FHI Federatie van technologiebranches

Welcome

Hartelijk welkom

Hybrid configuration of Board-to-Board connectors - Data / Signal / Power

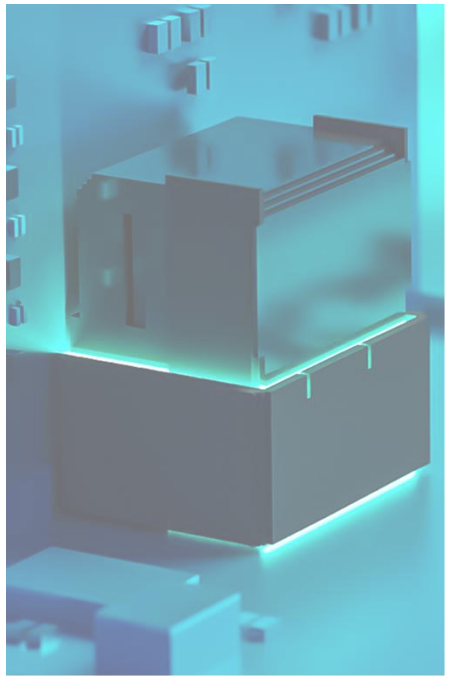
Detlef E. Preißler

April 14th, 2025

PHOENIX CONTACT

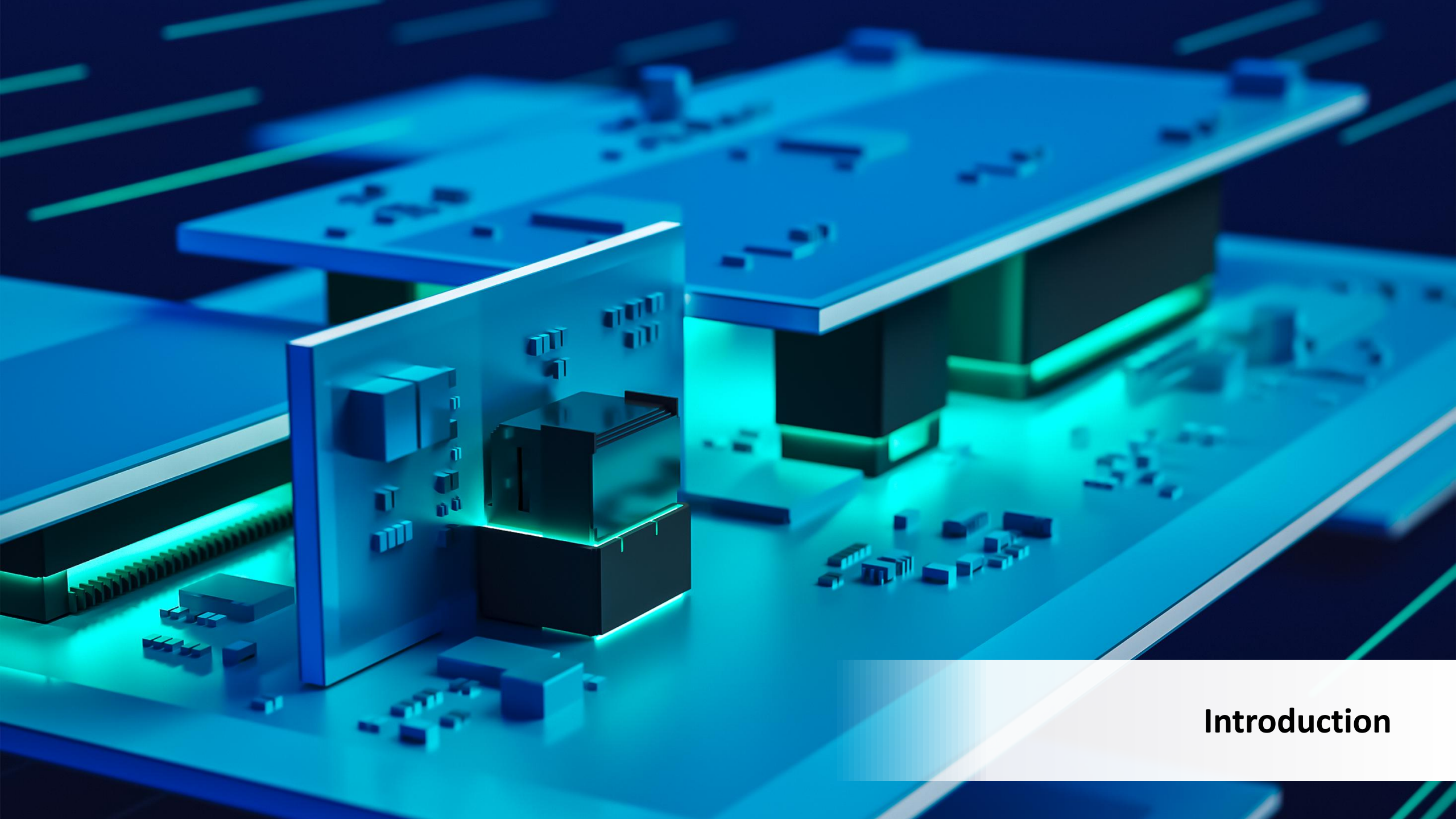
FHI Federatie van technologiebranches

Agenda



- Introduction
- Definition: Data / Signals / Power – what does hybrid means?
- What are classic Hybrid Connectors?
- FINEPITCH portfolio at a glance
- Board-to-board connections with hybrid assignments – a technological view
- Real application example - PICMG ModBlox7™
- Conclusion

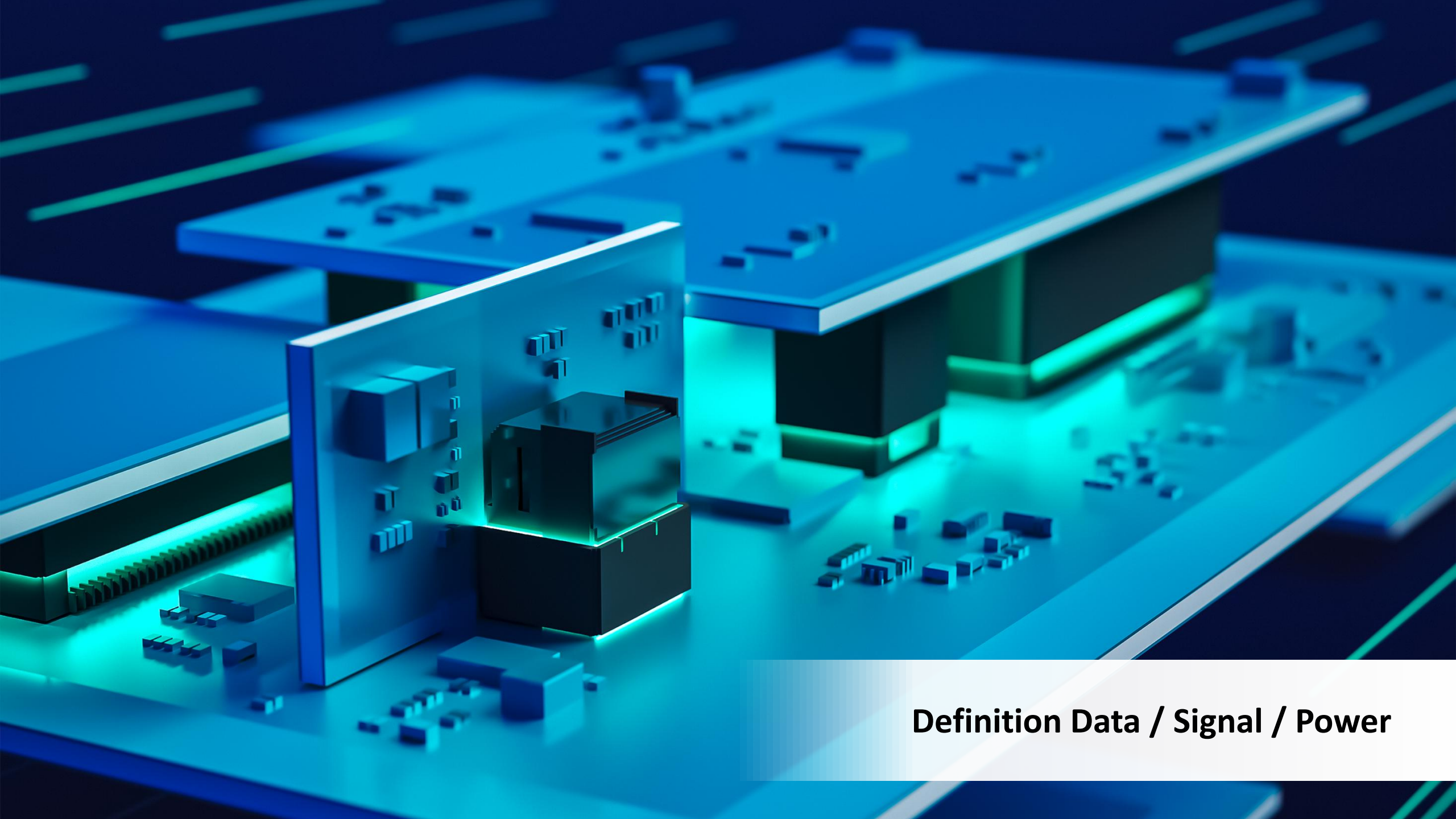
PHOENIX CONTACT



Introduction

Presenter: Detlef E. Preißler

- **Dipl.-Ing. Electrical Engineering** (University of Hanover, Master Degree) general Electrical Engineering/Microelectronics
- **Over 30 years**
  electromechanical components and connectors
- **Sr. Market Specialist** Board-to-Board Connectors
  dpreissler@phoenixcontact.com
- **Phoenix Contact GmbH & Co. KG BA**
  Device Connectors
  HQ Germany Phoenix Contact Germany



Definition Data / Signal / Power

Definition Data / Signals / Power

Data

Definition according to DIN 44300:

Data is a string of characters that contains a specific piece of information. They are transferred between systems or stored on systems.

Data is therefore the abstract unit of information that is transmitted by signals.

Definition Data / Signals / Power

Signal

Definition according to DIN 44300:

A signal is a physical carrier of data. In electrical engineering, an electrical signal is the representation of a message by physical quantities such as voltage, current, frequency, phase position or magnetic field strength.

The information is encoded in the change of these quantities.

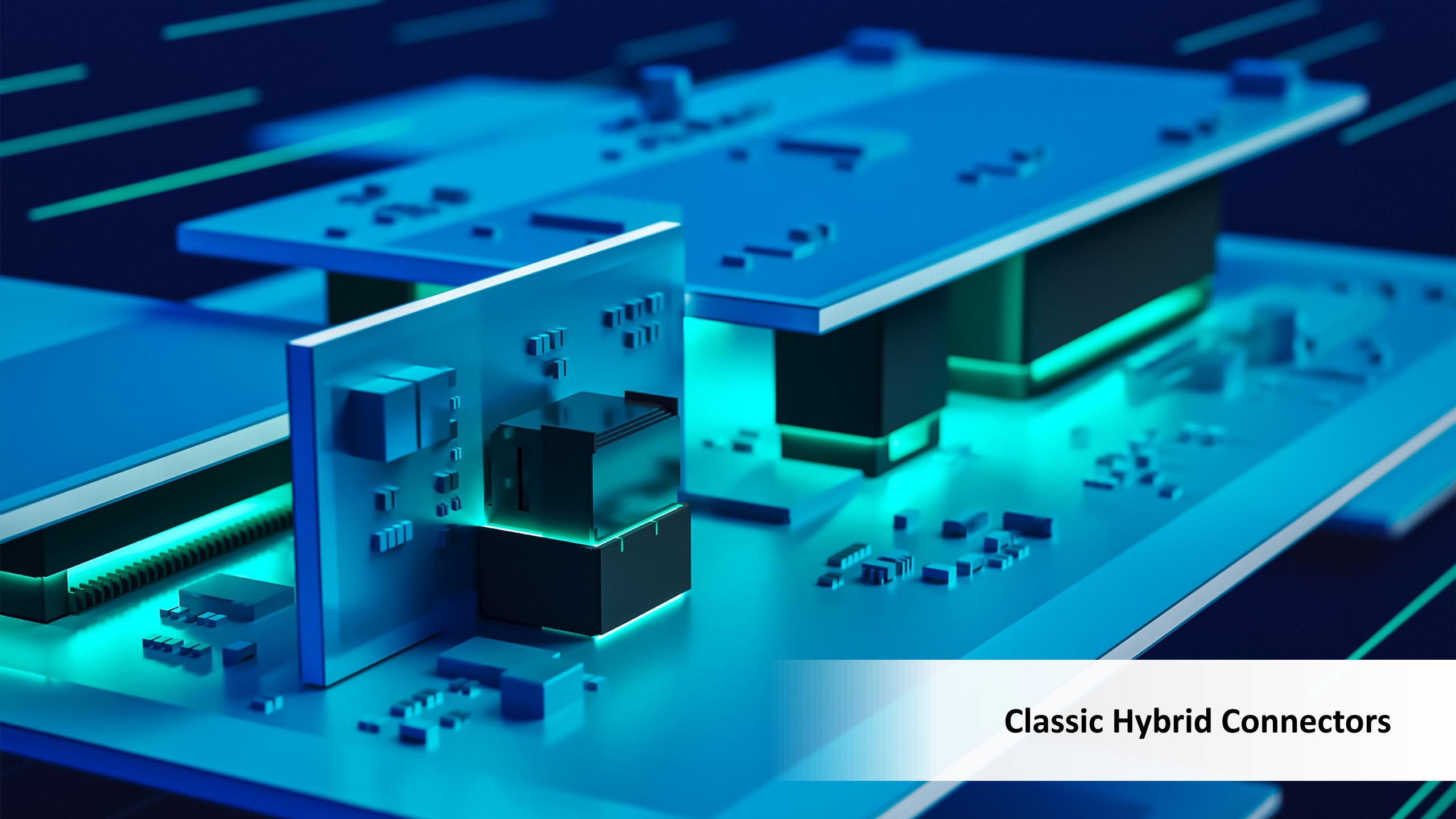
Definition Data / Signals / Power

Power

Definition according to IEC 60050:

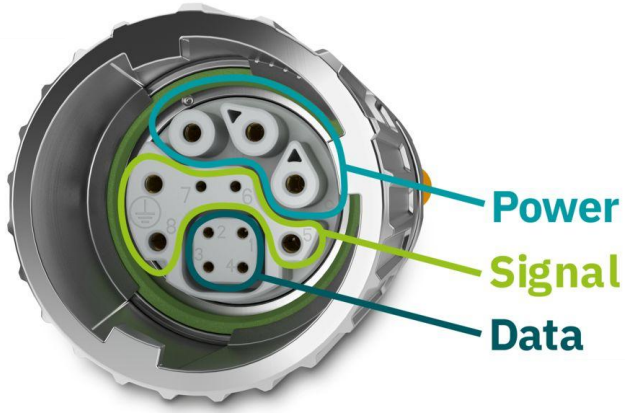
"Power" or electrical power is the amount of energy per unit of time that is transmitted or converted in an electrical system.

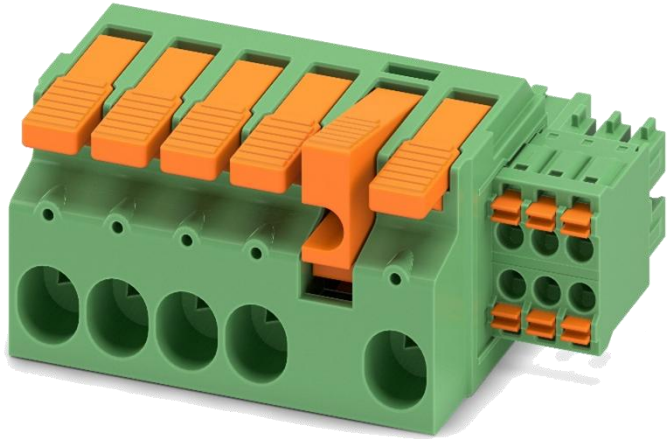
It is usually given in watts (W) and can be calculated as a product of voltage and current.



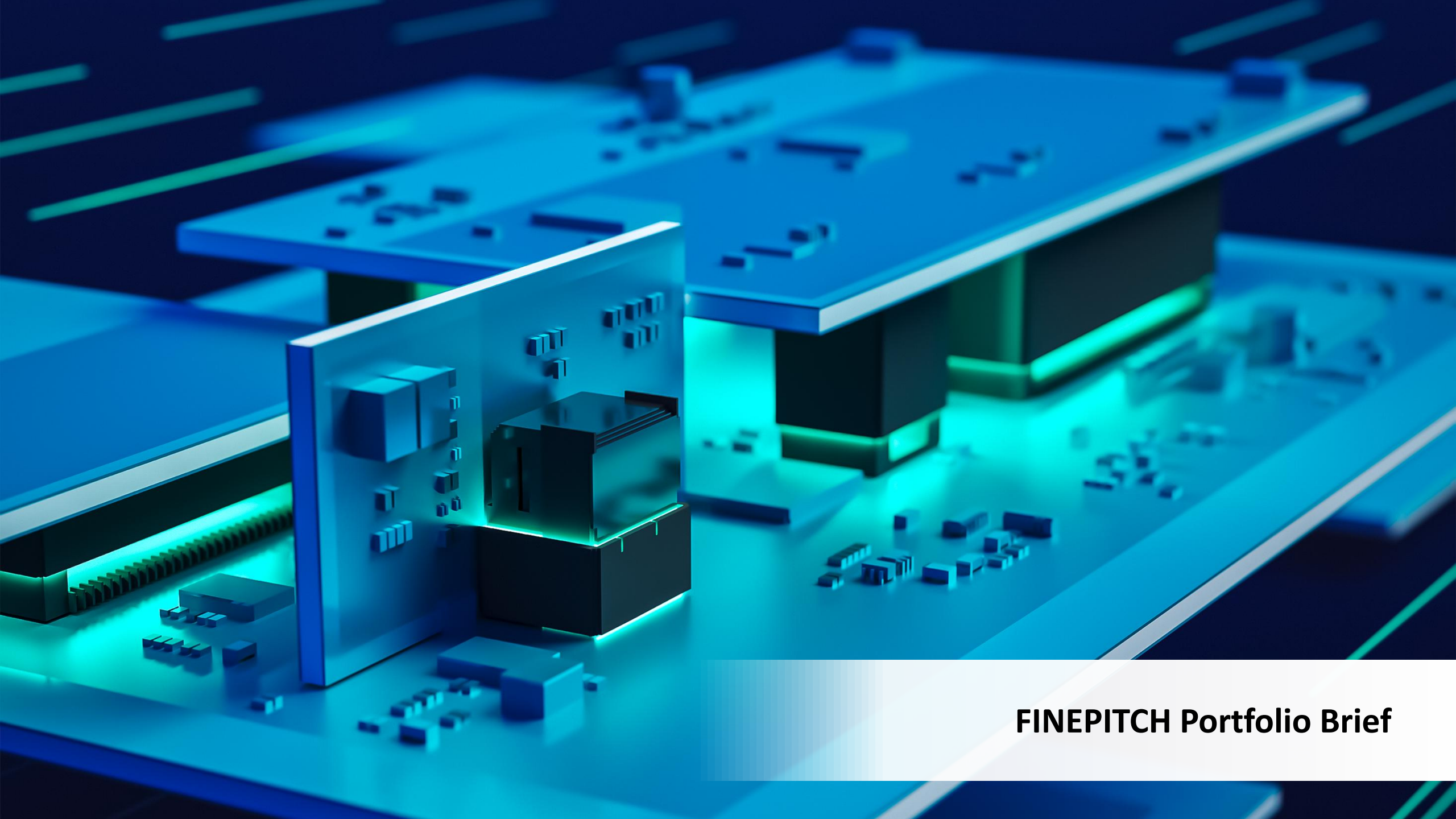
Classic Hybrid Connectors

Classic Hybrid Connectors





… and board-to-board connectors?



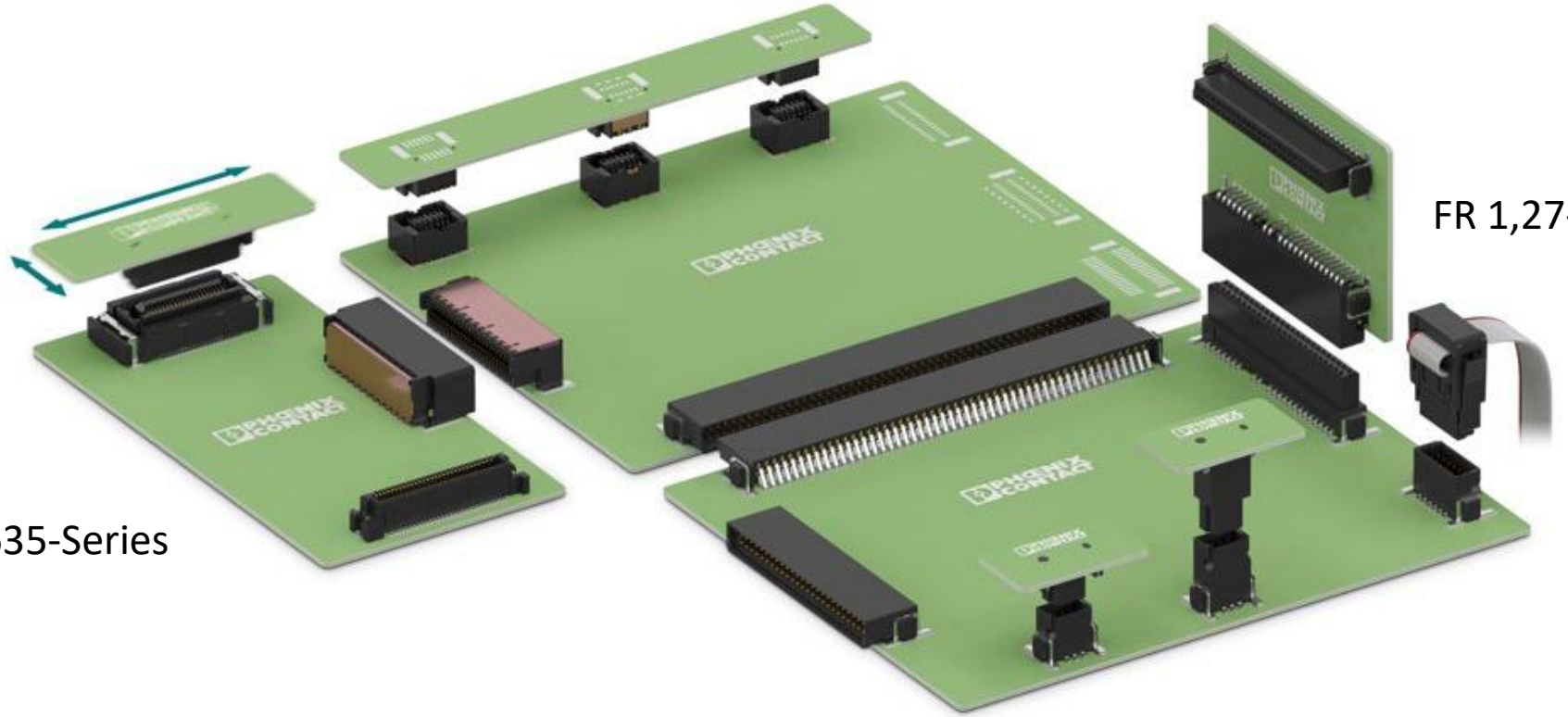
FINEPITCH Portfolio Brief

Federatie van technologiebranches

Hybrid configuration of Board-to-Board connectors - Data / Signal / Power

FINEPITCH portfolio at a glance

FP 0,8-Series



FR 1,27-Series

FS 0,635-Series

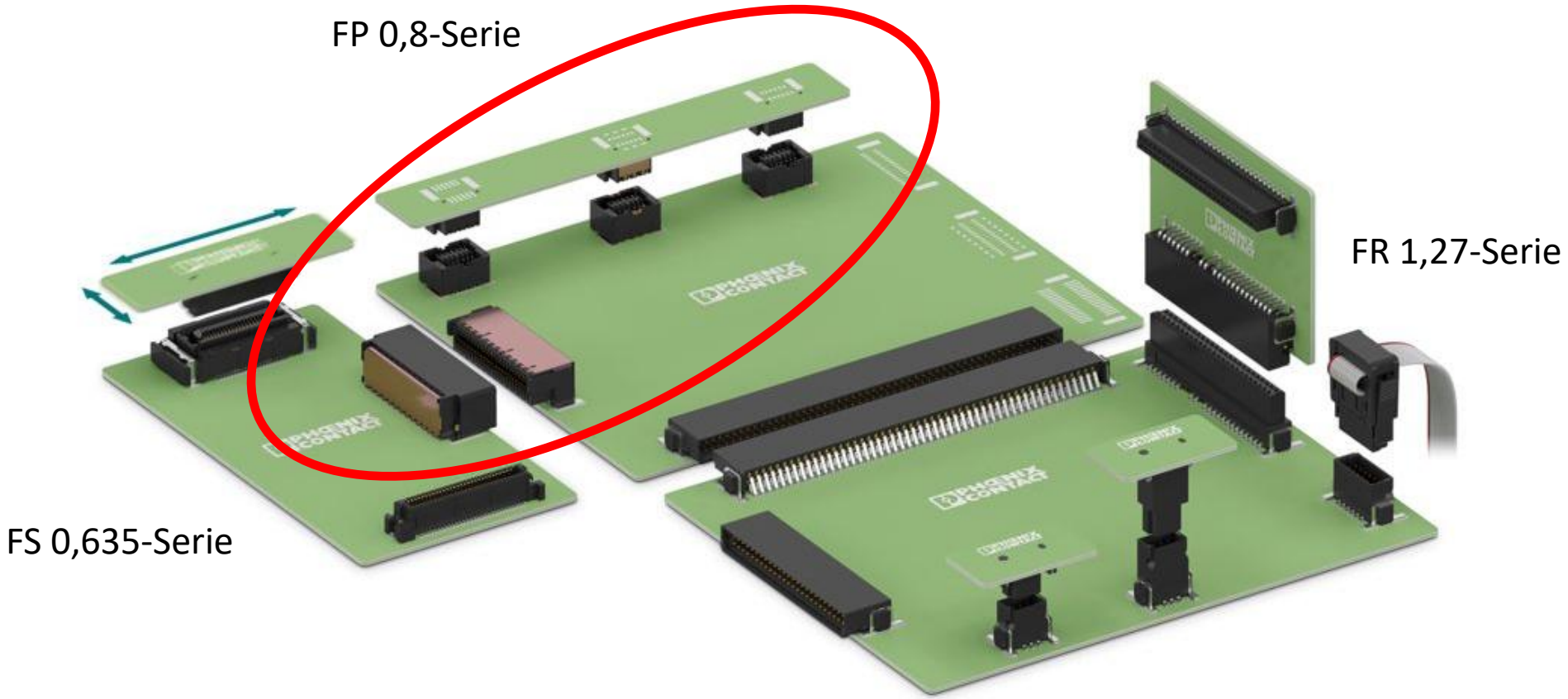
[Board-to-Board-Connectors FINEPITCH | Phoenix Contact]

PHOENIX CONTACT

Federatie van technologiebranches

Hybrid configuration of Board-to-Board connectors - Data / Signal / Power

FINEPITCH portfolio at a glance

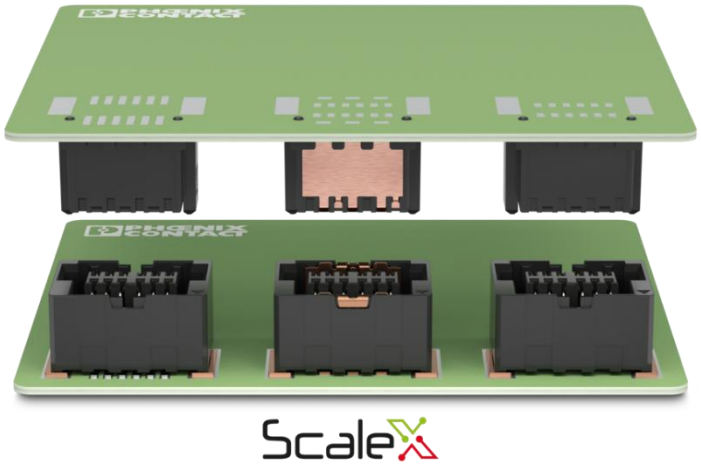


PHOENIX CONTACT

Federatie van technologiebranches

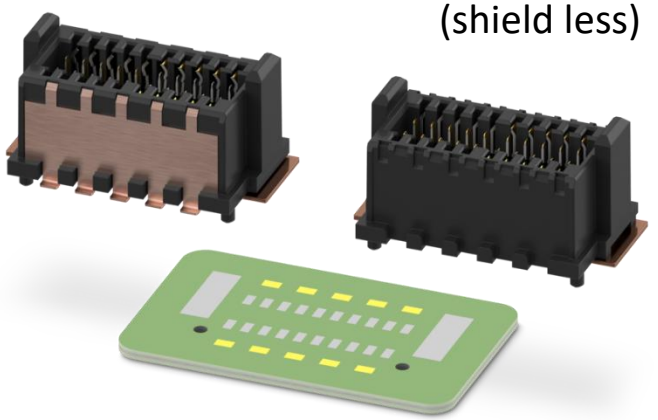
Hybrid configuration of Board-to-Board connectors - Data / Signal / Power

FINEPITCH Board-to-Board-Connectors: FP 0,8



shielded SH

w/o shield SL
(shield less)



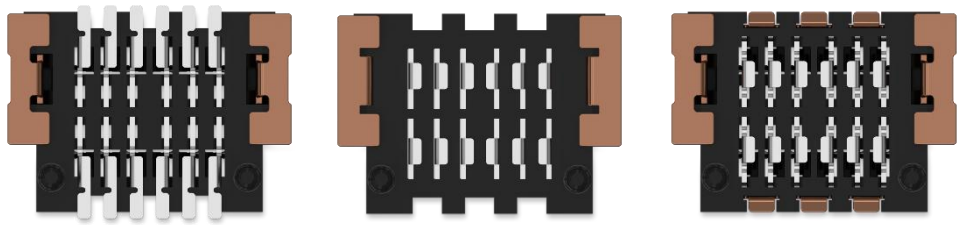
Main features:

- Pitch: 0,8 mm
- PCB-Footprints: AOI, SH, SL
- Pin counts: 12, 20, 32, 52, 80
- Stack height: 6 - 21 mm
- Data rates: up to 52 Gbps
- Op. current: 1.7 A per contact (fully powered)
- Mating cycles: 500

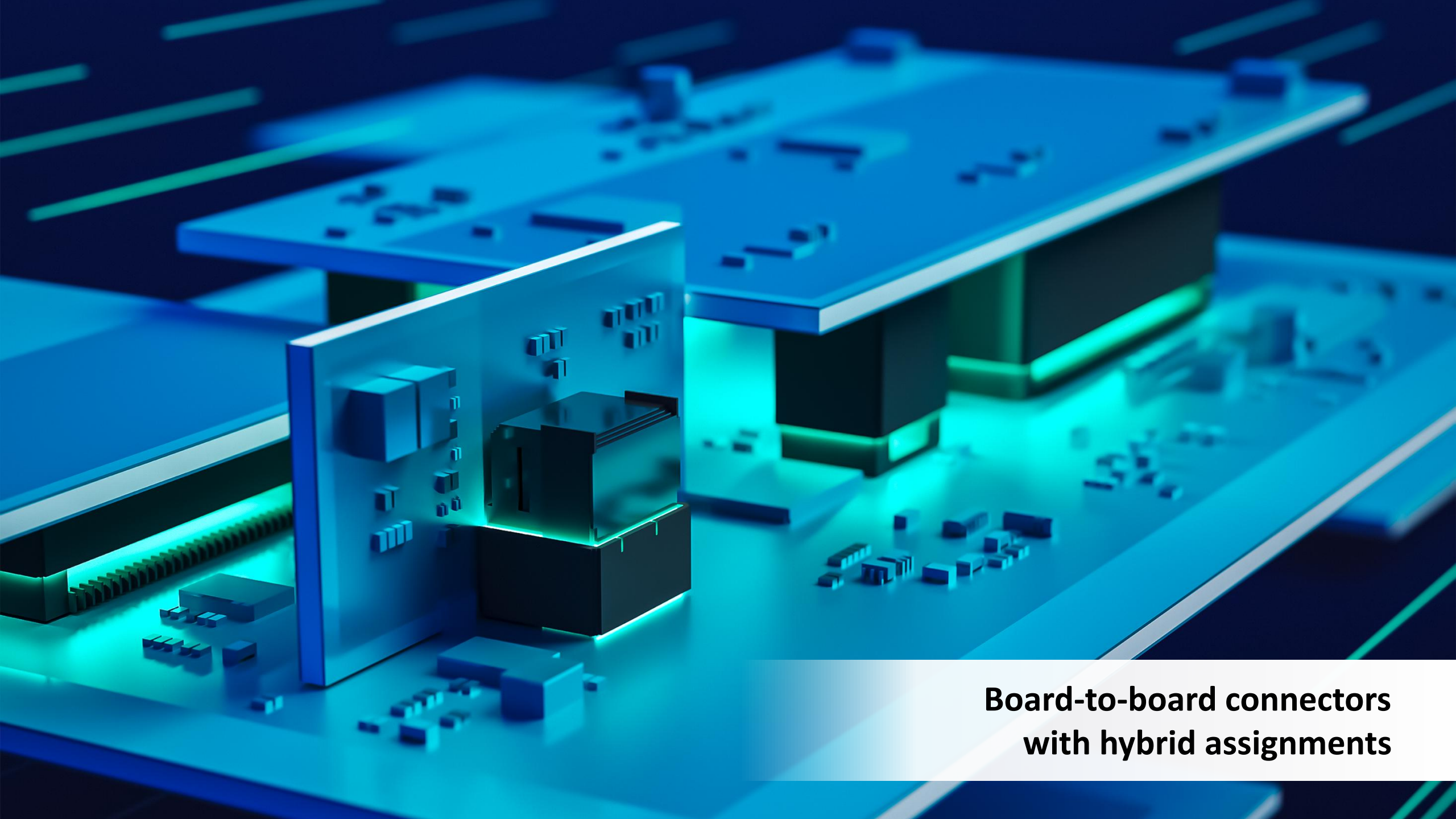
unshielded
AOI

w/o shield SL

shielded
SH



PHOENIX CONTACT



Board-to-board connectors with hybrid assignments

Federatie van technologiebranches

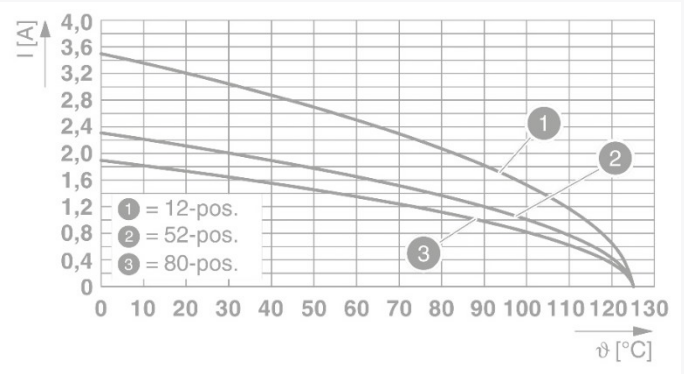
Hybrid configuration of Board-to-Board connectors - Data / Signal / Power

Board-to-board connections with hybrid assignments

Fully powered

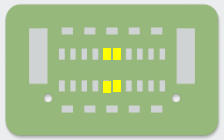
All contacts are fully powered.

12-pos.	**3.2 A** @ 20 °C
52-pos.	**2.1 A** @ 20 °C
80-pos.	**1.7 A** @ 20 °C

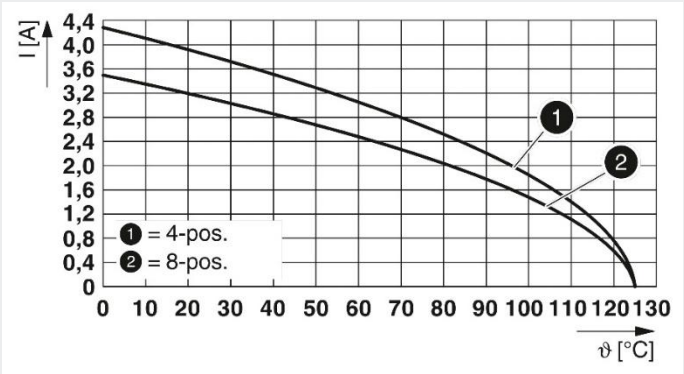


Partial powered

Only selected pins are used as power pins



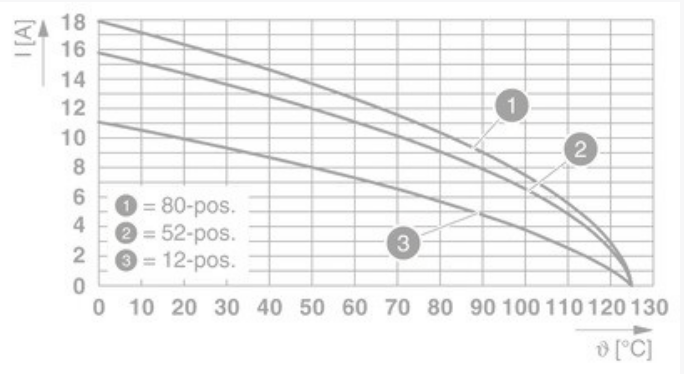
4-pos.	**3.9 A** @ 20 °C
8-pos.	**3.2 A** @ 20 °C



Powered over shield

The galvan. separated shield metals are used as power contacts (hybrid conn.)

12-pos.	**10 A** @ 20 °C
52-pos.	**14 A** @ 20 °C
80-pos.	**16 A** @ 20 °C

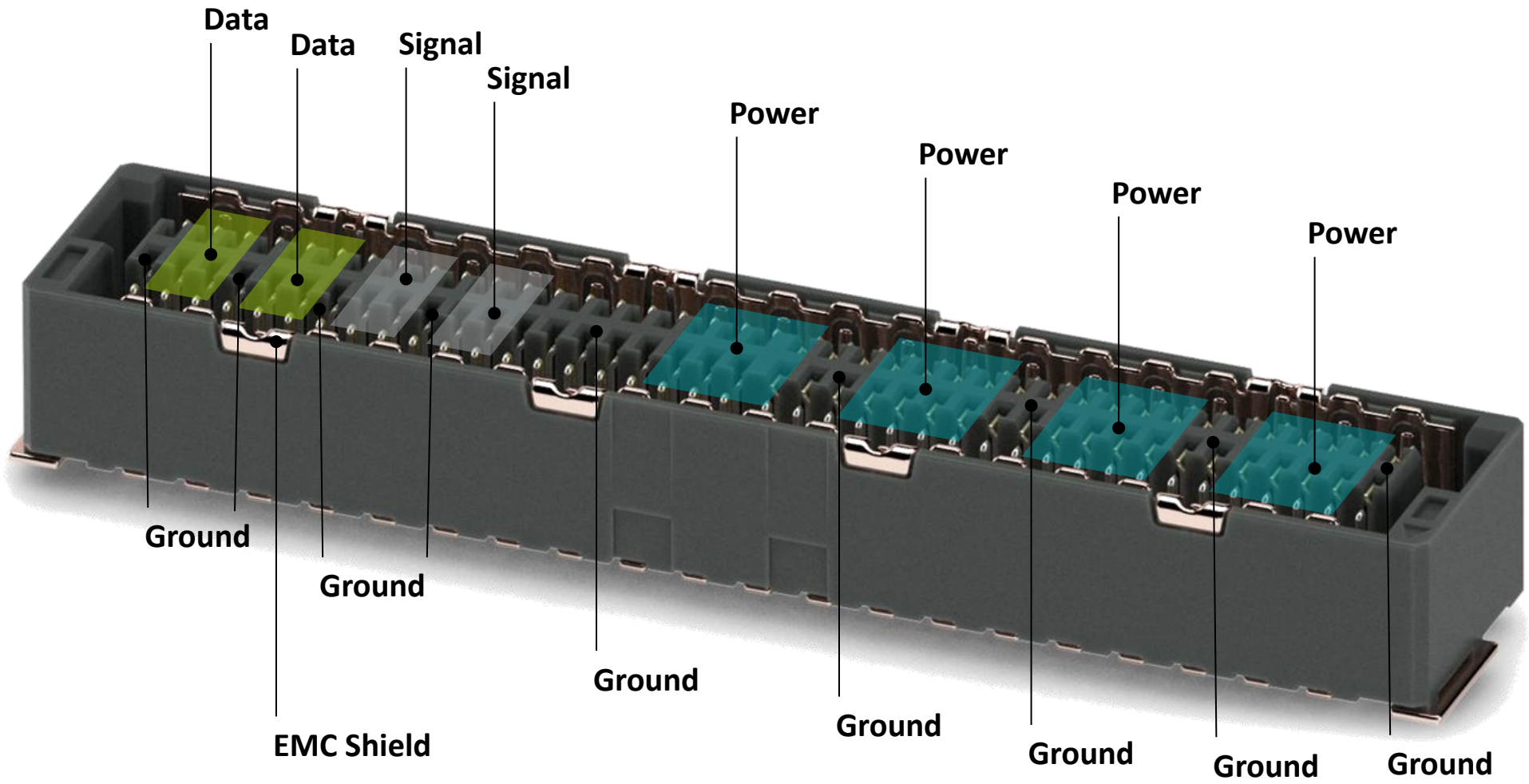


PHOENIX CONTACT

Federatie van technologiebranches

Hybrid configuration of Board-to-Board connectors - Data / Signal / Power

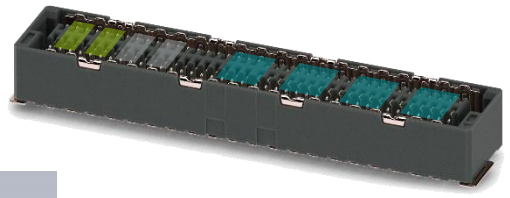
Board-to-board connections with hybrid assignments

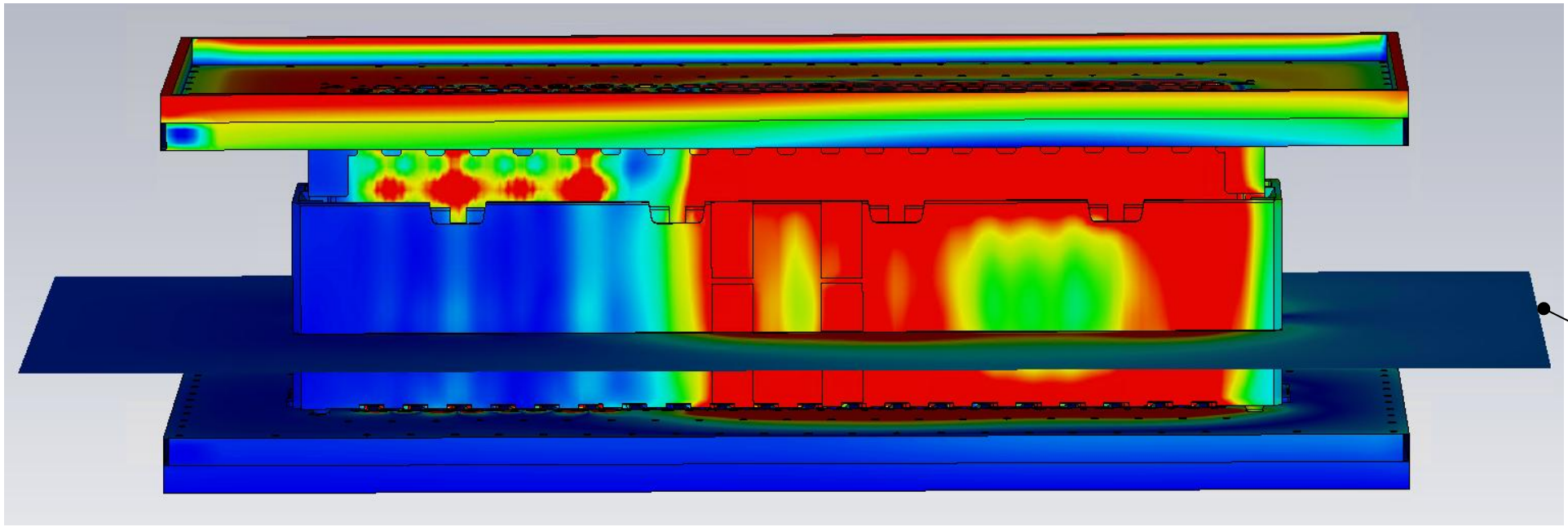


PHOENIX CONTACT

Hybrid configuration of Board-to-Board connectors - Data / Signal / Power

Board-to-board connections with hybrid assignments

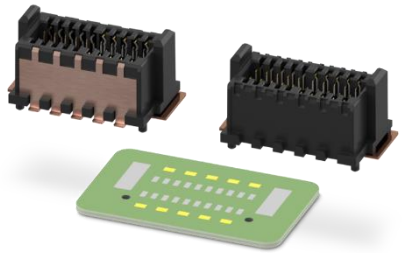


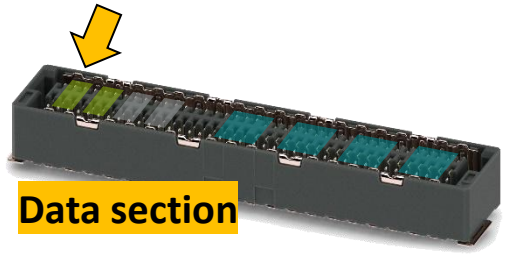


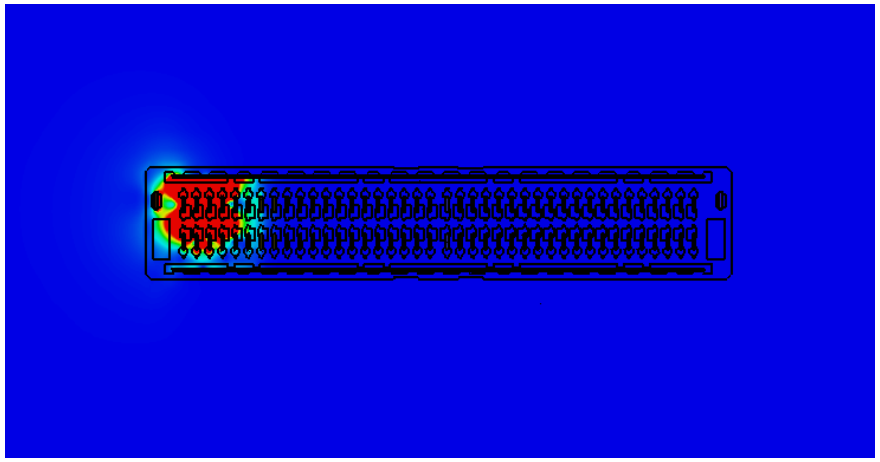
Federatie van technologiebranches

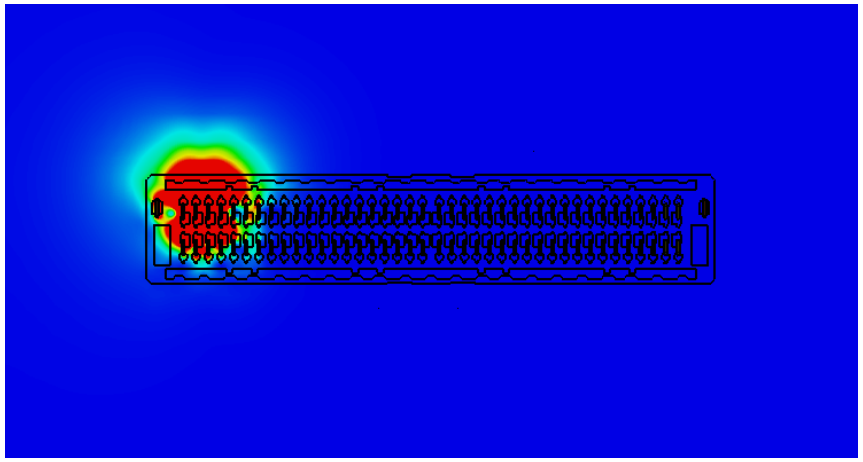
Hybrid configuration of Board-to-Board connectors - Data / Signal / Power

Board-to-board connections with hybrid assignments





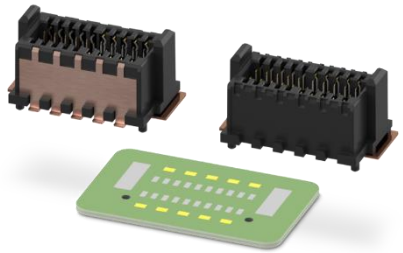


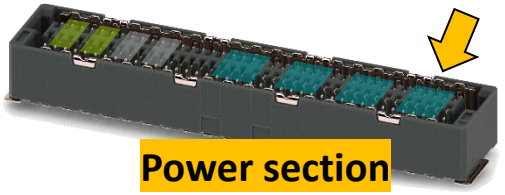


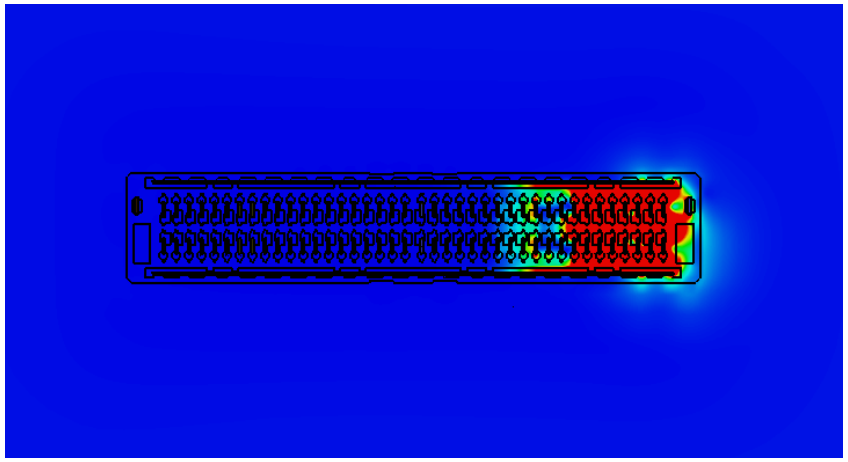
PHOENIX CONTACT

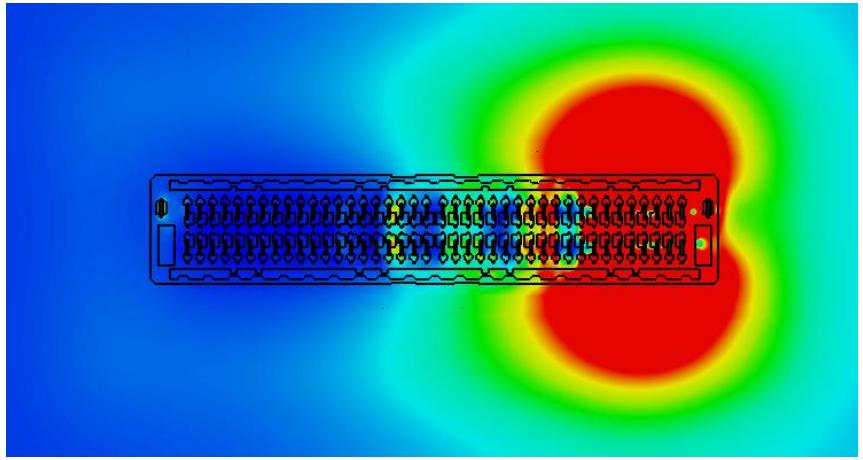
Hybrid configuration of Board-to-Board connectors - Data / Signal / Power

Board-to-board connections with hybrid assignments



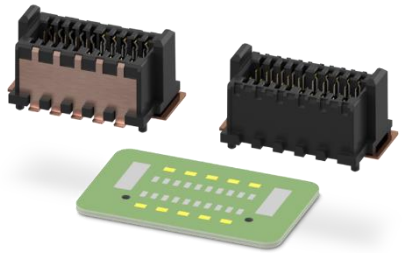


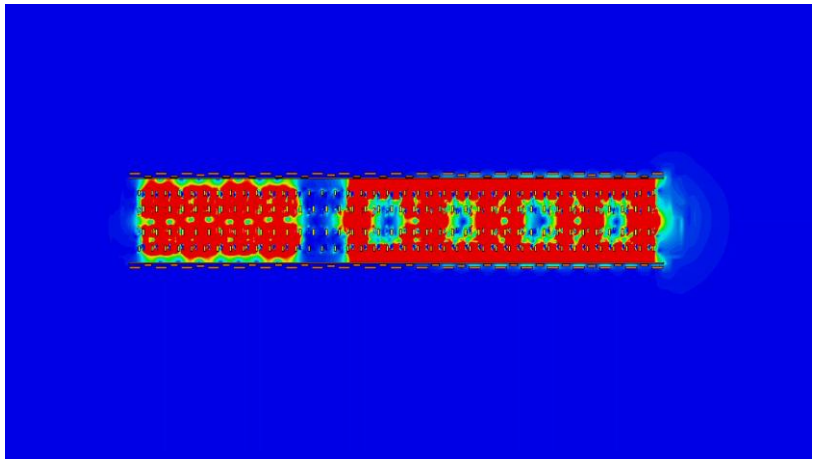


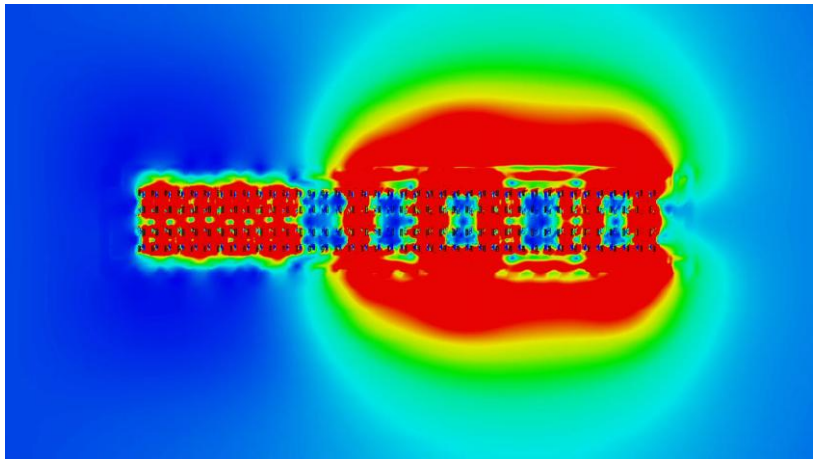


Hybrid configuration of Board-to-Board connectors - Data / Signal / Power

Board-to-board connections with hybrid assignments

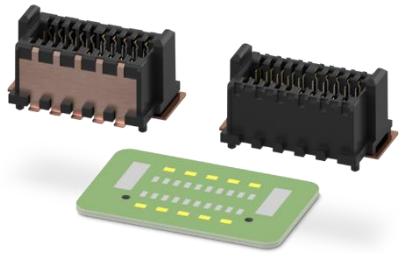




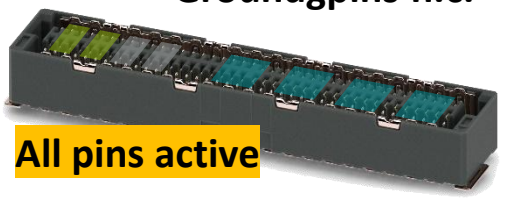


Hybrid configuration of Board-to-Board connectors - Data / Signal / Power

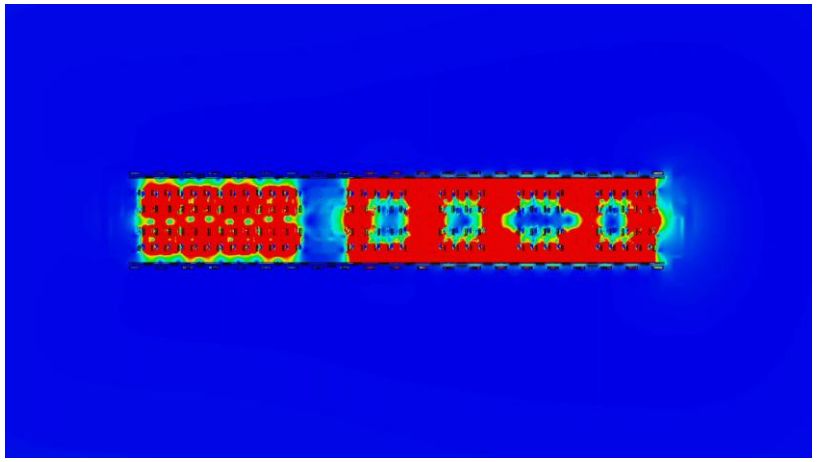
Board-to-board connections with hybrid assignments

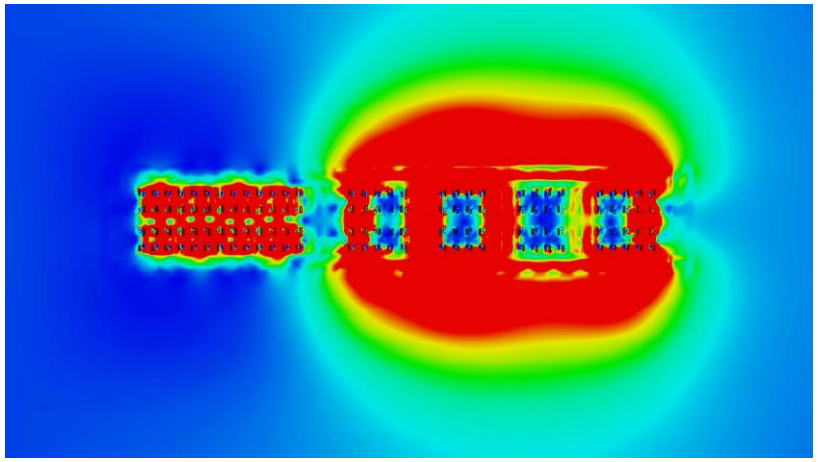


Groundgpins n.c.



All pins active

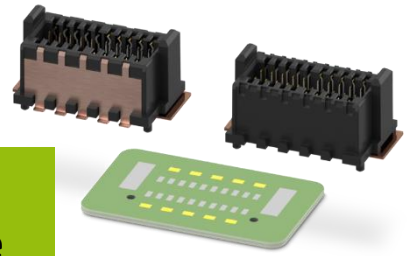




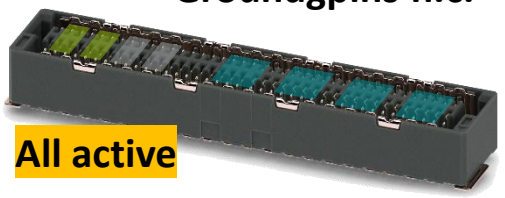
Federatie van technologiebranches

Hybrid configuration of Board-to-Board connectors - Data / Signal / Power

Board-to-board connections with hybrid assignments



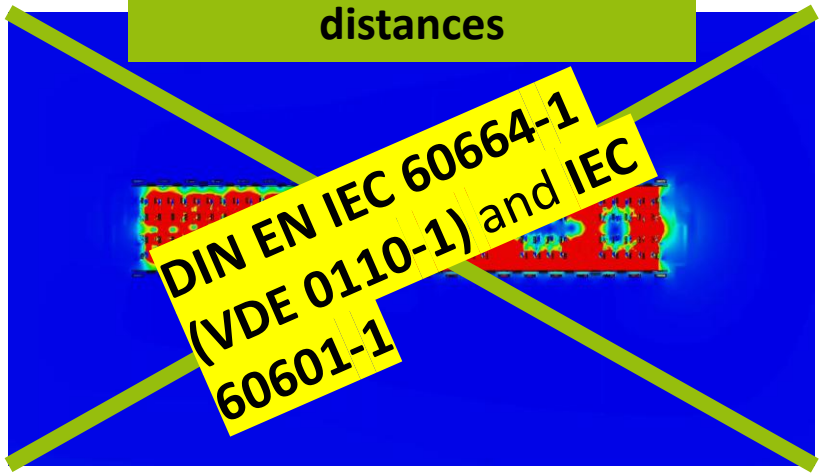
Groundgpins n.c.

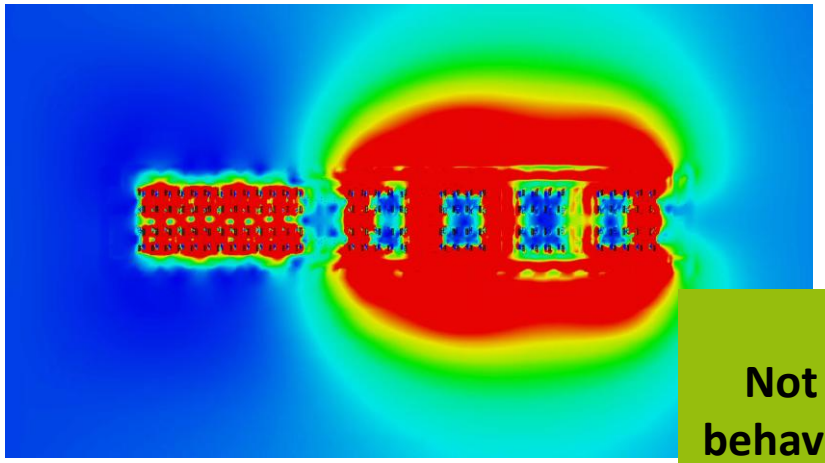


All active

Metal shields limit the clearance and creepage distances

DIN EN IEC 60664-1 (VDE 0110-1) and IEC 60601-1





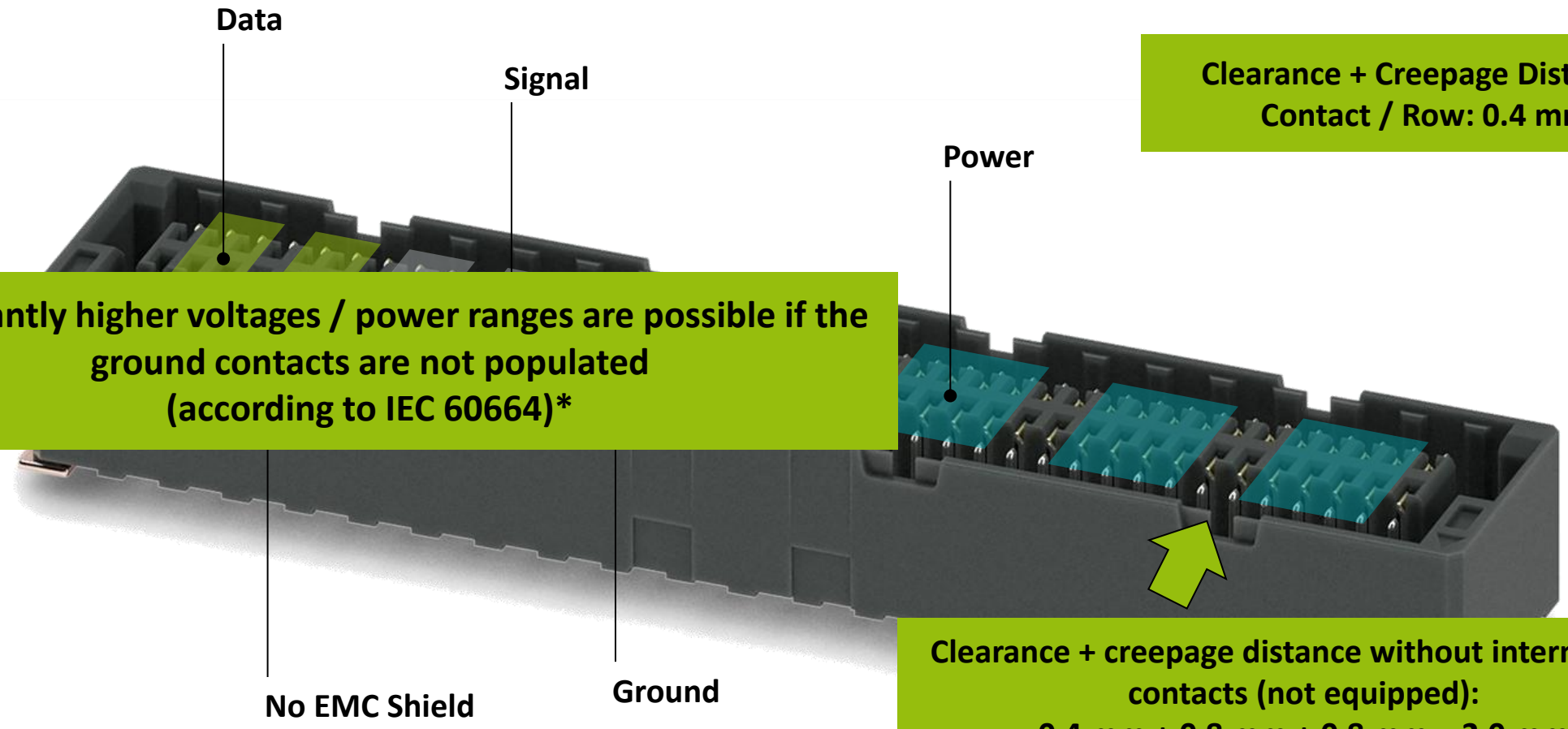
Not a big impact on EMC behavior from Data & Signal, but it does have a big impact from the power transmission!

PHOENIX CONTACT

Federatie van technologiebranches

Hybrid configuration of Board-to-Board connectors - Data / Signal / Power

Board-to-board connections with hybrid assignments



Clearance + Creepage Distance:
Contact / Row: 0.4 mm

Significantly higher voltages / power ranges are possible if the ground contacts are not populated (according to IEC 60664)*

Clearance + creepage distance without intermediate contacts (not equipped):
0,4 mm + 0,8 mm + 0,8 mm = 2,0 mm

*** "Dead metal parts" reduce the distances around the pin diameter/thickness**

PHOENIX CONTACT

Concrete application – PICMG ModBlox7™

ModBlox7 - PICMG

Modular Industrial PC System

Federatie van technologiebranches

Hybrid configuration of Board-to-Board connectors - Data / Signal / Power

Concrete application – PICMG ModBlox7™

ModBlox7

PICMG®

Modular Industrial PC System

Excerpt ModBlox7™ Specification

Table 7 Pin-assignment of internal board-to-board connector

	J1/J2 Connector			J3/J4 Connector		
1a	+12V		1b	+12V		1b
2a	GND	A8_USB2+	2b	GND	B8_USB2+	2b
3a	A7_USB2+	A8_USB2-	3b	B7_USB2+	B8_USB2-	3b
4a		GND	4b		GND	4b
5a	GND		5b	GND		5b
6a			6b			6b
7a			7b			7b
8a	GND		8b	GND		8b
9a			9b			9b
10a			10b			10b
11a	GND		11b	GND		11b
12a			12b			12b
13a			13b			13b
14a	GND		14b	GND		14b
15a			15b			15b
16a			16b			16b
17a	GND		17b	GND		17b
18a			18b			18b
19a			19b			19b
20a	GND		20b	GND		20b
21a			21b			21b
22a			22b			22b
23a	GND		23b	GND		23b
24a			24b			24b
25a			25b			25b
26a	GND		26b	GND		26b
27a			27b			27b
28a			28b			28b
29a	GND		29b	GND		29b
30a			30b			30b
31a			31b			31b
32a	GND		32b	GND		32b
33a			33b			33b
34a			34b			34b
35a			35b			35b
36a			36b			36b
37a			37b			37b
38a	A1_PE_EN#	A_PE_RST#	38b	B1_PE_EN#	B_PE_RST#	38b
39a	A_I2C_SCL	A_I2C_SDA	39b	B_I2C_SCL	B_I2C_SDA	39b
40a	+12V		40b	+12V		40b

PHOENIX CONTACT

Concrete application – PICMG ModBlox7™

3 Analyse der Baugruppe mittels Thermographie

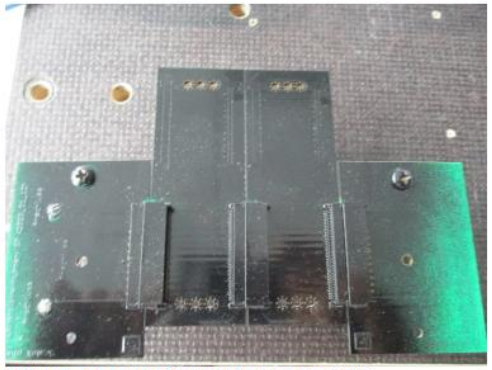


Bild 7 – Geschwärzte Baugruppe für Thermographie

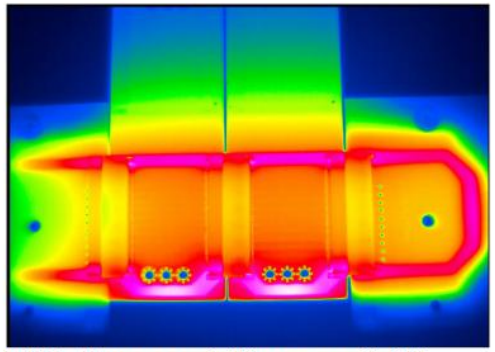


Bild 8 –Baugruppe als Thermographiebild

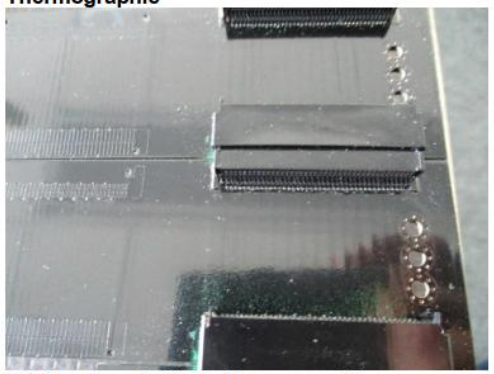
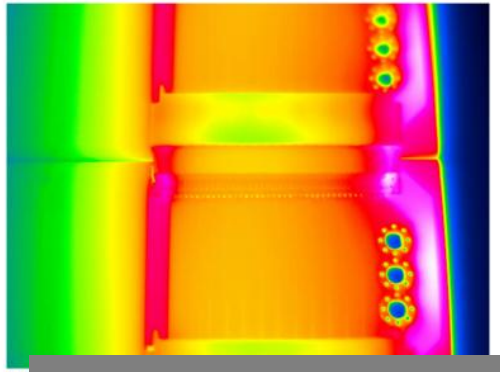


Bild 9 – Geschwärzte Baugruppe für Thermographie

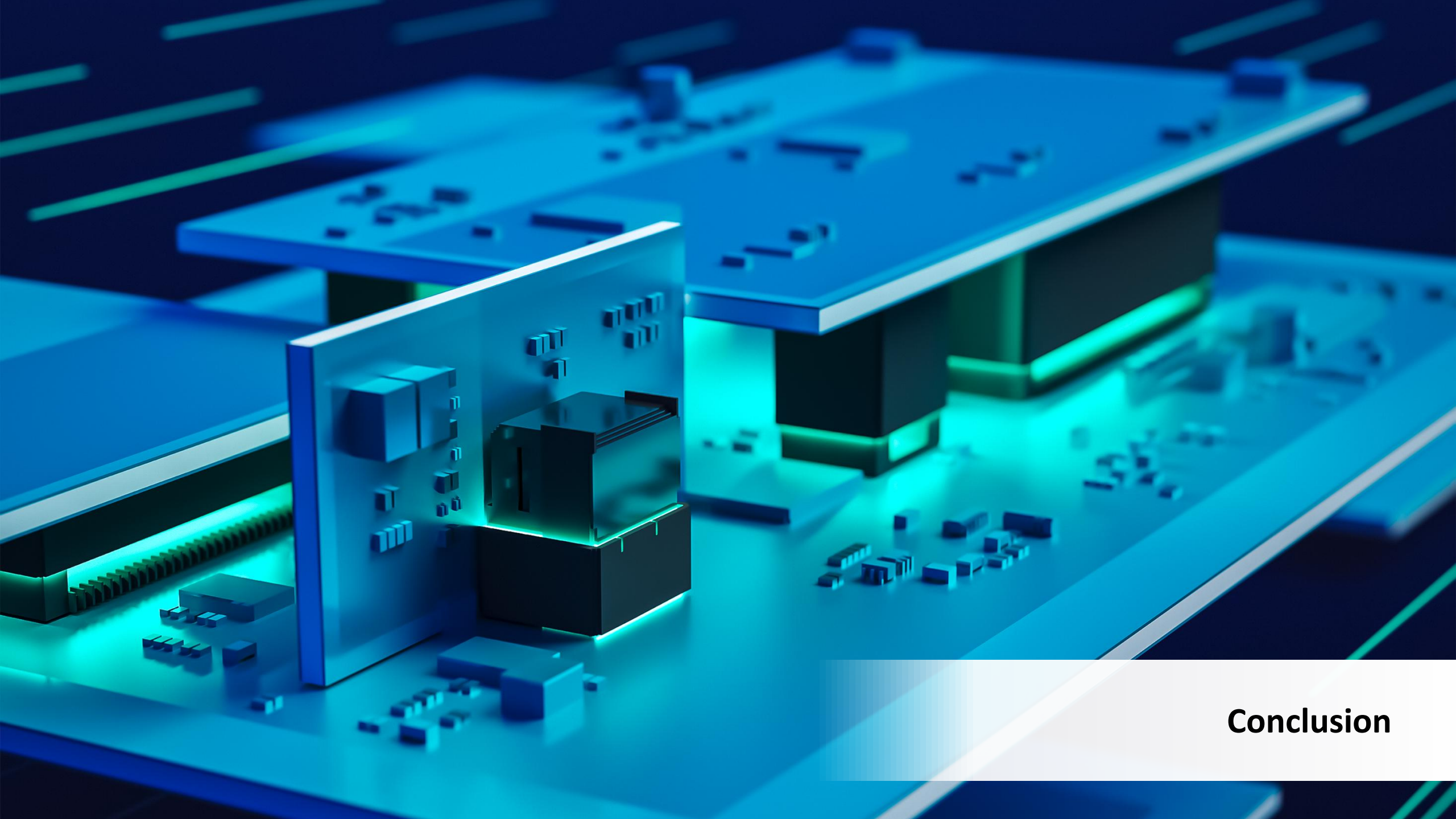


Bi

Excerpt from PxC Lab Report
12 A current load

Table 7 Pin-assignment of internal board-to-board connector

J1/J2 Connector				J3/J4 Connector			
1a	+12V		1b	1a	+12V		1b
2a	GND	A8_USB2+	2b	2a	GND	B8_USB2+	2b
3a	A7_USB2+	A8_USB2-	3b	3a	B7_USB2+	B8_USB2-	3b
4a		GND	4b	4a		GND	4b
5a	GND		5b	5a	GND		5b
6a	A5_U		6b	6a	B5_US		6b
7a	A5_U		7b	7a	B5_US		7b
8a	GND		8b	8a	GND		8b
9a	A3_U		9b	9a	B3_US		9b
10a	A3_U		10b	10a	B3_US		10b
11a	GND		11b	11a	GND		11b
12a	A2_U		12b	12a	B2_US		12b
13a	A2_U		13b	13a	B2_US		13b
14a	GND		14b	14a	GND		14b
15a	A1_U		15b	15a	B1_US		15b
16a	A1_U		16b	16a	B1_US		16b
17a	GND		17b	17a	GND		17b
18a	A1_U		18b	18a	B1_US		18b
19a	A1_U		19b	19a	B1_US		19b
20a	GND		20b	20a	GND		20b
21a	A4_P		21b	21a	B4_PE		21b
22a	A4_P		22b	22a	B4_PE		22b
23a	GND		23b	23a	GND		23b
24a	A3_P		24b	24a	B3_PE		24b
25a	A3_P		25b	25a	B3_PE		25b
26a	GND		26b	26a	GND		26b
27a	A2_P		27b	27a	B2_PE		27b
28a	A2_P		28b	28a	B2_PE		28b
29a	GND		29b	29a	GND		29b
30a	A1_P		30b	30a	B1_PE		30b
31a	A1_P		31b	31a	B1_PE		31b
32a	GND		32b	32a	GND		32b
33a	A3_P		33b	33a	B3_PE		33b
34a	A3_P		34b	34a	B3_PE		34b
35a	A3_P		35b	35a	B3_PE		35b
36a	A1_P		36b	36a	B1_PE		36b
37a	A1_PE_CLK-	A2_PE_EN#	37b	37a	B1_PE_CLK-	B2_PE_EN#	37b
38a	A1_PE_EN#	A_PE_RST#	38b	38a	B1_PE_EN#	B_PE_RST#	38b
39a	A_I2C_SCL	A_I2C_SDA	39b	39a	B_I2C_SCL	B_I2C_SDA	39b
40a	+12V		40b	40a	+12V		40b



Conclusion

Conclusion

- Data / Signal / Power in a Connection
- EMC shielding & ground adjacend contacts attenuate the electromagnetic influences
- Application example: ModBlox7™

- More flexibility by using an connector (pin assignment)
- Partial pin assembly supports higher op. voltages and power because of bigger clearance and creepage distance

BUT: Every application has its special features and must be examined on a case-by-case basis!

Federatie van technologiebranches

Thank you

Hartelijk dank voor uw aandacht

Hybrid configuration of Board-to-Board connectors - Data / Signal / Power

Detlef E. Preißler

April 14th, 2025

PHOENIX CONTACT