

control transformers

single phase

Conform to IEC/EN 61558-2-2; 2-6 (24V) and 2-4 (>24V) - UL 506 and CSA 22.2 - No. 66
 Single-phase 50-60 Hz - class I
 Insulation voltage between windings : 4 510 V
 Max. ambient operating temperature : 60°C
 Protected against accidental contact with live parts up to 1 000 VA

Electrical characteristics

Rated power in VA IEC/CSA	Permissible instantaneous power in VA IEC/EN 61558-2-2 with cos φ of									Voltage drop (ΔU) as a % with cos φ of			No-load loss ^(*) (W)	Total loss at rated voltage ^(*) (W iron + W copper)	Efficiency with cos φ of			Ucc (%)
	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	0.3	0.6	1			0.3	0.6	1	
40	90	80	72	66	61	57	53	51	53	5.7	7.9	9.2	6.3	10.0	0.55	0.71	0.80	8.0
63	160	140	130	120	110	100	95	91	130	5.3	7.3	8.6	7.6	12.9	0.59	0.75	0.83	7.5
100	240	210	190	170	160	150	140	140	140	5.0	6.5	6.8	8.8	16.3	0.65	0.79	0.86	7.9
160	460	390	330	290	260	230	210	190	180	3.1	5.1	7.4	12.1	23.9	0.67	0.80	0.87	6.1
250	830	690	590	510	450	400	360	330	310	2.8	4.8	7.2	18.0	37.4	0.67	0.80	0.87	5.9
400	1 600	1 300	1 100	1 000	890	800	730	680	650	2.4	3.9	5.6	22.5	44.4	0.73	0.84	0.90	4.6
630	2 100	1 800	1 600	1 400	1 300	1 200	1 100	1 000	1 100	2.5	3.8	4.9	24.1	54.8	0.78	0.87	0.92	4.1
1 000	5 400	4 600	4 000	3 600	3 300	3 000	2 700	2 600	2 600	1.6	2.4	3.1	44.2	75.3	0.80	0.89	0.93	2.6
1 600	9 100	8 100	7 300	6 700	6 200	5 800	5 500	5 300	5 700	1.4	1.9	2.1	65.5	84.2	0.85	0.92	0.95	1.9
2 500	8 100	7 300	6 600	6 100	5 700	5 400	5 200	5 100	5 600	1.7	2.2	2.3	86.5	131.6	0.85	0.92	0.95	2.1
4 000	15 800	13 100	11 100	9 600	8 300	7 400	6 700	6 100	5 600	2.2	4.1	6.6	108.0	240.0	0.77	0.86	0.92	2.7

(*) Maximum values when different according to secondary voltages

Mechanical characteristics

Figure 1 : 40 to 1 000 VA

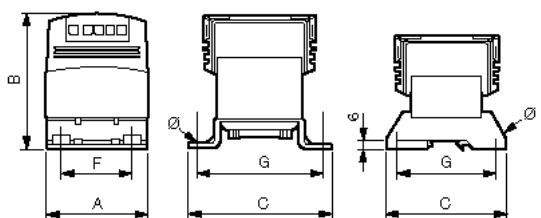


Figure 2 : 1 600 to 2 500 VA

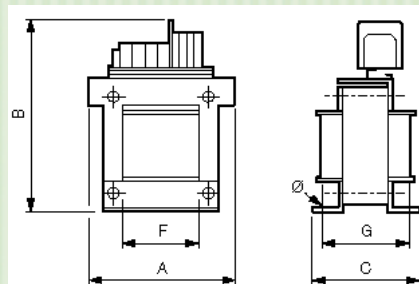
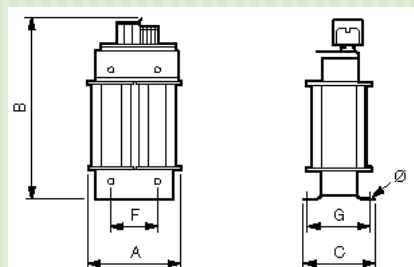


Figure 3 : 4 000 VA



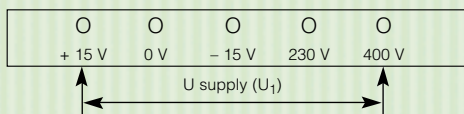
Sizing of transformer

$$P_{inrush} = 0.8 (\sum P_m + \sum P_r + P_a)$$

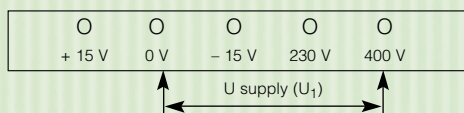
160 and 250 VA :
Reduced dimensions

(1) Table giving derating according to temperatures available on request
 (2) 40-63 - 100 VA can also be fixed on rail

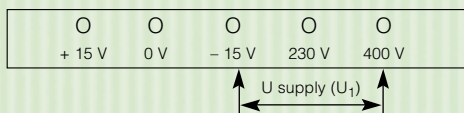
Power VA		Secondary	Dimensions (mm)			Fixing ⁽²⁾ (mm)			Max. weight (kg)	Connection				Fig.
			A	B max.	C	F	G	Ø		Primary		Secondary		
										Cable (mm ²) flexible	rigid	Cable (mm ²) flexible	rigid	
40	24 V-48 V-24/48 V 115 V-230 V-230 V E	84	97	115	50	100	4.5	1.5	1 to 4	1 to 4	1 to 4	1 to 4	1	
63	//	84	110	115	50	100	4.5	2	1 to 4	1 to 4	1 to 4	1 to 4	1	
100	//	84	124	115	50	100	4.5	2.7	1 to 4	1 to 4	1 to 4	1 to 4	1	
160	//	108	120	150	75	125	5.5	4.9	1 to 4	1 to 4	1 to 4	1 to 4	1	
250	//	108	139	150	75	125	5.5	5.4	1 to 4	1 to 4	1 to 4	1 to 4	1	
400	//	126	143	175	75	150	5.5	6.9	1 to 4	1 to 4	1 to 4	1 to 4	1	
630	//	150	158	206	100	175	7	9.9	1 to 16	1 to 16	1 to 16	1 to 16	1	
1 000	//	150	199	206	100	175	7	14.9	1 to 16	1 to 16	1 to 16	1 to 16	1	
1 600	115 V-230 V	220	231	191	150	153	9	26	2.5 to 10	1.5 to 16	2.5 to 10	1.5 to 16	2	
	24 V	220	231	191	150	153	9	25.6	2.5 to 10	1.5 to 16	lug Ø 10	lug Ø 10	2	
2 500	115 V-230 V-230 V E	300	292	171	200	114	9	33.1	4 to 16	1.5 to 25	4 to 16	1.5 to 25	2	
	24 V	300	292	171	200	114	9	33.1	4 to 16	1.5 to 25	lug Ø 10	lug Ø 10	2	
4 000	115 V-230 V-230 V E	240	400	170	180	136	10	27.5	4 to 16	1.5 to 25	4 to 16	1.5 to 25	3	



- 1) if $U_1 > 230$ or 400 V
- 2) if $I_2 < I_{2n}$ (if the load is less than the nominal load reduce the secondary voltage)

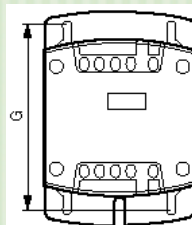


if $U_1 \approx 230$ or 400 V with load $I_2 \approx I_{2n}$



if $U_1 < 230$ or 400 V with load $I_2 \approx I_{2n}$

Fixing of transformers of VA rating from 160 to 1 000 VA



Attachment at 3 points possible with additional fixing slot on the secondary side

compact transformers

open type single phase

Conform to IEC/EN 61558-2-4 or 2-6

Single phase 50-60 Hz - class I

Insulation voltage: Primary/Secondary 3 550 V

Primary/Earth 2 400 V

Secondary/Earth (12 - 24 V) = 250 V > 24 V = 1 500 V

Max. ambient operating temperature : 35°C

Protected against accidental contact with live parts up to 220 VA

Dimensions

Fig. 1 - 40 to 220 VA

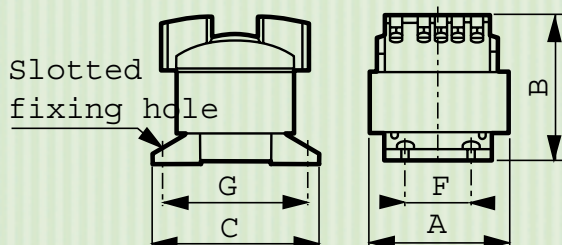


Fig. 2 - 310 to 1250 VA

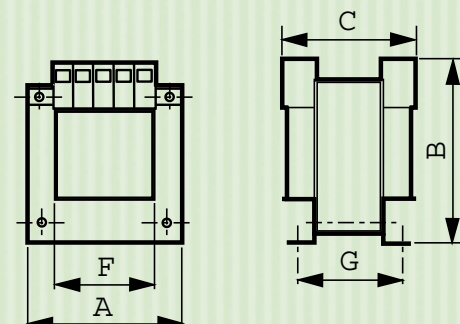


Fig. 3 - 800 to 2500 VA

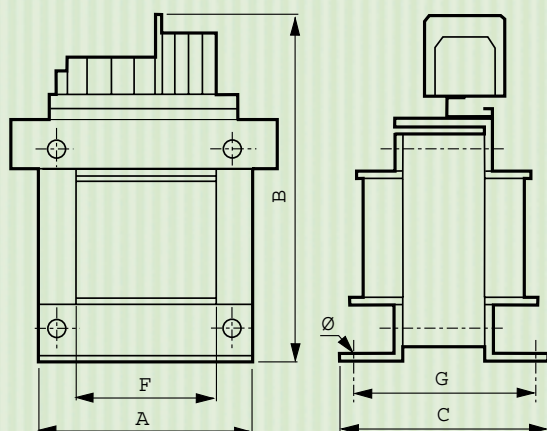
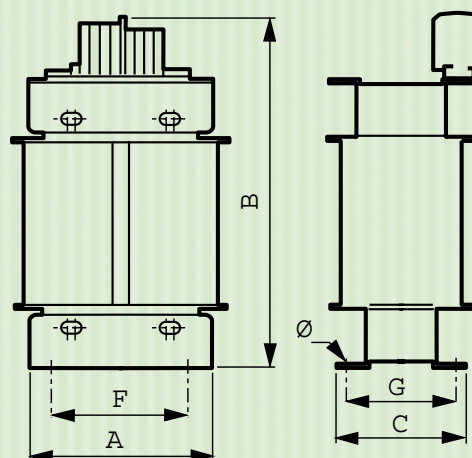


Fig. 4 - 4000 VA



Electrical characteristics for 24 V or 2 x 12 V secondary

Cat. No.	Power (VA)	Dimensions (mm)			Fixing (mm)			Weight (kg)	No-load loss (W)	Voltage drop as % with		Efficiency with		Ucc %	Primary connection cable mm ²			Secondary connection cable mm ²			FIG
		A	B	C	F	G	Ø			cos φ 1	cos φ 0-45	cos φ 1	cos φ 0-45		flexible	rigid	ø mm	flexible	rigid	ø mm	
6425 00	40	84	70	98	40	86	4-5	1							1 to 4	1 to 4	4-5	1 to 4	1 to 4	4-5	1
6425 02	63	84	77	98	40	86	4-5	1-3	4-9	13-5	10-2	0-79	0-64	11-8	1 to 4	1 to 4	4-5	1 to 4	1 to 4	4-5	1
6425 03	100	84	86	98	40	86	4-5	1-6	6-2	10-5	8-7	0-83	0-68	9-5	1 to 4	1 to 4	4-5	1 to 4	1 to 4	4-5	1
6425 04	160	84	104	98	40	86	4-5	2-4	9-1	8-8	7-4	0-83	0-69	7-9	1 to 4	1 to 4	4-5	1 to 4	1 to 4	4-5	1
6425 05	220	96	115	110	40	98	4-5	3-4	12-6	6-9	6-3	0-85	0-71	6-5	1 to 4	1 to 4	4-5	1 to 4	1 to 4	4-5	1
6425 06	310	126	126	107	90	76	6-5	4-6	15-1	7-2	4-1	0-86	0-74	5-9	1 to 4	1 to 4	4-5	1 to 16	1 to 25	6-5	2
6425 07	450	126	126	126	90	94	6-5	6	21-8	6	3-2	0-88	0-76	4-9	1 to 4	1 to 4	4-5	1 to 16	1 to 25	6-5	2
6425 08	630	126	126	141	90	105	6-5	8	25-5	4-3	2-6	0-91	0-82	3-5	1 to 4	1 to 4	4-5	1 to 16	1 to 25	6-5	2
6425 09	800	220	222	150	122	120	7	12-4	33-4	3-6	2-2	0-92	0-84	3	0-25to5	0-5 to 10	-	4 to 35	2-5 to 50	-	3
6425 10	1000	220	222	170	122	140	7	14-7	34-4	3-5	2-2	0-93	0-86	2-9	0-25to5	0-5 to 10	-	4 to 35	2-5 to 50	-	3
6425 11	1250	220	222	179	122	149	7	16	48	2-8	1-9	0-93	0-85	2-4	0-25to6	0-5 to 10	-	4 to 35	2-5 to 50	-	3
6425 12	1600	225	231	160	150	136	9	20	58-3	2-4	1-9	0-93	0-86	2-1	0-25to6	0-5 to 10	-	-	-	12	3
6425 13	2000	225	231	190	150	166	9	26-3	61-3	2-3	2	0-95	0-89	2-1	2-5to10	1-5 to 16	-	-	-	12	3
6425 14	2500	300	290	172	200	127	9	32-6	89-5	2-1	1-7	0-94	0-88	1-9	2-5to10	1-5 to 16	-	-	-	12	3

compact transformers

open type single phase *(continued)*

Electrical characteristics for 48 V or 2 x 24 V secondary

Cat. No.	Power (VA)	Dimensions (mm)			Fixing (mm)			Weight (kg)	No-load loss (W)	Voltage drop as % with		Efficiency with		Ucc %	Primary connection câble mm ²			Secondary connection cable mm ²			FIG
		A	B	C	F	G	Ø			cos φ 1	cos φ 0-45	cos φ 1	cos φ 0-45		flexible	rigid	ø mm	flexible	rigid	ø mm	
6425 40	40	84	70	98	40	86	4-5	1							1 to 4	1 to 4	4-5	1 to 4	1 to 4	4-5	1
6425 42	63	84	77	98	40	86	4-5	1-3	4-9	13-5	10-2	0-79	0-64	11-8	1 to 4	1 to 4	4-5	1 to 4	1 to 4	4-5	1
6425 43	100	84	86	98	40	86	4-5	1-6	6-2	10-5	8-7	0-83	0-68	9-5	1 to 4	1 to 4	4-5	1 to 4	1 to 4	4-5	1
6425 44	160	84	104	98	40	86	4-5	2-4	9-1	8-8	7-4	0-83	0-69	7-9	1 to 4	1 to 4	4-5	1 to 4	1 to 4	4-5	1
6425 45	220	96	115	110	40	98	4-5	3-4	12-6	6-9	6-3	0-85	0-71	6-5	1 to 4	1 to 4	4-5	1 to 4	1 to 4	4-5	1
6425 46	310	108	110	124	84	90	6-5	4-6	15-1	7-2	4-1	0-86	0-74	5-9	1 to 4	1 to 4	4-5	1 to 16	1 to 25	6-5	2
6425 47	450	126	126	126	90	94	6-5	6	21-8	6	3-2	0-88	0-76	4-9	1 to 4	1 to 4	4-5	1 to 16	1 to 25	6-5	2
6425 48	630	126	126	141	90	105	6-5	8	25-5	4-3	2-6	0-91	0-82	3-5	1 to 4	1 to 4	4-5	1 to 16	1 to 25	6-5	2
6425 49	800	150	144	150	122	120	7	11-4	33-4	3-6	2-2	0-92	0-84	3	1 to 4	1 to 4	4-5	1 to 16	1 to 25	6-5	2
6425 50	1000	150	144	170	122	140	7	14-3	34-4	3-5	2-2	0-93	0-86	2-9	1 to 4	1 to 4	4-5	1 to 16	1 to 25	6-5	2
6425 51	1250	220	222	179	122	149	7	16	48	2-8	1-9	0-93	0-85	2-4	0-25 to 6	0-5 to 10	-	4 to 35	2-5 to 50	-	3
6425 52	1600	220	231	160	150	136	9	20	58-3	2-4	1-9	0-93	0-86	2-1	0-25 to 6	0-5 to 10	-	-	-	12	3
6425 53	2000	220	231	190	150	166	9	25-9	61-3	2-3	2	0-95	0-89	2-1	2-5 to 10	1-5 to 16	-	-	-	12	3
6425 54	2500	300	290	172	200	127	9	32-2	89-5	2-1	1-7	0-94	0-88	1-9	2-5 to 10	1-5 to 16	-	-	-	12	3

Electrical characteristics for 115 V PMS, earth centre tap

Cat. No.	Power (VA)	Dimensions (mm)			Fixing (mm)			Weight (kg)	No-load loss (W)	Voltage drop as % with		Efficiency with		Ucc %	Primary connection câble mm ²			Secondary connection cable mm ²			FIG
		A	B	C	F	G	Ø			cos φ 1	cos φ 0-45	cos φ 1	cos φ 0-45		flexible	rigid	ø mm	flexible	rigid	ø mm	
6425 60	40	84	70	98	40	86	4-5	1							1 to 4	1 to 4	4-5	1 to 4	1 to 4	4-5	1
6425 62	63	84	77	98	40	86	4-5	1-3	4-9	12-9	9-6	0-80	0-65	10-9	1 to 4	1 to 4	4-5	1 to 4	1 to 4	4-5	1
6425 63	100	84	86	98	40	86	4-5	1-6	6-2	11-3	8-9	0-83	0-68	9-7	1 to 4	1 to 4	4-5	1 to 4	1 to 4	4-5	1
6425 64	160	84	104	98	40	86	4-5	2-4	9-1	9-1	7-3	0-83	0-69	7-8	1 to 4	1 to 4	4-5	1 to 4	1 to 4	4-5	1
6425 65	220	96	115	110	40	98	4-5	3-4	12-6	6-9	6-2	0-85	0-71	6-3	1 to 4	1 to 4	4-5	1 to 4	1 to 4	4-5	1
6425 66	310	108	110	105	84	90	6-5	4-5	15-1	6-1	3-3	0-84	0-71	4-9	1 to 4	1 to 4	4-5	1 to 16	1 to 25	4-5	2
6425 67	450	126	126	108	90	94	6-5	6	21-8	6-1	3-2	0-87	0-76	4-9	1 to 4	1 to 4	4-5	1 to 16	1 to 25	4-5	2
6425 68	630	126	126	123	90	105	6-5	7-8	25-5	4-3	2-6	0-91	0-82	3-5	1 to 4	1 to 4	4-5	1 to 16	1 to 25	4-5	2
6425 69	800	150	144	142	122	120	7	11-4	33-4	3-7	2-2	0-92	0-84	3	1 to 4	1 to 4	4-5	1 to 16	1 to 25	6-5	2
6425 70	1000	150	144	170	122	140	7	14-3	34-4	3-3	2-2	0-93	0-86	2-8	1 to 4	1 to 4	4-5	1 to 16	1 to 25	6-5	2
6425 71	1250	150	144	179	122	149	7	15-6	48	2-8	1-9	0-93	0-86	2-3	1 to 4	1 to 4	4-5	1 to 16	1 to 25	6-5	2
6425 72	1600	220	231	160	150	136	9	20-3	58-3	2-3	1-8	0-93	0-86	2	0-25 to 6	0-5 to 10	-	4 to 16	1-5 to 25	-	3
6425 73	2000	220	231	190	150	166	9	25-6	61-3	2-3	2	0-95	0-89	2-1	0-25 to 6	0-5 to 10	-	4 to 16	1-5 to 25	-	3
6425 74	2500	300	290	172	200	127	9	32-5	89-5	2	1-9	0-94	0-88	1-9	2-5 to 10	1-5 to 16	-	4 to 35	2-5 to 50	-	3

compact transformers

open type - single-phase (continued)

Electrical characteristics for 115/230 V secondary

Cat. No.	Power (VA)	Dimensions (mm)			Fixing (mm)			Weight (kg)	No-load loss (W)	Voltage drop as % with		Efficiency with		Ucc %	Primary connection cable mm ²			Secondary connection cable mm ²			FIG
		A	B	C	F	G	Ø			cos φ 1	cos φ 0.45	cos φ 1	cos φ 0.45		flexible	rigid	ø mm	flexible	rigid	ø mm	
6425 80	40	84	70	98	40	86	4.5	0.9	4	18.5	12.7	0.75	0.58	15.7	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	1
6425 82	63	84	77	98	40	86	4.5	1.3	4.9	12.5	9.7	0.80	0.65	11	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	1
6425 83	100	84	86	98	40	86	4.5	1.6	6.2	10.7	8.9	0.83	0.68	9.7	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	1
6425 84	160	84	104	98	40	88	4.5	2.4	9.1	8.8	7.3	0.83	0.69	7.9	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	1
6425 85	220	96	115	110	40	98	4.5	3.4	12.6	6.8	6.2	0.85	0.71	6.4	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	1
6425 86	310	108	110	105	84	90	6.5	4.6	15.1	5.7	3	0.85	0.71	4.6	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	2
6425 87	450	126	126	108	90	94	6.5	6	21.8	6	3.2	0.87	0.76	4.9	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	2
6425 88	630	126	126	123	90	105	6.5	7.8	25.5	4.3	2.6	0.91	0.81	3.5	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	2
6425 89	800	150	144	142	122	120	7	11.4	33.4	3.5	2.2	0.92	0.84	2.9	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	2
6425 90	1000	150	144	162	122	140	7	14.3	34.4	3.5	2.3	0.93	0.86	3	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	2
6425 91	1250	150	144	170	122	149	7	15.8	48	2.7	1.9	0.93	0.86	2.3	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	2
6425 92	1600	220	231	160	150	136	9	20.3	58.3	2.3	1.9	0.93	0.86	2.1	0.25 to 6	0.5 to 10	-	0.25 to 6	0.5 to 10	-	3
6425 93	2000	220	231	190	150	166	9	25.6	61.3	2.2	2	0.95	0.89	2.1	0.25 to 6	0.5 to 10	-	0.25 to 6	0.5 to 10	-	3
6425 94	2500	300	290	172	200	127	9	32.4	89.5	2	1.9	0.94	0.88	1.9	2.5 to 10	1.5 to 16	-	2.5 to 10	1.5 to 16	-	3

Electrical characteristics for 230 V secondary

Cat. No.	Power (VA)	Dimensions (mm)			Fixing (mm)			Weight (kg)	No-load loss (W)	Voltage drop as % with		Efficiency with		Ucc %	Primary connection cable mm ²			Secondary connection cable mm ²			FIG
		A	B	C	F	G	Ø			cos φ 1	cos φ 0.45	cos φ 1	cos φ 0.45		flexible	rigid	ø mm	flexible	rigid	ø mm	
6426 00	40	84	70	98	40	86	4.5	0.9	4	18.5	12.7	0.75	0.58	15.7	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	1
6426 02	63	84	77	98	40	86	4.5	1.3	4.9	12.5	9.7	0.80	0.65	11	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	1
6426 03	100	84	86	98	40	86	4.5	1.6	6.2	10.7	8.9	0.83	0.68	9.7	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	1
6426 04	160	84	104	98	40	86	4.5	2.4	9.1	8.8	7.3	0.83	0.69	7.9	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	1
6426 05	220	96	115	110	40	98	4.5	3.4	12.6	6.8	6.2	0.85	0.71	6.4	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	1
6426 06	310	108	110	105	84	90	6.5	4.6	15.1	5.7	3	0.85	0.71	4.6	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	2
6426 07	450	126	126	108	90	94	6.5	6	21.8	6	3.2	0.87	0.76	4.9	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	2
6426 08	630	126	126	123	90	105	6.5	7.8	25.5	4.3	2.6	0.91	0.81	3.5	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	2
6426 09	800	150	144	142	122	120	7	11.4	33.4	3.5	2.2	0.92	0.84	2.9	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	2
6426 10	1000	150	144	162	122	140	7	14.3	34.4	3.5	2.3	0.93	0.86	3	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	2
6426 11	1250	150	144	170	122	149	7	15.8	48	2.7	1.9	0.93	0.86	2.3	1 to 4	1 to 4	4.5	1 to 4	1 to 4	4.5	2
6426 12	1600	220	231	160	150	136	9	20.3	58.3	2.3	1.9	0.93	0.86	2.1	0.25 to 6	0.5 to 10	-	0.25 to 6	0.5 to 10	-	3
6426 13	2000	220	231	190	150	166	9	25.6	61.3	2.2	2	0.95	0.89	2.1	0.25 to 6	0.5 to 10	-	0.25 to 6	0.5 to 10	-	3
6426 14	2500	300	290	172	200	127	9	32.4	89.5	2	1.9	0.94	0.88	1.9	2.5 to 10	1.5 to 16	-	2.5 to 10	1.5 to 16	-	3

how to calculate the rated power of a transformer

In equipment containing control devices, the transformer power depends on the maximum power required at a given moment (inrush power), the permanent power, the voltage drop and power factor

When determining the inrush power required, the following factors should always be taken into account :

- two inrush currents cannot occur at the same time
- power factor $\cos \varphi$ equals 0.5
- at maximum, 80% of devices are supplied at the same time (this percentage can be calculated precisely for each device)

Determination of the inrush power

Where a simplified calculation of the power is required, the following formula can be used :

$$P_{\text{inrush}} = 0.8 (\Sigma P_m + \Sigma P_v + P_a)$$

ΣP_m : sum of all contactor steady state power levels

ΣP_v : sum of all power levels of indicators and LEDs*

P_a : inrush power of the largest contactor

Example :

A machine tool control cabinet comprising :

- 10 contactors for 4 kW motors, with a steady state power of 8 VA
- 4 contactors for 18.5 kW motor, with a steady state power of 20 VA
- 1 contactor for 45 kW motor, with a steady state power of 20 VA, and an inrush power of 250 VA $\cos \varphi$ 0.5
- 25 remote control relays, with a steady state power of 4 VA
- 45 signalling LEDs, with a consumption of 1 VA each

$$- \Sigma P_m = 280 \text{ VA } \{ (10 \times 8 \text{ VA}) + (4 \times 20 \text{ VA}) + (1 \times 20 \text{ VA}) + (25 \times 4 \text{ VA}) \}$$

$$- \Sigma P_v = 45 \text{ VA } (45 \times 1 \text{ VA})$$

$$- P_a = 250 \text{ VA}$$

$$P_{\text{inrush}} = 0.8 (280 + 45 + 250) = 460 \text{ VA at } \cos \varphi \text{ 0.5}$$

Determination of the rated power of a transformer

For control transformers, in particular, simply start with an inrush power at $\cos \varphi$ 0.5 and read the size from the table below

Rated power in VA IEC and CSA	Admissible instantaneous power in VA IEC 60989 with $\cos \varphi$ of:								
	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
40	140	120	100	88	79	71	64	59	55
63	270	230	200	170	150	140	130	120	110
100	380	320	280	240	220	200	180	160	150
160	900	770	670	590	520	470	440	400	390
250	1 200	1 000	870	870	880	620	570	530	510
400	2 000	1 700	1 500	1 300	1 200	1 100	1 000	940	940
630	2 200	1 900	1 700	1 500	1 300	1 200	1 200	1 100	1 200
1 000	4 600	4 000	3 800	3 300	3 000	2 800	2 600	2 500	2 600
1 600	6 600	5 900	5 400	4 900	4 600	4 300	4 100	4 000	4 300
2 500	6 000	5 600	5 300	4 900	4 900	4 800	4 800	4 900	6 100
4 000	16 000	14 000	12 000	10 000	9 000	8 200	7 500	6 900	6 700

From the example above, an inrush of 460 VA at $\cos \varphi$ 0.5 gives a transformer size of 160 VA

Checking the selection

As a precaution, make the following checks on each of your devices :

- first calculate the sum of the steady state power for the coils and the LEDs powered at the same time
- then apply a coefficient : use either our hypothetical figure of 80% of devices at steady state power, or the actual calculation for your equipment.
- the power of the chosen transformer shall be greater than or equal to the result of the calculation.

* LED = Light Emitting Diode

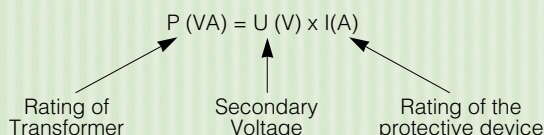
protection of transformers, primary and secondary circuits

Protection of transformers

In accordance with IEC 60742 (BS EN 60742) and IEC 60989 standards, transformers must be protected against overload and short circuit conditions which may occur during normal operation.

The standard does not specify the location of the protective device : it is the manufacturer's responsibility to choose the most suitable position, either on the primary or secondary side. The rating, type and location of the protective device are indicated on the device identification plate.

Clause 14 of BS 3535 effectively specifies the rating of the transformer as a factor of the rating (in A) of the protective device with the secondary voltage value (in V).



Ratings, types and location of protective devices to be used for transformer protection according to VA rating and secondary voltage :

Rated power (VA) IEC/CSA	24 V			48 V			110 V			230 V		
	Fuse A	Type	Curve C MCB	Fuse A	Type	Curve C MCB	Fuse A	Type	Curve C MCB	Fuse A	Type	Curve C MCB
40	2	T		1	T		400 m	T		200 m	T	
50	2	T	2	1	T	1	500 m	T	0.5	200 m	T	0.2
63	3-15	T		1.6	T		630 m	T		315 m	T	
100	4	gG	4	2	gG	2	1	gG	1	0.5	gG	0.5
150	6	gG	6	4	gG	4	2	gG	2		gG	
160	8	gG	8	4	gG	4	2	gG	2	1	gG	1
200	8	gG	8	4	gG	4	2	gG	2	1	gG	1
250	10	gG	10	6	gG	6	2	gG	2	1	gG	1
300	12	gG	12	6	gG	6	4	gG	4	2	gG	2
400	16	gG	16	8	gG	8	4	gG	4	2	gG	2
500	20	gG	20	10	gG	10	6	gG	6	2	gG	2
630	25	gG	25	12	gG	12	8	gG	8	4	gG	4
750		gG		16	gG	16	8	gG	8	4	gG	4
1 000	40	gG	40	20	gG	20	8	gG	8	4	gG	4
1 250		gG			gG		12	gG	12		gG	
1 500		gG			gG		16	gG	13	8	gG	8
1 600	63	gG	63	32	gG	32	16	gG	13	8	gG	8
2 000		gG			gG		20	gG	20	8	gG	8
2 500	100	gG	100	50	gG	50	20	gG	20	10	gG	10
3 000		gG			gG		32	gG	32		gG	
3 500		gG			gG		32	gG	32		gG	
4 000		gG			gG		32	gG	32	16	gG	16
5 000		gG			gG		50	gG	50		gG	

Protection of primary and secondary circuits

General

Circuits must be protected against overload and short circuit conditions.

Protection against overload is compulsory if the circuit is likely to be affected by an overload current. This protection can be installed at the supply source or end of the circuit.

Protection against a short circuit is compulsory in all installations ; this protection has to be installed at the supply source of the circuit.

Supply circuits (transformer primary)

The transformer is a device which cannot itself generate overload. Its supply circuit therefore only requires protection against a short circuit. When a transformer is energized, a very high inrush current (around 25 In⁽¹⁾) is produced for approximately 10 ms.

When protecting the circuit, both factors must be considered.

Legrand offers three possibilities :

- type aM cartridge fuses,
- type D MCBs (with magnetic tripping set at 15 In average),
- type C MCBs (with magnetic tripping set at 6 In average).

Example : control transformer 630 VA - 230/24 V Cat. No. 6421 08

In primary 2.74 A

I inrush at power-up 68.5 A (25 x 2.74 A)

Protection against a short circuit can be provided by :

- type aM 6 A cartridge fuse
- type D 6 A MCBs
- type C 16 A MCBs

(1) In = nominal rating of circuit

Minimum protection rating for primary supply of the transformer

Power (VA)	230 V single-phase			400 V single-phase			400 V three-phase		
	aM fuse	C MCB	D MCB	aM fuse	C MCB	D MCB	aM fuse	C MCB	D MCB
40	1	1		1	1		1		
50	1	1	1	1	1		1		
63	1	2	1	1	1		1		
100	1	3	1	1	2				
150	1	6	2	1	2	1			
160	1	6	2	1	2	1	1		
200	1	6	3	1	3	2			
250	2	8	3	1	3	2	1		
300	2	10	6	2	6	2			
400	4	10	6	2	6	2	2		
500	6	16	6	4	10	3			
630	6	16	6	4	10	3	2	6	
750	8	16	10	6	10	6			
1 000	10	20	10	6	16	6			3
1 250	10	25	16	6	20	10			
1 500	10	32	16	10	20	10			
1 600	10	32	16	10	20	10	6	16	6
2 000	12	40	20	10	25	16			
2 500	16	40	20	10	32	16	8	20	10
3 000	16	50	32	12	40	20			
3 500	20	50	32	16	40	20			
4 000	20	63	32	16	50	20	10	25	16
5 000	25	80	50	20	63	32			

These values are given for information only for transformers with inrush currents of around 25 In.

Protection of the secondary circuit

The secondary circuit must be protected against overload and short circuit conditions.

For overload, check that the protection rating chosen is lower than or equal to the transformer secondary current.

For short circuit, ensure that a short circuit occurring at the furthest point of the circuit will trigger the protective device within 5 seconds.

Legrand offers two possibilities :

- type gG cartridge fuses
- type C MCBs (with magnetic tripping set at 6 In average)

If the transformer only supplies a single circuit, and provided the calculations show perfect compatibility, transformer protection (if on secondary) and circuit protection can be one and the same. A single protective device performs both functions (see table of transformer protective devices).

If the transformer supplies several circuits, overload and short circuit calculations must be performed for each individual circuit. To check that the device chosen is suitable, an approximate minimum short circuit value can be obtained using the following formula.

Formula for determining the secondary protection rating :

Calculate the minimum short circuit at the furthest point on the circuit :

$$I_{c/c \text{ min.}} = \frac{U_s}{\left(\frac{U_s^2}{P} \times \frac{U_{c/c \%}}{100} \right) + \frac{2pl}{S}}$$

U_s = transformer secondary voltage

P = transformer power

U c/c % = transformer short circuit voltage

l = line length in m

S = line cross-section in mm²

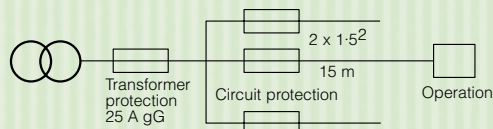
ρ copper = 0.027 Ω mm²/m

Choose the protection rating so as to obtain a cut-off time of 5 seconds max. for a current I c/c defined above :

$$\text{type gG fuse : } I_n \leq \frac{I_{c/c \text{ min.}}}{4}$$

$$\text{type C MCB : } I_n \leq \frac{I_{c/c \text{ min.}}}{8}$$

Example : control transformer 630 VA - 230/24 V Cat. No. 6421 08



$$I_{c/c \text{ min.}} = \frac{24}{\left(\frac{24^2}{630} \times \frac{3.8}{100} \right) + \frac{2 \times 0.027 \times 15}{1.5}} = 41.76 \text{ A}$$

$$\frac{41.76}{4} = 10.44 \rightarrow \text{gG 10 A max.} \quad \frac{41.76}{8} = 5.22 \rightarrow \text{C type DX 5 A max.}$$