Application Note

05/2024 AP009002EN

# Transformer

## Transformer STZ; STI; STN; DTZ; UTI
## Operation manual for transformers

| | |
|---|---|
| Level 1 | 1 – Fundamental – No previous experience necessary<br>2 – Basic – Basic knowledge recommended<br>3 – Advanced – Reasonable knowledge required<br>4 – Expert – Good experience recommended |

Powering Business Worldwide

**Service**

For service and support, please contact your local sales organisation.

Eaton.com/contacts
Eaton.com/aftersales

**Original operating instructions**

The German version of this document is the original operating instructions.

All non-German language editions of this document are translations of the original operating instructions.

1. Edition 2021, publication date 02/2021
2. Edition 2024, publication date 05/2024

# Contents

## Danger! - Dangerous electrical voltage!

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Cover or enclose any adjacent live components.
- Follow the engineering instructions (AWA/IL) for the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system.
- The system installer is responsible for implementing the earth connection.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specification, otherwise this may cause malfunction and/or dangerous operation.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been properly installed and with the housing closed.
- Wherever faults may cause injury or material damage, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction.
- Transformers may have hot surfaces during and immediately after operation.
- The applicable national safety regulations and accident prevention recommendations must be applied to all work carried on live transformers.
- The electrical installation must be carried out in accordance with the relevant electrical regulations (e. g. with regard to cable cross sections, fuses, PE).
- Transport, installation, commissioning and maintenance work must be carried out only by qualified per-sonnel (IEC 60364, HD 384 and national occupational safety regulations).
- Installations containing transformers must be provided with additional monitoring and protective devices in accordance with the applicable safety regulations.
- All covers and doors must be kept closed during operation.
- To reduce the hazards for people or equipment, the user must include in the machine design measures that restrict the consequences of a malfunction or failure.

# Disclaimer

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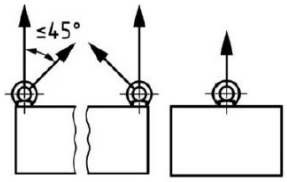
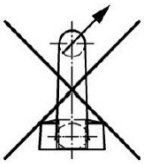
# 1 General

Improper lifting can lead to personal injury or property damage.

Lift the device with the right equipment (e. g. use of work gloves) and by qualified staff only.




Zum Heben alle Ringmuttern verwenden
Use all eye nuts for lifting



Bei Seitenzug nicht anwenden
Do not use under shear tension

# 2 Assembly

Strain relief: Cable leads or connection rails have to be fixed near terminal/bar.

Take care to the distances around the device!

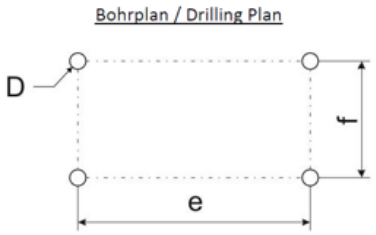
Consider correct air flow when wall mounting.

Transformers and Chokes with integrated cooling channels are intended for upright mounting only.

The user is responsible for installing the device in accordance with the safety regulations (e.g. EN, DIN, VDE) and all other relevant national or local regulations regarding lead and ground sizing, overload protection, etc.

A correct grounding, cable dimensioning and appropriate overload- and short circuit protection for safe opera-tion must be ensured.

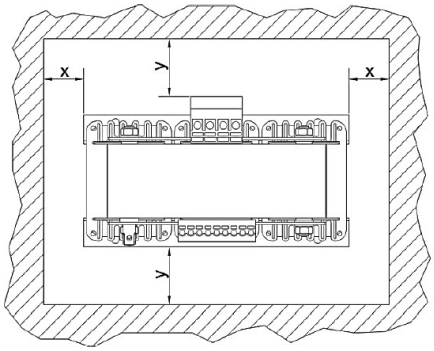
# 3 Mounting

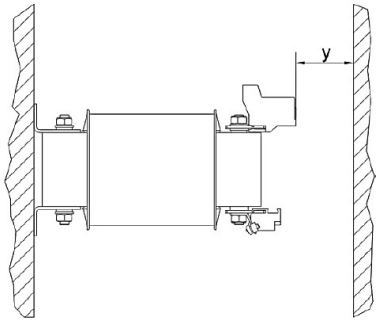




| D | Nm | D | Nm |
|---|---|---|---|
| M4 | 2,5 | M10 | 37 |
| M5 | 4,5 | M12 | 64 |
| M6 | 8 | M16 | 160 |
| M8 | 19 | M20 | 310 |

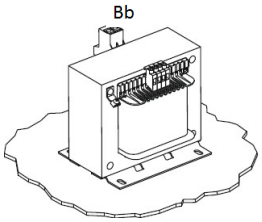
# 4 Mounting Position



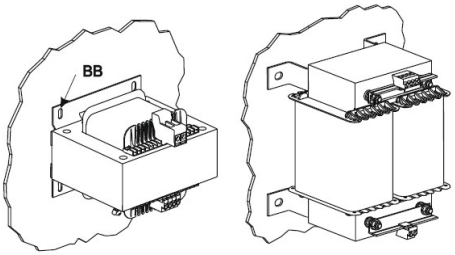



# 5 Single Phase Transformer

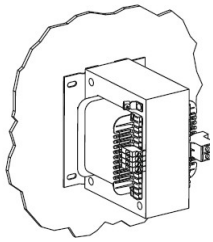
M1




M2



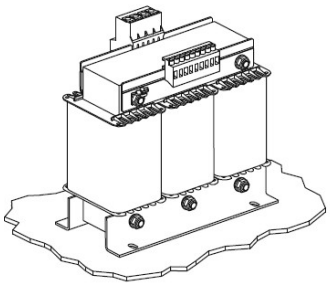

M3



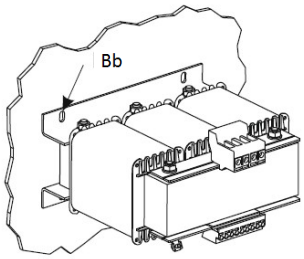
| STI<br>STZ | STN | UTI | M<br>[Montage] | Bb | D | e<br>[mm] | f<br>[mm] | X<br>[mm] | y<br>[mm] |
|---|---|---|---|---|---|---|---|---|---|
| | 0,06 | | 1, 2, 3 | 4,8 x 8 | M4 | 50 | 56 | 30 | 30 |
| 0,06 | 0,1 | | 1, 2, 3 | 4,8 x 8 | M4 | 64 | 47 | 30 | 30 |
| 0,1 | | 0,1 | 1, 2, 3 | 4,8 x 8 | M4 | 64 | 61 | 30 | 30 |
| 0,16 | 0,16 | | 1, 2, 3 | 4,8 x 8 | M4 | 64 | 70 | 30 | 30 |
| 0,2 | 0,2/0,25 | 0,2 | 1, 2, 3 | 5,8 x 12 | M5 | 80 | 63 | 30 | 30 |
| 0,25 | 0,315 | | 1, 2, 3 | 5,8 x 12 | M5 | 80 | 72 | 30 | 30 |
| 0,315 | 0,4 | 0,315 | 1, 2, 3 | 5,8 x 12 | M5 | 90 | 68 | 30 | 30 |
| 0,4 | 0,5 | | 1, 2, 3 | 5,8 x 12 | M5 | 90 | 80 | 30 | 30 |
| 0,5 | | 0,5 | 1, 2, 3 | 5,8 x 12 | M5 | 90 | 100 | 30 | 30 |
| 0,63 | 0,63 | 0,63 | 1, 2, 3 | 7 x 15 | M6 | 122 | 82 | 30 | 30 |
| 0,8 | 0,8 | 0,8 | 1, 2, 3 | 7 x 15 | M6 | 122 | 99 | 30 | 30 |
| 1 | 1 | 1 | 1, 2, 3 | 7 x 15 | M6 | 122 | 125 | 30 | 30 |
| 1,3 | 1,3/1,6 | | 1, 2, 3 | 7 x 15 | M6 | 135 | 110 | 30 | 30 |
| | 2 | | 1, 2, 3 | 7 x 15 | M6 | 135 | 140 | 30 | 30 |
| 1,6 | | | 1, 2, 3 | 10 x 18 | M8 | 150 | 110 | 30 | 30 |
| 2,0/2,5 | | | 1, 2, 3 | 10 x 18 | M8 | 150 | 122 | 30 | 30 |
| | 2,5 | | 2 | ø11 | M10 | 190 | 200 | 30 | 30 |
| 3 | 3 | | 2 | ø11 | M10 | 190 | 200 | 30 | 30 |
| | 4 | | 2 | ø11 | M10 | 190 | 200 | 30 | 30 |
| 4 | | | 2 | ø11 | M10 | 190 | 200 | 30 | 30 |
| 5,3 | | | 1 | 10 x 18 | M8 | 230 | 126 | 30 | 30 |
| 8,3 | | | 1 | 10 x 18 | M8 | 230 | 156 | 30 | 30 |
| 13,3 | | | 1 | 13 x 20 | M12 | 270 | 172 | 40 | 40 |

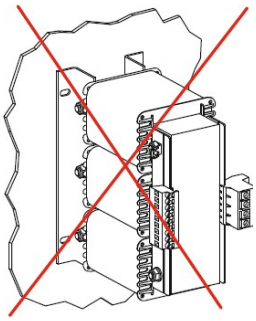
# 6 Three Phase Transformer

M1



M2



| DTZ | M [Montage] | Bb | D | e [mm] | f [mm] | X [mm] | y [mm] |
|---|---|---|---|---|---|---|---|
| 0,1 | 1, 2 | 5 x 8 | M4 | 100 | 45 | 30 | 30 |
| 0,16 | 1, 2 | 5 x 8 | M4 | 100 | 55 | 30 | 30 |
| 0,25 | 1, 2 | 8 x 12 | M4 | 130 | 57 | 30 | 30 |
| 0,4 | 1, 2 | 8 x 12 | M6 | 130 | 72 | 30 | 30 |
| 0,5 | 1, 2 | 8 x 12 | M6 | 170 | 58 | 30 | 30 |
| 0,63 | 1, 2 | 8 x 12 | M6 | 170 | 78 | 30 | 30 |
| 1 | 1, 2 | 8 x 12 | M6 | 175 | 97 | 30 | 30 |
| 1,6 | 1, 2 | 7 x 13 | M6 | 176 | 95 | 30 | 30 |
| 2 | 1, 2 | 10 x 18 | M8 | 185 | 95 | 30 | 30 |
| 2,5 | 1, 2 | 10 x 18 | M8 | 200 | 102 | 30 | 30 |
| 4 | 1, 2 | 10 x 18 | M8 | 224 | 119 | 30 | 30 |
| 6,3 | 1, 2 | 10 x 18 | M8 | 224 | 145 | 30 | 30 |
| 8 | 1 | 10 x 18 | M8 | 350 | 126 | 30 | 30 |
| 10 | 1 | 10 x 18 | M8 | 350 | 141 | 30 | 30 |
| 12,5 | 1 | 10 x 18 | M8 | 350 | 156 | 30 | 30 |
| 16 | 1 | 13 x 20 | M12 | 400 | 143 | 40 | 40 |
| 20 | 1 | 13 x 20 | M12 | 400 | 173 | 40 | 40 |
| 25 | 1 | 13 x 20 | M12 | 400 | 202 | 40 | 40 |

# 7 Operation of Transformers

Before connecting the device check the technical data on the attached label. In case of parallel operation of the transformer particularly short circuit voltage and connection group.

Further the grounding condition and the connections of the device are to be examined for their correctness before operation.

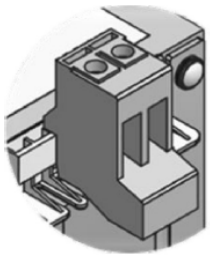
Possibly existing primary tappings are to be adjusted to the existing mains voltage.

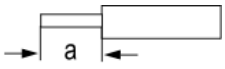
Note: In case of delta wiring the connection of the triangle has to be changed as well.

Note: Both, the coil and the iron core get hot during operation. Surface temperatures up to 140°C are possible and permissible.

# 8 Connection

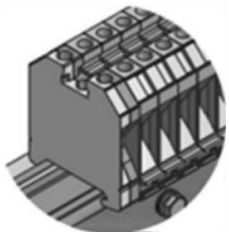
| | |
|---|---|
| 1 | Screw |
| 2 | Spring (lock) washer |
| 3 | Flat washer |
| 4 | Cable lug or rail |
| 5 | Nut |
| 6 | Protective conductor |
| 7 | Bus bar |

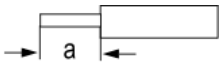





| Cable Cross section [mm²] | | | | a | Torque [Nm] | Standard tool |
|---|---|---|---|---|---|---|
| Nominal | Solid | Stranded (*1) | Stranded (*2) | mm | | |
| 4 | 6 | 6 | 4 | 9 | 0.5-1.0 | 0.8x4.0 |
| 10 | 16 | 16 | 10 | 14 | 1.2-2.0 | 0.8x4.0 |

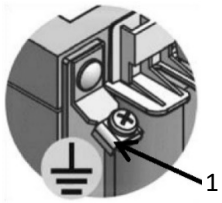
(*1) ... Stranded without wire end ferrule
(*2) ... Stranded with wire end ferrule

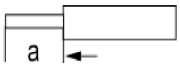




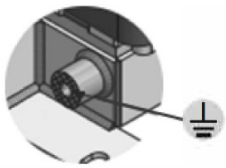

| Cable Cross section [mm²] | | | | a | Torque [Nm] | Standard tool |
|---|---|---|---|---|---|---|
| Nominal | Solid | Stranded (*1) | Stranded (*2) | mm | | |
| 4 | 6 | 6 | 4 | 10 | 0,5-1,0 | 0,6x3,5 |
| 10 | 16 | 16 | 16 | 12 | 1,2-1,9 | 1,0x5,5 |
| 16 | 16 | 25 | 16 | 16 | 3,0-4,0 | 1,0x5,5 |
| 35 | 35 | 50 | 35 | 18 | 4,0-5,0 | 1,2x6,5 |
| 50 | 16 | 70 | 50 | 24 | 3,5-6,0 | S4 |
| 120 | 16 | 150 | 95 | 27 | 12-20 | S6 |
| 240 | | 240 | 185 | 40 | 25-30 | S8 |

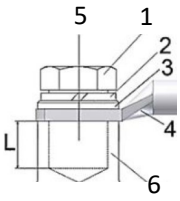
(*1) ... Stranded without wire end ferrule
(*2) ... Stranded with wire end ferrule



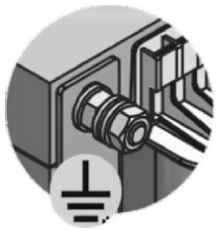



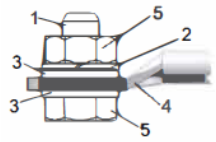

| 1 | a [mm] | Torque [Nm] | Standard tool |
|---|---|---|---|
| M4 | 11 | 1.0 | PH2 |



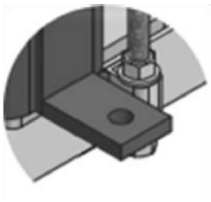


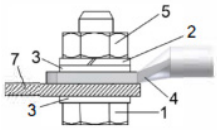

| 1 – 6 | L [mm] | Torque [Nm] |
|---|---|---|
| M12 | 18 | 64 |

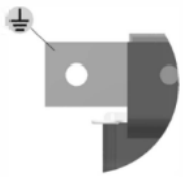





| 1 - 7 | Torque [Nm] |
|---|---|
| M8 | 19 |
| M10 | 37 |
| M12 | 64 |



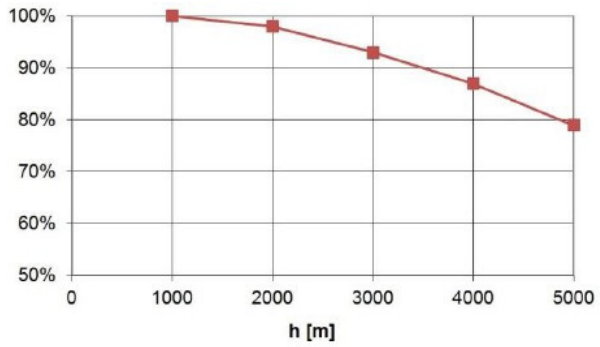


**Attention!**
When tightening the screws, counter-holding is necessary!

# 9 Derating

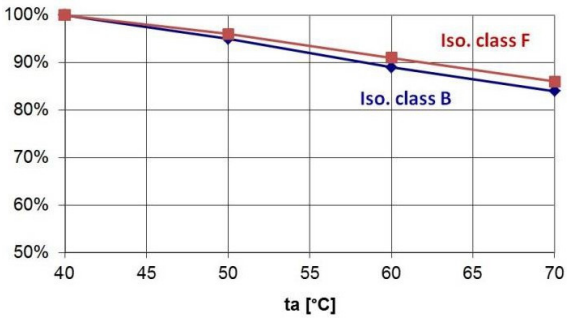
## 9.1 Installation Altitude




| Alt | $S_N$ |
|---|---|
| [m] | [%] |
| ≤1000 | 100% |
| 2000 | 98% |
| 3000 | 93% |
| 4000 | 87% |
| 5000 | 79% |

The installation height and the power reduction are directly related and are described here.

## 9.2 Ambient Temperature




| ta | $S_{N(B)}$ | $S_{N(F)}$ |
|---|---|---|
| [°C] | [%] | [%] |
| 40 | 100% | 100% |
| 50 | 95% | 96% |
| 60 | 89% | 91% |
| 70 | 84% | 86% |

Valid for Single Phase Transformers $S_N$ > 2kVA and Three Phase Transformers $S_N$ ≤ 2,5kVA.

# 10 Maintenance

**Safety Regulations**

for work with electrical equipment.

1. Disconnect mains!
2. Prevent reconnections!
3. Test for absence of harmful voltages!
4. Ground and short circuit!
5. Cover or close of nearby live parts!

Subsequently, the following work can be performed:

- Clean the Transformer with dry, grease-free compressed air (depending upon existing danger of pol- lution in regular intervals)
- Examine grounding of the devices
- Examine bolt connections (terminals or bus bars) To energize, apply in reverse order!

# 11 Engineering

## 11.1 Size selection for control transformers

### Determination of the continuous rating

The control transformer must be rated in size so that the voltage drop remains within the permissi-ble tolerance range even under unfavorable conditions. The determination of the transformer rating id performed by the addition of all the sealing powers of all loads which are to be connected simulta-neously as well as addition of the inrush power of the largest load and multiplying the result by a factor of 0.8. In the ratings of the loads are very similar, the sum of all inrush power of the simulta-neously connected loads is added to the sum of all the sealing powers and the result is multiplied by a factor of 0.8.

### Determination of the short time rating

In the primary requirement is to switch large contactors, it is recommended that the control trans-former is selected on the basis of the short time rating. In the most cases, this will mean that the transformer rating is reduced. It is important to ensure that the sealing power does not exceed the continuous rating.

## 11.2 Protection of control transformers

### Operational conditions

The protective device shown in the table below must be connected upstream of the primary. The overload release of the circuit-breaker must be set to the started current. The current to be set must also be started on the rating plate of the transformer. If a short circuit release is present it must be set to the maximum value. The setting value of the circuit –breaker apply up to 1.06 times the rated voltage. For a higher mains voltage the +5% terminal is to be used. In the case of transformers > 2.0kVA (DT..>4.0kVA) the circuit-breaker may trip under certain mains supply conditions (Lk >6kA) and with unfavorable starting torque. In such cases we recommend the use of an inrush current limiter. The inrush current limiter can be ordered as an accessory.

**Setting range of the motor-protective circuit-breaker as a function of the STI, STZ and DTZ transformer rated power (VA)**

| Part no. | Primary voltage | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 200 V | | 230 V | | 400 V | | 415 V | | 440 V | | 500 V | | 690 V | |
| | Protective device | Setting A | Protective device | Setting A | Protective device | Setting A | Protective device | Setting A | Protective device | Setting A | Protective device | Setting A | Protective device | Setting A |
| ST…0,06 | - | | PKZM0-0,4 | 0.3 | PKZM0-0,25 | 0.2 | PKZM0-0,25 | 0.2 | PKZM0-0,25 | 0.2 | PKZM0-0,16 | 0.2 | PKZM0-0,16 | 0.1 |
| ST…0,1 | - | | PKZM0-0,63 | 0.5 | PKZM0-0,4 | 0.3 | PKZM0-0,4 | 0.3 | PKZM0-0,4 | 0.3 | PKZM0-0,25 | 0.2 | PKZM0-0,25 | 0.2 |
| ST…0,16 | - | | PKZM0-1 | 0.8 | PKZM0-0,63 | 0.5 | PKZM0-0,63 | 0.5 | PKZM0-0,63 | 0.4 | PKZM0-0,4 | 0.4 | PKZM0-0,4 | 0.3 |
| ST…0,2 | - | | PKZM0-1,6 | 1.0 | PKZM0-0,63 | 0.6 | PKZM0-0,63 | 0.6 | PKZM0-0,63 | 0.5 | PKZM0-0,63 | 0.5 | PKZM0-0,4 | 0.3 |
| ST…0,25 | - | | PKZM0-1,6 | 1.3 | PKZM0-1 | 0.7 | PKZM0-1 | 0.7 | PKZM0-1 | 0.7 | PKZM0-0,63 | 0.6 | PKZM0-0,63 | 0.4 |
| ST…0,315 | - | | PKZM0-1,6 | 1.5 | PKZM0-1 | 0.9 | PKZM0-1 | 0.9 | PKZM0-1 | 0.8 | PKZM0-1 | 0.7 | PKZM0-0,63 | 0.5 |
| ST…0,4 | - | | PKZM0-2,5 | 2.0 | PKZM0-1,6 | 1.1 | PKZM0-1,6 | 1.1 | PKZM0-1,6 | 1.0 | PKZM0-1 | 0.9 | PKZM0-1 | 0.7 |
| ST…0,5 | - | | PKZM0-2,5 | 2.4 | PKZM0-1,6 | 1.4 | PKZM0-1,6 | 1.3 | PKZM0-1,6 | 1.2 | PKZM0-1,6 | 1.1 | PKZM0-1 | 0.8 |
| ST…0,63 | - | | PKZM0-4 | 3.0 | PKZM0-2,5 | 1.7 | PKZM0-2,5 | 1.7 | PKZM0-1,6 | 1.6 | PKZM0-1,6 | 1.4 | PKZM0-1,6 | 1.0 |
| ST…0,8 | - | | PKZM0-4 | 3.8 | PKZM0-2,5 | 2.2 | PKZM0-2,5 | 2.1 | PKZM0-2,5 | 2.0 | PKZM0-2,5 | 1.7 | PKZM0-1,6 | 1.3 |
| ST…1,0 | - | | PKZM0-6,3 | 4.7 | PKZM0-4 | 2.7 | PKZM0-4 | 2.6 | PKZM0-4 | 2.5 | PKZM0-2,5 | 2.2 | PKZM0-1,6 | 1.6 |
| ST…1,3 | - | | PKZM0-10 | 6.3 | PKZM0-4 | 3.5 | PKZM0-4 | 3.4 | PKZM0-4 | 3.2 | PKZM0-4 | 2.8 | PKZM0-2,5 | 2.0 |
| ST…1,6 | - | | PKZM0-10 | 7.4 | PKZM0-6,3 | 4.2 | PKZM0-6,3 | 4.1 | PKZM0-4 | 4.0 | PKZM0-4 | 3.4 | PKZM0-2,5 | 2.5 |
| ST…2,0 | - | | PKZM0-16 | 10.0 | PKZM0-6,3 | 5.3 | PKZM0-6,3 | 5.1 | PKZM0-6,3 | 4.8 | PKZM0-6,3 | 4.2 | PKZM0-4 | 3.1 |
| DT…0,1 | PKZM0-0,4 | 0.4 | PKZM0-0,4 | 0.3 | PKZM0-0,25 | 0.2 | PKZM0-0,25 | 0.2 | PKZM0-0,25 | 0.2 | PKZM0-0,16 | 0.1 | PKZM0-0,16 | 0.1 |
| DT…0,16 | PKZM0-0,63 | 0.5 | PKZM0-0,63 | 0.5 | PKZM0-0,4 | 0.3 | PKZM0-0,4 | 0.3 | PKZM0-0,4 | 0.3 | PKZM0-0,25 | 0.2 | PKZM0-0,25 | 0.2 |
| DT…0,25 | PKZM0-1 | 0.8 | PKZM0-1 | 0.7 | PKZM0-0,63 | 0.4 | PKZM0-0,63 | 0.4 | PKZM0-0,4 | 0.4 | PKZM0-0,4 | 0.3 | PKZM0-0,4 | 0.3 |
| DT…0,4 | PKZM0-1,6 | 1.3 | PKZM0-1,6 | 1.1 | PKZM0-1 | 0.7 | PKZM0-1 | 0.6 | PKZM0-0,63 | 0.6 | PKZM0-0,63 | 0.5 | PKZM0-0,63 | 0.4 |
| DT…0,5 | PKZM0-2,5 | 1.6 | PKZM0-1,6 | 1.4 | PKZM0-1 | 0.8 | PKZM0-1 | 0.8 | PKZM0-1 | 0.7 | PKZM0-1 | 0.6 | PKZM0-0,63 | 0.5 |
| DT…0,63 | PKZM0-2,5 | 2.0 | PKZM0-2,5 | 1.8 | PKZM0-1,6 | 1.0 | PKZM0-1,6 | 1.0 | PKZM0-1 | 0.9 | PKZM0-1 | 0.8 | PKZM0-0,63 | 0.6 |
| DT…1,0 | PKZM0-4 | 3.1 | PKZM0-4 | 2.7 | PKZM0-2,5 | 1.6 | PKZM0-1,6 | 1.5 | PKZM0-1,6 | 1.4 | PKZM0-1,6 | 1.3 | PKZM0-1 | 0.9 |
| DT…1,6 | PKZM0-6,3 | 5.0 | PKZM0-6,3 | 4.3 | PKZM0-4 | 2.5 | PKZM0-2,5 | 2.4 | PKZM0-2,5 | 2.3 | PKZM0-2,5 | 2.0 | PKZM0-1,6 | 1.4 |
| DT…2,0 | PKZM0-6,3 | 6.2 | PKZM0-6,3 | 5.4 | PKZM0-4 | 3.1 | PKZM0-4 | 3.0 | PKZM0-4 | 2.8 | PKZM0-2,5 | 2.5 | PKZM0-2,5 | 1.8 |
| DT…2,5 | PKZM0-10 | 7.6 | PKZM0-10 | 6.7 | PKZM0-4 | 3.8 | PKZM0-4 | 3.7 | PKZM0-4 | 3.5 | PKZM0-4 | 3.1 | PKZM0-2,5 | 2.2 |
| DT…4,0 | PKZM0-16 | 12.0 | PKZM0-16 | 10.4 | PKZM0-6,3 | 6.0 | PKZM0-6,3 | 5.8 | PKZM0-6,3 | 5.5 | PKZM0-6,3 | 4.8 | PKZM0-4 | 3.5 |
| DT…6,3 | - | | - | | - | | - | | - | | - | | PKZM0-6,3 | 5.5 |

For all other transformers use transformer-protective circuit-breakers PKZM0-..-T.

Eaton is an intelligent power management company dedicated to protecting the environment and improving the quality of life for people everywhere. We make products for the data center, utility, industrial, commercial, machine building, residential, aerospace and mobility markets. We are guided by our commitment to do business right, to operate sustainably and to help our customers manage power — today and well into the future. By capitalizing on the global growth trends of electrification and digitalization, we're accelerating the planet's transition to renewable energy sources, helping to solve the world's most urgent power management challenges, and building a more sustainable society for people today and generations to come.

Eaton was founded in 1911 and has been listed on the New York Stock Exchange for more than a century. We reported revenues of $23.2 billion in 2023 and serve customers in more than 160 countries. For more information, visit www.eaton.com. Follow us on LinkedIn.

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