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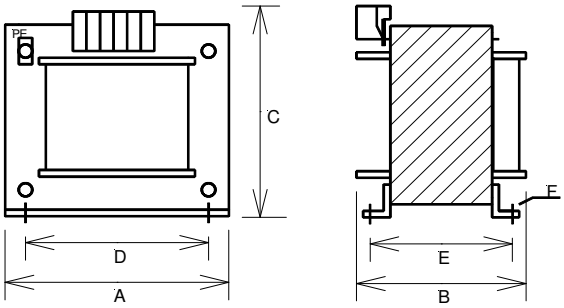
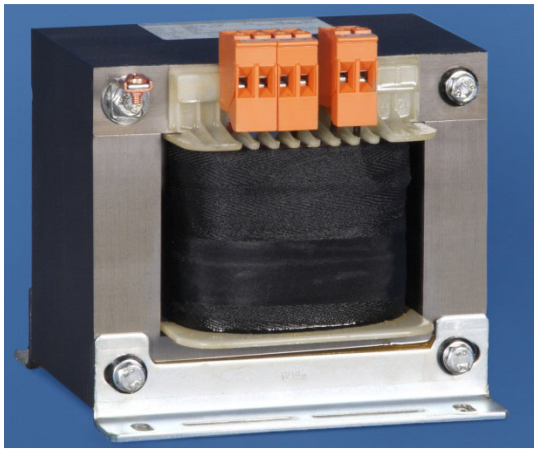
1. Single - phase control transformers

1.1 Type ST 63 – 2500 VA, mains transformer

Corresponding to VDE 0570/ DIN EN 61558-2-2,
DIN EN 61558-2-4, DIN EN 61558-2-1





Construction:
Open transformer, separate windings. Type protection IP 00, suitable for installations up to IP 23.
Corrosion protection via complete impregnation. Insulation class T50B (T40E).

Type	Power	*short-term performance	Design size	Copper weight	Total weight	Dimensioning					
						A	B	C	D	E	F
	VA	VA	Core	kg	kg	mm	mm	mm	mm	mm	mm
ST 006	63	130	EI 78	0.22	1.4	78	75	125	56	54	5.8x11
ST 010	100	225	EI 96	0.35	2.1	96	90	125	84	70	5.8x11
ST 016	160	530	EI 105	0.47	3.1	105	90	125	84	70	5.8x11
ST 020	200	630	EI 105	0.50	4.0	105	105	125	84	85	5.8x11
ST 025	250	730	EI 120	0.81	4.6	120	100	125	90	82	5.8x11
ST 032	320	1130	EI 120	0.90	5.7	120	109	125	90	89	5.8x11
ST 040	400	1530	EI 120	1.10	6.5	120	122	125	90	101	5.8x11
ST 050	500	2000	EI 135	1.20	8.0	135	130	130	104	106	5.8x11
ST 063	630	2900	EI 135	1.55	8.4	135	130	130	104	106	5.8x11
ST 080	800	3700	EI 150	1.80	13.0	150	146	155	122	126	7x13
ST 100	1,000	4000	EI 150	2.40	13.5	150	146	155	122	126	7x13
ST 120	1,200	4100	EI 174	3.20	14.4	174	140	200	135	106	7x13
ST 160	1,600	4260	EI 174	3.70	22.0	174	175	200	135	136	7x13
ST 200	2,000	5700	EI 192	4.90	25.0	192	180	200	150	144	10x18
ST 250	2,500	6300	EI 192	5.50	26.0	192	190	200	150	150	10x18

see technical annotations 17.1

Standard voltages:

Primary 230 V and/or 400 V +/- 5%
Secondary 24 V or 230 V
Other voltages on request

Ordering example:

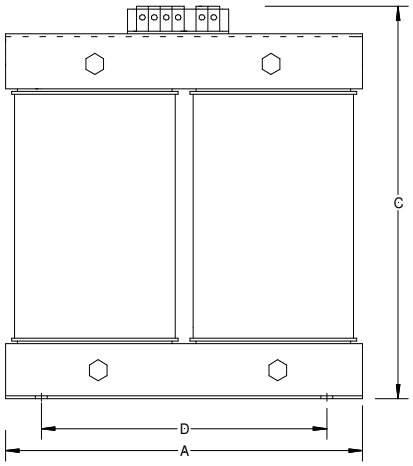
Primary	230 V +/- 5%
Secondary	24 V 100 VA
Reference number:	ST010230024

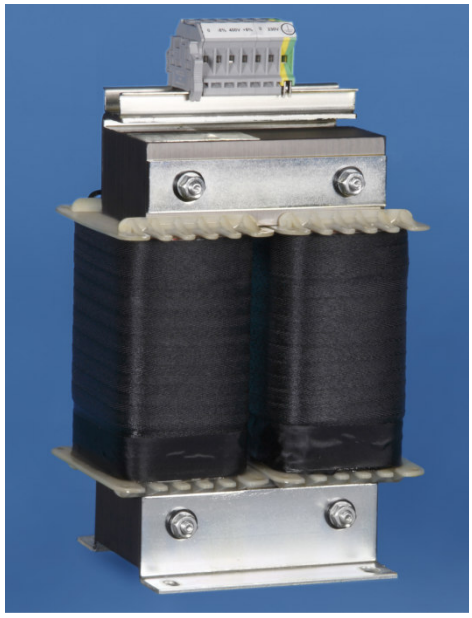
To assure see technical data 17.2.

Single – phase control transformers

1.2 Type STU 1.6 – 6.3 KVA, vertical

Corresponding to VDE 0570/ DIN EN 61558-2-2, DIN EN 61558-2-4





Construction:
Open transformer, separate windings. Type protection IP 00, suitable for installations up to IP 23.
Corrosion protection via complete impregnation. Insulation class T50B (T40E).

Type	Power	*Short-term performance	Copper weight	Total weight	Dimensioning					
					A	B	C	D	E	F
	KVA	VA	kg	kg	mm	mm	mm	mm	mm	mm
STU 1.6	1.6	4,350	4.50	17.0	160	141	208	100	103	7.0
STU 2.0	2.0	5,150	4.90	21.0	176	141	228	112	102	10.0
STU 2.5	2.5	9,000	7.50	25.0	200	135	260	124	107	10.0
STU 3.0	3.0	11100	8.80	33.0	200	147	260	124	119	10.0
STU 4.0	4.0	13200	11.50	27.0	226	138	357	136	110	11.0
STU 5.0	5.0	14100	12.80	32.0	226	172	357	136	144	11.0
STU 6.3	6.3	22000	16.50	58.0	280	173	360	176	143	12.0

**see technical annotations 17.1*

Standard voltages:

Primary 230 V and/or 400 V +/- 5%
Secondary 24 V or 230 V
Other voltages on request

Ordering example:

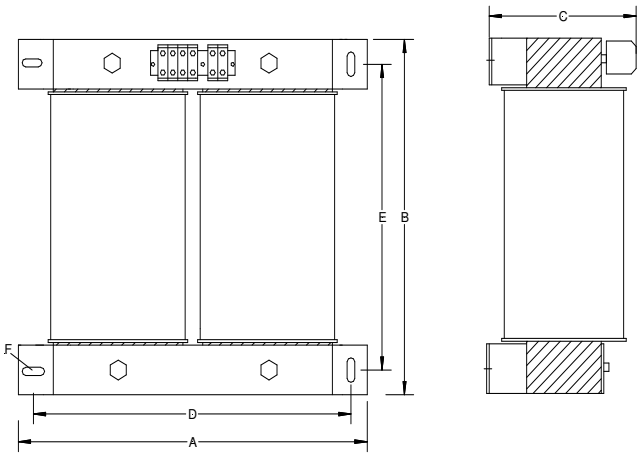
Primary	400 V +/- 5%
Secondary	230 V 1.6 KVA
Reference number:	STU1.6400230

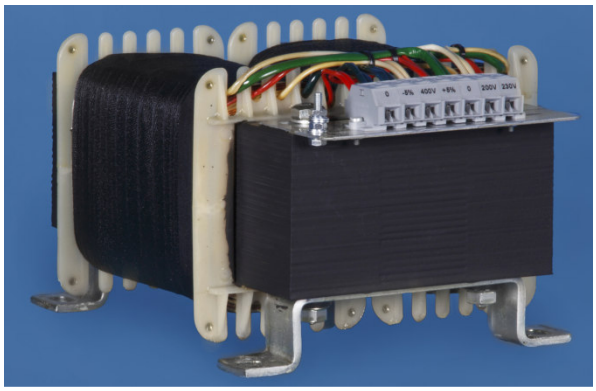
To assure see technical data 17.2.

Single - phase control transformers

1.3 Type STUL 1.6 – 6.3 KVA, horizontal

Corresponding to VDE 0570/ DIN EN 61558-2-2, DIN EN 61558-2-4





Construction:
Open transformer, separate windings. IP 00 type protection, suitable for installations up to IP 23.
Corrosion protection via complete impregnation. Insulation class T50B (T40E).

Type	Power	*Short-term performance	Copper weight	Total weight	Dimensioning					
					A	B	C	D	E	F
	KVA	VA	kg	kg	Mm	mm	mm	mm	mm	mm
STUL 1.6	1.6	4350	4.50	17.0	166	250	165	146	160	7x13
STUL 2.0	2.0	5150	4.90	21.0	166	270	165	146	176	7x13
STUL 2.5	2.5	9000	7.50	25.0	194	300	160	174	200	7x13
STUL 3.0	3.0	11100	8.80	33.0	194	300	172	174	200	7x13
STUL 4.0	4.0	13200	11.50	27.0	228	310	148	192	222	7x13
STUL 5.0	5.0	14100	12.80	32.0	228	310	182	192	222	7x13
STUL 6.3	6.3	22000	16.50	58.0	260	400	180	234	280	9x13

**see technical annotations 17.1*

Standard voltages:

Primary 230 V and/or 400 V +/- 5%
Secondary 24 V or 230 V
Other voltages on request

To assure see technical data 17.2.

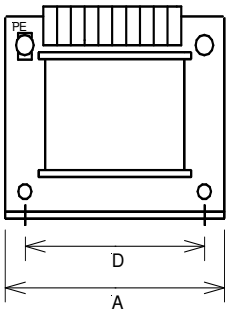
Ordering example:

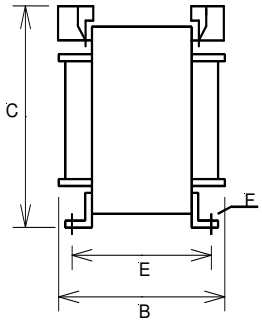
Primary	400 V +/- 5%
Secondary	230 V 1.6 KVA
Reference number:	STUL1.6400230

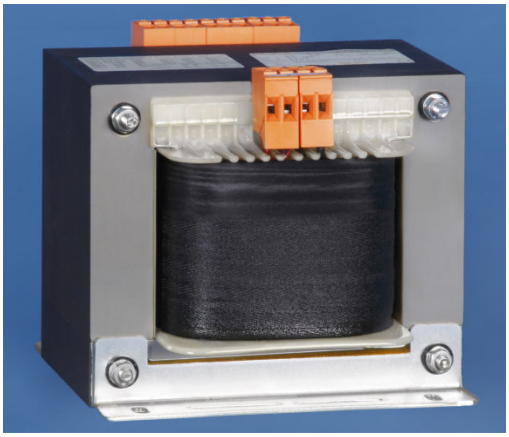
Single - phase universal control transformers

1.4 Type UST 160 – 2500 VA

Corresponding to VDE 0570/ DIN EN 61558-2-2,
DIN EN 61558-2-4







Construction:
Universal voltage. Open transformer, separate windings. Type protection IP 00, suitable for installations up to IP 23.
Corrosion protection via complete impregnation. Insulation class T50B (T40E).

Type	Power	*Short-term performance	Copper weight	Total weight	Dimensioning					
					A	B	C	D	E	F
	VA	VA	kg	kg	mm	mm	mm	mm	mm	mm
UST 016	160	470	0.80	3.5	105	90	125	84	70	5.8x11
UST 032	320	925	1.10	6.6	120	109	125	90	89	5.8x11
UST 040	400	1250	1.20	6.7	120	122	125	90	101	5.8x11
UST 050	500	1540	1.80	5.5	135	130	130	104	106	5.8x11
UST 063	630	2370	2.10	6.6	135	130	130	104	106	5.8x11
UST 080	800	3400	2.60	12.7	150	146	155	122	126	7x13
UST 100	1000	3860	3.10	15.1	150	146	155	122	126	7x13
UST 160	1600	4000	4.60	12.1	174	175	200	135	136	7x13
UST 200	2000	5180	4.90	15.4	192	180	200	150	144	10x18
UST 250	2500	8600	7.50	17.8	192	190	200	150	150	10x18

see technical annotations 17.1

Standard voltages:
Primary voltage
200-208-230-240-360-380-400-415-420-
440-460-480-500-530-550 V

Ordering example:

Primary	208 V
Secondary	115 V 2,000 VA
Reference number:	UST2.0208115

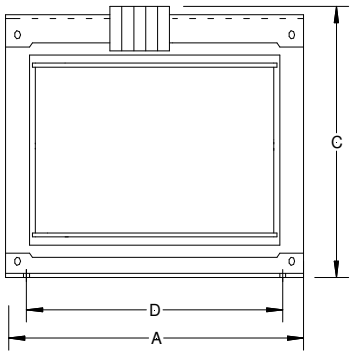
Secondary:
115/ 230 Volt

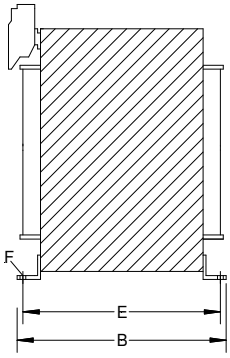
Other voltages on request. To assure see technical data 17.2.

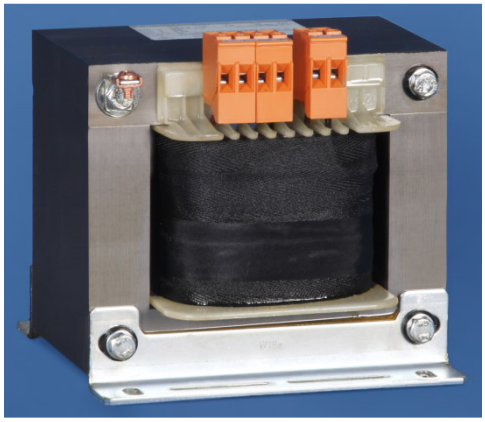
2. Single - phase isolation transformers

2.1 Type TR 60 – 1,600 VA

Corresponding to VDE 0570/ DIN EN 61558-2-4







Construction:
Open transformer, separate windings. Fixed with angle irons, up to 160 VA also available: snapable on bearing rails TS 35. Type protection IP 00, suitable for installations up to IP 23.
Corrosion protection via complete impregnation. Insulation class T40E.

Type	Power	Design size	Copper weight	Total weight	Dimensioning					
					A	B	C	D	E	F
	VA	Core	kg	kg	mm	mm	mm	mm	mm	mm
TR 006	60	EI 78	0.38	1.4	78	73	84	40	60.0	4.3
TR 010	100	EI 84	0.45	1.8	84	102	79	64	55.0	4.8
TR 016	160	EI 105	0.80	3.5	105	82	115	60	62.5	5.3
TR 020	200	EI 105	0.90	4.0	105	100	115	60	80.5	5.3
TR 032	320	EI 120	0.90	5.0	120	118	107	90	81.0	5.8
TR 040	400	EI 120	1.10	6.6	120	138	107	90	101.0	5.8
TR 050	500	EI 135	1.60	6.5	135	122	119	104	91.0	5.8
TR 063	630	EI 135	1.80	8.0	135	136	119	104	104.0	5.8
TR 080	800	EI 150	2.30	13.9	150	156	132	122	126.0	7.0
TR 100	1000	EI 174	2.60	12.7	174	128	153	135	102.0	9.0
TR 120	1200	EI 174	3.10	15.1	174	138	153	135	112.0	9.0
TR 140	1400	EI 174	3.30	18.0	174	148	153	135	122.0	9.0
TR 160	1600	EI 174	3.50	21.0	174	168	153	135	142.0	9.0

Standard voltages:

Primary 230 V and/or 400 V
Secondary 24V or 230Vq
Other voltages on request

Ordering example:

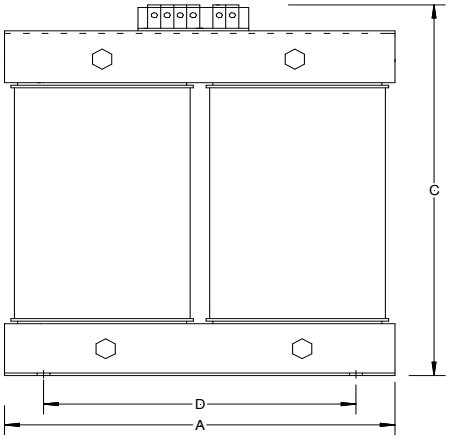
Primary	400V
Secondary	230 V 1.6 KVA
Reference number:	TR160400230

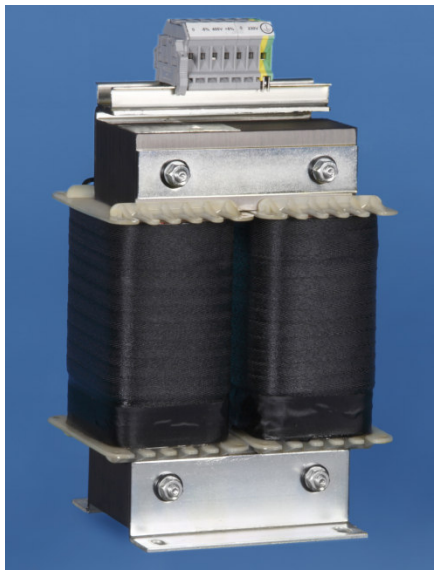
To assure see technical data 17.2.

Single – phase isolation transformers

2.2 Type TRU 2 - 16 KVA vertical

Corresponding to VDE 0570/ DIN EN 61558-2-4





Construction:
Open transformer separate windings. Fixed with angle irons.
Type protection IP 00 suitable for installations up to IP 23.
Corrosion protection via complete impregnation. Insulation class T40E.

Type	Power	Design size	Copper Weight	Total weight	Dimensioning					
					A	B	C	D	E	F
	KVA	Core	kg	kg	mm	mm	mm	mm	mm	mm
TRU 2.0	2.0	UI 132	4.9	21.0	176	141	228	112	102.0	10.0
TRU 2.5	2.5	UI 150	7.5	25.0	200	135	260	124	107.0	10.0
TRU 3.0	3.0	UI 150	8.8	33.0	200	147	260	124	119.0	10.0
TRU 4.0	4.0	UI 168a	11.5	27.0	226	138	357	136	110.0	11.0
TRU 5.0	5.0	UI 168	12.8	31.5	226	172	357	136	144.0	11.0
TRU 6.3	6.3	UI 210a	16.5	57.0	280	173	360	176	143.0	12.0
TRU 8.0	8.0	UI 210a	16.5	59.0	280	173	428	176	143.0	12.0
TRU 10.0	10.0	UI 210	20.0	70.0	280	188	428	176	158.0	12.0
TRU 12.5	12.5	UI 210	24.0	85.0	280	203	428	176	173.0	12.0
TRU 16.0	16.0	UI 210	28.0	102.0	280	233	428	176	203.0	12.0

Standard voltages:

Primary 230 V and/or 400 V
Secondary 24 V or 230 V
Other voltages on request

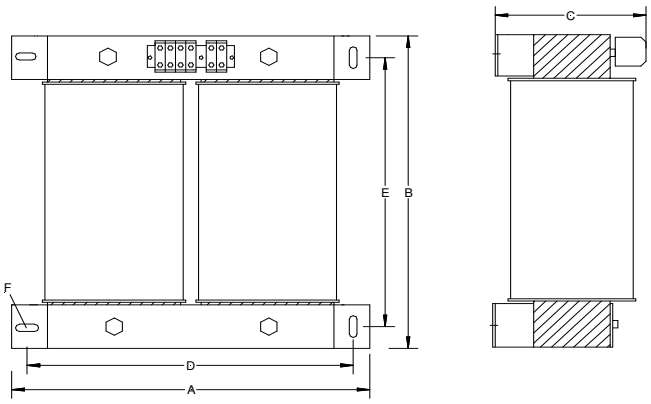
Ordering example:

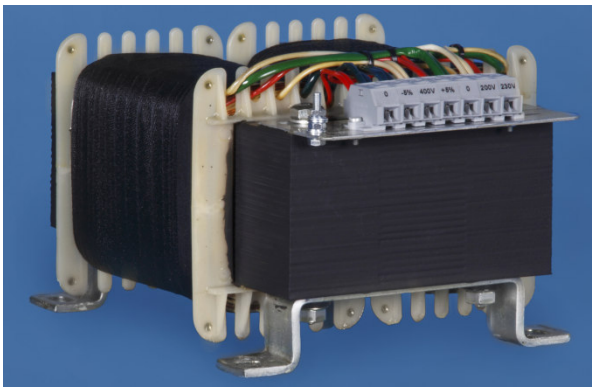
Primary	400 V
Secondary	230 V 2.0 KVA
Reference number:	TRU2.0400230

Single – phase isolation transformers

2.3 Type TRUL 2 - 16 KVA horizontal

Corresponding to VDE 0570/ DIN EN 61558-2-4





Construction:
Open transformer separate windings. Fixed with angle irons
Type protection IP 00 suitable for installations up to IP 23.
Corrosion protection via complete impregnation. Insulation class T40E.

Connecting elements act in accordance with amperage and are either clamps bolts or copper taps.

Type	Power	Design size	Copper Weight	Total weight	Dimensioning					
					A	B	C	D	E	F
	KVA	Core	kg	kg	mm	mm	mm	mm	mm	mm
TRUL 2.0	2.0	UI132	4.9	21.0	166	270	165	146	176	7x13
TRUL 2.5	2.5	UI150	7.5	25.0	194	300	160	174	200	7x13
TRUL 3.0	3.0	UI150	8.8	33.0	194	300	172	174	200	7x13
TRUL 4.0	4.0	UI168a	11.5	27.0	228	310	148	192	222	7x13
TRUL 5.0	5.0	UI168	12.8	31.5	228	310	182	192	222	7x13
TRUL 6.3	6.3	UI210a	16.5	57.0	260	400	180	234	280	9x13
TRUL 8.0	8.0	UI210a	16.5	59.0	260	400	180	234	280	9x13
TRUL 10.0	10.0	UI210	20.0	70.0	260	400	210	234	280	9x13
TRUL 12.5	12.5	UI210	24.0	85.0	260	400	225	234	280	9x13
TRUL 16.0	16.0	UI210	28.0	102.0	260	400	255	234	280	9x13

Standard voltages:

Primary 230 V and/or 400 V
Secondary 24 V or 230 V
Other voltages on request

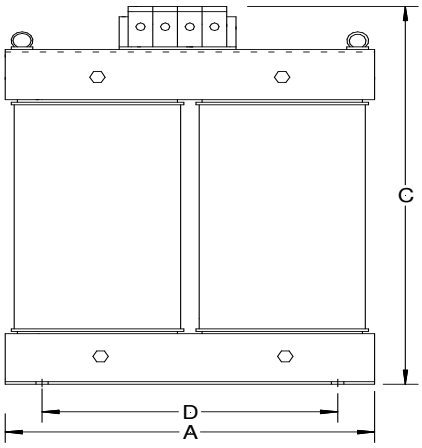
Ordering example:

Primary	400 V
Secondary	230 V 2.0 KVA
Reference number:	TRUL2.0400230

Single – phase isolation transformers

2.4 Type TL 22.5 - 250 KVA vertical

Corresponding to VDE 0570 DIN EN 61558-2-4
VDE 0532 DIN EN 60076



Construction:
Open transformer separate windings. Fixed with angle irons
Type protection IP 00 suitable for installations up to IP 23.
Corrosion protection via complete impregnation. Insulation class T40E.
Connecting elements act in accordance with amperage and are either clamps bolts or copper taps.
To achieve optimal efficiency we use low-loss steel-plates. The windings consist of high class enamelled copper wire of the classes of insulation F or H. Ambient temperature: 40°C. Assembling on horizontal faces applicable for protection class 1.

More power constructions in cases other frequencies and modified ambient temperatures on request.

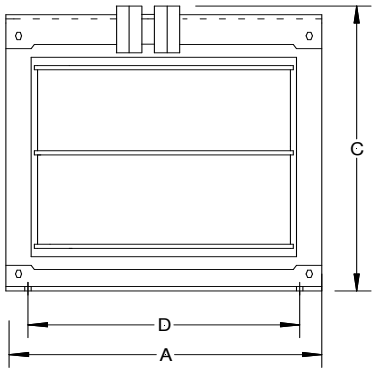
Type	Power	*Uk	*P_{Fe}	*P_{CU}	Copper weight	Total weight	Dimensioning					
							A	B	C	D	E	F
	KVA	%	W	W	kg	kg	Mm	mm	mm	mm	mm	mm
TL 22.5	22.5	4.3	123	923	18.5	100.0	320	280	475	196	214	13
TL 25.5	25.5	4.0	123	902	24.6	106.0	320	280	475	196	214	13
TL 28.0	28.0	4.4	134	1144	27.1	124.0	360	260	580	270	180	14
TL 31.5	31.5	5.1	146	1474	23.4	128.0	360	270	580	270	190	14
TL 35.5	35.5	4.8	163	1588	23.4	141.0	360	285	580	270	205	14
TL 40.0	40.0	4.7	188	1791	26.4	167.0	400	285	660	300	215	18
TL 45.0	45.0	4.5	195	1877	30.0	171.0	400	285	660	300	215	18
TL 50.0	50.0	4.2	218	1926	31.7	188.0	400	300	660	300	230	18
TL 63.0	63.0	3.9	244	2173	39.5	216.0	400	340	660	300	250	18
TL 80.0	80.0	3.4	317	2426	48.3	284.0	480	370	750	360	250	18
TL 100.0	100.0	3.1	359	2582	60.6	324.0	480	390	750	360	270	18
TL 125.0	125.0	2.9	416	2833	74.0	373.0	480	420	750	360	295	18
TL 160.0	160.0	3.2	541	3450	95.5	484.0	600	440	810	450	275	18
TL 200.0	200.0	4.4	526	4836	124.4	562.0	600	470	810	450	300	18
TL 250.0	250.0	3.8	611	5070	137.3	693.0	600	540	810	450	360	18

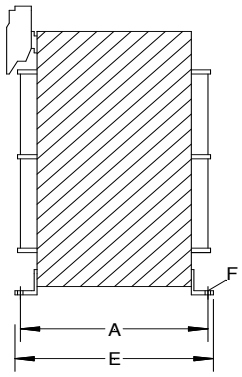
see technical annotations 17.1

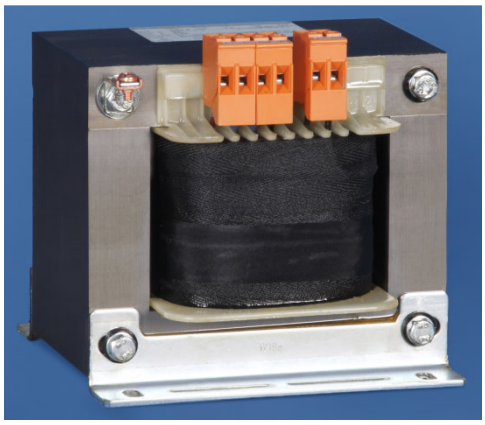
3. Single – phase safety transformers

3.1 Type SI 20 – 1400 VA

Corresponding to VDE 0570/ DIN EN 61558-2-6







Construction:
Secondary up to 50 Volt. Open transformer separate windings. Fixed with angle irons.
Up to 160 VA also available: snapable for bearing rails 35
Type protection IP 00 suitable for installations up to IP 23.
Corrosion protection via complete impregnation. Insulation class T40E.

Type	Power	Design size	Copper weight	Total weight	Dimensioning					
					A	B	C	D	E	F
	VA	Core	kg	kg	mm	mm	mm	mm	mm	mm
SI 002	20	EI 66	0.25	0.95	66	60	80	50	62.5	4.3
SI 004	40	EI 66	0.35	1.20	66	72	80	50	53.0	4.3
SI 006	60	EI 78	0.45	1.40	78	73	84	40	60.0	4.3
SI 008	80	EI 84	0.55	2.00	84	72	96	50	72.5	4.3
SI 010	100	EI 84	0.38	1.80	84	102	79	64	55.0	4.8
SI 020	200	EI 105	0.90	4.00	105	100	115	60	80.5	5.3
SI 032	320	EI 120	0.90	5.00	120	118	107	90	81.0	5.8
SI 040	400	EI 120	1.10	6.60	120	138	107	90	101.0	5.8
SI 050	500	EI 135	1.60	6.50	135	122	119	104	91.0	5.8
SI 063	630	EI 135	1.80	8.00	135	136	119	104	104.0	5.8
SI 080	800	EI 150N	2.30	13.90	150	156	132	122	126.0	7.0
SI 100	1000	EI 174	2.60	12.70	174	128	153	135	102.0	9.0
SI 120	1200	EI 174	3.10	15.10	174	138	153	135	112.0	9.0
SI 140	1400	EI 174	3.30	18.00	174	148	153	135	122.0	9.0

Ordering example:

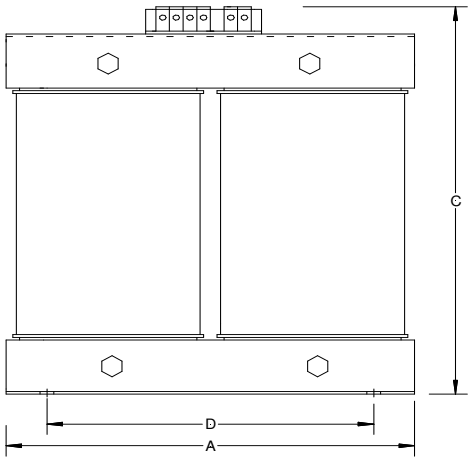
Primary 230 V
Secondary 42 V 500 VA
Reference number: SI050230042

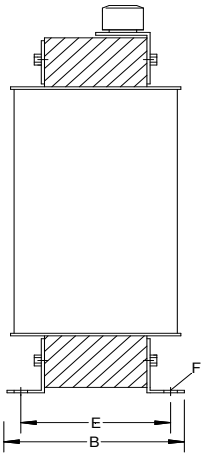
To assure see technical data 17.2.

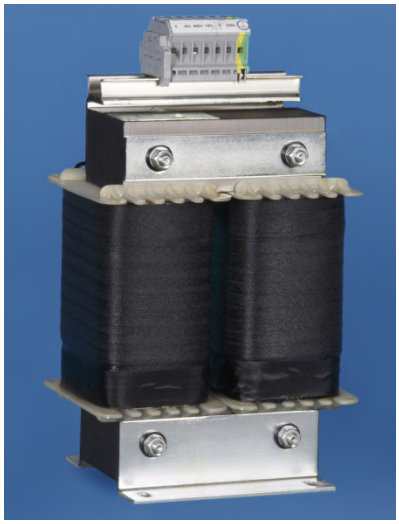
Single – phase safety transformers

3.2 Type SIU 1.5 - 10 KVA vertical

Corresponding to VDE 0570/ DIN EN 61558-2-6







Construction:
Secondary up to 50 Volt. Open transformer separate windings. Fixed with angle irons
Type protection IP 00 suitable for installations up to IP 23.
Corrosion protection via complete impregnation. Insulation class T40E.

Type	Power	Design size	Copper weight	Total weight	Dimensioning					
					A	B	C	D	E	F
	KVA	Core	kg	kg	mm	mm	mm	mm	mm	mm
SIU 1.5	1.5	UI 120	4.5	17.0	160	141	208	100	103	7
SIU 2.0	2.0	UI 132	4.9	21.0	176	141	228	12	102	10
SIU 2.5	2.5	UI 150	7.5	25.0	200	135	260	124	107	10
SIU 3.0	3.0	UI 150	8.8	33.0	200	147	260	124	119	10
SIU 4.0	4.0	UI 168a	11.5	27.0	226	138	357	136	110	11
SIU 5.0	5.0	UI 168	12.8	31.5	226	172	357	136	14	11
SIU 6.3	6.3	UI 210a	16.5	57.0	280	173	360	176	143	12
SIU 8.0	8.0	UI 210a	18.5	59.0	280	173	428	176	143	12
SIU 10.0	10.0	UI 210	20.0	70.0	280	188	428	176	158	12

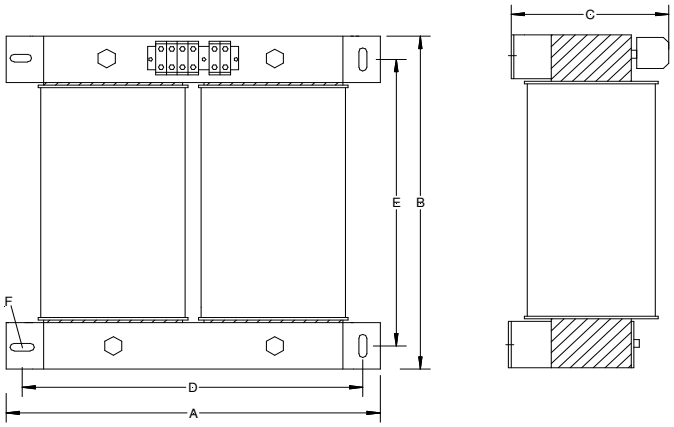
Ordering example:

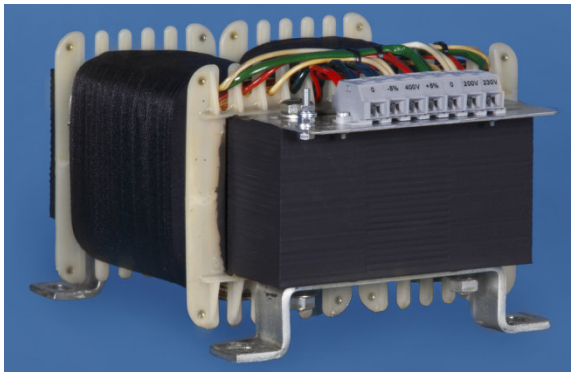
Primary 230 V
Secondary 24 V 1.5 KVA
Reference number: SIU1.5230024

Single – phase safety transformers

3.3 Type SIUL 1.5 - 10 KVA horizontal

Corresponding to VDE 0570/ DIN EN 61558-2-6





Construction:
Secondary up to 50 Volt. Open transformer separate windings. Fixed with angle irons
Type protection IP 00 suitable for installations up to IP 23.
Corrosion protection via complete impregnation. Insulation class T40E.

Type	Power	Design size	Copper weight	Total weight	Dimensioning					
					A	B	C	D	E	F
	KVA	Core	kg	kg	mm	mm	mm	mm	mm	mm
SIUL 1.5	1.5	UI 120	4.5	17.0	166	250	165	146	160	7x13
SIUL 2.0	2.0	UI 132	4.9	21.0	166	270	165	146	176	7x13
SIUL 2.5	2.5	UI 150	7.5	25.0	194	300	160	174	200	7x13
SIUL 3.0	3.0	UI 150	8.8	33.0	194	300	172	174	200	7x13
SIUL 4.0	4.0	UI 168a	11.5	27.0	286	310	148	192	222	7x13
SIUL 5.0	5.0	UI 168	12.8	31.5	228	310	182	192	222	7x13
SIUL 6.3	6.3	UI 210a	16.5	57.0	260	400	180	234	280	9x13
SIUL 8.0	8.0	UI 210a	18.5	59.0	260	400	180	234	280	9x13
SIUL 10.0	10.0	UI 210	20.0	70.0	260	400	210	234	280	9x13

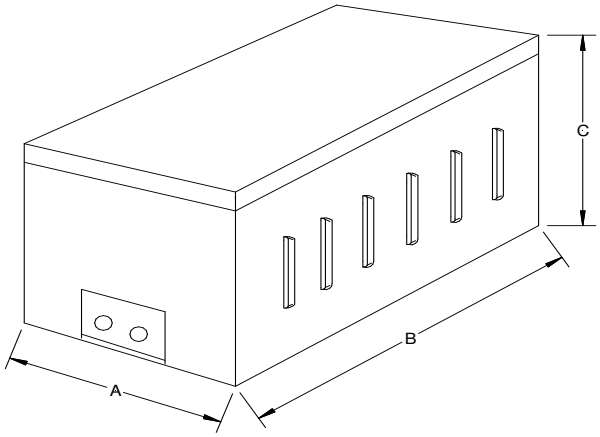
Ordering example:

Primary 230 V
Secondary 42 V 1.5 KVA
Reference number: SIUL1.5230042

Single – phase safety transformers

3.4 Type SIG 63 – 1000 VA in case IP 23

Corresponding to VDE 0570/ DIN EN 61558-2-6



Construction:
Secondary up to 50 Volt. Separate windings. Corrosion protection via complete impregnation. Insulation class T40E.

Deep-drawn steel-sheet housing for wall fastening. Conditionally short-circuit proof by replaceable cut-out switches. Metric cable connections.
Type protection: Covered transformer IP 23.

Type	Power	Design size	Copper weight	Total weight	Case	Dimensioning		
						A	B	C
	VA	Core	kg	kg	Size	mm	mm	mm
SIG 006	63	EI 78	0.38	2.10	5c	124	127	106.5
SIG 010	100	EI 84	0.45	2.50	5c	124	127	106.5
SIG 016	160	EI 105	0.80	4.95	12	152	202	155.5
SIG 020	200	EI 105	0.90	5.45	12	152	202	155.5
SIG 032	320	EI 120	0.90	6.45	12	152	202	155.5
SIG 040	400	EI 120	1.10	8.05	12	152	202	155.5
SIG 050	500	EI 135	1.60	7.95	12	152	202	155.5
SIG 063	630	EI 135	1.80	9.45	12	152	202	155.5
SIG 080	800	EI 150 N	2.30	17.07	13	222	303	190.0
SIG 100	1000	EI 174	2.60	15.87	13	222	303	190.0

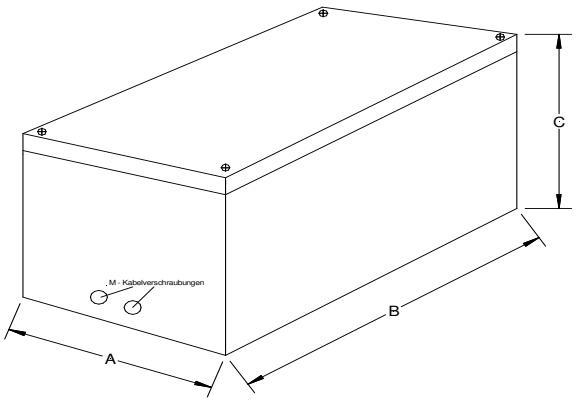
Ordering example:

Primary 230 V
Secondary 24 V 100 VA
Reference number: SIG010230024

Single – phase safety transformers

3.5 Type SIW 63 – 1000 VA in case IP 54

Corresponding to VDE 0570/ DIN EN 61558-2-6



Construction:
Secondary up to 50 Volt. Separate windings. Corrosion protection via complete impregnation. Insulation class T40E.

Deep-drawn steel-sheet housing for wall fastening. Conditionally short-circuit proof by replaceable cut-out switches. Metric cable connections.
Type protection: Covered transformer IP 54.

Type	Power	Design size	Copper weight	Total weight	Case	Dimensioning		
						A	B	C
	VA	Core	kg	kg	Size	mm	mm	mm
SIW 006	63	EI 78	0.38	2.25	SH 189.144.32/83	136	240	80
SIW 010	100	EI 84	0.45	2.65	SH 189.144.32/83	136	240	80
SIW 016	160	EI 105	0.80	4.35	SH 189.144.32/83	136	240	80
SIW 020	200	EI 105	0.90	4.85	SH 189.144.32/83	136	240	80
SIW 032	320	EI 120	0.90	8.70	SH 265.194.64/89	198	320	139
SIW 040	400	EI 120	1.10	8.45	SH 265.194.64/89	198	320	139
SIW 050	500	EI 135	1.60	8.35	SH 265.194.64/89	198	320	139
SIW 063	630	EI 135	1.80	9.85	SH 265.194.64/89	198	320	139
SIW 080	800	EI 150 N	2.30	15.75	SH 265.194.64/89	198	320	139
SIW 100	1000	EI 174	2.60	14.55	SH 265.194.64/89	198	320	139

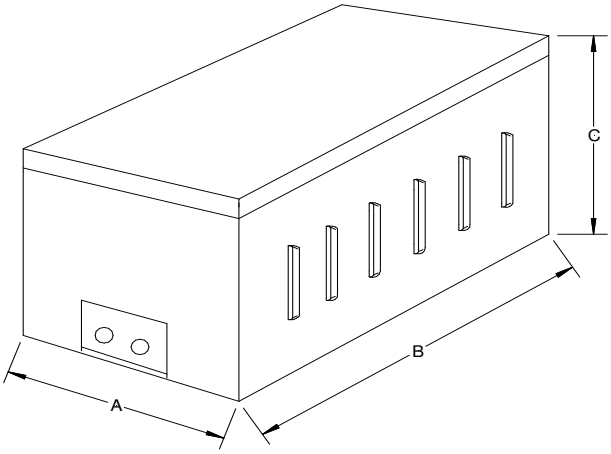
Ordering example:

Primary 230 V
Secondary 24 V 100 VA
Reference number: SIW010230024

Single – phase safety transformers

3.6 Type SIG 1.5 - 10 KVA in case IP 23

Corresponding to VDE 0570/ DIN EN 61558-2-6



Construction:
Secondary up to 50 Volt. Separate windings. Corrosion protection via complete impregnation. Insulation class T40E.

Deep-drawn steel-sheet housing for wall fastening. Conditionally short-circuit proof by replaceable cut-out switches. Metric cable connections.
Type protection: Covered transformer IP 23.

Type	Power	Design size	Copper weight	Total weight	Case	Dimensioning		
						A	B	C
	KVA	Core	kg	kg	Size	mm	mm	mm
SIG 1.5	1.5	UI 120	4.5	22.1	14	302	382	220
SIG 2.0	2.0	UI 132	4.9	26.1	14	302	382	220
SIG 2.5	2.5	UI 150	7.5	30.1	14	302	382	220
SIG 3.0	3.0	UI 150	8.8	38.1	14	302	382	220
SIG 4.0	4.0	UI 168	11.5	34.8	15	350	500	272
SIG 5.0	5.0	UI 168	12.8	39.3	15	350	500	272
SIG 6.3	6.3	UI 210	16.5	64.8	15	350	500	272
SIG 8.0	8.0	UI 210	18.5	66.8	15	350	500	272
SIG 10.0	10.0	UI 210	20.0	77.8	15	350	500	272

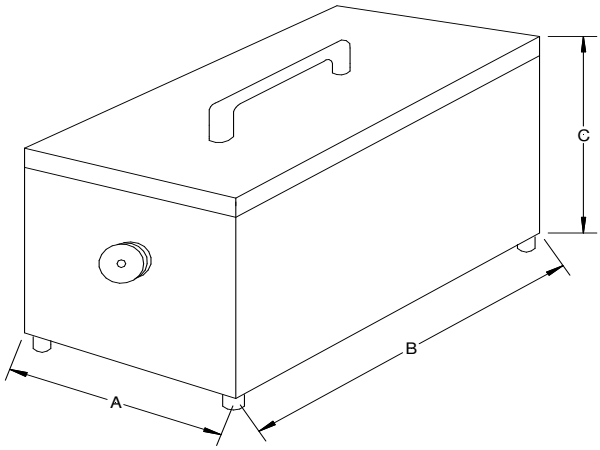
Ordering example:

Primary 230 V
Secondary 24 V 1.5 KVA
Reference number: SIG1.5230024

Single – phase safety transformers

3.7 Type SK 63 – 3000 VA in portable case

Corresponding to VDE 0570/ DIN EN 61558-2-6



Construction:
Secondary 24 Volt or 42 Volt. Separate windings. Corrosion protection via complete impregnation. Insulation class T40E.

Protection class III. Portable case with cable connection and mains plug with cut-out switch. Secondary 1x CEE electrical outlet.

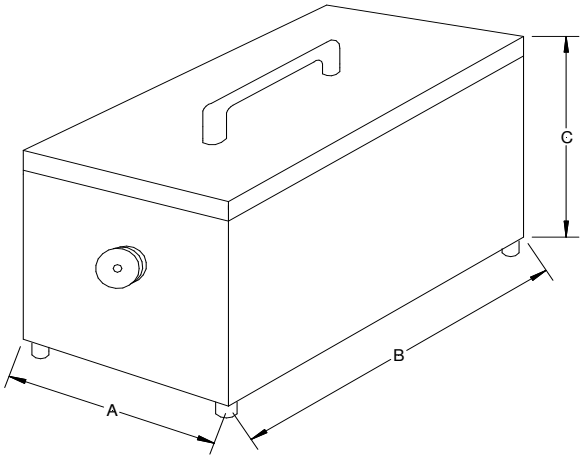
As hand lamp transformer available up to 630 VA.

Type	Power	Design size	Copper weight	Total weight	Dimensioning		
					A	B	C
	VA	Core	kg	kg	mm	mm	mm
SK 006	63	EI 78	0.38	2.1	165	295	160
SK 010	100	EI 84a	0.45	2.5	165	295	160
SK 016	160	EI 105	0.80	4.2	165	295	160
SK 020	200	EI 105	0.90	4.7	165	295	160
SK 032	320	EI 120	0.90	6.7	200	280	200
SK 050	500	EI 135	1.60	8.2	200	280	200
SK 080	800	EI 150N	2.30	16.1	200	280	200
SK 100	1000	EI 174	2.60	14.9	200	280	200
SK 160	1600	EI 174	3.50	23.7	200	280	200
SK 200	2000	EI 132	4.90	28.1	220	360	530
SK 250	2500	EI 150	7.50	32.1	220	360	530
SK 300	3000	EI 150	8.80	40.1	220	360	530

Single – phase safety transformer

3.8 Type KT 100 – 3600 VA in case grouted

Corresponding to VDE 0100 und VDE 0570/ DIN EN 61558-2-4



Construction:
Secondary 230 Volt. Separate windings. Corrosion protection via complete impregnation. Insulation class T40E. Fractional casting resin.

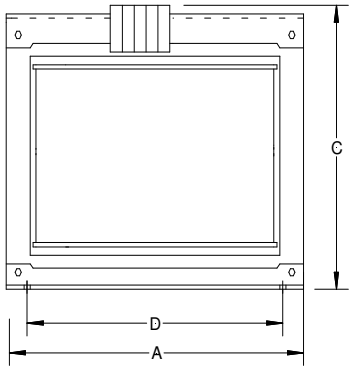
Protection class II. Portable case with cable connection and mains plug with cut-out switch. Secondary 1x electrical outlet.

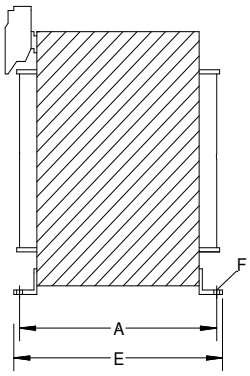
Type	Power	Design size	Copper weight	Total Weight	Dimensioning		
					A	B	C
	VA	Core	kg	Kg	mm	mm	mm
KT 010	100	EI 84a	0.38	2.5	165	295	160
KT 020	200	EI 105	0.90	4.7	165	295	160
KT 032	320	EI 120	0.90	6.7	200	280	200
KT 050	500	EI 135	1.60	8.2	200	280	200
KT 063	630	EI 135	1.80	9.7	200	280	200
KT 080	800	EI 150N	2.30	16.1	200	380	200
KT 100	1000	EI 174	2.60	14.9	200	380	200
KT 160	1600	EI 174	3.50	23.7	200	380	200
KT 200	2000	UI 132	4.90	28.1	220	360	530
KT 250	2500	UI 150	7.50	32.1	220	360	530
KT 300	3000	UI 150	8.80	40.1	220	360	530
KT 400	4000	UI 168a	11.50	34.1	220	360	530
KT 500	5000	UI 168a	12.80	38.6	220	360	530
KT 630	6300	UI 210a	16.50	66.0	250	380	560

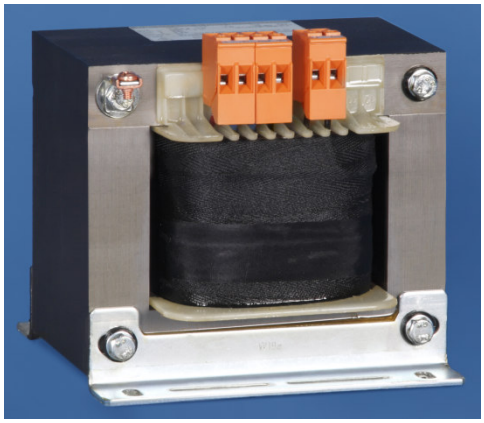
4. Fan transformers

4.1 Type LÜ Step transformers for exhausters

Corresponding to VDE 0570/ DIN EN 61558-2-13







Construction:
Step transformer with 7 steps. Economy winding standing on an angle iron.
Screw-type terminals VGB 4. Dip impregnate. Insulation class T40E.
Type protection IP 00 Protection class II.

Input voltage: **230 V 50/60 Hz**
Output voltage: **80/100/120/140/160/180/230 V**

Type	Load current	Copper weight	Total weight	Dimensioning							
				A	B	C	D	E	F	G	H
	A	kg	kg	Mm	Mm	mm	mm	mm	mm	mm	mm
LÜ 18	1.8	0.35	1.4	78	57	92	68	56	4.8	9	44
LÜ 40	4.0	0.90	2.6	96	76	107	82	84	5.8	11	60
LÜ 70	7.0	1.60	5.3	120	85	126	89	90	5.8	11	69
LÜ 130	13.0	0.30	7.2	135	102	135	103	104	5.8	11	86
LÜ 220	22.0	2.80	13.5	135	150	135	151	104	5.8	11	134

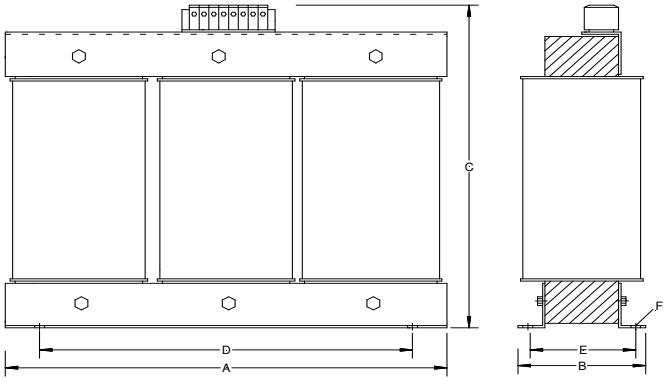
Input voltage: **400 V 50/60 Hz**
Output voltage: **140/170/200/235/270/310/400 V**

Type	Load current	Copper weight	Total weight	Dimensioning							
				A	B	C	D	E	F	G	H
	A	kg	kg	Mm	Mm	mm	mm	mm	mm	mm	mm
LÜ 10	1.0	0.35	1.4	78	57	92	68	56	4.8	9	44
LÜ 20	2.0	0.80	2.5	96	76	107	82	84	5.8	11	60
LÜ 40	4.0	1.50	5.2	120	85	126	89	90	5.8	11	69
LÜ 65	6.5	2.10	7.1	135	102	135	103	104	5.8	11	86
LÜ 150	15.0	2.90	13.8	135	150	135	151	104	5.8	11	134

5. Three – phase transformers

5.1 Type DT 0.16 - 20 KVA vertical

Corresponding to VDE 0570/ DIN EN 61558-2-1 DIN EN 61558-2-4 DIN EN 61558-2-6



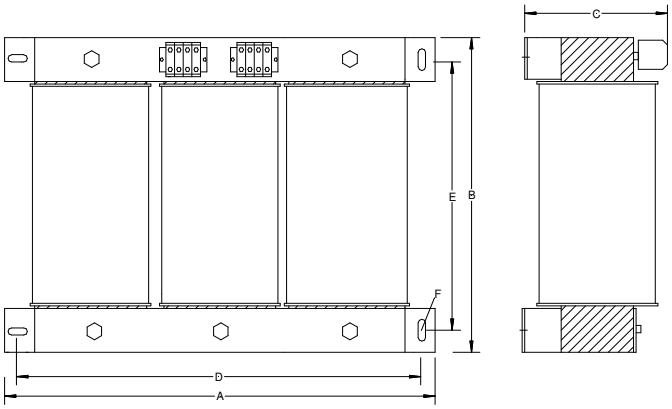
Construction:
Open transformer separate windings. Type protection IP 00 suitable for installations up to IP 23.
Corrosion protection via complete impregnation. Max. ambient temperature 40° C
Insulation class „E“

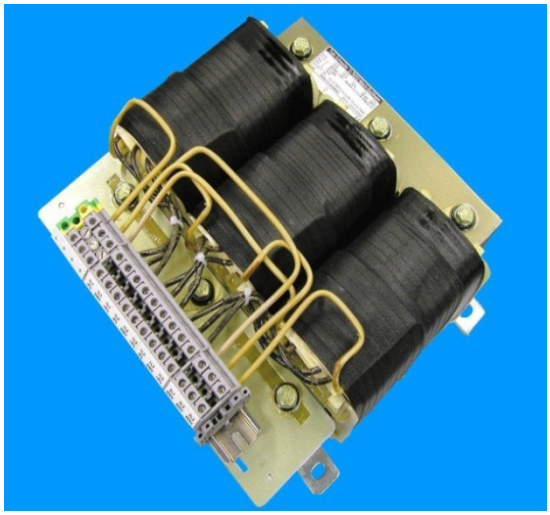
Type	Power	Design size	Copper weight	Total weight	Dimensioning					
					A	B	C	D	E	F
	KVA	Core	kg	kg	mm	mm	mm	mm	mm	mm
DT 0.16	0.16	UI 60	0.7	2.5	120	79	112	90	49	4.8
DT 0.20	0.20	UI 75	1.4	4.2	150	85	136	113	50	5.8
DT 0.32	0.32	UI 75	1.6	5.8	150	100	136	113	65	5.8
DT 0.40	0.40	UI 75	1.6	5.8	150	100	136	113	65	5.8
DT 0.50	0.50	UI 90	1.8	6.5	180	92	157	136	57	8.0
DT 0.63	0.63	UI 90	2.2	8.5	180	102	157	136	67	8.0
DT 0.80	0.80	UI 90	2.9	10.4	180	112	157	136	77	8.0
DT 1.00	1.00	UI 114	3.4	14.0	228	104	198	176	71	7.0
DT 1.25	1.25	UI 114	4.9	15.5	228	104	198	176	71	7.0
DT 1.60	1.60	UI 120	5.8	19.0	240	117	208	185	81	10.0
DT 2.00	2.00	UI 120	6.9	23.0	240	132	208	185	96	10.0
DT 2.50	2.50	UI 132	8.5	30.0	264	141	228	200	102	10.0
DT 3.15	3.15	UI 150	12.0	42.0	300	147	260	224	119	10.0
DT 4.00	4.00	UI 150	13.0	46.0	300	160	260	224	132	10.0
DT 5.00	5.00	UI 180	15.0	51.0	360	153	305	264	125	10.0
DT 6.30	6.30	UI 180	18.0	60.0	360	168	305	264	140	10.0
DT 8.00	8.00	UI 210	25.0	73.0	420	163	360	316	133	12.0
DT 10.00	10.00	UI 210	26.0	74.0	420	163	428	316	133	12.0
DT 12.50	12.50	UI 210	33.0	91.0	420	173	428	316	143	12.0
DT 16.00	16.00	UI 210	38.0	115.0	420	203	428	316	173	12.0
DT 20.00	20.00	UI 210	42.0	141.0	420	233	428	316	203	12.0

Three – phase transformers

5.2 Type DTL 0.2 - 20 KVA horizontal

Corresponding to VDE 0570/ DIN EN 61558-2-1
DIN EN 61558-2-4 DIN EN 61558-2-6





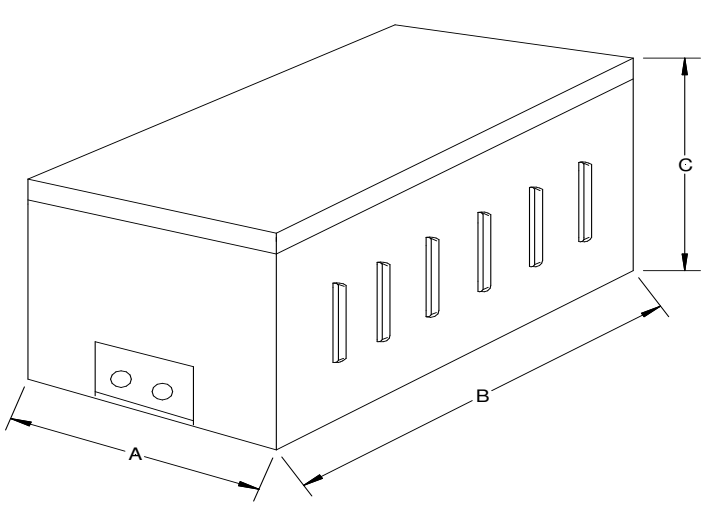
Construction:
Open transformers separate windings. Type protection IP 00 suitable for installations up to IP 23.
Corrosion protection via complete impregnation. Max. ambient temperature 40° C
Insulation class „E“.

Type	Power	Design size	Copper weight	Total weight	Dimensioning					
					A	B	C	D	E	F
	KVA	Core	kg	kg	mm	mm	mm	mm	mm	mm
DTL 0.20	0.20	UI 75	1.4	4.2	156	150	85	140	100	5.8
DTL 0.32	0.32	UI 75	1.6	5.8	156	150	100	140	100	5.8
DTL 0.40	0.40	UI 75	1.6	5.8	156	150	100	140	100	5.8
DTL 0.50	0.50	UI 90	1.8	6.5	206	180	92	184	120	8.0
DTL 0.63	0.63	UI 90	2.2	8.5	206	180	102	184	120	8.0
DTL 0.80	0.80	UI 90	2.9	10.4	206	180	112	184	120	8.0
DTL 1.00	1.00	UI 114	3.4	14.0	254	228	104	228	152	7.0
DTL 1.25	1.25	UI 114	4.9	15.5	254	228	104	228	152	7.0
DTL 1.60	1.60	UI 120	5.8	19.0	290	240	117	258	160	10.0
DTL 2.00	2.00	UI 120	6.9	23.0	290	240	132	258	160	10.0
DTL 2.50	2.50	UI 132	8.5	30.0	290	264	141	258	176	10.0
DTL 3.15	3.15	UI 150	12.0	42.0	330	300	147	298	200	10.0
DTL 4.00	4.00	UI 150	13.0	46.0	330	300	160	298	200	10.0
DTL 5.00	5.00	UI 180	15.0	51.0	394	360	153	358	240	10.0
DTL 6.30	6.30	UI 180	18.0	60.0	394	360	168	358	240	10.0
DTL 8.00	8.00	UI 210	25.0	73.0	452	420	163	408	280	12.0
DTL 10.00	10.00	UI 210	26.0	74.0	452	420	163	408	280	12.0
DTL 12.50	12.50	UI 210	33.0	91.0	452	420	173	408	280	12.0
DTL 16.00	16.00	UI 210	38.0	115.0	452	420	203	408	280	12.0
DTL 20.00	20.00	UI 210	42.0	141.0	452	420	233	408	280	12.0

Three – phase transformers

5.3 Type DTG 0.16 - 4 KVA in case IP 23

Corresponding to VDE 0570/ DIN EN 61558-2-1 DIN EN 61558-2-4 DIN EN 61558-2-6



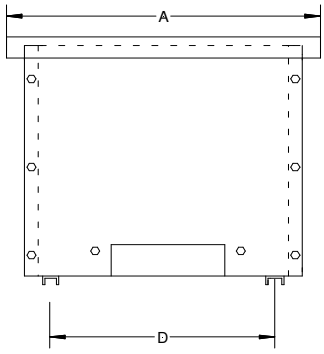
Construction:
Open transformer separate windings. Type protection IP 23.
Corrosion protection via complete impregnation. Max. ambient temperature 40° C
Insulation class „E“.

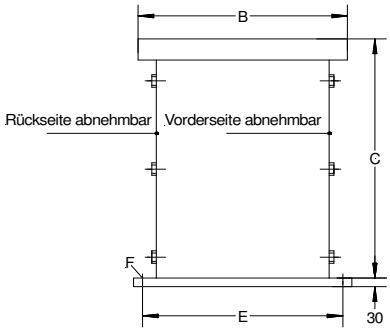
Type	Power	Design size	Copper weight	Total weight	Dimensioning		
					A	B	C
	KVA	Core	kg	kg	mm	mm	mm
DTG 0.16	0.16	UI 60	0.7	4.0	152	202	155
DTG 0.20	0.20	UI 75	1.4	5.7	152	202	155
DTG 0.32	0.32	UI 75	1.6	7.3	152	202	155
DTG 0.40	0.40	UI 75	1.6	7.3	152	202	155
DTG 0.50	0.50	UI 90	1.8	8.0	152	202	155
DTG 0.63	0.63	UI 90	2.2	10.0	152	202	155
DTG 0.80	0.80	UI 90	2.9	12.0	152	202	155
DTG 1.00	1.00	UI 114	3.4	17.5	222	303	190
DTG 1.25	1.25	UI 114	4.9	18.9	222	303	190
DTG 1.60	1.60	UI 120	5.8	22.5	222	303	190
DTG 2.00	2.00	UI 120	6.9	26.5	222	303	190
DTG 2.50	2.50	UI 132	8.5	33.5	222	303	190
DTG 3.15	3.15	UI 150	12.0	47.4	302	382	220
DTG 4.00	4.00	UI 150	13.0	51.5	302	382	220

Three - phase transformers

5.4 Type DTG 5 - 20 KVA in case IP 23

Corresponding to VDE 0550/ 0570





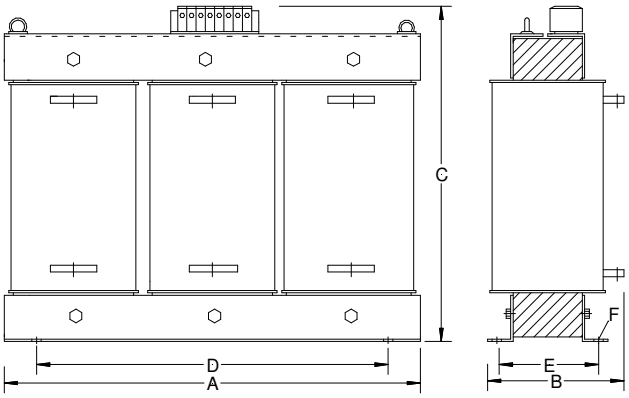
Construction:
Open transformer separate windings. Type protection IP 23.
Corrosion protection via complete impregnation. Max. ambient temperature 40° C
Insulation class „E“.

Type	Power	Design size	Copper weight	Total weight	Dimensioning					
					A	B	C	D	E	F
	KVA	Core	kg	kg	mm	mm	mm	mm	mm	mm
DTG 5.00	5.00	3 UI 180	15.0	69.0	580	440	470	264	400	11x15
DTG 6.30	6.30	3 UI 180	18.0	78.0	580	440	470	264	400	11x15
DTG 8.00	8.00	3 UI 210	25.0	91.0	580	440	470	316	400	11x15
DTG 10.00	10.00	3 UI 210	26.0	92.0	580	440	470	316	400	11x15
DTG 12.50	12.50	3 UI 210	33.0	109.0	580	440	470	316	400	11x15
DTG 16.00	16.00	3 UI 210	38.0	133.0	580	440	470	316	400	11x15
DTG 20.00	20.00	3 UI 210	42.0	159.0	580	440	470	316	400	11x15

Three – phase transformers

5.5 Type DL 22 - 400 KVA

Corresponding to VDE 0532/ DIN EN 60076
VDE 0570/ DIN EN 61558



Construction:
Open transformer separate winding. Type protection IP 00 suitable for installations up to IP 23.
Corrosion protection via complete impregnation. Max. ambient temperature 40° C.

To achieve an optimal efficiency we use low-loss steel-plates. The windings consist of high class enamelled copper wire of the classes of insulation F or H.
Connecting elements act in accordance with amperage and are either clamps bolts or copper taps.
Assembling on horizontal faces applicable for protection class 1. Other frequencies modified ambient temperatures Power range up to 1000 KVA on request.

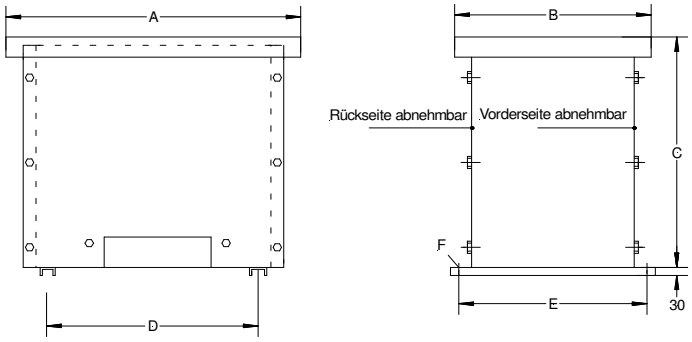
Type	Power	Uk	*PFE	*PCu	Copper weight	Total weight	Dimensioning					
							A	B	C	D	E	F
	KVA	%	W	W	kg	kg	mm	mm	mm	mm	mm	mm
DL 22	22	5.3	151	1095	25.0	105.0	480	220	475	356	154	13x20
DL 28	28	4.1	162	1033	26.0	131.0	480	250	475	356	184	13x20
DL 35	35	3.6	192	1035	28.0	160.0	480	280	475	356	214	13x20
DL 40	40	3.7	192	1196	43.0	175.0	480	280	475	356	214	13x20
DL 50	50	3.7	258	1750	41.0	226.0	540	285	580	450	205	13x20
DL 56	56	3.6	258	1802	51.0	236.0	540	285	580	450	205	13x20
DL 63	63	4.1	297	2286	48.0	270.0	600	285	660	500	215	18x26
DL 80	80	3.8	333	2479	67.0	312.0	600	300	660	500	230	18x26
DL 100	100	4.0	376	3035	80.0	357.0	600	340	660	500	250	18x26
DL 125	125	3.9	475	3926	83.0	453.0	720	360	750	600	250	18x26
DL 140	140	3.9	497	3977	100.0	470.0	720	370	750	600	250	18x26
DL 180	180	3.7	545	5195	110.0	580.0	720	420	750	600	295	18x26
DL 200	200	3.4	676	5343	116.0	736.0	900	440	810	750	275	18x26
DL 250	250	4.5	676	6603	165.0	785.0	900	440	810	750	275	18x26
DL 315	315	4.5	786	6669	236.0	934.0	900	470	810	750	300	18x26
DL 400	400	5.1	966	8455	252.0	1171.0	900	540	810	810	360	18x26

see technical annotations 17.1

Three – phase transformers

5.6 Type DLG 25 - 400 KVA in case IP 23

Corresponding to VDE 0532/ DIN EN 60076
VDE 0570/ DIN EN 61558



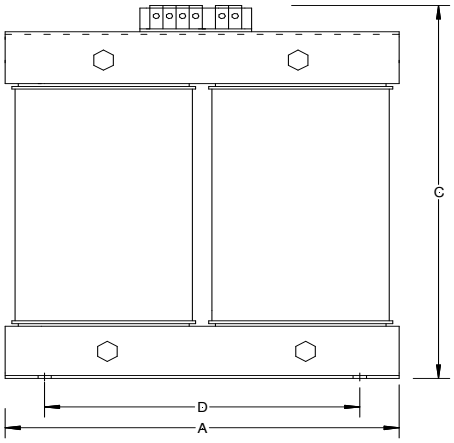
Construction:
Open transformer separate windings. Type protection IP 23. Insulation class „F“.
Corrosion protection via complete impregnation. Max. ambient temperature 40° C.
Power range up to 1000 KVA on request.

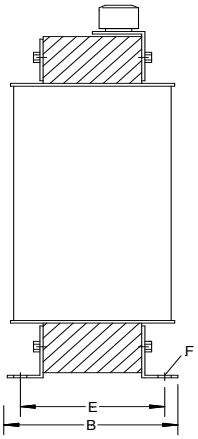
Type	Power	Design size	Copper Weight	Total weight	Case	Dimensioning					
						A	B	C	D	E	F
	KVA	Core	Kg	kg	Size	mm	mm	mm	mm	mm	mm
DLG 25.0	25.0	UI 390	48.0	168.0	150	740	510	560	356	460	11x15
DLG 31.5	31.5	UI 440	55.0	185.0	160	825	630	670	356	510	11x15
DLG 40.0	40.0	UI 440	56.0	215.0	160	825	630	670	400	510	11x15
DLG 50.0	50.0	UI 440	56.0	248.0	160	825	630	670	400	510	11x15
DLG 63.0	63.5	UI 550	87.0	323.0	170	1020	760	740	400	590	11x15
DLG 80.0	80.0	UI 550	98.0	383.0	170	1020	760	740	600	590	11x15
DLG 100.0	100.0	UI 550	120.0	453.0	180	1150	860	830	600	590	11x15
DLG 125.0	125.0	UI 580	206.0	573.0	180	1150	860	830	600	720	11x15
DLG 163.0	163.0	UI 580	225.0	668.0	180	1150	860	830	600	720	11x15
DLG 200.0	200.0	UI 820	220.0	878.0	250	1260	800	1150	765	760	11x15
DLG 250.0	250.0	UI 820	280.0	1041.0	250	1260	800	1150	765	760	11x15
DLG 315.0	315.0	UI 920	320.0	1266.0	250	1260	800	1150	900	760	11x15
DLG 400.0	400.0	UI 920	439.0	1502.0	250	1260	800	1150	900	760	11x15

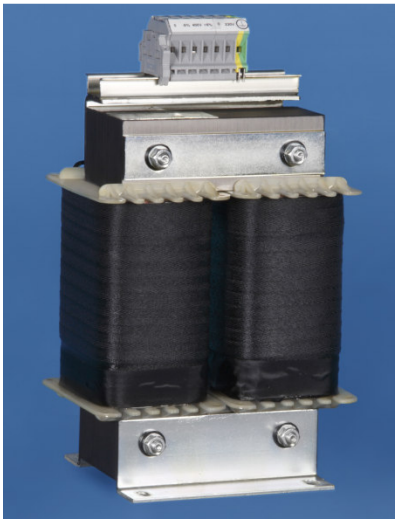
6. Transformers for medically used premises

6.1 Type MTRU 2 - 10 KVA Single - phase

Corresponding to VDE 0570 DIN EN 61558-2-15







Construction:
Open transformer separate windings. Type protection IP 00 suitable for installations up to IP 23.
Corrosion protection via complete impregnation. Max. ambient temperature 40° C
Insulation class T40E.

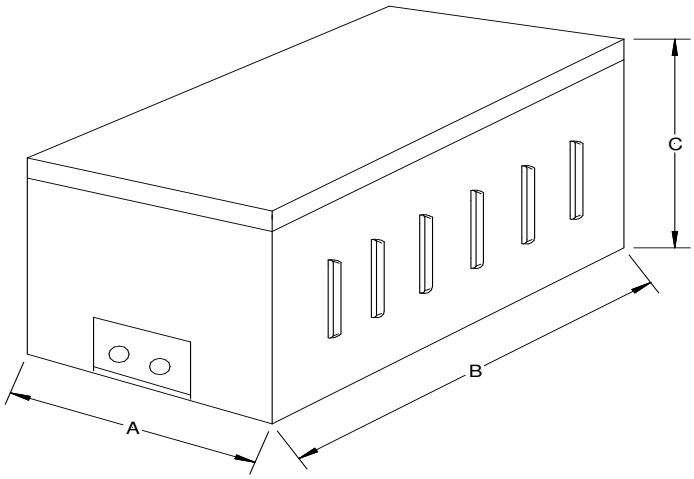
For medically used premises. Fixed with angle irons protective winding between primary and secondary.
Including centre tapping.

Type	Power	Design Size	Copper weight	Total weight	Dimensioning					
					A	B	C	D	E	F
	KVA	Core	kg	kg	mm	mm	mm	mm	mm	mm
MTRU 2.0	2.0	UI 132	7.9	21.0	176	141	225	112	102	10
MTRU 2.5	2.5	UI 150	7.5	25.0	200	135	260	124	107	10
MTRU 3.0	3.0	UI 150	8.8	33.0	200	147	260	124	119	10
MTRU 4.0	4.0	UI 168	11.5	27.0	226	138	357	136	110	11
MTRU 5.0	5.0	UI 168	12.8	31.5	226	172	357	136	144	11
MTRU 6.3	6.3	UI 210	16.5	57.0	280	173	360	176	143	12
MTRU 8.0	8.0	UI 210	16.5	59.0	280	173	428	176	143	12
MTRU 10.0	10.0	UI 210	20.0	70.0	280	188	428	176	158	12

Transformers for medically used premises

6.2 Type MTRUG 2 - 10 KVA Single - phase in case

Corresponding to VDE 0570 DIN EN 61558-2-15



Construction:
Separate winding. Type protection: covered transformer IP.
Corrosion protection via complete impregnation. Max. ambient temperature 40° C
Protection class II. Insulation class T40E.

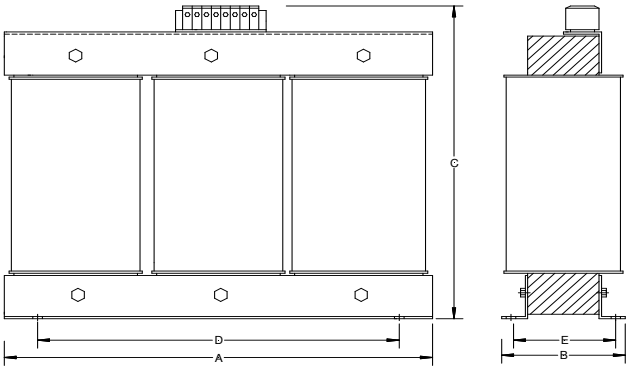
For medically used premises. Fixed with angle irons protective winding between primary and secondary.
Including centre tapping.

Type	Power	Design size	Copper weight	Total weight	Case	Dimensioning		
						A	B	C
	KVA	Core	kg	kg	Size	mm	mm	mm
MTRUG 2.0	2.0	UI 132	7.9	26.10	14	302	382	220
MTRUG 2.5	2.5	UI 150	7.5	30.10	14	302	382	220
MTRUG 3.0	3.0	UI 150	8.8	38.10	14	302	382	220
MTRUG 4.0	4.0	UI 168	11.5	34.80	15	350	500	272
MTRUG 5.0	5.0	UI 168	12.8	39.30	15	350	500	272
MTRUG 6.3	6.3	UI 210	16.5	64.80	15	350	500	272
MTRUG 8.0	8.0	UI 210	16.5	66.80	15	350	500	272
MTRUG 10.0	10.0	UI 210	20.0	77.80	15	350	500	272

Transformers for medically used premises

6.3 Type MDT 0.2 – 6.3 KVA Three - phase

Corresponding to VDE 0570/ DIN EN 61558-2-15



Construction:
Open transformer separate windings. Type protection IP 00 suitable for installations up to IP 23.
Corrosion protection via complete impregnation. Max. ambient temperature 40° C
Insulation class „E“.

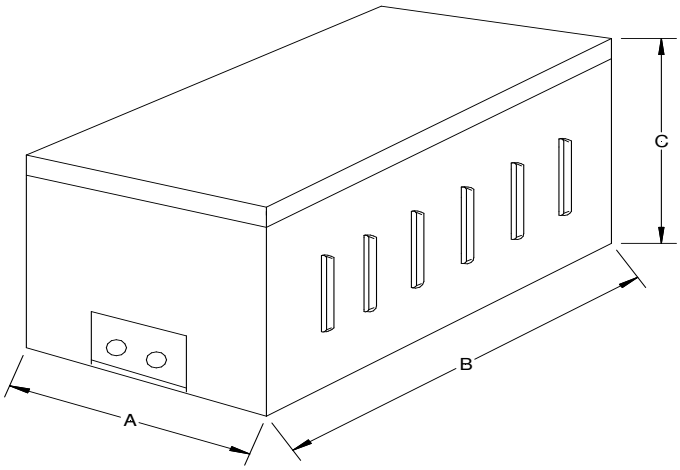
For medically used premises. Fixed with angle irons protective winding between primary and secondary.
Including centre tapping.

Type	Power	Design size	Copper weight	Total weight	Dimensioning					
					A	B	C	D	E	F
	VA	Core	kg	kg	mm	mm	mm	mm	mm	mm
MDT 0.20	200	3 UI 75	1.4	4.2	150	85	136	113	50	5.8
MDT 0.32	320	3 UI 75	1.6	5.8	150	100	136	113	65	5.8
MDT 0.40	400	3 UI 75	1.6	5.8	150	100	136	113	65	5.8
MDT 0.50	500	3 UI 90	1.8	6.5	180	92	157	136	57	8.0
MDT 0.80	800	3 UI 90	2.9	10.4	180	112	157	136	77	8.0
MDT 1.00	1000	3 UI 114	3.4	14.0	228	104	198	176	71	7.0
MDT 1.60	1600	3 UI 120	5.8	19.0	240	117	208	185	81	10.0
MDT 2.00	2000	3 UI 120	6.9	23.0	240	132	208	185	96	10.0
MDT 3.15	3150	3 UI 150	12.0	42.0	300	147	260	224	119	10.0
MDT 4.00	4000	3 UI 150	13.0	42.0	300	160	260	224	132	10.0
MDT 5.00	5000	3 UI 180	15.0	51.0	360	153	305	264	125	10.0
MDT 6.30	6300	3 UI 180	18.0	60.0	360	168	305	264	140	10.0

Transformers for medically used premises

6.4 Type MDTG 0.2 - 4 KVA Three – phase in case

Corresponding to VDE 0570/ DIN EN 61558-2-15



Construction:
Open transformer separate windings. Type protection IP 23.
Corrosion protection via complete impregnation. Max. ambient temperature 40° C
Insulation class „E“.

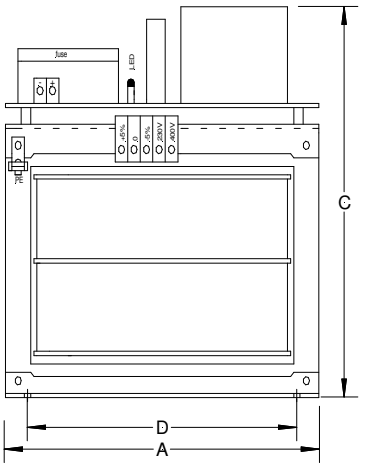
For medically used premises. Protection winding between primary and secondary.
Including centre tapping.

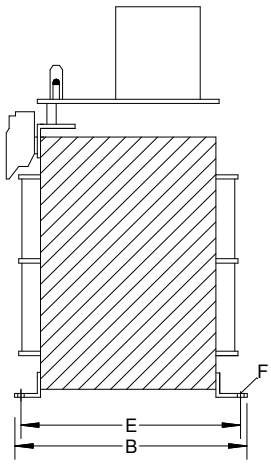
Type	Power	Design size	Copper weight	Total weight	Dimensioning		
					A	B	C
	VA	Core	kg	kg	mm	mm	mm
MDTG 0.20	200	3 UI 75	1.4	5.7	152	202	155
MDTG 0.32	320	3 UI 75	1.6	7.3	152	202	155
MDTG 0.40	400	3 UI 75	1.6	7.3	152	202	155
MDTG 0.50	500	3 UI 90	1.8	8.0	152	202	155
MDTG 0.80	800	3 UI 90	2.9	12.0	152	202	155
MDTG 1.00	1000	3 UI 114	3.4	17.5	222	303	190
MDTG 1.60	1600	3 UI 120	5.8	22.5	222	303	190
MDTG 2.00	2000	3 UI 120	6.9	26.5	222	303	190
MDTG 3.15	3150	3 UI 150	12.0	47.4	302	303	220
MDTG 4.00	4000	3 UI 150	13.0	51.5	302	303	220

7. Single – phase power supply units

7.1 Type TEGT 24 V/ 1.5 - 3A smoothed

Corresponding to VDE 0570 DIN EN 61558-2-6





Construction:
The unregulated compactly constructed single – phase power supply units of the model series TEGT was especially generated for the switch cabinet construction. These rectifier units are characterised by high reliability and operating safety.

The configuration occurs with bridge-rectification smoothing capacitor protection circuit and secondary cut-out switch. All these components are installed on a conductor plate.
If desired the devices are also available with a snap-on mounting.

Technical data:

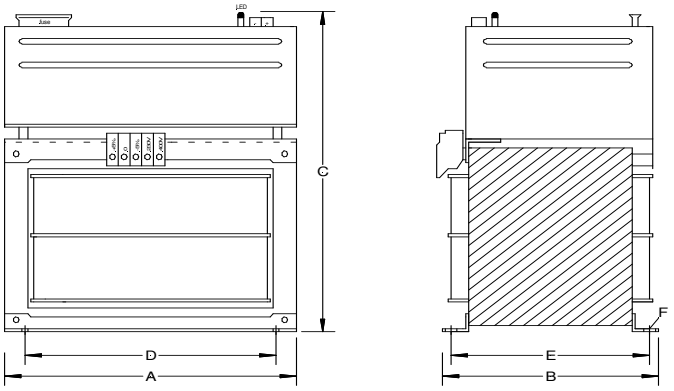
Input voltage:	230/400 VAC 50/60 Hz
Output voltage:	24 VDC (other tensions on request)
Output current:	1.5 - 3 A (see table)
Differential protection:	Cut-out switch
Protective circuit:	Varistor
Ripple:	< 5%
Cooling:	Convection
Operating mode:	Continuous duty
Insulation class:	T40E
Ambient temperature:	Max. 40°C
Type protection:	IP 00 suitable for installations up to IP 23
Primary pin:	Transformer terminals
Secondary pin:	Printed terminals
Operation display:	LED

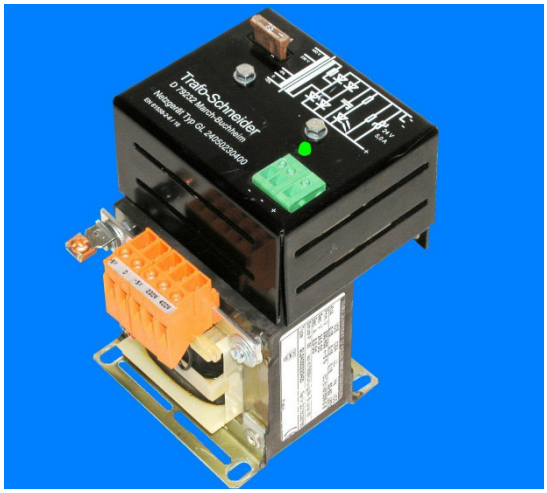
Type	Power	Output current	Dimensioning					
			A	B	C	D	E	F
	W	A	mm	mm	mm	mm	mm	mm
TEGT 35	36	1.5	78	75	106	56	46	M4
TEGT 55	53	2.2	78	75	106	56	46	M4
TEGT 75	72	3.0	85	75	123	64	47	M4

Single – phase power supply units

7.2 Type GL 24 V/ 5 – 10 A smoothed

Corresponding to VDE 0570 DIN EN 61558-2-6





Construction:
The unregulated compactly constructed single – phase power supply units of the model series GL are versatile applicable.

The configuration occurs with bridge-rectification smoothing capacitor protection circuit and secondary cut-out switch. All these components are installed on a conductor plate.

Stabilised version: See separate product description STB.

Technical data:

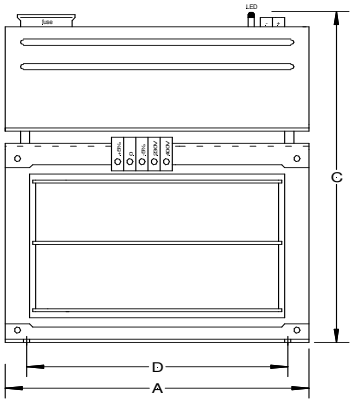
Input voltage:	230/400 VAC 50/60 Hz
Output voltage:	24 VDC (other tensions on request)
Output current:	5 - 10 A (see table)
Differential protection:	Cut-out switch
Protective circuit:	Varistor
Ripple:	< 5%
Cooling:	Convection
Operating mode:	Continuous duty
Insulation class:	T40E
Ambient temperature:	Max. 40°C
Type protection:	IP 00 suitable for installations up to IP 23
Primary pin:	Transformer terminals
Secondary pin:	Printed terminals
Operation display:	LED

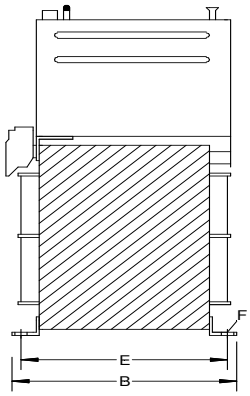
Type	Power	Output Current	Dimensioning					
			A	B	C	D	E	F
	W	A	mm	mm	mm	mm	mm	mm
GL24050	120	5.0	96	106	135	84	83	M5
GL24080	180	7.5	120	103	180	90	69	M5
GL24100	240	10.0	240	115	180	90	81	M5

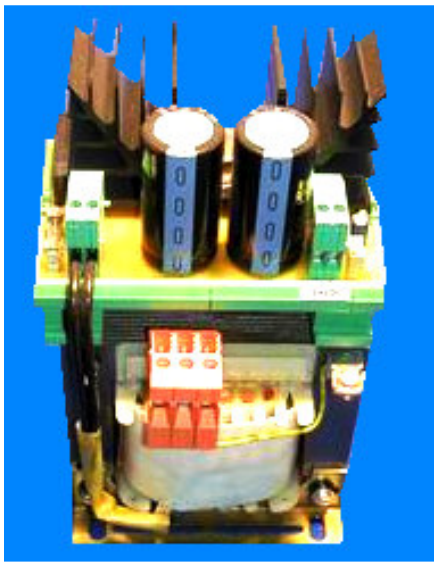
Single – phase power supply units

7.3 Type STB 24 V/ 1 – 5 A stabilised

Corresponding to VDE 0570/ DIN EN 61558-2-6







Construction:
The single – phase power supply units of the model series STB are built-on in compact construction as stabilised direct current supply with in-phase control. This construction is characterised by high stability and small Ripple (<20 mVss).
The attached current limiting a thermal overload protection und a protective circuit arrange for highest reliability. The detection and stabilisation are integrated on a module which if required may be assembled on bearing rails (TS 35). The output voltage is adjustable.

Technical data:

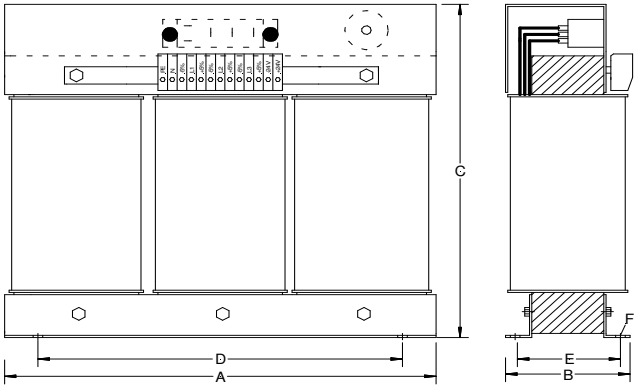
Input voltage:	230/400 VAC 50/60 Hz
Output voltage:	24 VDC (other tensions on request)
Output current:	1 - 5 A (see table)
Differential protection:	Continuous short-circuit protection
Line regulation:	Typ. 0.02 %/V
Load correction:	Typ. 0.3 % (Engine idle – full load)
Ripple:	< 20 mVss
Cooling:	Convection
Operating mode:	Continuous duty
Insulation class:	T40E
Ambient temperature:	Max. 40°C
Type protection:	IP 00 suitable for installations up to IP 23
Fitting position:	In the direction of convection
Primary pin:	Transformer terminals
Secondary pin:	Printed terminals
Operation display:	LED

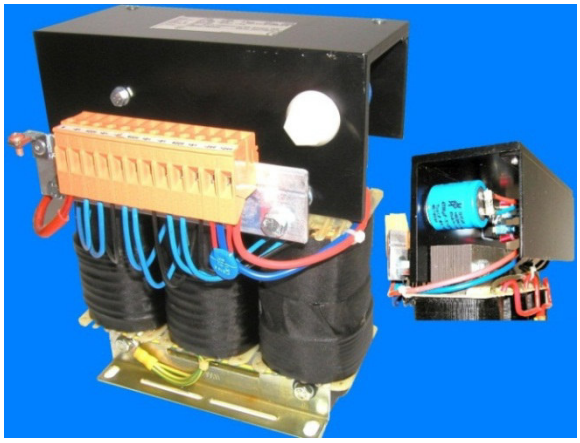
Type	Power	Output current	Dimensioning					
			A	B	C	D	E	F
	W	A	mm	mm	mm	mm	mm	mm
STB24010	24	1.0	91	100	137	56	46	M5
STB24020	48	2.0	115	100	170	64	61	M5
STB24030	72	3.0	115	100	170	64	61	M5
STB24040	96	4.0	160	105	172	84	70	M5
STB24050	120	5.0	115	155	180	84	135	M5

8. Three – phase power supply units

8.1 Type DBH 24 V/ 10 – 40 A smoothed

Corresponding to VDE 0570/ DIN EN 61558-2-6





Construction:
Three – phase power supply unit separate windings. Corrosion protection via complete impregnation. The smoothed compactly constructed three – phase power supply units of the model series DBH are characterised by high reliability and operating safety.
Particularly small footprint!

Technical data:

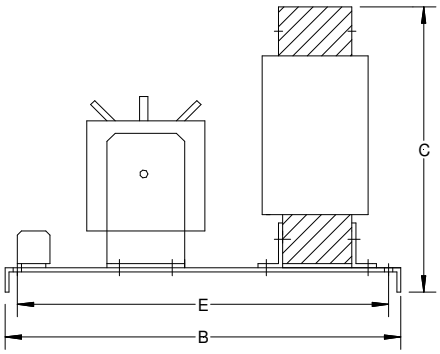
Input voltage:	3 x 400 VAC 50/60 Hz
Output voltage:	24 VDC (other tensions on request)
Output current:	10 - 40 A (see table)
Ripple:	< 3 %
Cooling:	Convection fitting position in the direction of convection
Operating mode:	Continuous duty
Insulation class:	T40E
Ambient temperature:	Max. 40°C
Type protection:	IP 00 suitable for installations up to IP 23

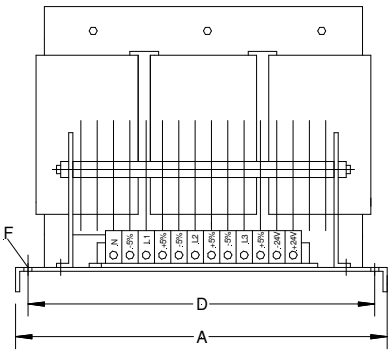
Type	Power	Output current	Design size	Copper weight	Total Weight	Dimensioning					
						A	B	C	D	E	F
	W	A	Core	kg	kg	mm	mm	mm	mm	mm	mm
DBH 2410	36	10.0	125	1.35	5.7	150	104	224	106	76	6.8
DBH 2416	53	16.0	150	2.20	7.5	209	112	199	106	66	6.8
DBH 2420	72	20.0	150	3.00	10.4	209	132	199	106	86	6.8
DBH 2430	53	30.0	175	3.90	15.5	244	162	226	135	88	6.8
DBH 2440	72	40.0	175	4.90	14.7	244	162	226	135	88	6.8

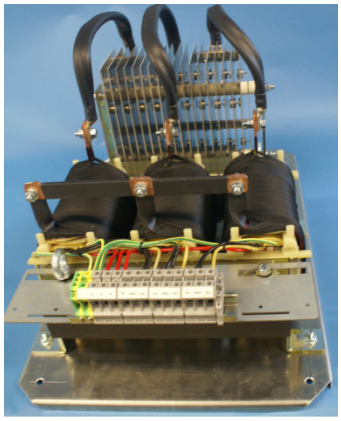
Three – phase power supply units

8.2 Type DBM 24 V/ 40 – 300 A

Corresponding to VDE 0570/ DIN EN 61558-2-6







Construction:
Three- phase power supply unit on mounting plate separate windings. Corrosion protection via complete impregnation. The compactly built-on three – phase power supply units of the model series DBM are characterised by high reliability and operational safety.

Technical data:

Input voltage:	3 x 400 VAC 50/60 Hz
Output voltage:	24 VDC
Output current:	40 - 300 A (see table)
Ripple:	< 3 %
Cooling:	Convection fitting position in the direction of convection
Operating mode:	Continuous duty
Insulation class:	T40E
Ambient temperature:	Max. 40°C
Type protection:	IP 00 suitable for installations up to IP 23

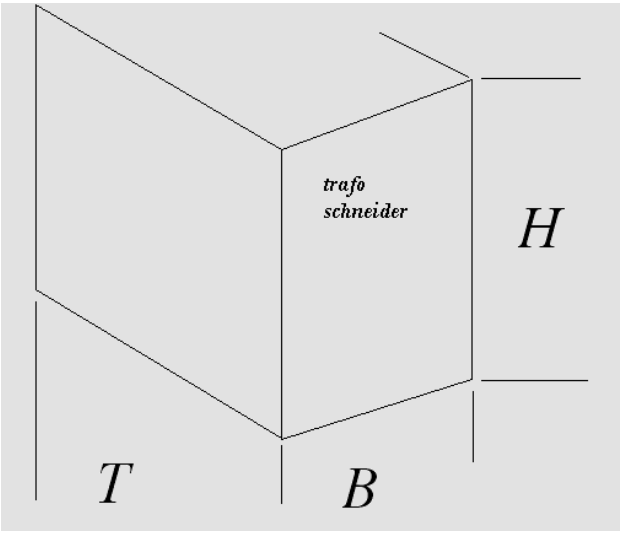
Type	Output current	Design size	Copper weight	Total weight	Dimensioning					
					A	B	C	D	E	F
	A	Core	kg	kg	mm	mm	mm	mm	mm	mm
DBM 2440	40	3UI90	4.9	147	260	460	250	230	430	6.8
DBM 2460	60	3UI114	8.5	22	300	460	260	270	430	6.8
DBM 2480	80	3UI132	9.4	28	300	460	260	270	430	6.8
DBM 24100	100	3UI132	12	37	340	550	300	310	520	6.8
DBM 24120	120	3UI132	15	42	340	550	300	310	520	6.8
DBM 24160	160	3UI132	12	51	340	550	300	310	520	6.8
DBM 24200	200	3UI150	17	59	340	550	300	310	520	6.8
DBM 24250	250	3UI180	21	63	450	550	480	410	520	11.0
DBM 24300	300	3UI210	25	80	450	550	480	410	520	11.0

Higher output currents and other voltages on request.

9. Primary switching controller COMPETENT

9.1 General

Reliability corresponding to
VDE 0805/ DIN EN 60950/ IEC 950



Construction:
High efficiency continuous short-circuit protected and permanently no-load.
Absolutely compact and place-saving with very limited weight.
Fitted with noise suppression corresponding to EN 55011 / DIN EN 55022 Class B
Fault-free operation corresponding to DIN EN 50082-1/-2
Operation display by using LEDs
Global accredited
Also suitable for labile networks
Parallel operation

Technical data:

Output voltage:	up to PSG240500 24 VDC +/- 3 % from PSG240500-COSMO 24 VDC +/- 1 %
Output current:	1.25 - 40 A (see table)
Type protection:	IP20
Protection class:	I II
Power factor at 115 V:	0.50 – 0.58 capacitive
Power factor at 230 V:	0.43 - 0.82 capacitive
Power factor at D400 V:	0.53 - 0.61 capacitive
Typical efficiency:	85 - 90 %
Anchorage:	on cap rails DIN EN 50022-35

More technical data see 9.4 or on request

Primary switching controller COMPETENT

9.2 Single - phase

Type	Power	*I_a	Ripple	*U_E	*I_E	*$N_Ü$	weight	Dimensioning		
								B	H	T
PSG	W	A	mV_{PP}		A	ms	kg	mm	mm	mm
240125	30	1.25	<50	A	0.35	>80	0.2	45	105	72
2402	48	2.00	<50	A	0.60	>70	0.2	45	105	72
24025	60[*1]	2.50	<100	A	0.60	>80	0.6	65	108	123
2405	120[*1]	5.00	<100	B	1.23	>80	0.8	86	147	123
2405COSMO	120[*3]	5.00	<50	C	0.90	>20	0.9	70	139	132
2410	240[*1]	1.00	<100	D	2.20	>15	1.2	86	205	123
2410COSMO	240[*3]	1.00	<50	C	1.80	>35	1.2	70	164	148
2410COSMO400	240[*3]	10.00	<50	**E**	1.74	>10	1.2	70	141	151
2420	480[*1]	20.00	<100	F	4.20	>15	1.9	86	240	153
2420COSMO	480[*2]	20.00	<50	G	3.00	>20	2.0	86	173	227

***I_a** *Output current* ***U_E** *Input voltage range (see below)*
*** I_E** *Input current at 230 V* ***$N_Ü$** *Holdup time at 230 V*

[*1] : adjustment range of output voltage typical 23 – 27 V
[*2] : adjustment range of output voltage typical 23 – 29 V
[*3] : adjustment range of output voltage typical 23 – 30 V

Input voltage range:

A : 94 - 265 VAC 47 - 63 Hz without transfer
B : 97 - 265 VAC 47 - 63 Hz without transfer
C : 187 - 265 VAC 47 - 63 Hz reversible via solder bridge to 93 - 132 VAC 47 - 63 Hz
D : 195 - 265 VAC 47 - 63 Hz reversible via solder bridge to 97 - 132 VAC 47 - 63 Hz
E : far range 195 - 500 VAC 47- 63 Hz
F : 195 - 265 VAC 47 - 63 Hz
G : 190 - 265 VAC 47 - 63 Hz

9.3 Three - phase

Type	Power	*I_a	Ripple	*U_E	*I_E	*$N_Ü$	weight	Dimensioning		
								B	H	T
PSG	W	A	mV_{PP}		A	ms	kg	mm	mm	mm
2410-400	240[*3]	10.00	<50	H	0.70	>5	1.4	81	160	153
2420-400	480[*1]	20.00	<100	H	1.50	>5	1.9	86	240	153
2420-COSMO400	480[*2]	20.00	<50	H	1.50	>5	2.0	86	173	227
2440-400	960[*1]	40.00	<100	H	3.00	>5	3.6	130	185	292

***I_a** *Output current* ***U_E** *Input voltage range (see below)*
*** I_E** *Input current at D 400 V* ***$N_Ü$** *Holdup time at D 400 V*

[*1] : adjustment range of output voltage typical 23 – 27 V
[*2] : adjustment range of output voltage typical 23 – 29 V
[*3] : adjustment range of output voltage typical 23 – 30 V

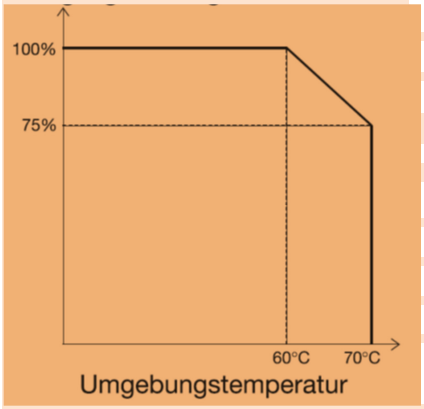
Input voltage range:

H : far range 3x 340 - 550 VAC 47 - 63 Hz

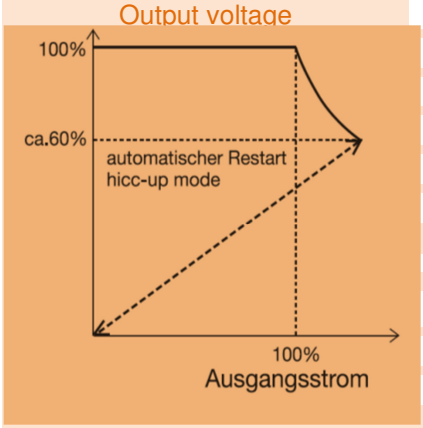
Primary switching controller COMPETENT

9.4 Technical data

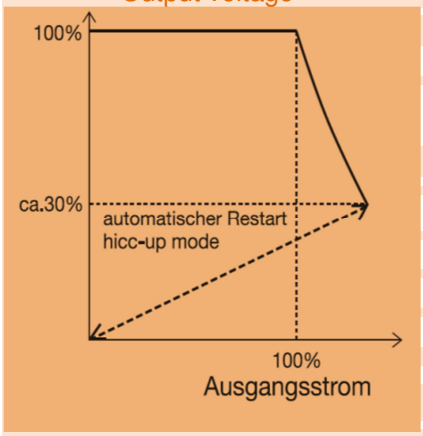
Output



CURRENT LIMITING CHARACTERISTIC
1.25 A / 2 A
Output voltage



CURRENT LIMITING CHARACTERISTIC
5 / 10 / 20 / 40 A
Output voltage

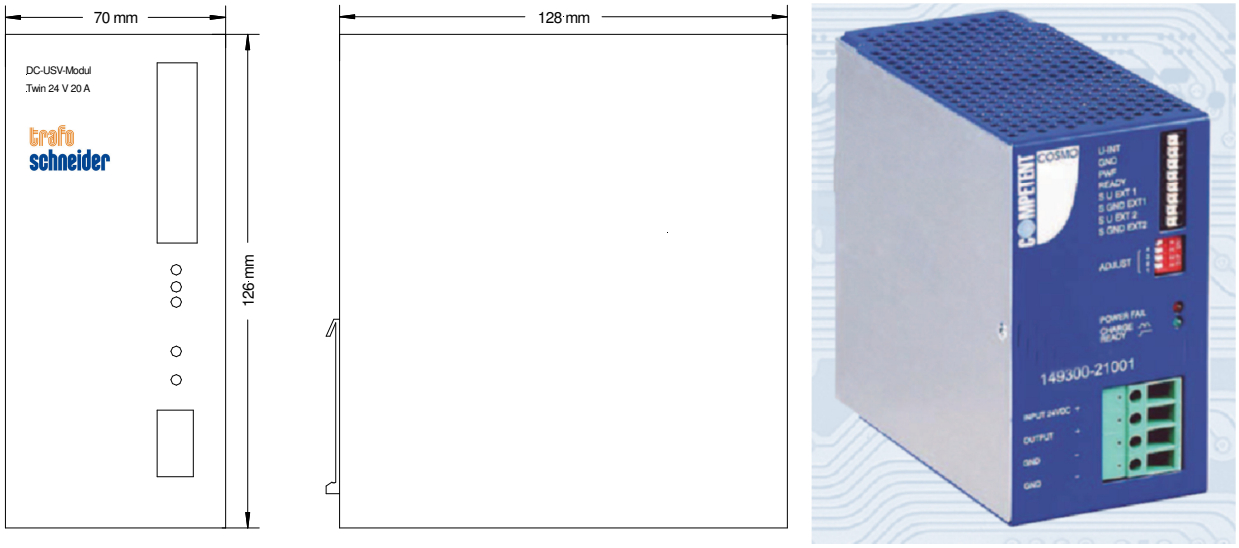


REGULATION	
Mains regulation	< 0.2 % at U_{Ein} ± 15 %
Load control	< 1 % at 0 A – > > I_{NENN}
Dynamics	> 2 ms at 10 <–> 90 % I_{NENN} Overshoot < 2 %
GUARD AND MONITORING	
Current limiting	Continuous short-circuit protected
Overload-proof	yes
Open-circuit proof	yes
Output voltage surveillance disconnection	yes
RELIABILITY	
Outlet	VDE 0805/ EN 60950/IEC 950/UL 1950
	Safety-low voltage (SELV) DIN EN 60950
Protection class	Class I / Class II bt
Type protection	IP 20
Leakage current (1.25 A / 2 A)	< 0.25 mA (47 - 63 Hz mains frequency)
Leakage current (5 A / 10 A)	< 0.75 mA (47 - 63 Hz mains frequency)
Leakage current (20 A / 40 A)	< 3.50 mA (47 - 63 Hz mains frequency)
EMV CE – CERTIFIZIED	DIN EN 55011 DIN EN 50082-1/-2
Noise suppression	DIN EN 55011/DIN EN 55022 Class B
Static discharge ESD IEC 1000-4-2	8 kV contact discharge method 15 kV air discharge method
EM fields IEC 1000-4-3	10 V/m
Burst IEC 1000-4-6	4 kV Input 2 kV Output / capacitive injected
Surge IEC 1000-4-5	4 kV asymmetrical 4 kV symmetrical
Conducted disturbance type ENV 50141 IEC 1000-4-6	10 V 150 kHz...80 MHz
OPERATING DATA	
Temperature range	- 10°C to + 70°C at free convection
Performance derating	2.5 % / K from + 60°C (see chart)
Storage temperature	- 25°C to + 85°C
ASSEMBLY	
Installation	Plastic gate for installation on Cap rail DIN EN 50022-35
Fitting position	Wall mounted Input terminals at the top Output terminals at the bottom

10. DC-USV COMPETENT- COSMO

10.1 DC-USV Buffer module 24 V/ 20 A - 480 W

In conjunction with COMPETENT-COSMO Switch-mode power supply or transformer power supply unit



- Reliability corresponding to VDE 0805/ EN 60950/ IEC 950
- Fitted with noise suppression corresponding to EN 55011/ Class B
- Fault-free operation corresponding to EN 50082-1/ -2
- Width of case only 70 mm
- Parallel operation possible
- Integrated diode decoupling
- Vertical configuration on cap rails
- weight ca. 1.2 kg
- Spring-type terminals
- ta 60°C
- Type protection IP 20

Technical data

Input

Nominal voltage	24 VDC
Input voltage range	19.2 – 31.2 VDC
Nominal input current	0.6 A in charging mode
Switching threshold for UPS-operation adjustable via DIP switch	14.0 – 29.0 V ± 1 %

Output

Output voltage for Buffer operation	14.0 – 29.0 V +/- 1 % according to the adjusted switching threshold (DIP switch + 1 V stages)
Direct current voltage	0 – 20 A
Energy storage	maintenance-free electrolytic capacitor
Ready signal (buffer charged)	Output up to max. 31.2 VDC / 35.0 mA sink
PWF Signal (mains failure)	Output up to max. 31.2 VDC / 35.0 mA sink

Signalling

Operation display (LED) red	Power Fail signals buffer operation
Operation display (LED) green blinking	Buffer is charging
Operation display (LED) green length	Buffer charged

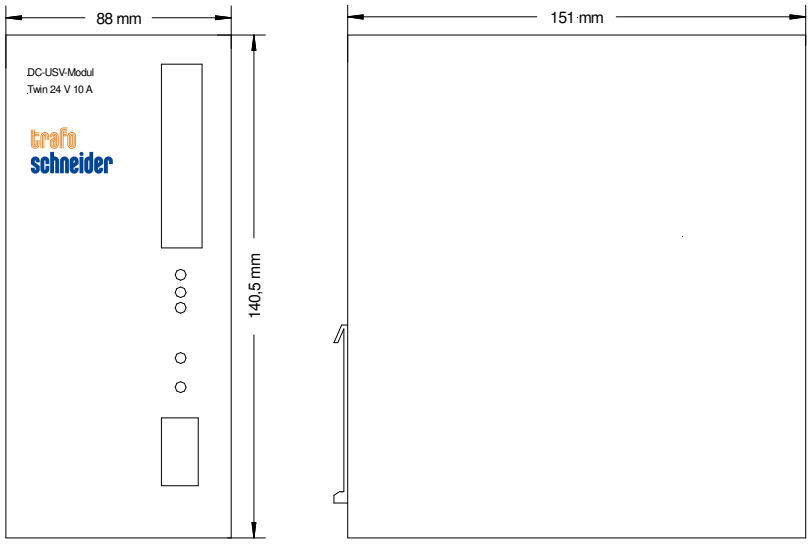
Power failure bridging time

Current [A]	Buffer time [s]
1	4.0
5	1.0
10	0.5
20	0.2

DC-USV COMPETENT- COSMO

10.2 DC-USV module TWIN 24 V / 10 A - 240 W

In conjunction with COMPETENT-COSMO Switch-mode power supply



- Reliability corresponding to VDE 0805/ EN 60950/ IEC 950
- Fitted with noise suppression corresponding to EN 55011/ EN 55022 Class B
- Fault-free operation corresponding to EN 50082-1/ -2
- Width of case only 88 mm
- Vertical configuration on cap rails
- Weight ca. 2.1 kg
- Spring-type terminals 2.5 mm^2
- ta 50°C (ideal for battery 25^0C)
- Type protection IP 20

Technical data

Input

Nominal voltage	24 VDC
Input voltage range	21.5 – 30.0 VDC
Battery charge current adjustable	0.5 – 1.0 A
System release / switch off	dry contact or 24 V control voltage
Switching threshold for UPS-operation adjustable	21.5 – 23.4 V
Power failure bridging time adjustable	reversible: 4 – 30 s / 30 – 180 s / length

Output

Nominal output voltage	24 V ± 1 %
Output voltage on battery power	26.5 – 19.0 VDC
Direct current output	0 – 10 A
Battery fuse intern	T 10 A
Power failure bridging time	ca. 30 min at 1 A 4 min at 5 A 45 s at 10 A
Warning contact for Battery Partial discharge	at 21.5 V (resistant 1.25 A 125 V 60 VA)
Deep discharge protection	yes switching threshold typ. 19.5 V
Power fail signal	yes isolated (relay contact 1.25 A 125 V 60 VA)
Accumulator	1.2 Ah maintenance-free lead fleece accumulator

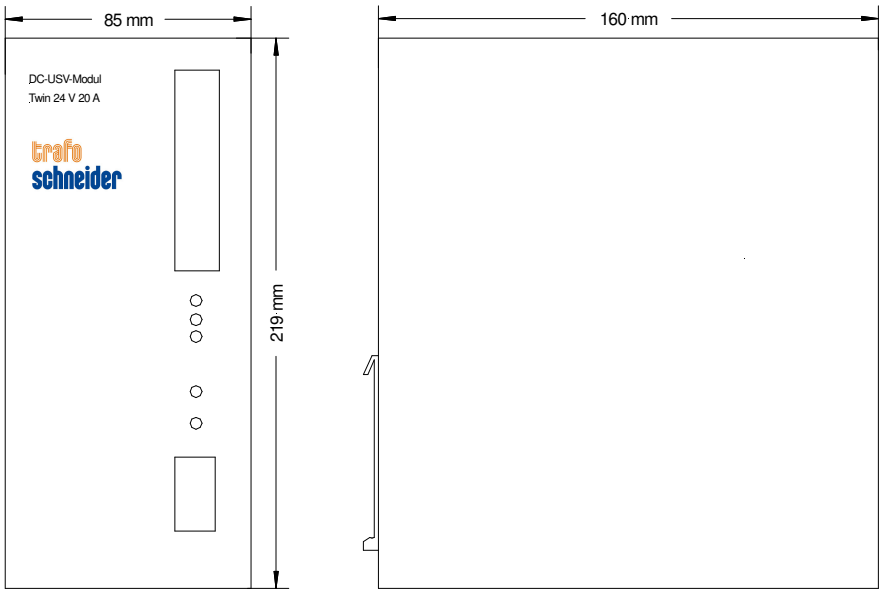
Signalling

Operating display (LED) green	= Input voltage ok.
Operating display (LED) red	= advance warning (at < 22 VDC battery voltage).
Operating display (LED) red and directional contact	= battery damaged system not ready.
Operating display (LED) yellow and relay change-over contact	= Power fail signal.

DC-USV COMPETENT- COSMO

10.3 DC-USV module TWIN 24 V / 20 A - 480 W

In conjunction with COMPETENT-COSMO switch-mode power supply



- Reliability corresponding to VDE 0805/ EN 60950/ IEC 950
- Fitted with noise suppression corresponding to EN 55011/ EN 55022 Class B
- Fault-free operation corresponding to EN 50082-1/ -2
- Width of case only 858 mm
- Vertical configuration on cap rails
- Weight ca. 2.5 kg
- Screw-type terminals 6.0 mm^2
- ta 50°C (ideal for battery 25^0C)
- Type protection IP 20

Technical data

Input

Nominal voltage	24 VDC
Input voltage range	22.5 – 30.0 VDC
Battery charge current	0.7 – 2.0 A
System release / switch off	dry contact or 24 V control voltage
Switching threshold for UPS-operation adjustable	22.2 – 23.4 V
Power failure bridging time	Load control / contingent on load and battery

Output

Nominal output current	24 V ± 1 %
Output voltage	27.0 – 19.5 VDC
On battery power	
Direct current output	0 – 20 A
Power failure bridging time	contingent on external accumulator
Warning contact for battery	yes
Partial discharge	
Deep discharge protection	at 19.5 V
Power fail signal	isolated (relay contact)
Battery pack external	additional necessary

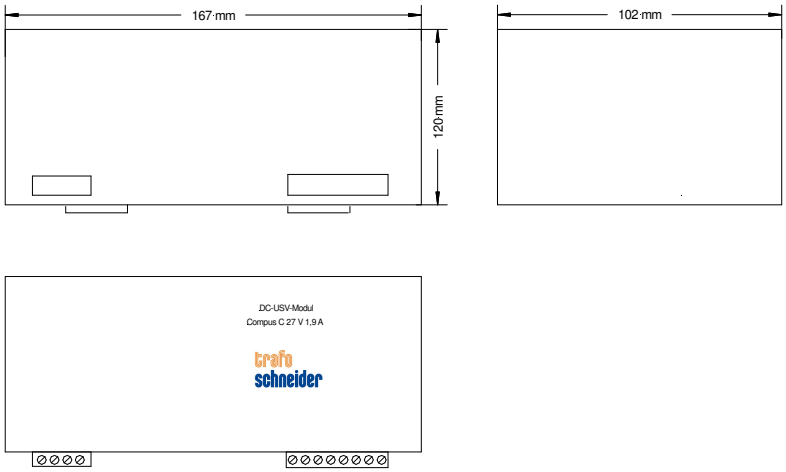
Signalling

Operation display (LED) green	= Input voltage ok.
Operation display (LED) red	= Advance warning (at < 22 VDC battery voltage).
Operation display (LED) red and directional contact	= Battery damaged system not ready.
Operation display (LED) yellow and relay change-over contact	= Power fail signal.

DC-USV COMPETENT- COSMO

10.4 DC-USV Compus C 27 V/ 1.9 A

Contains power supply unit charging device DC-UPS-module and accumulator



- Reliability corresponding to VDE 0805/ EN 60950/ IEC 60950
- Standards CE-standard EN 61000-4-2 3 4 5 EN 610003-2A
- Fitted with noise suppression corresponding to EN 55022 Class B
- Input voltage range 90 – 264 VAC /127 – 370 VDC
- Integrated automatic battery exercise test
- Deep discharge protection
- Adjustable power failure bridging time
- Vertical configuration on cap rails
- Optional available with PC interface

Technical data

Input

Nominal voltage	110 / 230 VAC
Input voltage range	90 – 264 VAC / 127 – 370 VDC
Frequency	47 – 63 Hz
Efficiency	typ. 89 %

Output

Output voltage in mains operation	27.0 VDC ± 2 %
Output voltage on battery power	26.5 – 19.45 VDC
Max. output current	1.9 A

Operation displays

LED „Power“	Output voltage ok.
LED „USV“	Battery power
LED „USV-Warnung“	Warning battery voltage < 22.0 VDC

DC-USV COMPETENT- COSMO

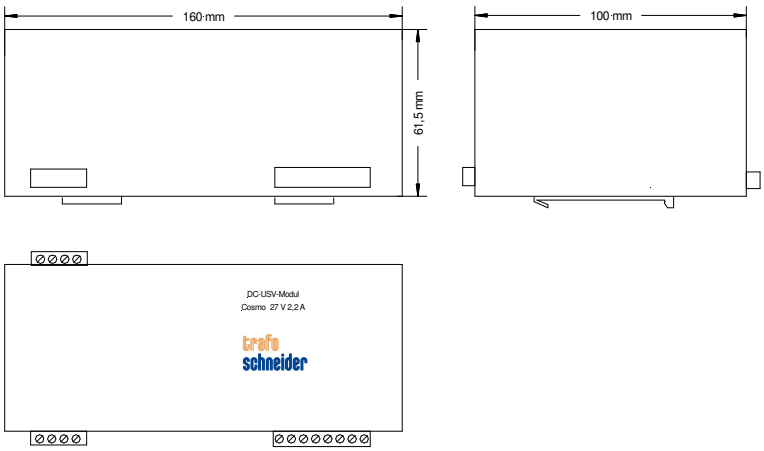
10.4 DC-USV Compus C 27 V / 1.9 A

Control input	
Enable input	via isolated make contact or with 5.0 – 36.0 VDC control voltage
Message outputs	
Warning battery voltage < 22.0 VDC	isolated relay contact 125 V / 1.5 A 60 VA
UPS-operation	isolated relay contact 125 V / 1.5 A 60 VA
General	
Power failure bridging time	ca. 15 min at 1.9 A (adjustable)
Deep discharge cut-off	Switching threshold typ. 19.5 VDC
Battery pack	1.3 Ah maintenance-free lead fleece accumulator
Weight	2.0 kg
Ambient temperature	0 to + 45°C ideal for battery 25°C
Type protection	IP 20
Anchorage	Clamping elements for cap rail mounting
Connection	push terminals and screw-type terminals

DC-USV COMPETENT- COSMO

10.5 DC-USV COMPETENT- COSMO 27 V / 2.2 A

Compact UPS – contains power supply unit charging device and DC-UPS-module



- Far range input 95 – 265 VAC / 45 – 63 Hz
- Adjustable output voltage
- Adjustable charge current
- Load-dependent deep discharge protection
- Integrated automatic battery exercise test
- Reliability corresponding to VDE 0805/ EN 60950/ IEC 950
- Fitted with noise suppression corresponding to EN 55022 Class B
- Standard CE-standard EN 61000-4-2 3 4 5 EN 610003-2A
- Compact case on cap rail
- Message outputs
- ta 45°C (ideal for battery 25°C)
- Push terminals and screw-type terminals
- Weight ca. 0.7 kg

Technical data

Input

Nominal voltage	115 / 230 VAC 45 – 63 Hz
Input voltage range	95 VAC – 265 VAC
Input current	max. 0.6 A
Reliability	VDE 0805/ EN 60950/ IEC 60950
Protection class	Class I
Type protection	IP 20

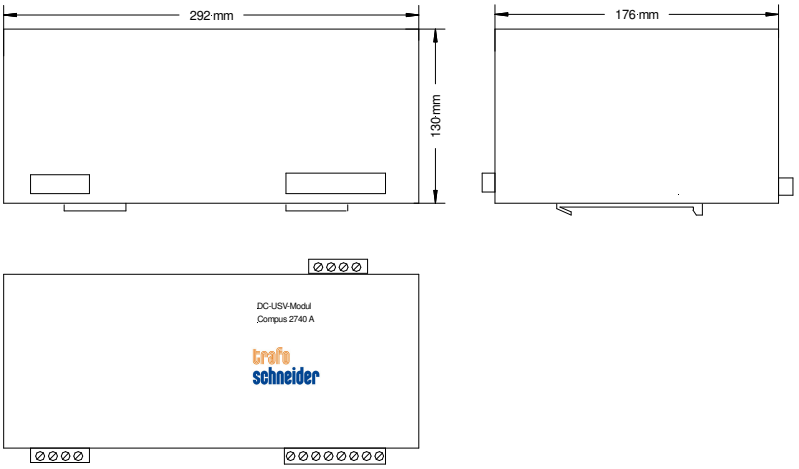
Output

Output voltage	26.2 VDC – 27.6 VDC ± 1 %
Output power	2.2 A (complete current = load * charge current)
Current limiting battery	2.2 A Hicc up 120 – 350 mA adjustable
Battery test	Cycle 10 sec/ length 150 msec
Efficiency	typ. 88 %
Temperature range	0°C – 45°C at free convection
Relative air humidity	95 % non-condensing

DC-USV COMPETENT- COSMO

10.6 DC-USV COMPUS 2740 27 V/ 35 A

Contains power supply unit charging device and DC-UPS-module



- Reliability corresponding top VDE 0805 / EN 60950 / IEC 60950
- Standard CE-standard EN 61000-4-2 3 4 5 EN 610003-2A
- Fitted with noise protection corresponding to EN 55022 Class B
- Input voltage range 3 x 340 V – 550 VAC
- Deep discharge protection
- Adjustable power failure bridging time
- Integrated automatic battery exercise test
- Vertical configuration on cap rail
- Optional available with PC interface

Technical data

Input

Nominal voltage	3 x 360 – 500 VAC
Input voltage range	3 x 340 – 550 VAC
Frequency	47 – 63 Hz
Efficiency	typ. 92 %
Inrush current	< 50 A

Output

Output voltage in mains operation	27.0 VDC ± 1 %
Output voltage on battery power	26.5 – 19.5 VDC
Max. output current	35.0 ADC
Max. battery charge current	2.5 ADC

Operation displays

LED „USV-Dienst gesetzt“	Communication via RS232
LED „USV-Warnung“	Warning battery voltage < 23.3 V
LED „USV-Batteriebetrieb“	Battery power
LED „USV-Inbetriebnahme“	Disengaging
LED „USV-Power“	Output voltage ok.

DC-USV COMPETENT- COSMO

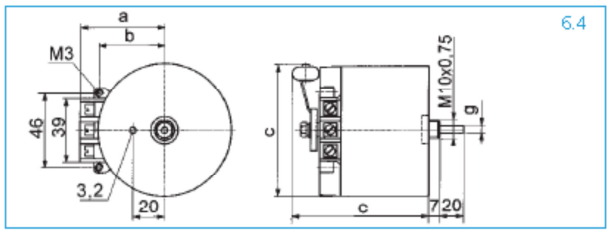
10.6 DC-USV COMPUS 2740 27 V/ 35 A

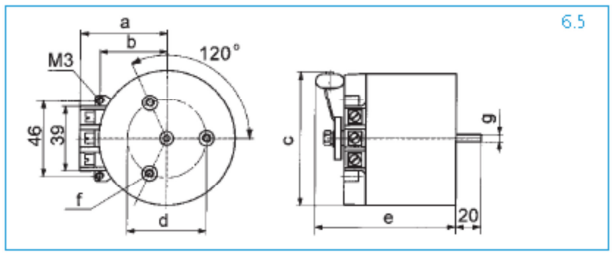
Control input	
Enable input	via isolated make contactor with 5.0 – 36.0 VDC control voltage
Message outputs	
Warning battery voltage < 23.2 VDC	isolated relay contact 125 V / 1.5 A 60 VA
UPS operation	isolated relay contact 125 V / 1.5 A 60 VA
General	
Power failure bridging time	dependent on external battery and load current
Deep discharge cut-off	Switching threshold typ. 19.5 VDC
Battery pack	external
Weight	4.4 kg
Ambient temperature	0 to + 45°C ideal for battery 25°C
Type protection	IP 20
Anchorage	Clamping elements for cap rail mounting
Connection	Push terminals and screw-type terminals

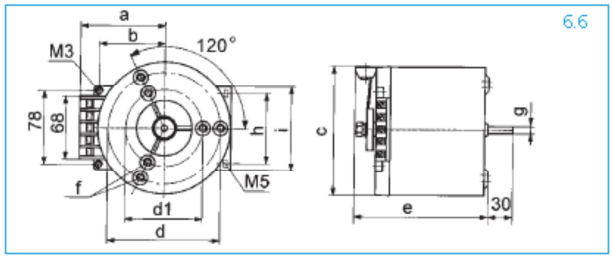
11. Toroidal regulator transformer

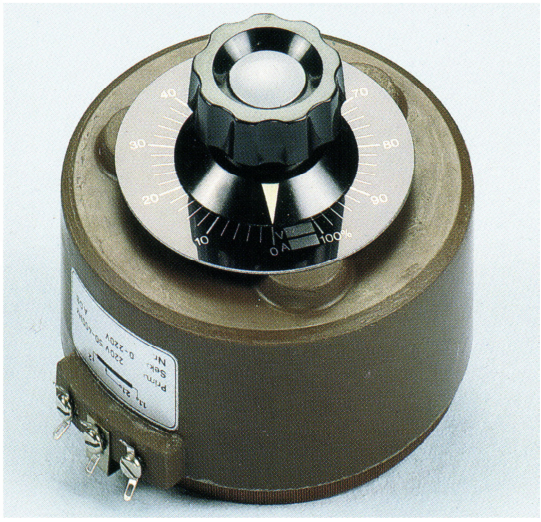
11.1 Type RV Single – phase with economy winding fractional casting

Corresponding to VDE 0570 DIN EN 61558









Outline drawing	Image	Dimensioning									
No.		a	b	c	d	d1	e	f	G	h	i
		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
1	6.4	50	37	79	-	-	67		6	-	-
2	6.5	50	37	79	26	-	71	M6	6	-	-
3	6.4	50	37	79	-	-	72		6	-	-
4	6.5	50	37	79	26	-	76	M6	6	-	-
5	6.4	55	43	88	-	-	72		6	-	-
6	6.5	55	43	88	26	-	76	M6	6	-	-
7	6.4	55	43	88	-	-	77		6	-	-
8	6.5	55	43	88	26	-	81	M6	6	-	-
9	6.4	55	43	88	-	-	81		6	-	-
10	6.5	55	43	88	26	-	86	M6	6	-	-
11	6.4	55	43	88	-	-	87		6	-	-
12	6.5	55	43	88	26	-	91	M6	6	-	-
13	6.4	62	55	106	-	-	78		6	-	-
14	6.5	62	55	106	26	-	86	M6	6	-	-
15	6.4	62	55	106	-	-	93		6	-	-
16	6.5	62	55	106	26	-	101	M6	6	-	-
17	6.6	72	55	125	100	80	130	M6	10	66	82
18	6.6	84	69	149	100	80	111	M6	10	76	92
19	6.6	84	69	149	100	80	116	M6	10	76	92
20	6.6	84	69	149	100	80	121	M6	10	76	92
21	6.6	90	83	166	95	-	129	M6	10	-	-

Toroidal regulator transformer

Type RV Single – phase with economy winding fractional casting

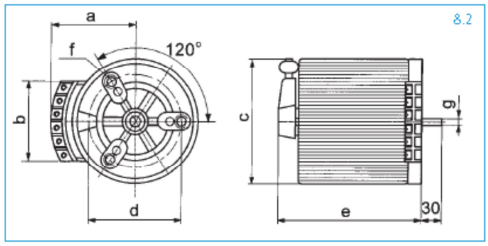
Input 230 V Output 0 - 230 V		Input 230 V Output 0 - 260 V		Input 400 V Output 0 - 400 V					Outline Drawing
Type*	Current	Type*	Current	Type*	Current	Design size	Copper weight	Total weight	No.
	A		A		A		kg	kg	
RV230/1-Z	1.00	—	—	—	—	G0045	0.04	1.25	1
RV230/1-3	1.00	—	—	—	—	G0045	0.04	1.25	2
RV230/125-Z	1.25	RV260/08-Z	0.8	—	—	G0050	0.05	1.35	3
RV230/125-3	1.25	RV260/08-3	0.8	—	—	G0050	005	1.35	4
—	—	RV260/125-Z	1.25	—	—	G050	0.08	1.65	5
—	—	RV260/125-3	1.25	—	—	G050	0.08	1.65	6
RV230/160-Z	1.60	RV260/14-Z	1.40	—	—	G055	0.15	1.85	7
RV230/160-3	1.60	RV260/14-3	1.40	—	—	G055	0.15	1.85	8
RV230/2-Z	2.00	RV260/16-Z	1.60	—	—	G060	0.17	2.05	9
RV230/2-3	2.00	RV260/16-3	1.60	—	—	G060	0.17	2.05	10
RV230/25-Z	2.50	RV260/2-Z	2.00	—	—	G065	0.18	2.20	11
RV230/25-3	2.50	RV260/2-3	2.00	—	—	G065	0.18	2.20	12
RV230/3-Z	3.00	RV260/25-Z	2.50	—	—	G55	0.25	2.90	13
RV230/3-3	3.00	RV260/25-3	2.50	—	—	G55	0.25	2.90	14
RV230/45-Z	4.50	RV260/3-Z	3.00	—	—	G70	0.32	3.60	15
RV230/45-3	4.50	RV260/3-3	3.00	—	—	G70	0.32	3.60	16
RV230/63-3	6.30	RV260/45-3	4.50	RV400/2-3	2.00	G180	0.50	4.95	17
RV230/8-3	8.00	—	—	RV400/25-3	2.50	G260	0.77	4.95	18
—	—	RV260/63-3	6.30	RV400/3-3	3.00	G265	0.82	6.00	19
RV230/10-3	10.00	RV260/8-3	8.00	RV400/4-3	4.00	G270	0.86	6.45	20
RV230/12-3	12.00	RV260/10-3	10.00	RV400/5-3	5.00	G375	1.52	8.90	21

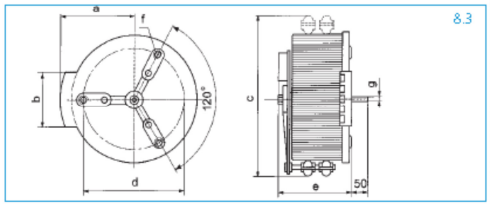
* -Z: Central fixture
-3: 3- point fixture

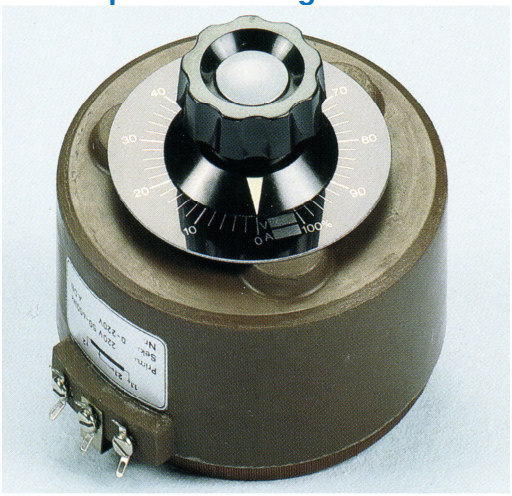
Toroidal regulator transformers are used for continuous tension regulation in industry and laboratories. Fractional casting construction with plug-in axle. Strong composition ease of assembly contact arm with roller. Several variable transformers may be belted by the same axis so all the units are simultaneously operable. Via series connection higher voltages may be controlled than single transformers allow. An increase in output is achieved by parallel arrangement.

Toroidal regulator transformer

11.2 Type RGE Single – phase with separate windings







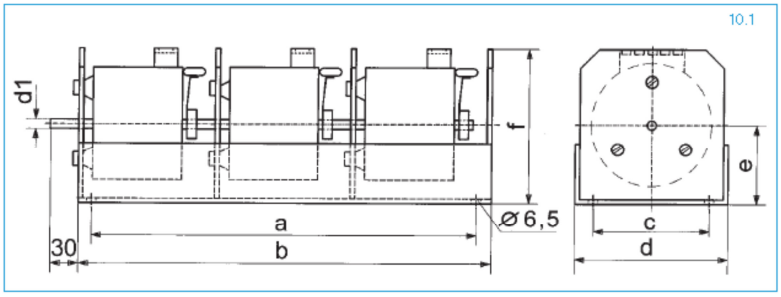
Outline drawing	Image	Dimensioning						
No.		a	b	c	d	E	f	G
		mm	mm	mm	mm	mm	mm	Mm
22	8.2	95	86	168	100	125	M6	10
23	8.2	95	86	168	100	130	M6	10
24	8.2	95	86	168	100	140	M6	10
25	8.2	95	86	168	100	145	M6	10
26	8.2	95	86	168	100	150	M6	10
27	8.2	95	86	168	100	155	M6	10
28	8.2	95	86	168	100	160	M6	10
29	8.3	148	92	305	160	165	M6	10
30	8.3	148	92	305	160	170	M6	10
31	8.3	148	92	305	160	170	M6	10
32	8.3	150	92	320	160	165	M6	10
33	8.3	150	92	320	160	170	M6	10
34	8.3	150	92	326	160	175	M6	10

3- point fixture. Construction with screwed connection, bow collector on the face side at design sizes P261-P296, shell side at design sizes G3266-G4076A, proof voltage 4kV, suitable for installations corresponding to protection class II.

Input 230 V Output 0 - 230 V		Input 230 V Output 0 - 260 V		Input 230 V Output 0 - 300 V					Outline drawing
Type	Current	Type	Current	No.	Current	Design size	Copper weight	Total weight	No.
	A		A		A		kg	kg	
RGE230/25	2.50	RGE260/2	3.00	22	1.6	P261	1.27	7.3	22
RGE230/315	3.15	RGE260/25	2.50	23	3.2	P266	1.47	8.1	23
RGE230/4	4.00	RGE260/315	3.15	24	2.5	P276	1.84	8.5	24
RGE230/5	5.00	-	-	25	3.0	P281	2.01	9.2	25
-	-	RGE260/4	4.00	26	-	P286	2.22	9.7	26
-	-	RGE260/5	5.00	27	4.0	P291	2.48	10.1	27
RGE230/63	6.30	-	-	28	-	P296	2.64	10.6	28
-	-	RGE260/8	8.00	29	6.3	G3266	5.72	17.6	29
RGE230/10	10.00	-	-	30	-	G3171	7.30	18.8	30
-	-	-	-	31	8.0	G3271	6.67	19.8	31
RGE230/12	15.02	RGE230/10	10.00	32	-	G4066	7.60	21.5	32
-	-	RGE230/12	12.00	33	10.0	G4071	9.40	23.6	33
RGE230/16	16.00	-	-	34	-	G4067A	9.90	26.0	34

Toroidal regulator transformer

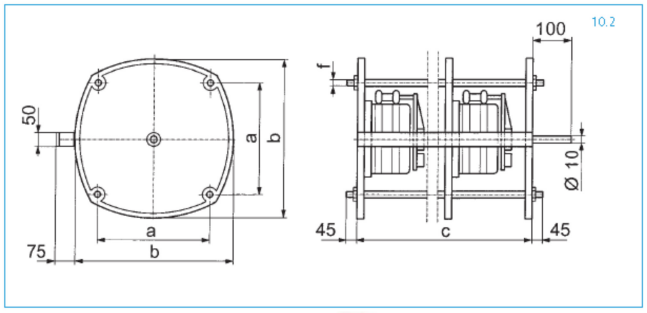
11.3 Type YRV Three – phase with economy winding

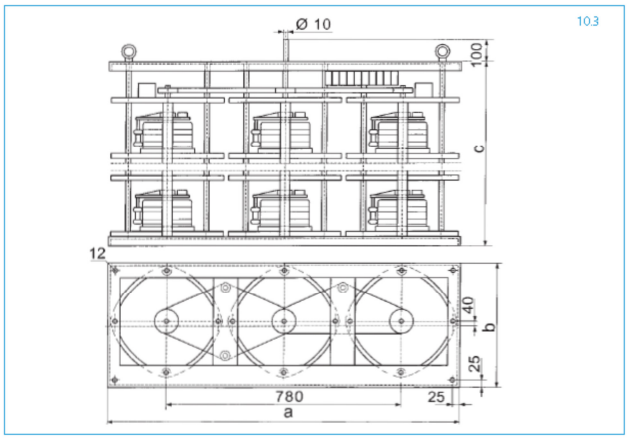


Input 3x 400 / 230 V Output 3x 0 – 400 / 230 V		Input 3x 400 / 230 V Output 3x 0 – 450 / 260 V											
Type	**Current**	**Type**	**Current**	**Design size**	**Copper weight**	**Total weight**	**Dimensioning**						
							a	**b**	**c**	**d**	**E**	**f**	**g**
	A		**A**		**kg**	**kg**	mm	mm	mm	mm	mm	mm	mm
YRV 400/1	1.00	-	-	3/G0045	0.12	6.20	95	86	168	100	125	M6	10
YRV 400/125	1.25	-	-	3/G0050	0.15	6.70	95	86	168	100	130	M6	10
-	-	YRV 450/125	1.25	3/G050	0.24	7.40	95	86	168	100	140	M6	10
YRV 400/16	1.60	-	-	3/G055	0.45	7.80	95	86	168	100	145	M6	10
YRV 400/2	2.00	YRV 450/16	1.60	3/G060	0.51	8.40	95	86	168	100	150	M6	10
YRV 400/25	2.50	YRV 450/2	2.00	3/G065	0.54	8.80	95	86	168	100	155	M6	10
YRV 400/3	3.00	YRV 450/25	2.50	3/G55	0.75	11.50	95	86	168	100	160	M6	10
YRV 400/45	4.50	YRV 450/3	3.00	3/G70	0.96	13.40	148	92	305	160	165	M6	10
YRV 400/63	6.30	YRV 450/45	4.50	3/G180	1.50	18.70	148	92	305	160	170	M6	10
YRV 400/8	8.00	-	-	3/G260	2.31	21.00	148	92	305	160	170	M6	10
-	-	YRV 450/63	6.30	3/G265	2.46	22.00	150	92	320	160	165	M6	10
YRV 400/10	10.00	YRV 450/8	8.00	3/G270	2.58	23.70	150	92	320	160	170	M6	10
YRV 400/12	12.00	YRV 450/10	10.00	3/G375	4.56	29.50	150	92	326	160	175	M6	10

Toroidal regulator transformer

11.4 Type YR Three – phase with economy winding





Input 3x 400 / 230 V Output 3x 0 – 400 / 230 V		Input 3x 400 / 230 V Output 3x 0 – 450 / 260 V									
Type	**Current**	**Type**	**Current**	**Design size**	**Copper weight**	**Total weight**	**Outline drawing**	**Dimensioning**			
								a	**b**	**c**	**f**
	A		**A**		**kg**	**kg**	**No.**	**mm**	**mm**	**mm**	**mm**
YR 400/18	18	YR 450/15	15	3-G0045	5.10	31	10.2	178	240	550	M10
YR 400/25	25	YR 450/20	20	3-G0050	8.00	51	10.2	249	335	500	M10
YR 400/32	32	YR 450/25	25	3-G050	10.20	56	10.2	249	335	500	M10
-	-	YR 450/32	32	3-G055	11.60	67	10.2	249	335	500	M10
YR 400/40	40	YR 450/36	36	3-G060	16.10	80	10.2	249	335	670	M10
YR 400/50	50	YR 450/40	40	3-G065	16.70	106	10.2	249	335	1100	M12
YR 400/60	60	YR 450/50	50	3-G55	21.20	114	10.2	249	335	1100	M12
-	-	YR 450/64	64	3-G70	24.30	129	10.2	249	335	1100	M12
YR 400/80	80	-	-	3-G180	32.70	150	10.2	249	335	1400	M12
YR 400/90	90	YR 450/75	75	3-G260	31.60	220	10.3	1200	500	810	
-	-	YR 450/90	90	3-G265	36.90	255	10.3	1200	500	810	
YR 400/120	120	-	-	3-G270	46.00	277	10.3	1200	500	975	
-	-	YR 450/120	120	3-G375	49.50	325	10.3	1200	500	980	
YR 400/160	160	YR 450/140	140	3-G375	68.00	365	10.3	1200	500	1200	

Related equipment just as control knobs motor drives scales and spare parts need to be special ordered.
More types on request.

12. Chokes

Power and commutation choke

It increases the natural impedance of the attached load. The gradient of the current rising as well as harmonic components get abated. It bypasses mains inrushes and borders the peaking power.

Please indicate in your order: II root mean square current nominal current and nominal voltage.

Direct-current smoothing choke

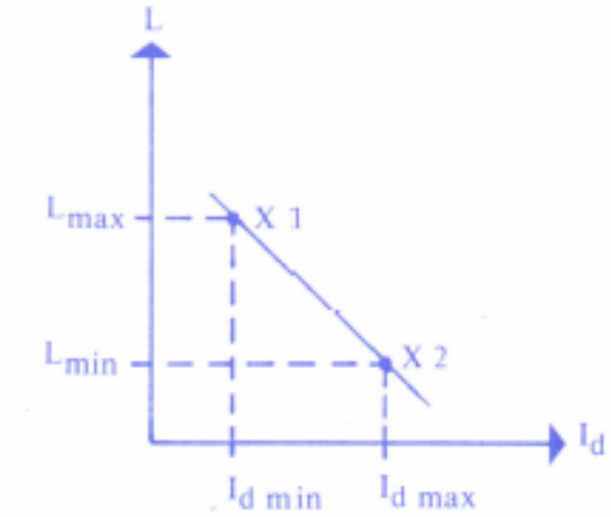
As energy buffer it is placed between load and voltage source. It does not only calender the vibrant co-current flow but also extends the conduction interval of otherwise intermittent control modes. The typical direct-current smoothing choke only permits a little change in its inductance in the range up to the nominal current (linear characteristic).

Please indicate in your order: root mean square current and nominal current.

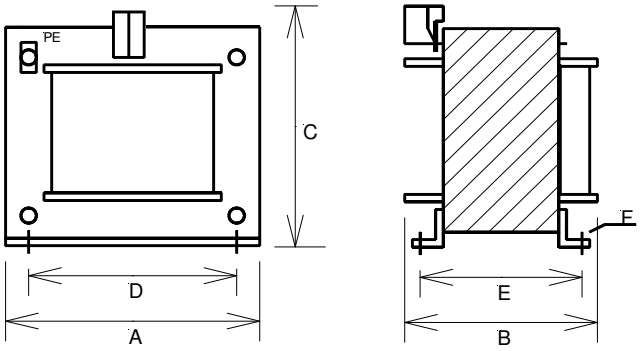
Circular current regulators

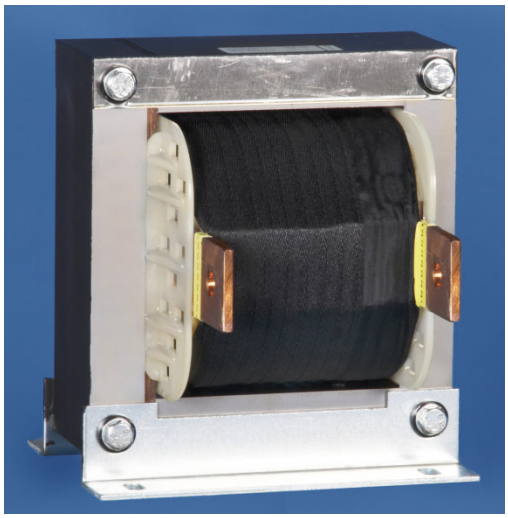
They are assembled in converter-fed actuations to commutate calender and border the circular current. By the placement of iron into the inductor the inductance becomes dependent on the amperage. The regulator characteristic is defined by two marks and arbitrary.

Please indicate in your order: Maximum inductance at current 1 minimal inductance at current 2 effective inductance.



12.1 Type KDE Single - phase mains commutating choke

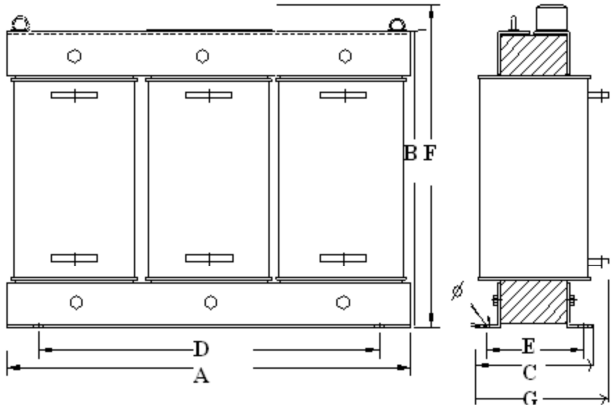


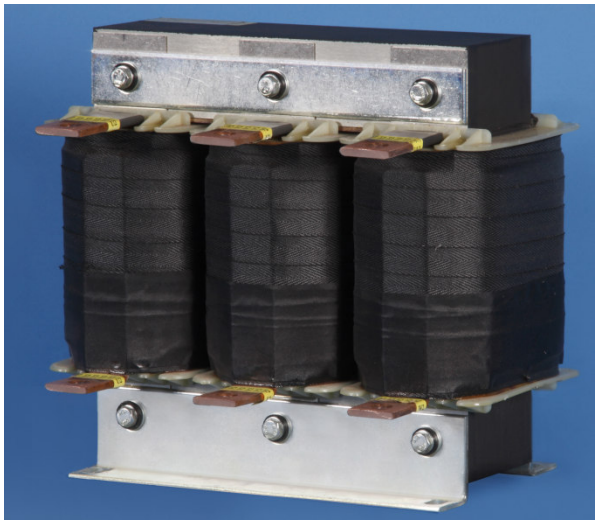


Construction:
Mains voltage 230 or 400 V Uk = 4 %
Frequency 50 … 400 Hz
Type protection IP 00 suitable for installations up to IP 23. VBG 4
Fixed with angle irons
Corrosion protection via complete impregnation.
Connecting elements comply with amperage. Up to 160 A clamp terminal more than 160 A
CU - connecting links.

Type	Tension	I max	Copper Weight	Total Weight	Dimensioning					
					A	B	C	D	E	F
	V	A	kg	kg	mm	Mm	mm	mm	mm	mm
BV2304-0016-E	230	16.0	0.18	1.4	78	96	87	56	53	4.8x9
BV2304-0020-E	230	20.0	0.26	1.4	84	89	92	64	46	4.8x9
BV2304-0025-E	230	25.0	0.30	1.7	84	98	92	64	55	4.8x9
BV2304-0031-E	230	31.5	0.51	2.4	96	95	104	84	59	5.8x11
BV2304-0040-E	230	40.0	0.47	2.8	96	105	104	84	69	5.8x11
BV4004-0010-E	400	10.0	0.21	1.4	78	96	87	56	53	4.8x9
BV4004-0012-E	400	12.5	0.23	1.6	84	98	92	64	55	4.8x9
BV4004-0016-E	400	16.0	0.37	2.3	96	95	104	84	59	5.8x11
BV4004-0020-E	400	20.0	0.42	2.8	96	105	104	84	69	5.8x11
BV4004-0025-E	400	25.0	0.52	3.6	96	119	104	84	83	5.8x11
BV4004-0031-E	400	31.5	0.70	4.0	120	101	123	90	69	5.8x11
BV4004-0040-E	400	40.0	0.89	5.1	120	113	123	90	81	5.8x11
BV4004-0050-E	400	50.0	0.93	6.7	120	133	123	90	101	5.8x11
BV4004-0061-E	400	61.0	1.20	7.5	150	109	149	122	83	7x13

12.2 Type KDD Three - phase mains commutating choke





Construction:
Mains voltage 400 V Uk = 4 %
Frequency 50 … 400 Hz
Type protection IP 00 suitable for installations up to IP 23. VBG 4
Fixed with angle irons
Corrosion protection via complete impregnation
Connecting elements comply with amperage. Up to 160 A clamp terminal more than 160 A
CU - connecting links.

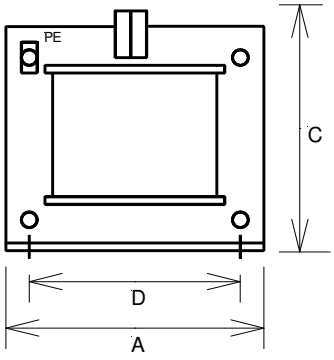
Type	Nominal Current	Copper weight	Total Weight	Dimensioning							
				A	B	C	D	E	F	G	ø
	A	kg	kg	mm	mm	mm	mm	mm	mm	mm	mm
BV4004-0040	40	1.9	6.0	180	166	75	136	56	190	110	7
BV4004-0050	50	2.0	8.6	180	166	85	136	66	190	120	7
BV4004-0061	61	2.5	10.0	180	166	95	136	76	190	130	7
BV4004-0080	80	4.3	13.0	210	185	97	175	57	215	130	7
BV4004-0100	100	4.2	15.0	210	185	115	175	95	215	150	7
BV4004-0125	125	5.3	19.5	240	220	101	185	81	255	150	10
BV4004-0160	160	7.1	22.0	240	220	111	185	91	255	160	10
BV4004-0200	200	7.6	27.0	240	220	121	185	101	255	170	10
BV4004-0250	250	10.8	34.0	300	280	122	224	94	310	180	10
BV4004-0315	315	13.7	42.0	300	280	135	224	107	301	195	10
BV4004-0400	400	17.4	50.0	300	280	147	224	119	310	210	10
BV4004-0500	500	20.6	65.0	360	345	156	264	128	375	210	10

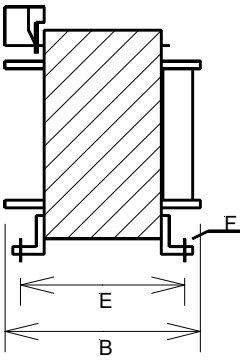
12.3 Type LD 1 Direct-current smoothing chokes EI

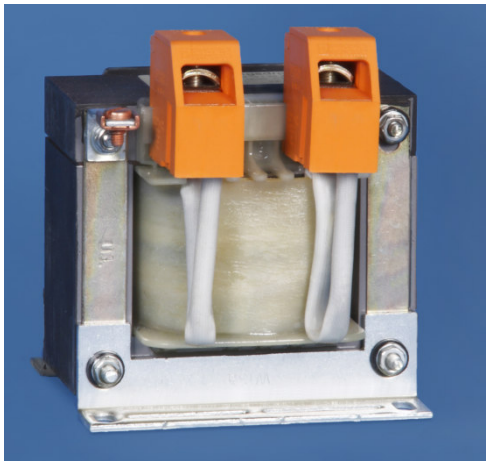
Appointment of design size for chokes with grid-independent development of inductance.

1. Example:
I_{eff} = 25 A; L = 20 mH = 0.02 H
LI^2_{eff} = 0.02 x 25 x 25 = 12.5
Next higher value in the following tables LI^2_{eff} = 13.7 that is Type LD 1 1500

2. Example:
I_{eff} = 39 A; L = 20 mH = 0.02 H
LI^2_{eff} = 0.02 x 39 x 39 = 30.42
Next higher value in the following tables LI^2_{eff} = 31.8 that is Type LD 2 35

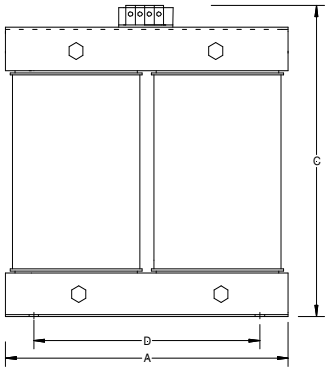


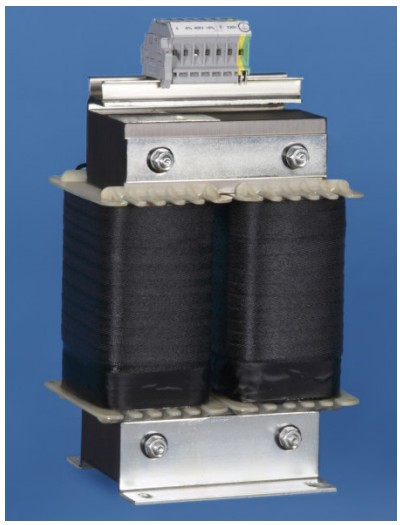




Type	Mag. load	Total Weight	Dimensioning					
			A	B	C	D	E	F
	LI^2 eff.	kg	mm	mm	mm	mm	mm	mm
LD 1 0020	0.18	0.8	66	48	75	50	43	4.8
LD 1 0030	0.27	0.9	66	58	75	50	55	4.8
LD 1 0075	0.70	1.5	85	60	85	64	50	4.8
LD 1 0100	0.91	2.0	85	75	85	64	61	4.8
LD 1 0130	1.20	2.5	106	89	95	84	61	5.8
LD 1 0160	1.45	3.1	106	102	95	84	74	5.8
LD 1 0250	2.30	4.2	130	105	120	104	75	5.8
LD 1 0320	2.90	5.1	130	115	120	104	85	5.8
LD 1 0500	4.45	6.6	150	122	140	122	80	7.0
LD 1 0630	5.70	8.0	150	132	140	122	90	7.0
LD 1 0800	7.30	9.5	170	150	150	135	88	7.0
LD 1 1000	9.10	12.0	170	161	155	135	106	7.0
LD 1 1500	13.70	14.5	170	171	155	135	116	7.0

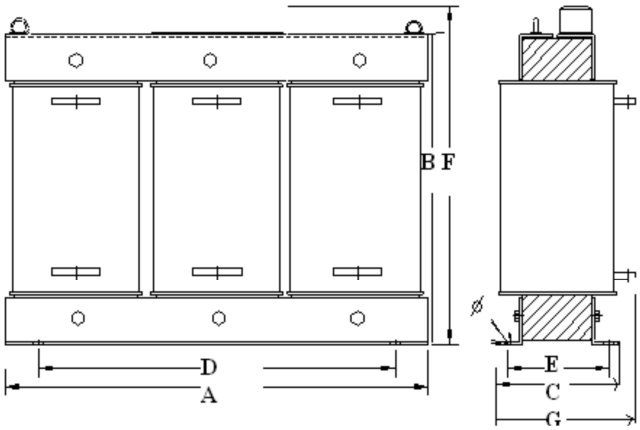
12.4 Type LD 2 + 4 Direct-current smoothing chokes UI

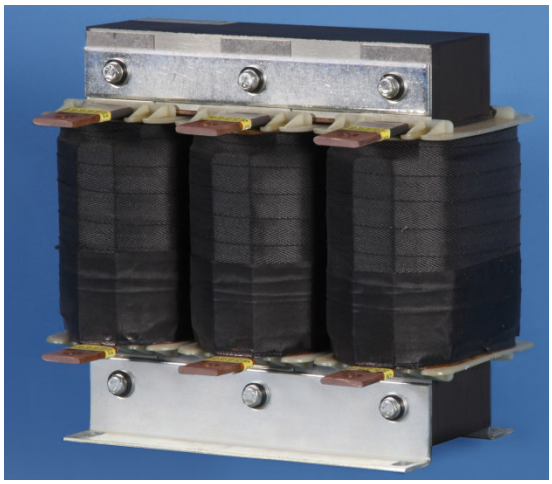




Type	Mag. Load	Total Weight	Dimensioning					
			A	B	C	D	E	F
	LI^2 eff.	kg	mm	mm	mm	mm	mm	mm
LD 2 25	22.8	24	200	180	255	140	145	11 /15
LD 2 30	27.3	29	200	195	255	140	160	11 /15
LD 2 35	31.8	31	240	165	305	200	125	11 /15
LD 2 40	36.4	33	240	165	305	200	125	11/15
LD 2 45	41.0	40	240	180	305	200	140	11/15
LD 2 50	45.5	41	240	180	305	200	140	11/15
LD 2 63	54.5	52	280	195	355	240	151	11/15
LD 2 75	68.1	60	280	210	355	240	166	11/15
LD 2 88	80.0	70	280	225	355	240	181	11/15
LD 2 100	90.0	74	280	225	355	240	181	11/15
LD 2 125	113.0	80	280	255	355	240	211	11/15
LD 4 115	127	59	330	200	330	290	150	9
LD 4 135	150	61	330	200	330	290	150	9
LD 4 150	166	64	330	200	330	290	150	9
LD 4 175	194	81	330	245	380	280	195	9
LD 4 200	220	87	330	245	380	280	195	9
LD 4 250	278	115	360	272	430	300	212	11
LD 4 300	340	125	360	272	430	300	212	11
LD 4 350	389	135	360	272	430	300	212	11
LD 4 400	450	155	420	255	480	360	195	11
LD 4 500	560	165	420	255	480	360	195	13
LD 4 630	700	210	430	305	480	370	235	13
LD 4 800	890	275	510	335	480	450	265	13
LD 4 900	1000	285	510	335	480	450	265	13
LD 4 1000	1120	345	600	355	530	540	275	13
LD 4 1350	1500	435	560	355	780	500	275	13
LD 4 1650	1850	545	560	405	780	500	275	13

12.5 Type FKD Filter circuit chokes



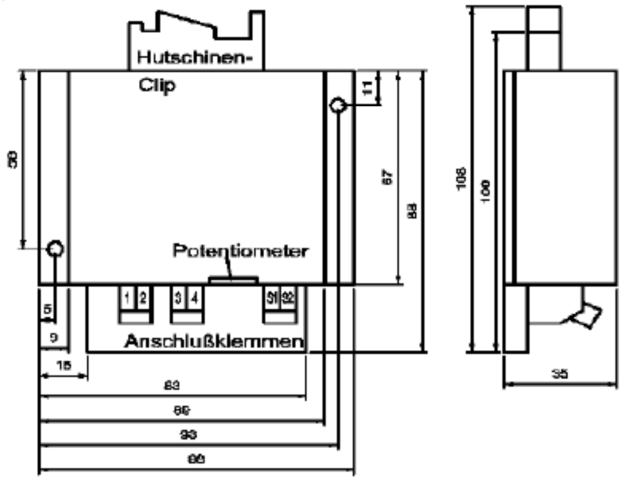


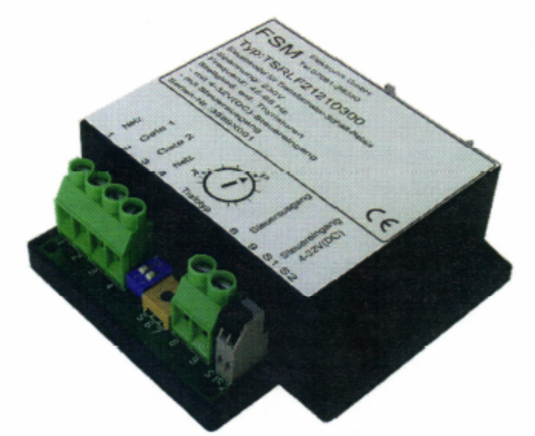
Construction:
Choking factor p: 5.67 % + 7 % + 8 % + 13.5 %
Frequency 50 … 400 Hz
Type protection IP 00 suitable for installations up to IP 23. VBG 4
Vertical fixed with angle irons
Corrosion protection via complete impregnation
Clamp terminal Cu- banners more than 60 KVAr also with connecting wire
Audio frequency suppressor on request

Type	Qc	p	Copper weight	Total weight	Total loss	Dimensioning							
						A	B	C	D	E	F	G	ø
	KVAr	%	kg	kg	W	mm	mm	mm	mm	mm	mm	mm	mm
FKD 27	10	5.67	2.10	9.50	65	180	166	95	136	76	190	130	7x13
FKD 44	15	5.67	3.25	13.70	105	240	220	91	185	71	255	140	9x13
FKD 44	20	5.67	5.05	15.40	110	240	220	91	185	71	255	140	9x13
FKD 46	25	5.67	5.90	20.50	115	240	220	112	185	92	255	161	9x13
FKD 46	30	5.67	7.15	21.70	125	240	220	112	185	92	255	161	9x13
FKD 47	40	5.67	9.60	31.80	140	240	220	121	185	101	255	170	9x13
FKD 61	50	5.67	12.50	39.40	170	300	280	135	224	107	310	195	10x18
FKD 61	60	5.67	17.65	44.30	185	300	280	135	224	107	310	195	10x18
FKD 62	80	5.67	20.80	49.10	205	300	280	147	224	119	310	210	10x18
FKD 62	100	5.67	25.70	59.40	225	300	280	162	224	134	310	225	10x18
FKD 27	10	7.0	2.10	9.50	65	180	166	95	136	76	190	130	7x13
FKD 44	15	7.0	3.15	13.60	100	240	220	91	185	71	255	140	9x13
FKD 44	20	7.0	4.85	15.20	110	240	220	91	185	71	255	140	9x13
FKD 46	25	7.0	5.90	20.50	115	240	220	112	185	92	255	161	9x13
FKD 46	30	7.0	7.15	21.70	120	240	220	112	185	92	255	161	9x13
FKD 47	40	7.0	8.50	30.70	130	240	220	117	185	97	255	166	9x13
FKD 60	50	7.0	14.70	36.70	135	300	280	122	224	94	310	185	10x18
FKD 61	60	7.0	16.90	43.60	150	300	280	135	224	107	310	195	10x18
FKD 62	80	7.0	19.70	48.00	190	300	280	147	224	119	310	210	10x18
FKD 62	100	7.0	25.30	59.00	210	300	280	162	224	134	310	225	10x18

13. Transformer switch relays

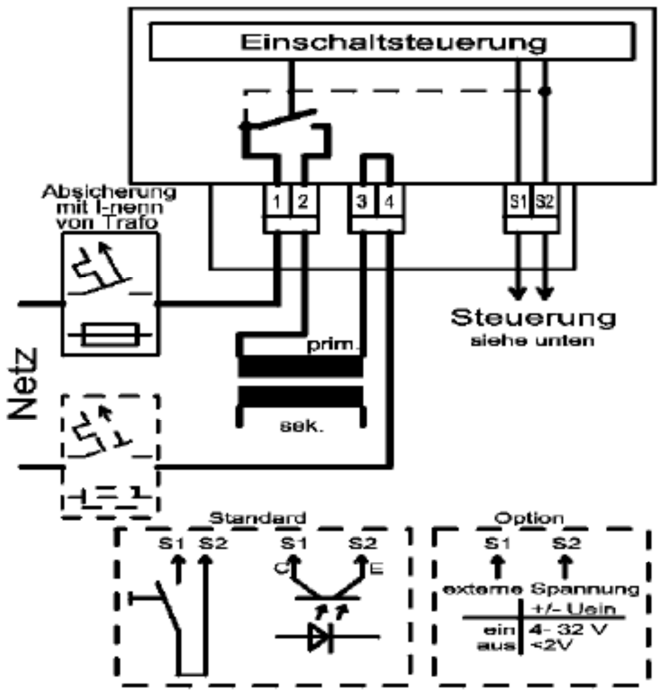
13.1 Type TSRL Transformer switch relay





TSRL is an electronic relay for switching transformers. Using its patented soft start-up operation it activates one or more single – phase transformers open-circuited or on-load without inrush.
By the use of the soft start-up operation the inrush is not only bordered but avoided.

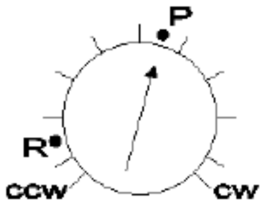
The transformers may be fused speedily on their nominal current on the primary side by the TSRL so they are optimally protected. Frequently switched transformers may now be optimised as well by the TSRL which means a laying-up with up to 1.6 tesla induction low-loss plates and low copper loss. Therefore the transformers may be planned more cost-efficient and low-loss. The TSRL gets basically connected between mains switch and transformer. However it may also be used as mains switch on its own if it is activated by the control input. No through-connection losses are generated. There is no electrical isolation in this application.



The TSRL biases the transformer for a short time before every switching-on.
That happens via unipolar acting voltage pulses. The power of the bias is equal for all transformers und should reach the inflexion point of the hysteresis curve. The amplitude of the therefore necessary voltage pulses needs to be aligned to the different types of transformers like package core or toroidal transformers. For this purpose a potentiometer inside the TSRL is used.

Transformer switch relays

Type TSRL Transformer switch relay



Toroidal transformers: At the mark R.

Transformers with coil former (package core transformers):
At the mark P (factory-provided adjustment)
The right adjustment for package transformers (P) may vary between "10 and 2 o'clock".

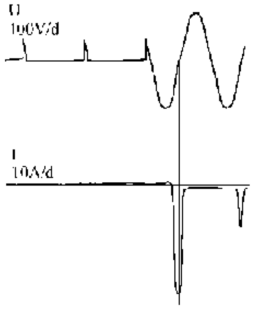
Cut band core transformers: place potentiometer between marks "P" and "R".

Adjustment aid for potentiometer: A pointer instrument for AC voltage switched in series to the TSRL (e.g. parallel to the open cut-out switch) shows if the switch-on occurs with or without current pulses. In case there are current peaks neither while nor at the end of the bias the TSRL is adjusted correctly to the transformer (The cursor stays still). Optimal adjustment: see adjusting guidelines below.

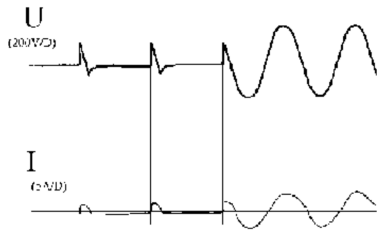
General safety indication: The TSRL needs to be installed and commissioned by electro-technical expert staff. It does not switch electrical isolated at the switching operation via control input and without mains switch because a thyristor with extra snubber-R-C chain link is connected parallel to clamp 1 and 2. Therefore it needs to be unlocked for works on the attached transformer or the load on the secondary side before the TSRL.

Caution: Do not inject external voltage into the control input (clamp S1/S2) using the standard version.
The clamps S1 and S2 are mains potential afflicted so the attached contact or rather optocoupler transistor needs to be isolated and feature a proof voltage of 2.5 KV. If a wire strap is used in place of the contact between clamp S1 and S2 it has to be isolated accordingly.

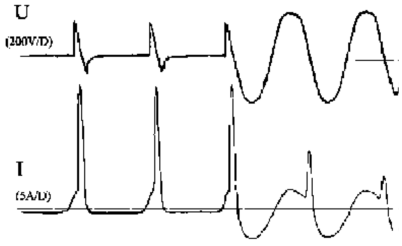
Adjustments using the example of a toroidal transformer



False Adjustment:
The bias is too fragile. The potentiometer stands too far on the left. The positive magnetising current scallops are too small. A big negative inrush becomes visible (Transformer at-rest).



Correct adjustment:
The bias is just strong enough. The potentiometer stands right.
There is no inrush visible (Loaded transformer).



False adjustment:
The bias is too strong. The potentiometer stands too far on the rigth. Big positive Magnetizing current scallops become visible
(Loaded transformer).

Transformer switch relays

Type TSRL Transformer switch relay

Technical data

(Start-up operation corresponding to patent No.: DE 42 17 866 EP 05 75 715 B1 US 005 517 380A)

Nominal voltage:
Standard: 230 V; 190 VAC - 260 VAC; Peak voltage max. 800 V
Option: 110 V; 95 VAC - 135 VAC; Peak voltage max. 600 V
Option: 400 V; 350 VAC - 450 VAC; Peak voltage max. 1200 V
Option: 500 V; 410 VAC - 560 VAC; Peak voltage max. 1600 V
Option: 90 VAC - 260 VAC; Peak voltage max. 800 V
(Half-wave failure surveillance only possible with special features)
Frequency: 45 - 65 Hz
Overvoltage category: III
Nominal current:
Standard: 16 A up to 50^0 C ambient temperature. 14 A at 60^0 C 12 A at 70^0 C
Maximum peak current: 400 A (t_{peak} = 10 ms) Leakage current 11 mA at 230 V
Limit load integral: 800 A^2s (t = 10 ms)
Option: 32 A up to 30^0 C ambient temperature. 28 A up to 40^0 C 25 A at 50^0 C 22 A at 60^0 C 19 A at $70^{0\,C.}$ Maximum peak current: 500 A (t_{spitze} = 10 ms) Leakage current 11 mA at 230 V
Limit load integral: 1250 A^2s (t = 10 ms)
Power failure: In case of power failure > 60 ms soft start-up at power recurrence
Option half-wave failure surveillance: In case of power failure > 2 ms soft start-up at power recurrence
Fuse: The safety values from "Nominal voltage" need to be followed with the fuse.

Raising delay:	Adjustment TP1	to R	to P	Dim R	Dim P
Mains on with operated control input		ca. 0.88 s	ca. 0.15 s	ca. 0.95 s	ca. 0.45 s
Switch-on via control input		ca. 0.25 s	ca. 0.06 s	ca. 0.35 s	ca. 0.30 s
At switch-off via control input	ca. 0.03 – 0.05 s				

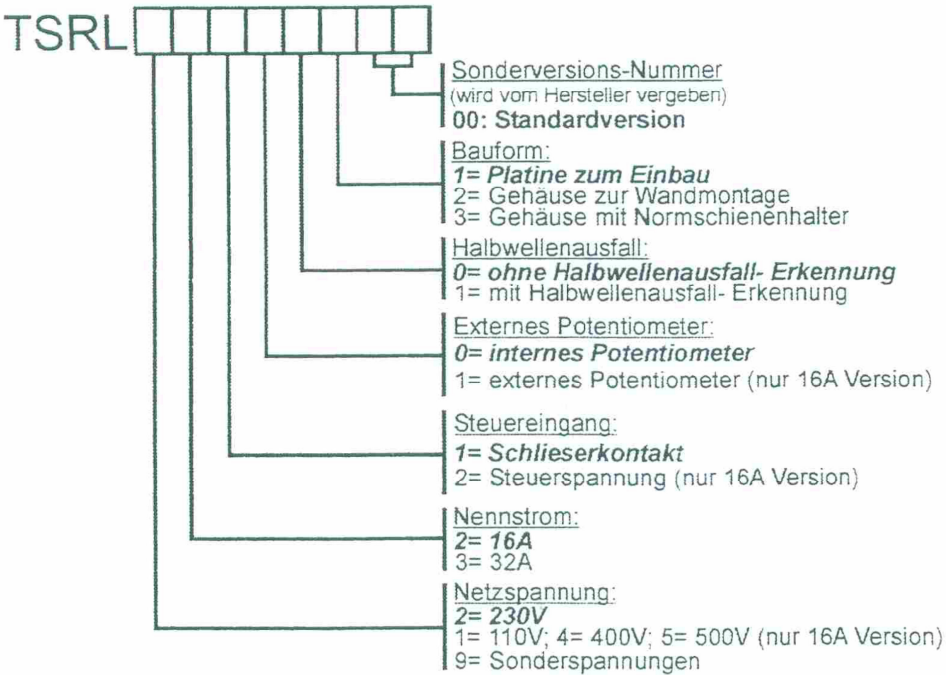
Frequency of operation: Dependent on type of transformer (package transformer or toroidal transformer) typical 25 cycles of operation in succession then 60 s break required (package transformer) up to any number of cycles of operation without break (toroidal transformer).
Durability: ca. 5 m cycles
Control input: Standard: Via external isolated make contact or via transistor of an external optocoupler. Contact voltage 5 V; Contact current 14 mA. Clamps S1/S2 are connected with mains potential.
Option control input: Via optocoupler electrically isolated. Control voltage: 4 - 32 VDC (pole independent). Control current: 1 - 12 mA
Ext. potentiometer for attachments: Resistance: 1 – 2.5 KOhm max. pipeline length 0.5 m Ucw-ccw= 5 VDC
Potentiometer connected with mains potential (Proof voltage 2.5 KV)
e.g. Timer functioning
EMV (CE): Fault-free operation: EN 61000-6-2 transient emissions: EN 61000-6-3
To follow the safety values for the transient emission (clicks) the TSRL without extra power supply filtering may only be switched on or off five times per minute.

Connections:
16 A Network / Load terminals: Screw-type terminals clamping range 0.2 – 2.5 mm^2 locked torque 0.5 – 0.6 Nm
32 A Network / Load terminals: Screw-type terminals clamping range 0.2 - 4 mm^2 locked torque 0.5 – 0.6 Nm
Control input: Spring terminal clamping range 0.1 - 2 mm^2
Ext. potentiometer: Spring terminal clamping range 0.1 – 0.5 mm^2
Anchorage: Quick fastening on 35 mm bearing rail corresponding to DIN EN 50022 / DIN EN 50035
Wall fastening of the case via two fixing holes 4.5 mm
Circuit board mounting (without case) via three fixing holes 3.2 mm

Transformer switch relays

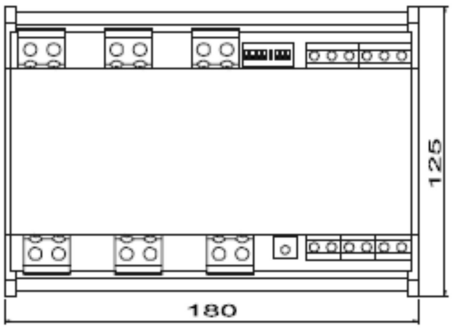
Type TSRL Transformer switch relay

Building type:	Capsuled in moulded case. As board: open
Degree of pollution:	In case 3; as conductor plate 2
Type protection:	IP 20 as conductor plate IP 00
Protection class:	Attachment of protection class II
Dimensions (LxBxH):	99 x 88 x 35 mm; circuit board 77.5 x 85 x 30 mm
Case:	Material ABS flammability class UL94 V0
Installation:	Minimum distance to exoergic attachments at least 10 mm
Weight:	0.2 kg
Shock strength:	10 g
Humidity:	95 % non-condensing
Operating temperature:	0°C up to + 60°C special version: - 20°C up to + 70°C
Storage temperature:	- 10°C up to + 70°C



Transformer switch relays

13.2 Type TSRD Transformer switch relay



The TSRD is an electronic load contactor to switch transformers connected to the three-phase current. Using a patented soft start-up operation it switches on three-phase transformers as well as three single-phase transformers together open-circuited or on-load without inrush. The inrush is not only bordered but avoided by the soft start-up operation.

Three-phase transformers are classified in primary connection symbols triangle or star without Mp (Application D) and connection symbol star with Mp (Application S). Applications with three single-phase transformers are distinguished between transformers that are operated between every phase and N (Application N) and those that are operated between every two phases (Application L) (see operating instructions). The TSRD monitors the stress level of the three phases as well as the phase sequence of the attached three-phase current. The TSRD gets basically connected between mains switch and transformer. However it may also be used as mains switch on its own if it is activated by the control input I.

The soft start-up of the transformer occurs via thyristors which are bypassed after the full plug of an external bypass contactor to minimise the power losses inside the TSRD. The contactor is only needed in AC 1 – classes and is not included in delivery. The TSRD internally conducts a contactor pull control to be sure the thyristors are bypassed. The switch-off also occurs by the thyristors because the bypass conductor first and after that the thyristors are switched off. The transformers may be fused speedily on their nominal current on the primary side by the TSRD so they are optimally protected. Frequently switched transformers may now be optimised as well by the TSRD which means a laying-up with 1.6 tesla induction low-loss plates and low copper loss.

The TSRD is suitable e.g. with isolation - control - filament – and vehicle transformers in industry plant construction and research.

Transformer switch relays

Type TSRD Transformer switch relay

Functions:

1. DIP switch:
The following adjustments may be conducted via the DIP switches:
Error correction – Rotation direction detection – Control inputs - Message 1 – Application

2. OK - LED:
The illuminating diode OK (green) illuminates when TSRD is in OK status and blinks with different velocities if there are annoyances. (see operating instructions).

3. Soft start-up operation:
The TSRD biases the transformer before the full plug with unipolar voltage pulses.

3a. Three – phase transformers:
In three-phase transformers (Applications D and S) the magnetic flux inside the iron core is balanced during the bias. To this end the voltage pulse's amplitude is increased from an initial value up to a terminal value of a quarter mains period (5 ms at 50 Hz). The terminal value is the same for all three-phase transformers and needn't be adjusted. To assure the soft start-up operation works right the three-phase transformers have to be connected winding correctly to the TSRD.

3b. Single – phase transformers:
In single-phase transformers (Application N and L) the magnetic flux inside the iron core is drifted into the inflexion point of the hysteresis curve during the bias. The power of the bias that is necessary to reach the reflexion point of the hysteresis curve is the same for all transformers. The amplitude of the therefore necessary voltage pulses needs to be aligned to the different types of transformers like package core or toroidal transformers. The potentiometer (TP1) inside the TSRD serves for that factory-provided adjustment for package core transformers (see operating instructions).

4. Message output 1:
The illuminating diode "Meldung 1" (yellow) illuminates when the relay contact at the clamps 23 and 24 is closed. If for message output 1the function "Voll-Ein-Meldung" (factory-provided adjustment) is chosen the relay contact gets closed when the TSRD completely switched on the connected transformer after the end of bias (magnetic residual setting).
Using the function "Ok-Meldung" the relay contact gets closed after spreading the mains voltage and successful initialisation of the TSRD. The contact stays closed until an annoyance arises (see operating instructions). At the function "Fehler-Meldung" the relay contact is closed as soon as an annoyance arises (see operating instructions). If no message is chosen the relay contact will not be accessed or rather be accessed according to the client's desired function.

5. Message output 2: (Option)
The message output 2 is an optional relay message output whose function will be determined corresponding to the client's requirements. The illuminating diode "Meldung 2" (yellow) illuminates when the relay contact at the clamps 33 and 34 is closed.

Transformer switch relays

Type TSRD Transformer switch relay

6. Rotation direction detection:
The TSRD detects the phase sequence of the three-phase current after spreading the mains voltage. By using the DIP switch 2 it may be chosen if the TSRD switches on the connected transformer only at right-handed or also at left-hand phase sequence.

7. Failure management:
The TSRD recognises diverse annoyances which activate a cut-out of the connected transformer (see 2). At the TSRD may be chosen via the DIP switch if it switches on the transformer autonomously when the mentioned annoyance is eliminated or not until the remote on signal at control input is applied recently.

8. Contactor pull control:
By using the contactor pull control it may be monitored if the bypass contactor attracts after full plug or not. To this end the tension across the thyristors inside the actuating element L3-T3 is detected. In case the tension does not become null when the bypass contactor should have bypassed the actuating elements the TSRD goes into annoyance and switches off the transformer. When the bypass conductor is attracted the thyristors inside the actuating elements L1-T1 and L2-T2 get switched off und not switched on again until the connected transformer's power down. If the current through the actuating element L3-T3 is smaller than 20 mA the TSRD does not recognize anymore if the bypass contactor did not become attracted.

Technical data

(Start-up operation corresponding to patent No.: DE 42 17 866 EP 05 75 715 B1 US 005 517 380A)

Nominal voltages:					
Standard:	400 V; 320 VAC – 440 VAC; Peak voltage max. 1200 V				
Option:	200 V; 160 VAC – 230 VAC; Peak voltage max. 800 V				
Option:	500 V; 400 VAC – 550 VAC; Peak voltage max. 1600 V				
Frequency:	45 - 65 Hz				
Overvoltage category:	III				
Nominal current:					
Standard:	32 A. Maximum peak voltage: 400 A (t_{peak} = 10 ms) leakage current on disabled state 12 mA at 400 V. limit load control: 800 A^2s (t = 10 ms)				
Option:	50 A. Maximum peak current: 600 A (t_{peak} = 10 ms) leakage current on disabled state 12 mA at 400 V. limit load control: 1800 A^2s (t = 10 ms)				
Power failure:	In case of power failure ≥ 80 ms soft start-up at power recurrence				
Fuse:	The safety values from "Nominal voltage" need to be followed with the fuse.				
Raising delay: (50 Hz)	Application D	Mains on with operated control input 1 ca. 0.42 s			
		Switch-on via control input 1 ca. 0.25 s			
	Application S	Mains on with operated control input 1 ca. 0.46 s			
		Switch-on via control input 1 ca. 0.29 s			
	Application N	Adjustment TP1		at R	at P
		Mains on with operated control input 1		ca. 0.96 s	ca. 0.36 s
		Switch-on via control input 1		ca. 0.23 s	ca. 0.09 s
	Application L	Mains on with operated control input 1		ca. 0.89 s	ca. 0.39 s
		Switch-on via control input 1		ca. 0.22 s	ca. 0.1 s
Falling delay: (50Hz)	At switch-off via control input 1:		Application D	ca. 0.07 - 0.09 s	
			Application S	ca. 0.08 - 0.10 s	
			Application N	ca. 0.08 - 0.10 s	
			Application L	ca. 0.08 - 0.10 s	
Frequency of operation:	Optional				
Durability:	Dependant on the contact load of the control relay for the bypass contactor (Clamps 13/ 14)				
Control input 1 and 2:	Via optocoupler inside the TSRD isolated				
	Activation A1-A2 or A4-A5		U= 16 – 121 VAC/DC I= 1 – 8.3 mA		
	Activation A1-A3 or A4-A6		U= 93 – 550 VAC I= 1.3 - 8.1 mA		

Transformer switch relays

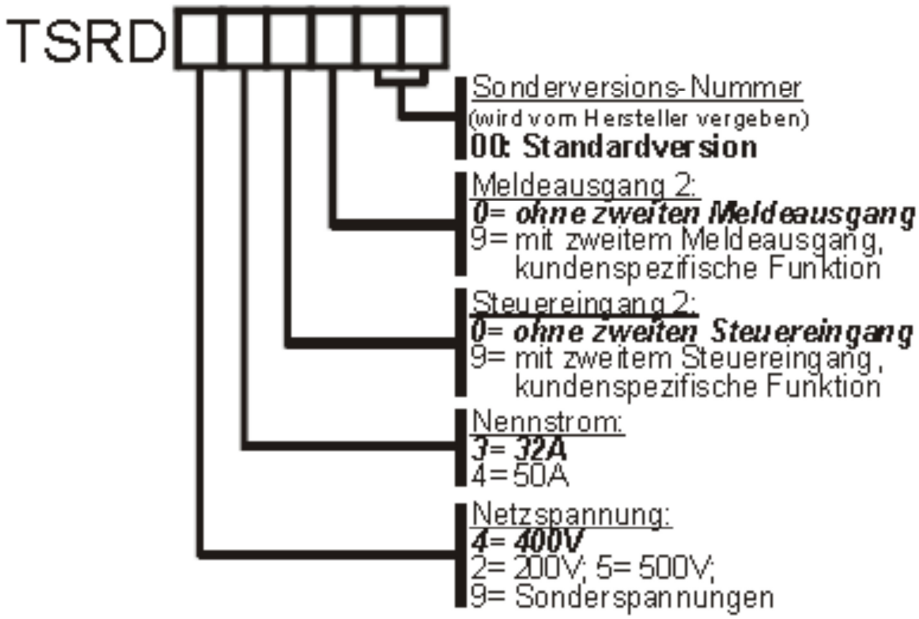
Type TSRD Transformer switch relay

Option control output	Relay closing contact max. breaking capacity (Ohm resistive load): 2000 VA
1 + 2 bypass contactor	Max. switching voltage 380VAC Max. switching current: 10A 8A/250VAC 5A/380VAC
Activation	Nominal load (Ohm resistive load) 8A/ 24 VDC. Durability mechanical 20x $10^{6.}$ Electrical 100x 10^{3} at nominal load.
Bypass contactor:	Max. allowable on-delay: 0.29 s at 50 Hz 0.24 s at 60 Hz Max. allowable on-delay: 0.36 s at 50 Hz 0.28 s at 60 Hz To dejam the contactor coil it is advisable to connect the coil in parallel to an RC-circuit.
Internal consumption:	1.7 W
EMV (CE):	Fault-free operation: EN 50082-2 transient emissions: EN 50081-1 To follow the safety values for the transient emission (clicks) the TSRD without extra Power supply filtering may only be switched on or off five times per minute.

Connections:

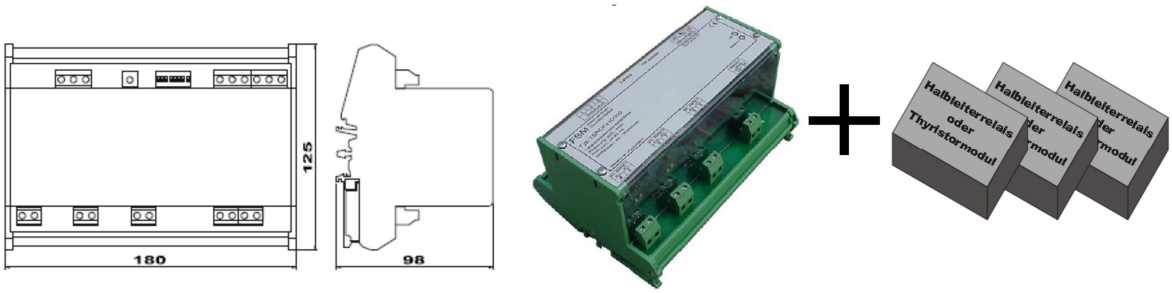
32 A Network / Load terminals: Screw-type terminals clamping range 0.2 – 4 mm^2 locked torque 0.5 – 0.6 Nm
50 A Network / Load terminals: Screw-type terminals clamping range 0.5 - 10 mm^2 locked torque 1.2 – 1.5 Nm

Control in-/outputs:	Screw-type terminals clamping range 0.2 – 2.5 mm^2 locked torque 0.5 – 0.6 Nm
Anchorage:	Quick fastening on 35 mm bearing rail corresponding to DIN EN50022 / DIN EN50035
Building type:	capsuled in moulded case
Degree of pollution:	3
Type protection	IP 20
Protection class:	Attachment of protection class II
Dimensions (LxBxH):	180 x 125 x 98 mm
Case:	Material PVC and polyamide flammability class UL94 V0
Weight:	0.8 kg
Shock strength:	10 g
Humidity:	95 % non-condensing
Operating temperature:	0° C up to + 60° C extra version: - 20° C up to +80° C
Storage temperature:	- 10° C up to + 70° C



Transformer switch relays

13.3 Type TSRDF Transformer switch relay



The TSRDF is a control module which realises a transformer switch relay with its external tyristors or solid-state relays as an actuator for the three-phase current. Transformers may often be switched with its help. Using a patented soft start-up operation the TSRDF switches three-phase transformers as well as three single-phase transformers together open-circuited or on-load without inrush. The inrush is not only bordered but avoided by the soft start-up operation. Three-phase transformers are classified in primary connection symbols triangle or star without Mp (Application D) and connection symbol star with Mp (Application S). Applications with three single-phase transformers are distinguished between transformers that are operated between every phase and N (Application N) and those that are operated between every two phases (Application L) (see operating instructions). The TSRDF monitors the stress level of the three phases as well as the phase sequence of the attached three-phase current. The TSRDF may be delivered for switching external thyristors or in another version for instantaneous switching solid-state relay. It is operated by the actuating elements (solid-state relays or thyristor modules or single thyristors with snubber circuit) between network and transformer.
The TSRDF is able to switch a bypass contactor which bypasses the actuating elements and minimizes the power loss.

The TSRDF applies with often switched welding transformers filament transformers or transformers with high power in industry plant construction and research.

Functions:

1. DIP switch:
The following adjustments may be conducted via the DIP switches:
Error correction – Rotation direction detection – Control inputs - Message 1 – Application

2. OK - LED:
The illuminating diode OK (green) illuminates when TSRDF is in OK status and blinks with different velocities if there are annoyances. (see operating instructions).

3. Soft start-up operation:
The TSRDF biases the transformer before the full plug with unipolar voltage pulses.

3a. Three – phase transformers:
In three-phase transformers (Applications D and S) the magnetic flux inside the iron core is balanced during the bias. To this end the voltage pulse's amplitude is increased from an initial value up to a terminal value of a quarter mains period (5 ms at 50 Hz). The terminal value is the same for all three-phase transformers and needn't be adjusted. To assure the soft start-up operation works right the three-phase transformers have to be connected winding correctly to the TSRDF.

3b. Single – phase transformers:
In single-phase transformers (Application N and L) the magnetic flux inside the iron core is drifted into the inflexion point of the hysteresis curve during the bias. The power of the bias that is necessary to

reach the reflexion point of the hysteresis curve is the same for all transformers. The amplitude of the therefore necessary voltage pulses needs to be aligned to the different types of transformers like package core or toroidal transformers. The potentiometer (TP1) inside the TSRDF serves for that factory-provided adjustment for package core transformers (see operating instructions).

4. Message output 1:
The illuminating diode "Meldung 1" (yellow) illuminates when the relay contact at the clamps 23 and 24 is closed. If for message output 1the function "Voll-Ein-Meldung" (factory-provided adjustment) is chosen the relay contact gets closed when the TSRDF completely switched on the connected transformer after the end of bias (magnetic residual setting).
Using the function "Ok-Meldung" the relay contact gets closed after spreading the mains voltage and successful initialisation of the TSRDF. The contact stays closed until an annoyance arises (see operating instructions). At the function "Fehler-Meldung" the relay contact is closed as soon as an annoyance arises (see operating instructions). At the function “Bypass-Schütz-Ansteuerung” the TSRDF switches off the actuating elements after full plug as soon as the bypass contactor bypassed it. The TSRDF does not switch on the actuating elements again until the bypass contactor is switched off. So the used contact of the contactor may be switched without abrasion.

5. Message output 2: (Option)
The message output 2 is an optional relay message output whose function will be determined corresponding to the client’s requirements. The illuminating diode "Meldung 2" (yellow) illuminates when the relay contact at the clamps 33 and 34 is closed.

6. Rotation direction detection:
The TSRDF detects the phase sequence of the three-phase current after spreading the mains voltage. By using the DIP switch 2 it may be chosen if the TSRDF switches on the connected transformer only at right-handed or also at left-hand phase sequence.

7. Failure management:
The TSRDF recognises diverse annoyances which activate a cut-out of the connected transformer (see operating instructions). At the TSRDF may be chosen via the DIP switch if it switches on the transformer autonomously when the mentioned annoyance is eliminated or not until the remote on signal at control input is applied recently.

Transformer switch relays

Type TSRDF Transformer switch relay

Technical data

(Start-up operation corresponding to patent No.: DE 42 17 866 EP 05 75 715 B1 US 005 517 380A)

Nominal voltages:
Standard: 400 V: 320 VAC – 440 VAC; peak voltage max. 1200 V
Option: 200 V: 160 VAC – 230 VAC; peak voltage max. 800 V
Option 500 V: 400 VAC – 550 VAC; peak voltage max. 1600 V
Frequency: 45 - 65 Hz
Overvoltage category: III

Actuating element:
Standard: Solid-state relay instantaneous switching 2.5 KV proof voltage between control and load circuit. Characteristics for the solid-state relay:

Idling control voltage DC:	U_{HiLo}= 5 V
DC- internal resistance:	R_{HiLo}=120 ohm
Maximum available control current:	I_{HiLo}=10 mA
Maximum allowable input delay:	tein=0.2 ms
Maximum allowable output delay:	taus=0.25 ms

Option thyristors: Combustion with opto-triacs via multiplier R_{VG} in TSRDF

Unenn	200 V	400 V	500 V
R_{VG}	68 ohm	121 ohm	150 ohm

Characteristics for the thyristors:

Max. available gate current:	I_{Gt}=220 mA
Max. allowable ignition delay:	t_{gd}=0.2 ms
Max. allowable recovery time:	t_q=0.25 ms
Gate cathode resistance:	R_{GK}=120 Ohm/ 0.25 W
Gate cathode diode:	D_{GK}= e.g.: 1N4004

Power failure: In case of power failure > 80 ms soft start-up at power recurrence

Input delay: (50 Hz)

Application D	Mains on with operated control input 1	ca. 0.42 s	
	Switch-on via control input 1	ca. 0.25 s	
Application S	Mains on with operated control input 1	ca. 0.46 s	
	Switch-on via control input 1	ca. 0.29 s	
Application N	Adjustment TP1	at R	at P
	Mains on with operated control input 1	ca. 0.96 s	ca. 0.36 s
	Switch-on via control input 1	ca. 0.23 s	ca. 0.09 s
Application L	Mains on with operated control input 1	ca. 0.89 s	ca. 0.39 s
	Switch-on via control input 1	ca. 0.22 s	ca. 0.1 s

Output delay: At switch-off via control input: without bypass contactor: ca. 0.04-0.06 s
With bypass contactor: ca. 0.33-0.35 s

Ferquency of operation: Optional
Control input 1and 2: Via optocoupler inside the TSRDF isolated

Activation A1-A2 or A4-A5:	U= 16 - 121 VAC/DC	I= 1.8 - 3 mA
Activation A1-A3 or A4-A6:	U= 93 – 550 VAC	I= 1.3 – 8.1 mA

Control output 1 and 2: Relay closing contact

Max. breaking capacity (Ohm resistive load):	2000 VA
Max. switching voltage :	380 VAC
Max. switching current:	10 A

Nominal load (Ohm resistive load): 8 A /250 VAC 5 A/ 380 VAC 8 A/ 24 VDC
Durability: mechanical 20x 10^6 electrical 100x 10^3 at nominal load

Bypass contactor:

Max. allowable on-delay:	0.3 s at 50 Hz	0.23 s at 60 Hz
Max. allowable dropout delay:	0.3 s at 50 Hz	0.23 s at 60 Hz

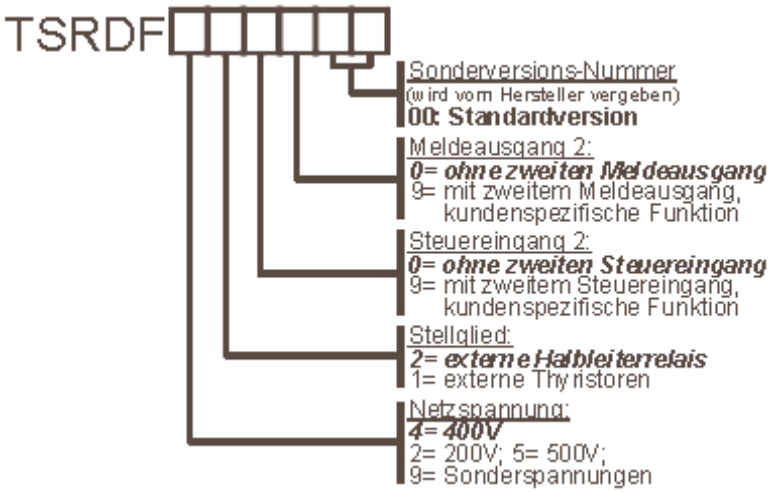
To dejam the contactor coil it is advisable to connect the coil in parallel to an RC-circuit.

EMV (CE): Fault-free operation: EN 50082-2 transient emissions: EN 50081-1
To follow the safety values for the transient emission (clicks) the TSRDF without extra power supply filtering may only be switched on or off five times per minute.

Transformer switch relays

Type TSRDF Transformer switch relay

Connections:	Screw-type terminals clamping range 0.2 – 2.5 mm^2 locked torque 0.5 – 0.6 Nm
Anchorage:	Quick fastening on 35 mm bearing rail corresponding to DIN EN50022 / DIN EN50035
Building type:	capsuled in moulding case
Degree of pollution:	3
Type protection:	IP 20
Protection class:	Attachment of protection class II
Dimensions (LxBxH):	180 x 125 x 98 mm
Case:	Material PVC and polyamide flammability class UL94 V0
Weight:	0.5 kg
Shock strength:	10 g
Humidity:	95 % non-condensing
Operating temperature:	0°C up to + 60°C Extra version: - 20°C up to + 80°C
Storage temperature:	- 10°C up to + 70°C



14. Blas magnetisation unit

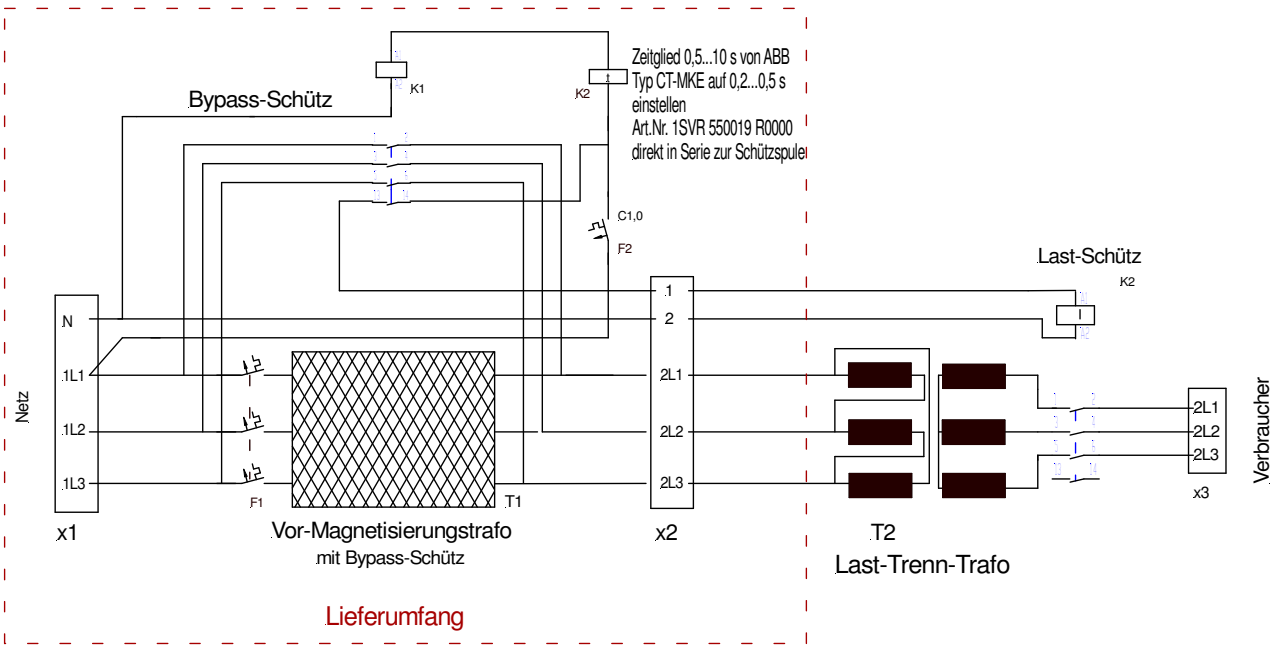
At the blas magnetisation unit the transformer is not switched directly to the network at first. The starting current inrush is absorbed with a further added small transformer. The small transformer does not get bypassed by using a bypass contactor before the main transformer is magnetised. This means a very certain and approved solution for a soft start-up.

Example for a blas magnetisation unit 1.0 KVA corresponding to VDE 0570/EN61558-2-4 Insulation class
T40B separate windings. The primary and secondary voltage in each case is 3 x 400 Volt 50-60 Hz. The secondary current is only 1.45 A. Therewith transformers from 50...100 KVA may be switched on softly. The windings are observed via temperature switches in every winding.

Scope of delivery:

- Main components:
- Blas magnetisation transformer
- Bypass contactor K1
- Time relay K1'
- Case Type protection IP 23
- 2 pieces of cable entry M 32 for main circuit
- 1 piece of cable entry M 16 for control circuits load contactor ready for connection wired on clamps.

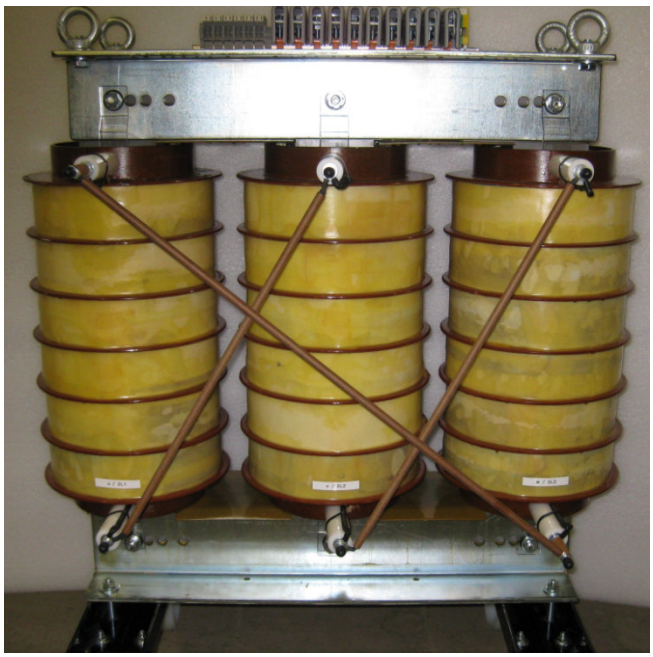
The load contactor K2 is not included in delivery. The load contactor may be dropped if it is ensured that the main transformer is switched on no-load.



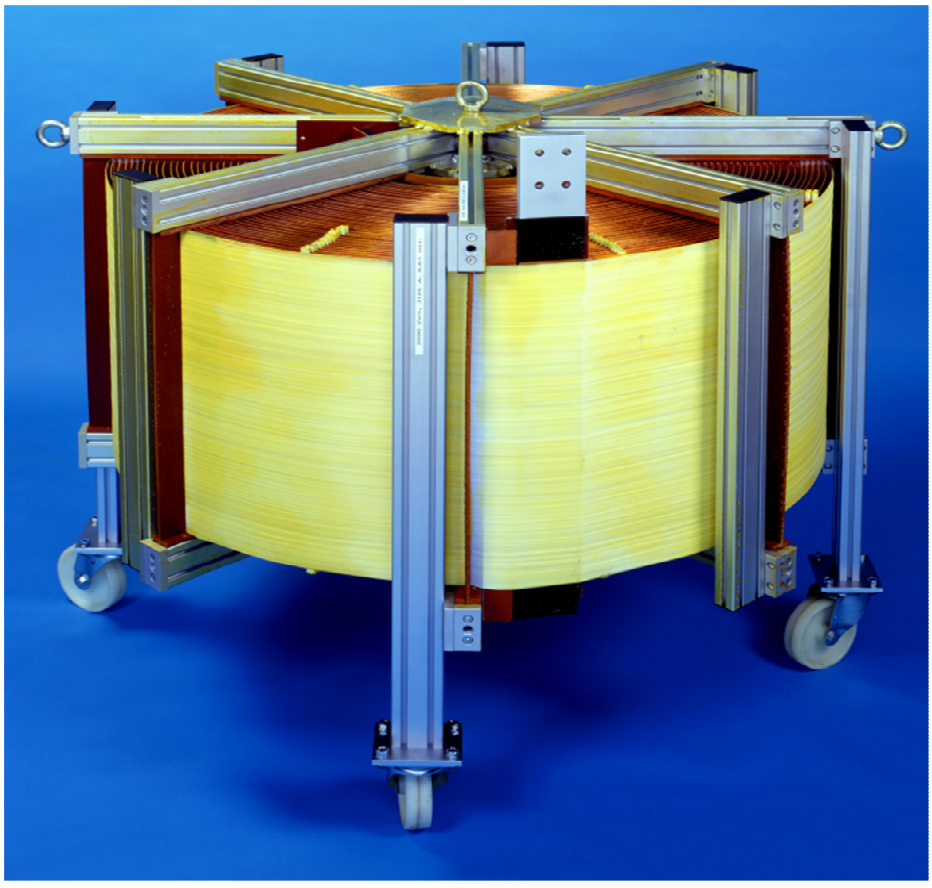
Contactor coil voltage 230 Volt. In case of networks without N or no secured N or a different input voltage a control transformer with e.g. 400/230 Volt needs to be added.

15. Examples of custom-made products

Cable check
transformer 80 KVA



Blas magnetisation
transformer 50 KVA



Air-cored reactor
3125 A 0.63 mH

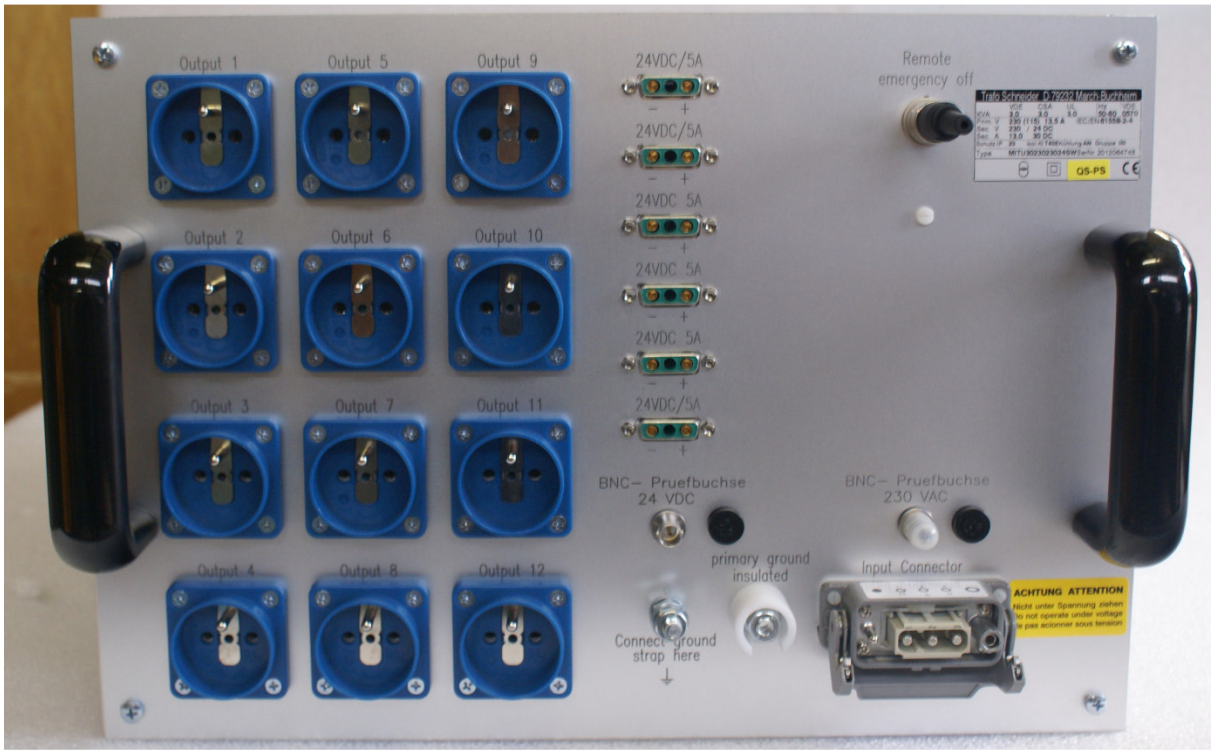
Examples of custom-made products

Isolation transformer 800 kVA
Primary 3 x 400 Volt; Secondary 3 x .4 .... 19 Volt; 3 x 22790 A
Via primary reversible in 10 steps
Secondary view

Outdoor transformer for electricity supplier

16. Examples of complete apparatus production

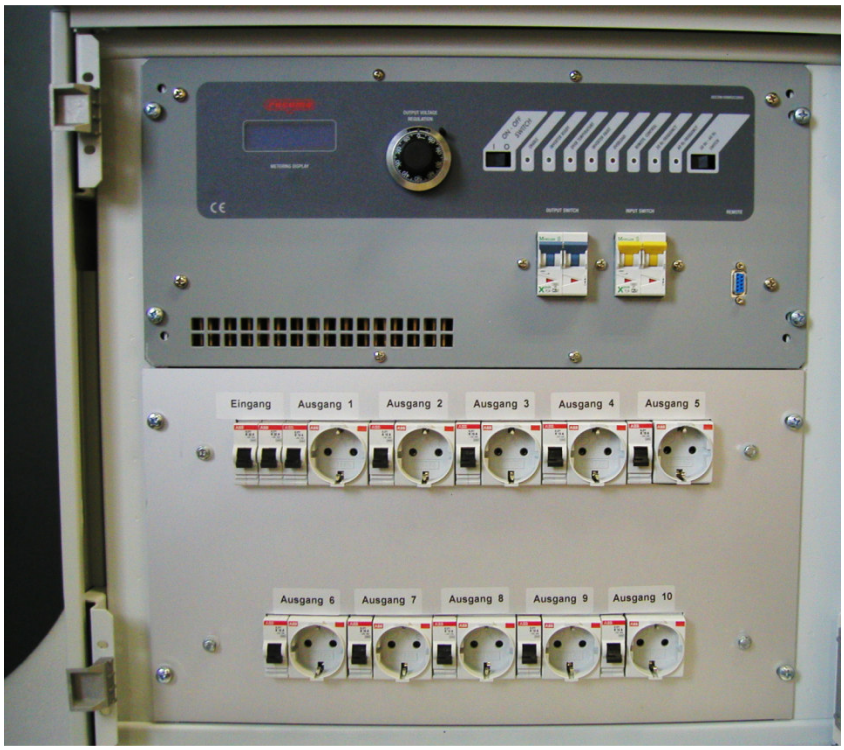
Noise-suppression transformer for satellite systems



Noise-suppression transformer for satellite systems. Back side

Examples of complete apparatus production

15 KVA current supply for communication satellite system in mobile action. Lightning current test at the FH Kiel with 50 kA amplitude.



Power inverter
50/60 Hz
0 - 230 V 3 KVA

Analyser for photovoltaic power inverter

Current supply 45 kVA for satellite systems

Air-cooled galvanic commutator

Water-cooled galvanic commutator 40 KVA

UPS- Systems in Modular Design
Left 40 KVA

Below 2x 160 KVA with battery cabinet and air conditioning equipment

17. Technical data

17.1 Technical annotations

***Short-time power at control transformers**
This is an important criterion for the choice of control transformers. It is the short-term delivered maximum demand the transformer is able to dispense with an efficiency factor of cos φ =0.5 (inductive) whereat the output voltage may decrease maximum 5 % below the nominal value. The Short-time corresponding to IEC is defined for a period of 20 ms at an approximate time of 6 seconds. This is required to guarantee safe switching of contactors (inductive load with high pull-in power compared to the holding power). This characteristic refers exclusively to control transformers.

***Uk Short circuit voltage**
That is the characteristic of the power transformer's internal resistance und gets declared in percentage of the primary nominal voltage. It is the voltage laying against the primary winding of a transformer when nominal current flows in secondary short-circuited winding. The short circuit voltage shall normally be as small as possible so that even at high loads the voltage on the secondary coil only falls slightly. Contrary to that there is the increase of the short circuit current with decreasing short circuit voltage.

***P_{Fe} Iron losses**
The losses caused by the reversal of magnetism are called hysteresis losses; the losses caused by turbulent flows are called eddy current losses. Hysteresis losses and eddy current losses are abstracted with the term iron losses. The iron losses are not load-dependent. They appear in service and at rest. The iron losses are proportional to the input voltage squared. The losses given in our catalogue refer to the operating temperature and are calculated approximate values by computing.

***P_{Cu} Copper losses**
They are joule effect losses. They depend on the load and increase squared with it.
We also use this term for aluminium windings.

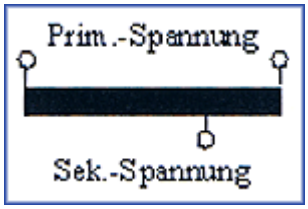
Transformers
are electric equipment transmitting electric energy from a system with given characteristics to a system with desired characteristics corresponding to the principle of electro-magnetic induction.

Control transformers
are transformers with electrically separated windings for supply of control and indicating circuits. The control transformers are built corresponding to VDE 0570/ DIN EN 61558-2-2 DIN EN 61558-2-4. They have to be furnished with beheadings (preferable 5 %).

Isolation transformers
are transformers with electrically separated windings to comply with the requirements of the safety measures "Schutztrennung" for the connection of a single current consumer (VDE 0570/ DIN EN 61558-2-4).

Safety isolating transformers
are transformers whose input and output windings are electrically separated and which are destined to power a current distribution circuit an attachment or other devices with safety extra-low voltage up to 50 V AC voltage (effective value) and/or 120 V unpolished DC voltage between the conductors or every conductor and ground (VDE 0570/ DIN EN 61558-2-6).

Autotransformers
are transformers with partly common input and output winding. The winding with the low voltage is part of the winding with the higher voltage. Hereby the design size decreases compared to transformers with separated windings



Type power NT = Nominal load x (1-low voltage: high voltage)

Operating mode

Continuous duty (DB)
The operating time is so long it reaches the steady operating temperature.

Intermittent duty (AB)
The operating time declared as allowable is so short it does not reach the steady operating temperature. The successive stoppage in which the transformers on the input side become separated from the network is however not long enough to reach a cooling-down to the ambient temperature. The indication of nominal power in this catalogue refers to operating mode DB. Operating mode AB possibly offers smaller types. The duty factor is calculated like that:
ED = (Load period in min/ approximate time in min) * 100 %.
The approximate time (length of break + length of load) must not exceed 10 min though. The type power is calculated as follows:

$$NT = N\sqrt{\frac{ED\%}{100}}$$

Isolation
The transformers listed in our catalogue are built up with insulants of class E or B or F and may basically assembled in dry rooms only. For the charge in abrasive environments transformers may subjected to special resin impregnation on request. So humidity's impacts get largely eliminated. E.g. repeated suchlike impregnations with curing in a protective paint containing a special active agent against mould and the attack of dry rot (fungus attack) serve to attainment of resistance to tropical influence.

Nominal primary voltage (Rated input voltage)
The nominal primary voltage is the transformer's dedicated supply voltage for the determined operating conditions by the producer (For multiphase systems phase voltage).

Nominal secondary voltage (Rated output voltage)
Nominal secondary voltage or secondary load voltage is characterised as a voltage that adapts under load with nominal power at nominal frequency and efficiency factor cos Ч = 1 after reaching the steady operating temperature on the output terminals. It is always that smaller than the secondary open-circuited voltage the fall of potential comes out in no-load condition.

Nominal frequency
Every represented transformer is suitable for the use in mains power supplies with frequencies 50/60 Hz. The contemplated losses falls of potential and efficiency factors refer to the nominal frequency of 50 Hz. Dimensioning the transformers for other frequencies changes the nominal power corresponding to the following table:

Frequency Hz	162/3	40	42	50	60	75	100	200	300
N in % of type power	35	80	84	100	110	115	130	135	140

In case of using a standard transformer with the specification of frequency 50/60 Hz in a 60 Hz mains power supply the indicated nominal power must not be crossed. Other frequencies have to be considered while dimensioning.

Nominal power
The nominal powers indicated in our catalogue are the extractable performances in VA or KVA on the output side. They apply for:

- Separate windings with a conversion
- Continuous duty
- Nominal frequency 50/60 Hz
- Ambient temperature + 40° C

Ambient temperature
If an unimpeded access of cooling air is assured the allowable excess temperatures corresponding to VDE 0550 or 0532 (e.g. 80° C for insulation class T 40/b) at max. 40° C ambient temperature are not crossed by the heating during operation. In case of different ambient temperatures the nominal power changes corresponding to the following table:

Ambient temperature in degree C	45	50	55	60	65	70
Nominal power in % of type power	95	85	80	75	70	60

Connection symbol
If there is no special connection symbol three-phase transformers are crafted in star-star connection (YyO) with led through zero point on the secondary side. The connection symbols are Yyn0 for transformers with separate windings und Ynab0 for autotransformers. The neutral point may be loaded by ca. 10 % of the line current without particular measures. The connection symbol marks the circuit of the windings and their phasing to each other. The big letter is assigned to the primary winding the small letter to the secondary winding.

Type protection
The IP – type protection names the protection against contact foreign object protection and waterproofing of electrical equipment. Corresponding to DIN 40 050 single type protections are defined e.g. as follows:

IP 00 No particular protection

IP 20 Protection against intrusion of contaminants with an aperture of more than 12 mm

IP 23 Protection against intrusion of contaminants with an aperture of more than 12 mm and protection against spray up to 60 degrees to the perpendicular line.

IP 54 Entire protection against contact and protection against dust deposit and spray.

Protection class
Protection class expresses for what kind of precaution against incorrect contact voltage the attachments are prepared or in which ones they are involved.
To **protection class I** belong transformers and inductors whose complete tangible metal parts being able to get charged in case of operational insulation errors are connected permanently and well conducting among themselves to the device for the connection of an earthing equipment conductor. They become compromised to the precaution protective grounding by connecting the earthing equipment conductor.
To **protection class II** belong transformers whose complete tangible conductive parts are separated from those that may be charged in case of operational insulation errors by additional insulation (protective insulation). They have no device for the connection of an earthing equipment conductor.

To **protection class III** belong transformers whose complete tangible conductive parts are separated from those that may be charged in case of operational insulation errors by additional insulation (protective insulation). They have no device for the connection of an earthing equipment conductor. They work exclusively with safety extra-low voltage.

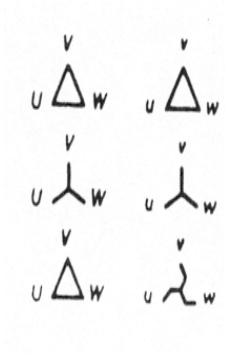
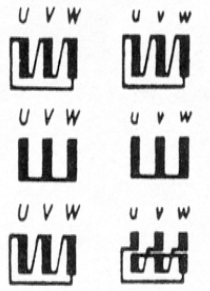
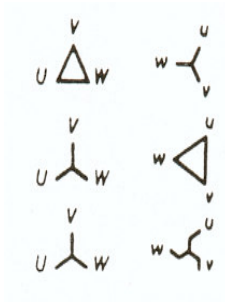
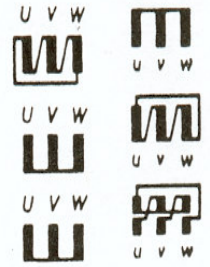
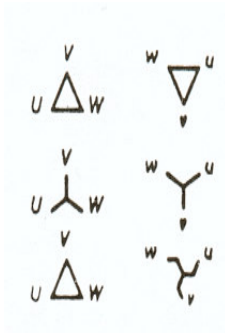
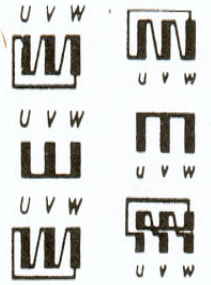
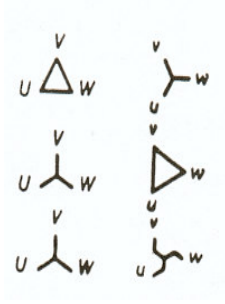
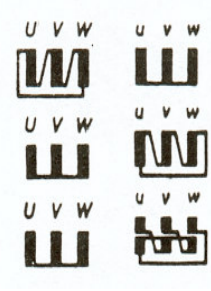
We prepare every described transformer inductor or power supply unit for protection class I.

17.2 Fuse protection of control and isolation transformers

The transformer protected switch listed in the table e.g. PKZM0 by Eaton is added on the primary side. The overload release is adjusted to the stated current. If there should be a short-circuit trip it gets adjusted to the maximum value.
The adjustment values of the circuit breakers count up to 1.06 times of the nominal voltage. For higher mains voltage +/- 5% clamps shall be used.
For transformers > 2 KVA action of circuit breaker may happen in case of certain grid conditions (I_k> 6 KA) combined with an awkward electric torque. In such cases we recommend an input current limiter. This one may be ordered as additional equipment.

Trans-former power	Protective unit PKZM0 at primary voltage:											
	230V		400V		415V		440V		500V		690V	
in KVA	PKZM0-	adjustment in A	PKZM0-	adjustment in A	PKZM0-	adjustment in A	PKZM0-	adjustment in A	PKZM0-	adjustment in A	PKZM0-	adjustment in A
0.02	0.16-T	0.1	0.16-T	0.5	0.16-T	0.15	0.16-T	0.1	0.16-T	0.1	0.16-T	0.1
0.04	0.25-T	0.2	0.25-T	0.2	0.16-T	0.15	0.16-T	0.15	0.16-T	0.15	0.16-T	0.1
0.06	0.40-T	0.3	0.25-T	0.2	0.25-T	0.2	0.25-T	0.2	0.16-T	0.2	0.16-T	0.1
0.10	0.63-T	0.5	0.40-T	0.3	0.40-T	0.3	0.40-T	0.3	0.25-T	0.2	0.25-T	0.2
0.16	1.0-T	0.8	0.63-T	0.5	0.63-T	0.5	0.63-T	0.4	0.40-T	0.4	0.40-T	0.3
0.20	1.6-T	1.0	0.63-T	0.6	0.63-T	0.6	0.63-T	0.5	0.63-T	0.5	0.40-T	0.3
0.25	1.6-T	1.3	1.0-T	0.7	1.0-T	0.7	1.0-T	0.7	0.63-T	0.6	0.63-T	0.4
0.32	1.6-T	1.5	1.0-T	0.9	1.0-T	0.9	1.0-T	0.8	1.0-T	0.7	0.63-T	0.5
0.40	2.5-T	2.0	1.6-T	1.1	1.6-T	1.1	1.6-T	1.0	1.0-T	0.9	1.0-T	0.7
0.50	2.5-T	2.4	1.6-T	1.4	1.6-T	1.3	1.6-T	1.2	1.6-T	1.1	1.0-T	0.8
0.63	4.0-T	3.0	2.5-T	1.7	2.5-T	1.7	2.5-T	1.6	1.6-T	1.4	1.6-T	1.0
0.80	4.0-T	3.8	2.5-T	2.2	2.5-T	2.1	2.5-T	2.0	2.5-T	1.7	1.6-T	1.3
1.00	6.3-T	4.7	4.0-T	2.7	4.0-T	2.6	4.0-T	2.5	2.5-T	2.2	2.5-T	1.6
1.20	6.3-T	5.8	4.0-T	3.3	4.0-T	3.2	4.0-T	3.0	4.0-T	2.7	2.5-T	1.9
1.40	10.0-T	6.7	4.0-T	3.8	4.0-T	3.7	4.0-T	3.5	4.0-T	3.1	2.5-T	2.3
1.60	10.0-T	7.4	6.3-T	4.2	6.3-T	4.1	6.3-T	4.0	4.0-T	3.4	4.0-T	2.5
2.00	16.0-T	10.0	6.3-T	5.3	6.3-T	5.1	6.3-T	4.8	6.3-T	4.2	4.0-T	3.1
2.50	16.0-T	11.5	10.0-T	6.6	10.0-T	6.4	10.0-T	6.0	6.3-T	5.3	6.3-T	4.0
3.00	20.0-T	16.0	16.0-T	10.0	16.0-T	10.0	10.0-T	7.1	10.0-T	6.2	6.3-T	4.5
4.00	20.0T	18.1	16.0-T	10.4	16.0-T	10.0	16.0-T	10.0	10.0-T	8.3	10.0-T	6.0
5.00	25.0-T	24.0	16.0-T	14.0	16.0-T	13.5	16.0-T	12.5	16.0-T	11.0	10.0-T	8.0
6.30	32.0	30.0	20.0-T	17.5	16.0-T	15.3	16.0-T	15.8	16.0-T	13.9	16.0-T	10.2

17.3 Connection symbols for three-phase transformers

Notation characteristic	Connection symbol	Phasor diagram	Circuit layout	Secondary neutral point
0	Dd0			non-existent
	Yy0			ca. 10% resilient
	Dz0			fully resilient
5	Dy5			**fully resilient**
	Yd5			non-existent
	Yz5			**fully resilient**
6	Dd6			Non-existent
	Yy6			ca. 10% resilient
	Dz6			fully resilient
11	Dy11			**fully resilient**
	Yd11			non-existing
	Yz11			**fully resilient**

The bold circuit shall be preferred. If there is no indication of connection symbol in the order we deliver corresponding to Yy0.

17.4 Conversion table for three-phase autotransformers

Type power KVA	Throughput power					
	230:115	400:230	415:380	440:380	500:200	500:380
0.10	0.20	0.24	1.20	0.74	0.18	0.42
0.13	0.26	0.30	1.50	0.96	0.23	0.54
0.16	0.32	0.38	1.90	1.20	0.28	0.67
0.20	0.40	0.47	2.40	1.50	0.36	0.84
0.25	0.50	0.60	3.00	1.80	0.45	1.00
0.32	0.64	0.76	3.80	2.30	0.57	1.30
0.40	0.80	0.95	4.80	2.90	0.72	1.70
0.50	1.00	1.20	6.00	3.70	0.90	2.10
0.63	1.26	1.50	7.50	4.60	1.10	2.60
0.80	1.60	1.90	9.50	5.90	1.40	3.30
1.00	2.00	2.40	11.90	7.40	1.80	4.20
1.50	3.00	3.50	17.90	11.10	2.70	6.30
2.00	4.00	4.70	23.80	14.80	3.60	8.40
2.50	5.00	6.00	29.70	18.50	4.50	10.50
3.00	6.00	7.10	35.70	22.50	5.40	12.60
3.50	7.00	8.30	41.60	26.00	6.30	14.70
4.00	8.00	9.50	47.60	29.00	7.20	16.80
4.50	9.00	10.70	53.50	33.00	8.10	18.90
5.00	10.00	12.00	59.50	37.00	9.00	21.00
6.00	12.00	14.30	71.40	44.00	10.80	25.20
7.50	15.00	17.84	89.25	55.00	13.50	31.50
8.80	17.60	21.00	104.00	65.00	15.80	37.00
10.00	20.00	23.80	119.00	74.00	18.00	42.00
12.50	25.00	30.00	148.00	92.00	22.50	52.00
15.00	30.00	35.70	178.00	111.00	27.00	63.00
17.50	35.00	41.60	208.00	129.00	31.50	73.00
20.00	40.00	47.60	238.00	148.00	36.00	84.00
22.50	45.00	53.00	267.00	166.00	40.00	94.00
25.00	50.00	59.50	297.00	185.00	45.00	105.00
30.00	60.00	71.00	357.00	222.00	54.00	126.00
35.00	70.00	83.00	416.00	259.00	63.00	147.00
40.00	80.00	95.00	476.00	296.00	72.00	168.00

18. Certificate DIN EN ISO 9001:2015

CERTIFICATE

kiwa

Number	97681	
Issued on	08.12.2017	
Valid from	12.12.2017	
Valid until	11.12.2020	Page 1 of 1

Kiwa International Cert GmbH
certifies that the company

Trafo-Schneider GmbH

Waidmattenstraße 8
79232 March-Buchheim

for the scope

Development, manufacture and testing of electrical components of the energy supply

has implemented and applies a Quality Management System, which is in compliance with the requirements of

ISO 9001:2015

Kiwa International Cert GmbH
Managing Director

Kiwa International Cert GmbH
i.A.
Technical Manager

DAkkS
Deutsche Akkreditierungsstelle
D-ZM-16102-01-00

Kiwa International Cert GmbH
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20097 Hamburg
Germany
Telefon +49 (0)40 30 39 49 60
Telefax +49 (0)40 30 39 49 79
e-mail: info@kiwa.de
www.kiwa.de

19. General terms and conditions

(1) General / ambit:

(a) For all acts of sale and contracts for work and materials with us the present contract conditions are counting exclusively. We do not accept client's terms that are conflicting or divergent from these clauses unless we acclaimed to them in written form. Our contract conditions apply even though we implicitly export a consignment knowing of conflicting or digressive terms of our signatory.

(b) Every agreement made with our customers concerning conclusion content and implementation of the contract are recorded in the contract the present contract conditions and a confirmation of order possibly accorded by us.

(c) Our terms only apply towards business clients and – in case of existent continuous business connections – also for every future transaction with the client unless otherwise agreed.

(2) Offers bidding documents

(a) Offers signed by the customer are obligatory quotes unless otherwise agreed. We can accept this offer within two weeks.

(b) After declared acceptance of the customer offer we are entitled to withdraw from the contract if the delivery of the appointed object may not be secured because of act of God log range strikes lack of raw materials or congeneric reasons

(c) Illustrations descriptions and technical data apply referred to time of data access in which these are included. Consignment of a comparable article in kind and quality to appointed affair to same price e.g. connection type because of technical progress stays reserved provided to be reasonable for the client.

(d) We reserve property and copy rights for illustrations drawings calculations and sundry documents. Its transmission to third party requires our written consent. The same applies to documents and data referred to as "confidential". Preceding applies equally to us-committed customer documents. These can be passed yet to such third parties we used to fulfil the contract.

(3) Prices conditions of payment compensation retention

(a) Our prices apply ex factory and exclusive package transportation and unloading. The value added tax is not included in the stated selling price; it becomes shown separately amounting to providence by law on day of invoice in our bill.

(b) If our costs increase or reduce after contract conclusion through no fault of our own e.g. our procurement we reserve to adjust prices to the new situation. On demand we verify cost reductions as well as cost increases after their occurrence to our clients.

(c) Unless deviation is determined our (purchase price) claim is due for payment tax-free within 30 days from date of invoice. We allow a cash discount of 2 % for payments we get credited within eight days from date of invoice. Forwarding and packaging costs are not discountable.

(d) In case of commencing default of payment the legal requirements apply e.g. to the dispensability of a demand note and to an interest payment.

(e) The customer is only entitled to compensation if his counterclaims are accepted by us established as final and absolute or undisputed.

(f) The customer is only entitled to practice possessory lien if his counterclaim is based on the same contractual relationship.

(4) Delivery time delivery

(a) The compliance with delivery time determined by us is conditional upon the clarification of all technical questions. Our delivery commitment besides assumes the fulfilment of possible commitments mentioning our clients. The exception of the unfulfilled agreement rests reserved.

General terms and conditions

(b) Provided to be reasonable to the client we are entitled to partial performance and delivery.

(c) If our agreement with the customer constitutes a business to be settled on a fixed date (§§ 286 para. 2 No. 4 BGB 376 HGB) we are liable for corresponding to the legal requirements. At this juncture our liability to pay damages is limited to damages that are typical for the contract and predictable. If the customer can invoke abolition of interest to the further contract management the preceding applies respectively (clauses 1 and 2).

(d) If we fall behind and this is based on deliberate or grossly negligent default of contract by ourselves we are liable for corresponding to the legal requirements. In case we are imposed by gross negligence our liability for damages is limited to damages that are predictable and typically commencing. We likewise commence corresponding to the legal requirements if the default caused by ourselves bases on the culpable breach of contract; the restriction of clause 2 2. sub-clause applies accordingly.

(e) For the rest we advocate every completed week of our culpable delay with a generalised penalty payment amounting to 0.5 % of delivery value but not exceeding 5 %.

(f) Further statutory claims and rights for the customer remain unaffected by these terms.

(g) Furthermore the onus of proof distribution remains unaffected.

(h) A default of our representatives and assistants is imputed to us in each case.

(i) If the customer gets into default of acceptance or breaches culpably ulterior obligations the legal requirements apply.

(5) Passing of risk cost of packaging consignment

(a) Unless different appointment in our acceptance of order delivery ex works and therewith placing the goods at the disposal at our business location is arranged.

(b) The packing of the goods is calculated at cost price to the customer. Special agreements apply to their retraction.

(c) Sending goods happens at the expense on customer. On demand and for account of customer we cover the consignment by cargo insurance.

(6) Defects guarantees requirement to give notice of defects liability lapse of time

(a) The technical data sheets or rather the operating instructions that come first in doubt before advices we gave as unsealed suggestions govern for the use of delivery item.

(b) Information in brochures descriptions and documents enclosed to the contract neither constitute warranted properties nor guarantee of durability unless being referred to as such or assumed by ourselves.

(c) If we assured condition or durability of a delivery item it lacks and through this adversity outside the delivery item appears we are liable – regardless of the following rules – in case the compensation of the resulting damage is comprised by the respectively furnished guarantee.

(d) In ambit of § 377 HGB the customer underlies the local inspecting obligation and requirement to give notice of defects. Outside of § 377 HGB the customer has to analyse the delivery item directly upon receipt and inform us about obvious defects within ten working days.

(e) In case a defect at the delivery item appears within the limitation period which had already been existing at the point the passing of risk happened we are in bond of our own choice to supplementary performance in the form of rectification of the defect or replacement of defect-free product unless we can refuse that by act of law.

General terms and conditions

(f) If we choose supplementary performance in case of defect we bear the charges that are required to remove the defects (cf. § 439 para. 2 BGB) as long as they did not increase because of movement of the delivery item to other places than the place of delivery.

(g) For supplementary performance the customer has to allow us an appropriate period during its course reduction of the purchase price and cancellation of the contract is excluded. If the supplementary performance fails the client is of his own choice entitled to reduce or declare cancellation of the contract. The legal premises apply to this purpose.

(h) For claim for damages by the customer that trace back to deliberate or grossly negligent attitude by ourselves we are liable corresponding to the legal requirements. If we are not accused deliberate breach of contract our commitment limits to the predictable damage that typically commences. Paragraph (4) lit. (h) applies respectively.

(i) If we culpably breach contract we are liable corresponding to the legal requirements. Paragraph (4) lit. (h) and preceding lit.(h) clause 2 apply respectively.

(j) If the customer for the rest is entitled to claim for damages instead of activity (delivery) because of our culpable breach of duty preceding lit. (i) applies respectively comprehensive.

(k) We are liable for culpably caused damages caused by ourselves concerning life body and health of customer or included third parties that are worthy of protection corresponding to the legal requirements. The same applies to forcing liability corresponding to the law on product liability. Paragraph (i) clause 3 applies respectively.

(l) Unless different preceding rules our responsibility is excluded.

(m) The limitation period for warranty claims are 12 months from passing of risk. As opposed to this the legal requirements apply providing that the agreement refers to a delivery item that is normally used for a building and caused its defectiveness. Sentence 1 let above determination in (k) untouched.

(7) Joint liability

(a) A liability for damages lasting beyond paragraph (6) is regardless of legal nature of objected claim excluded. This applies in particular to liabilities to pay damages for culpa in contrahendo due to other breach of duty or because of § 823 BGB unless we are accused of deliberate or grossly negligent attitudes.

(b) Preceding rules lit. (a) applies respectively if the customer in place of compensation for damages requests compensation of useless charge instead of activity.

(d) Every excision and confinement of our liability for damages also extends to the personal commitment of our employees jobholders associates representatives and assistants

(8) Secret lien obligations resale

(a) Until the fulfilment of every generated claim at the time of conclusion of the contract also from add on sales replacement and reorders we reserve property on delivery items.

(b) The customer is bound to treat the delivery item with reservation carefully and insure it for own account to replacement value against fire water and burglary. Necessary maintenance and inspections of caveat item need to be conducted or rather let be carried in time by the customer at his own expense.

(c) Distraints or other accesses / interventions of a third party on the caveat item need to be told us immediately in writing to be able to bring suit if indicated corresponding to § 771 ZPO. At the same time the customer advises the third party of our established property. If the third party is unable to compensate the process costs to us for such a complaint the customer has to answer for this.

General terms and conditions

(d) The customer is authorised to alienate the goods subject to retention of title in ordinary course of business. Already now all claims that arise with the resale of goods subject to retention of title to third party amounting to gross amount (incl. value added tax) of our requirements are ceded to us by the customer. This applies despite the fact the delivery item is resold without or after converting. We accept this assignation.

(e) In spite of and after assignation the customer lasts authorised precariously to aspirate claims assigned to us in the name of himself and for his own account. A countermand by us is only admissible in case of existence of a factual reason for this und ceases as long as the customer fulfils his duties of payment existing counterpart us does not get into default and is not adjudged his bankrupt.

(f) If there is a factual reason for countermand of direct debit authorisation available according to lit. (e) and the countermand is followed by us assigned book accounts on demand have to be appointed to us including their debitors the assignation needs to be revealed to the debitors and all documents necessary for own collection have to be handed out.

(g) Converting or alteration of delivery item by the customer is always conducted for us. If goods subject to retention of title are converted together with other matters being foreign for us we acquire co-ownership of the new matter at the rate of gross price of the delivery item bought at us with other processed matters relating to the point of converting. For the matter arising through converting applies the same as for with reservation delivered object of purchase.

(h) To assure our claims the customer also assigns us those requirements which accrue him from connecting the delivery item with an estate towards a third party.

(i) On demand of our customer we approve the collaterals allowed to us insofar the attainable proceeds from their exploitation exceeds our claims which need to be assured more than 10 %. The choice of the approved collateral falls to us.

(9) Changes to the contract choice of law jurisdiction

(a) For relinquishing a verbal confirmation or closing verbal agreements which intend or cause change of the closed contract based on existing contract conditions only our management is authorised however not the rest of our staff.

(b) Every materialised contract is subject to German legislation. The application of United Nations Convention on Contracts for the International Sale of Goods is excluded.

(c) Jurisdiction for all disputes with business people is our business location. Besides we are entitled to sue the customer at the court of his residence. Incidentally the statutory provisions apply.

20. Contact details

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Waidmattenstr. 8
D- 79232 March-Buchheim

phone 0049 (0) 7665 92 30 0
fax 0049 (0) 7665 92 30 22
e-mail info@trafo-schneider.de
internet www.trafo-schneider.de

sales tax identification number corresponding to § 27 a value added tax act: DE13593847

Approach
A5 exit Freiburg Mitte coming from Basel – turn into direction Umkirch - after 1.7 km turn to the right into direction March on L 116 – cross railway and keep straight on for 500 m. At the second traffic lights turn to the left into direction Gottenheim - Follow L 187 ca. 400 m than turn to the right into Am Untergrün - After ca. 100 m you reached the target.

A5 exit Freiburg Nord coming from Karlsruhe – turn to the right into direction Holzhausen follow Benzhauserstraße for 1.2. km – At the next crossroads turn to the left into Buchheimerstraße and follow it 1.6 km - In Buchheim turn to the left follow Hauptstraße 500 m and turn to the right at the second traffic lights into Stegenbachstraße – Follow 400 m than turn to the left into Am Untergrün - After ca. 100 m you reached the target.

Own notes