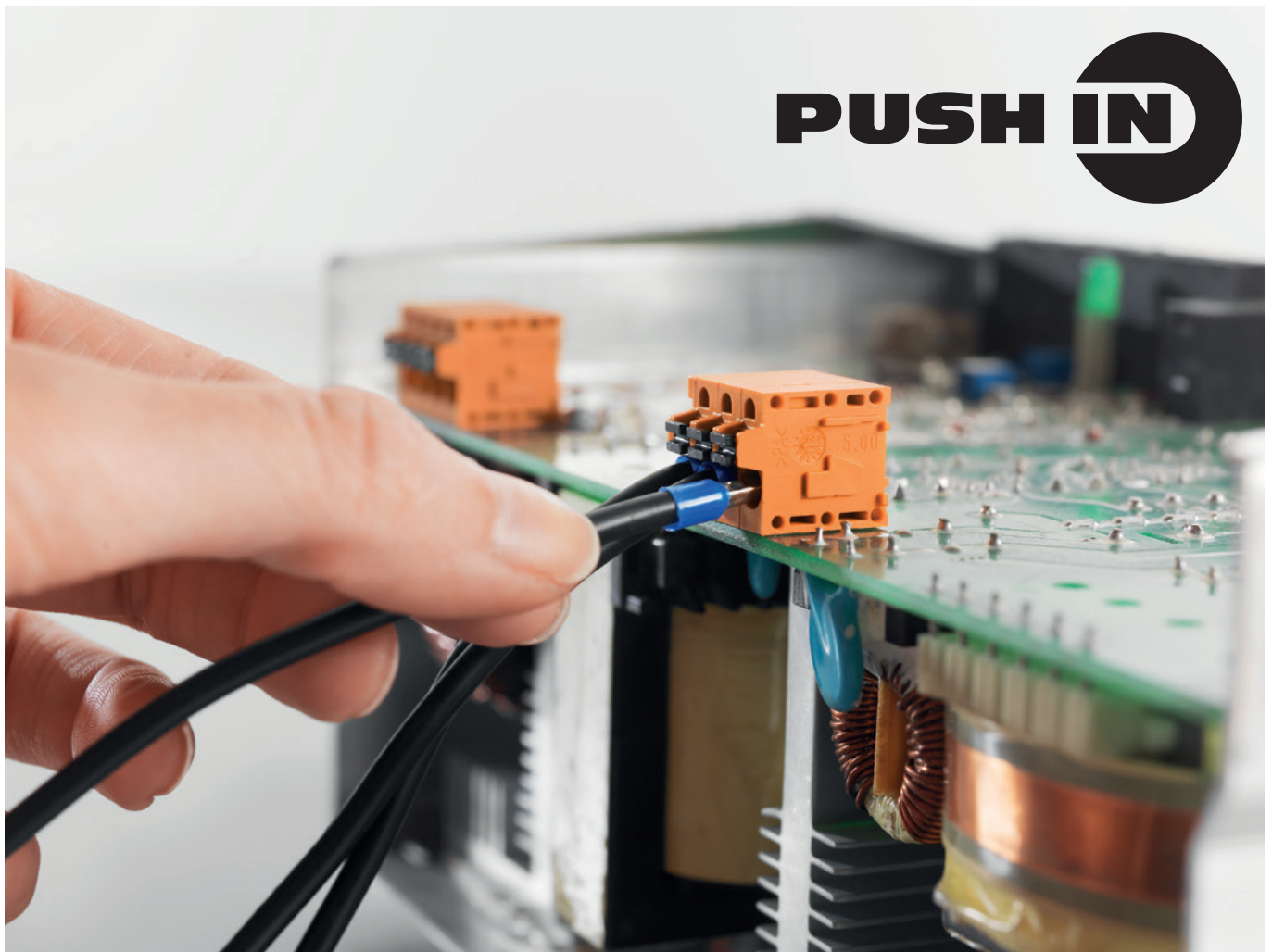


**PUSH IN wire connection for device manufacturers**  
Incomparable user-friendliness, simple handling,  
fast and safe cabling

White paper



# Contents

## **1 Introduction**

## **2 PUSH IN wire connection**

- 2.1 How it works
- 2.2 Benefits for device manufacturers
- 2.3 Safety - proven many times over

## **3 Recommendations for applications**

- 3.1 Handling PUSH IN device connections
- 3.2 Frequently asked questions (FAQ)

## **4 Summary of PUSH IN wire connection**

## **5 PUSH IN wire connection from Weidmüller**

- 5.1 Competence for over 160 years
- 5.2 Tested safety
- 5.3 Weidmüller PUSH IN wire connection highlights

## **PUSH IN wire connection for device manufacturers**

### **Incomparable user-friendliness, simple handling, fast and safe cabling**

When it comes to device installation, the time factor plays an essential role for all device manufacturers and their customers. Safety, i.e. the protection of humans and machines, is also a top priority.

When it comes to spring-based connection technologies, the "PUSH IN" direct-insert connection impresses through its simple, safe-handling and minimum wiring time. The stripped solid or stranded wire conductor with crimped on wire-end ferrule is simply inserted into the contact point – job done!

Compared to connection systems using screws and tension clamps, PUSH IN reduces wiring times by up to 80 percent.

The PUSH IN direct plug connection means real user-friendliness for all users, simple handling, quick and safe cabling and clear benefits over conventional connection systems.

Users can find lots of useful information on simple integration into device designs in this white paper.

## 2. PUSH IN wire connection

### Time-saving connection – direct plug in

Wires with wire-end ferrules and single-stranded wires can be inserted directly thanks to the PUSH IN connection technology. This saves time and ensures reliable contacting.

#### 2.1 How it works

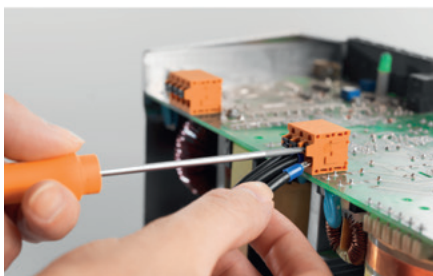
##### 2.1.1 Connectivity

The stripped solid or stranded wire conductor with crimped on wire end ferrules is simply plugged into the contact point. So no tools are required for the wire connection. This creates a reliable, vibration-proof and gas-proof connection.



##### 2.1.2 Releasing/Rewiring

As a rule, PUSH IN connections have an actuation "pusher". The contact point can be opened easily and the conductor removed by pressing the "pusher". This ensures really quick, clear wiring, and the same applies for releasing for rewiring.

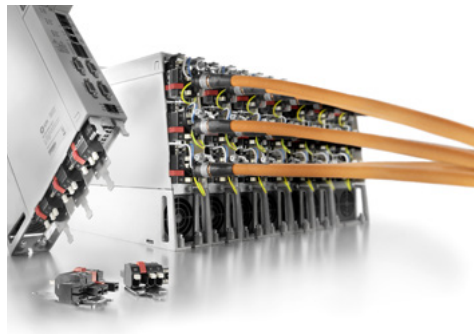


## 2.2 Benefits of the PUSH IN wire connection for Device manufacturers

### 2.2.1 Space-saving front connection

The PUSH IN connection takes various wire cross-sections and is designed as a front connection, i.e. the conductor entry and the spring actuation to release the connected conductor are in parallel to one another, hence in the same direction.

This means device manufacturers can use PUSH IN direct connections to achieve high contact density within a small space, which allows creative and innovative designs of compact, space-saving devices with high levels of technical performance.

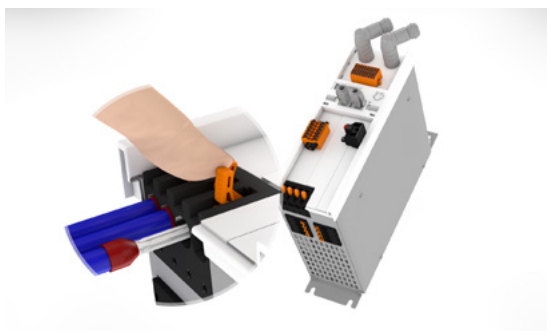


### 2.2.2 Suitable for all device designs

Especially for automation components such as controllers with high connection density, the space saving front connection allows the implementation of compact device designs.



For power electronics devices, with strict requirements in terms of safety and operation, PUSH IN connections with lever actuators have become popular. This allows the convenient and safe connection of cables, especially those with large connection cross-sections.

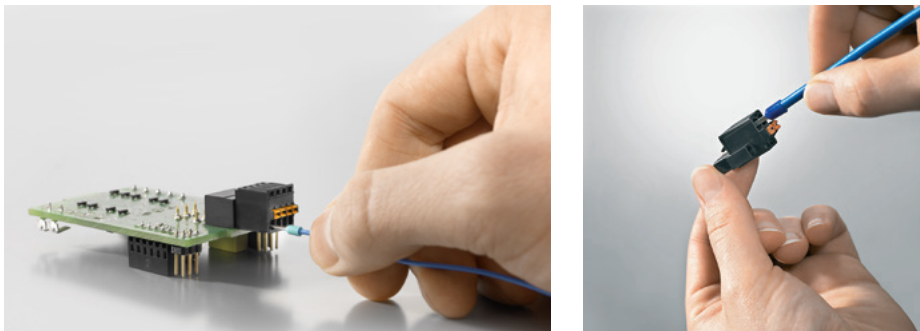


Quick-to-install PUSH IN connections have also become established for device-internal wiring. Especially within solar inverters, the no-maintenance connection is an impressive option in all conditions, e.g. extreme temperature differences.

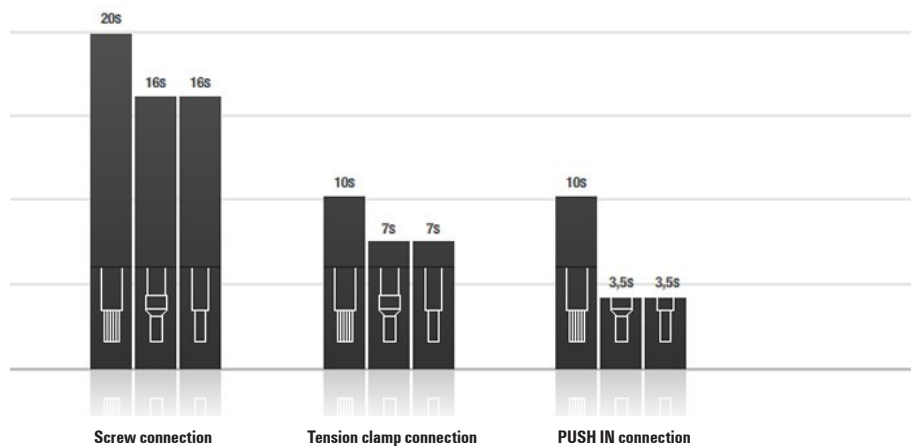


### 2.2.3 Significantly reduce wiring times

In order to connect the prepared conductor, the PUSH IN wire connection no longer requires the contact point to be opened with a screwdriver. This step is not needed, which saves time. With PUSH IN, a stripped, rigid conductor is simply slotted into the contact point and the connection is already made. Stranded conductors and fine-stranded conductors with crimped on wire-end ferrules and ultrasound-welded conductors can be simply connected without using tools.

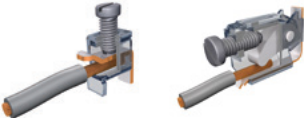
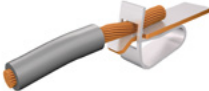



An overview of connection times for different connection systems - such as screws, tension clamps and PUSH IN - makes this clear. The times compared in the graphic relate to the process of 'Connecting the conductor'. All the connection types shown in the graphic can be used both with and without wire-end ferrules.



## PUSH IN compared to other established wire connection methods

As well as the considerable saving from the faster connection times of the PUSH IN direct connection, there are other significant benefits to this connection compared to established screw or tension clamp connection methods:

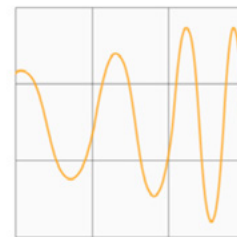
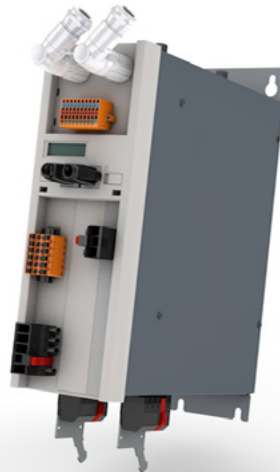
Screw connection	Tension clamp connection	PUSH IN connection
		
<p><b>Advantages:</b></p> <ul style="list-style-type: none"> <li>• Most operators are familiar with the intuitive handling</li> <li>• A large conductor clamping area is covered</li> </ul>	<p><b>Advantages:</b></p> <ul style="list-style-type: none"> <li>• Constant conductor clamping force independent of the operator</li> <li>• Well suited for use in applications that are strongly exposed to vibrations and shock</li> </ul>	<p><b>Advantages:</b></p> <ul style="list-style-type: none"> <li>• Fast, tool-less wire connection with direct insertion technology</li> <li>• Constant conductor clamping force independent of the operator</li> <li>• Well suited for use in applications that are strongly exposed to vibrations and shock</li> <li>• Incorrect operation prevented by means of a pusher</li> <li>• Wire feed and the operation are aligned in the same direction which permits a compact equipment design</li> </ul>
<p><b>Disadvantages:</b></p> <ul style="list-style-type: none"> <li>• Conductor clamping force is dependent on the tightening torque applied by the operator</li> <li>• Depending on the operating conditions, the plant operator may have to retighten the screws</li> <li>• When tightening screws, a conductor may be pushed down (if the system does not have push-down protection)</li> </ul>	<p><b>Disadvantages:</b></p> <ul style="list-style-type: none"> <li>• Operators may confuse the contact points and apertures for operating tools</li> </ul>	<p><b>Disadvantages:</b></p> <ul style="list-style-type: none"> <li>• When connecting the maximum wire cross-section (with a wire-end ferrule) in a contact point, it is often the case that a very compact and special crimp shape is required and the maximum wire-end ferrule can be used without the need for a plastic collar</li> </ul>

### 2.3 Safety - proven many times over

**High conductor extraction forces and vibration resistance make PUSH IN a safe connection technology which is established all over the world**

PUSH IN connectors are designed based on the tension clamp principle, which means that the spring for the wire connection is held separately in the enclosure. This design feature ensures a separation of mechanical and electrical functions. The benefit is high conductor extraction forces. At the same time, stranded wire conductors do not splice on insertion. The direct insertion method is impressive for all users thanks to its reliable, vibration-resistant and airtight connection, even and especially for long-term use.

For applications with strong vibrations and shocks, such as those in drive technology, terminals with spring power have proven their superiority to screw connections. The constant force of the spring guarantees a safe connection in the long term, even where there are strict requirements in terms of vibration and shock, e.g. in accordance with IEC 61373/10.2011. The subsequent inspections and adjustment normal for non-maintenance-free screw connections are not required.



IEC 61373/10.2011

Another characteristic of the PUSH IN connection system is the high temperature resistance in continuous operation, which means PUSH IN offers a long service life and high operational reliability across a wide range of operating temperatures, thanks to its low power consumption and intrinsic heating. This enables applications in strong heat or cold, i.e. tough climatic conditions. Connection and wiring is also possible without issues at extreme temperatures from -40°C to the maximum body of the insulating body of the contact point (typically 100°C to 120°C).



PUSH IN provides safety in virtually all applications: the tests going beyond normal standards allow use in a wide range of industries, whether in sensitive and/or harsh environments such as traffic engineering, process engineering, energy supply or shipbuilding. In short, users of PUSH IN are undoubtedly on the safe side, as this connection technology withstands challenges in a wide range of machines and systems around the world every day. Device manufacturers who demand high standards of performance, reliability, safety and flexibility will find the PUSH IN wire connection an impressive, efficient solution.



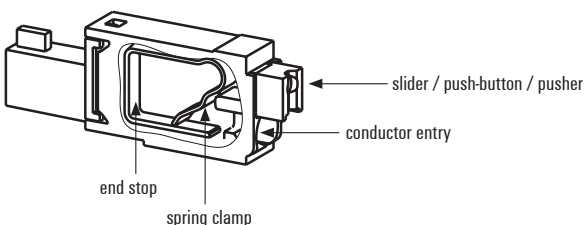
## 3. Recommendations for applications

### PUSH IN in the device installation

#### 3.1 Handling of PUSH IN device connections

Handling PUSH IN connections is remarkably simple, a distinction only needs to be made between two approaches: on the one hand the handling of stripped solid or stranded wire conductors with crimped-on wire-end ferrules and on the other hand stranded conductors without wire-end ferrules. The graphic (see below) shows the structure of PUSH IN device connections and the two handling methods.

**PUSH IN connector design:**



**Handling:**

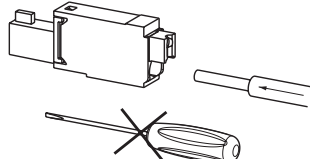
**Recommended tool:**

- Screwdriver blade 0.4 x 2.5
- Screwdriver blade standard DIN 5264

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**Solid conductors:**

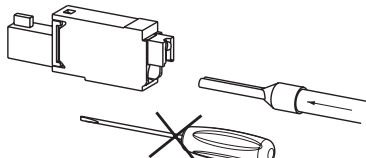
1. A stripped solid conductor is simply plugged into the contact point up to the end stop.




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**Conductors with wire-end ferrule:**

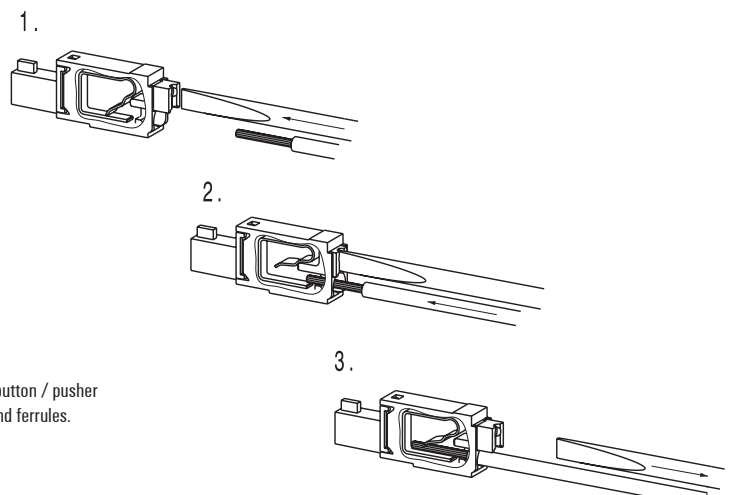
1. Stranded conductors with crimped-on wire-end ferrules, with and without plastic collars, are simply plugged into the contact point up to the end stop.  
When plugging-in, an initial resistance (spring clamp) has to be overcome




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**Flexible conductors:**

1. Open the contact point by activating the slider / push-button / pusher
2. Insert stranded conductors, without crimped-on wire-end ferrules.
3. Remove tool from slider / push-button / pusher

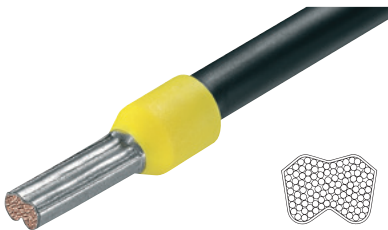


### 3.2 Frequently asked questions (FAQ) on PUSH IN device connections

Since users may still have questions, despite the easy of use, simple handling and quick and safe wiring of PUSH IN direct plug connections, the most frequent questions have been put together and explained with diagrams.

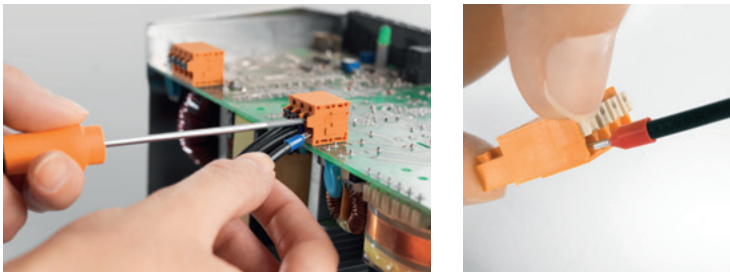
#### What crimp shape for wire-end ferrules is best for PUSH IN connections?

Rectangular crimped wire-end ferrules are particularly easy to fit into a PUSH IN connection. Special trapezium crimp shapes in accordance with norm EN 6049701 are most suitable for compact device connections.

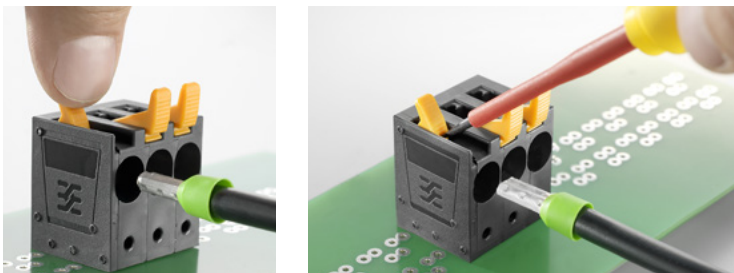


#### Are there differences in the handling of different actuation types??

Most PUSH IN connections have an actuation pusher. The contact point can be opened easily and the conductor removed by pressing the "pusher" with a screwdriver or by hand.



At the same time, there are also other actuation types, such as levers, for other applications, for example for connections with a large connection cross-section (see below). This enables the contact point to be opened with little effort and with no special tools required. This means, users can actuate PUSH IN connections simply by hand or using a conventional screwdriver.



The connections for shielded cables for power electronics are stripped as short as possible for reasons of electromagnetic compatibility (EMC). A combination of "PUSH IN" connection system and pushers has proven ideal.

Even conductors with short stripping or thin conductors can easily be inserted into the open contact point. Then the locked in pusher is unlocked with a push to the side by hand and the conductor is securely clamped in place.



**Are PUSH IN device connections maintenance-free?**

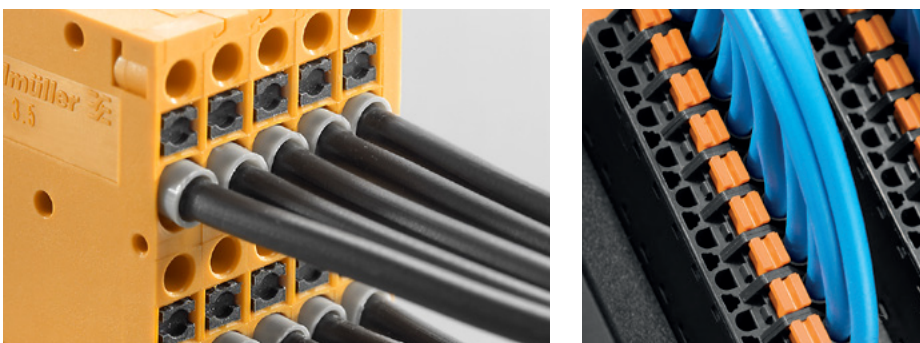
Providing there is no permanent pulling force on the conductor connected, PUSH IN connections can be assumed to be maintenance-free.

**How does the behaviour of PUSH IN connections in response to vibrations and shock compare to screw connections?**

For applications which are strongly exposed to vibrations and shock, spring terminals have proven considerably superior to screw connections. The constant spring force guarantees a permanent safe contact. Subsequent inspection or adjustment, as is required for non-maintenance-free screw connections, is not required.

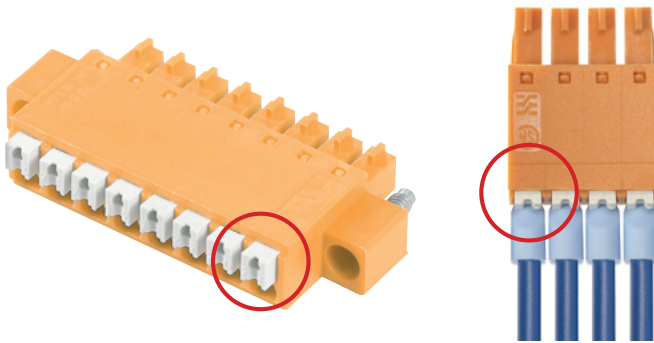
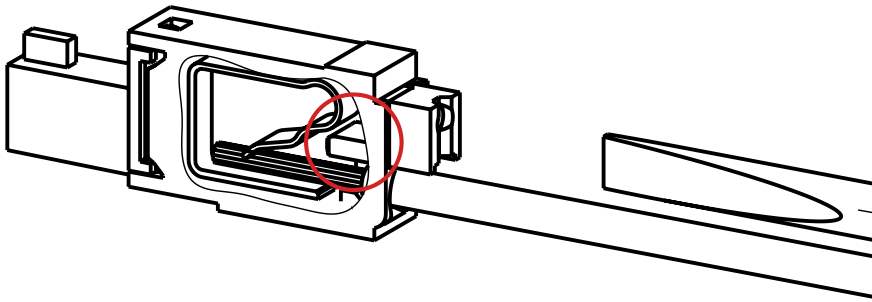
**How does a user recognise that the conductor is securely connected?**

First, you insert the conductor into the contact point until it stops. Note the stripping lengths specified by the manufacturer and the recommended wire-end ferrules. The stopper can be detected when the conductor is fully inserted. The conductor insulation or the insulation on the wire-end ferrule should be covered by the insertion area of the contact point (see below). In order to check it is properly seated, give a gentle tug on the conductor.



**Is it a problem if the pusher slips a little lower into the plug-in connector when the conductor is connected?**

This is no problem, the design means the pusher has a little space when the conductor is connected and it can slip into the plug-in connector as far as the spring, depending on its position (see diagrams below). This has no effect on functionality.



**Can double wire-end ferrules / TWIN wire-end ferrules be used in PUSH IN device connections?**

If twin wire-end ferrules are used in adjacent contact points, their alignment is important. This applies in particular to very compact device connections, as the design means the connections are very close to one another (see diagrams below)



## **4. Summary of PUSH IN wire connection**

### **PUSH IN wire connection for device manufacturers**

PUSH IN is an impressive connection system with a wide range of applications. The spring-based "PUSH IN" connection is now used in millions of products variants for secure, vibration-resistant connections. This applies to modular terminal blocks, device connectivity and for electronics and automation components.

Users rate the PUSH IN direct connection very highly in practice. Two common statements illustrate this perfectly: "In service cases, the terminals are simply easier to handle". And "we have opted for a connection solution with screwless direct insertion in order to guarantee quick, safe wiring".

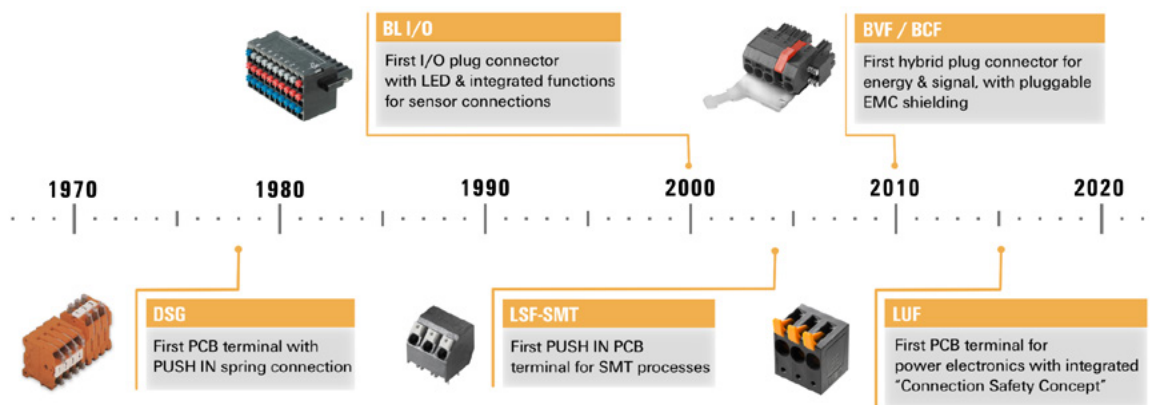
Last but not least, the PUSH IN connection successfully prevents wiring errors, with no special tools required for rewiring either. The prepared conductors are simply inserted in the contact points and that's it – a safe, airtight connection. All you need is a simple screwdriver to release the connection. Most PUSH IN connections have a pusher. The contact point can be opened easily and the conductor removed by pressing the "pusher" – no tools needed.

## 5. PUSH IN wire connection from Weidmüller

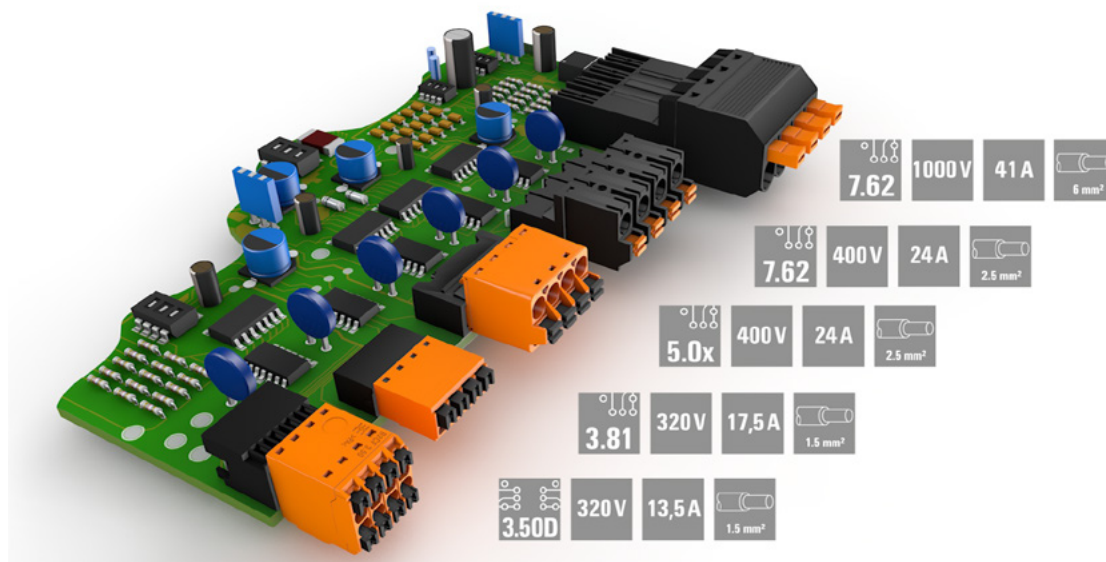
### Simple, safe and versatile

#### 5.1 Competence for over 160 years

Your requirements and challenges continually spur us on to come up with innovations and pioneering solutions from which you benefit as a whole. For over 160 years we have been synonymous with performance, competence and reliability – and have carried forward this tradition consistently with many achievements in the field of connectivity. Our customers always lie at the heart of all our efforts. Close collaboration with industry helps us develop future-proof, innovative solutions and not only to contribute our connectivity expertise time and again – but also to constantly extend it. Find out here what milestones which have already been passed with the introduction of PUSH IN technology for device connectivity:



The spring-based "PUSH IN" connection is used in more than one million Weidmüller product variants for secure, vibration-resistant connections. For PUSH IN device connectivity, Weidmüller offers a comprehensive range of automation components with high connection density and power electronics with strict safety requirements.



## 5.2 Tested safety

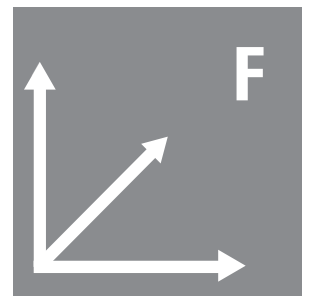
### High conductor extraction forces and vibration resistance make PUSH IN one of the securest connection systems in the world

Conformity with standards and the consistently high level of quality of all electronic parts and components are among the key factors that are critical to success in product development, particularly in an industrial environment. Our PUSH IN wire connection meets all the requirements for device connections in industrial environments. The following versions for safety testing are listed as examples and aim to clarify the stringent testing procedure. The accredited Weidmüller testing laboratory and relevant approval certificates are evidence of the high quality level of Weidmüller PUSH IN wire connection.

The IEC 60947-7-1 standard stipulates a range of tests in applications such as PCB terminal blocks and plug-in connectors or modular terminal blocks for wire connections. In the required tests, the contact points of one type are tested for compliance with defined limit values. The twist test and tension test, plus the conductor pull test serve to check that the terminals are not exhibiting unauthorised damage or loosening. These tests apply for connections with round copper wires, i.e. for one-strand, stranded and flexible conductors with wire-end ferrules.

#### Mechanical stability:

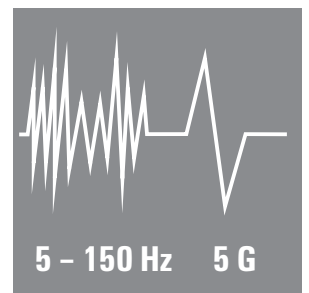
Stability properties are covered by normative values as well as additional testing in practice. In the tension test carried out, the conductor is exposed to a defined, even tensile force for 1 minute against the direction of insertion. The axial torque, e.g. for a 1.5 mm<sup>2</sup> PCB terminal block for device connections, per contact point (pin) is significantly higher than the values permitted by the IEC 60947-7-4 standard. A clamping force per pin of over 150 N (limit value of 40 N for 1.5 mm<sup>2</sup> conductor cross-sections) in the axial direction is many times higher than the requirements of the standard.



#### Vibration and shock resistance:

The constant spring force of Weidmüller PUSH IN connections ensures a permanent, secure contact even in high-vibration and shock conditions.

The PUSH IN device connectivity has been proven to withstand a simulated life-cycle test. The test spectrum covers increased broadband noise and shock to IEC 61373/10.2011 with a category 1B severity level ("body mounted") in the frequency range of 5 to 150 Hz and with an ASD level of 1.857 (m/s<sup>2</sup>)<sup>2</sup>/Hz 3 dB and an effective acceleration of 5.72 m/s<sup>2</sup> and 240 degrees of freedom (DOF). The test duration is five hours per axis. The semi-sinusoidal shock wave has a peak acceleration of 50 m/s<sup>2</sup> and a nominal duration of 30 ms.



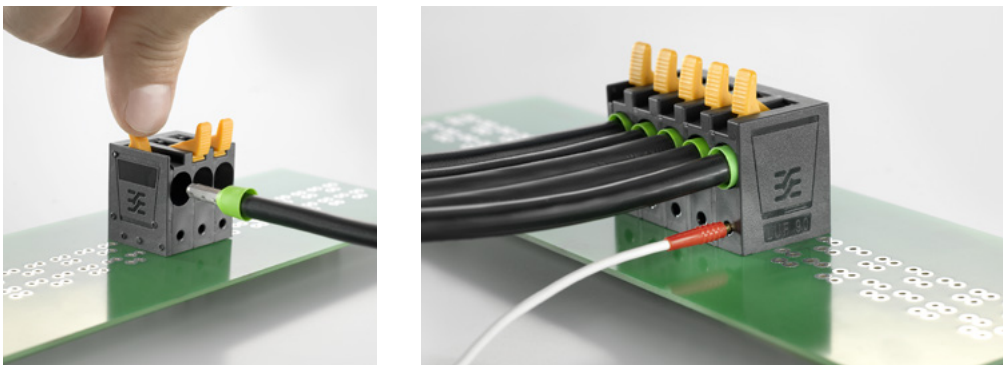
### 5.3 Weidmüller highlights of PUSH IN wire connection

Close collaboration with industry helps us develop future-proof, innovative solutions and not only to contribute our connectivity expertise time and again – but also to constantly extend it. Find out the new highlights Weidmüller has to offer for device connectivity with PUSH IN wire connection.

#### Secure and efficient connection of power electronics devices

LUF-10 00 makes easy contact with the printed circuit board using the PUSH IN connection system.

In addition to its particularly simple handling, the LUF also provides high levels of contact point intrinsic safety in accordance with the Connection Safety Concept. The quick and safe wire connection with PUSH IN connection system as well as the simple and secure lever operation for contact-point opening allows for quick, convenient and therefore economical wiring.



#### Convenient PUSH in connection solution with openable contact point

BVFL 7.62/HP with openable pusher for easy connections, even under difficult conditions.

Shielded cables for power electronics are stripped as short as possible for reasons of electromagnetic compatibility (EMC). Connection with large "PUSH IN" connectors is correspondingly complex. The same applies to cables with small cross-sections where often the lack of a "third hand" is felt for their connection or special support tools must be used.

Our BVFL 7.62HP facilitates and accelerates this process without the need for special tools. The combination of "PUSH IN" connection technology and lift-up actuation lever ("Pusher") allows you to easily insert even stripped short or thin wires into the open contact point. Then you unlock the locked "Pusher" simply by pushing sideways by hand.

The proven "PUSH IN" function is retained in full, while the deployable contact point allows easy connection even in difficult conditions. Make use of the significant time savings to reduce your installation costs.



Work quickly while avoiding errors - convenient connectivity solutions with openable contact point significantly reduces the installation time in the field with frequency converters, for example.

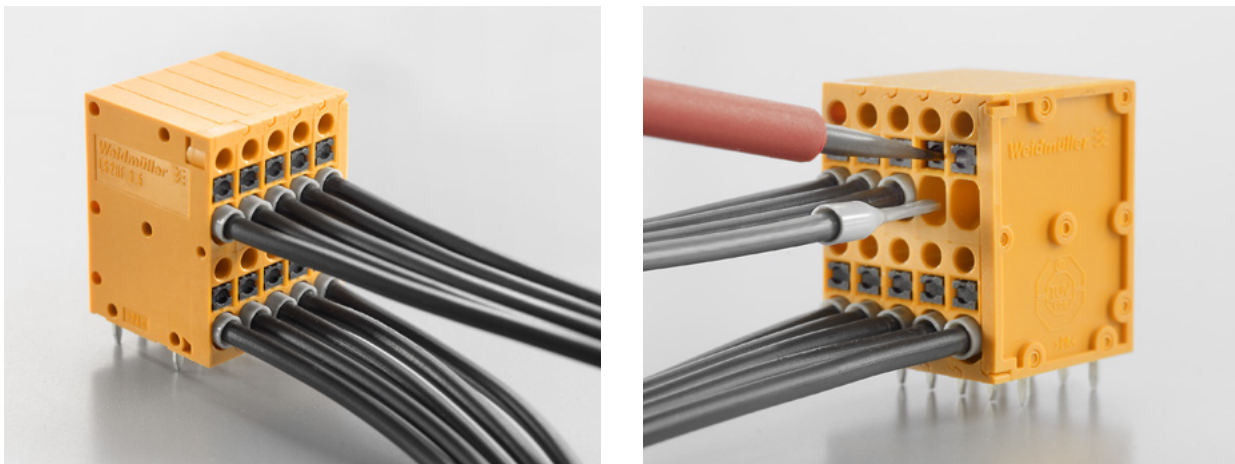
**Simple connection of wire cross sections of up to 1.5 mm<sup>2</sup> in its most compact form**

LS2HF with PUSH IN connection system on two connection levels in a 3.5 mm pitch

Ensuring compact dimensions through miniaturisation, while maintaining excellent functionality: these are the challenges faced when designing, for example, monitoring and I/O systems and devices in the field of building automation. The new two-row OMNIMATE Signal LS2HF PCB terminal meets both of these requirements at once thanks to its space-saving design and especially quick PUSH IN connection system.

Optimised for wire cross-sections of up to 1.5 mm<sup>2</sup> and pitch of 3.5 mm.

The LS2HF has an integrated pusher to make opening the contact point easier. An additional test point has also been integrated, making it easy to take service measurements from the device. With a 90° wire-insertion angle, the compact two-row design allows for the simple integration of the LS2HF into the front panel of a device.



**Employ compact, functional connection solutions**

Weidmüller OMNIMATE Signal BLF 2.5/SL 2.5 PUSH IN PCB plug-in connectors

Especially for controls, I/O systems and signal interfaces in drive technology, it is now a question of ensuring components are as compact as possible while offering excellent functionality and simple handling. The new Weidmüller OMNIMATE Signal BLF/SL 2.5 PCB connectors and the associated SL 2.5 male headers combine these requirements. This is thanks to the space-saving design and the particularly quick PUSH IN connection system -

Optimised for wire cross-sections of up to 0.5 mm<sup>2</sup> and a grid dimension of 2.5 mm.

The BLF 2.5 connector has an integrated pusher to make opening the contact point easier. There is also an additional test point for user-friendly service measurements on the device. The SL 2.5 male header has two available outlet directions in various device designs and ensures excellent accessibility to the connector even in confined spaces.



Quick and safe wiring with high compound density: the PCB connectors in a 2.5 mm pitch allow for space-saving signal interfaces for a variety of devices such as industrial controls and servo drives.

**More information:**

► [www.weidmueller.com/push-in](http://www.weidmueller.com/push-in)

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## René Arntzen

### Author of the white paper

After obtaining a degree in Industrial Engineering, René Arntzen (born 1985) began his career as a Product Manager at the Weidmüller Group. Since 2011, he has been responsible for the signal connector product family for device manufacturers. Before studying for his degree, he completed an apprenticeship as an electrical engineer and worked in electrical maintenance during his university studies. During this time, he was able to gain a great deal of practical experience in and expand his knowledge of electrical connectivity.

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We reserve the right to make technical changes. 08/2021