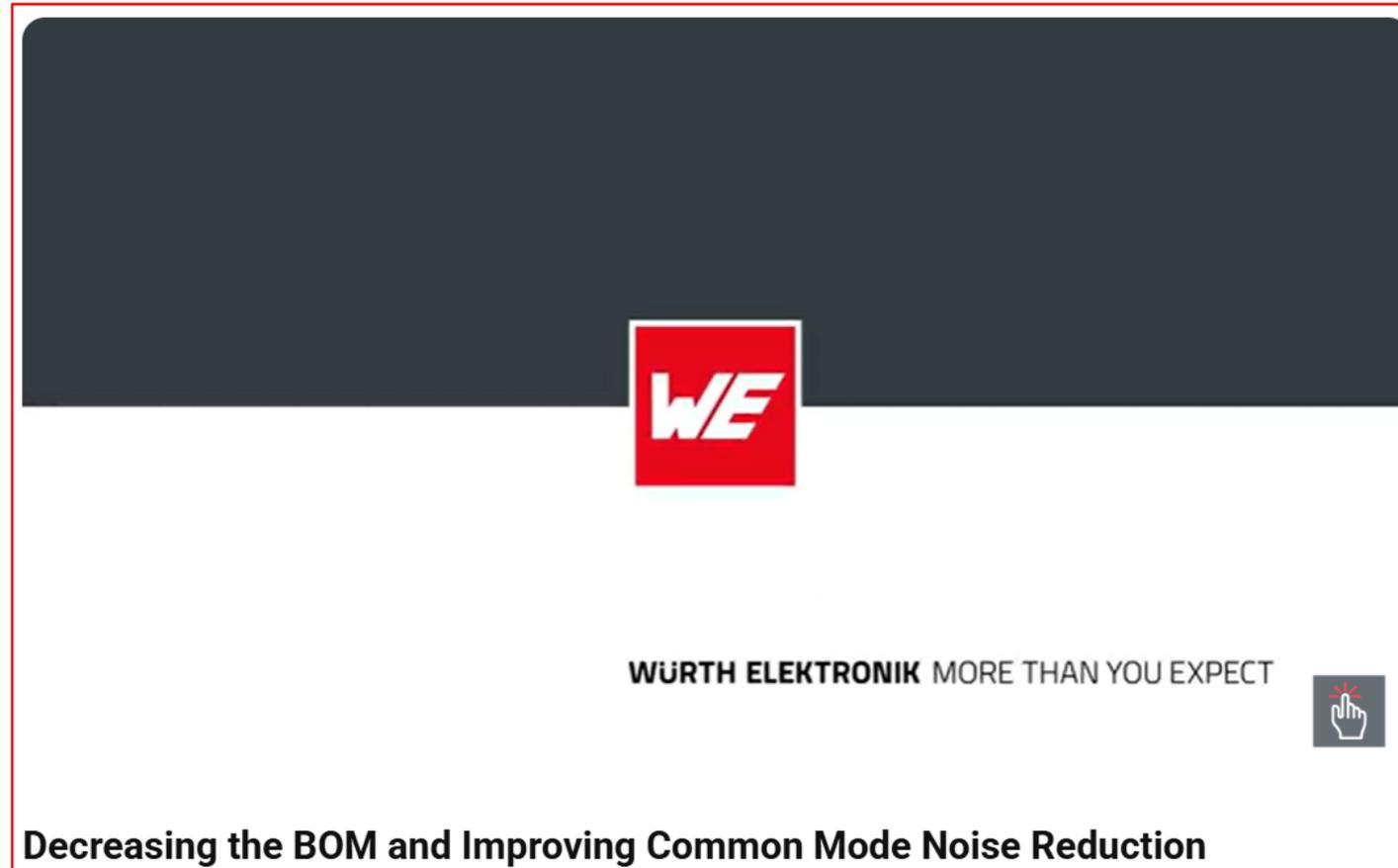
## Digital Isolators



# EISOS SOLUTIONS FOR ISOLATION

## Stitching Capacitor



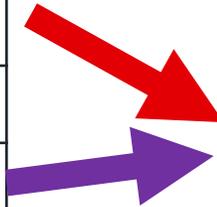
<https://www.we-online.com/en/support/knowledge/video-center?d=decreasing-the-bom-and-improving-common-mode-noise-reduction>

# EISOS SOLUTIONS FOR ISOLATION

Are the components for „Isolation“ interchangeable?



IEC60747	
-5-5	
Component	
-17	
n.a.	Type of Isolation



IEC62368-1	
Device	
Type of Isolation	



IEC61558-2-16	
Component	
Type of Isolation	



IEC 60384 - 14	
Component	
n.a.	



**IEC62368-1**

**Implementation:**

- 5.4.4.4 Solid insulation in semiconductor devices
- 5.4.9 Electric strength test

**IEC62368-1**

**Implementation:**

- 5.4 Insulation materials and requirements
- Annex G Components

