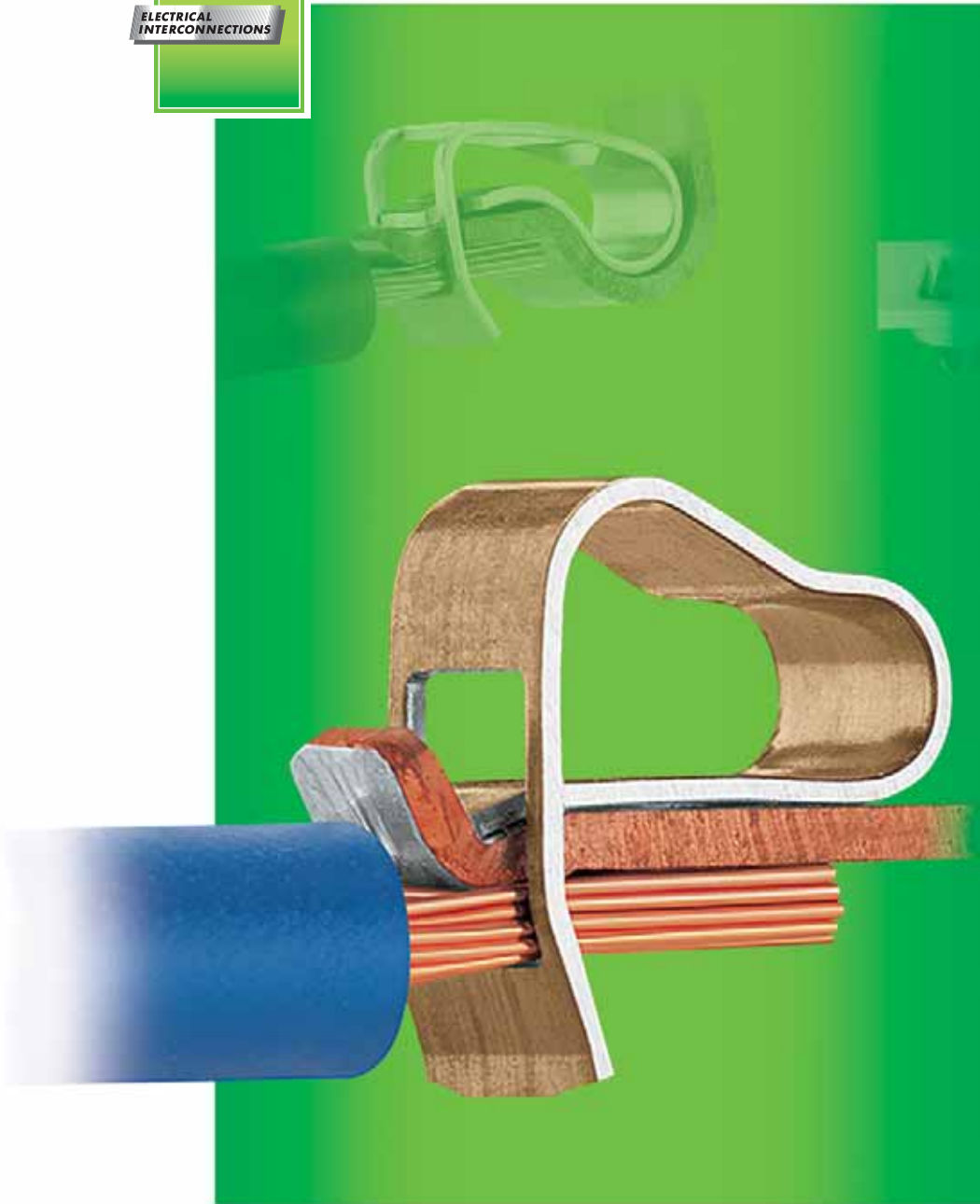


ELECTRICAL
INTERCONNECTIONS



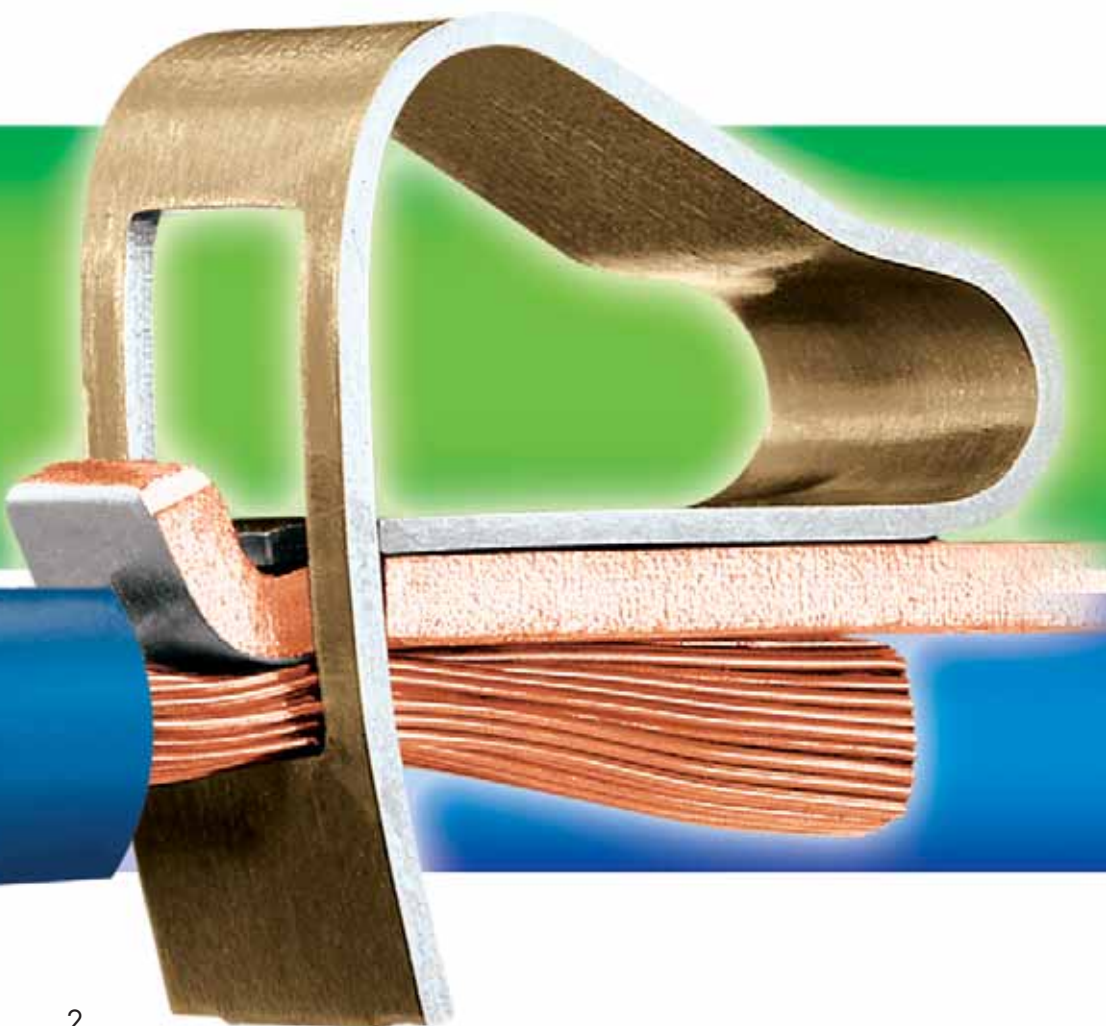
- The WAGO CAGE CLAMP® Technology
- Vibration-proof - fast - maintenance-free!

WAGO®
INNOVATIVE CONNECTIONS

The WAGO CAGE CLAMP® Technology

For nearly 30 years, WAGO CAGE CLAMP® technology has provided vibration-proof and maintenance-free clamping connections, resulting in improved availability of installations and devices - to the profit of WAGO customers in global competition.

Vibration-proof - fast - maintenance-free!



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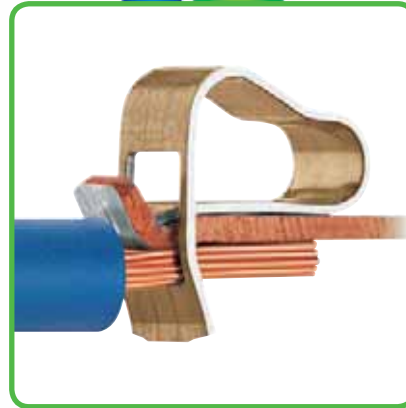
GE CLAMP®

• CLAMP types

• 1977 **The original WAGO CAGE CLAMP®**

For solid, stranded and flexible conductors. The birth of a new industry standard in electrical connection technology worldwide.

Patent No. 270 6482



• 1996 **CAGE CLAMP® Compact**

The compact version of the original CAGE CLAMP® connection. The foundation of ultra-small rail-mounted terminal blocks up to 4mm².

Patent No. 196 41206



• 1998 **POWER CLAMP**

For rail-mounted terminal blocks for conductors from 25mm² up to 95mm². WAGO redefines the limits of spring terminal technology.

Patent No. 198 17924



• 2003 **CAGE CLAMP®S**

A new quantum leap. A universal connection for all copper conductors, like the original CAGE CLAMP®. Additional benefit: direct connection of stripped solid conductors and flexible conductors with ferrule.

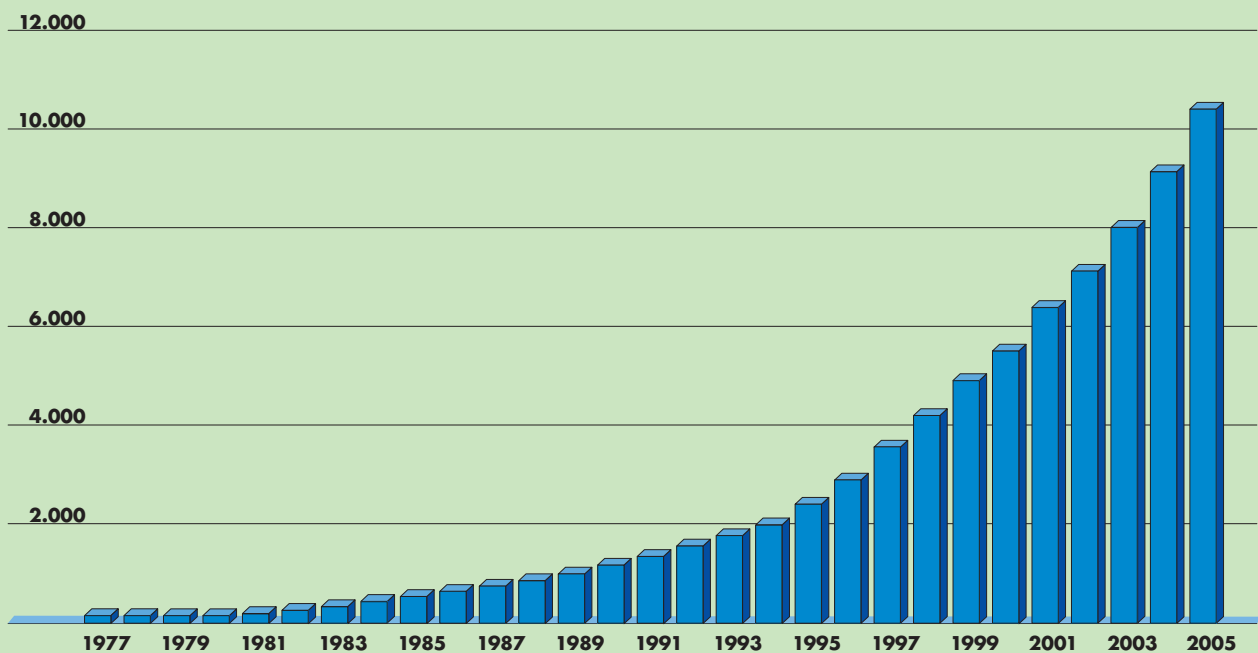
Patent No. DE-A 102 39273, DE-A 102 60545, EP-A 1 391 965



System features and benefits

- WAGO provides the most comprehensive product range using the universal CAGE CLAMP® connection technology
- Wire range 0.08 mm² to 95 mm²
- All important approvals assure worldwide acceptance
- Space saving: terminals with CAGE CLAMP® connection are up to 30% smaller than comparable products in the market
- Damage-free conductor clamping due to pre-programmed clamping force, dependant on conductor diameter
- Safe and clear handling
- Unlimited range of applications
- Worldwide industry standard
- Time and cost effective, because it is
 - **vibration-proof**
 - **fast**
 - **maintenance-free**

Number of CAGE CLAMP® springs produced up to the present time (in millions)

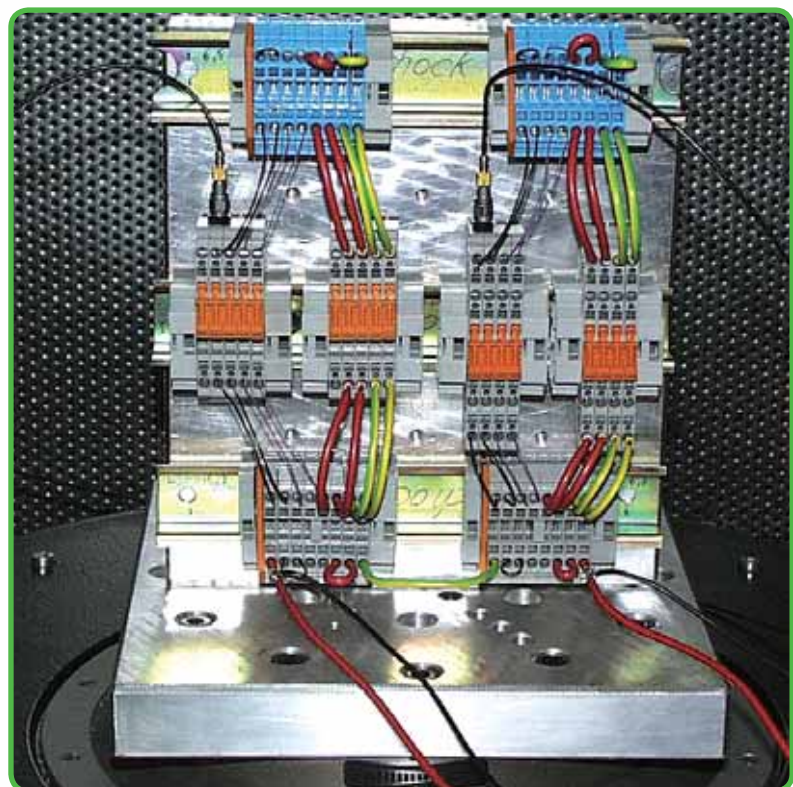
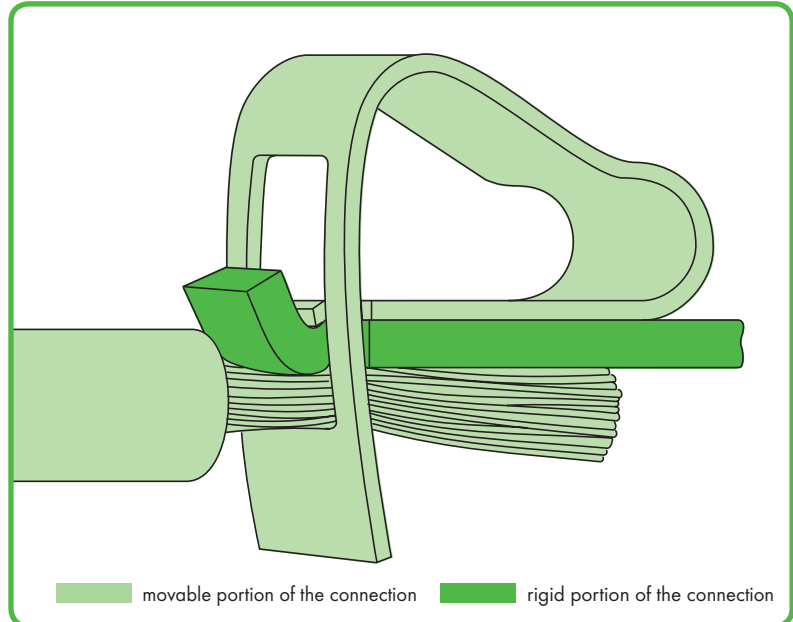


Vibration- and shock-proof – maintenance-free

The **vibration-proof** properties of CAGE CLAMP® connections were tested and verified in a vibration test to IEC/EN 60068-2-6. In this test, a variable frequency band up to 2000 Hz, at different accelerations up to 20 G and different amplitudes up to 20 mm, was passed in three axes. Extremely demanding test requirements for electrical installations in rolling stock (IEC/EN 61373) are prescribed by railway authorities or the testing agencies for marine approvals, such as GL, LR and DNV. These rigorous tests were also passed.

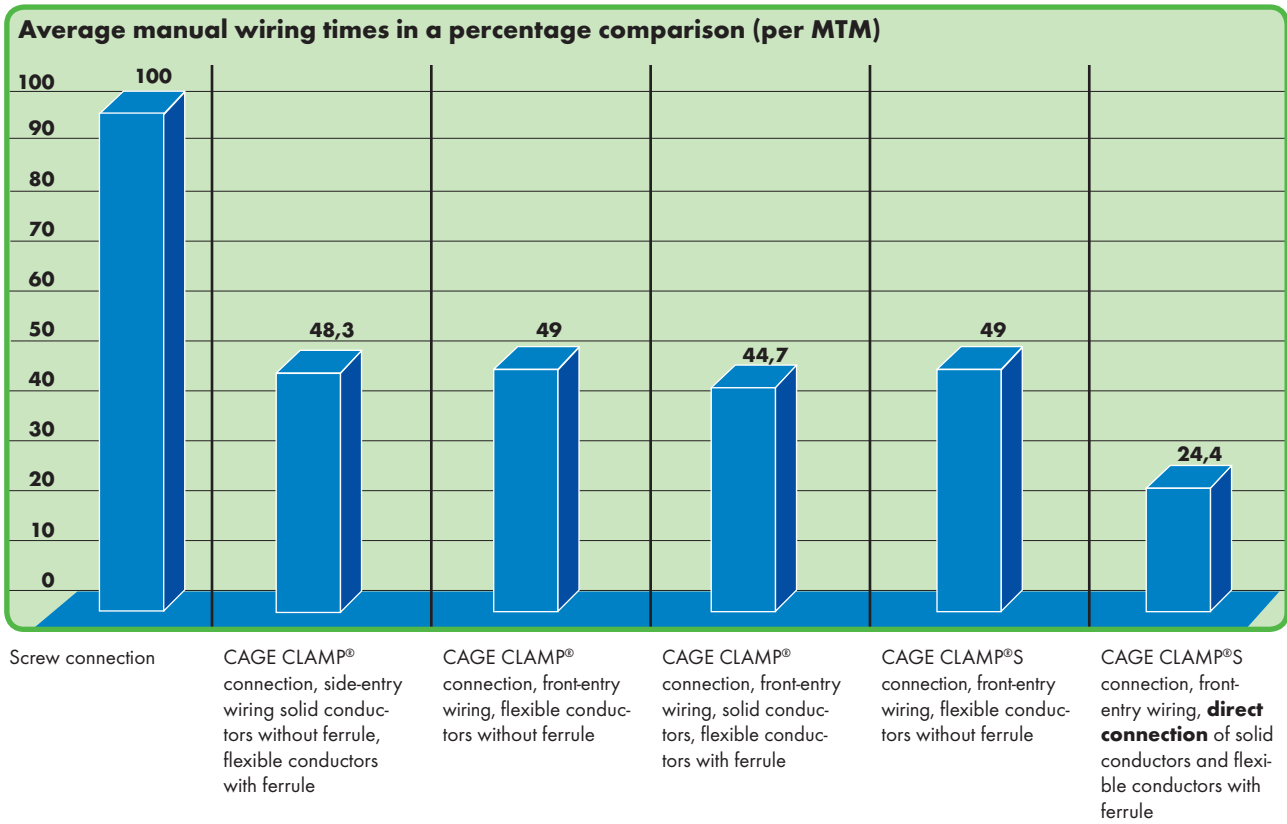
In the **impact test** to IEC/EN 60068-2-27 or for railway applications to IEC/EN 61373, the test samples were exposed to instant shock stresses, instead of permanent vibrations. Stresses up to 100 G on the x, y, and z-axis were passed without any problems.

The **maintenance-free** feature results from the excellent long term consistency of the electrical and mechanical properties of the clamping connection – more accurately, the clamping point. The voltage drop test serves in the evaluation of the clamping point quality under stresses such as vibrations, temperature changes and corrosive influences, in order to verify the gastightness of the contact point. The CAGE CLAMP® technology has proven its long term consistency in laboratory tests by international approval authorities as well as in worldwide applications. The result is a maintenance-free guarantee, reducing service costs and increasing the availability and reliability of installations and devices.



Time saving

- CAGE CLAMP® technology reduces labour charges due to significantly reduced wiring times
- Faster commissioning and elimination of service costs due to the maintenance-free condition provide additional savings
- Material and labour costs can also be reduced, when the conductors are used without prior preparation, i.e. crimping of ferrules or pin terminals. The front-entry wiring provides the ideal prerequisite. Well respected users expressly indicate this fact in their specifications.



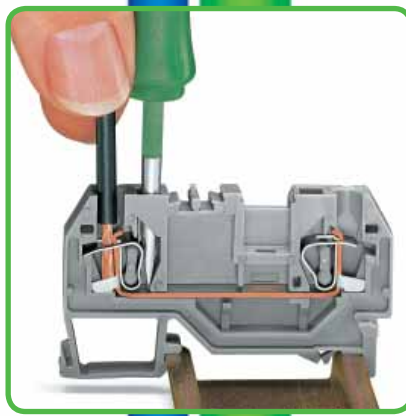
Simple and clear handling



Front-entry wiring:
CAGE CLAMP®S connection



Front-entry wiring:
CAGE CLAMP®S connection,
direct connection of solid
conductors and flexible con-
ductors with ferrule



**Front-entry
wiring:**
CAGE CLAMP®
connection



Side-entry wiring:
CAGE CLAMP® connection

One conductor per clamping point – clamps all copper conductors, free of damage

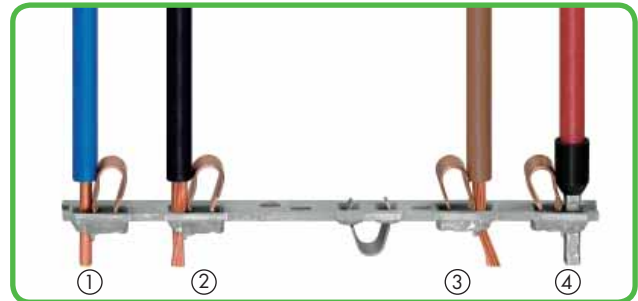
A number of VDE directives prescribe or recommend, respectively, that only one conductor should or must be connected per clamping point, e.g., DIN VDE 0611 Part 4, 02.91, section 3.1.9. WAGO complies with this safety requirement expressed in the corresponding directives.

The following technical and economical benefits are thus realised for the user:

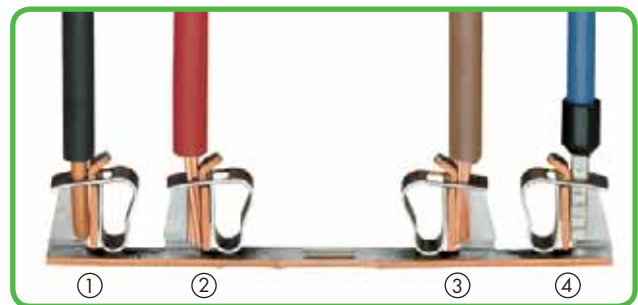
- Each conductor is clamped independently from others
- Any wire size combination per potential can be safely connected
- Where re-wiring is required, only the conductor to be changed is removed from the clamping point, all other conductors remain safely clamped
- The arrangement of more than two clamping points on one current bar permits the multiplication of potentials, without jumpers or additional terminal blocks

CAGE CLAMP® and CAGE CLAMP®S connections clamp CU conductors from 0.08 mm² to 35 mm² (95 mm²), or from 0.25 mm² to 25 mm², respectively. Splice protection is not required – but can be used.

The conductor is pressed against the current bar in the **predefined contact area**, without damaging it. The clamping force automatically adjusts to the wire size. Possible conductor deformation is balanced, an accidental loosening is safely prevented.

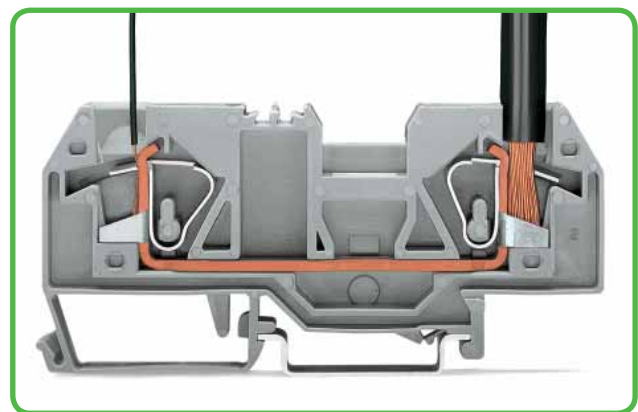


CAGE CLAMP®S connection: one conductor per clamping point



CAGE CLAMP® connection: one conductor per clamping point

- ① solid
- ② stranded
- ③ flexible
- ④ flexible with ferrule (gastight crimped)



A connection usually not seen in the field: A 0.2 mm² conductor (left) and nominal diameter 16 mm² (right) in one 16 mm² terminal block

Gastight clamping point – measurable contact quality

Frequently occurring industrial atmospheres capable of influencing the long term consistency of clamping points, are simulated in the thermal chamber for climatic tests. All WAGO products comply with the requirements of the following climatic tests:

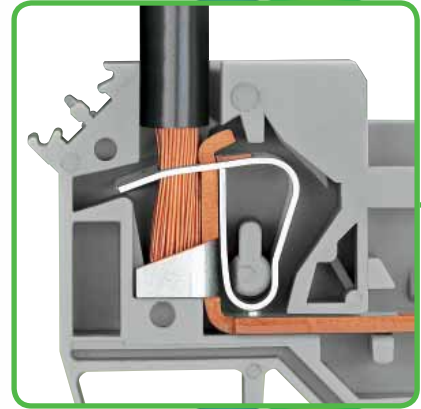
- Temperature change stresses to IEC/EN 60947-7-1, IEC/EN 60998-2-2
- Industrial atmosphere to EN ISO 6988, IEC/EN 60068-2-42, IEC/EN 60068-2-60
- Salt spray to IEC/EN 60068-2-11, marine applications GL, LR, DNV
- Quick temperature changes to IEC/EN 60068-2-14 Relative humidity, cyclical (12 + 12 hours) to IEC/EN 600689-2-30, marine applications GL, LR, DNV

The long term consistency of the low contact resistance of CAGE CLAMP® and CAGE CLAMP®S connections is the result of the **gastightness** at the clamping points. The connected conductor is pressed against the current bar (electrolyte copper with lead-free block tin surface coating) within the defined contact zone, by the spring clamp (acid and saltwater proof CrNi spring steel). The conductor is embedded into the soft tin layer at a high specific contact pressure and hence immune against corrosive creeping.

The contact pressure

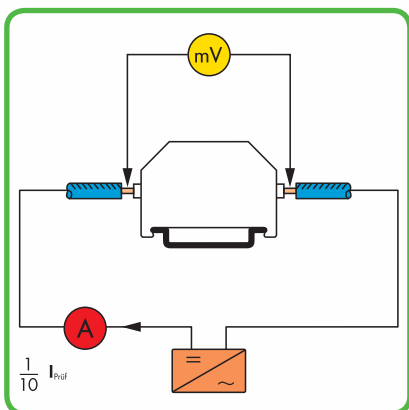
$$P \left[\frac{\text{N}}{\text{mm}^2} \right] = \frac{\text{Force } F [\text{N}]}{\text{Area } A [\text{mm}^2]}$$

has the same level in CAGE CLAMP® as in screw terminals.



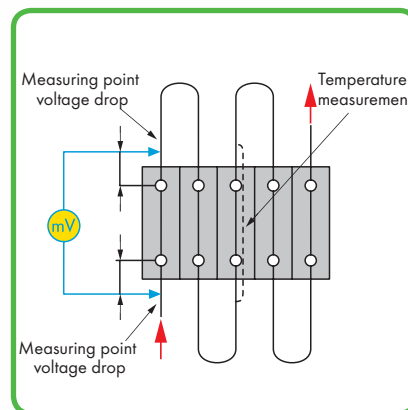
The quality of a clamping point can best be evaluated, using the following test procedures:

The **voltage drop test** is used to evaluate the quality of the clamping point under stresses such as vibration, temperature changes and industrial atmospheres.



Test arrangement "voltage drop test"

The **temperature-rise test** is required for examination of the clamping point, including the surrounding insulating enclosure, at rated current, overcurrent and short-circuit current levels.



Test arrangement "temperature-rise test"

High current-carrying capacity

The **short time withstand capacity** is defined in standards such as IEC/EN 60947-7-1 for through rail-mounted terminal blocks, as a **current-carrying capacity of 120 A per mm² nominal diameter** for the duration of 1 second. **In the case of a 95 mm² high-current terminal block of the WAGO Series 285, this translates to 11,440 A!**

Ground (earth) conductor terminal blocks to be tested are submitted to 120 A per mm² for 3 x one second. The pass criterion for the test is the voltage drop (limit value and constancy). CAGE CLAMP® and CAGE CLAMP®S connections pass this test without damage and impairment of the functionalities.



Test arrangement "short time withstand current test"



Unrealistic test of a CAGE CLAMP® rail-mounted terminal block, 4 mm²: **Increase of current without time limit.** In such an extreme test – fuse devices would have interrupted the current –, **the terminal block is undamaged.**

Global acceptance

As inventors and pioneers for spring clamp terminals, WAGO had an idea in 1951, when founding the company: to clamp electrical conductors via spring force, instead of a screw mechanism. Today, more than 50 years later, WAGO is the globally recognized leader in spring clamp technology.

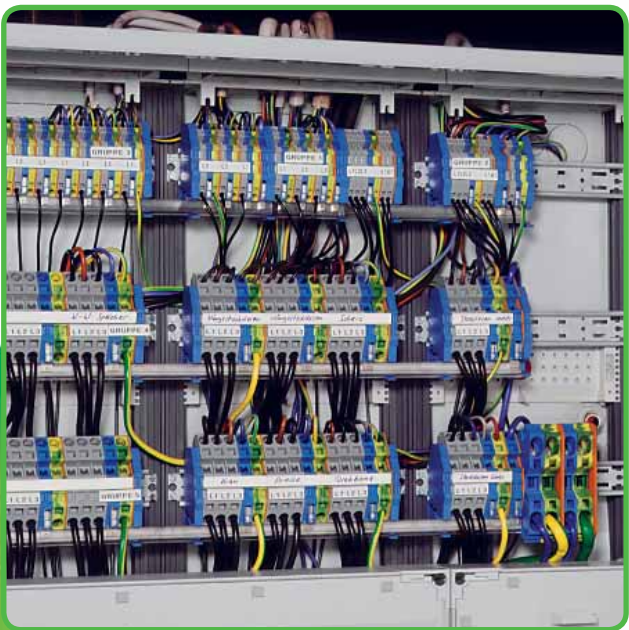
WAGO products with CAGE CLAMP® connecting technologies have proven themselves since their market introduction in 1977 in all application conditions in electrical and electronic engineering, having obtained all important international approvals.



In installation and machine engineering, plant automation, automotive sector, rail and marine applications, as well as in the on-/offshore sector, ...



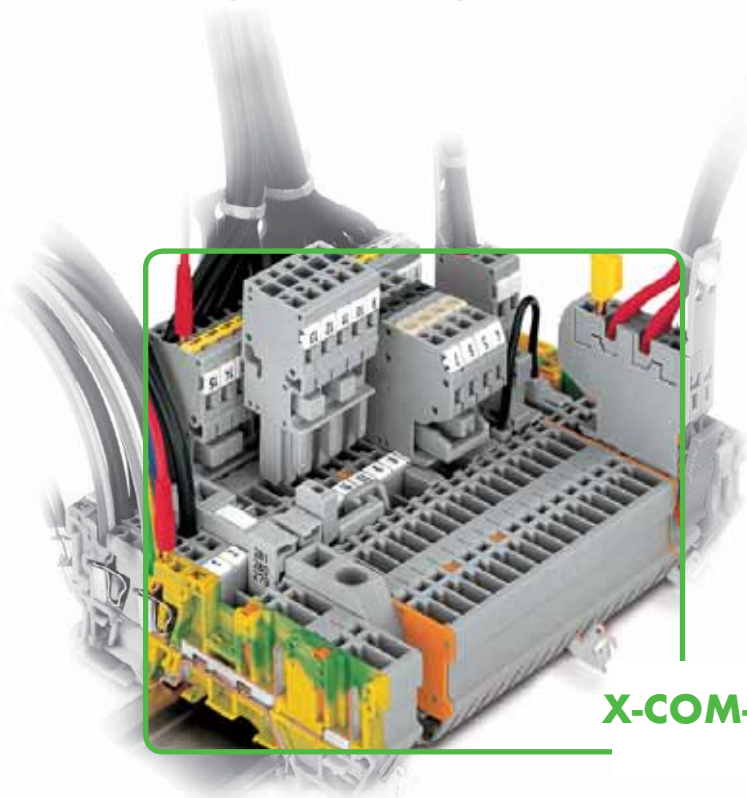
Global acceptance



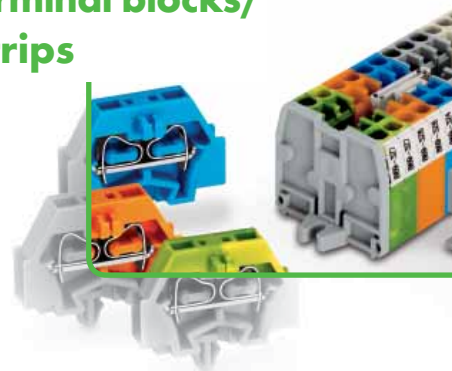
... in the chemical and petrochemical industry, in switch-gear engineering, food processing, printing and postprint processing machinery, in power stations of any energy sector, elevators and escalators, in building installation and automation, instrument engineering and industrial electronics, etc.



Examples of products with CAGE CLAMP® tec

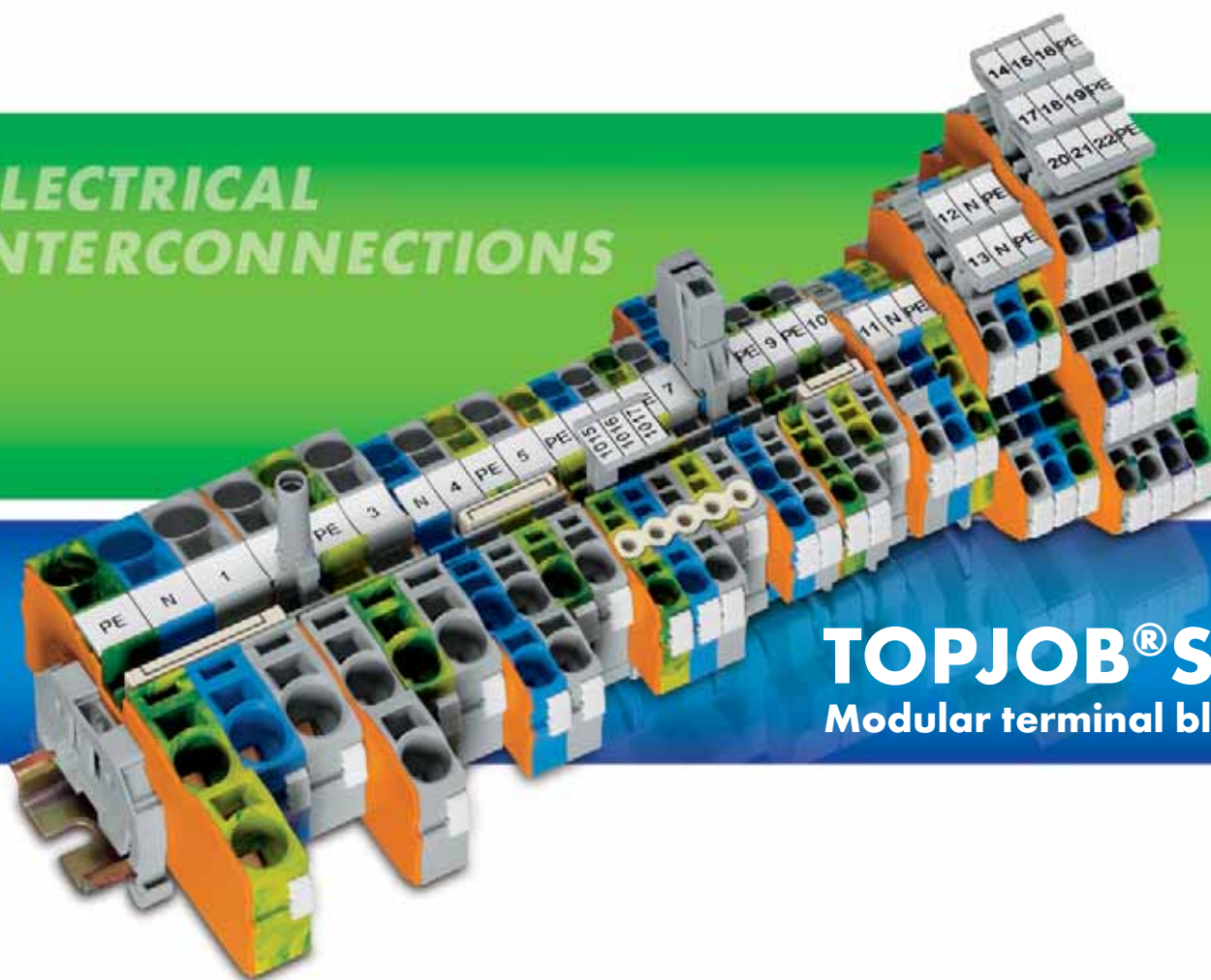


Modular terminal blocks/
terminal strips



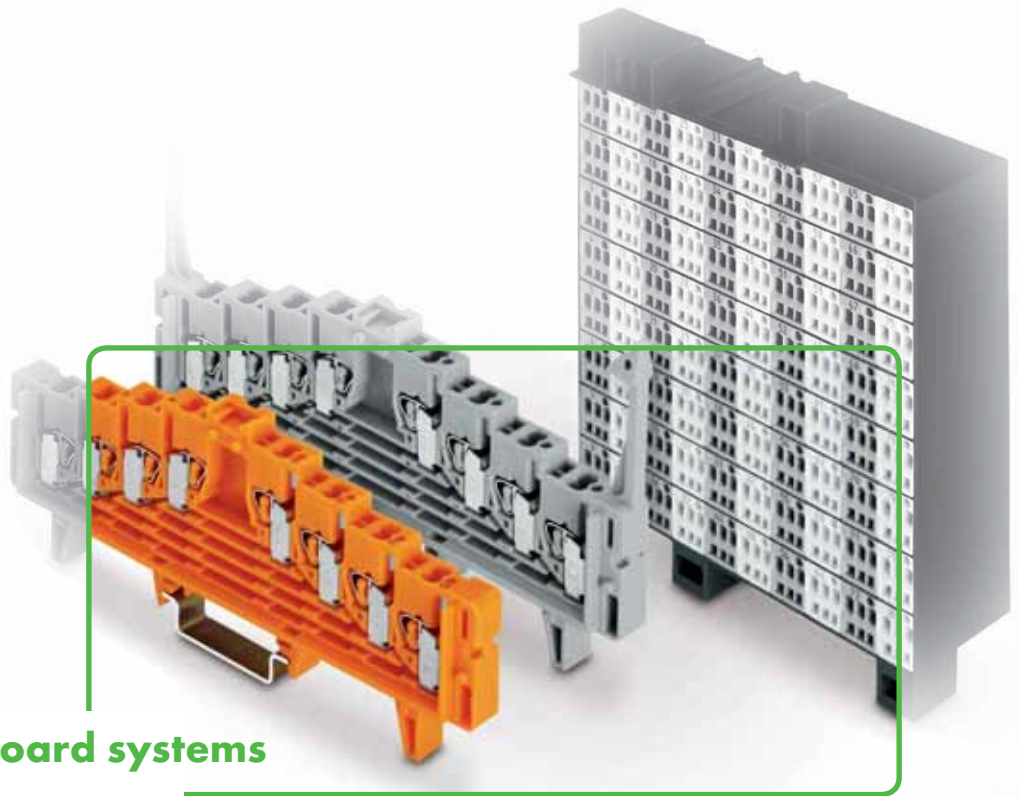
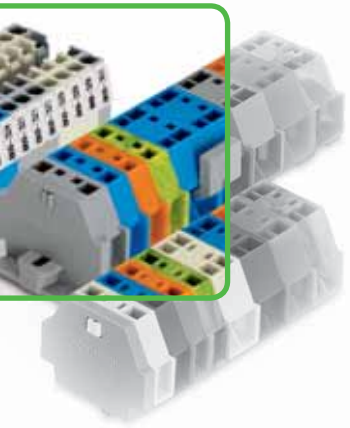
X-COM-SYSTEM

**ELECTRICAL
INTERCONNECTIONS**



TOPJOB® S
Modular terminal blocks

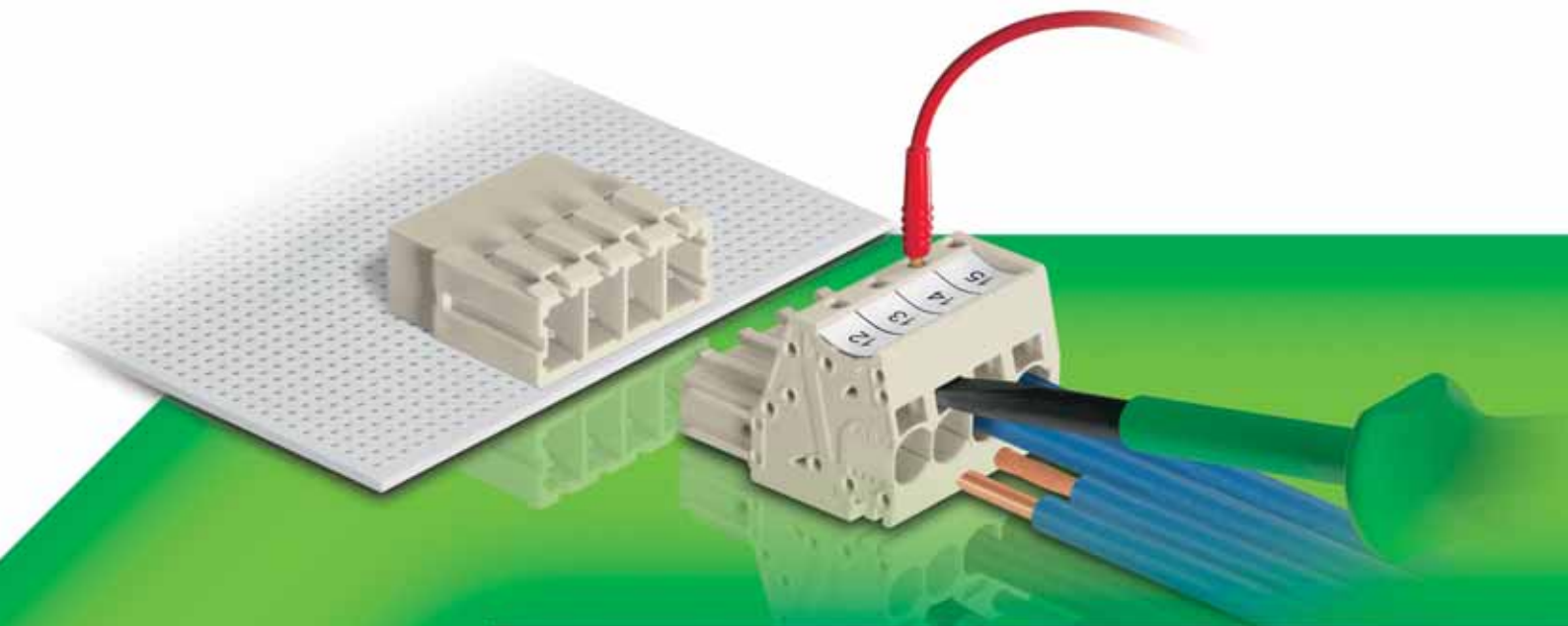
hnology



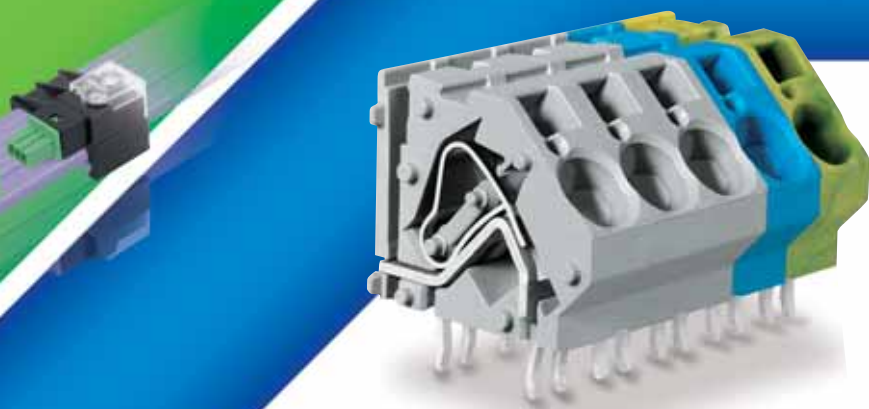
Patchboard systems



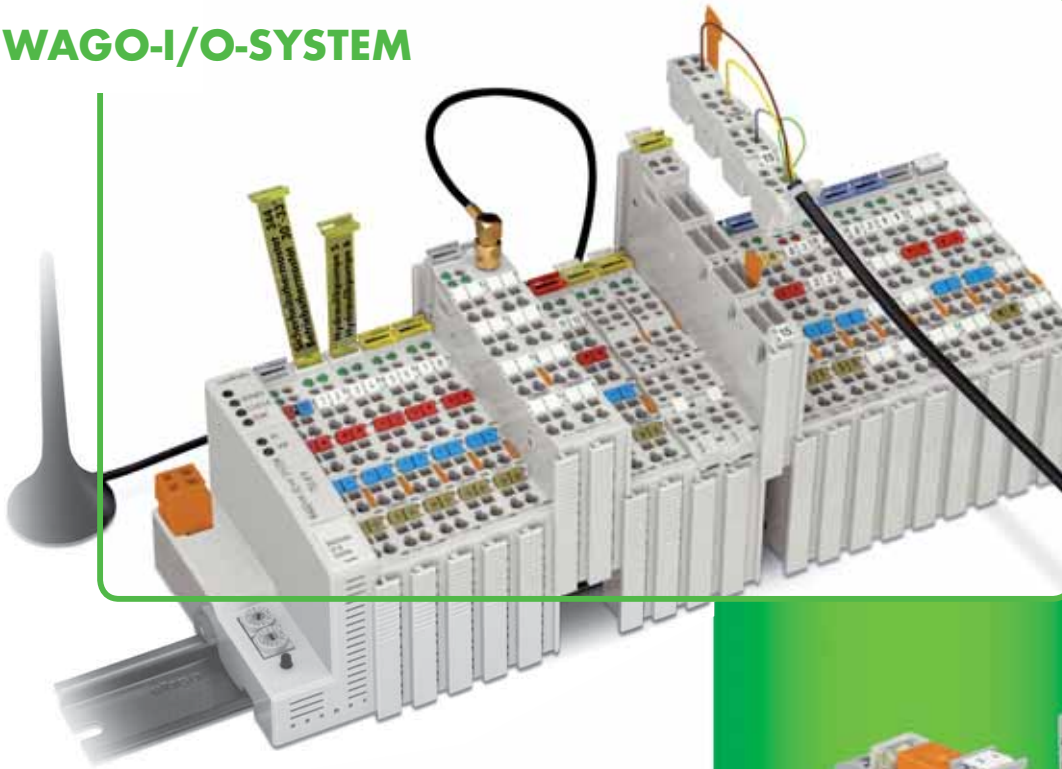
WINSTA[®]
Plug-in connector system



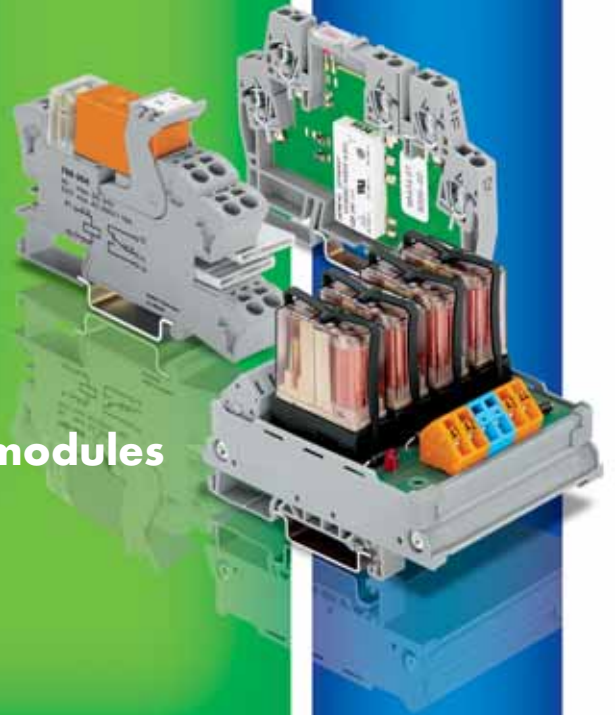
Connectors and PCB terminal blocks



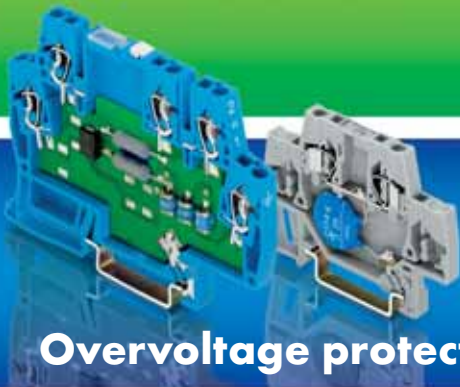
WAGO-I/O-SYSTEM



Transducers



Relay modules



Overvoltage protection

ELECTRONIC

WAGO World-wide

Argentina

AEA S.A.C.I.F.
Asunción 2130, (1419) Buenos Aires
Phone ++ 54 /11 /4574 1555
robertor@schillig.com.ar

Australia

NHP ELECTRICAL ENGINEERING
PRODUCTS PTY LTD
43-67 River Street, Richmond, Victoria, 3121
P.O. Box 199
Phone ++ 61/3/9429-2999
export@wago.com

Austria

WAGO Kontakttechnik Ges.m.b.H.
Laxenburger Straße 244, 1230 Wien
Phone ++ 43/1/6 15 07 80
info.at@wago.com

Belgium

WAGO Kontakttechnik
Excelsiorlaan 11, 1930 Zaventem
Phone ++ 32/2/717 90 90
info-be@wago.com

Brazil

WAGO Eletroeletrônicos Ltda
Rua América Simões 1470
São Roque da Chave - Itupeva - SP
13295-000
Phone ++ 56-2-747 01 52
info.br@wago.com

Canada

Please contact WAGO USA

Chile

Desimat Chile
Puerto Vespuccio 9670, Pudahuel Santiago
Phone ++ 56-2-7470152
ventaschile@desimat.cl

China

WAGO ELECTRONIC (TIANJIN) Co. LTD
No. 5, Quan Hui Road
Wu Qing Development Area,
Tianjin 301700
Phone ++ 86/22/59617688
info-cn@wago.com

CIS Countries

WAGO Kontakttechnik
Repräsentanz Moskau
ul. Lesnaya, 43, off. 329, 127055 Moskau
Phone ++ 7/095/978 66 70
info@wago.ru

Colombia

T.H.L. LTDA
Cra. 35 # 89- 35, Bogotá
Phone ++ 571/621 85 50
ventas-thl@thltda.com

Croatia

M.B.A. d.o.o. za trgovinu i zastupanje
Frana Supila 5,51211 Matulji HR
Phone ++ 00385 51 275-736
mba@ri.htnet.hr

Czech Republic

WAGO Elektro spol. s.r.o.
Nad Iselem 21
14700 Praha 4 - Hodkovičky
Phone ++ 420 261 090 143
61400 Brno - Husovice
Phone ++ 420 545 423 010
info.cz@wago.com

Denmark

WAGO Danmark
Filial af WAGO Kontakttechnik
GmbH & Co. KG
Lejrvvej 29, 3500 Værløse
Phone ++ 45 /44 35 77 77
salg.dk@wago.com

Ecuador

INSETEC CIA. LTDA.
El Zurriago 177 y El Vengador
P. O. Box 17-16-016, Quito
Phone ++ 593 /2 /253 - 757
g.castro@insetec.com.ec

Egypt

IBN Engineering Instrumentation & Control
71 a El Shaheed Ahmed Hamdi St.
King Faisal, Giza
Phone ++ 20-2-7214350
sales@ibnengineering.com

Estonia

OÜ ELTARKO
Laki 14 - 502, 10621 Tallinn
Phone ++ 372 651 7731
andres@eltarko.ee

Finland

WAGO Kontakttechnik GmbH & Co. KG
Filial i Finland
Pultitie 2A, 00880 Helsinki
Phone ++ 358-9-7744 060
export@wago.com

France

WAGO CONTACT S.A.
Paris Nord 2
83 rue des Chardonnerets
B.P. 55065 - Tremblay en France
95947- ROISSY CDG CEDEX
Phone ++ 33 /148172590
info-fr@wago.com

Germany

WAGO Kontakttechnik GmbH & Co. KG
Postfach 28 80 · 32385 Minden
Hansastraße 27 · 32423 Minden
Phone ++ 49/5 71/8 87-0
Fax ++ 49/5 71/8 87-169
info@wago.com
www.wago.com

Greece

PANAGIOTIS SP. DIMOULAS-'BIOMAT'
Kritis Str. 26, 10439 Athen
Phone ++ 30-210/8833337
export@wago.com

Great Britain

WAGO Limited
Triton Park, Swift Valley Industrial Estate
RUGBY, Warwickshire, CV21 1SG
Phone ++ 44 /1788 /568008
uksales@wago.com

Hong Kong

National Concord Eng., Ltd.
Unit A-B, 5/F., Southeast Industrial Building,
611-619 Castle Peak Road
Tsuen Wan, N.T.
Phone ++ 852/24 29 26 11
sales@nce.com.hk

Hungary

WAGO Hungária KFT
Ipari Park, Gyár u. 2, 2040 Budaörs
Phone ++ 36/23/502-170
info@wago.hu

Iceland

S. Gudjonsson ehf
Audbrekku 9-11, 202 Kopavogur
Phone ++ 354 /520-4500
export@wago.com

India

WAGO & CONTROLS (INDIA) LTD.
C-27, Sector-58, Phase-III,
Noida-201 301, Gautam Budh Nagar (U. P.)
Phone ++ 91/120/258 04 09/10
info@wagoindia.com

Indonesia

P.T. Timur Agungmulia Kencana
Graha Mulxindo, 2nd Floor
Jl. Sultan Iskandar Muda No. 88L
Jakarta 12240
Phone ++ 62/21/7228888
tak_electric@cbn.net.id

Iran

Patsa Industry
2, Bahar Str., South Shiraz Ave., Tehran
P.O. Box.: 15875-1698, Zip Code: 14369
Phone ++ 98-21-88047626
export@wago.com

Ireland

Drives & Controls
Unit F4, Riverview Business Park
Nangor Road, Dublin 12
Phone ++ 353 /1/4604474
wago@drivesandcontrols.ie

Israel

Comtel Israel Ltd
20 Hataas st., Bet Hapaamon,
Kefar-Saba 44425
Phone ++ 972 9 7677 240
sales@comtel.co.il

Italy

WAGO ELETTRONICA SRL
Via Vittoria, 5/b
40068 S. Lazzaro di Savena (BO)
Phone ++ 39/051/6272170
info-ita@wago.com

Japan

WAGO Co. of JAPAN Ltd.
Nittetsu ND-Tower Building 4F
Kameido 1-5-7
Koto-Ku, Tokyo 136-0071
Phone ++ 81/3/5627/2050
info-jp@wago.com

Korea

Hankuk Sangsa Co. &
Mahani Electric Co. Ltd.
576-8, Bisan-2dong, Dongan-Ku
Anyang-City, Kyungki-Do., 431-821
Tel. ++ 82/31/463 3300
export@wago.com

Latvia

'INSTABALT LATVIA' SIA
Vestienas iela 6, , LV-1035
Phone ++ 371 790 1188
info@instabalt.lv

Lithuania

'INSTABALT LIT' UAB
187, Vilnius, 2035
Phone ++ 370 52 322 295
info@instabalt.lt

Luxembourg

Please contact WAGO Belgium

Malaysia

WAGO Rep. Off. Malaysia
Leis. Comm. Square
806, Bl.A4, Pussat Dagang Setia Jaya
9, Jalan PJS 8/9
46150 Petaling Jaya, Selangor Darul Ehsan
Phone ++ 60-3-78771776
E-Mail kian.guan.tan@wago.com

Mexico

Über WAGO USA
Phone ++ 52/5526446916
info.mx@wago.com

Morocco

HPH Materials (M) Sdn. Bhd.
4, Jalan Nilam 1/6, Subang Hi-Tech Ind. Park
40000 Shah Alam, Selangor D.E.
Phone ++ 60-3-5638 2213

Netherlands

WAGO Nederland
van Leeuwenhoekstraat 20-1
3846 CB Harderwijk
Phone ++ 31/341/ 439039
info-nl@wago.com

New Zealand

Engineering Computer Services Ltd.
Corner Te Rapa & Mahana Road
P.O. Box 20-204, Te Rapa, Hamilton
Phone ++ 64/7/849 2211
export@wago.com

Norway

WAGO NORGE FILIAL AV
WAGO Kontaktechnik GmbH & Co. KG
Jerikoveien 20
1067 Oslo
Phone ++ 47-22309450
info.no@wago.com

Peru

Desimat Peru
Av Enrique Salazar Barreto 280
Surco-Lima 33
Phone ++ 51-1-2731892
export@wago.com

Philippines

Please contact WAGO Singapore

Poland

WAGO ELWAG sp. z o. o.
ul. Piékna 58 a, 50-506 Wrocław
Phone ++ 48 / 71/ 3 60 46 70/78
wago.elwag@wago.com

Portugal

MORGADO & CA. LDA-SEDE
Estrada Exterior da
Circunvalação 3558/3560
Apartado 1057, 4435 Rio Tinto
Phone ++ 351/22/9770600
export@wago.com

Saudi Arabia

Al Quraishi Electrical Services of S.A.
P.O. Box 7386, Dammam-31462
Phone ++ 966/3 /85 725 37
export@wago.com

Singapore

WAGO Electronic Pte Ltd
10 Upper Aljunied Link, # 04-04
York International, Industrial Building
Singapore 367904
Phone ++ 65/62866776
info.sing@wago.com

Slovak Republic

WAGO Elektrik spol.s r.o.
Odborárska 52
83102 Bratislava
export@wago.com

Spain

DICOMAT S.L.
Avda. de la Industria, 36
Apartado Correos, 1.178
28108-Alcobendas (Madrid)
Phone ++ 34/91/6621362 (6 lineas)
madrid@dicomat-asetyc.com

South Africa

Shorrock Automation (Pty) Ltd
Postnet Suite # 219
Private Bag X 8, Elardus Park
0047 PRETORIA
Phone ++ 27/2/3454449
sales@shorrock.co.za

Sweden

WAGO Sverige
Tyskland Filial
Datavägen 9 A, 17543 Järfälla
Phone ++ 46-858410680
info.se@wago.com

Switzerland

WAGO CONTACT SA
Route de l'Industrie 19, 1564 Domdidier
Phone ++ 41/26 /676 75 00
info.switzerland@wago.com

Syria

Zahabi Co.
8/5 Shouhadaa St., P.O. Box 8262
Aleppo
Phone ++ 963/21/2122235/6
export@wago.com

Taiwan R.O.C.

WAGO Taiwan
8/F., No. 48, Jing-An Road,
Chung-Ho City, 23556, Taipei Hsien.
Phone ++ 886/2/2244/2569
export@wago.com

Thailand

WAGO Representative Office Thailand
4th Floor, KS Building
213/6-8 Rachada-Phisek Road
Dingdaeng Bangkok 10320
Phone ++ 66/2/6935611
pote.c@wago.com

Turkey

SAROZ DI. S TIC.VE MÜ. S. LTD. .STI.
BOSTANCIYOLU CAD. SAV. SOK.
NO.: 20 KAT: 2 YUKARIDUDULLU
81230 ÜMRANIYE-ISTANBUL
Phone ++ 90/216/4994777
saroz@saroz.com.tr

United Arab Emirates

Binghalib Engineering Ent.
Al Wasit Street, Industrial Area No. 2
P.O. Box 6969, Sharjah
Phone ++ 971/6 /5434111
export@wago.com

USA

WAGO CORPORATION
N120 W19129 Freistadt Road
Germantown, WI 53022
Phone ++ 1/262/255-6222
info.us@wago.com

Venezuela

PETROBORNAS, C.A.
Av. Principal UD 304-Zona Ind. Los Pinos
C.C. Los Pinos-Local E
8015-Puerto Ordaz-Edo, Bolivar
Phone ++ 58/286 9943406
info@petrobornas.net

Vietnam

Please contact WAGO Singapore



WAGO Kontakttechnik GmbH & Co. KG
Postfach 28 80 · 32385 Minden
Hansastraße 27 · 32423 Minden
Phone +49 (0) 571 / 887-0
Fax +49 (0) 571 / 887-169
info@wago.com
www.wago.com