DIGITAL ISOLATORS – THE NEXT STEP IN SIGNAL PROTECTION

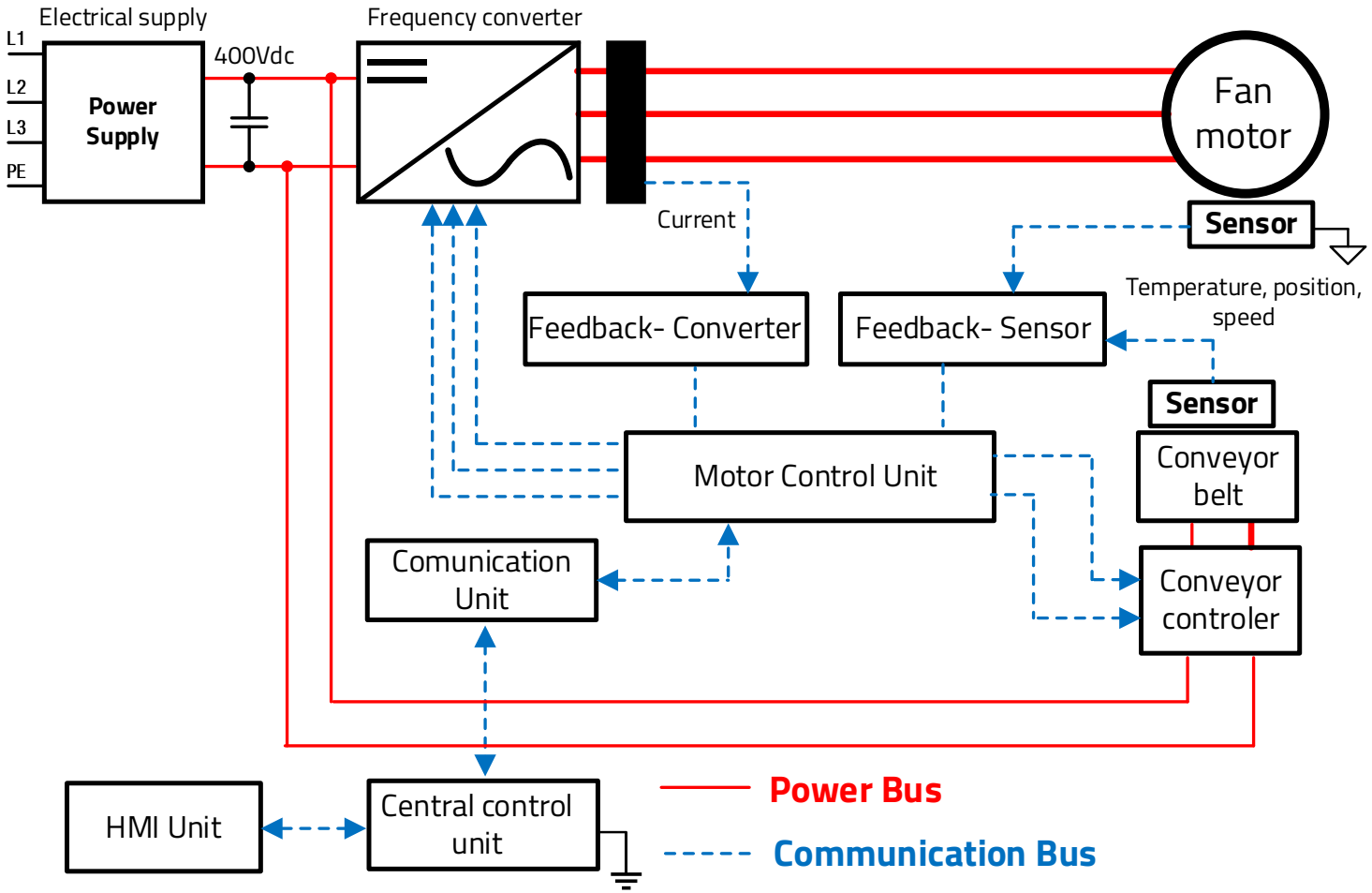
Artem Beliakov

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

THE NEED FOR ISOLATION!

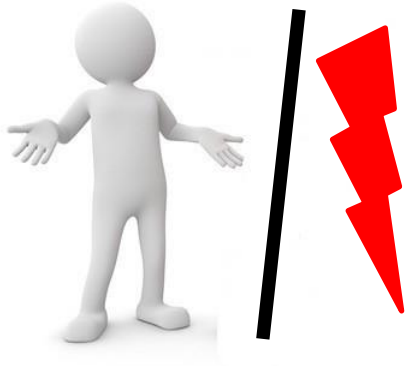
Need for Signal Isolation

Application example - warehouse logistics



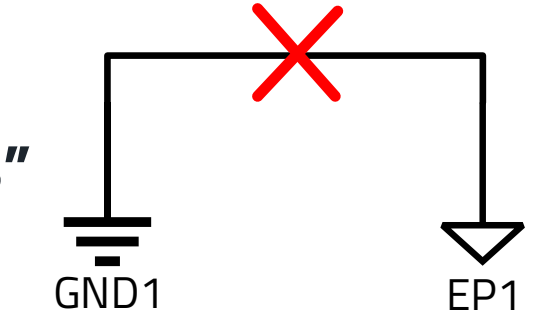
Need for Signal Isolation

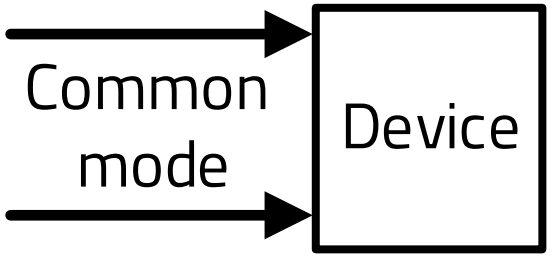
Main reasons



“Safety barrier between hazardous voltages and a user”

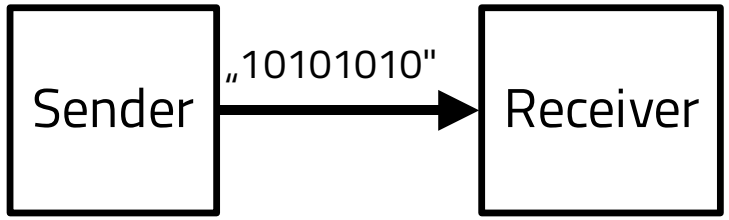
“Separation of ground loops between spatial circuits”





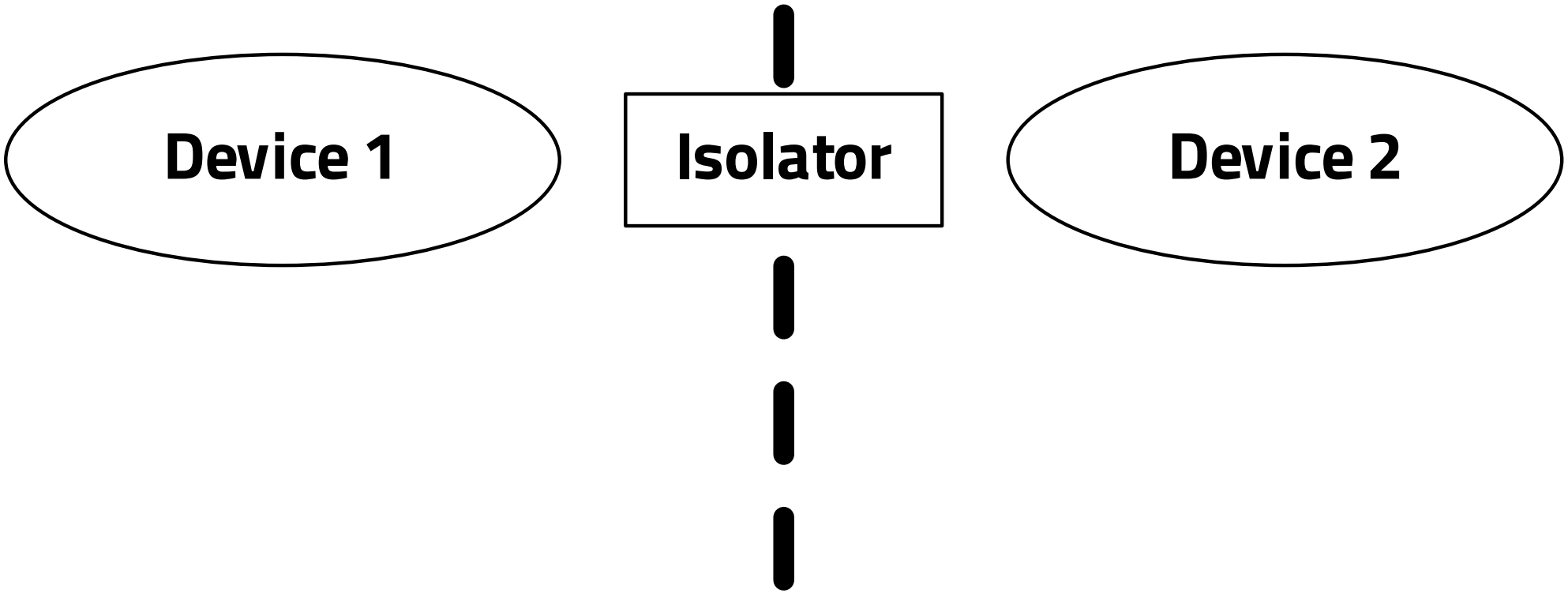
“Minimization of common mode interference”

“Interference-free data transmission”



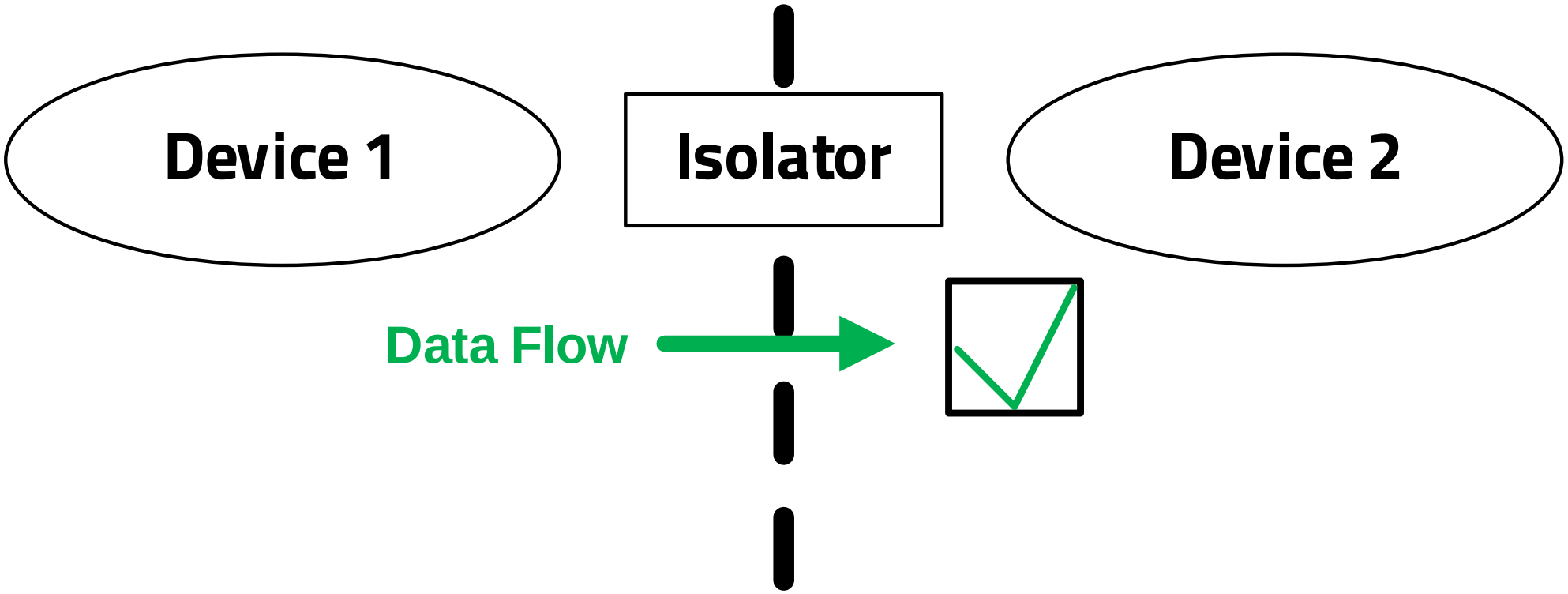
Need for Signal Isolation

Functions of an insulator



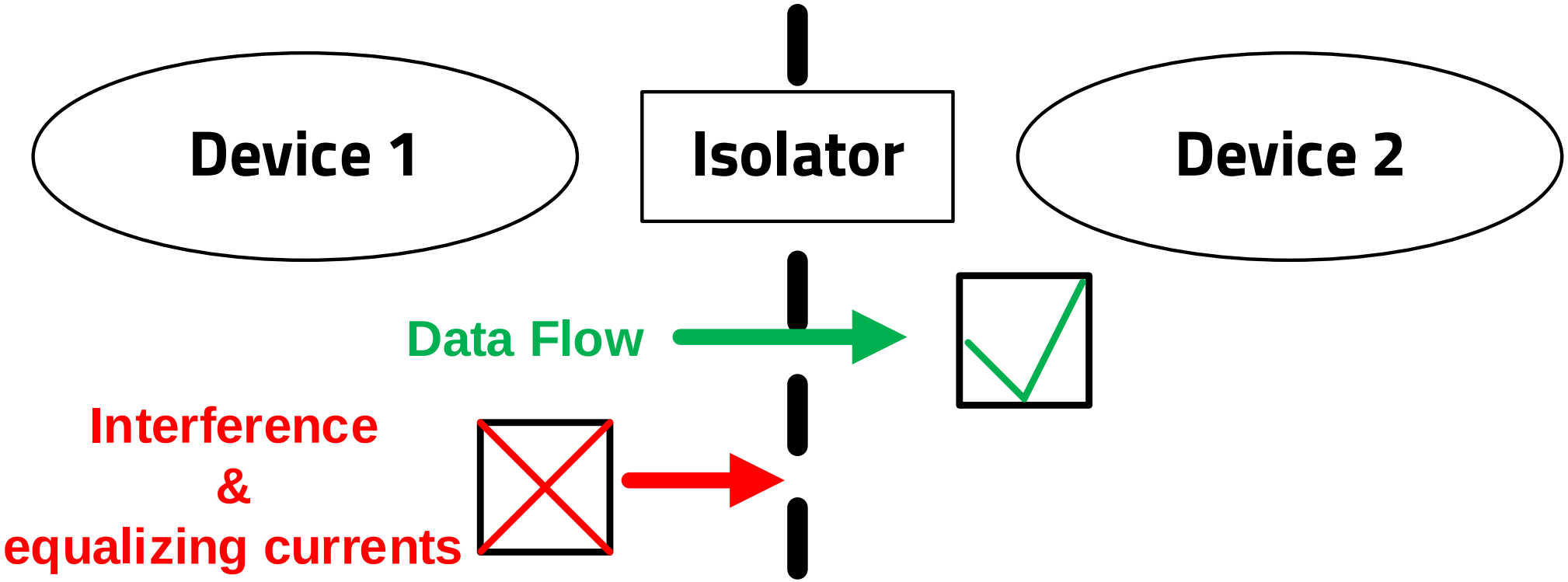
Need for Signal Isolation

Functions of an insulator



Need for Signal Isolation

Functions of an insulator



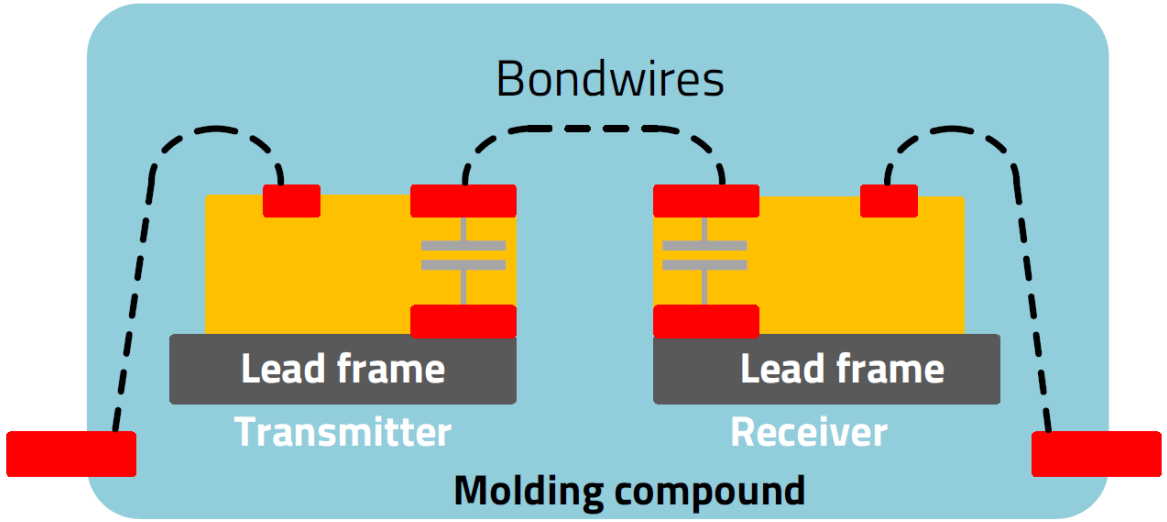
- **Interference and potential equalisation currents** are held back by the galvanic isolation

Capacitive Isolation Technology

Inside a digital isolator

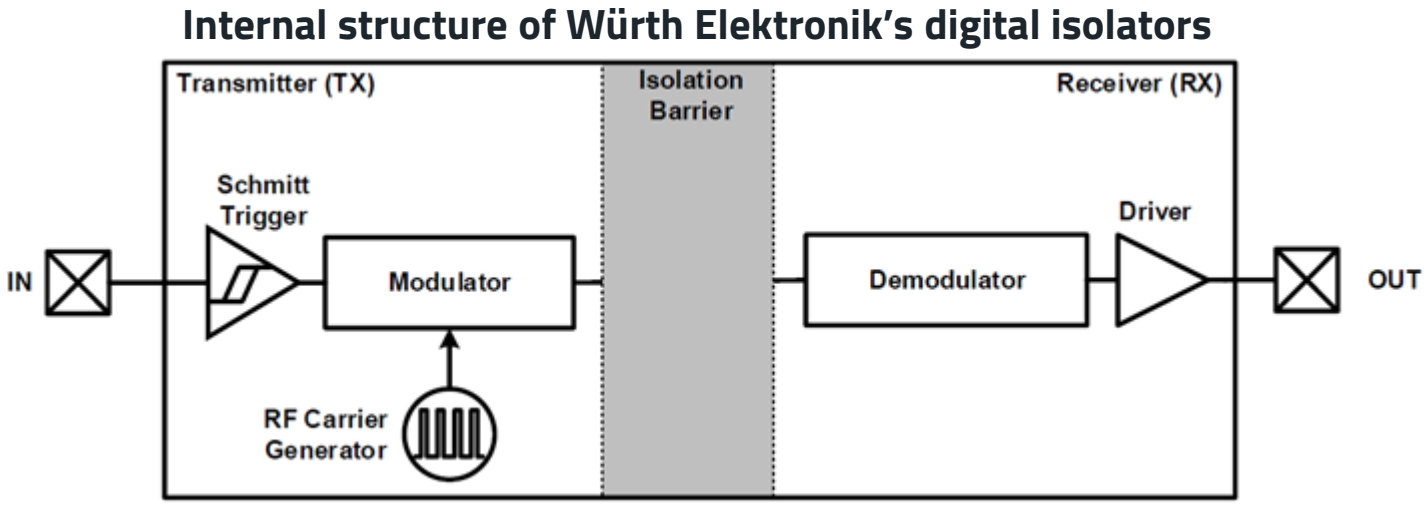
WE's isolators are built on capacitive technology

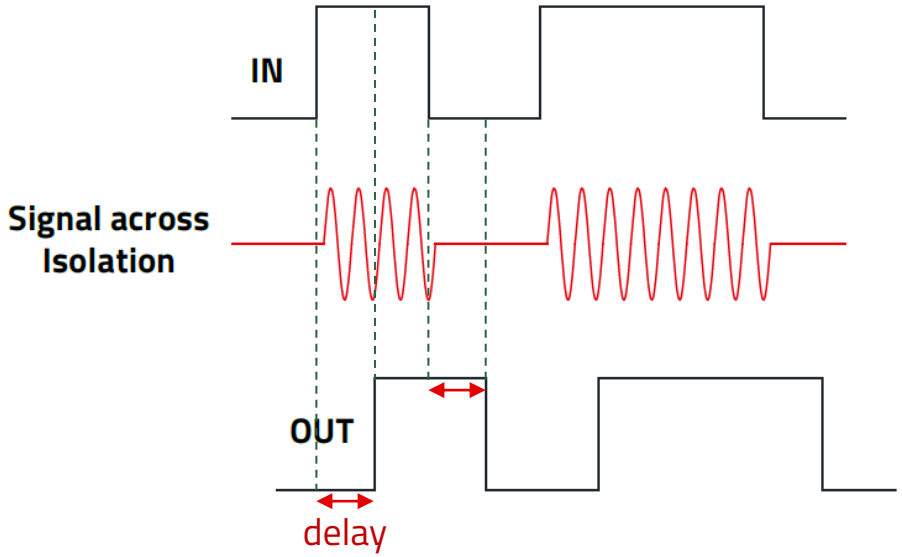
- Electric field changes with the level of charge on a capacitor plate
- The charge is proportional to the level of the signal that should be transferred



Signal transmission through a capacitive isolation barrier

Inside a digital isolator





APPLICATIONS

What is it good for?

Digital Isolators Application

Broad variety of success stories

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

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Solar and Industrial Power Supplies

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

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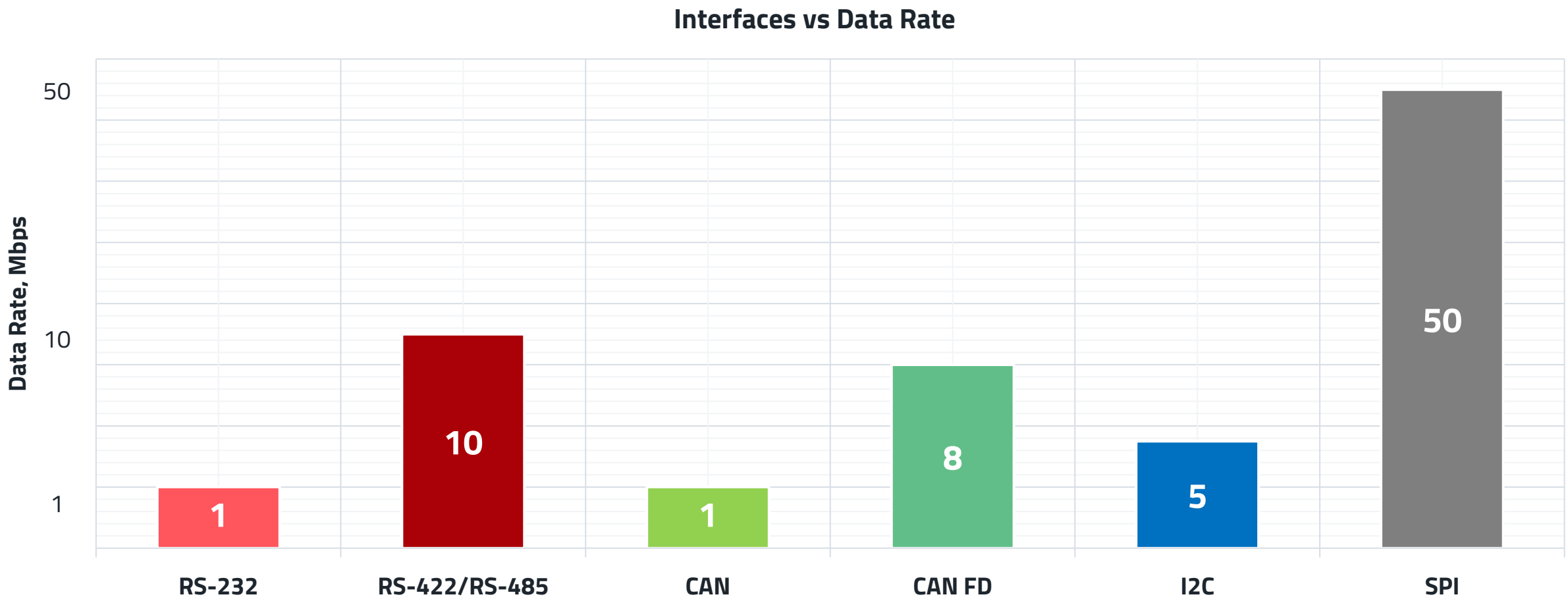
Electric Vehicles Charging and Electric Meters

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

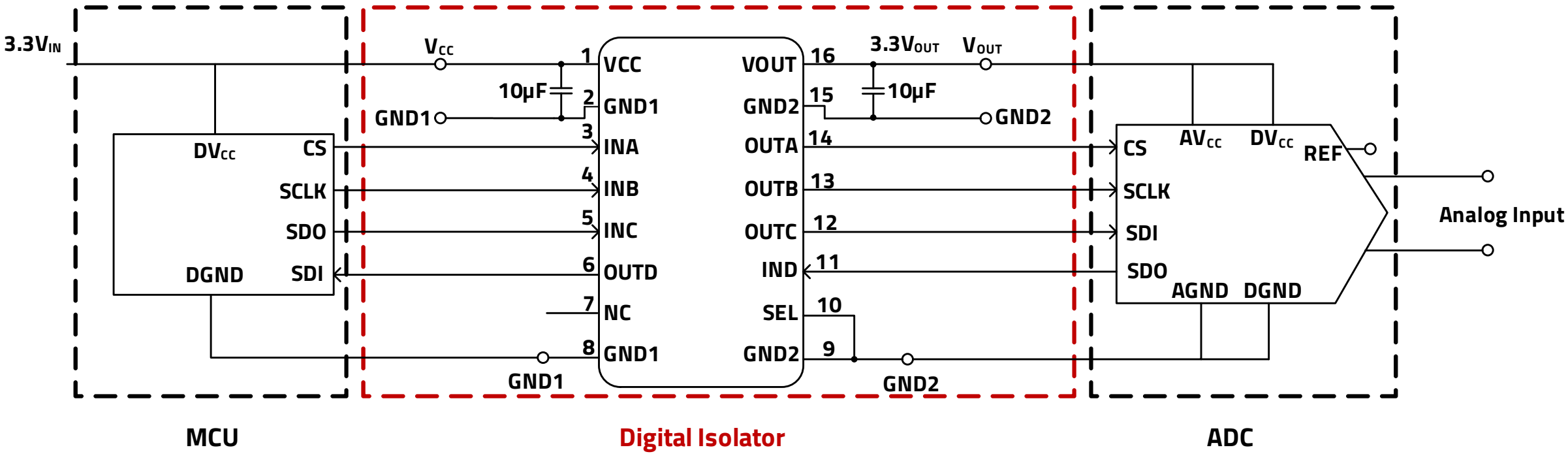
Application Examples

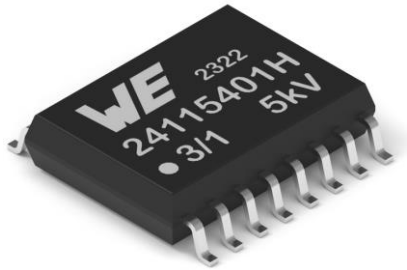
Interfaces vs Data Rate



Application Examples

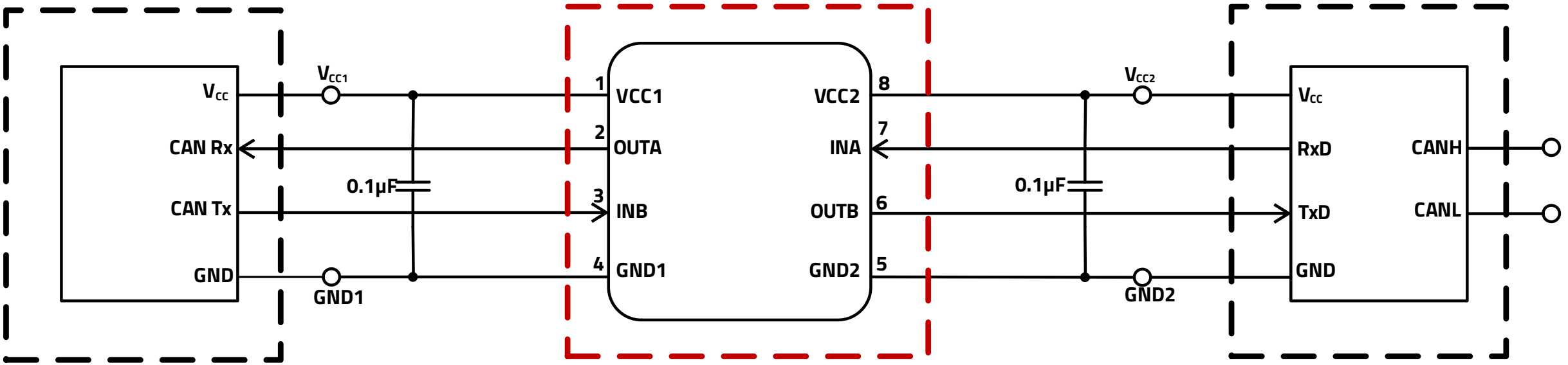
Isolation of the serial peripheral interface (SPI)

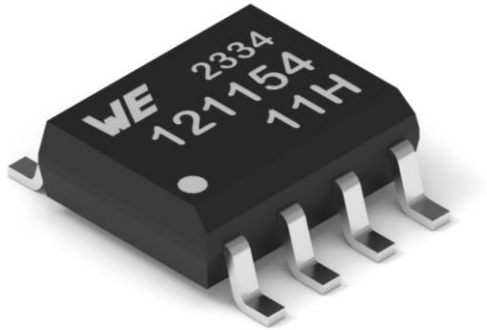




Application Examples

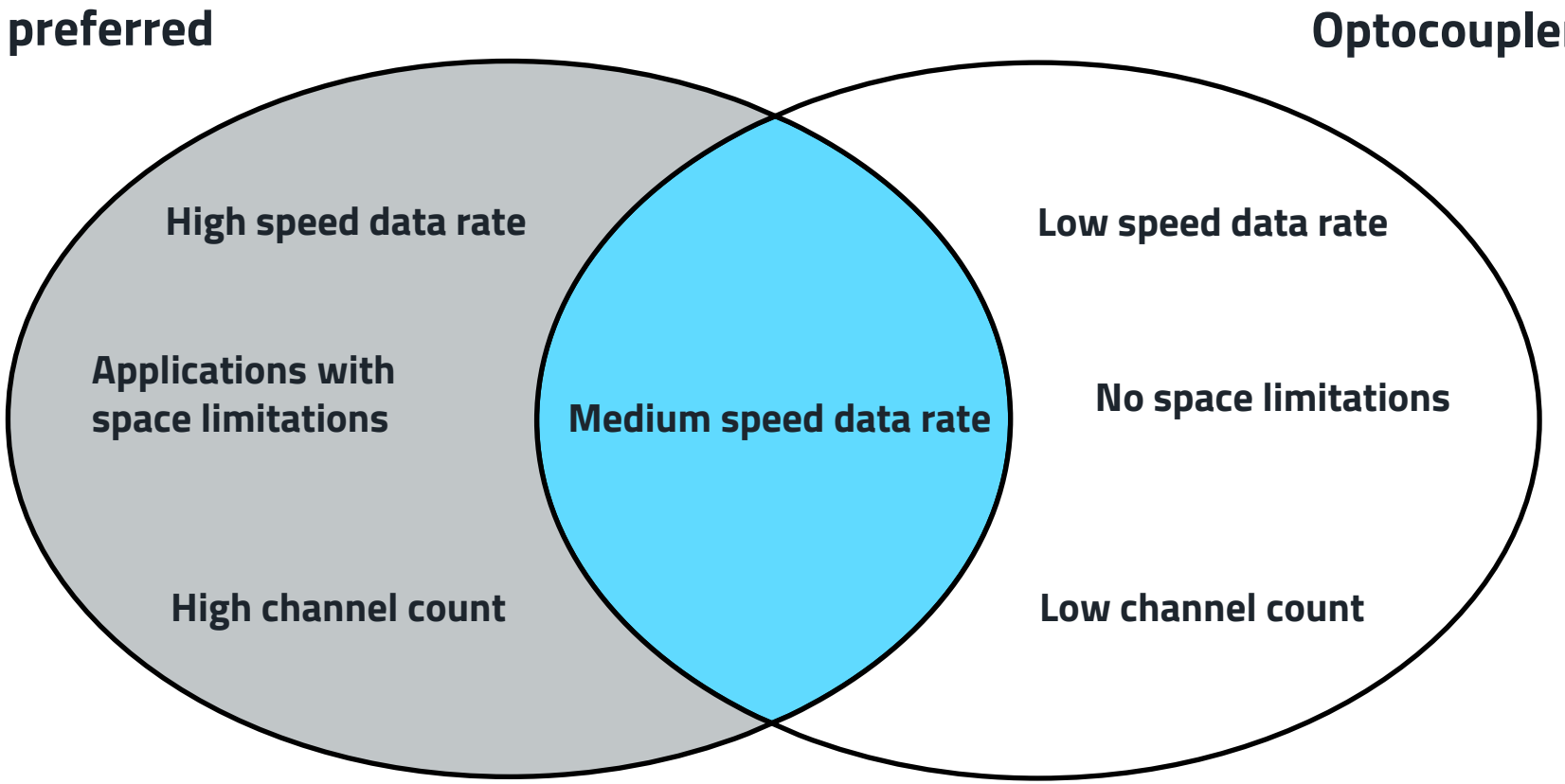
Isolation of the CAN bus





Which for what?

Optocouplers and Digital Isolators – when do use what?



DEVICES & SPECIFICATIONS

Critical Values
&
Parameters

Digital Isolators

Essential design-In parameters

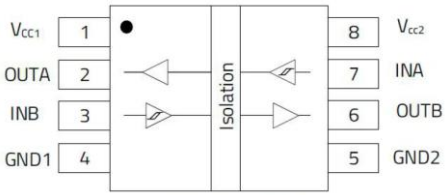
- **Data rate**
  - The number of bits that are transmitted per second
- **Voltage isolation**
  - Voltage level (in kV) that can be applied across the isolation barrier for a period of time
- **Propagation delay**
  - Delay between input and output signals (ns)
- **CMTI**
  - Common mode transient immunity is maximum possible rate of rise / fall of the common mode voltage between two isolated circuits.
- **Default output**
  - Predefined state of output pin when the input channel of isolator is unpowered

Digital Isolators

Portfolio overview

2 channel without DC/DC

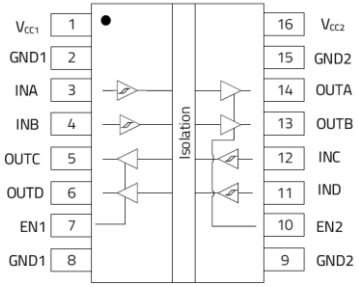
WPME-CDIS



- Isolation Voltage: **3750Vrms** per 60sec
- **Basic isolation**
- Channel configuration: **2/0** and **1/1**
- Default output **high** and **low**
- Data Rate: **150Mbps**
- Supply Voltage: **2.375V to 5.5V**
- CMTI: **±150kV/µs**
- Propagation Delay (typ.): **12ns**
- Package: **SOIC-8NB**

4 channel without DC/DC

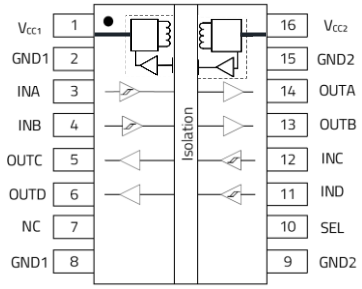
WPME-CDIS



- Isolation Voltage: **5000Vrms** per 60sec
- **Reinforced isolation**
- Channel configuration: **4/0, 3/1, 2/2**
- Default output **high** and **low**
- Data Rate: **150Mbps**
- Supply Voltage: **2.375V to 5.5V**
- CMTI: **±150kV/µs**
- Propagation Delay (typ.): **12ns**
- Package: **SOIC-16WB**

4 channel with integrated DC/DC

WPME-CDIP



- Isolation Voltage: **5000Vrms** per 60sec
- **Reinforced isolation**
- Integrated 0.65W Isolated DC/DC
- Channel configuration: **4/0, 3/1, 2/2**
- Default output **high** and **low**
- Data Rate: **100Mbps**
- Supply Voltage: **3.15V to 5.5V**
- CMTI: **±150kV/µs**
- Propagation Delay (typ.): **10ns**
- Package: **SOIC-16WB**

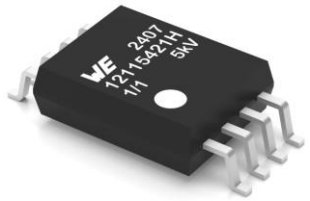
Digital Isolators

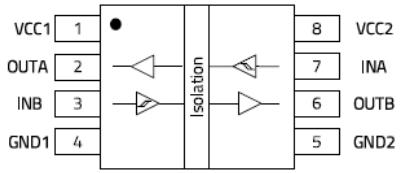
Portfolio overview

COMING SOON!

2 channel without integrated DC/DC

WPME-CDIS





- Isolation Voltage: **5000Vrms**
- **Reinforced isolation** (pending)
- Channel configuration: **2/0** and **1/1**
- Default output **high** and **low**
- Data Rate: **150Mbps**
- Supply Voltage: **2.375V to 5.5V**
- CMTI: **±150kV/µs**
- Propagation Delay (typ.): **12ns**
- Package: **SOIC-8WB**

Upgrade 3750 to 5000Vrms!

ISOLATION CERTIFICATIONS

Applicable Certifications

Safety First!

&

VDE

Applicable Certifications

Safety First!

&

VDE

→ **UL 1577**
Nonoptical Isolating Devices

SOIC-16WB & SOIC-8NB : E535458
→ **Single Protection**

- Isolation **3750Vrms** per 60sec for SOIC-8NB
- Isolation **5000Vrms** per 60sec for SOIC-16WB

→ **IEC 60747-17 (VDE 0884-17)**
Semiconductor devices - Part 17: Magnetic and capacitive coupler for basic and reinforced insulation

SOIC-16WB package : Certification number 40058069
→ **Reinforced Isolation**

SOIC-8NB package : Certification number 40058073
→ **Basic Isolation**

Applicable Certifications

Basic and Reinforced isolation

- **Functional Isolation** provides only necessary isolation for the correct operation of the system and doesn't protect against electrical shock

- **Basic isolation** provides in addition to the functional isolation a protection against electric shock

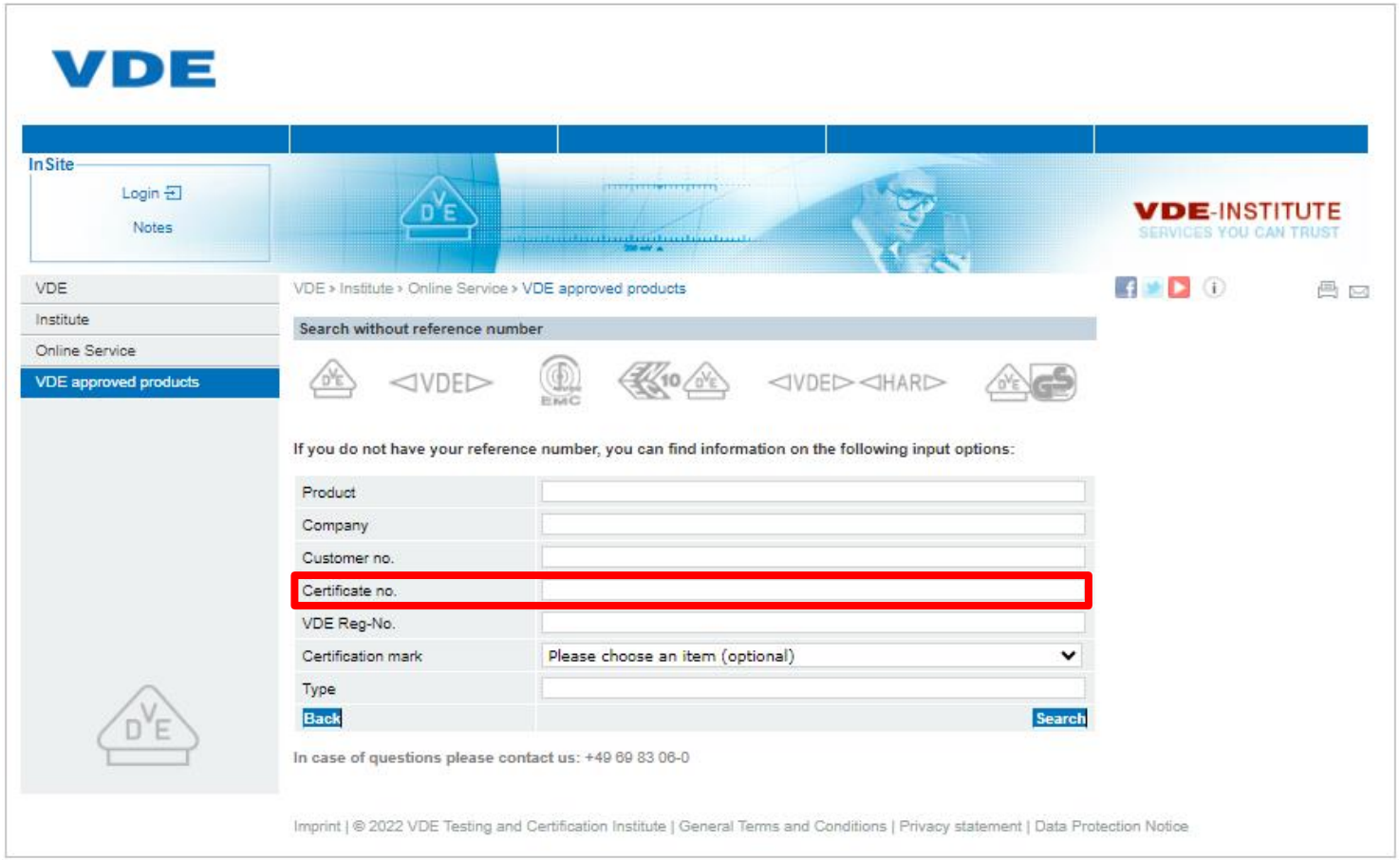
- Compared to an isolator providing basic insulation, an isolator providing **reinforced insulation** has greater requirements on its test voltage

Symbol	IEC 60747-17 (VDE 0884-17)	
	Basic Isolation	Reinforced Isolation
Package	SOIC-8NB	SOIC-16WB
V_{IOSM} - max. surge isolation voltage	5000 Vpk	7070 Vpk
Test	V_{TEST} = 1.3 x V_{IOSM} V_{TEST} = 6.5kV	V_{TEST} = 1.6 x V_{IOSM} V_{TEST} = 11.3kV
Failure rate over lifetime	≤ 1000 ppm	≤ 1 ppm

Clearance/Creepage	4mm	8mm

Applicable Certifications

VDE 0884-17 / IEC 60747-17 approved!



The link: www2.vde.com/en/institute/onlineservice/vde-approved-products/pages/Detail-Search.aspx

Applicable Certifications

UL 1577 Recognized!

Nonoptical Isolating Devices - Component

COMPANY E535458

Wuerth Elektronik eiSos GmbH & Co. KG
Max-Eyth-Str. 1
Waldenburg, Baden-Wurttemberg 74638 Germany

Marking: Company name model designation, and the Recognized Component Mark
Note: For additional marking information, refer to the Guide Information Page.

Single protection non-optical isolator providing 3750 Vac isolation, Model(s): *18012015411H, 18012015411L, 18012115411H, 18012115411L*

Single protection non-optical isolator providing 5000 Vac isolation, Model(s): *18014015401H, 18014015401L, 18014115401H, 18014115401L, 18014215401H, 18014215401L*

Single protection non-optical isolators at 5000 Vac isolation voltage, Model(s): *18024015401H, 18024015401L, 18024115401H, 18024115401L, 18024215401H, 18024215401L*

Last Updated on 2023-07-31

DESIGN-IN TOOLS

Service & Support

Online Catalog – Example CDIP series

Products

SOIC 16WB

	Order Code	Data-sheet	Simu-lation	Downloads	$V_{CC\ min.}$ (V)	$V_{CC\ max.}$ (V)	Channel Configuration	t_{PLH}, t_{PHL} (ns)	DR (Mbps)	CMTI (kV/µs)	V_{ISO} (V (RMS))	Default Output	Evaluation Boards	Samples
	18024015401H	SPEC	RE	6 FILES	3.15	5.5	4/0	10	100	150	5000	High	18824015401H	1
	18024015401L	SPEC	RE					10	100	150	5000	Low	18824015401L	1
	18024115401H	SPEC	RE					10	100	150	5000	High	18824115401H	1
	18024115401L	SPEC	RE					10	100	150	5000	Low	18824115401L	1
	18024215401H	SPEC	RE					10	100	150	5000	High	18824215401H	1
	18024215401L	SPEC	RE					10	100	150	5000	Low	18824215401L	1

EDA models: Components ZIP

ALT Altium_WPME-CDIP (rev23a).IntLib | 182 KB

CDS Cadence_WPME-CDIP (rev23a).zip | 743.2 KB

EAG Eagle_WPME-CDIP (rev23a).lbr | 38.7 KB

CAD files ZIP

3D 3D_CDIP_18024x15401x (rev1).pdf | 301.2 KB

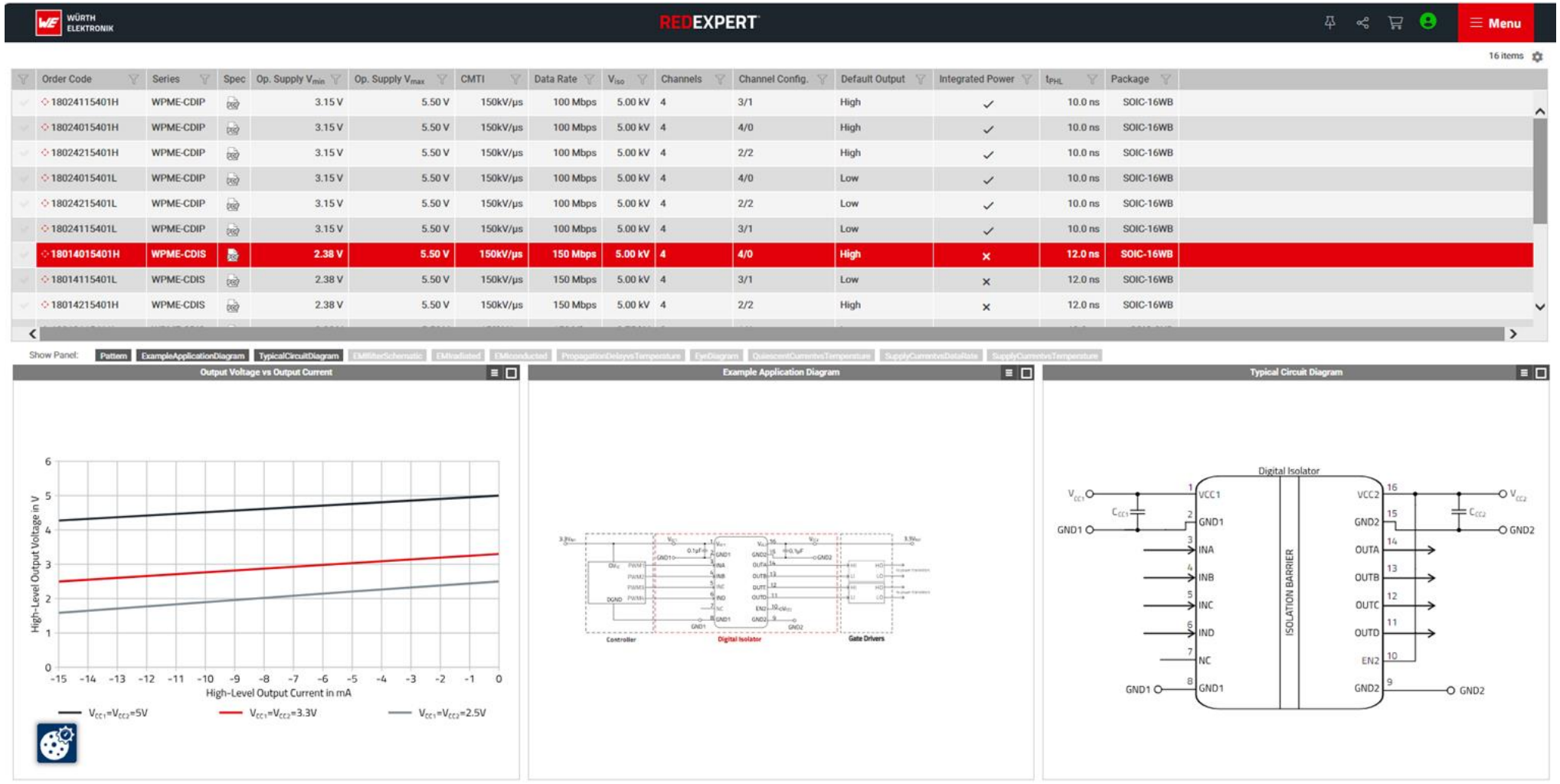
IGS IGS_CDIP_18024x15401x (rev1).igs | 3 MB

STP STP_CDIP_18024x15401x (rev1).stp | 898 KB

Download all 6 files as zip archive ZIP

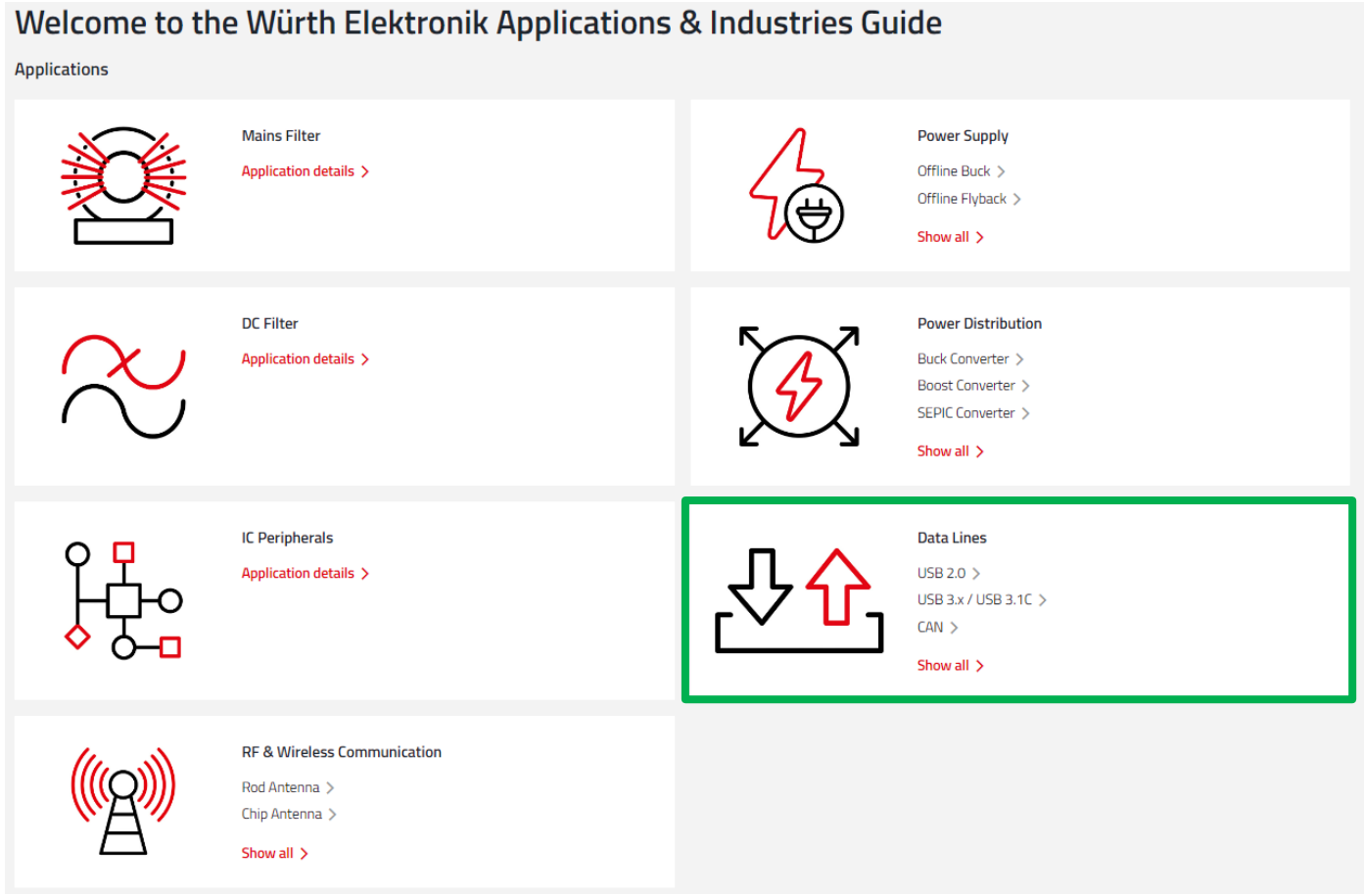
Service & Support

REDEXPERT



Service & Support

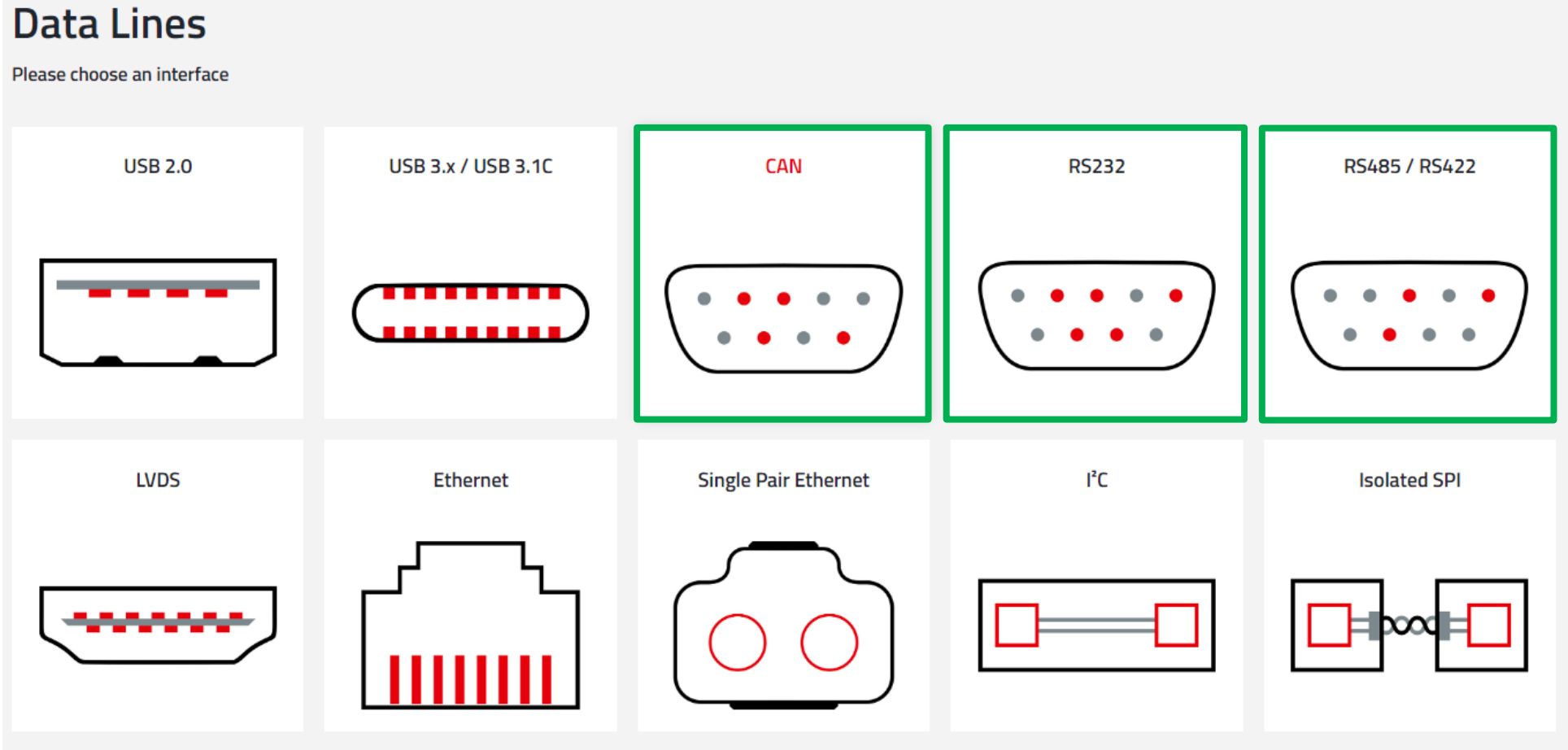
Applications & Industries Guide



The link: www.we-online.com/en/components/applicationguide

Service & Support

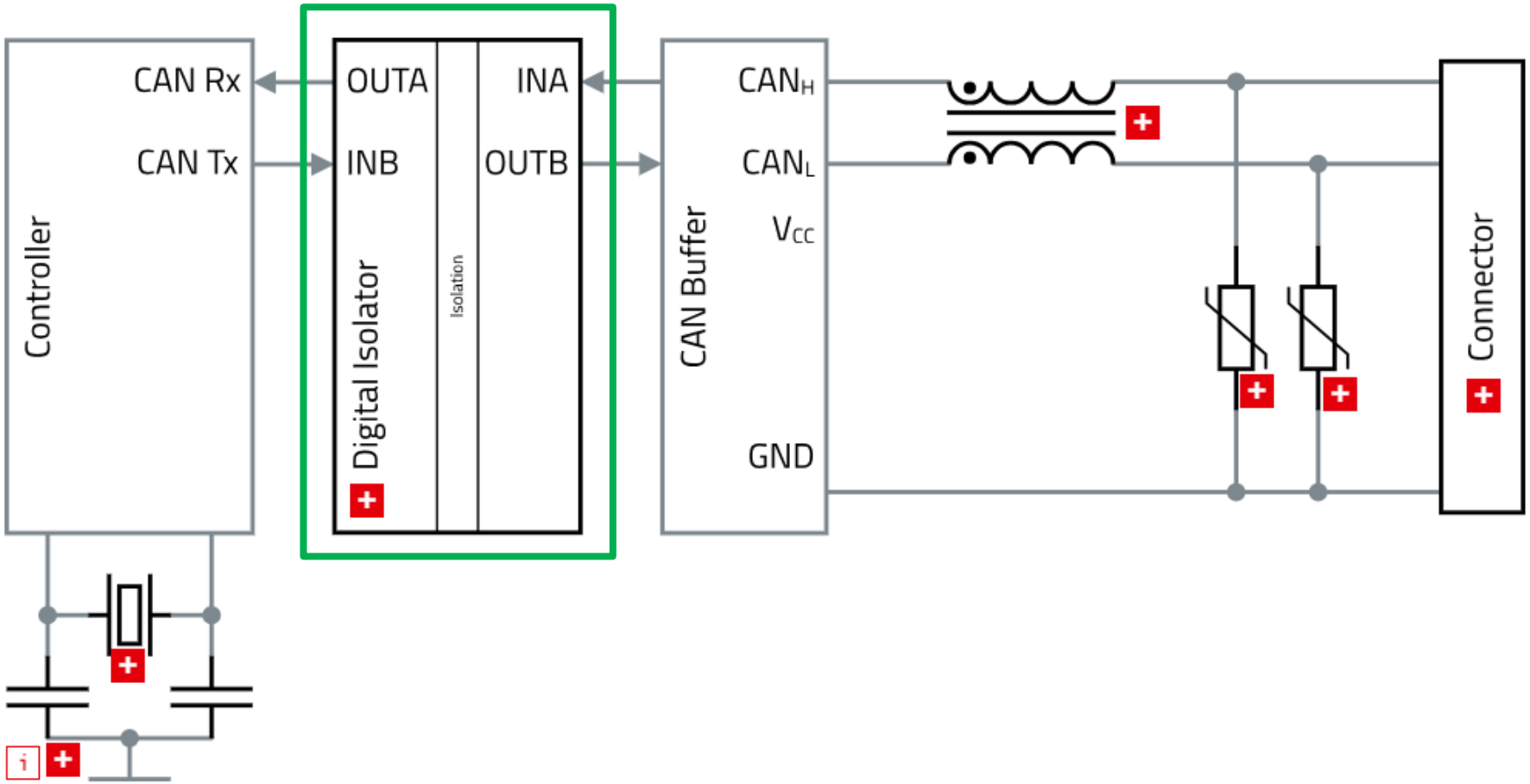
Data Lines



The link: www.we-online.com/en/components/applicationguide/appguide_data_lines

Service & Support

Data Lines - **CAN**

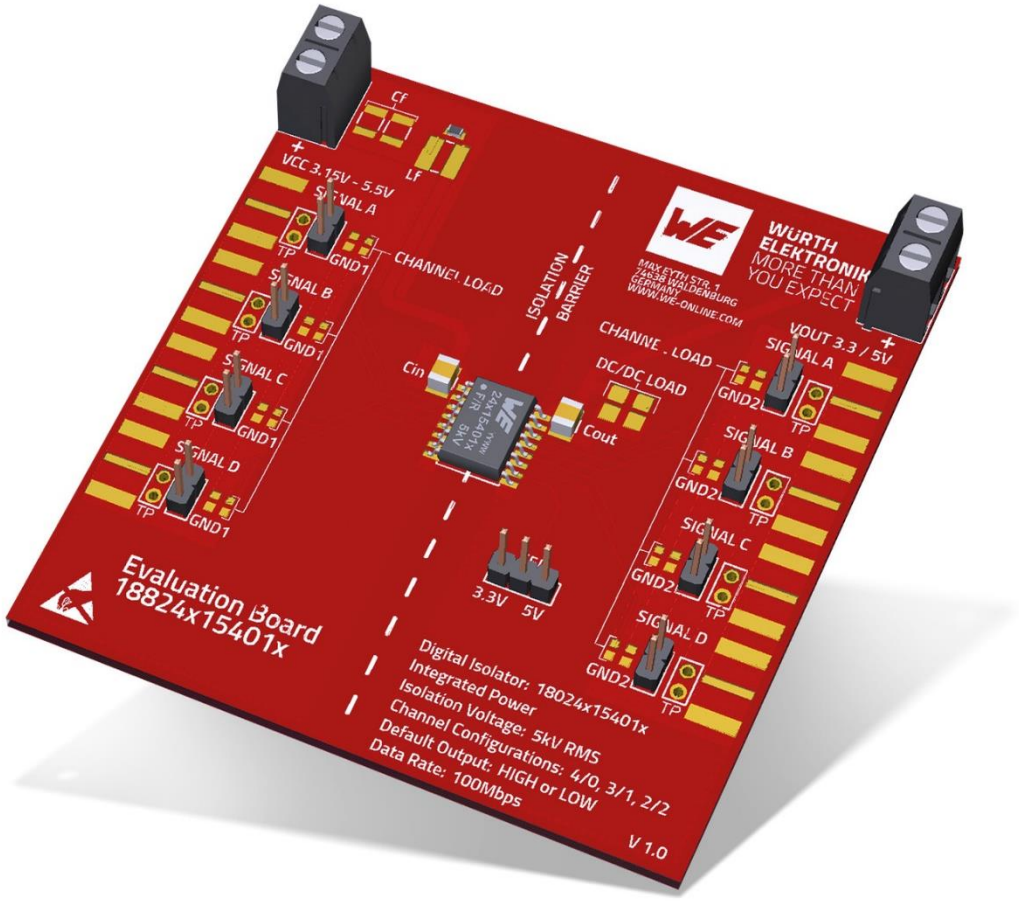


The link: www.we-online.com/en/components/applicationguide/can

EvalBoards

Evaluation Board

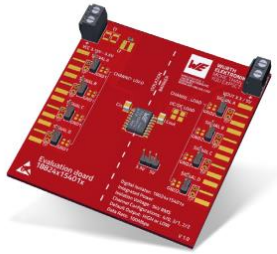
- 4 channel digital isolator with integrated 0.65 W isolated DC/DC converter
- Supply voltage: 3.15 to 5.5 V
- DC/DC converter output 3.3 or 5 V (selectable via jumper)
- The footprints of the optional input filter are optimized for SMT assembly
- Low propagation delay: 10 ns typical
- High speed data rate up to 100 Mbps
- Header pins or optional edge mounted SMA connectors (must be ordered separately if necessary) for signal sources
- Conducted and radiated EMI compliant according to EN55032 / CISPR32 class B



EvalBoards

Evaluation Board – Quick Start Guide

WÜRTH ELEKTRONIK
MORE THAN YOU EXPECT



QUICK START GUIDE

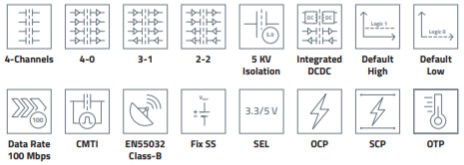
Digital Isolator Evaluation Board for 18024x15401x SOIC-16WB

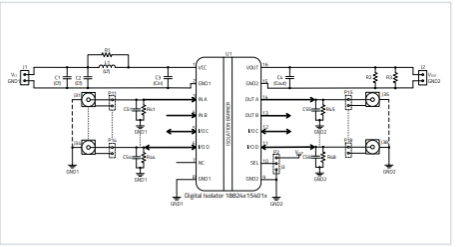
Evaluation Board 18824x15401x

Version 1.0

SCHEMATIC

Features





For accurate V_{IN} and V_{OUT} voltage measurements it is recommended to measure directly at the input and output capacitors. It is **not** recommended to use this evaluation board with input and output wire lengths longer than 1 m.

For the datasheet of the digital isolators visit us at: **www.we-online.com/wpme-cdip**

This product is highly sensitive to electrostatic discharge (ESD). As such, always use proper ESD precautions when handling. Failing to follow the aforementioned recommendations can result in severe damage to the part.

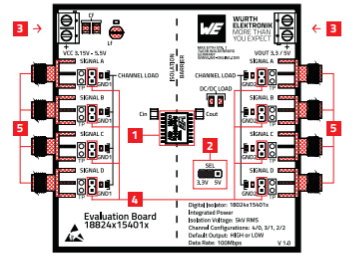
Evaluation Board P/N	Digital Isolator P/N	Channel configurations	Default Output
18824015401H	18024015401H	4/0	High
18824015401L	18024015401L		Low
18824115401H	18024115401H	3/1	High
18824115401L	18024115401L		Low
18824215401H	18024215401H	2/2	High
18824215401L	18024215401L		Low

Ref. Des.	Description (Order Code)
U1	4 channel digital isolator with integrated DC-DC converter (18024x15401x)
C1, C2	Filter ceramic chip capacitor 10µF, 16V, X7R, 1210 (opt.) (885012209014)
C3, C4	Ceramic chip capacitor 10µF, 16V, X7R, 1210 (885012209014)
C51...C58	Channel Load ceramic chip capacitor 0603 (optional)
J1, J2	Screw Terminal Block (691502710002)
J3	Jumper for selection output voltage of integrated DC/DC converter (609002115121)
J31...J38	SMA connector (optional) (60312202114509)
L1	Filter SMD Inductor 4u7H (optional) (744773047)
P11...P18	THT 2-pin header (61300211121)
P2	THT 3-pin header (61300311121)
R1	Shunt SMD Resistor 00, 0603
R2, R3	DC/DC Load SMD Resistor, 1206 (optional)
R41...R48	Channel Load SMD Resistor, 0603 (optional)

WARNING!
Before operating read the attached important notice document!

For Layout, Gerber and Step files visit us on www.we-online.com/wpme-cdip

OVERVIEW



Default jumper position

Description
V_{CC} 3.15 – 5.5 V
V_{OUT} 3.3 or 5 V
V_{ISO} 5 kV_{RMS}
DR up to 100 Mbps

1. CDIP Capacitive Digital Isolator Powered SOIC-16WB
2. Jumpers (J3) for selection output voltage of integrated DC/DC converter
3. Terminal block screw connectors for V_{CC} and V_{OUT}
4. THT 2-pin headers for input and output digital signals
5. SMA connectors (optional) for input and output digital signals

Optional components

Absolute maximum ratings
Caution: Exceeding the abs. max. values given in the datasheet may affect the device negatively and may cause permanent damage.

This evaluation board is intended to be operated in a research and development environment under the supervision of qualified technicians and engineers who are trained and experienced in the safe use of electronics. This evaluation board was designed and tested according to CISPR32 Class B standards under Würth Elektronik laboratory test conditions, as indicated in the data sheet of the corresponding digital isolator. Operation in other test setups may cause unintended electrical behavior and exceed the stated performance and limits imposed by the CISPR32 Class B standards. This evaluation board is not intended for usage in final applications. This evaluation board is not intended for resale.

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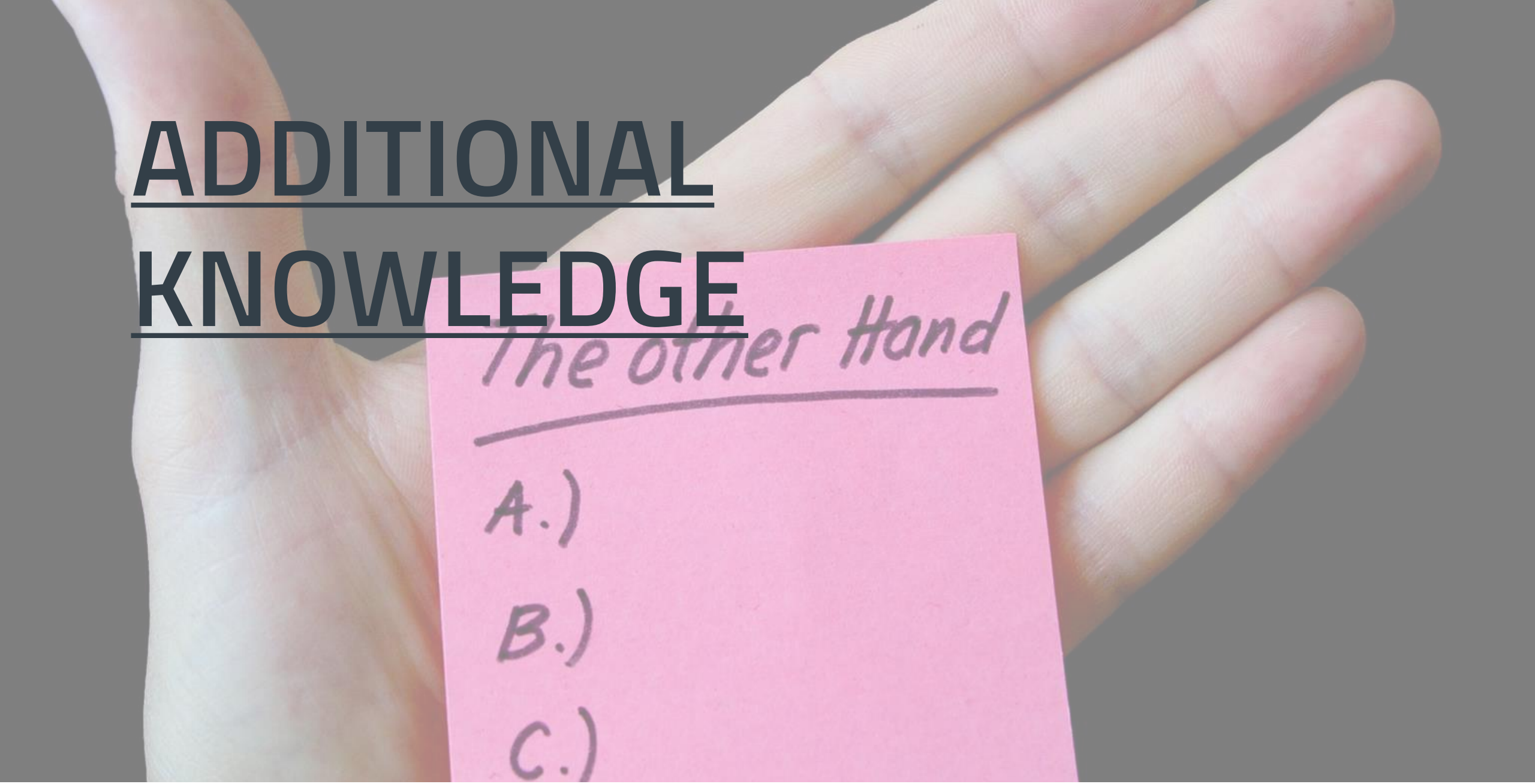
ADDITIONAL KNOWLEDGE



Additional Knowledge

Power Electronics News

Summary:

- Applications that need a signal isolation.
- Main functions of an isolator.
- Different types of isolation technics.
- Detailed explanation of the inner structure of the digital isolator.
- Example applications for digital isolators.

Link to article:

Reliable Galvanic Isolation Simplified

Service & Support

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Services

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Design-In Support

EMC Filter Design Support

Layout Review Support

Thermal Design Support

Services

- **ADM trainings**
- **ADM basic technical support**
- **ADM pricing and lead time support**
- **Customer trainings/seminars**
- **Visit focus customers**
- **Business tracking / reports**
- **Sales app (define and provide content)**
- **Sales tools (Product Overview, Show Boards)**

Many THANKS for your attention!

DIGITAL ISOLATORS – THE NEXT STEP IN SIGNAL PROTECTION

Artem Beliakov

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT