

Push-In Plus technology

Reducing panel wiring time by 60%

SCOPE

When building a modern control panel, wiring the components in the panel is almost always the most time-consuming part of the job. So any new way to reduce that time is good news for anyone involved in panel building and their customers. That's why Omron has taken the concept of push-in cable connection to a new level and has developed a patent-pending system called Push-In Plus technology. The result is that wiring a control panel can now be achieved in 40% of the time it used to take with conventional screw block terminals. Moreover, Push-In Plus technology provides a connection that is five times stronger than the IEC standard and it requires no re-tightening after transit or during maintenance.

This White Paper explains how Push-In Plus technology achieves such high performance and how Panel Builders and their customers will benefit.

TABLE OF CONTENTS

Executive summary	2
Principle of operation	3
The Omron difference	4
Test data on push-in force	5
Test data on stability and connection strength	6
Benefits summary	9
Panel products with Push-In Plus technology	11
Part of a fundamental new approach	12
Patents	13

Executive summary

Push-in cable connectors have been available for many years, and not surprisingly they provide quicker connection than screw-based terminal blocks. But when stranded wire without ferrule is used, panel builders need to open the locking gate with a screwdriver with one hand, while they thread the wire with the other - this single-handed threading can be a little awkward. In addition, the manual force required to push in the wire to achieve a stable connection can cause muscle - fatigue and RSI – especially with the more complex panels that may have as many as 200 to 300 components and more than 1,000 wires that need connecting.

The Push-In Plus technology from Omron has all the time-saving benefits of traditional push-in terminals, but with none of the drawbacks. It can be used with ferruled wire, bare stranded wire or solid copper wire. For all three wire types the engineer has both hands free to thread the wire – so no awkward single-handed threading. What's more, the engineer needs only a very light force to make a stable connection, less than the force required to insert an ear-phone jack. But perhaps most surprising about the Push-In Plus technology is its tensile strength. Once inserted it requires a very large force to dislodge the wire – more than five times the IEC standard. But obviously, purposely disconnecting the wire is quick and easy, with the insertion of a screwdriver to open the clamp.

Push-In Plus technology

- Very light insertion force less than earphone jack.
- Extreme long-term stability
- 60% faster than traditional screw-type terminals
- No re-tightening necessary
- Both hands are free to thread wire

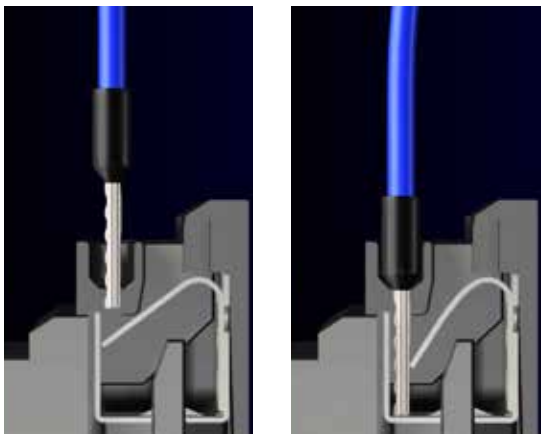
Principle of operation

The operating principle of Push-In Plus technology is similar to conventional push-in terminals: a spring-loaded latch is positioned in such a way that a wire can easily squeeze through the contact point but is then held in place due to the uni-directional nature of the spring. See images below. However, thanks to patent-pending new technology developments, superior materials and advanced manufacturing techniques, Omron has optimised this principle to minimise insertion force and maximise the connection's tensile strength.

With ferrule or solid wire

In the case of wire with ferrule or solid wire, the contact spring is opened automatically when the conductor is pushed in and thereby provides the required pressure force against the current bar.

1. Insert wire, that's it.



With stranded wire

1. Insert screwdriver into hole release aperture to open latch and leave screwdriver in aperture
2. Insert wire
3. Release the screwdriver to fix the wire.



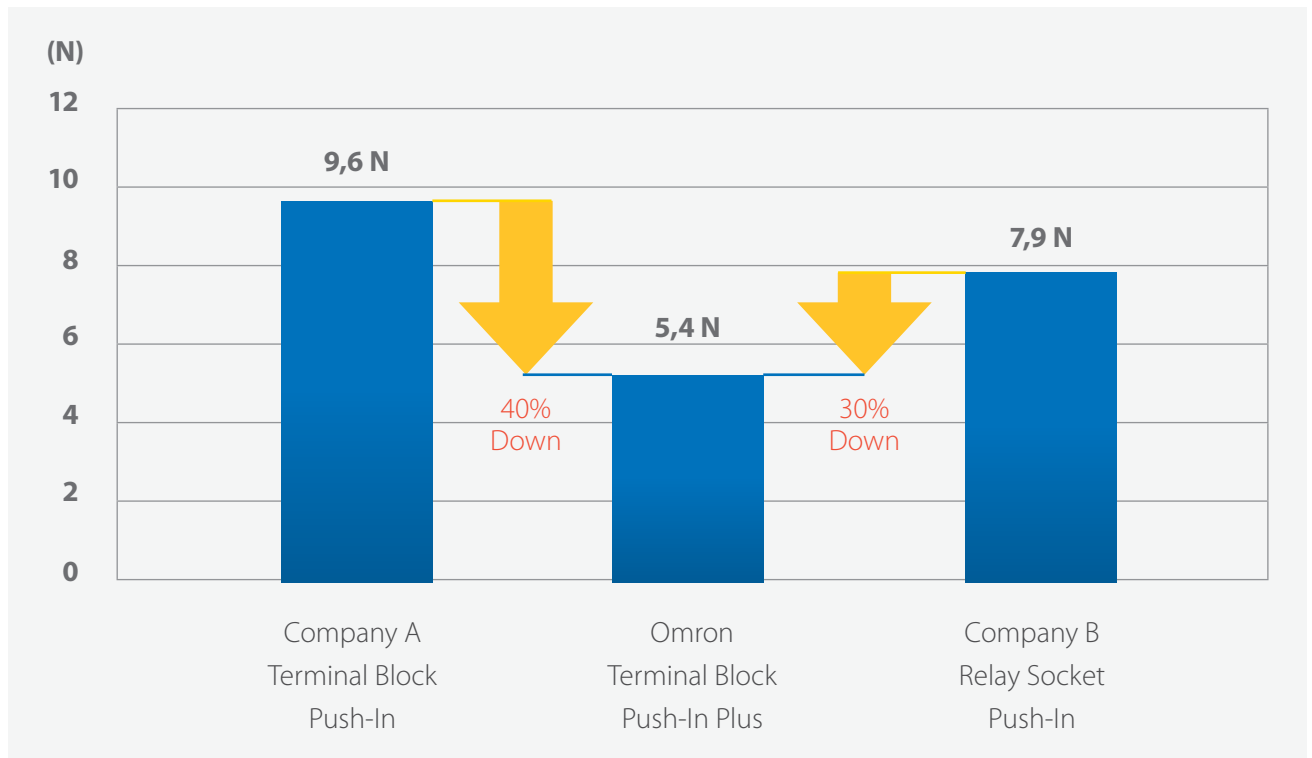
The Omron difference

This high-performing Push-In Plus technology is developed by drawing on experience and expertise in core competencies of Switch and Relay technology. This has enabled the mechanical engineers to optimise the form, balance, and repulsion force of the spring-loaded latch. We also researched and tested the best fitting materials and optimised their thickness and overall dimensions. On top of that, our advanced manufacturing systems ensure high-precision production.

In short, Push-In Plus technology is a result of well-researched design and advanced manufacturing techniques. Patents have been applied for.

Insertion force comparison

Please note: insertion force varies by factors of wire type (with ferrule or solid), material, wire diameter and other factors. The averaged results are shown below.

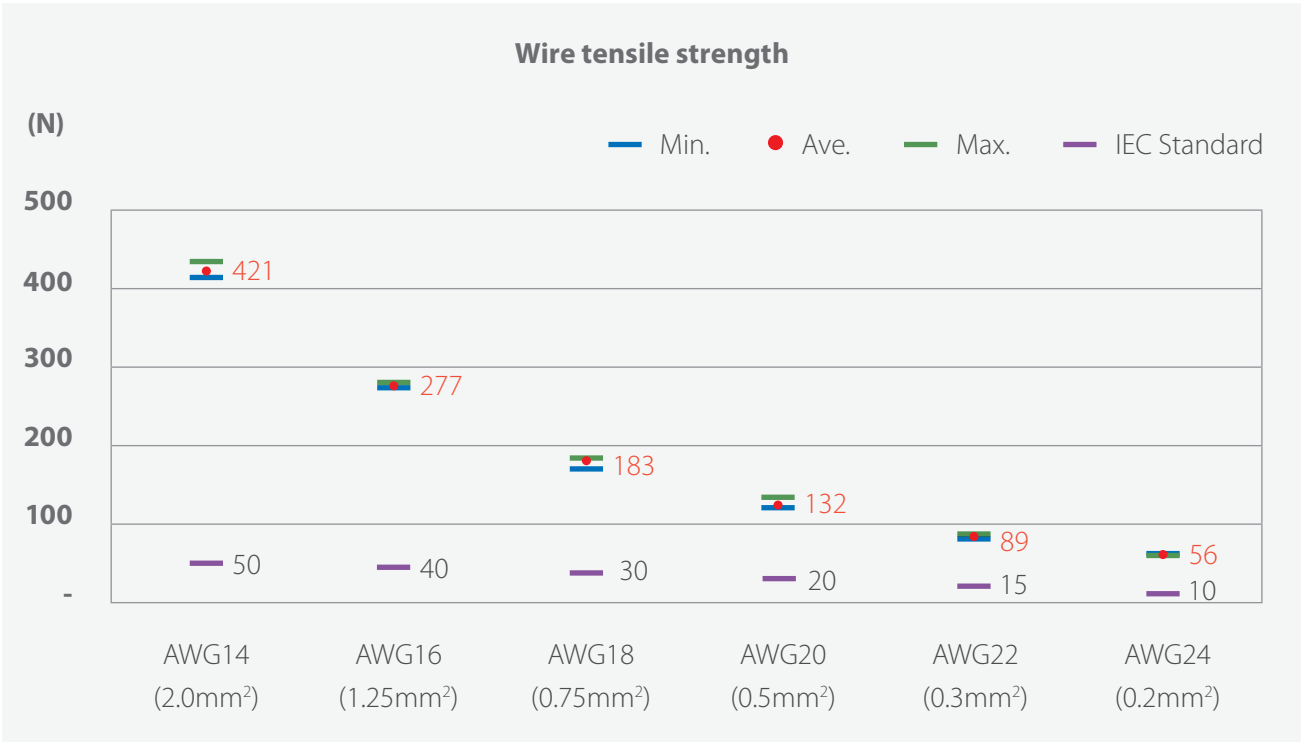


Measurement with steel gauge supposing AWG20 (0.5mm²) solid wire.

As tested by Omron laboratories in December 2015.

Test data on tensile strength

Despite the low insertion force, the connection’s tensile strength on each of the wire sizes is more than five times the IEC standard value, even when a thin 0.2mm2 wire is tested.

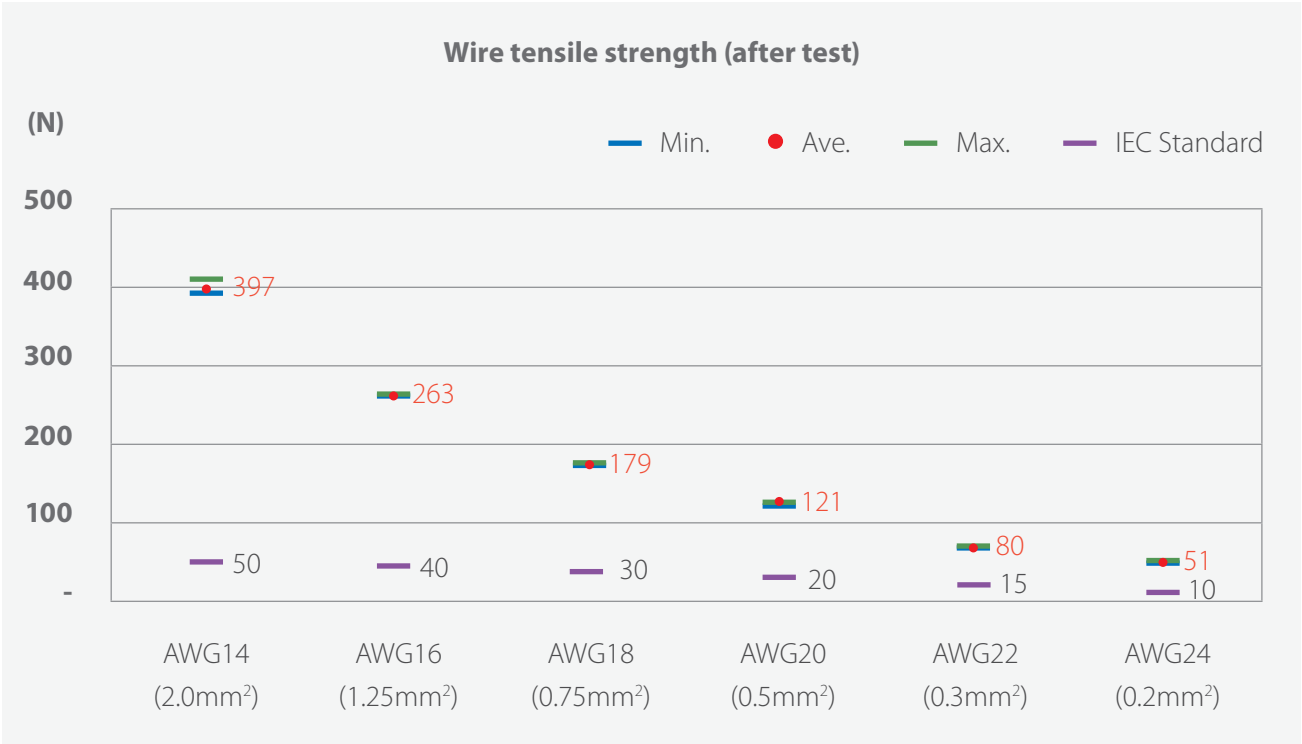


As tested by Omron in December 2015. Value with solid wire.

Conclusion: extreme reliability. The connection is solid and reliable, yet allows for quick release during maintenance or panel upgrades.

Test data on tensile strength after long-term operation

After the equivalent of four years operation, the connection’s tensile strength is still more than five times that of the IEC standard. Confirming that there is no risk of wire loosening over long-term operation.

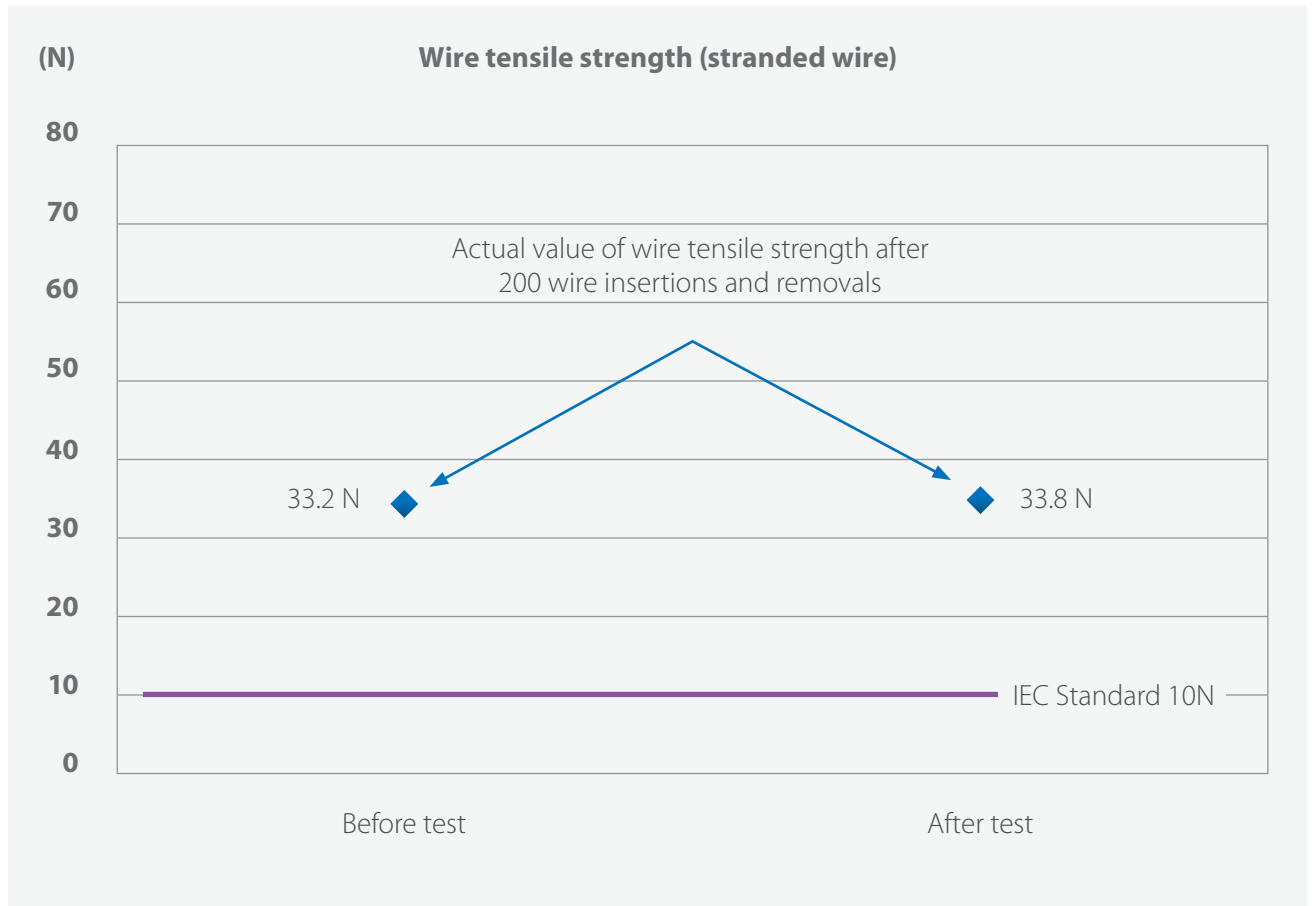


As tested by Omron in December 2015. Value with solid wire,
Value after test is measured after leaving 96 hours in atmosphere at 105°C.

Conclusion: extreme long-term stability. No risk of loosening over long-term operation.

Test data on tensile strength after 200 cycles

Even after 200 cycles there is no performance deterioration. That's because the smart design and superior materials of Push-In Plus technology have optimized the spring displacement and material, to ensure no plastic deformation.



As tested by Omron in December 2015. Value with stranded wire.
By screw driver + wire insertion and removal. (most severe case)

Conclusion: Extreme reliability. Even when the operating spring is frequently used, the connection remains solid and reliable.

Benefits summary

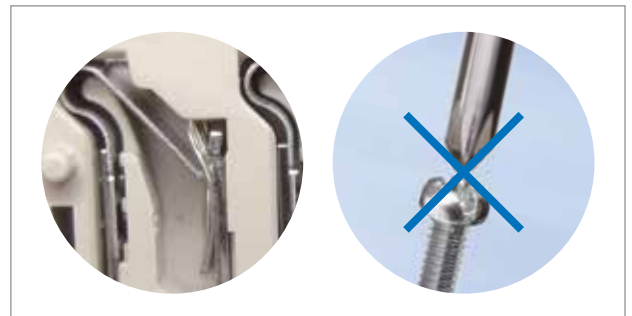
Push-In Plus technology reduces the effort it takes to wire a component while ensuring each wire has been fully inserted without damaging the ferrule. This has been achieved by optimizing the setting of spring displacement so that the wire material is not deformed. This helps guarantee a solid reliable connection yet allows for quick release during maintenance or panel upgrades. The spring connection is not loosened by long-term operation. As shown earlier, an accelerated life test simulating continuous operation shows no deterioration in the connection's tensile strength after four years. Other benefits include:

- Push-In Plus technology withstands vibration during both shipping and operation
- The cable entry aperture is positioned at the front which supports easy wiring
- Push-In Plus technology reduces the wiring effort by approximately 60% compared to conventional screw terminals
- The technology also makes it possible to use both hands to thread the wire, even when mounting stranded wires without a ferrule. This is because the screwdriver, used to open the spring-loaded latch, remains in its position without being held.

Easy to work by all front-side operation



Push-In Plus Technology are good at vibration proof. No Re-tightening Required



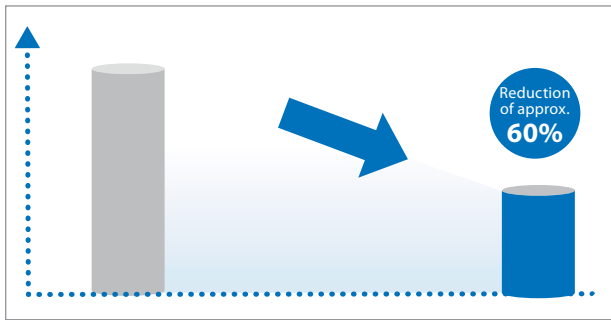
Screwdriver held in place to free both your hands



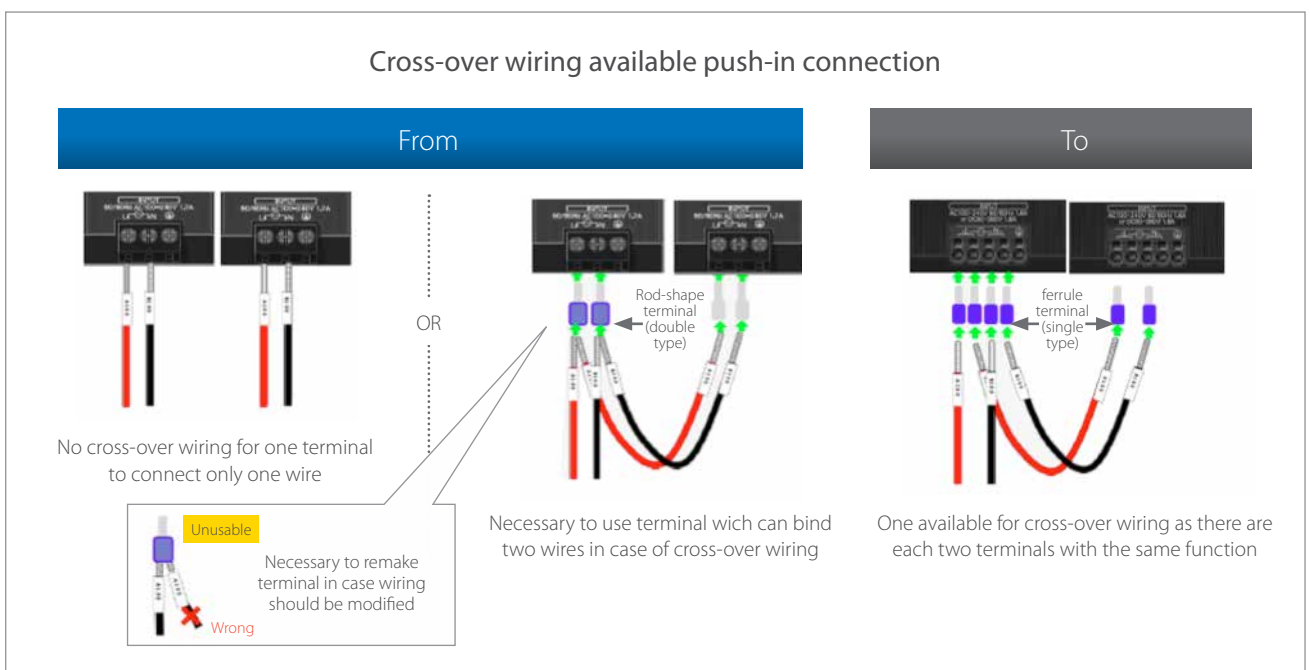
Low impact for finger by soft insert Employee's health



Push-In Plus Technology contribute Reduce wiring process by 60%



Example



Control panel products with Push-In Plus technology

Omron has launched 18 new products families (approximately 600 items) with Push-In Plus technology on 1st April 2016 and will continue to expand its portfolio – specially for panel builders. These include:

- Relay Sockets
- Slim Relays
- Solid State Relays
- Relay Terminal
- Power Supply
- Terminal Blocks
- Monitoring Relays
- Timers
- Temperature Controller
- Power Monitor (Energy Monitor)
- PLC-IO units
- Connector Terminal Blocks

For more information visit www.omron-ap.com/panelsolutions/

Part of a fundamental new approach

The three pillars of modern control panel design

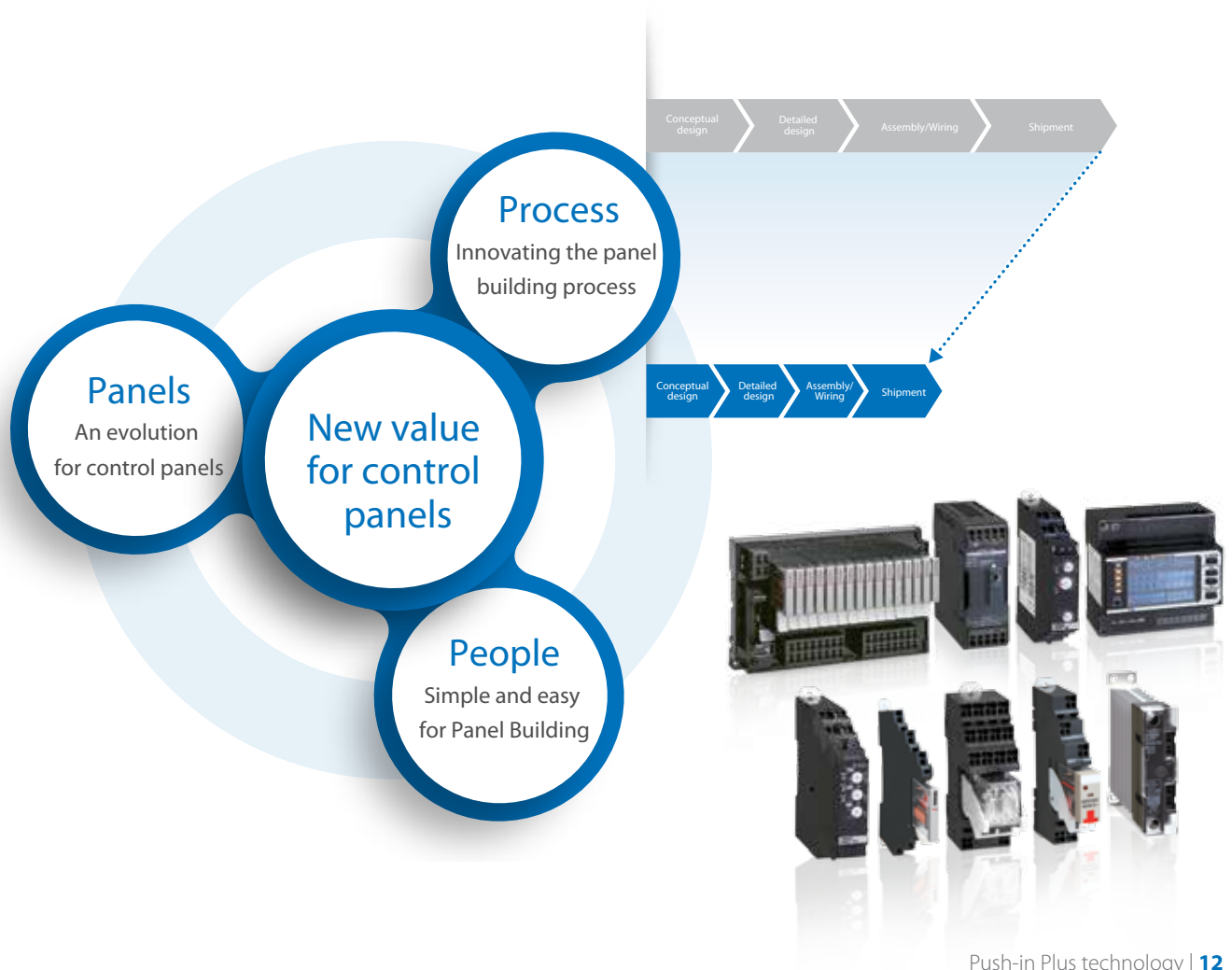
Omron has set itself an important mission to support Panel Builders by offering continuous innovation via a planned evolution. To help realise this mission we have initiated our New Value for Control Panels programme. A programme that satisfies all aspects of signal, control and distribution in panel building and focusses on three pillars:

- Evolution in **Panel** design
- Innovation in the panel building **Process**
- Making life simple and easy for the **People** in panel building.

The complete Omron portfolio has been redesigned into smaller, slimmer components that use a standardized height and proprietary Push-In Plus technology to simplify the wiring and assembly process.

Push-In Plus technology is especially linked to the “People” pillar and enables customers to:

- reduce actual wiring time
- use both hands for easy handling wire, even when using stranded wire
- avoid the re-tightening wires
- reduce health problem risk (hand muscle fatigue and RSI)



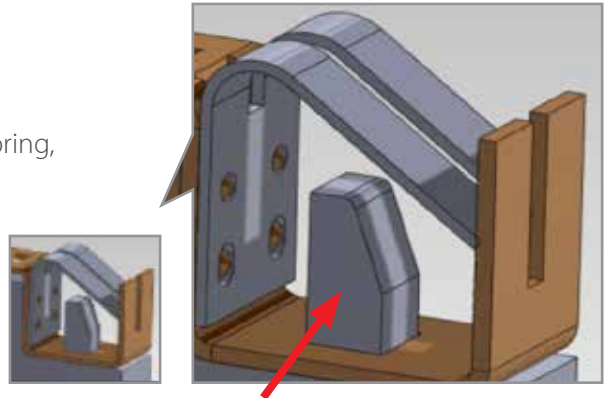
Patents

Simply reducing the insertion force is not difficult in terms of design structure. However, it is difficult to combine low insertion force with a high tensile strength of connection once inserted - our target was more than five times that of IEC standard in each applicable wire case. In addition, we also wanted this connection to be highly reliable for extended periods, even in various conditions.

These challenges and goals led to us developing some patented technology for Push-In Plus technology, as explained below.

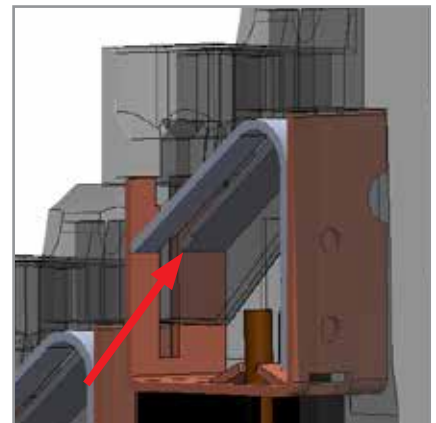
1. Structure to prevent the spring plastically deforming

By inserting a plastic part, which is the same shape as the spring, onto the metal part, we avoid bending the spring.



2. Structure connection to prevent wiring connection failure

Normally a partition is required in the case of a twin spring, which enables double wires. We created this partition with a special (patented) structure to ensure that the wire does not take an unwanted direction. This partition also makes the total Push-In element stronger and further avoids plastic deformation. => 200 operation even in various conditions.



* All pictures are artist impressions, actual products are slightly difference.

AUTHOR

Hiroto Nagaishi

Panel Solution Business Developer

Omron Europe B.V.

Waldburgstrasse 21

70563 Stuttgart

Germany

Tel +49 (0)711 51869 113

hiroto.nagaishi@eu.omron.com

Hiroto Nagaishi earned his electrical engineering bachelor's degree at Nagasaki University before he joined Omron in Japan in 2002 as Engineer in the relay development team, specialised in solid state relays (such as G3PE). His career continued as sales engineer followed in 2010 by G-PM of terminal relays (ex. G2RV) and sockets. In 2012 he moved to the USA accepting the role local PMM of relays to apply his knowledge. He joined the Panel Solutions Marketing team in Europe in 2013 up to present day.

Omron Industrial Automation

Headquartered in Kyoto, Japan, Omron Corporation is a global leader in the field of automation. Established in 1933 and headed by President Yoshihito Yamada, Omron has more than 37,500 employees in 35 countries working to provide products and services to customers in a variety of fields including industrial automation, electronic components industries, and healthcare. The company is divided into five regions and head offices are in Japan (Kyoto), Asia Pacific (Singapore), China (Shanghai), Europe (Amsterdam) and US (Chicago).



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OMRON Asia Pacific Regional HQ

T (65) 6835 3011
F (65) 6835 2711
E apac_enquiry@ap.omron.com
W omron-ap.com

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Australia

TF 1300 766 766
F (61-2) 9878 6981
E au_enquiry@ap.omron.com
W omron.com.au

India

T (91-22) 7128 8400
F (91-22) 7115 5602
E in_enquiry@ap.omron.com
W omron-ap.co.in

Indonesia

T (62-21) 2949 7500
F (62-21) 2949 7555
E id_enquiry@ap.omron.com
W omron.co.id

Malaysia

T (60-3) 7688 2888
F (60-3) 7688 2833
E my_enquiry@ap.omron.com
W omron-ap.com.my

New Zealand

T (64-9) 358 4400
F (64-9) 358 4411
E nz_enquiry@ap.omron.com
W omron-ap.co.nz

Philippines

T (63-2) 811 2831
F (63-2) 811 2583
E ph_enquiry@ap.omron.com
W omron-ap.com.ph

Singapore

T (65) 6547 6789
F (65) 6547 6769
E sg_enquiry@ap.omron.com
W omron-ap.com.sg

Thailand

T (66-2) 942 6700
F (66-2) 937 0501
E th_enquiry@ap.omron.com
W omron-ap.co.th

Vietnam

T (84-4) 3556 3444
F (84-4) 3556 3443
E hcm_enquiry@ap.omron.com
W omron.com.vn