Voltage Regulated Distribution Transformer

J. Schneider Elektrotechnik GmbH

SmartActiveTransformer

The economical alternative

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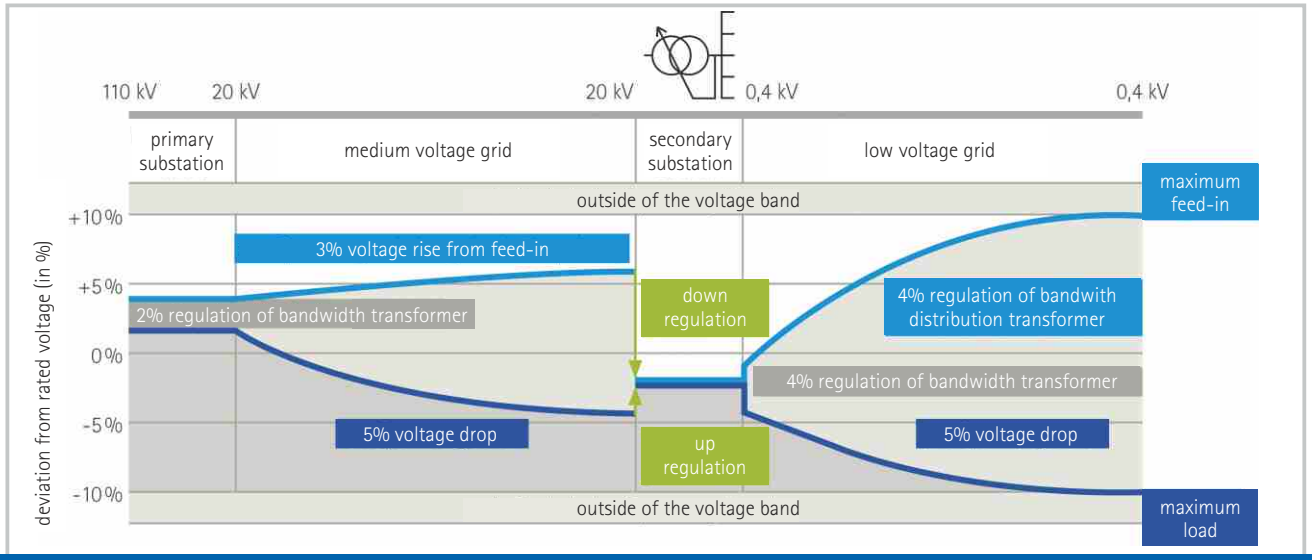
The economical alternative to grid expansion – optimal grid capacity utilisation: the integration of increasingly decentralised energy sources feeding renewable energy into low-voltage systems presents energy providers with increasingly greater challenges.

The specified nominal voltage range of +/- 10% according to DIN 50160 only allows a maximum voltage rise of 3% for decentralised energy sources. The remaining bandwidth must be available for medium voltage, voltage drops, and setting accuracy.
In this context, more and more network operators are being forced to undertake expensive expansion activities in their grids, even though the available power capacity in the affected low-voltage distribution network is still far from being reached.

This is precisely where the core problem of adherence to the voltage range becomes the focus of a variable local network transformer, which adjusts the voltage dynamically. By decoupling the voltages in the medium and low-voltage networks, 11 percent, rather than 3 percent, are now available for voltage spikes that occur while feeding into the low-voltage network. In many cases, use of this type of controllable local network transformer enables network expansion to be omitted completely or at least significantly reduced in the few remaining cases.

In each case, the already available operating equipment can be utilised to a high degree by the network operator resulting in more economical operation.



The ideal solution for power distribution network operators

Maintenance-free, long-lasting

- no lifetime-limited electronics in the circuit breaker
- maintenance-free for its entire lifespan thanks to vacuum technology
- lifetime analogy to conventional local network transformers

Low lifecycle costs

- 700,000 reliable circuits make maintenance unnecessary
- the on-load tap changer operates reliably throughout the entire lifetime of the transformer
- motor and controller may be easily replaced as required

Maximum operating reliability

- critical operating conditions are excluded by the reactor principle
- a communication interface enables integration with the control room as required
- the SmartActiveTransformer features the entire know-how of more than 35,000 vacuum switches and over 10,000 reactor switches developed by Maschinenfabrik Reinhausen, which are used around the world

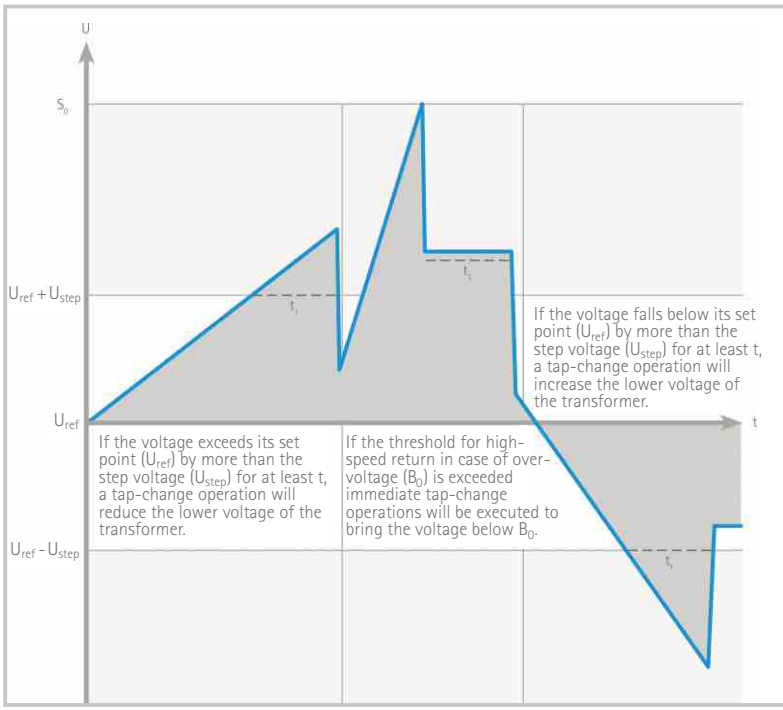
Fit for the future

- a maximum of 9 operating positions and step spacing of up to 3% enable a control range up to 24%
- the on-load tap changer is also configurable asymmetrically for situations primarily featuring loads or primarily featuring feeds
- The voltage range of +/- 10% as per DIN 50160 can be fully utilised

Control algorithm

The integrated voltage regulator enables completely autonomous operation, whereby the SmartActiveTransformer independently adapts to the current network conditions. For this purpose, the voltage carried by the low-voltage bus bar includes all 3 phases, and the control parameters react accordingly. Threshold hunting also prevents build up in the switch due to phase asymmetry.

The definable parameters for the control algorithm include the target voltage (Usoll), the step voltage (Ustep), the dead time (t1), and the threshold for the high-speed transfer switch (So). In addition to parameterisable standard algorithm, individual alternative algorithms may also be implemented as required. Standard protocols also make communicative connection with cross-systems possible.



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The SmartActiveTransformer suits any compact station

The on-load tap changer was specially developed and optimally integrated with the transformer tank in which the switches operate in special vacuum cells to exclude the possibility of oil contamination, thus no second oil vessel is required for the circuit.
The innovative design enables the SmartActiveTransformer to correspond with the dimensions of local network transformers, and it is easily integrated with conventional compact stations. In connection with the control cabinets, it also includes all of the functions that are required for self-sufficient voltage regulation.

Regulator function

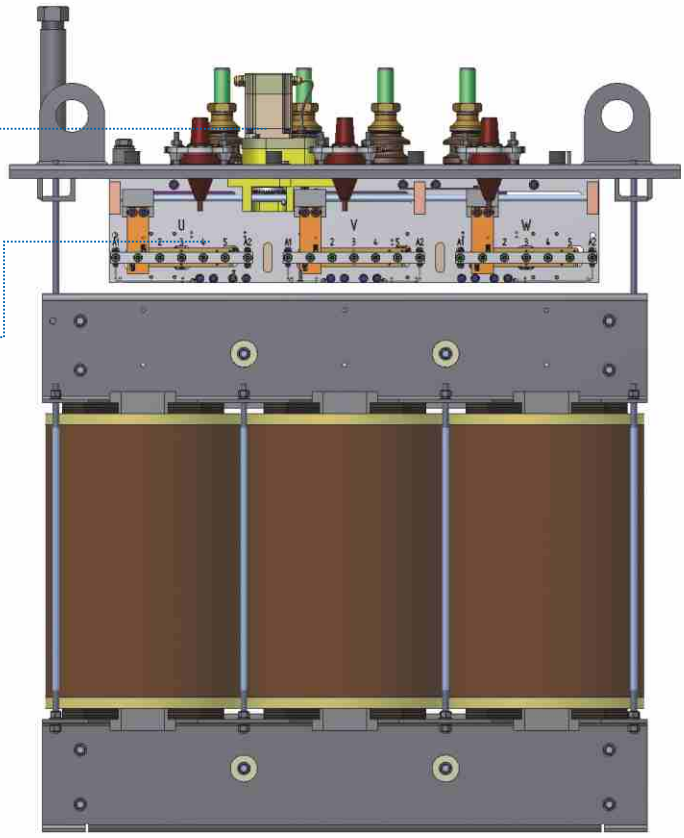
- voltage regulation on the low-voltage bus bar
- three-phase voltage measurement
- automatic, remote and manual modes
- higher/lower operation
- Ethernet and RS232 interfaces
- IEC 60870-5-101, IEC 60780-5-104 and IEC 61850 control system protocols
- powder-coated sheet metal housing
- IP54 degree of protection

Drive function

- step motor
- duration less than 1 second per cycle

Load switching function

- on-load tap changer based on the reactor principle
- electric arcs are quenched in specially developed vacuum switch tubes
- space-saving integration
- maintenance-free for the lifetime of the transformer (up to 700,000 cycles)
- regulation on the upper voltage side



Technical data

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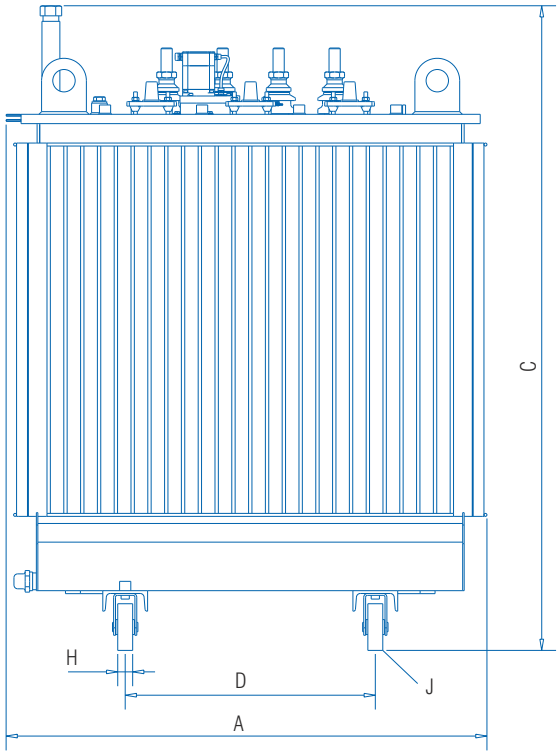
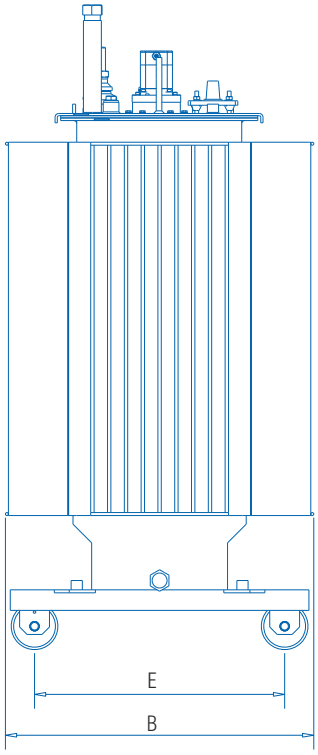
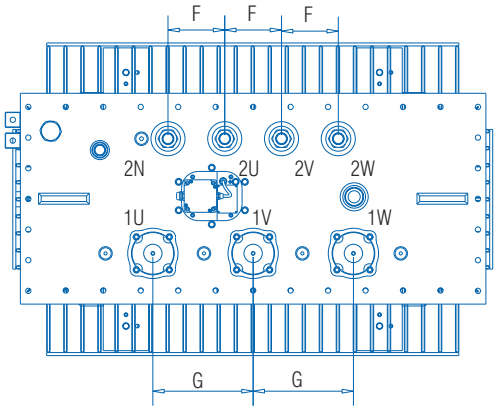
Technical data	SmartActiveTransformer	Options
winding material	copper / alu at $B_0 - C_K$	
high voltage	selectable, max. 24 kV voltage class	
steps	up to max 9 steps, configuration selectable e.g. +/- 4 x „X%“; +4/-3 x „X%“; +6/-2 x „X%“	
step voltages	selectable, max. 600V, common 1,5%, 2%, 2,5%	
frequency	50 Hz	
low voltage	selectable	
vector group	Dyn 5	more on request
cooling	ONAN	
max. installation altitude	1000 m over NN	
HV bushings	12 - 24 kV / 250 A plug-bushing DIN 50190	12 - 24 kV / 250 A ceramic-bushing DIN 50386
LV-bushings	flange connection DIN 43675	conductor terminal IEC 61238
tank type	hermetic-corrugated tank	
protective device	non	transformer protection DGPT 2
thermometer pocket	thermometer pocket according to DIN 42554 on LV side	dial thermometer
driving rolls	lengthwise and crosswise DIN EN 50216-4, material: steel	
coating	RAL 7033, total coating thickness >= 140 μm	more on request

Power loss		$A_0 - B_K$				$B_0 - B_K$				$B_0 - C_K$			
S_N [kVA]	uk [%]	$P_{0\ (Trafo)}$ A_0 [W]	$P_{0\ (Trafo+PA)}$ <=B_0+15% [W]	$P_{K\ (Trafo+PA)}$ B_K [W]	weight [kg]	$P_{0\ (Trafo)}$ B_0 [W]	$P_{0\ (Trafo+PA)}$ <=C_0+15% [W]	$P_{K\ (Trafo+PA)}$ B_K [W]	weight [kg]	$P_{0\ (Trafo)}$ B_0 [W]	$P_{0\ (Trafo+PA)}$ <=C_0+15% [W]	$P_{0\ (Trafo+PA)}$ C_K [W]	weight [kg]
250	4	300	415	2750	1910	360	480	2750	1740	360	480	3250	1650
400	4	430	590	3850	2380	520	680	3850	2200	520	680	4600	2000
630	4	600	780	5400	2950	730	910	5400	2600	730	910	6500	2400
630	6	560	740	5600	3150	680	860	5600	2750	680	860	6750	2550
800	6	650	900	7000	3500	800	1050	7000	2950	800	1050	8400	2750

Technical data voltage regulator and control cabinet	
voltage	3 x 400 V
current	1,0 A
frequency	50 Hz
test voltage to ground	2 kV / 1 minute
duration of tap change operation	0,9 s
shortest gap between tap-change operation	3 s
interfaces	Ethernet, RS 232
protocols	IEC 60870-5-101, IEC 60870-5-104, IEC 61850
housing (W x H x D)	380 x 380 x 180 mm
weight	15 kg







Dimensions SmartActiveTransformer [mm]

	250 kVA 10/20 kV	400 kVA 10/20 kV	630 kVA 10/20 kV	630 kVA 10/20 kV	800 kVA 10/20 kV
uk	4 %	4 %	4 %	6 %	6 %
A	1080	1260	1410	1500	1550
B	810	900	900	920	1040
C	1650	1650	1750	1750	1800
D	520	670	670	670	670
E	520	670	670	670	670
F	150	150	150	150	150
G	265	265	265	265	265
H	40	40	40	40	40
J	Ø 125	Ø 125	Ø 125	Ø 125	Ø 125

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