SIEMENS

siemens.com/energy/transformers

FITformer® REG

The adaptable distribution transformer

Answers for energy.

Variable input voltage, constant output voltage

Modern networks adapt to prevailing conditions, whether it's a peak load or high incoming supply.

Distributed power generation from renewable sources is more than just a passing trend, and will mean that the load flow in power supply systems will become increasingly complex in the future. The more cost-efficient that wind turbines and photovoltaic plants become, the more attractive they will be, especially in rural areas – and this will make it even more difficult for network operators to maintain a constant voltage.

The solution is to convert the network infrastructure to create an efficient, high-performance system that is exceptionally adaptable. Customers and suppliers will play an important role in planning this system, as will prosumers (electricity consumers who double as producers). This is because unsteadiness in their load, the amount of power they feed into the grid, and their storage capabilities are subject to considerable fluctuations.

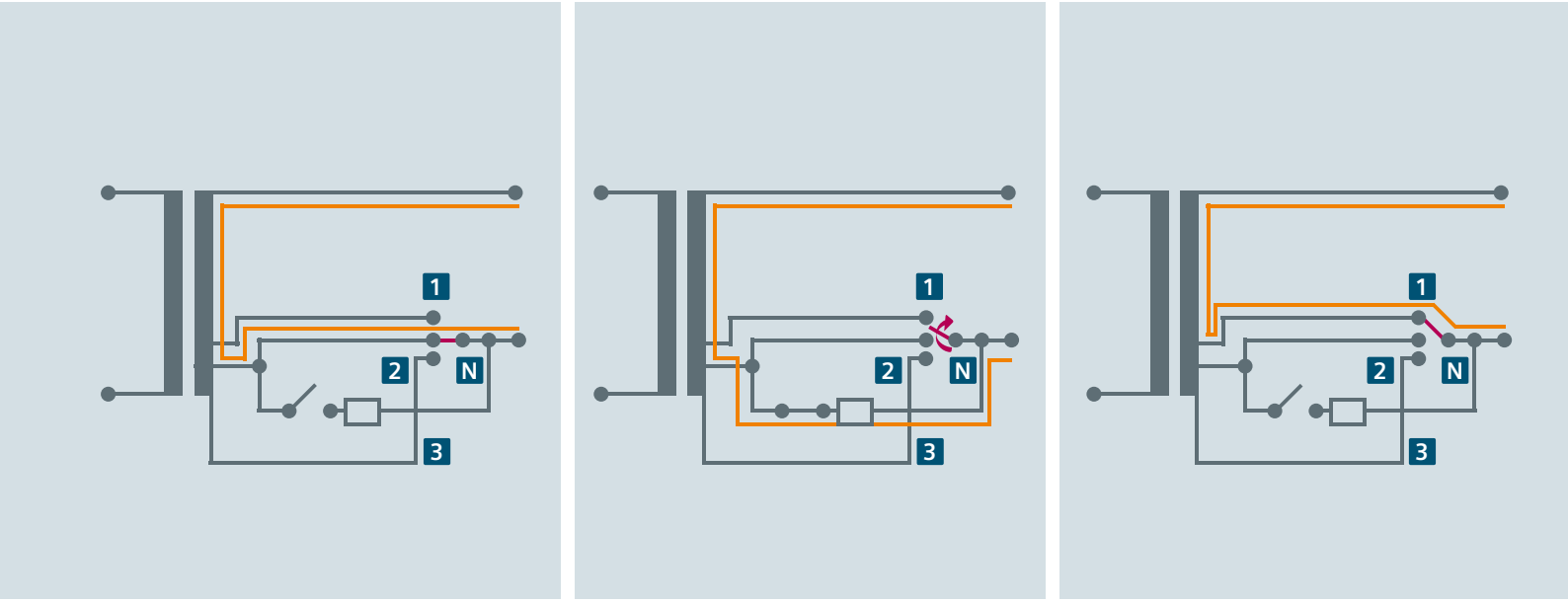
FITformer® REG –
Your sustainable success model for integrating renewable energies

The regulated distribution transformer FITformer REG from Siemens can change its transformation ratio under load. In this way, it guarantees distributed infeed from small generating plants and helps energy suppliers to stay within the permissible voltage band, without violating the EN 50160 standard. This is achieved by the transformer's three low-voltage taps, which are routed inside the hermetically sealed corrugated tank to the control unit directly on the transformer. A specially developed bushing provides a space-saving and reliable transition from the transformer to the control unit. All the usual connections as well as the high-voltage tap area for load-free changing of the transformation ratio remain unchanged. The operating properties and dimensions of the distribution transformer remain more or less unchanged. Thanks to its space-saving design, the FITformer REG can be used in all normal compact stations.

The voltage in the system can vary considerably as a result of different operating states. The extremes are known as "heavy load without distributed infeed" and "light load with maximum distributed infeed." Voltages are considerably higher with high infeed, whereas they are reduced in the case of a heavy load.

The challenge for the network operator lies in the maximum voltage difference between the two cases, such as the maximum difference at a node between a heavy load and a light load, e.g., with photovoltaics (ΔU; see Diagram 1 on page 4).

In this case, the FITformer REG distribution transformer adjusts the voltage at the infeed node up or down and thereby reduces the voltage difference ΔU, as shown in Diagram 2 on page 5.



Switching under load – the principle of regulation in the low-voltage system

Adaptable control

The circuit basically consists of vacuum and air break contactors, resistors, and a control unit.

The principle consists in activating a bypass by closing a contactor. The current then flows over the bypass, in order to ensure a faultless switch over of the mechanical vacuum contactor. Thus avoids the occurrence of unwanted voltage peaks or drops even under rated loads during the switch over.

The contactor for the bypass gets opened and therefore deactivated after achieving the target position.

The control is event-driven, which rules out the possibility of an internal malfunction like the incorrect closure of a vacuum contactor.

High degree of reliability

Electromechanical switching devices – which have already proven their viability in countless different applications – also form the core element of the regulated distribution transformer FITformer REG. Highly robust and reliable vacuum contactors are used for power ratings of 400 kVA upwards, with sizable currents. These contactors are notable for their exceptionally high reliability, operational safety, and compact design.

The on and off switching processes occur in hermetically encapsulated vacuum interrupters from which arcs cannot escape. As a result, the design can still be compact in spite of its high switching capacity.

Each interrupter is tested before it leaves the factory, using state-of-the-art, high-precision testing methods. These tests ensure the high quality that will guarantee reliable operation over long periods. With up to two million operating cycles at rated operating current, the Siemens contactors – for example, those used on the 400 kVA transformer – offer a considerably longer life span than their conventional counterparts. There is also a contact erosion indicator on every interrupter to provide information about the condition of the contacts. The interrupters can be exchanged when the indicator shows that they are reaching the end of their life. This enables the long mechanical service life of the contactors (five million operating cycles) to be fully exploited.

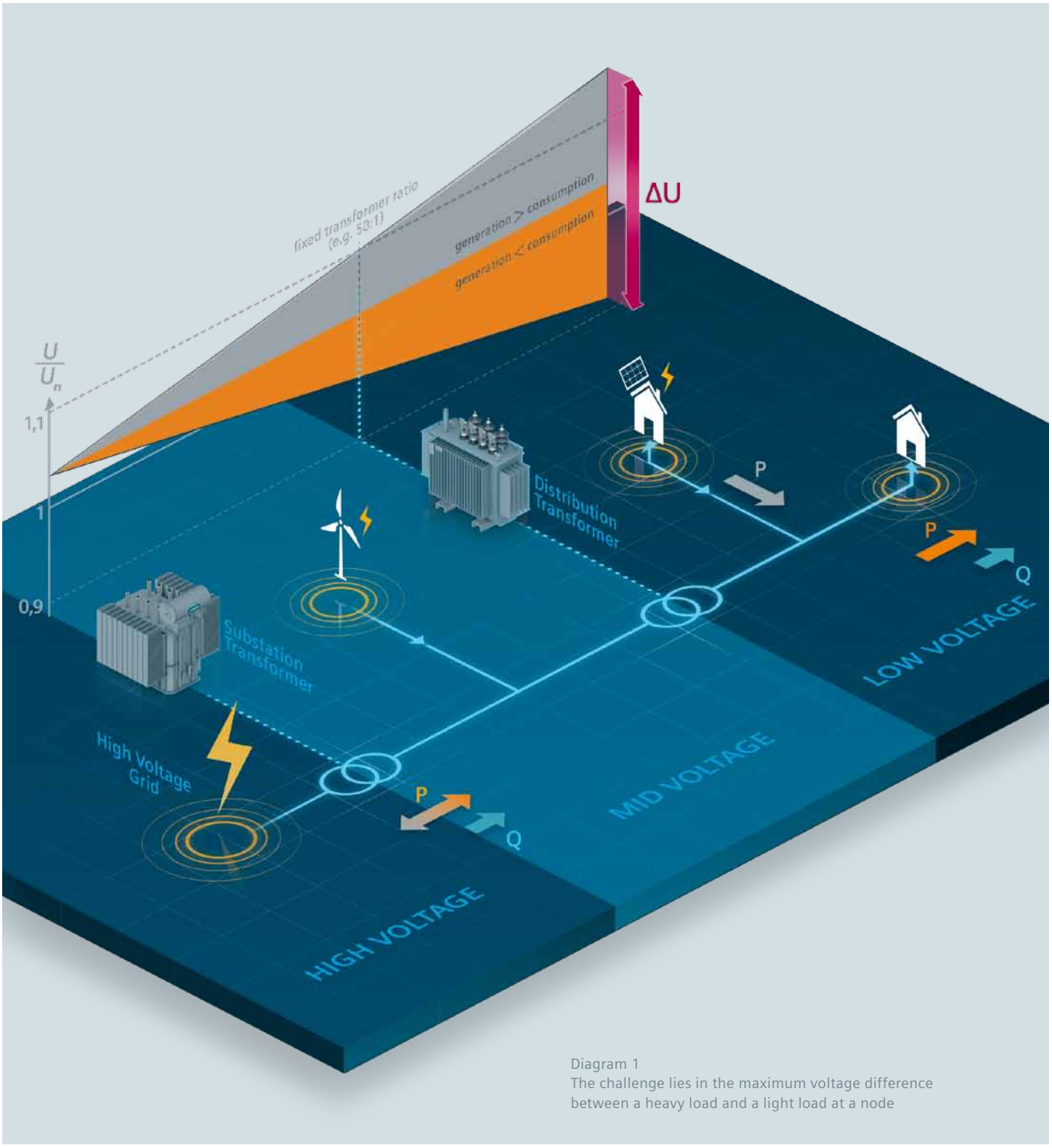


Diagram 1
The challenge lies in the maximum voltage difference between a heavy load and a light load at a node

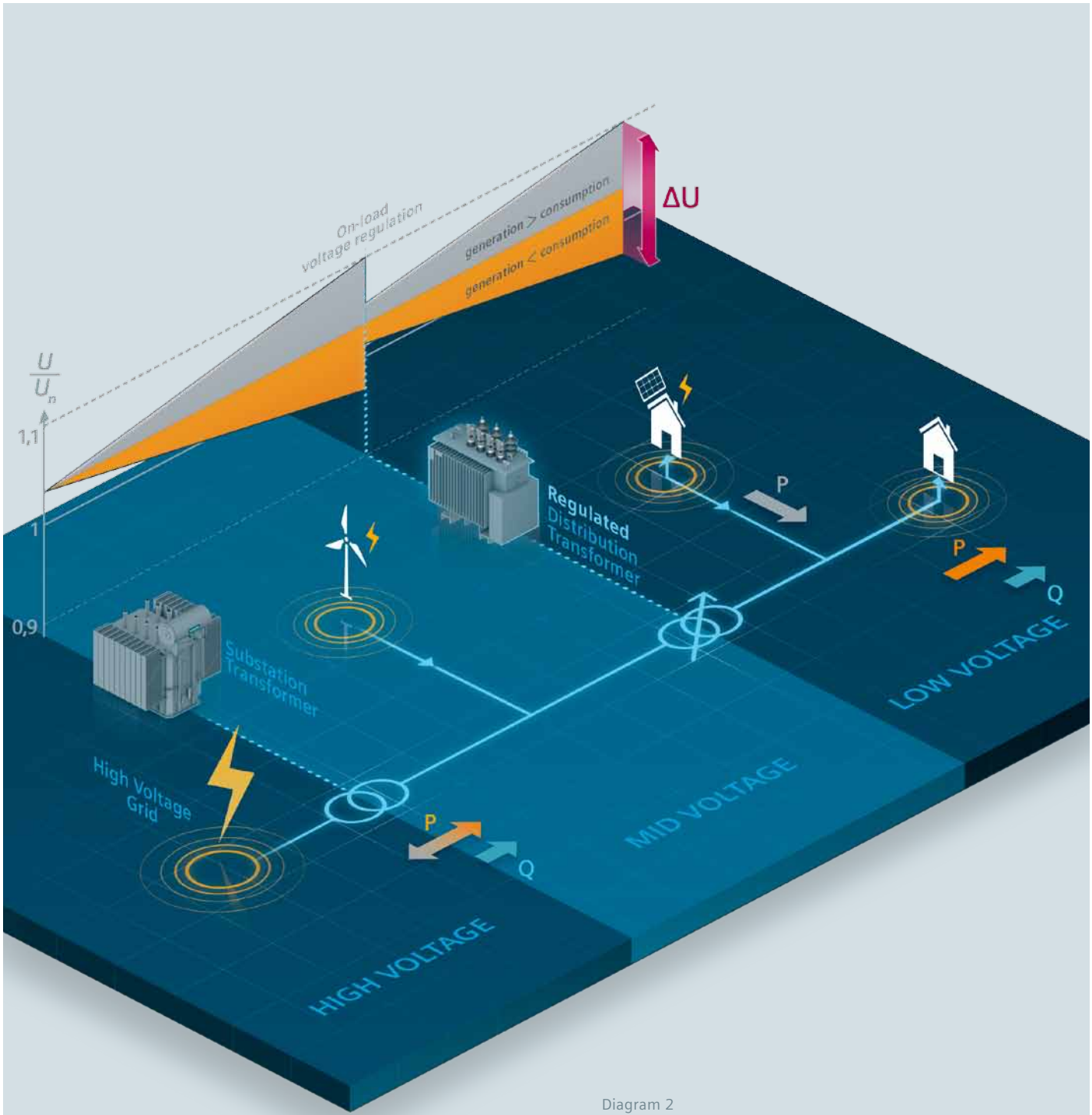


Diagram 2
The regulated distribution transformer adjusts the voltage at the infeed node, thereby reducing the voltage difference

Convenient control, reliable regulation

SIPLUS S7-300

Controlling of format: SIPLUS S7-300

The rugged SIPLUS S7-300 ensures the problem-free operation of the FITformer REG.

The modular SIPLUS controllers comprise a large number of standardized, flexible, and scalable products and modules for automation solutions. For this reason, the regulated distribution transformer can be equipped or retrofitted as required with a communications processor for remote control or monitoring.

The large-capacity main memory also offers enough space for integrated local control.

Scalable control

When power is fed to the FITformer REG, it starts up under wired program control and goes to its nominal position. If the CPU is booted, it runs through a startup routine. A minimum wait time of ten seconds ensures that the network is in stable condition before the cyclic program processing is enabled, which activates the control system.

The phase voltage is detected in three phases so that the average voltage can be calculated accurately and there can be a plausibility check between the winding phases.

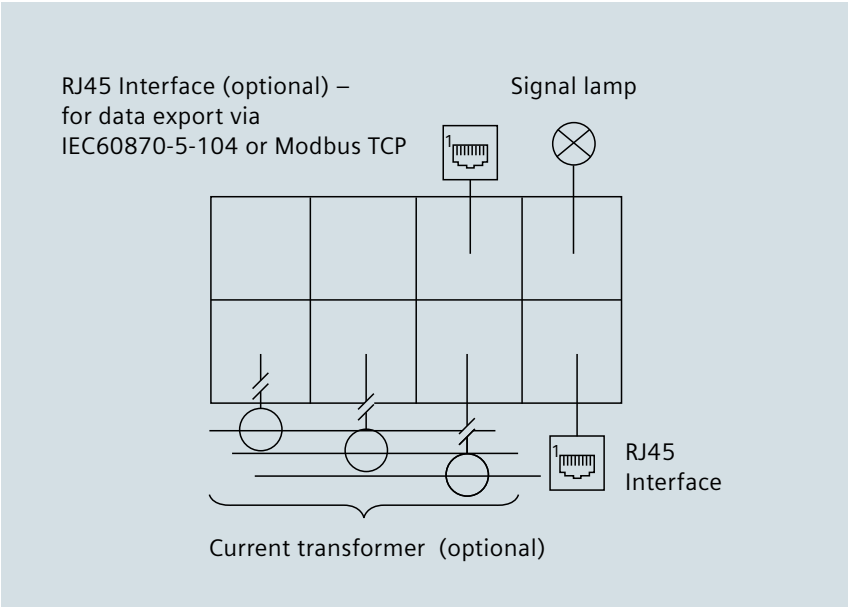
1. Resistor
2. Contactor
3. Surge arrester
4. Coupling relay
5. Fuses with bypass-contactor below
6. Fault indicating contact
7. Connection terminal for external current measurement
8. Switch for test and normal operation
9. Control unit (S7-300)
10. Communication processor (optional)
11. Galvanic network-separation

Flexible with data security

The voltage is controlled in two stages. Beside the desired rated voltage, values for the voltage limits for slow and fast switch-over can be entered as parameter. The control system is selectively matched to various network conditions by setting the delay time. All values can be freely parameterized separately for the upper and lower limits.

Data loss can be ruled out because all control parameters are stored on a micro-memory card (MMC) and are reloaded by the CPU automatically after a power failure. This eliminates the need for a backup battery and saves the expense of maintenance that this would generate.

Vacuum contactor



Overview of interfaces

Can be expanded to meet requirements

As an option, the FITformer REG can be equipped with an additional ammeter. This allows a more accurate assessment of the network state in terms of the amount of power being fed in by generating plants and the load drawn in the low-voltage system. The addition of these parameters increases the accuracy and reliability of the transformer control.

For remote monitoring and control the FITformer REG can additionally be equipped with a communication processor. Therefore the protocolls IEC 60870-5-101, IEC 60870-5-104, Modbus RTU and Modbus TCP/IP are available. With this extension the adaptable Distribution Transformer is capable to be integrated in a Smart-Grid. Thus enables a realization of a regulation based on decentralized measurements in the low voltage grid.

In this regard Siemens offers with the SICAM product portfolio, the option of a master control unit that specifies setpoint values for both the regulated distribution transformer and for distributed generators on the basis of measured values derived from the process. This is achieved by integrating smart meters directly via the CX1 protocol. In this way, the existing distribution network structure can be optimally utilized for communications functions by means of power line carriers.

Alternatively, the FITformer REG can also be controlled by external signals.

Your sustainable success model for integrating renewable power

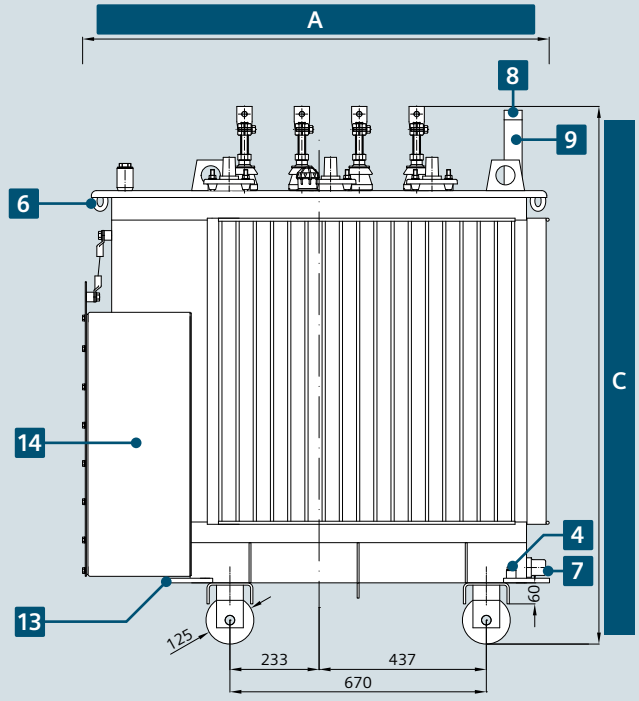
- Ensures voltage quality and guarantees feed-in of decentrally generated energy in the grid
- Cost saving alternative to grid extension
- Additional setting range on the medium-voltage side for optimum operation
- Compact design
- Low number of switching cycles due to broad load-regulated tapping range (thus eliminates the need for security measures to avoid regulation loops)
- No moving components in the active part of the transformer
- Many years of experience with reliable contactor and control technology from Siemens

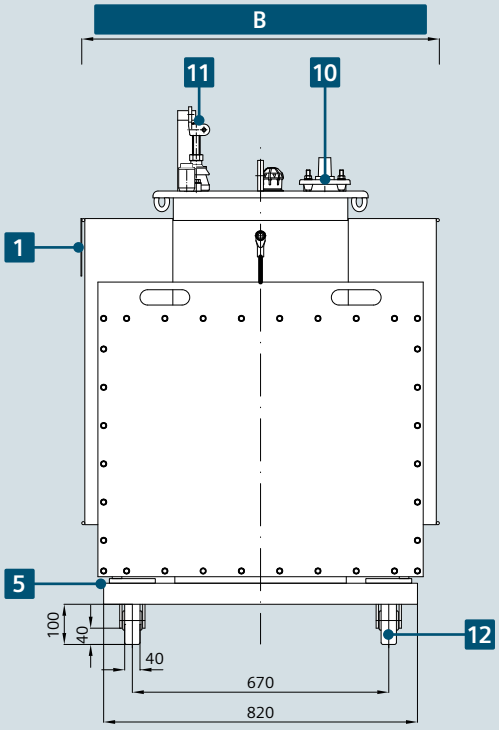
Facts and figures

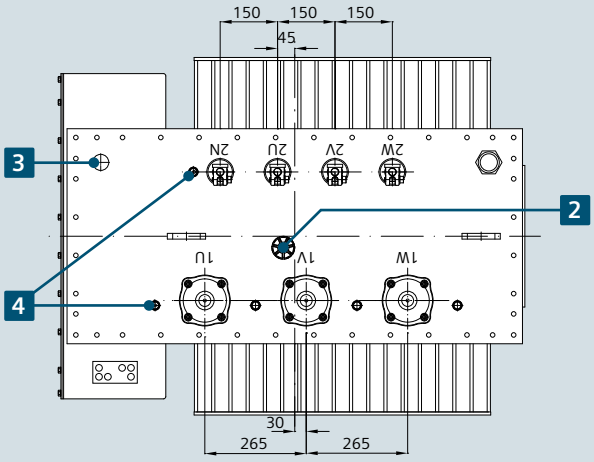
The power range of the regulated distribution transformers extends up to 630 kVA, with a maximum operating voltage of 36 kV and a low-voltage control range in three stages.

Design example with 400 kVA and 630 kVA

EN 60076-compliant transformer	400 kVA	630 kVA
Type of cooling	ONAN	
Max. ambient temperature	40 °C	
Installation height	max. 1,000 m	
Frequency	50 Hz	
High-voltage	21,000 V	
Taps	±2.5 %; ±5 % (switchable when de-energized)	
Insulation level	LI 125 AC 50	
Low-voltage	420 V	
Load regulation range	±3.57 %	±4.34 %
Insulation level	LI – AC 3	
Vector group	Dyn5	
No-load losses (A0)	430 W	600 W
Load losses (Bk)	3,850 W	5,400 W
Total loss tolerance	+10 %	
Impedance voltage	4 % ±10 %	
Length (A) x width (B) x height (C)	1,240 x 850 x 1,405 mm	1,450 x 960 x 1,545 mm
Total weight/oil weight	1,650 kg/295 kg	2,590kg/410kg







1. Rating plate (position can be changed)
2. Setting device for off-circuit tap changer
3. Thermometer pocket (thermometer upon order)
4. Grounding system
5. Hauling lug diam. 31
6. Lashing lug
7. Oil drainage device
8. Screw plug
9. Filling pipe
10. HV bushing 24-250 type A EN 50180
11. LV bushing 1 kV EN 50386
12. Rollers (upon order)
13. Additional lifting points
14. Load control

Published by and copyright © 2013:
Siemens AG
Energy Sector
Freyeslebenstrasse 1
91058 Erlangen, Germany

Siemens AG
Energy Sector
Power Transmission Division
Transformers
Katzwanger Strasse 150
90461 Nuremberg, Germany

For more information, please contact
our Customer Support Center.
Phone: +49 180/524 70 00
Fax: +49 180/524 24 71
(Charges depending on provider)

E-Mail: support.energy@siemens.com

Power Transmission Division
Order No. E50001-G640-A220-V1-4A00 | Printed in Germany |
Dispo 19201 | c4bs No. 7481 |
TH 101-130054 | WÜ | 473261 | PA | 06131.

Printed on elementary chlorine-free bleached paper.