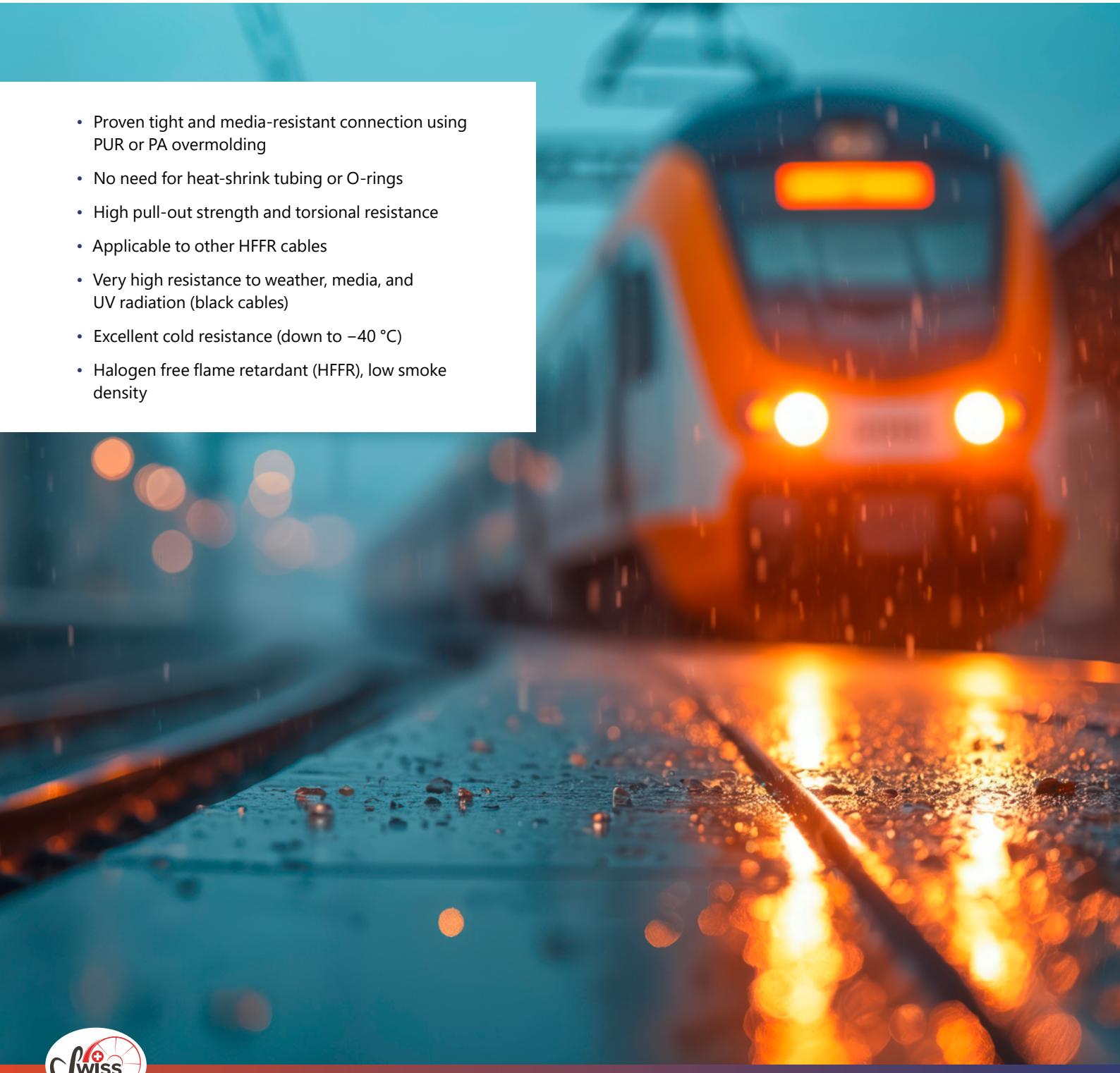
Studer Cables
Connected to HARTING

Cable Solutions with Adhesion Technology

Media-Resistant Connection – Even Under Heavy Motion



- Proven tight and media-resistant connection using PUR or PA overmolding
- No need for heat-shrink tubing or O-rings
- High pull-out strength and torsional resistance
- Applicable to other HFFR cables
- Very high resistance to weather, media, and UV radiation (black cables)
- Excellent cold resistance (down to −40 °C)
- Halogen free flame retardant (HFFR), low smoke density

swiss made

The requirements for tight, mechanically resilient cable connections to plugs, taps, or connectors – are increasing – especially in industrial, mobile or media-exposed environments. Conventional solutions with halogen free flame retardant (HFFR) cables often reach their limits, especially in automation. This can significantly increase costs.

Adhesion technology offers an innovative solution here: Through a special material modification of the cable sheath, the cable and the overmolding anchor at the molecular level – permanently, without additional sealants.

Functionality of adhesion technology

When cables are overmolded using our innovative adhesion technology, the molecular chains of the functional cable sheath and the overmolding compound diffuse into each other's layers. This creates a powerful anchoring that remains permanently strong and reliable mechanical stress – both in terms of strength and tightness. In contrast, conventional cables without adhesion technology (reference) lack this molecular anchoring. During injection molding, their surfaces merely partly melt and adhere superficially to the overmolding material, resulting in a far weaker bond. The outcome: significantly reduced durability and resistance when subjected to mechanical or environmental stress.

As part of comprehensive testing, several prototypes were produced that combined our adhesion cable technology with commonly used overmolding materials, such as polyurethane (PUR) and polyamide 66 (PA). The aim of the evaluation was to compare the pull-out forces and the tightness of the overmolded adhesion cables against conventional cable systems. This under a wide range of mechanical and environmental stress conditions – with convincing results in favour of adhesion technology.

Fig. 01 a and **b** show the two different modes of operation in comparison.

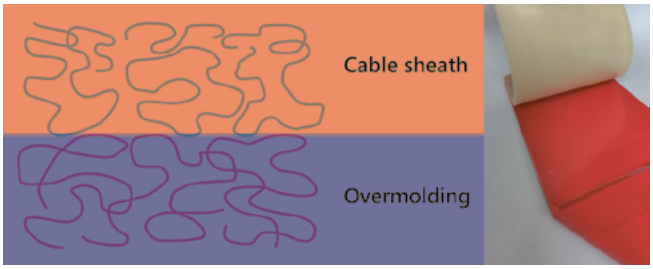


Fig. 01 a: Melt bonding with standard cables – no real connection.

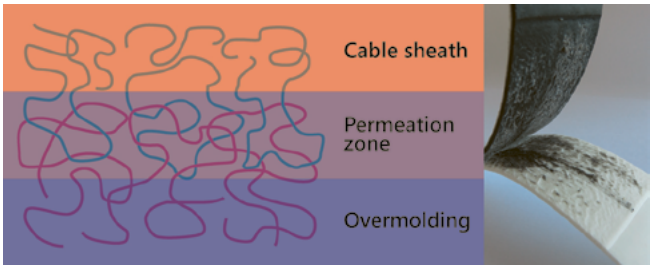


Fig. 01 b: Molecular diffusion in adhesive cables – permanent anchoring.

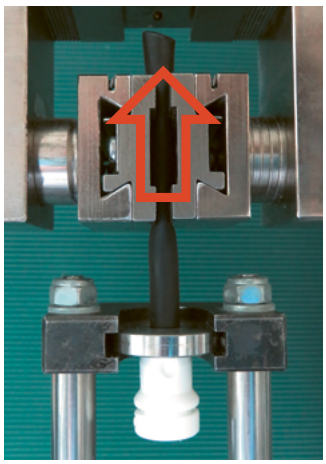


Fig. 02 a: Tensile test setup

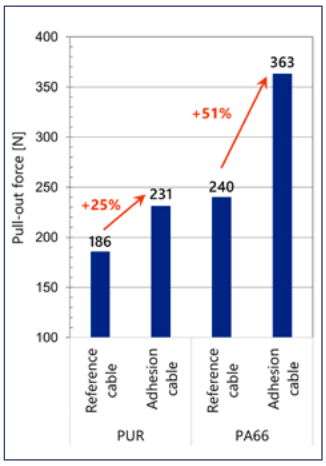


Fig. 02 b: Measurement results

High bond strength for overmolding

The injection-molded connections were subjected to tensile tests to evaluate their mechanical stability.

Fig. 02 a shows the test set up.

Fig. 02 b presents the results:

- Overmolded with PUR: +25 % pull-out strength compared to reference.
- Overmolded with PA: +51 % pull-out strength compared to reference.

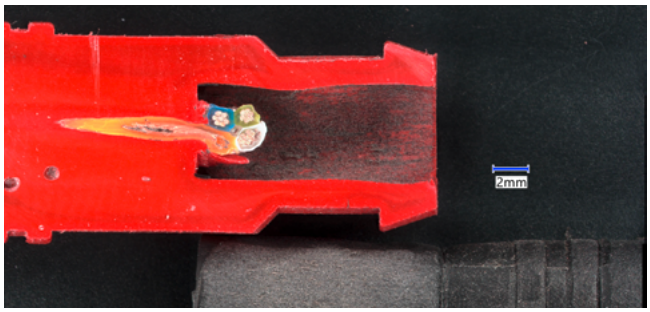


Fig. 03 a: Extraction point adhesion cable

Fig. 03 a shows the overmolding at the pull-out point with visible remnants of the adhesion cable still attached. This indicates that the break did not occur at the interface between the cable and the overmolding, but within the cable sheath itself. The bond strength between the two materials is so high, that it exceeds the intrinsic strength of the sheath. As a result, when subjected to force, the break occurs in the sheath material rather than at the junction.

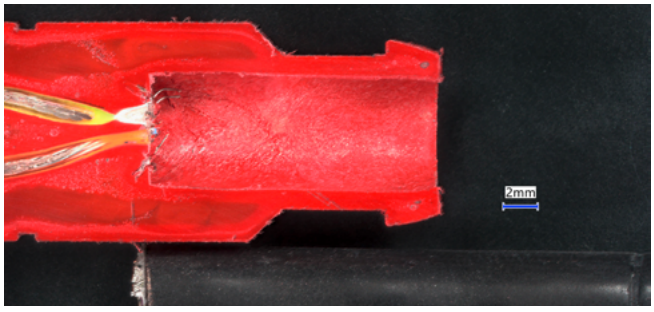


Fig. 03 b: Extraction point for reference cable

Fig. 03 b shows in contrast the overmolding after the pull-out test using a conventional reference cable. Notably, there are no remnants of the cable material on the overmolding. This indicates that the bond strength between the cable sheath and the overmolding is lower than the internal strength of either material. As a result, the break occurs at the interface between cable and overmolding, requiring significantly less pull-out forces.

Fig. 04 a: Test setup torsion

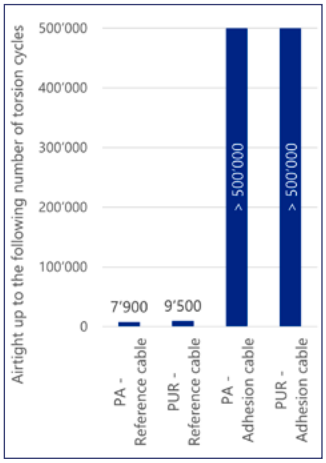


Fig. 04 b: Measurement results

High resistance to torsion

In torsion tests, the overmolded cables were twisted axially by ±45 ° and compressed air tests were carried out at regular intervals in a water bath to check for leaks. As soon as a leak occurred, the test was stopped.

The results in **Fig. 04 b** show that the reference cable became leaky after less than 10,000 cycles, while the adhesion cable remained leak-proof after more than 500,000 cycles.

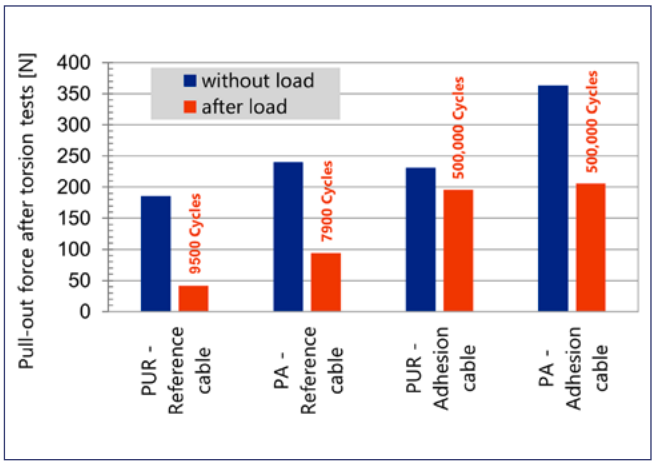
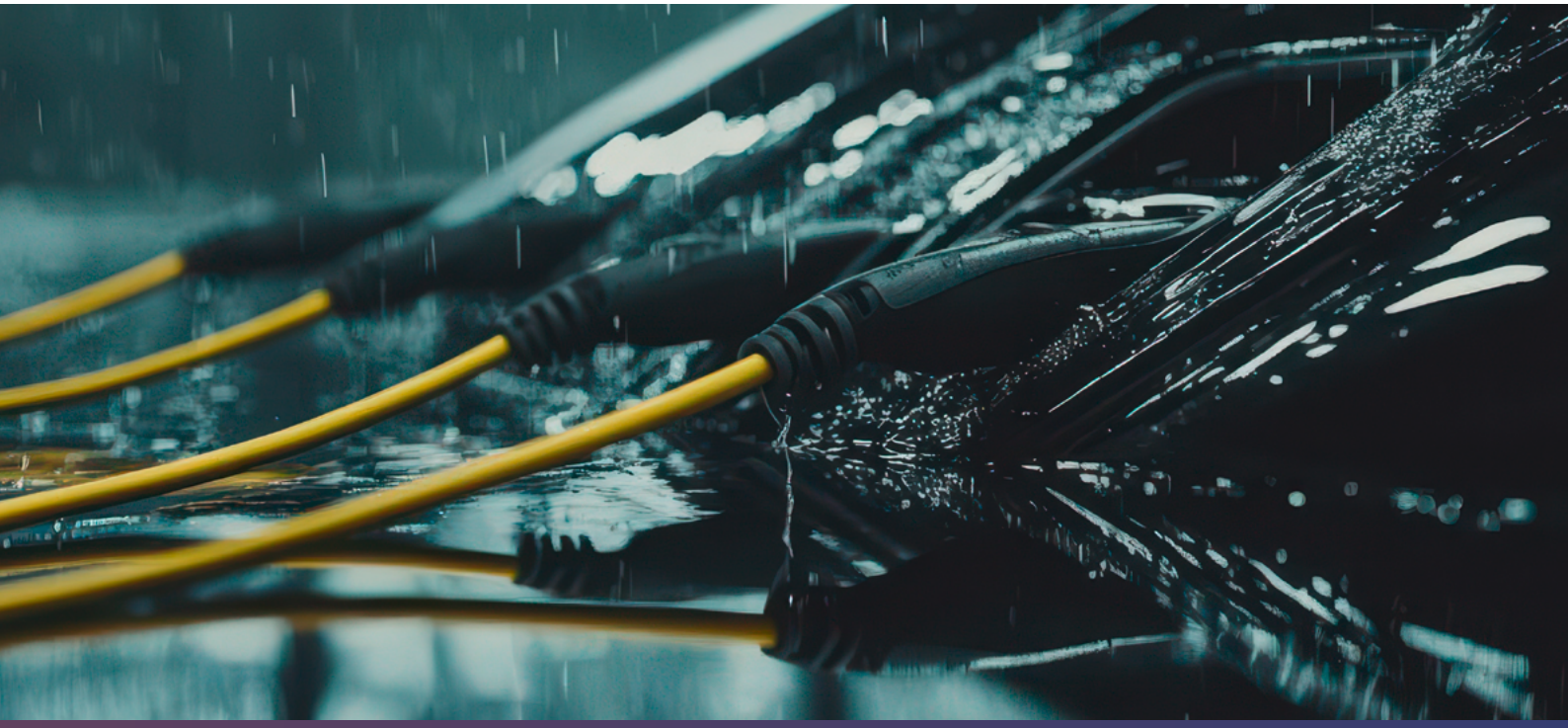


Fig. 05: Measurement results

The pull-out tests shown in **Fig. 05** further confirm the high stability of the adhesion cables after this torsional stress. After more than 500,000 torsion cycles, the pull-out force of the adhesion cables is still at the same level as the unstressed reference cables. In comparison, the pull-out force of the stressed reference cables has already fallen to less than half of the original value, even though significantly fewer torsion cycles were performed.



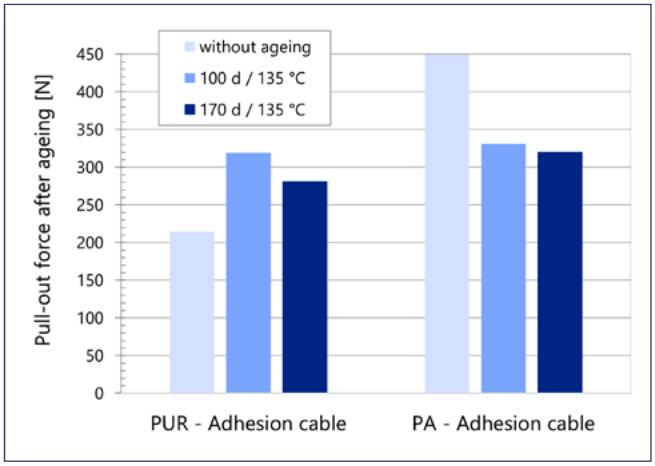


Fig. 06: Measurement results

Excellent long-term temperature resistance

To simulate long-term stress, the adhesion cables overmolded with PA or PUR were stored in an oven at 135 °C for several months. After storage, the pull-out force of the cables from the overmolding was measured.

As shown in **Fig. 06**, both types of adhesion cable connections maintained very high pull-out forces even after 170 days of heat exposure. These results confirm that the molecular anchoring between the adhesion cable and the overmolding material remains intact under prolonged thermal stress. Adhesion technology therefore demonstrates exceptional long-term resistance to high temperatures.

Compliance with standards

The adhesion technology was tested on **BETA**trans® DATA-ENX C-flex 100 Ω CAT 5 / 5e FOAM - Adhesion. This adhesion cable meets all requirements for class EM 104 sheathing material in accordance with standards EN 50264-1, EN 0306-1, EN 50306-3 as well as those of classes M in accordance with EN 50306-4 and EN 45545-2. The tables below show selected results determined in accordance with the relevant standard. Further information can be found in the data sheets.

Tests on the cable

PROPERTIES	REQUIREMENTS		STATUS
	Standard	Rated value	
Tensile strength (median)	EN 60811-501	≥ 10 MPa	ok
Elongation at break (median)	EN 60811-501	≥ 125 %	ok
Ageing acc. Arrhenius	on the cable	20,000 hours at 85 °C	ok
Hot set test (200 °C, 15 minutes, 20N/cm2)	EN 60811-507	≤ 100 % with load ≤ 25 % without load	ok
Water absorption (168h at 70 °C)	EN 50305	300 V / 1 minute between metal shield and water	ok
UV-resistance	EN 50618	No cracks	ok

Resistance on the pre-assembled cable

PROPERTIES	REQUIREMENTS		STATUS
	Standard	Rated value	
Oil IRM 902 (24 hours at 100 °C)	EN 50305	1.5 kV / 1 minute between screen and water	ok
Oil IRM 903 (24 hours at 65 °C)	EN 50305	1.5 kV / 1 minute between screen and water	ok
Oil IRM 903 (19 weeks at 40 °C)	EN 50305	1.5 kV / 1 minute between screen and water	ok
N-oxalic acid (168 hours at 23 °C)	EN 50305	1.5 kV / 1 minute between screen and water	ok
Caustic soda (168 hours at 23 °C)	EN 50305	1.5 kV / 1 minute between screen and water	ok
Cold bending (–40 °C)	EN 60811-504	No cracks	ok

Fire protection in rail vehicles (EN 45545-2)

PROPERTIES	REQUIREMENTS		STATUS
	Standard	Rated value	
Smoke density (HL3)	EN 61034-2	Light transmission > 70 %	ok
Toxicity of burning gases	EN 50305	Insulation ITC ≤ 6	ok
Toxicity of burning gases	EN 50305	Sheathing ITC ≤ 3	ok

Transferability to other cables

The adhesion technology is fully transferable to a wide range of halogen free flame retardant (HFFR) cables – including power cables – without compromising their standard-compliant properties. This ensures broad compatibility and seamless integration into existing cable designs and regulatory frameworks.

Secure connection for demanding applications

Adhesion technology redefines cable assembly by enabling permanently tight, mechanically robust and standard-compliant connections – even under most demanding operating conditions. It delivers significant advantages over conventional connection methods, particularly in applications involving motion, mechanical stress, or safety-critical environments.

Reliable and sustainable quality

We would be happy to advise you personally and demonstrate the full potential of our adhesion technology. Whether you're interested in samples or developing custom adaptations for your specific application, we're ready to support you every step of the way.

Let's collaborate to further develop this innovative technology – tailored precisely to your product requirements.

Put your trust in Studer Cables – for innovative, sustainable and forward-looking solutions.

Further information and technical data can be found on our website: **https://studercables.com/en/products**

In addition to first-class products, Studer Cables offers comprehensive advice, precise calculations and other services. We are happy to answer any questions you may have in person.

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