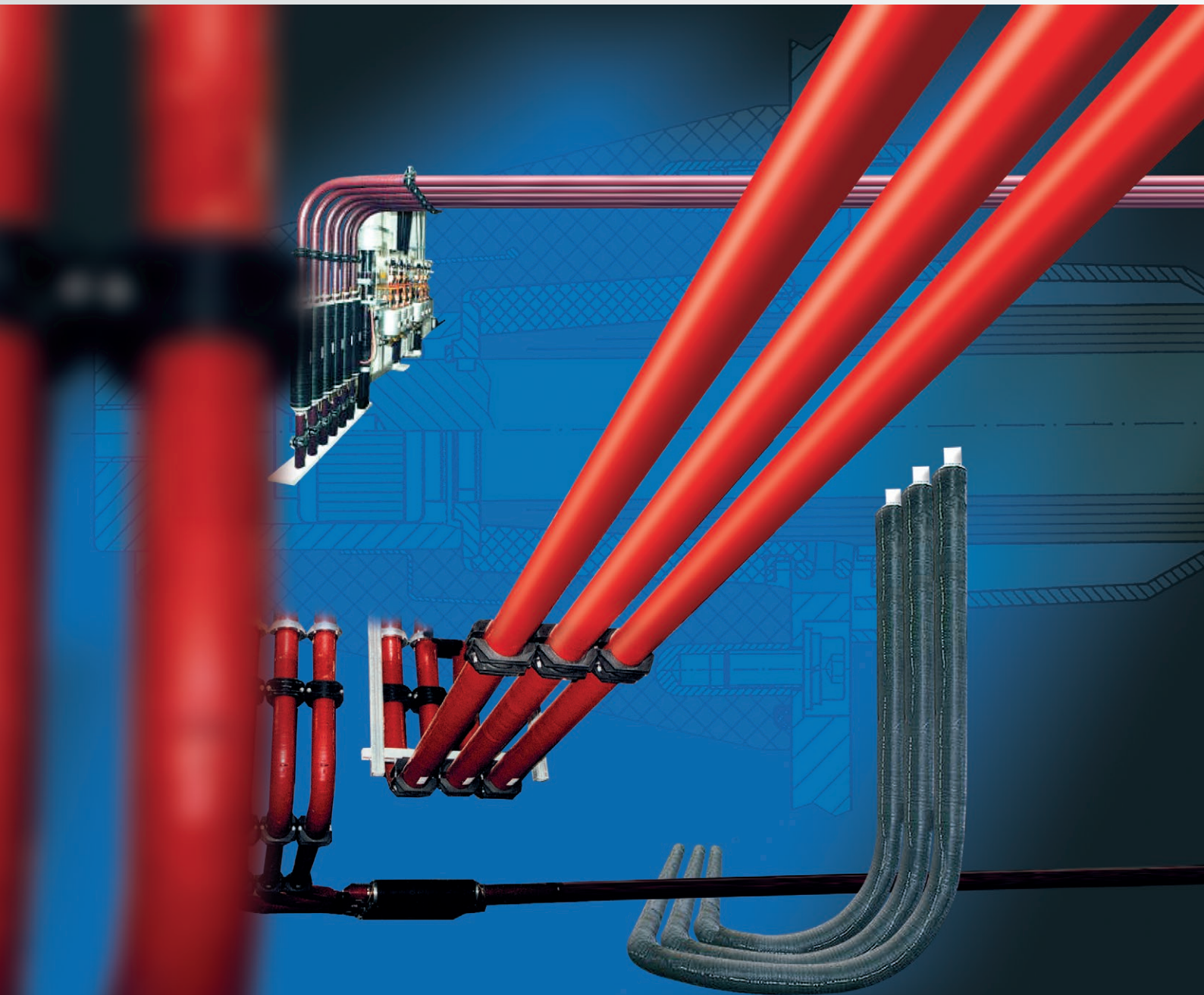




Instrument Transformers

SIS Solid Insulation System



RITZ HAMBURG
RITZ GERMANY WIRGES · KIRCHAICH · DRESDEN
RITZ AUSTRIA MARCHTRENK RITZ HUNGARY KECSKEMET RITZ CHINA SHANGHAI RITZ USA HARTWELL

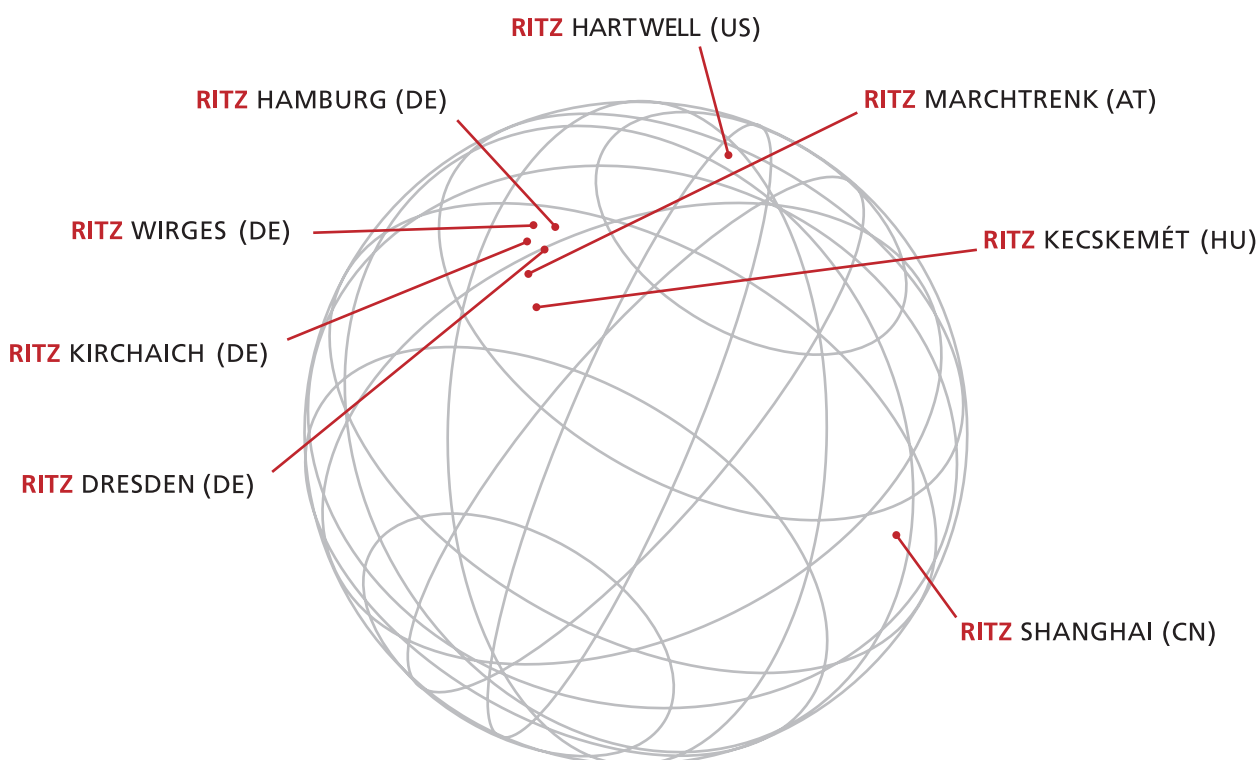
RITZ Instrument Transformers GmbH – Core competency

Under the trading name „RITZ Instrument Transformers GmbH“ RITZ has been pooling its activities to gather new strengths since 01/08/2007.

The tradition and knowledge of the parent company “RITZ Messwandler Hamburg” and the subsidiary “RITZ Messwandler Dresden (TuR)” has been united with the companies “Wandler- und Transformatoren-Werk Wirges (WTW)” and “Messwandlerbau Bamberg (MWB)” under this name. This merger unites a total of more than two hundred years of know-how in instrument transformers production.

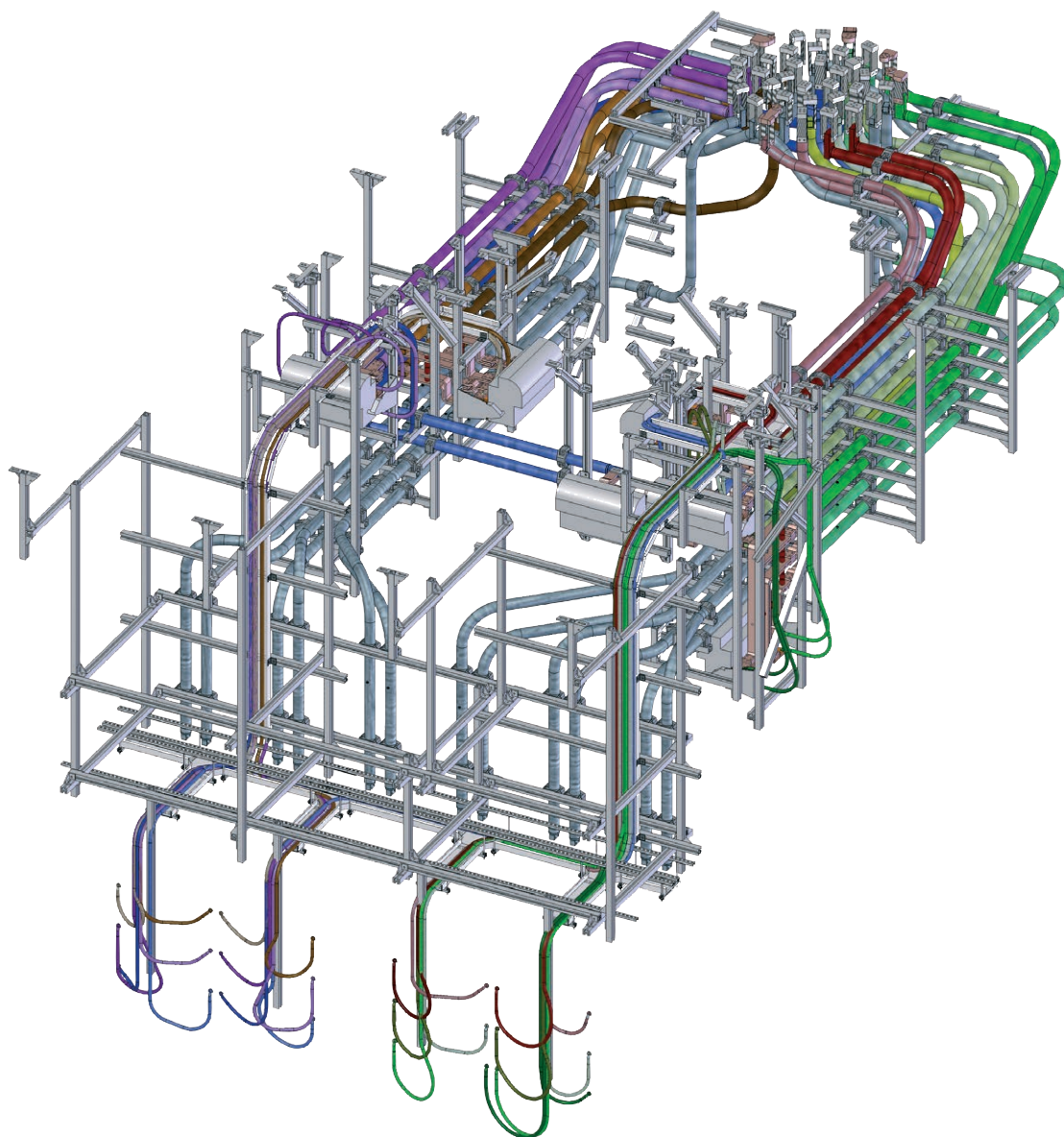
In addition, RITZ has decided to concentrate on the core business of medium voltage and low voltage transformers in which the high voltage division is sold. The resources gained through this shall now be applied for additional innovations and quality standards in the medium and low voltage products. RITZ is therefore securing its position on the global market.

The overseas corporations of RITZ Instrument Transformers GmbH in Austria (Marchtrenk), Hungary (Kecskemét), China (Shanghai) and USA (Hartwell) strengthen the company’s position on the international market.



Contents

General Design	4
Bus Bar Design Principle Outdoor Application	5
Production Length Multiple Bus Bar Connections	6
Bus Bar Connection Earthing	7
Bus Bar Fixing Fixing Clamp	8
Dimensioning Conductor Material	9
Quality Tests	10
Ordering Information	11



General

The RITZ **SIS** Solid Insulated Bus Bar System especially offers for transmission of higher currents and/or limited space requirements a cost-effective and safe alternative to parallel-connected cable systems, metal-enclosed bus bar or bus duct systems.

The equipment produced plays an important part in power generation and power distribution. Therefore, highest demands are made with respect to industrial safety.

By constantly supervising the manufacturing process as well as ongoing modifications to the materials used, the highest degree of safety is guaranteed. The available test equipment allows all of the type and routine tests necessary.

Before delivery each bus bar segment and connecting sleeve gets routine testing.

All requirements with respect to the protection of personnel and equipment are met. The following inherent benefits speak for the use of fully insulated bus bars:

Design

System Specific Benefits

- Compact design
- Reduced requirements for the installation space
- Small bending radii
- 3-dimensional geometric shape is possible
- Natural cooling due to effectual conductor design
- High operational reliability due to factory routine test of each bus bar
- Maintenance free

Safety Benefits

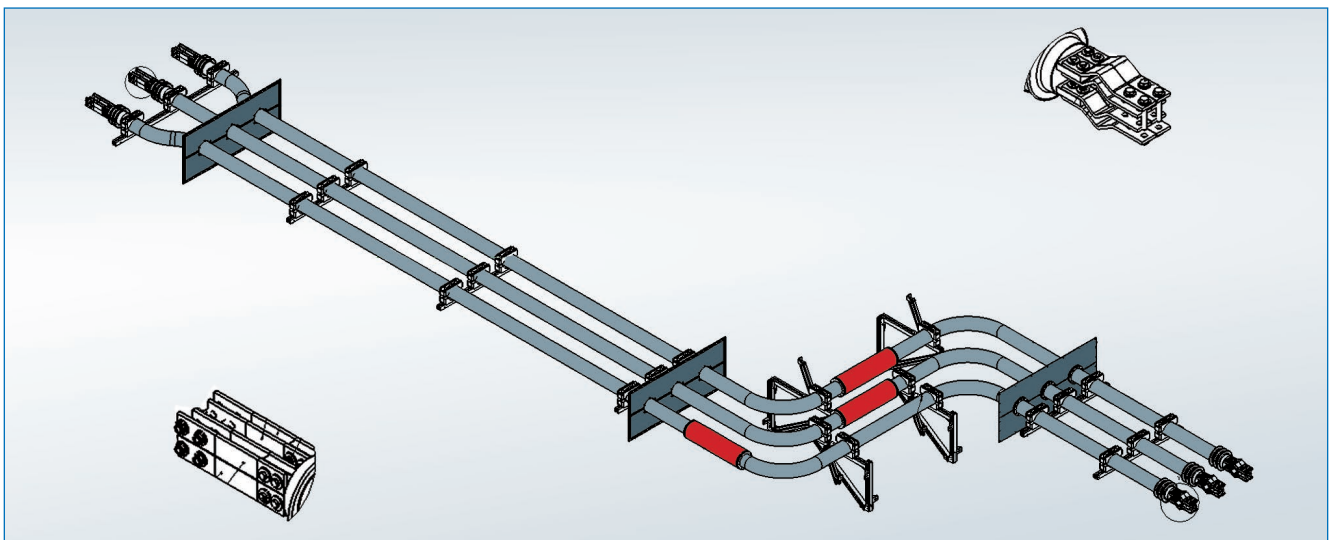
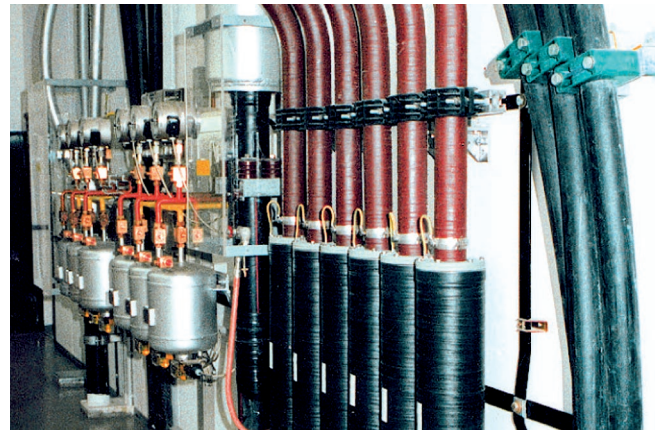
- Touch Safe
- Fully insulated and capacitive graded system
- High thermal and dynamic short circuit current withstand capabilities
- Excluded phase to phase short-circuits
- No toxic fumes in case of fire - self extinguishing
- High operating reliability due to routine tests for each bus bar element

Installation

- Easy installation due to standardized installation and fixing parts

RITZ Service

- Minimized project engineering for YOU as customer due to complete engineering service for bus bar routing including fixation system as 3D CAD model.
- Providing complete Installation documentation
- Supervisor support on request available.
- Installation team on request available

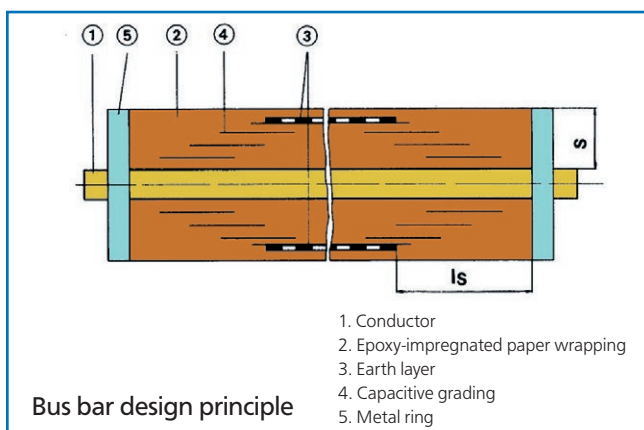


Bus Bar Design Principle

The bus bar insulation is built up with Resin Impregnated Paper (RIP). Crepe paper is wound around the conductor (copper or aluminium) and impregnated under vacuum with epoxy resin.

This results in cavity free insulation which is free of partial discharge. To avoid partial discharge by delamination of the insulation from the conductor a conducting layer is wrapped around the conductor.

Layers of insulating paper are built up on the high voltage layer according to the rated voltage. In these insulation layers the capacitive grading at the ends of the bus bars are included. These are dimensioned to reach an optimised electric field distribution on the surface of the bus bar. Thus a minimised grading length can be reached. Along the whole length of the bus bar, except the grading area, an earth layer is wound on the insulating layers. This earth layer is built up by semi conducting paper, aluminium foil layers and axial copper strips to reach a high short circuit current capability. A connection device is soldered on the copper strips used as earthing point of the bus bar. An additional three millimetres crepe insulation is applied over the earth layer as protection. After drying the insulation, the paper is impregnated with a low viscosity epoxy resin under vacuum conditions. The RITZ manufacturing technology permits to build a bus bar with any geometrical shape.



$U_{\max}$	min. length of grading (ls)	Insulation wrapping (s)
12 kV	175 mm	10,0 mm
24 kV	215 mm	12,5 mm
36 kV	330 mm	17,5 mm

Outdoor Application

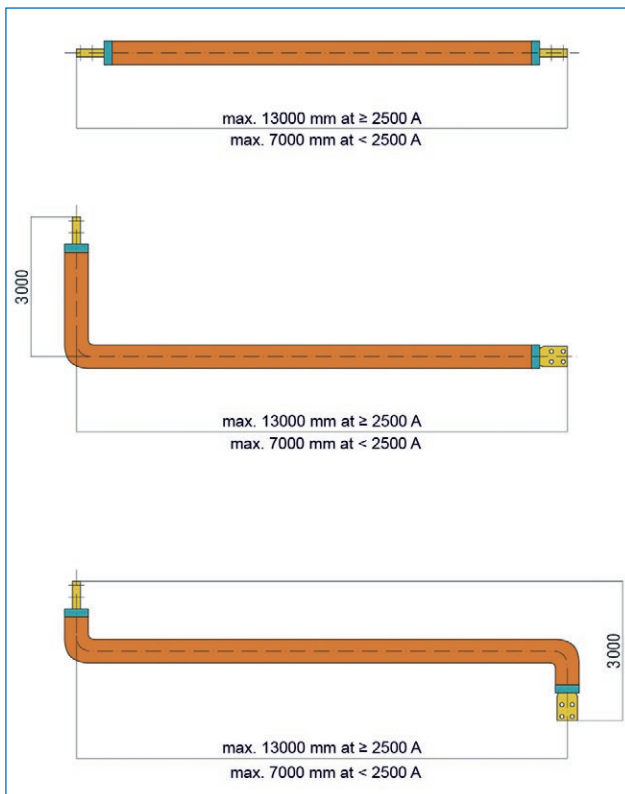
For outdoor applications the bus bar will be covered with a weatherproof stainless steel tube. To increase the creepage distance, the capacitive grading of the bus bar insulation is covered on the outside by shrinking sleeve sheds.



Production Length

The length and geometric shape is limited by the size of the equipment (such as the kiln), the means of transportation and the local facilities (building construction).

RITZ manufactures different bus bar shapes and lengths as show in the picture below.



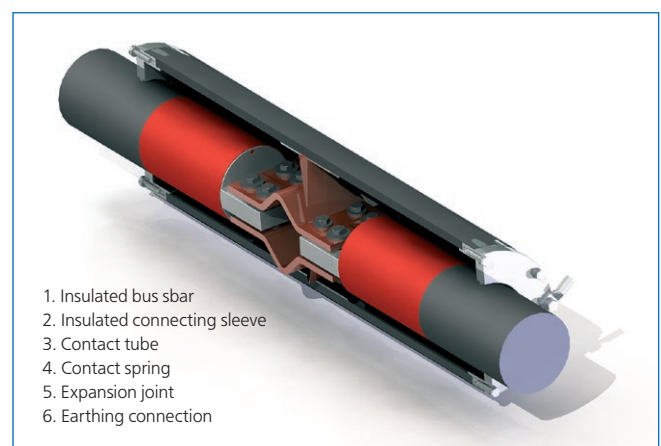
Multiple Bus Bar Connections

The length of the individual bus bars is limited by the manufacturing process, transportation and installation conditions. For complex installations the bus bars have to be connected. The connection is performed with flexible connectors between the bus bars to allow thermal expansion and to compensate for tolerances during installation.

These joints are fully insulated by connection sleeves, which cover the capacitive grading at the bus bar ends.

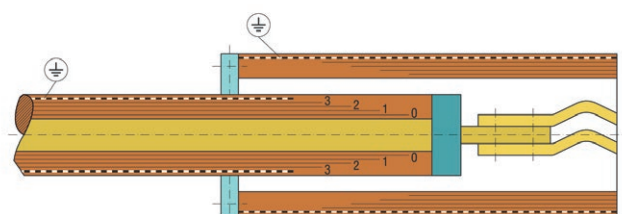
These connecting sleeves are also fully insulated and guarantee absolute safety upon contact throughout the whole length of the bus bar installation. For voltages above 12 kV the sleeves are also capacitive graded. The high voltage connection to the sleeve is realised by a contact spring installed on the flat connector of the bus bar. The connecting sleeve has an ingress protection class¹ IP 54. Higher protection classes are available upon request.

Outdoor connecting sleeves are manufactured with an aluminium or stainless steel protection tube. The sealing between bus bar and connecting sleeve is made by a rubber bellow and achieves the ingress protection class² IP 65.



The drawing shows the insulated conductor and the insulated tube. The capacitive layer of the bus bar and connecting sleeve are laid in the opposite direction which guarantees a homogenous electrical field inside the connecting sleeve.

Capacitive graded bus bar - connecting sleeve



- ¹ Ingress protection rating against dust and water according to IEC 60529 corresponding to NEMA 3/3s.
- ² Ingress protection rating against dust and water according to IEC 60529. A corresponding NEMA rating does not exist.



Bus Bar Connection

There are several variations of rigid or flexible connections between bus bar segments or between the bus bar and other equipment parts. The standard connection between the bus bars is a standardised flat terminal in accordance with the rated current.

For connecting the bus bar with other equipment parts the following options are available:

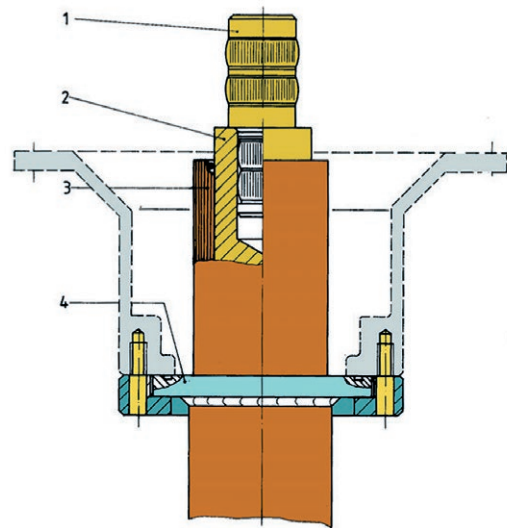
- Conductor end with flat terminal according to DIN 42 206.
- Conductor end with round bolt.
- According to customer's specification.
- If the insulated bus bar is to be connected gas-tight to an SF6-insulated switchgear, a metal flange is fitted at the earthed portion of the bus bar. Current connection can be done in an economical way by means of contact bolts or according to customer requirements.

Through the use of a fixed connection at both ends of the bus bar, a connecting sleeve should be attached to compensate for construction tolerances and thermal expansion of the bus bar during operation.

Earthing

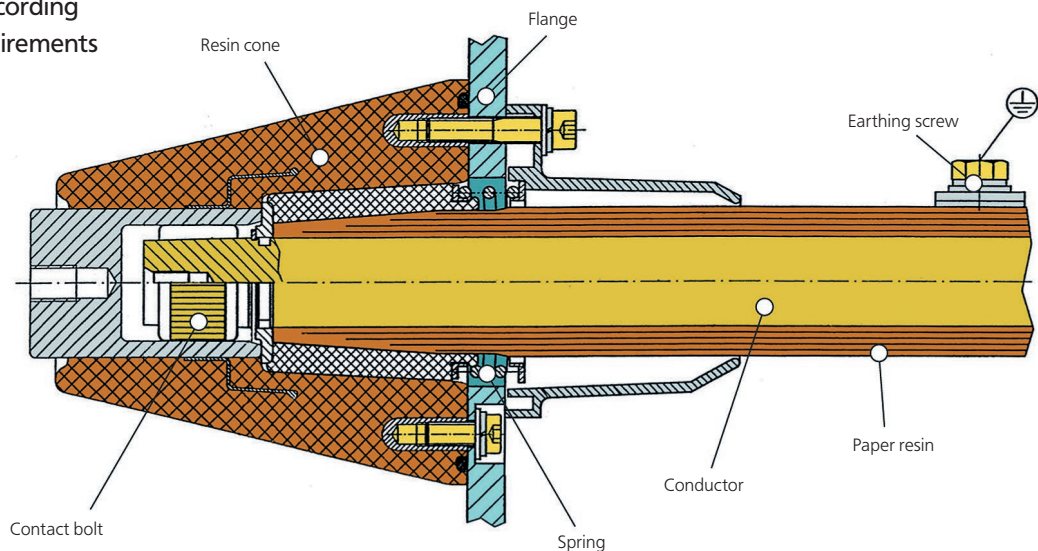
A separate earthing bus bar or earthing cable has generally to be installed parallel to the bus bar system. Every single bus bar, connecting sleeve and metallic fixation material has to be earthed on the earthing bus bar respectively earthing cable. Every single bus bar, connection sleeve and metallic fixation material has to be earthed on this earthing connection. If a bus bar or a connecting sleeve is not earthed correctly these elements will be destroyed after a certain amount of time.

Connection of bus bar to a GIS



1. Contact bolt
2. Conductor
3. Insulation
4. Metal flange

Special design according to customer requirements



Bus Bar Fixing

For installation of the bus bar system a flexible mounting system is used. Adjustments can easily be done at site. The bus bar fixing elements include aluminium C-profiles, angles, T-screws and fixing clamps. The fixing elements are adjustable with respect to each other and adjustable in all directions therefore allowing compensation for building tolerances. The fixing clamps include fixed bearings and slide bearings, allowing the bus bar to move axially within the fixing clamps in case of thermal expansion. In the first instance, the capability of the equipment to withstand a short-circuit, must be considered for the bus bar fixing. Another criterion is the natural frequency of the bus bar.

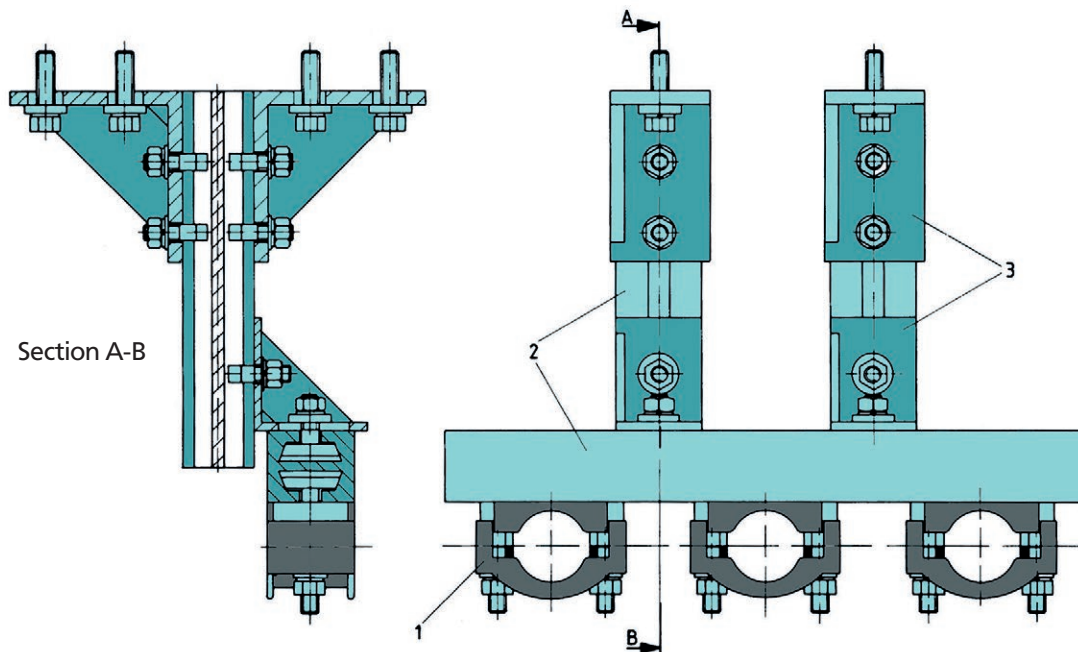
The distance between fixing points must be chosen to avoid resonance with respect to the power frequency of the system and its harmonics. The distance between the fixing points of the bus bar is individually calculated for each order.

A respective calculation tool is available, which includes:

- Bus bar diameter
- Phase distance
- Mass of the busbar
- Bending strength

Fixing Clamp

The fixing clamps are differentiated between slide bearing and fixed bearing clamps. The use of fixed or slide bearing clamps is determined by the fixing points given by the calculation tool. The construction of a slide bearing clamp is designed with a rubber washer and a metal washer is used for the fixed bearing clamp.



Bus Bar fixing

1. Plastic fixing clamps
2. Aluminium double-C-profile
3. Aluminium fixing angles



Dimensioning | Conductor Material

The bus bar conductors are dimensioned according to DIN 43670/671. The following criteria are taken into consideration:

- Thermal conductivity of the insulation
- Heat transmission between the insulation and ambient air (through convection and radiation)
- Natural cooling
- Skin effect

The bus bars are dimensioned for an ambient temperature of 40°C with a maximum temperature increase of 45°C in the conductor. Accordingly, the maximum temperature of the conductor is 85°C under natural cooling conditions. Deviations from the above dimensioning criteria shall be specified and can be considered when the design calculation is made. The conductor material can be copper (E-Cu) or aluminium (E-Al-MgSi 0,5).

Dimensions for conductor material E-Al-MgSi 0,5

$\frac{U_{(max)}}{I_N}$	12–24 kV	12 kV	17,5–24 kV	36 kV	
	ø Conductor (mm)	ø Bus Bar (mm)	ø Bus Bar (mm)	ø Conductor (mm)	ø Bus Bar (mm)
1250 A	40	65	70	40	80
1600 A	50	75	80	50	90
2000 A	60	85	90	70/15	110
2500 A	80/15	105	110	80/15	120
3150 A	100/15	125	130	100/15	140
4000 A	120/15	145	150	130/15	170
5000 A	150/15	175	180	160/15	200
6500 A	200/15	225	230		

Dimensions for conductor material E-Cu

$\frac{U_{(max)}}{I_N}$	12–24 kV	12 kV	17,5–24 kV	36 kV	
	ø Conductor (mm)	ø Bus Bar (mm)	ø Bus Bar (mm)	ø Conductor (mm)	ø Bus Bar (mm)
1250 A	33	57	62	33	72
1600 A	40	65	70	50	90
2000 A	50	75	80	60	100
2500 A	70/10	95	100	70/10	110
3150 A	90/10	115	120	90/10	130
4000 A	110/10	135	140	110/10	150
5000 A	140/10	165	170	140/10	180
6500 A	180/10	205	210	190/10	230

Other voltages and currents on request.

Quality

Before use in production, the material is subjected to the following tests:

a) Conductor material:

- Measurement of specific resistance

b) Insulating paper:

- Verification of purity
- Tearing strength test

c) Impregnating resin:

- Measurement of viscosity
- Measurement of viscosity increase (with temperature as parameter)
- Measurement of gelation time

The impregnating process is checked by the following measurements:

- Conditioning (degassing) of the resin compound
- Temperature in vacuum kiln
- Continuous evacuation controls
- Gelation temperature and time
- Post-curing temperature and time

In the development stages, general investigations were made and the following was determined:

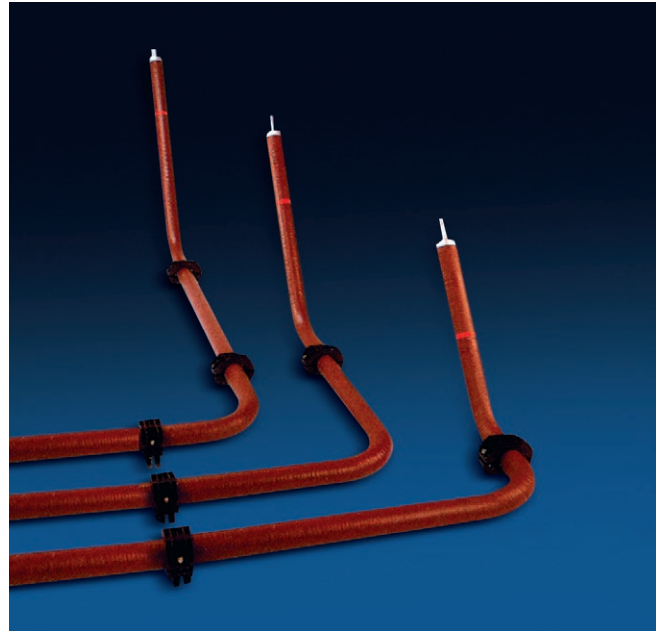
- Temperature of deflection under load (Martens method)
- Flexural strength
- Deflection
- Impact strength
- Module of elasticity
- Co-efficiency of thermal expansion
- Thermal conductivity

A differential thermal analysis (DTA) and life test was also performed.

Tests

Each bus bar and each connection sleeve is subjected to an electrical routine test, namely:

- Dry power frequency voltage withstand test
- Measurement of partial discharge quantity
- Measurement of capacitance and dielectric dissipation factor ($\tan \delta$)



The following type tests have been made:

- Dry power frequency voltage withstand test and measurement of partial discharge quantity
- Dry lightning impulse voltage withstand test
- Dry power frequency voltage withstand test and measurement of partial discharge quantity
- Temperature rise test
- Verification of thermal short-time withstand
- Dry power frequency voltage withstand test and measurement of partial discharge quantity
- Life time test

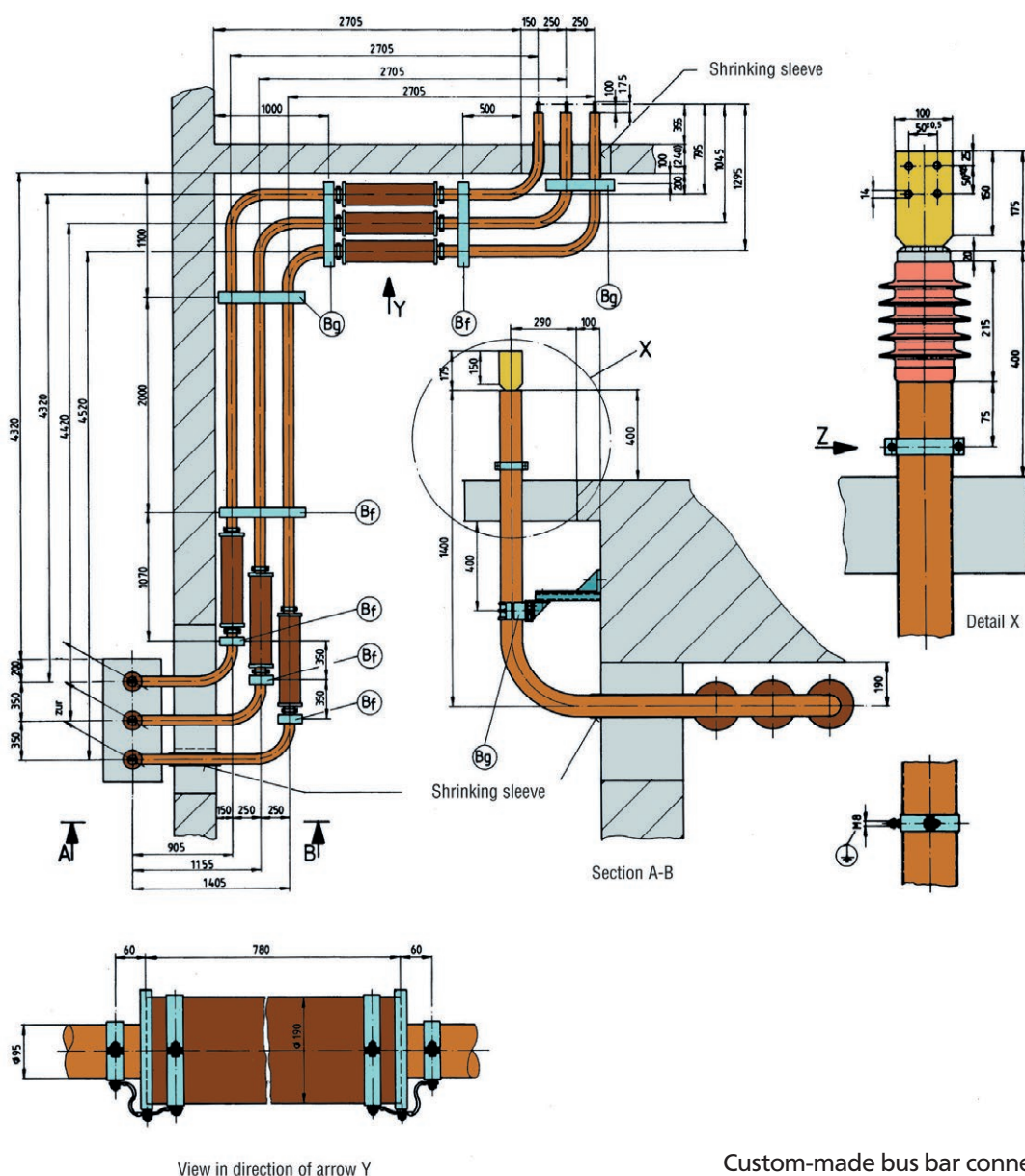


Ordering Information

Customers are kindly requested to supply the following information in their orders to enable quick processing in the factory:

- Rated voltage
- Rated current
- Short-circuit currents thermal I_{th} , dynamic I_{dyn}
- Frequency
- Max. ambient temperature
- Conductor material (aluminium, copper)

- Available earthing connection points/facilities
- Definition of bus bar terminal design
- Accurate building drawings including the information of the equipment positions (if available as CAD 2D, 3D files)
- Accurate drawings of the equipment that has to be connected – especially for the bus bar terminal connections (if available as CAD 2D, 3D files)
- Possible fixation installation method (wall, ceiling, floor, steel beam construction)



Custom-made bus bar connection

We look forward to our cooperation with you.

RITZ Product Overview

Medium Voltage Instrument Transformers

up to 72,5 kV

- Indoor and Outdoor
- Metal Clad Design
- Metalized Design
- Burst Proofed Metering Voltage Transformers for Railway Vehicle
- Sensor Types

Low Voltage Instrument Transformers

up to 1,2 kV

Current Transformers for Measuring and Protection Purposes

- Wound primary CT
- Summation CT
- CT for switch fuses
- Window type CT for high currents
- Split-core types for earth fault protection
- Auxiliary CT
- Window type CT
- Tube type CT
- Multi-range CT
- Split-core CT

Special Instrument Transformers for Measuring Purposes

- 3-phase CT
- Laboratory Current and Voltage Transformers
- Voltage Transformers

Instrument Transformers for Bill / Tariff Metering
Damping Inductance Devices against Ferroresonance

Cast Resin Power Transformers

up to 40,5 kV and 25 MVA

Applications

- Power Distribution
- Oil Platforms / Vessels
- Injection Systems
- Grounding Systems
- Traction Power Systems (Streetcar, Tram, Metro, Railway)
- Rectifier Drives
- Generator Excitation
- Transmitter Systems
- Laboratory Systems

Electronic Instrument Transformers and Sensors

Voltage-Sensoric

- Voltage up to 90 kV
- Accuracy of 0,2 %
- Frequency from 0 to 10 kHz

Current-Sensoric

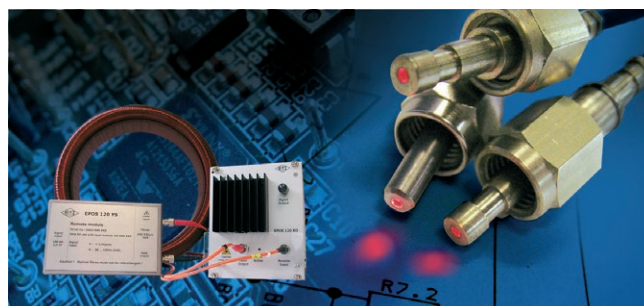
- Current up to 24000 A
- Accuracy of 0,01 %
- Frequency from 0 to 10 kHz

Applications

- Power Engineering
- Grid Analyse
- Traction Power Distribution Systems
- Protection Technology
- Elektro-chemistry
- Switchgear Systems
- Environment Engineering
- Automobile Industry
- Research

Customised Cast Resin Parts

- Development and formulation of cast resin moulding materials for electrical applications in low and medium voltage ranges and for electronics.
- Design and production of cast resin mouldings e.g. special bushings, fuse housings etc.



RITZ Instrument Transformers GmbH

Mühlberg 1 | 97514 Oberaurach-Kirchaich | GERMANY

Tel.: +49 95 49 89-0 | Fax: +49 95 49 89-11

E-Mail: info@ritz-international.com

www.ritz-international.com