

# Technical Data Distribution Transformers TUNORMA and TUMETIC

## Oil-immersed TUMETIC and TUNORMA three-phase distribution transformers

- Standard: DIN 42500
- Rated power: 50–2500 kVA
- Rated frequency: 50 Hz
- HV rating: up to 36 kV
- Taps on HV side:  $\pm 2.5\%$  or  $\pm 2 \times 2.5\%$
- LV rating: 400–720 V (special designs for up to 12 kV can be built)
- Connection: HV winding: delta  
LV winding: star (up to 100 kVA: zigzag)
- Impedance voltage at rated current: 4 % (only up to HV rating 24 kV and  $\leq 630$  kVA) or 6 % (with rated power  $\geq 630$  kVA or with HV rating  $> 24$  kV)
- Cooling: ONAN
- Protection class: IP00
- Final coating: RAL 7033 (other colours are available)

$U_m$ [kV]	LI [kV]	AC [kV]
1.1	–	3
12	75	28
24	125	50
36	170	70

- LI Lightning-impulse test voltage
- AC Power-frequency test voltage

Fig. 23: Insulation level (IP00)

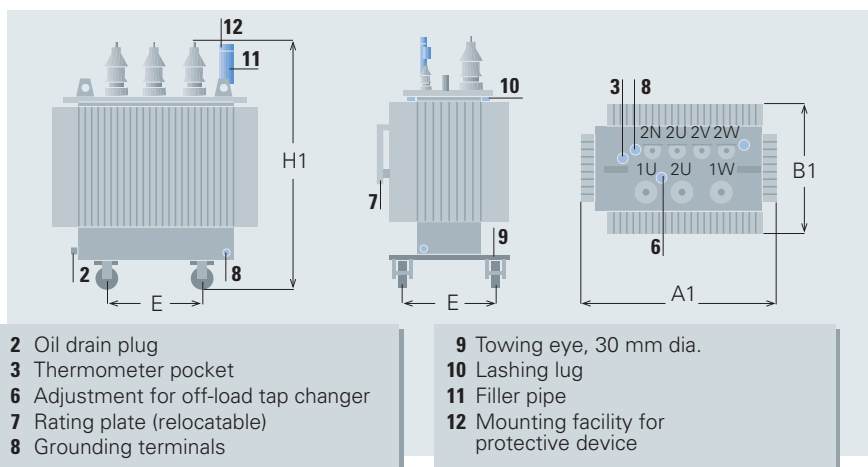
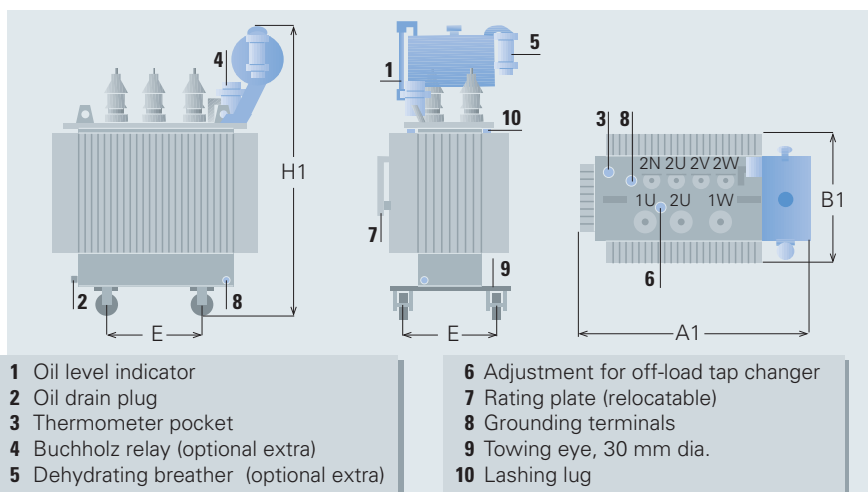


Fig. 24: TUMETIC distribution transformer (sealed tank)



Notes: Tank with strong corrugated walls shown in illustration is the preferred design. With HV ratings up to 24 kV and rated power up to 250 kVA (and with HV ratings  $> 24$ –36 kV and rated power up to 800 kVA), the conservator is fitted on the long side just above the LV bushings.

Fig. 25: TUNORMA distribution transformer (with conservator)

### Losses

The standard HD 428.1.S1 (= DIN 42500 Part 1) applies to three-phase oil-immersed distribution transformers 50 Hz, from 50 kVA to 2500 kVA,  $U_m$  to 24 kV.

For load losses ( $P_k$ ), three different listings (A, B and C) were specified. There were also three listings (A', B' and C') for no-load losses ( $P_0$ ) and corresponding sound levels.

Due to the different requirements, pairs of values were proposed which, in the national standard, permit one or several combinations of losses.

DIN 42500 specifies the combinations A-C', C-C' and B-A' as being most suitable.

The combinations B-A' (normal losses) and A-C' (reduced losses) are approximately in line with previous standards. In addition there is the C-C' combination. Transformers of this kind with additionally reduced losses are especially economical with energy (maximum efficiency  $> 99\%$ ). The higher costs of these transformers are counteracted by the energy savings which they make.

Standard HD 428.3.S1 (= DIN 42500-3) specifies the losses for oil distribution transformers up to  $U_m = 36$  kV. For load losses the listings D and E, for no-load losses the listings D' and E' were specified. In order to find the most efficient transformer, please see part "Transformer loss evaluation".

# Technical Data Distribution Transformers

## TUNORMA and TUMETIC

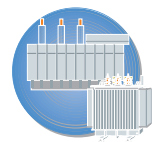
Rated power	Max. rated volt. HV side	Impe- danc- e voltage	Type		Combination of losses acc. CENELEC	No-load losses	Load losses	Sound press. level 1 m tolerance + 3 dB	Sound power level	Total weight		Dimensions						Dist. between wheel centers
			TUNORMA	TUMETIC						Length A1		Width B1		Height H1				
										TUNORMA	TUMETIC	TUNORMA	TUMETIC	TUNORMA	TUMETIC			
S <sub>n</sub> [kVA]	U <sub>m</sub> [kV]	U <sub>2</sub> [%]	4JB... 4HB...		P <sub>0</sub> [W]	P <sub>k</sub> 75* [W]	L <sub>PA</sub> [dB]	L <sub>WA</sub> [dB]	[kg]		[mm]		[mm]		[mm]		E [mm]	
50	12	4	..4744-3LB	B-A'	190	1350	42	55	340	350	860	980	660	660	1210	1085	520	
		4	..4744-3RB	A-C'	125	1100	34	47	400	430	825	1045	660	660	1210	1085	520	
		4	..4744-3TB	C-C'	125	875	34	47	420	440	835	985	660	660	1220	1095	520	
	24	4	..4767-3LB	B-A'	190	1350	42	55	370	380	760	860	660	660	1315	1235	520	
		4	..4767-3RB	A-C'	125	1100	34	47	430	460	860	860	660	660	1300	1220	520	
		4	..4767-3TB	C-C'	125	875	33	47	480	510	880	1100	685	660	1385	1265	520	
	36	6	..4780-3CB	E-D´	230	1450	x	52	500	x	1000	x	710	x	1530	x	520	
100	12	4	..5044-3LB	B-A'	320	2150	45	59	500	500	1090	1020	660	660	1275	1110	520	
		4	..5044-3RB	A-C'	210	1750	35	49	570	570	980	980	660	660	1315	1145	520	
		4	..5044-3TB	C-C'	210	1475	35	49	600	620	1030	930	660	660	1320	1150	520	
	24	4	..5067-3LB	B-A'	320	2150	45	59	520	530	1020	1140	685	660	1360	1245	520	
		4	..5067-3RB	A-C'	210	1750	35	49	600	610	1030	1030	690	660	1400	1280	520	
		4	..5067-3TB	C-C'	210	1475	35	49	640	680	960	1060	695	660	1425	1305	520	
	36	6	..5080-3CB	E-D´	380	2350	x	56	660	x	1050	x	780	x	1600	x	520	
160	12	4	..5244-3LA	B-A'	460	3100	47	62	620	610	1140	1140	710	710	1350	1185	520	
		4	..5244-3RA	A-C'	300	2350	37	52	700	690	1130	1010	660	660	1390	1220	520	
		4	..5244-3TA	C-C'	300	2000	38	52	760	780	985	1085	660	660	1380	1215	520	
	24	4	..5267-3LA	B-A'	460	3100	47	62	660	640	1150	1150	695	660	1440	1320	520	
		4	..5267-3RA	A-C'	300	2350	37	52	730	730	1030	930	695	660	1540	1420	520	
		4	..5267-3TA	C-C'	300	2000	37	52	800	820	1120	1120	710	660	1475	1355	520	
	36	6	..5280-3CA	E-D´	520	3350	x	59	900	x	1120	x	800	x	1700	x	520	
(200)	12	4	..5344-3LA	B-A'	550	3600	48	63	720	710	1190	1190	680	680	1450	1285	520	
		4	..5344-3RA	A-C'	360	2760	38	53	840	830	1070	1120	660	660	1470	1300	520	
		4	..5344-3TA	C-C'	360	2350	38	53	900	920	1130	1130	660	680	1450	1285	520	
	24	4	..5367-3LA	B-A'	550	3600	48	63	800	780	1290	1290	820	800	1595	1425	520	
		4	..5367-3RA	A-C'	360	2760	38	53	890	910	1110	1230	755	680	1630	1460	520	
		4	..5367-3TA	C-C'	360	2350	38	53	950	980	1080	1180	705	690	1595	1430	520	
	36	6	..5380-3CA	E-D´	600	3800	x	61	1000	x	1250	x	800	x	1700	x	520	

Dimensions and weights are approximate values. Rated power figures in parentheses are not standardized.

x: on request

\* In case of short-circuits at 75 °C

Fig. 26: Selection table: oil-immersed distribution transformers 50 to 2500 kVA



# Technical Data Distribution Transformers TUNORMA and TUMETIC

Rated power	Max. rated volt. HV side	Impe- dance voltage	Type		Combini- on of losses acc. CENELEC	No-load losses	Load losses	Sound press. level 1 m toler- ance + 3 dB	Sound power level	Total weight		Length A1		Width B1		Height H1		Dist. between wheel centers
			TUNORMA	TUMETIC						TUNORMA	TUMETIC	TUNORMA	TUMETIC	TUNORMA	TUMETIC	TUNORMA	TUMETIC	
$S_n$ [kVA]	$U_m$ [kV]	$U_2$ [%]	4JB...	4HB...		$P_0$ [W]	$P_k$ 75* [W]	$L_{PA}$ [dB]	$L_{WA}$ [dB]									E [mm]
250	12	4	..5444-3LA	B-A'	650	4200	50	65	830	820	1300	1300	810	810	1450	1285	520	
		4	..5444-3RA	A-C'	425	3250	40	55	940	920	1260	1260	670	820	1480	1415	520	
		4	..5444-3TA	C-C'	425	2750	40	55	1050	1070	1220	1220	690	700	1530	1310	520	
	24	4	..5467-3LA	B-A'	650	4200	49	65	920	900	1340	1340	800	760	1620	1450	520	
		4	..5467-3RA	A-C'	425	3250	39	55	1010	1010	1140	1190	760	680	1675	1510	520	
		4	..5467-3TA	C-C'	425	2750	40	55	1120	1140	1220	1340	715	710	1640	1475	520	
	36	6	..5480-3CA	E-E'	650	4250	x	62	1100	x	1350	x	800	x	1680	x	520	
(315)	12	4	..5544-3LA	B-A'	780	5000	50	66	980	960	1440	1330	820	820	1655	1385	670	
		4	..5544-3RA	A-C'	510	3850	40	56	1120	1100	1400	1250	820	820	1690	1415	670	
		4	..5544-3TA	C-C'	510	3250	40	56	1240	1260	1380	1260	820	820	1665	1390	670	
	24	4	..5567-3LA	B-A'	780	5000	50	66	1050	1030	1450	1350	840	840	1655	1510	670	
		4	..5567-3RA	A-C'	510	3850	40	56	1170	1150	1410	1270	820	820	1755	1610	670	
		4	..5567-3TA	C-C'	510	3250	40	56	1250	1280	1395	1290	820	820	1675	1540	670	
	36	6	..5580-3CA	E-E'	760	5400	x	64	1220	x	1420	x	960	x	1700	x	670	
400	12	4	..5644-3LA	B-A'	930	6000	52	68	1180	1160	1470	1390	930	930	1700	1425	670	
		4	..5644-3RA	A-C'	610	4600	42	58	1320	1310	1400	1360	820	820	1700	1430	670	
		4	..5644-3TA	C-C'	610	3850	42	58	1470	1470	1410	1390	820	820	1695	1420	670	
	24	4	..5667-3LA	B-A'	930	6000	52	68	1240	1220	1570	1570	940	940	1655	1510	670	
		4	..5667-3RA	A-C'	610	4600	42	58	1370	1350	1475	1400	820	820	1760	1615	670	
		4	..5667-3TA	C-C'	610	3850	42	58	1490	1520	1440	1400	820	820	1765	1540	670	
	36	6	..5580-3CA	E-E'	930	6200	x	65	1480	x	1470	x	990	x	1830	x	670	
(500)	12	4	..5744-3LA	B-A'	1100	7100	53	69	1410	1380	1500	1430	840	840	1710	1440	670	
		4	..5744-3RA	A-C'	720	5450	42	59	1650	1620	1560	1550	890	890	1745	1470	670	
		4	..5744-3TA	C-C'	720	4550	43	59	1700	1710	1500	1470	820	820	1745	1470	670	
	24	4	..5767-3LA	B-A'	1100	7100	53	69	1460	1440	1470	1530	835	850	1755	1610	670	
		4	..5767-3RA	A-C'	720	5450	42	59	1650	1620	1495	1420	835	820	1815	1665	670	
		4	..5767-3TA	C-C'	720	4550	43	59	1860	1910	1535	1500	820	820	1860	1645	670	
	36	6	..5780-3CA	E-E'	1050	7800	x	66	1680	x	1510	x	1030	x	1900	x	670	

Dimensions and weights are approximate values. Rated power figures in parentheses are not standardized.

x: on request

\* In case of short-circuits at 75 °C

Fig. 27: Selection table: oil-immersed distribution transformers 50 to 2500 kVA

# Technical Data Distribution Transformers

## TUNORMA and TUMETIC

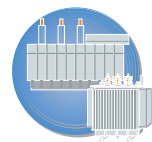
Rated power	Max. rated volt. HV side	Impe- dance voltage	Type		Combina- tion of losses acc. CENELEC	No-load losses	Load losses	Sound press. level 1 m toler- ance + 3 dB	Sound power level	Total weight		Dimensions						Dist. between wheel centers
			TUNORMA	TUMETIC						Length A1		Width B1		Height H1				
$S_n$ [kVA]	$U_m$ [kV]	$U_2$ [%]	4JB...	4HB...		$P_0$ [W]	$P_k$ 75* [W]	$L_{PA}$ [dB]	$L_{WA}$ [dB]									E [mm]
630	12	4	..5844-3LA	B-A'		1300	8400	53	70	1660	1660	1680	1480	880	880	1755	1585	670
		4	..5844-3RA	A-C'		860	6500	43	60	1850	1810	1495	1420	835	820	1785	1510	670
		4	..5844-3TA	C-C'		860	5400	43	60	2000	1990	1535	1380	820	820	1860	1520	670
		6	..5844-3PA	B-A'		1200	8700	53	70	1750	1760	1720	1560	890	890	1920	1685	670
		6	..5844-3SA	A-C'		800	6750	43	60	1950	1920	1665	1600	870	870	1740	1400	670
		6	..5844-3UA	C-C'		800	5600	43	60	2160	2130	1670	1560	830	830	1840	1500	670
	24	4	..5867-3LA	B-A'		1300	8400	53	70	1690	1650	1665	1640	860	860	1810	1595	670
		4	..5867-3RA	A-C'		860	6500	43	60	1940	1920	1685	1680	870	870	1910	1695	670
		4	..5867-3TA	C-C'		860	5400	43	60	2100	2130	1600	1490	820	820	1940	1725	670
		6	..5867-3PA	B-A'		1200	8700	53	70	1730	1720	1780	1580	880	880	1760	1610	670
		6	..5867-3SA	A-C'		800	6750	43	60	1970	1960	1645	1640	830	830	1810	1595	670
		6	..5867-3UA	C-C'		800	5600	43	60	2240	2210	1740	1670	880	880	1840	1625	670
		36	6	..5880-3CA	E-E'		1300	8800	x	67	1950	x	1740	x	1080	x	1940	x
(800)	12	6	..5944-3PA	B-A'		1450	10700	55	72	1990	1960	1780	1540	1000	1000	1905	1660	670
		6	..5944-3SA	A-C'		950	8500	45	62	2210	2290	1720	1830	900	960	1935	1630	670
		6	..5944-3UA	C-C'		950	7400	44	62	2520	2490	1760	1710	920	920	1975	1730	670
	24	6	..5967-3PA	B-A'		1450	10700	55	72	2000	1950	1720	1710	1000	1000	1885	1670	670
		6	..5967-3SA	A-C'		950	8500	45	62	2390	2340	1760	1710	960	960	1945	1730	670
		6	..5967-3UA	C-C'		950	7400	44	62	2590	2550	1770	1700	930	930	1985	1780	670
		36	6	..5980-3CA	E-E'		1520	11000	x	68	2400	x	1800	x	1100	x	2030	x
1000	12	6	..6044-3PA	B-A'		1700	13000	55	73	2450	2640	1790	1630	1000	1000	2095	2070	820
		6	..6044-3SA	A-C'		1100	10500	45	63	2660	2610	1830	1830	1040	1040	2025	1770	820
		6	..6044-3UA	C-C'		1100	9500	45	63	2800	2750	1830	1830	1040	1040	2105	1840	820
	24	6	..6067-3PA	B-A'		1700	13000	55	73	2530	2720	1830	1670	1090	1010	2095	2120	820
		6	..6067-3SA	A-C'		1100	10500	45	63	2750	2690	1790	1740	1050	1050	2055	1840	820
		6	..6067-3UA	C-C'		1100	9500	45	63	2830	2810	1725	1770	990	990	2065	1850	820
		36	6	..6080-3CA	E-E'		1700	13000	x	68	2850	x	2120	x	1160	x	2220	x

Dimensions and weights are approximate values. Rated power figures in parentheses are not standardized.

x: on request

\* In case of short-circuits at 75 °C

Fig. 28: Selection table: oil-immersed distribution transformers 50 to 2500 kVA



# Technical Data Distribution Transformers TUNORMA and TUMETIC

Rated power	Max. rated volt. HV side	Impe- dance voltage	Type		Combini- tion of losses acc. CENELEC	No-load losses	Load losses	Sound press. level 1 m tolerance + 3 dB	Sound power level	Total weight		Dimensions						Dist. between wheel centers
			TUNORMA	TUMETIC						Length A1		Width B1		Height H1				
S <sub>n</sub> [kVA]	U <sub>m</sub> [kV]	U <sub>2</sub> [%]	4JB...	4HB...		P <sub>0</sub> [W]	P <sub>k</sub> 75* [W]	L <sub>PA</sub> [dB]	L <sub>WA</sub> [dB]								E [mm]	
(1250)	12	6	..6144-3PA	B-A'	2100	16000	56	74	2900	3080	1930	1850	1260	1100	2110	2070	820	
		6	..6144-3SA	A-C'	1300	13200	46	64	3100	3040	1810	1780	990	990	2145	1880	820	
		6	..6144-3UA	C-C'	1300	11400	46	64	3340	3040	1755	1720	1015	1000	2235	1970	820	
	24	6	..6167-3PA	B-A'	2100	16000	56	74	2950	3200	2020	1780	1260	1100	2110	2220	820	
		6	..6167-3SA	A-C'	1300	13200	46	64	3190	3120	1840	1810	1060	1060	2115	1900	820	
		6	..6167-3UA	C-C'	1300	11400	46	64	3390	3330	1810	1780	1015	990	2245	2030	820	
	36	6	..6180-3CA	E-E'	2150	16400	x	70	3360	x	2150	x	1250	x	2350	x	820	
1600	12	6	..6244-3PA	B-A'	2600	20000	57	76	3450	3590	1970	1870	1220	1140	2315	2095	820	
		6	..6244-3SA	A-C'	1700	17000	47	66	3640	3590	2030	1760	1080	1090	2315	2010	820	
		6	..6244-3UA	C-C'	1700	14000	47	66	3930	3880	2020	1900	1110	1100	2395	2070	820	
	24	6	..6267-3PA	B-A'	2600	20000	57	76	3470	3690	2070	1830	1280	1120	2335	2320	820	
		6	..6267-3SA	A-C'	1700	17000	47	66	3670	3850	2030	2000	1230	1070	2265	2120	820	
		6	..6267-3UA	C-C'	1700	14000	47	66	4010	3950	2000	1850	1030	1030	2305	2010	820	
	36	6	..6280-3CA	E-E'	2600	19200	x	71	3930	x	2170	x	1340	x	2480	x	820	
(2000)	12	6	..6344-3PA	B-A'	2900	25300	58	78	4390	4450	2100	1890	1330	1330	2555	2540	1070	
		6	..6344-3SA	A-C'	2050	21200	49	68	4270	4430	2080	1840	1330	1330	2455	2250	1070	
		6	..6344-3UA	C-C'	2050	17500	49	68	4730	4710	2020	1730	1330	1330	2495	2170	1070	
	24	6	..6367-3PA	B-A'	2900	25300	58	78	4480	4500	2020	1860	1330	1330	2655	2660	1070	
		6	..6367-3SA	A-C'	2050	21200	49	68	4290	4490	2190	2030	1330	1330	2425	2280	1070	
		6	..6367-3UA	C-C'	2050	17500	49	68	4910	4840	2110	1980	1330	1330	2475	2180	1070	
	36	6	..6380-3CA	E-E'	3200	22000	x	75	5100	x	2260	x	1380	x	2560	x	1070	
2500	12	6	..6444-3PA	B-A'	3500	29000	61	81	5200	5090	2115	2030	1345	1330	2685	2550	1070	
		6	..6444-3SA	A-C'	2500	26500	51	71	5150	5110	2195	1950	1345	1330	2535	2450	1070	
		6	..6444-3UA	C-C'	2500	22000	51	71	5790	5660	2190	2190	1330	1330	2565	2240	1070	
	24	6	..6467-3PA	B-A'	3500	29000	61	81	5420	5220	2115	2030	1335	1330	2785	2675	1070	
		6	..6467-3SA	A-C'	2500	26500	51	71	5260	5220	2195	2030	1335	1335	2585	2580	1070	
		6	..6467-3UA	C-C'	2500	22000	51	71	5640	5470	2160	2080	1330	1330	2605	2305	1070	
	36	6	..6480-3CA	E-E'	3800	29400	x	76	5900	x	2320	x	1390	x	2790	x	1070	

Dimensions and weights are approximate values. Rated power figures in parentheses are not standardized.

x: on request

\* In case of short-circuits at 75 °C

Fig. 29: Selection table: oil-immersed distribution transformers 50 to 2500 kVA

# Power Transformers – General

## Oil-immersed three-phase power transformers with off- and on-load tap changers

### Cooling methods

Transformers up to 10 MVA are designed for ONAN cooling.

By adding fans to these transformers, the rating can be increased by 25%.

However, in general it is more economical to select higher ONAN ratings rather than to add fans.

Transformers larger than 10 MVA are designed with ONAN/ONAF cooling.

Explanation of cooling methods:

- ONAN: Oil-natural, air-natural cooling
- ONAF: Oil-natural, air-forced cooling (in one or two steps)

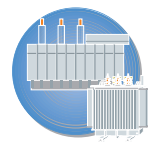
The arrangement with the attached radiators, as shown in the illustrations, is the preferred design. However, other arrangements of the cooling equipment are also possible.

Depending on transportation possibilities the bushings, radiators and expansion tank have to be removed. If necessary, the oil has to be drained and shipped separately.

Rated power [MVA]	HV range [kV]	Type of tap changer	Figure/ page
3.15 to 10	25 to 123	off-load	Fig. 31, page 5/19
3.15 to 10	25 to 123	on-load	Fig. 33, page 5/20
10/16 to 20/31.5	up to 36	off-load	Fig. 35, page 5/21
10/16 to 20/31.5	up to 36	on-load	Fig. 38, page 5/22
10/16 to 63/100	72.5 to 145	on-load	Fig. 41, page 5/23

Note: Off-load tap changers are designed to be operated de-energized only.

Fig. 30: Types of power transformers



# Power Transformers – Selection Tables

## Technical Data, Dimensions and Weights

Oil-immersed three-phase power transformers with off-load tap changer  
3150–10000 kVA,  
HV rating: up to 123 kV

- Taps on HV side:  $\pm 2 \times 2.5\%$
- Rated frequency: 50 Hz
- Impedance voltage: 6-10 %
- Connection: HV winding: star-delta connection alternatively available up to 24 kV  
LV winding: star or delta

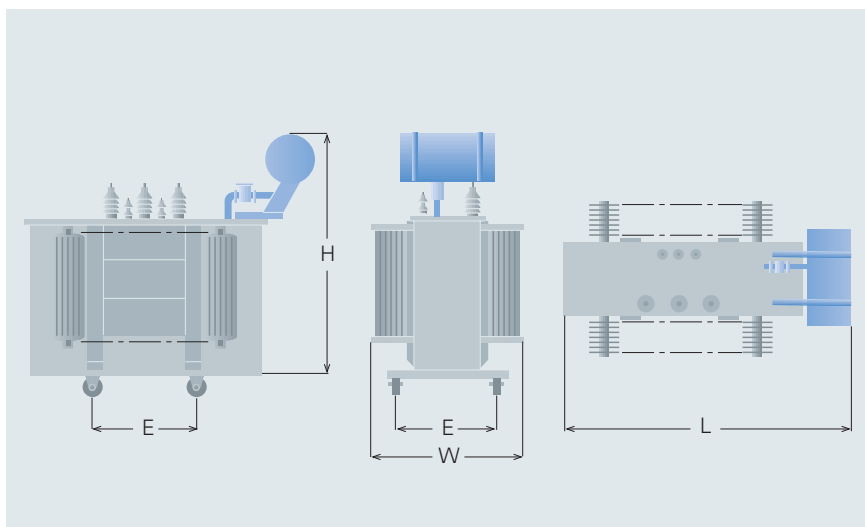


Fig. 31

Rated power [kVA] ONAN	HV rating [kV]	LV rating [kV]	No-load loss [kW]	Load loss at 75 °C [kW]	Total weight [kg]	Oil weight [kg]	Dimensions L/W/H [mm]	E [mm]
3150	6.1–36	3–24	4.6	28	7200	1600	2800/1850/2870	1070
4000	7.8–36	3–24	5.5	33	8400	1900	3200/2170/2940	1070
	50–72.5	3–24	6.8	35	10800	3100	3100/2300/3630	1070
5000	9.5–36	4–24	6.5	38	9800	2300	2550/2510/3020	1070
	50–72.5	4–24	8.0	41	12200	3300	3150/2490/3730	1070
	90–123	5–36	9.8	46	17500	6300	4560/2200/4540	1505
6300	12.2–36	5–24	7.7	45	11700	2500	2550/2840/3200	1505
	50–72.5	5–24	9.3	48	13600	3700	3200/2690/3080	1505
	90–123	5–36	11.0	53	18900	6600	4780/2600/4540	1505
8000	12.2–36	5–24	9.4	54	14000	3300	2580/2770/3530	1505
	50–72.5	5–24	11.0	56	15900	4200	3250/2850/4000	1505
	90–123	5–36	12.5	62	21500	7300	4880/2630/4590	1505
10000	15.2–36	6–24	11.0	63	16600	3900	2670/2900/3720	1505
	50–72.5	6–24	12.5	65	18200	4700	4060/2750/4170	1505
	90–123	5–36	14.0	72	25000	8600	4970/2900/4810	1505

Fig. 32

# Power Transformers – Selection Tables

## Technical Data, Dimensions and Weights

Oil-immersed three-phase power transformers with on-load tap changer  
3 150–10 000 kVA,  
HV rating: up to 123 kV

- Taps on HV side:  $\pm 16\%$  in  $\pm 8$  steps of  $2\%$
- Rated frequency: 50 Hz
- Impedance voltage: 6–10 %
- Connection: HV winding: star  
LV winding: star or delta

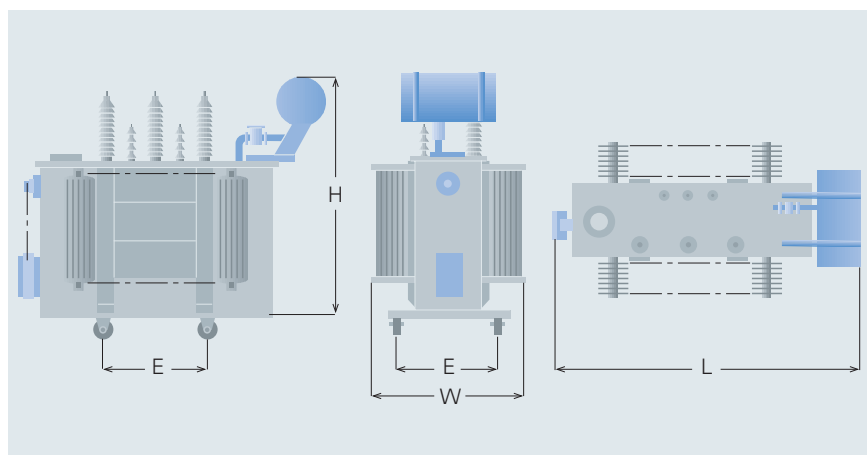
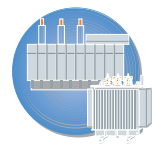


Fig. 33

Rated power [kVA] ONAN	HV rating [kV]	LV rating [kV]	No-load loss kW	Load loss at 75 °C [kW]	Total weight [kg]	Oil weight [kg]	Dimensions L/W/H [mm]	E [mm]
3150	10.9–36	3–24	4.8	29	9100	2300	3400/2300/2900	1070
4000	9.2–36	3–24	5.8	35	10300	2600	3500/2700/3000	1070
	50–72.5	4–24	7.1	37	13700	4100	4150/2350/3600	1070
5000	11.5–36	4–24	6.8	40	12300	3100	3600/2400/3200	1070
	50–72.5	5–24	8.4	43	15200	4500	4200/2700/3700	1070
	90–123	5–36	9.8	49	21800	8000	5300/2700/4650	1505
6300	14.4–36	5–24	8.1	47	14000	3600	3700/2700/3300	1505
	50–72.5	5–24	9.8	50	17000	5000	4300/2900/3850	1505
	90–123	5–36	11.5	56	23000	8500	5600/2900/4650	1505
8000	18.3–36	5–24	9.9	57	17000	4500	3850/2500/3500	1505
	50–72.5	5–24	11.5	59	19700	6000	4600/2800/4050	1505
	90–123	5–36	13.1	65	25500	9000	5650/2950/4650	1505
10000	22.9–36	6–24	11.5	66	20000	5200	4400/2600/3650	1505
	50–72.5	6–24	13.1	68	22500	6500	5200/2850/4100	1505
	90–123	5–36	14.7	76	29500	10250	5750/2950/4700	1505

Fig. 34





# Power Transformers – Selection Tables

## Technical Data, Dimensions and Weights

Oil-immersed three-phase  
power transformers  
with off-load tap changer  
10/16 to 20/31.5 MVA  
HV rating: up to 36 kV

- Rated frequency: 50 Hz, tapping range  $\pm 2 \times 2.5\%$
- Connection of HV winding: star
- Connection of LV winding: star or delta
- Cooling method: ONAN/ONAF
- LV range: 6 kV to 36 kV

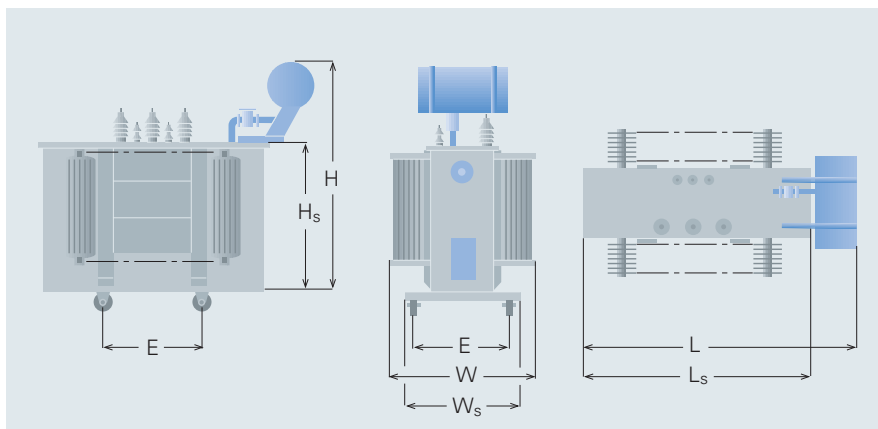


Fig. 35

Rated power at ONAN    ONAF		No-load loss	Load loss at		Impedance voltage of	
[MVA]	[MVA]		ONAN	ONAF	ONAN	ONAF
		[kW]	[kW]	[kW]	[%]	[%]
10	16	12	31	80	6.3	10
12.5	20	14	37	95	6.3	10
16	25	16	45	110	6.4	10
20	31.5	19	52	130	6.4	10

Fig. 36

Rated power at ONAN      ONAF		Dimensions L x W x H			Total weight	Oil weight	Shipping dimensions L <sub>s</sub> x W <sub>s</sub> x H <sub>s</sub>			Shipping weight incl. oil
[MVA]	[MVA]	[mm]			[kg]	[kg]	[mm]			[kg]
10	16	3700	2350	3900	22	4200	3600	1550	2650	22000
12.5	20	3800	2350	4000	25	4500	3700	1600	2800	23000
16	25	3900	2400	4100	30	5000	3800	1600	2800	27000
20	31.5	4200	2450	4600	35	5700	3900	1650	3000	31500

Fig. 37

# Power Transformers – Selection Tables

## Technical Data, Dimensions and Weights

Oil-immersed three-phase power transformer with on-load tap changer  
10/16 to 20/31.5 MVA,  
HV rating: up to 36 kV

- Rated frequency: 50 Hz, tapping range  $\pm 16\%$  in  $\pm 9$  steps
- Connection of HV winding: star
- Connection of LV winding: star or delta
- Cooling method: ONAN/ONAF
- LV range: 6 kV to 36 kV

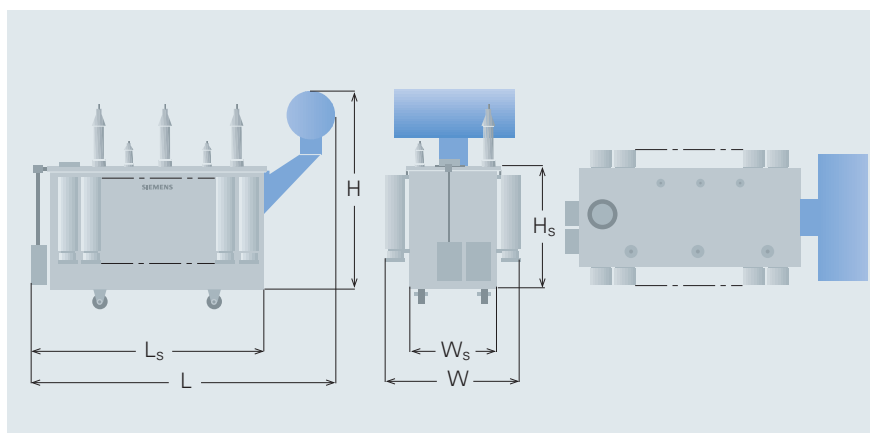


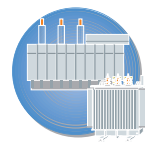
Fig. 38

Rated power at ONAN      ONAF		No-load loss [kW]	Load loss at ONAN      ONAF		Impedance voltage of ONAN      ONAF	
[MVA]	[MVA]		[kW]	[kW]	[%]	[%]
10	16	12	31	80	6.3	10
12.5	20	14	37	95	6.3	10
16	25	16	45	111	6.4	10
20	31.5	19	52	130	6.4	10

Fig. 39

Rated power at ONAN      ONAF		Dimensions L x W x H			Total weight	Oil weight	Shipping dimensions L <sub>s</sub> x W <sub>s</sub> x H <sub>s</sub>			Shipping weight incl. oil
[MVA]	[MVA]	[mm]			[kg]	[kg]	[mm]			[kg]
10	16	4800	2450	3900	27000	6200	4400	1550	2600	24000
12.5	20	4900	2500	4000	30000	6700	4500	1600	2650	27000
16	25	5050	2500	4100	34000	7000	4650	1650	2650	31000
20	31.5	5300	2550	4600	41000	9000	5000	1700	3000	37000

Fig. 40



# Power Transformers – Selection Tables

## Technical Data, Dimensions and Weights

Oil-immersed three-phase power transformers with on-load tap changer  
10/16 to 63/100 MVA,  
HV rating: from 72.5 to 145 kV

- Rated frequency: 50 Hz, tapping range  $\pm 16\%$  in  $\pm 9$  steps
- Connection of HV winding: star
- Connection of LV winding: star or delta
- Cooling method: ONAN/ONAF

Rated power at ONAN ONAF		No-load loss	Load loss at ONAN ONAF		Impedance voltage of ONAN ONAF	
[MVA]	[MVA]	[kW]	[kW]	[kW]	[%]	[%]
10	16	13	42	108	9.6	15.4
12.5	20	15	45	115	9.4	15.0
16	25	17	51	125	9.6	15.0
20	31.5	20	56	140	9.6	15.1
25	40	24	63	160	9.5	15.2
31.5	50	28	71	180	9.5	15.0
40	63	35	86	214	9.8	15.5
50	80	41	91	232	10.0	16.0
63	100	49	113	285	10.5	16.7

Fig. 41

Rated power at ONAN ONAF		Dimensions L x W x H			Total weight	Oil weight	Shipping dimensions L <sub>s</sub> x W <sub>s</sub> x H <sub>s</sub>			Shipping weight incl. oil
[MVA]	[MVA]	[mm]			[kg]	[kg]	[mm]			[kg]
10	16	6600	2650	4700	39000	12000	5200	1900	3000	35000
12.5	20	6700	2700	4800	43000	12500	5300	1950	3100	39000
16	25	6750	2750	5300	48000	13500	5400	2000	3000	43000
20	31.5	6800	2800	5400	54000	14000	5500	2000	3100	49000
25	40	6900	2900	5400	61000	14500	5700	2100	3150	56000
31.5	50	7050	2950	5500	70000	17000	5850	2150	3350	65000
40	63	7100	3000	5700	82000	18000	6100	2200	3450	75000
50	80	7400	3100	5800	97000	20500	6250	2300	3700	90000
63	100	7800	3250	6100	118000	25500	6800	2450	4000	109000

Fig. 42

# Power Transformers above 100 MVA



The power rating range above 100 MVA comprises mainly generator transformers and system-interconnecting transformers with off-load and/or on-load tap changers.

Depending on the on-site requirements, they can be designed as transformers with separate windings or as autotransformers, three- or single-phase, for power ratings up to over 1000 MVA and voltages up to 1500 kV.

We manufacture these units according to IEC 76, VDE 0532 or other national specifications.

Offers for transformers larger than 100 MVA only on request.

Fig. 43: Coal-fired power station in Germany with two 850-MVA generator transformers:  
Low-noise design, extended setting range and continuous overload capacity up to 1100 MVA

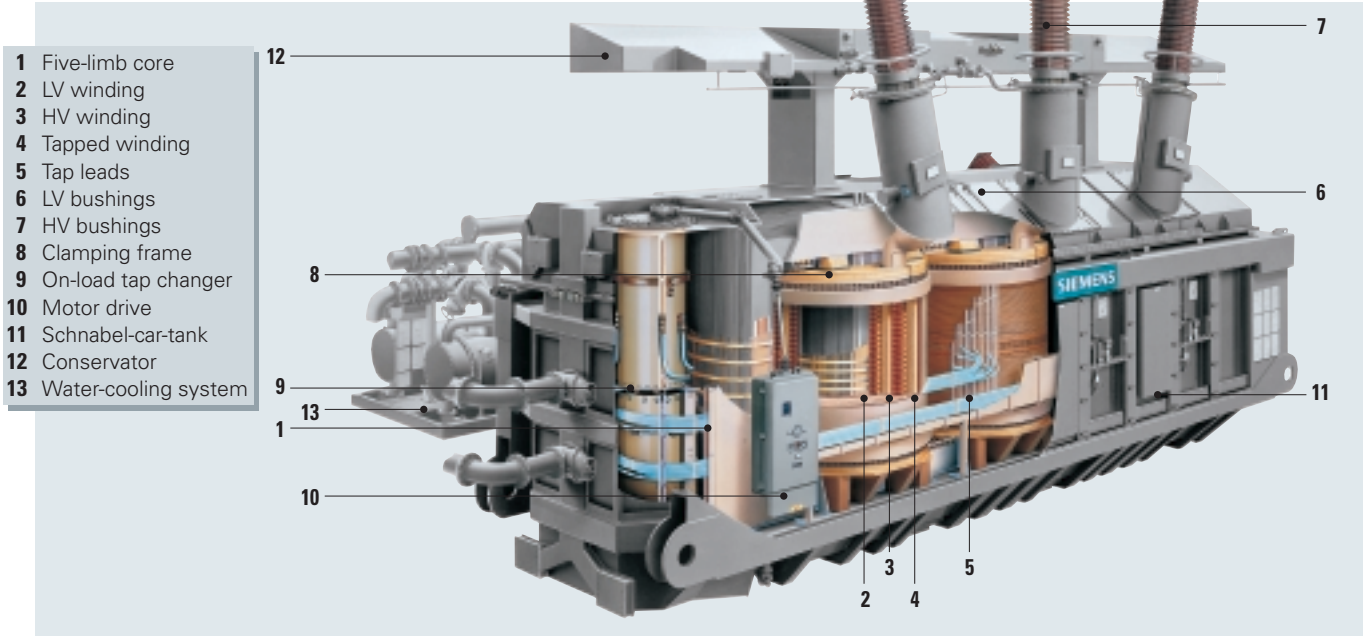
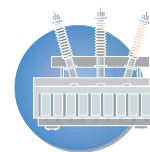


Fig. 44: View into an 850/1100-MVA generator transformer



# Power Transformers Monitoring System

## Siemens Monitoring System: Efficient Condition Recording and Diagnosis for Power Transformers

Complete acquisition and evaluation of up to 45 measured variables, automatic trend analysis, diagnosis and early warning – the new Siemens Monitoring System makes use of all possible ways of monitoring power transformers: Round the clock, with precision sensors for voltage, temperature or quality of insulation, and with powerful software for measured data processing, display or documentation – with on-line communication over any distance.

Maintenance and utilization of power transformers are made more efficient all-round. Because the comprehensive information provided on the condition of the equipment and auxiliaries ensures that maintenance is carried out just where it's needed, costly routine inspections are a thing of the past. And because the maintenance is always preventive, faults are reliably ruled out.

All these advantages enhance availability – and thus ensure a long service life of your power transformers. This applies equally to new and old transformers.

Equipping new transformers with the Siemens Monitoring System ensures that right from the start the user is in possession of all essential data—for quick, comprehensive analysis. And retrofitting on transformers already in service for considerable periods pays off as well.

Particularly in the case of old transformers, constant monitoring significantly reduces the growing risk of failure.

Offers for transformers larger 100 MVA only on request.



Fig. 45: An integrated solution – the complete Monitoring System housed in a cubicle of the transformer itself



# On-load Tap Changers

The on-load tap changers installed in Siemens power transformers are manufactured by Maschinenfabrik Reinhausen (MR). MR is a supplier of technically advanced on-load tap changers for oil-immersed power transformers covering an application range from 100 A to 4,500 A and up to 420 kV. About 90,000 MR high-speed resistor-type tap changers are successfully in service worldwide.

The great variety of tap changer models is based on a modular system which is capable of meeting the individual customer's specifications for the respective operating conditions of the transformer. Depending on the required application range selector, switches or diverter switches with tap selectors can be used, both available for neutral, delta or single-pole connection. Up to 107 operating positions can be achieved by the use of a multiple course tap selector.

In addition to the well-known on-load tap-changer for installation in oil-immersed transformers, MR offers also a standardized gas-insulated tap changer for indoor installation which will be mounted on dry-type transformers up to approx. 30 MVA and 36 kV, or SF<sub>6</sub>-type transformers up to 40 MVA and 123 kV.

The main characteristics of MR products are:

- Compact design
- Optimum adaption and economic solutions offered by the great number of variants
- High reliability
- Long life
- Reduced maintenance
- Service friendliness

The tap changers are mechanically driven – via the drive shafts and the bevel gear – by a motor drive attached to the transformer tank. It is controlled according to the step-by-step principle. Electrical and mechanical safety devices prevent over-running of the end positions. Further safety measures, such as the automatic restart function, a safety circuit to prevent false phase sequence and running through positions, ensure the reliable operation of motor drives.

For operation under extremely onerous conditions an oil filter unit is available for filtering or filtering and drying of the switching oil. Voltage monitoring is effected by microprocessor-controlled operation control systems or voltage regulators which include a great variety of data input and output facilities.

In combination with a parallel control unit, several transformers connected in parallel can be automatically controlled and monitored.

Furthermore, Maschinenfabrik Reinhausen offers a worldwide technical service to maintain their high quality standard. Inspections at regular intervals with only small maintenance requirements guarantee the reliable operation expected with MR products.



Fig. 46: MR motor drive ED 100 S

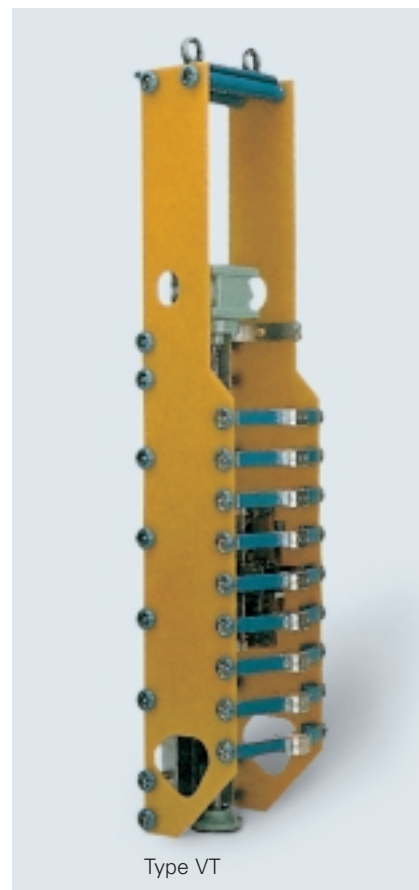


Fig. 47: Gas-insulated on-load tap changer

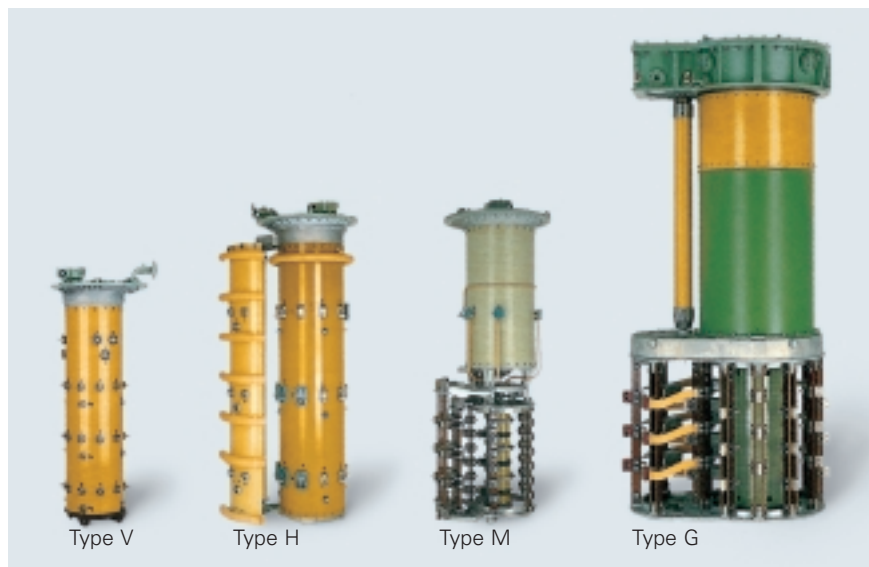


Fig. 48: Selection of on-load tap changers from the MR product range