



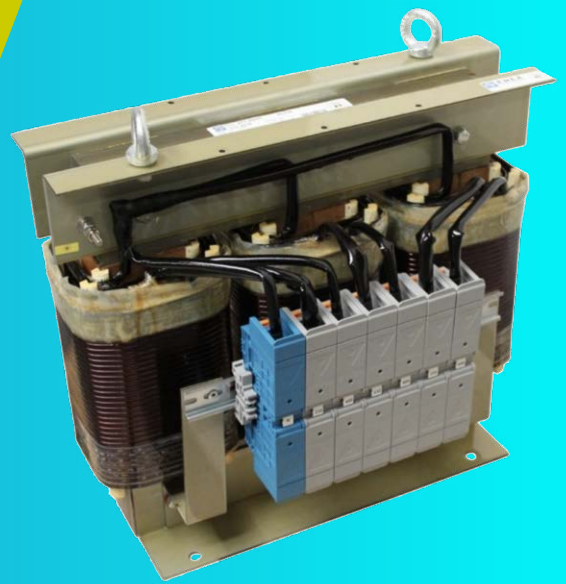
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# White paper

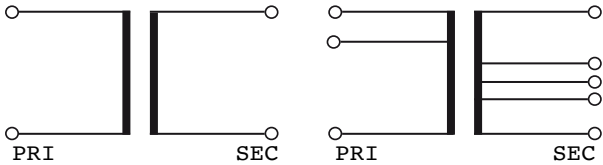
Isolating or  
autotransformer:  
which do I need?



## Isolating or autotransformer: which do I need?

In an **isolating transformer**, the primary and secondary windings are fully electrically separated by means of a basic isolation.

See circuit diagram:

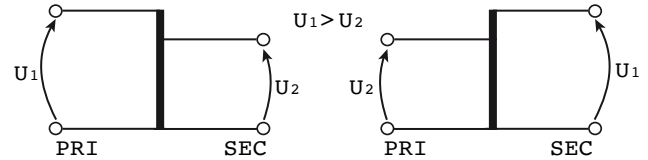


Electrical symbol:



In an **autotransformer**, by contrast, the primary and secondary windings are partly common.

See circuit diagram:



Electrical symbol:



The standard application for **both types** is the conversion or transformation of voltage, for example from 230V to 400V or from 230V to 24V.

In an isolating transformer the primary and secondary windings are **fully electrically separated**. The insulation between these windings - the basic isolation - must ensure a level of protection against electric shock. In this way the risks on the secondary side are limited in the event of inadvertent simultaneous contact with earth and one of the live parts.

This complete electrical separation gives the isolating transformer the additional advantage over the autotransformer that it allows the use of an earthing system, also referred to as a **neutral conductor system**.

The **neutral conductor system may be deviated** away from several times, to take account of operating reliability and personal safety.

By **not earthing** the secondary side of the safety isolating transformer one can obtain an **IT network**, which certainly offers the highest level of guarantee where operating continuity is concerned. Typical examples include complex production processes, rooms used for medical purposes and areas with an elevated risk of explosion. It must, of course, be ensured that personal safety is not jeopardised.

Conversely, the **neutral terminal** on the secondary side can be earthed. This is important for applications where a **clean earth** is required, for example with charging stations or HVAC installations.

In an autotransformer the secondary is realised by means of a **branch** directly off the primary winding. The primary and secondary sides of an autotransformer are therefore **not electrically separated**.

The primary winding creates a magnetic flux in the iron core. This entails that a **branch**, located somewhere on the primary winding, will take on a voltage related to the position of that branch on the primary winding.

## In summary



### Isolating transformer

#### Advantages:

- Both step-up and step-down transformation of voltages.
- Safer, due to the complete electrical separation.
- Neutral conductor system can be adjusted.
- Able to handle a greater imbalance in load (in the case of three-phase transformers (max. 10 - 15% imbalance).

#### Disadvantages:

- More copper is required in the construction, so it will be:
  - larger and more expensive.

#### Some applications:

- Modification of voltage:
  - Step-down transformation: connect a 230V electric motor to a 400V network.
  - Three-phase 400V heat pump with an additional asymmetric heating element on a three-phase 230V network.
- Network can be modified to IT, TT or TN.
- Operating continuity of production processes (IT network).
- Create a stable neutral conductor for charging stations or HVAC applications (TT network).
- Delta-Star circuit conversion: 3x230V Delta to 3x400V Star+N. The neutral may be placed on the earth here.



### Autotransformer

#### Advantages:

- Transformation of voltages
- Less copper is required in the construction, so it will be:
  - Smaller and cheaper.
  - Higher efficiency.

#### Disadvantages:

- No electrical separation, so less safe and therefore only useful in less sensitive applications (such as motors) where no electrical separation between input and output is required.
- On safety grounds step-down transformation e.g. 400V to 230V is not recommended.
- Cannot be used for modifications to the earthing system.
- Where no neutral is present (at the input) only a small imbalance is permissible (around 5% imbalance) because of zero displacement.
- The neutral point may not be placed on the earth in three-phase situations.

#### Some applications:

- Almost exclusively usable for adjusting the voltage, preferably upwards:
  - Connect a 400V electric motor to a 230V network.
  - Heat pump without an additional asymmetric, electrical heating element.



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