



EREA
TRANSFORMERS

erea • energy • engineering



White Paper

Isolating or
autotransformer:
which do I need?

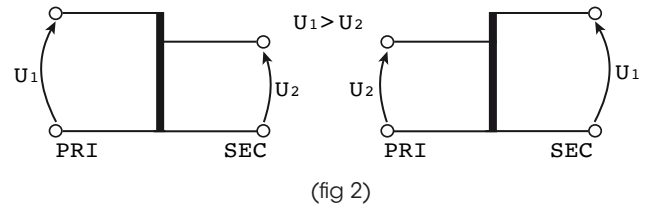
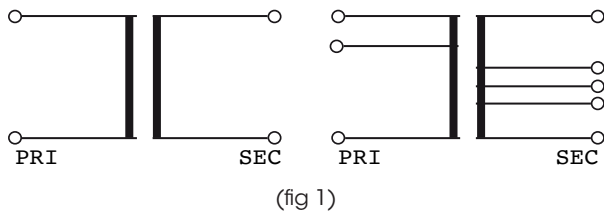
Isolating or autotransformer: which do I need?

General:

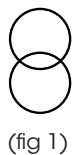
In an **isolating transformer** (fig 1) the primary and secondary windings are fully electrically separated by means of a basic isolation.

In an **autotransformer** (Figure 2), 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.

Isolating transformer

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.

Autotransformer

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 than an
▶ autotransformer

Some applications:

- Modification of voltage
 - ▶ Step-up 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



EREA
TRANSFORMERS

erea • energy • engineering

Need advice about the details
of your project?
Our committed and experienced
staff stand ready to assist.

EREA Energy Engineering

Ruggeveldstraat 1
2110 Wijnegem
BELGIUM

tel. + 32 3 355 16 00
fax + 32 3 355 16 01

www.erea.be

Transforming

since 1933