

# Three-Phase Transformers

## 4AP, 4AU Autotransformers

For matching purposes  
according to EN 61558-2-13

### Overview

- Shared input and output windings without electrical isolation
- Enable the voltage matching of electrical loads
- Designed for uninterrupted duty (100 % ON period)
- Vector group YNa0
- 4AP:  $t_a = 50\text{ °C}$  (T50/B), 4AU:  $t_a = 55\text{ °C}$  (T55/H)
- **RUUS**



4AP (left) and 4AU (right)

### Technical specifications

#### Maximum rated output power $P_n$ at different rated input voltages (degree of protection IP00)

With this version of the 4A...2-8HA20-2XA0 autotransformers, higher ratings than the quoted ratings can be found in the following table depending on the input voltage.

Transformers	Output power $P_n$ at input voltage				
	480 V kVA	460 V kVA	440 V kVA	415 V kVA	380 V kVA
4AP21 42-8HA20-2XA0	5	5.8	6.3	6.8	6.8
4AP25 52-8HA20-2XA0	9.1	10.5	11.4	12.3	12.3
4AP27 42-8HA20-2XA0	12.5	14.4	15.6	16.9	15.8
4AP27 52-8HA20-2XA0	16	18.4	20	21.6	20.3
4AP30 52-8HA20-2XA0	22.5	25.9	28.1	30.4	30.4
4AU30 32-8HA20-2XA0	31.5	36.2	39.4	42.5	42.5
4AU36 32-8HA20-2XA0	50	57.5	62.5	59.5	54.5

#### Primary-side short-circuit and overload protection with motor starter protectors

The otherwise customary consideration of the inrush current plays a subordinate role for an autotransformer. For this reason, it is possible to proceed as follows when selecting the motor starter protectors:

$$I_{1N} = \frac{P_{n \text{ load}}}{U_{1N} \times \sqrt{3}}$$

The motor starter protector resulting for this PRI current  $I_{1N}$  can be selected.

Example:

Type 4AP27  
Connection PRI  $U_{1N} = 480\text{ V}$

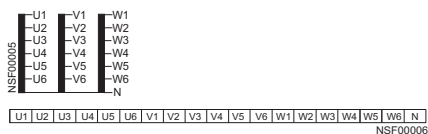
$$I_{1N} = \frac{15000\text{ VA}}{480\text{ V} \times \sqrt{3}} \times 1.1 = 19.9\text{ A}$$

Motor starter protector:  
3RV10 21-4CA10  
Set value 20 A

For other motor starter protectors see Catalog LV 1, Chapter 5 "Protection Equipment".

### Schematics

#### Circuit diagrams and terminal assignments



#### Rated voltage $U_N$ for type

4A□□□ □2-8HA20-2X.0  
V

480  
460  
440  
415  
400  
380

4A□□□ □2-8JT10-2X.0  
V

480  
460  
440  
415  
400 (380)<sup>1)</sup>  
230 (220)<sup>1)</sup>

#### Connection

U1-V1-W1  
U2-V2-W2  
U3-V3-W3  
U4-V4-W4  
U5-V5-W5  
U6-V6-W6

<sup>1)</sup> Operating with 3 AC 380 V at the input terminals results in an output voltage of 3 AC 220 V.

# Three-Phase Transformers

## 4FL Voltage Regulators

### 4FL voltage regulators, transformer type

#### Overview



4FL

- According to DIN VDE 0552
- Degree of protection IP21
- $t_a = 40\text{ °C/E}$

#### Design

The transformer-type voltage regulator supplies electrical loads with a constant voltage despite mains variations.

The advantage of a voltage regulator with a variable-ratio transformer is proportional changing of the sinewave, i. e. the voltage regulator is characterized in that the rms value, mean value and the peak value are held at constant ratios.

A perfect rms value is required, for example, by loads for which the loading is determined by the thermal limits. Strongly capacitive loads in DC units respond to the mean value. A slightly capacitive load is, however, influenced by the peak value. These factors are, however, only guaranteed for sinusoidal AC voltages and this can only be achieved easily by means of a variable-ratio transformer.

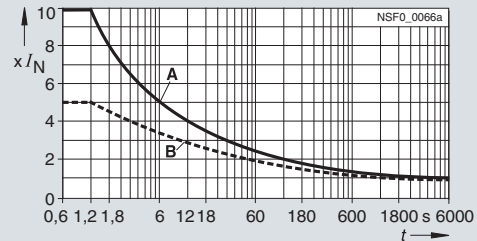
Voltage regulators stabilize the mains voltage  $U_1$  regardless of the frequency and power factor to the rated value of output voltage  $U_{2N}$  within the set control accuracy ( $\pm 1\%$  of  $U_{2N}$ ). The correcting time from the upper or lower limit to the rated value is between 1.5 s and 2.5 s. The curve shape of the supplied voltage is not changed.

The output voltage  $U_2$  is compared in the electronic step controller with a set reference voltage. In the event of a deviation in voltage greater than the set response value, the electronic step controller compensates the deviation with an accuracy of  $\pm 1\%$  using a servo motor and adjustable moving contact on the variable-ratio transformer.

Transformer-type voltage regulators:

- Are electrically connected to the network
- Can be overloaded temporarily (see characteristic curve)
- Can be installed in a sheet-steel enclosure to IP21 complete with any additional components
- Have a degree of efficiency of between 95 % and 98 %
- Are not maintenance-free
- For the values for control range and control deviation, see "Selection and ordering data" in Catalog LV 1.
- For symmetrical mains voltage: The voltage deviation is only monitored on one conductor and set for all three conductors.

- For asymmetrical mains voltage: the voltage deviation is monitored on each conductor and set individually for each conductor.
- The neutral conductor 1N must be connected. If no neutral conductor is present on the mains side, a neutral grounding transformer is required (on request).



Reference temperature:

- Curve A: winding temperature = ambient temperature
- Curve B: winding temperature = operating temperature

Overload capability (guide values)

#### Ambient conditions

4FL transformer-type voltage regulators are climate proof for installation in rooms with an internal climate according to DIN 50010.

Limit values:

- Ambient temperature at
  - Rated power +40 °C,
  - Minimum value -25 °C.
- Relative air humidity
  - At 40 °C up to 85 %,
  - Annual average up to 65 %
  - Condensation not permitted

#### Short-circuit and overload protection

Transformer-type voltage regulators must be protected with gL/gG fuses on the primary side against damage caused by short-circuits. The fuse rated current must be determined according to the highest primary current (present with the lowest input voltage). Overload and short-circuit protective devices according to the rated load current must be provided on the output side. An overload relay is integrated in the control circuit, the trip contacts (break or make) must be connected on a switch that automatically disconnects the transformer voltage regulator from the network in the event of a fault.

# Three-Phase Transformers

## Project planning aids

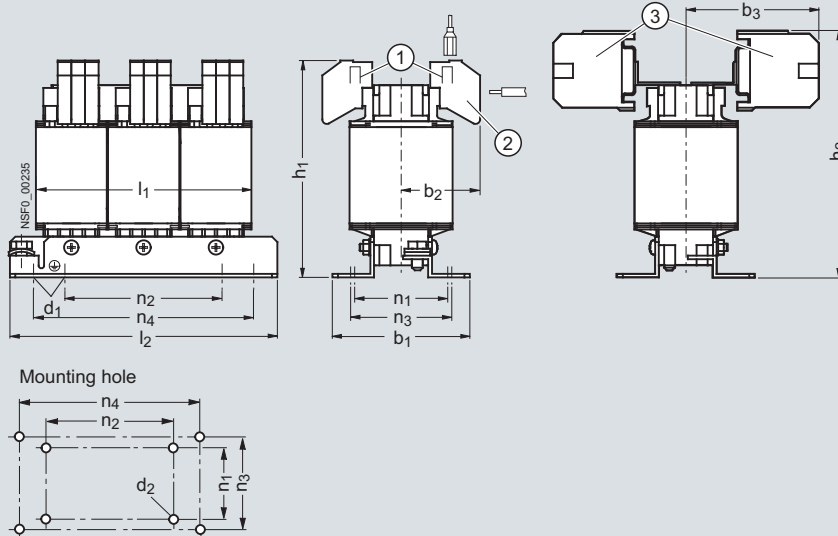
### Dimensional drawings

#### 4AP, 4AU safety, isolating, control and mains transformers $\leq 16$ kVA

#### 4AP safety, isolating, control and mains transformers and 4AP safety, isolating, control and mains transformers and autotransformers with selectable voltages $\leq 16$ kVA

#### 4AP17 to 4AP25

for any mounting position,  
fixing dimensions according to EN 60852-4 and DIN 41308-4



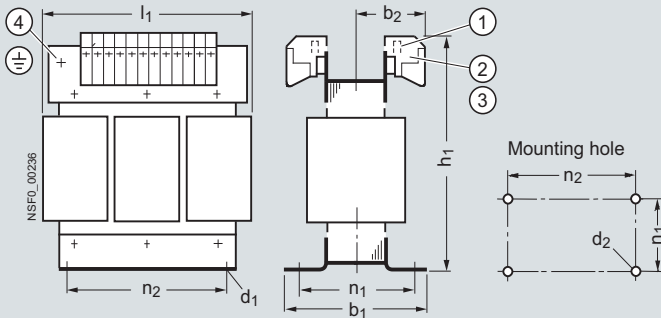
- ① Flat connectors DIN 46244-A 6,3-0,8
- ② Screw terminal  
24 A:  
solid 0,5 mm<sup>2</sup> ... 6 mm<sup>2</sup>,  
finely stranded 0,5 mm<sup>2</sup> ... 4 mm<sup>2</sup>
- ③ Screw terminal  
32 A:  
solid 0,75 mm<sup>2</sup> ... 10 mm<sup>2</sup>,  
finely stranded 1,5 mm<sup>2</sup> ... 6 mm<sup>2</sup>  
44 A:  
solid 1 mm<sup>2</sup> ... 16 mm<sup>2</sup>,  
finely stranded 1 mm<sup>2</sup> ... 10 mm<sup>2</sup>  
60 A:  
solid 1 mm<sup>2</sup> ... 16 mm<sup>2</sup>,  
stranded 10 mm<sup>2</sup> ... 25 mm<sup>2</sup>,  
finely stranded 2,5 mm<sup>2</sup> ... 16 mm<sup>2</sup>  
> 60 A:  
[see flat connectors](#)

Type	Rated power kVA <sup>1)</sup>	Design. According to DIN 41302	b <sub>1</sub>		b <sub>3</sub>	d <sub>1</sub>	d <sub>2</sub>	h <sub>1</sub>		h <sub>2</sub>		l <sub>1</sub>	l <sub>2</sub>	Mounting according to DIN 41308-4		Mounting according to EN 60852-4				Max. number of terminals per side			
				Max.				Max.	Max.	n <sub>1</sub>	n <sub>2</sub>			n <sub>3</sub>	n <sub>4</sub>	24 A	32 A	44 A	60 A				
4AP17	0,16	3UI 60/30	76	58	76	4,8 x 9	M4	130	143	122	148	47	90	58	136	12	12	6	9				
4AP18	0,25	3UI 75/25	73	56	73	5,8 x 11	M5	152	168	156	178	49	113	53	166	15	16	6	12				
4AP19	0,4	3UI 75/40	88	64	81	5,8 x 11	M5	152	168	156	178	64	113	68	166	15	16	6	12				
4AP20	0,63	3UI 90/30	99	59	76	7 x 12	M6	172	193	182	219	56	136	69	201	21	19	12	15				
4AP21	1	3UI 90/50	119	69	86	7 x 12	M6	172	193	182	219	76	136	89	201	21	19	12	15				
4AP25	1,6	3UI 114/62	131	76	92	7 x 12	M6	208	234	229	267	94	176	102	249	27	22	18	19				

<sup>1)</sup> The rated power is only applicable to transformers with separate windings (not to autotransformers).

**4AP, 4AU safety, isolating, control and mains transformers ≤ 16 kVA (continued)****4AP27 and 4AP30**

for any mounting position



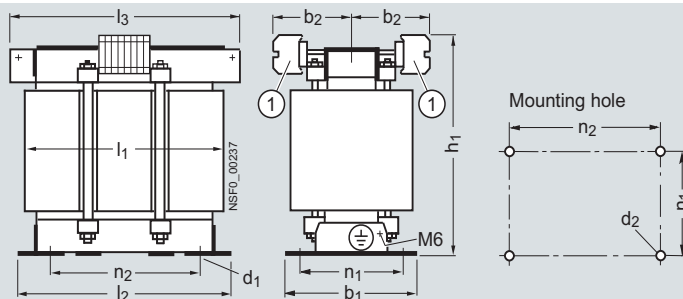
- ① Flat connectors DIN 46244-A 6,3-0,8
- ② Screw terminal  
24 A:  
solid 0,5 mm<sup>2</sup> ... 6 mm<sup>2</sup>,  
finely stranded 0,5 mm<sup>2</sup> ... 4 mm<sup>2</sup>
- ③ Screw terminal  
32 A:  
solid 0,75 mm<sup>2</sup> ... 10 mm<sup>2</sup>,  
finely stranded 1,5 mm<sup>2</sup> ... 6 mm<sup>2</sup>  
60 A:  
solid 1 mm<sup>2</sup> ... 16 mm<sup>2</sup>,  
stranded 10 mm<sup>2</sup> ... 25 mm<sup>2</sup>,  
finely stranded 2,5 mm<sup>2</sup> ... 16 mm<sup>2</sup>  
> 60 A:  
[see flat connectors](#)
- ④ Grounding screw M6

Type	Rated power kVA <sup>1)</sup>	Designation according to DIN 41302	b <sub>1</sub>	b <sub>2</sub> Max.	d <sub>1</sub>	d <sub>2</sub>	h <sub>1</sub> Max.	l <sub>1</sub>	Mounting according to DIN 41308		Max. number of terminals per side		
									n <sub>1</sub>	n <sub>2</sub>	24 A	32 A	60 A
4AP27	2,5	3UI 132/70	133	103	10 x 18	M8	242	264	101	200	27	21	15
4AP30	4; 5	3UI 150/75	148	105	10 x 18	M8	271	300	118	224	27	21	15

<sup>1)</sup> The rated power is only applicable to transformers with separate windings (not to autotransformers).

**4AU safety, isolating, control and mains transformers and****4AU safety, isolating, control and mains transformers and autotransformers with selectable voltages ≤ 16 kVA****4AU30 to 4AU39**

for any mounting position



- ① Screw terminal:  
18 A:  
solid 0,5 mm<sup>2</sup> ... 6 mm<sup>2</sup>,  
finely stranded 1,5 mm<sup>2</sup> ... 4 mm<sup>2</sup>  
23 A:  
solid 0,75 mm<sup>2</sup> ... 10 mm<sup>2</sup>,  
finely stranded 1,5 mm<sup>2</sup> ... 6 mm<sup>2</sup>  
43 A:  
solid 1 mm<sup>2</sup> ... 16 mm<sup>2</sup>,  
stranded 10 mm<sup>2</sup> ... 25 mm<sup>2</sup>,  
finely stranded 2,5 mm<sup>2</sup> ... 16 mm<sup>2</sup>  
81 A:  
solid or stranded 4 mm<sup>2</sup> ... 16 mm<sup>2</sup>  
> 81 A:  
[see flat-type and threaded pin terminals](#)

Permissible permanent load for 4AU36 and 4AU39 for arrangement on vertical surfaces:

$$0,95 \cdot P_n \text{ at } t_a = 55 \text{ °C}$$

$$P_n \text{ at } t_a = 45 \text{ °C}$$

Type	Rated power kVA <sup>1)</sup>	Designation according to DIN 41302	b <sub>1</sub>	b <sub>2</sub>	d <sub>1</sub>	d <sub>2</sub>	h <sub>1</sub>	l <sub>1</sub>	l <sub>2</sub>	l <sub>3</sub>	n <sub>1</sub>	n <sub>2</sub>	Max. number of terminals per side			
													18 A	23 A	43 A	81 A
4AU30	6,3	3UI 150/75	155	129	10 x 18	M8	270	300	264	310	118	224	35	31	23	14
4AU36	8; 10	3UI 180/75	169	134	10 x 18	M8	320	360	314	360	138	264	43	38	28	17
4AU39	12,5; 16	3UI 210/70	174	131	12 x 18	M10	370	420	366	410	141	316	50	45	33	20

<sup>1)</sup> The rated power is only applicable to transformers with separate windings (not to autotransformers).