

COMPLETE RANGE

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The technical data given herein represent reference points for numerous applications areas. Special and exceptional rules also apply. The following is intended as a brief introduction to the complex topic.

CE mark

EC directives have been passed by the Council of the European Union supported by the founding agreement of the European Economic Community (EEC), particularly Article 100. These EC directives serve towards harmonisation of the legal and administrative regulations in the various European Union (EU) Member States whenever differences in national regulations result in trade barriers or otherwise inhibit the functions of the European Union's internal market. The directives are to be transposed into the respective national laws by the national legislative authorities within the specified time periods. The manufacturer must affix the CE mark to products falling under the scope of specific EU directives as a symbol of conformity. This affects products included in the directives according to the 'new conception' (passed on 07.05.1985) which state the requirements on the technical condition of products.

CE mark:  Communautés Européennes

EU directives are legally binding regulations of the European Union. Meeting of these requirements is a precondition for marketing of the products in Europe. This does not apply to the rest of the world trade market. Affixing of the CE mark confirms the compliance of the products with the corresponding basic requirements of all directives applicable to the product. The CE mark is solely directed to the monitoring authorities as verification of the conformity to the directives. However, it is often misinterpreted as a 'quality symbol'. Hence it is often frequently requested, yet with no legal basis.

Although the EC declaration of conformity of the manufacturer must only be kept available for the monitoring authorities (at least 10 years after the last time it was placed on the market), customers may request the corresponding copies from us.

The directives to be applied are derived from the EC declaration of conformity for the respective product.

The directives which are most frequently applicable for the product range of our company are:

1. **Low Voltage Directive (2006/95/EC)** of the European Parliament and the Council from 12 December 2006 for harmonisation of the legislation of the Member States regarding electrical equipment for application within certain voltage limits. Nearly all products in our production range fall under the scope of this Low Voltage Directive.
2. **EMC Directive (2004/108/EC)** of the European Parliament and the Council from 15 December 2004 for harmonisation of the legislation of the Member States regarding electromagnetic compatibility and for elimination of the Directive 89/336/EEC. Nearly all products in product groups C and D of our production range fall under the scope of this EMC Directive.

Protection classes

The protection class is a design characteristic of a device indicating the safety with regard to dangerous currents passing through the body through direct contact.

The transformers with open frame constructions intended for installation in electrical enclosures or devices do not possess a protection class, but rather can only be prepared for one.

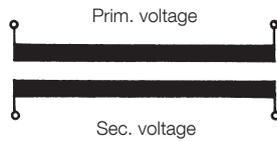
Protection class I: Device with protective earth connection and basic insulation

Protection class II: Device without protective earth connection but with double or reinforced insulation

Protection class III: Device without protective earth connection, where the protection against dangerous currents flowing through the body through direct contact is based on the supply with safety extra-low voltage (SELV) and no higher voltage than the SELV can be generated.

Transformers with separate windings

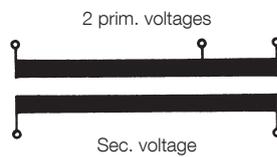
In these transformers there is no conducting connection between the individual windings. They are galvanically separated.



Taps

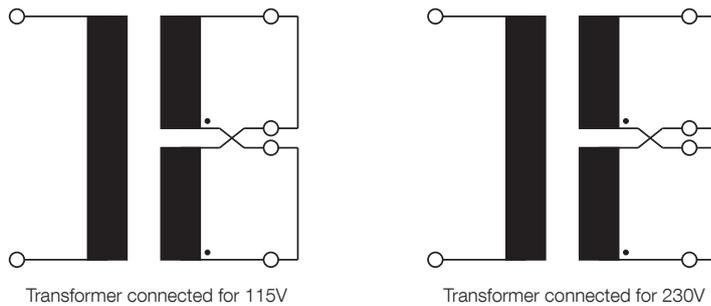
Transformers may be designed with primary as well as secondary taps.

Taps on the primary side serve towards adaption and use of the transformer with various grid voltages. The increased winding space requirement frequently makes it necessary to go to the next higher transformer type here. For grid adaptations of approx. 5% this enlargement is not required.



The need for further winding space also does not arise if a second primary voltage halved results in the first (e.g. 115V – 230V).

If two equal winding parts are connected in series or parallel the transformer can be used for both secondary voltages while retaining full output. Observe stated polarity!



In case of several secondary voltages the rated secondary current intensity is calculated based upon the highest secondary voltage. Therefore taps can only be loaded with the current intensity calculated from the power and the highest secondary voltage.

If full power is required for each of various secondary voltages, power or current intensity must be stated individually. It necessitates additional space and possibly the next larger transformer type.

Transformers with autotransformer windings

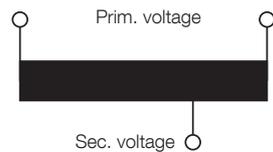
In an autotransformer winding there is a conducting connection between the primary and secondary windings. The output power is transmitted partly inductively and partly by current conduction. In part considerable size reductions compared with transformers with separate windings result. The smaller the difference between input and output voltage, the smaller the transformer.

Example:

Transformer	Nominal power	1000VA
	Undervoltage	230V
	Upper voltage	400V

$$\text{Type power } N = \text{rated power} \times \left(1 - \frac{\text{Undervoltage}}{\text{Upper voltage}}\right)$$

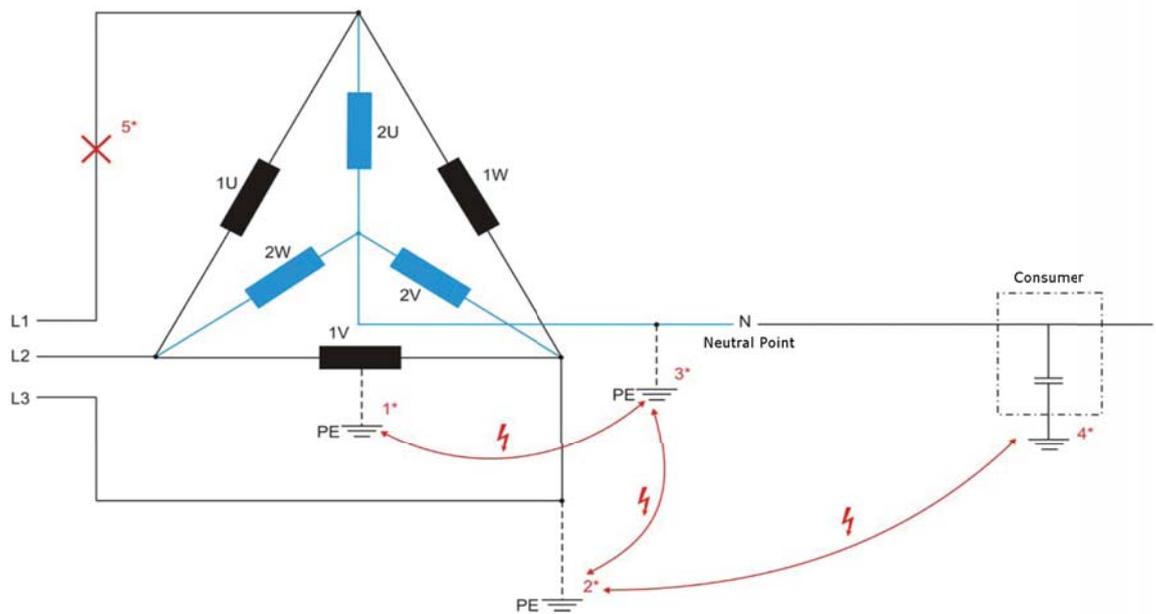
$$\text{Type power } N = 1000 \left(1 - \frac{230}{400}\right) = 1000 \times 0.425 = 425\text{VA}$$



Rather than a transformer sized for 1000VA, a transformer of size 425VA is needed.

Earthing of autotransformers in delta grids:

1U / 1V / 1W is a given delta grid (power generating plant, local company grid etc.)
 2U / 2V / 2W is the autotransformer / star point to be connected.



- 1*) Typical North American grid with earthed centre tap of a winding (e.g. 480V yields the typical 2x240V with 180° phase offset).
 Many household appliances such as washing machines, air conditioners etc. with high current draws have this network connection!
- 2*) Most common network type in Asia (Japan, Korea, Taiwan, Philippines)! 3-wire lines where the green conductor is simultaneously PE and phase L3!
 Should not be confused with the single-phase 3-wire line (L/N/PE)!
- 3*) European regulations often require an earthed neutral conductor N. If one considers the star point of the autotransformer in the delta grid there is a direct (and devastating) short circuit either through the PE conductor via L3 to N on the winding '2V' or via '2V' and the earthed '1V'.
- 4*) Consumers earthed on the secondary side, e.g. line filters, Y capacitors in primary switching controllers and intermediate circuits in frequency converters, also cause 3*) !!!
- 5*) If one phase fails on the primary side the star point can adopt a higher potential in an uncontrolled manner and will destroy the transformer or the connected consumers!

Operating modes

All of the standard transformers we manufacture are designed for **S1** continuous operation. S1 operation occurs when a transformer operates for any given time > 10min under the thermally permissible nominal current and the other nominal values. This corresponds to 100% duty cycle.

Short-time load (standard S3 with specification of duty cycle in %) – the duty cycle is calculated as follows:

$$ED = \frac{\text{Load duration in min.}}{\text{Cycle duration in min.}} \times 100 (\%)$$

Cycle duration = idle time + load duration (load duration must not exceed 10 min.)

The type power for short-time loading is calculated as follows:

$$NT = N \times \sqrt{\frac{ED (\%)}{100}} \quad \begin{array}{l} NT = \text{type power} \\ N = \text{Nominal power} \end{array}$$

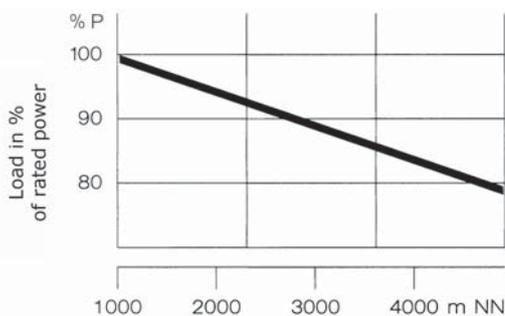
The additional operating modes **S2** (single load with long idle time), **S4, S5** (intermittent operation), **S6** (continuous operation with intermittent load), **S7** (uninterrupted operation with varying rated current at start and/or end of cycle) and **S8** (like S7, but with any number of variations in nominal current of specified duration and magnitude during one cycle) also exist. We can manufacture products for these operating modes upon request.

Power

All stated power data refers to collected secondary power in VA or kVA at continuous operation, excitation with nominal voltage, nominal frequency, cos phi = 1, an ambient temperature of max. 40°C and an installation altitude up to 1000 m above sea level (ASL).

Power is calculated from the product of nominal secondary voltage (volts) and nominal secondary current (amperes) in VA or kVA.

Power reduction dependent on installation altitude



Short-time rating (short-time load) of a transformer

In control circuits with mainly power demands by contactor coils and relay coils the control transformer is designed according to the possible short-time rating (initial power of coil) at cos w = 0.5 and a voltage drop of maximum 5%.

Heating

Unimpeded access of cooling air must be ensured. At ambient temperatures above 40°C rated power must be reduced according to the following chart:

°C	45	50	55	60
N (%)	95	85	80	75

Temperature rise

In general the transformers can be operated at higher power for a short time, but only if the maximum allowable average temperature rise is not exceeded and the prior continuous load was less than 100%.

Overload table:

Prior continuous load in % of rated power	Allowable duration of overload in % of rated power				
	150%	140%	130%	120%	110%
50	30min.	45min.	65min.	105min.	180min.
60	25min.	40min.	60min.	95min.	170min.
70	20min.	30min.	45min.	80min.	155min.
80	15min.	25min.	40min.	75min.	140min.
90	8min.	15min.	30min.	60min.	120min.

Temperatures

Under the nominal conditions a transformer has losses which are converted to heat. This 'self-heating' or 'overtemperature' is coupled to limit values according to the standards based on the insulation class of the insulating material and the ambient temperature. These values relate to the winding and hence the components in direct contact with it. The overtemperatures given in the following table are yielded from the average temperature rise for an ambient temperature of 40°C.

According to the standards, depending on the insulation class the 'hot spot' can lie between 5K (class A) and 15K (class H) above the table values given below. We can manufacture products with all listed insulation classes upon request.

Insulation class	Final temperature
A	105°C
E	115°C
B	120°C
F	140°C
H	175°C

We recommend that insulation class H **not** be used due to its poor efficiency.

Limits for low-voltage grids according to DIN IEC 38

In DIN IEC 38 ('IEC standard voltages') the standard voltage is specified to be single-phase 230VAC / 3-phase 400VAC. The grid tolerance is ±10%. This is taken into account in the design of all Riedel products.

Limits for nominal DC voltage according to DIN EN 61131-2

Irrespective of the load and the fluctuation in grid voltages according to DIN IEC 38 when RIEDEL power supplies are used the electronic control is supplied with a reliable operating voltage. Through the close magnetic coupling and the generous sizing RIEDEL power supplies exhibit voltage stability and comply with the limits for DC voltages given in DIN EN 61131-2.

Excerpt from the standard:

Rated value (Ve) 24VDC: 15%/+20% tolerance (min-max)
 Rated value (Ve) 48VDC: -15%/+20% tolerance (min-max)

Note:

Apart from the voltage tolerances for a screen/stabilised DC voltage, an overall AC voltage component with a peak value of 5% of the rated voltage is permissible. The absolute limits are 30/19.2V DC voltage for 24VDC and 60/38.4V DC voltage for 48VDC.