

protection of transformers, primary and secondary circuits

Protection of transformers

In accordance with the IEC EN 61558 standard, transformers must be protected against overload and short-circuit conditions which may occur during normal operation.

The standard does not specify the type or 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 to be indicated on the device identification plate.

Protection of the 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 energised, 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 12 In average)
- type C MCBs (with magnetic tripping set at 7 In average)

Example : control transformer 630 VA - 230/24 V Cat. No. 0442 37

In primary 2·74 A (VA ÷ V)
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 13 A MCBs - (16 A nearest UK)

Primary protection

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	0·5	1		0·25	1				
50	1	1	1	0·5	1				
63	1	2	1	0·5	1				
100	1	3	1	1	2	1			
150	2	6	2	1	3	1			
160	2	6	2	1	3	1	1		
200	2	6	3	1	3	2			
250	2	6	3	1	6	2	1		
300	4	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	2
750	8	16	10	6	10	6	2	6	3
1 000	10	20	10	6	16	6	4	10	3
1 250	10	25	16	6	20	10	4	10	6
1 500	10	32	16	10	20	10	4	16	6
1 600	10	32	16	10	20	10	6	16	6
2 000	12	40	16	10	25	10			
2 500	16	50	20	10	32	16	6	20	10
3 000	16	50	32	12	40	20			
3 500	20	50	32	16	40	20			
4 000	20	80	32	16	50	20	10	32	16
5 000	25	100	40	16	63	25	12	32	16

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

1 : In = nominal rating of circuit

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 7 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 :

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

Us = transformer secondary voltage

P = transformer power

U c/c % = transformer short-circuit voltage

l = line length in m

S = line cross section in mm²

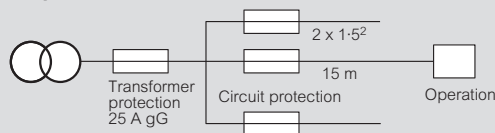
ρ copper = 0·027 Ω mm²/m

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. 0442 37



$$I_{c/c \text{ min.}} = \frac{24}{\left(\frac{24^2}{630} \times \frac{3\cdot3}{100}\right) + \frac{2 \times 0\cdot027 \times 15}{1\cdot5}} = 44\cdot42 \text{ A} = \text{Use either :}$$

$$\frac{44\cdot42}{4} = 11\cdot10 \rightarrow \text{gG fuse 10 A max.} \quad \frac{44\cdot42}{8} = 5\cdot55 \rightarrow \text{C type MCB 5 A max.}$$

Secondary protection

Ratings and types of protective devices to be used for single phase transformer protection according to VA rating and secondary voltage

Rated power (VA) IEC/CSA	24 V				48 V				110 V				230 V			
	Fuse		Curve C MCB	Fuse	Fuse		Curve C MCB	Fuse		Curve C MCB	Fuse		Curve C MCB	Fuse		Curve C MCB
	A	Type			A	Type		A	Type		A	Type				
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	1	gG	1				
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	6	gG	6	3	gG	3				
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					

filtered power supplies

open type single phase



Dimensions and technical information **opposite and p. 97**

Filtered power supplies for PLCs and other equipment requiring a voltage of 12 V DC or 24 V DC

Include :

- twin output terminals for ease of connection
- safety transformer with interference filtration
- fuse protection on output
- green LED output voltage indicator
- capacitor in filtered range

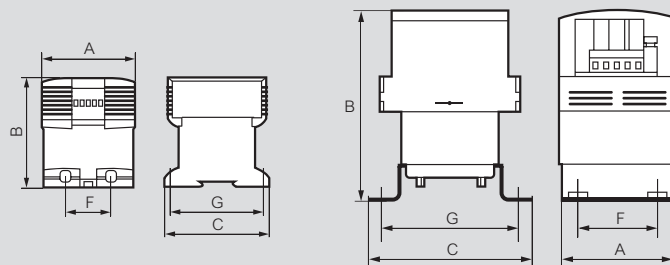
Supplied with a connection link for quick connection between - and \perp up to 15 A

Fixing options :

- clip directly to DIN rail up to 24 W
- clip on or screw fixing up to 120 W
- screw fixing only above 120 W

Pack	Cat. Nos.	Single phase filtered		C _{RU} US	
12 V_{DC} output					
230-400 V \pm 15 V _{AC} (input) / 12 V _{DC} (output)					
		Power (W)	Current rating (A)	Terminal capacity (mm ²) Flexible cable	
				Input	Output
1	0470 01	12	1	6	6
1	0470 02	30	2.5	6	6
1	0470 03	60	5	6	6
1	0470 04	120	10	6	6
24 V_{DC} output					
230-400 V \pm 15 V _{AC} (input) / 24 V _{DC} (output)					
		Power (W)	Current rating (A)	Terminal capacity (mm ²) Flexible cable	
				Input	Output
1	0470 20	12	0.5	6	6
1	0470 21	24	1	6	6
1	0470 22	60	2.5	6	6
1	0470 23	120	5	6	6
1	0470 24	240	10	6	6
1	0470 25	360	15	6	6

■ Dimensions



Cat. Nos. 0470 01/02/03 and 0470 20/21/22/23

Cat. Nos. 0470 04/24/25

Cat. Nos.	A (mm) Width	B (mm) Depth	C (mm) Height	F x G (mm) Fixing ctrs	Ø (mm)	Weight (Kg)
0470 01	68	98	88	DIN	-	1.00
0470 02	93	121	105	DIN	4-6	2.45
0470 03	105	135	115	DIN	4-6	3.60
0470 04	126	186	175	75 x 150	5-5	6.35
0470 20	68	98	88	DIN	-	1.00
0470 21	68	98	88	DIN	-	1.00
0470 22	93	121	105	DIN	4-6	2.45
0470 23	105	135	115	DIN	4-6	3.60
0470 24	126	186	175	75 x 150	5-5	6.40
0470 25	126	206	175	75 x 150	5-5	7.60

■ Technical information

Conform to IEC / EN 61558-2-6, UL 60950
CAN/CSA C22.2 N° 60 950.00



Products are compatible with EN 61131-2, EN 60204 and EN 61439 apparatus

Input voltage : 230/400 V_{AC} \pm 15 V single phase 50/60 Hz - Class I

Output voltage : 12 V_{DC} or 24 V_{DC}

Insulation voltage : Input/Output 4 510 V

Input/Earth 2 260 V

Output/Earth 500 V

Max. ambient temperature without derating : 60 °C

Ripple factor : <3 %

Cooling by natural convection

Integral fuse protection on output

Can be fixed to symmetrical rail 7.5 mm or 15 mm depth EN 60715

Screw fix only Cat. Nos. 0470 04/24 and 25

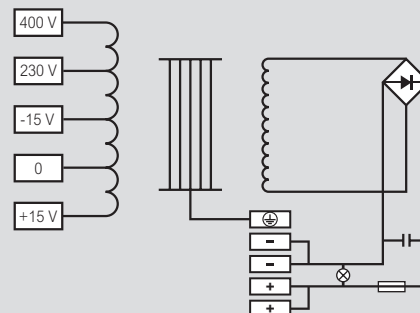
Screw fix or clip on to DIN rail Cat. Nos. 0470 02/03/22 and 23

Supplied with a connection link for quick connection between terminals and earth

Note : To conform to UL, product must be mounted in the vertical position (mounting against support) for Class A ambient temperature rating 25 °C

■ Operating diagram

Operating current up to 15 A



DX³ MCBs p. 56-57
Fuses p. 76-77



Download the full file at

<http://assets.kempstoncontrols.com/doc/Legrand%20Industrial%20and%20power%20protection%20catalogue.pdf>



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