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Edition 1.1

2007-03

Edition 1:2006 consolidated with amendment 1:2007

Ferrite cores – Dimensions –

Part 9: Planar cores

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FERRITE CORES – DIMENSIONS –

Part 9: Planar cores

FOREWORD

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International Standard IEC 62317-9 has been prepared IEC technical committee 51: Magnetic components and ferrite materials.

This International Standard cancels and replaces IEC 61860 published in 2000. This edition constitutes a technical revision. This International Standard includes the following significant technical changes and additions with respect to IEC 61860:2000:

a) addition of the planar EL family of cores;
b) addition of the low-profile ER family of cores;
c) the low-profile RM-family defined in IEC 61860:2000 has been moved to IEC 62137-4 for RM-cores and associated parts.

This consolidated version of IEC 62317-9 consists of the first edition (2006) [documents 51/849/FDIS and 51/858/RVD] and its amendment 1 (2007) [documents 51/866/CDV and 51/876/RVC].

The technical content is therefore identical to the base edition and its amendment and has been prepared for user convenience.

It bears the edition number 1.1.

A vertical line in the margin shows where the base publication has been modified by amendment 1.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 62317 consists of the following parts, under the general title *Ferrite cores – Dimensions*:

Part 1: General (under consideration)
Part 2: Pot cores (under consideration, currently available as IEC 60133)
Part 3: Half pot cores (under consideration, currently available as IEC 62323)
Part 4: RM-cores and associated parts
Part 5: EP-cores (under consideration, currently available as IEC 61596)
Part 6: ETD-cores (under consideration, currently available as IEC 61185)
Part 7: EER-cores
Part 8: E-cores
Part 9: Planar cores
Part 10: PM-cores (under consideration, currently available as IEC 61247)
Part 11: EC-cores (under consideration, currently available as IEC 60647)
Part 12: Uncoated ring cores (under consideration, currently available as IEC 61604)

The committee has decided that the contents of the base publication and its amendments will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

Nowadays, d.c.-d.c. converter power supplies increasingly employ transformers and chokes the windings of which are made of multi-layer printed circuit board or the windings are constructed in the motherboard, rather than the transformers wound by conventional copper wires. This part of IEC 62317 specifies the optimum shapes and dimensions of cores for SMD (Surface Mounted Device) and of cores for which the windings are constructed in the motherboard. The motherboard has slots cut out to accept the ferrite cores. This is called the total integration in a multi-layer motherboard. The core shape specified in this part of IEC 62317 satisfies the demand for lower profile as well as for smaller floor space.

FERRITE CORES – DIMENSIONS –

Part 9: Planar cores

1 Scope

This International Standard specifies the shapes and dimensions of ferrite cores for inductive components (transformers and chokes) of which the coil is typically constructed by multi-layer board or the coil is part of the motherboard.

The general consideration upon which the design of this range of cores is based is given in Annex A.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60205, *Calculation of the effective parameters of magnetic piece parts*

IEC 62317-4:2005, *Ferrite cores – Dimensions – Part 4: RM cores and associated parts*

3 Primary standard

3.1 Planar shape and dimensions

The main shapes and dimensions shall be as given in the following figures and tables.

The main shape, dimensions, and parameters for EL core are given in:

Figure 1 – Planar core EL and mating PLT-core;

Table 1 – Dimensions of planar core EL and the mating PLT-core;

Table 2 – Effective parameter values and A_{min} values.

The main shape, dimensions, and parameters for low-profile E-cores are given in:

Figure 2 – Low-profile E-core and mating PLT-core;

Table 3 – Dimensions of low-profile E-core and the mating PLT-core;

Table 4 – Effective parameter values and A_{min} values.

The main shape, dimensions, and parameters for ER-cores are given in:

Figure 3 – Low-profile ER-core;

Table 5 – Dimensions of low-profile ER-core;

Table 6 – Effective parameter values and A_{min} values.

A uniform dimensional nomenclature has been chosen in order to facilitate a comparison of major physical attributes among the different core shapes.

3.2 Dimensions of planar core EL and the mating PLT-core

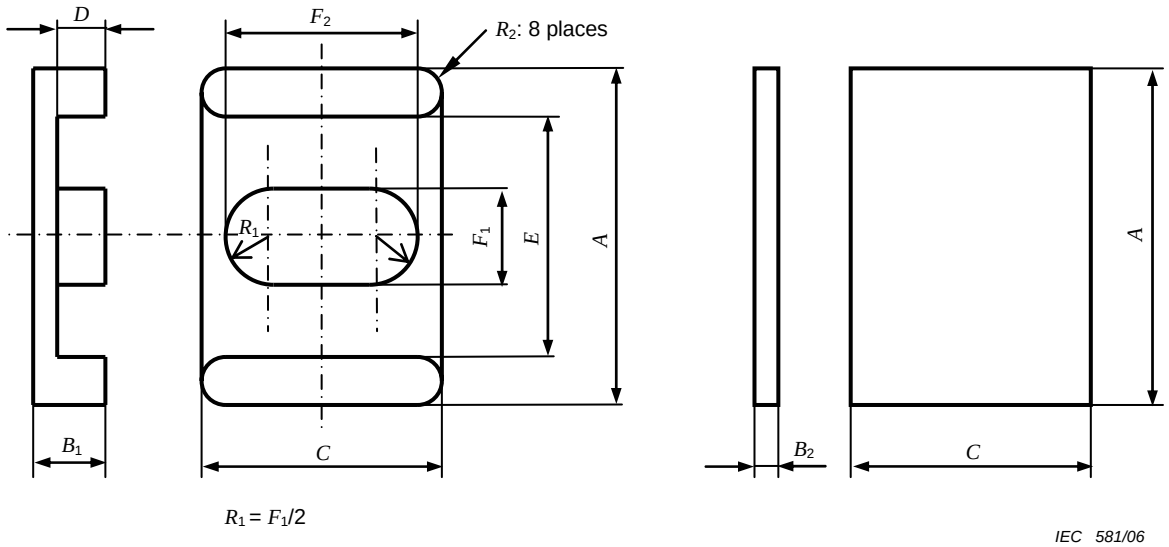

Figure 1 – Planar core EL and the mating PLT-core

Table 1 – Dimensions of planar core EL and the mating PLT-core

Dimensions in millimetres

Size		*A*	B_1	B_2	*C*	*D*	*E*	F_1	F_2	R_2
EL11 × 2,0	min.	10,80	1,91		8,60	0,90	8,97	2,68	6,25	0,3
	max.	11,20	2,11		9,00	1,10	9,37	2,88	6,55	
EL11 × 3,0	min.	10,80	2,91		8,60	1,90	8,97	2,68	6,25	0,3
	max.	11,20	3,11		9,00	2,10	9,37	2,88	6,55	
PLT11 × 1,0	min.	10,80		0,96	8,60					
	max.	11,20		1,06	9,00					
EL13 × 2,2	min.	12,75	2,09		10,20	0,90	10,63	3,19	7,41	0,3
	max.	13,25	2,29		10,60	1,10	11,03	3,39	7,71	
EL13 × 3,2	min.	12,75	3,09		10,20	1,90	10,63	3,19	7,41	0,3
	max.	13,25	3,29		10,60	2,10	11,03	3,39	7,71	
PLT13 × 1,2	min.	12,75		1,14	10,20					
	max.	13,25		1,24	10,60					
EL15,5 × 2,9	min.	15,20	2,82		12,15	1,40	12,67	3,82	8,81	0,3
	max.	15,80	3,02		12,65	1,60	13,17	4,02	9,21	
EL15,5 × 4,4	min.	15,20	4,32		12,15	2,90	12,67	3,82	8,81	0,3
	max.	15,80	4,52		12,65	3,10	13,17	4,02	9,21	
PLT15,5 × 1,4	min.	15,20		1,32	12,15					
	max.	15,80		1,52	12,65					
EL18 × 3,7	min.	17,70	3,55		14,15	1,90	14,70	4,45	10,27	0,3
	max.	18,30	3,75		14,65	2,10	15,30	4,65	10,67	
EL18 × 5,7	min.	17,70	5,55		14,15	3,85	14,70	4,45	10,27	0,3
	max.	18,30	5,75		14,65	4,15	15,30	4,65	10,67	

Table 1 (*continued*)

Dimensions in millimetres

Size		A	B_1	B_2	C	D	E	F_1	F_2	R_2
PLT18 × 1,7	min.	17,70		1,55	14,15					
	max.	18,30		1,75	14,65					
EL20 × 3,8	min.	19,65	3,73		15,70	1,90	16,37	4,91	11,43	0,5
	max.	20,35	3,93		16,30	2,10	16,97	5,21	11,83	
EL20 × 5,8	min.	19,65	5,68		15,70	3,85	16,37	4,91	11,43	0,5
	max.	20,35	5,98		16,30	4,15	16,97	5,21	11,83	
PLT20 × 1,8	min.	19,65		1,73	15,70					
	max.	20,35		1,93	16,30					
EL22 × 4,0	min.	21,60	3,92		17,30	1,90	17,98	5,41	12,54	0,5
	max.	22,40	4,12		17,90	2,10	18,68	5,71	13,04	
EL22 × 6,0	min.	21,60	5,87		17,30	3,85	17,98	5,41	12,54	0,5
	max.	22,40	6,17		17,90	4,15	18,68	5,71	13,04	
PLT22 × 2,0	min.	21,60		1,92	17,30					
	max.	22,40		2,12	17,90					
EL25 × 4,3	min.	24,55	4,19		19,65	1,90	20,48	6,17	14,29	0,5
	max.	25,45	4,39		20,35	2,10	21,18	6,47	14,79	
EL25 × 6,3	min.	24,55	6,14		19,65	3,85	20,48	6,17	14,29	0,5
	max	25,45	6,44		20,35	4,15	21,18	6,47	14,79	
PLT25 × 2,3	min.	24,55		2,19	19,65					
	max.	25,45		2,39	20,35					

Table 2 – Effective parameter values and A_{min} values

Size	C_1 mm^{-1}	C_2 mm^{-3}	l_e mm	A_e mm^2	V_e mm^3	A_{min}[a] mm^2	Remarks
EL-EL11 × 4,0	0,826 45	49,923 × 10^{-3}	13,7	16,5	226	15,9	Combination EL-EL refers to two shorter height EL cores for size-designation.
EL-EL13 × 4,4	0,666 66	28,815 × 10^{-3}	15,4	23,1	357	22,4	
EL-EL15,5 × 5,8	0,596 74	18,143 × 10^{-3}	19,6	32,9	646	31,9	
EL-EL18 × 7,3	0,538 30	12,162 × 10^{-3}	23,8	44,3	1 050	43,0	
EL-EL20 × 7,7	0,468 64	8,586 6 × 10^{-3}	25,6	54,6	1 400	52,9	
EL-EL22 × 8,0	0,412 80	6,231 4 × 10^{-3}	27,3	66,2	1 810	64,2	
EL-EL25 × 8,6	0,350 34	4,094 2 × 10^{-3}	30,0	85,6	2 570	83,0	
EL-PLT11 × 4,0	0,826 45	49,943 × 10^{-3}	13,7	16,5	226	15,9	Combination EL-PLT refers to one taller height EL core paired with one PLT core for each size-designation.
EL-PLT13 × 4,4	0,666 66	28,815 × 10^{-3}	15,4	23,1	357	22,4	
EL-PLT15,5 × 5,8	0,569 74	18,143 × 10^{-3}	19,6	32,9	646	31,9	
EL-PLT18 × 7,3	0,538 30	12,162 × 10^{-3}	23,8	44,3	1 050	43,0	
EL-PLT20 × 7,7	0,468 64	8,586 6 × 10^{-3}	25,6	54,6	1 400	52,9	
EL-PLT22 × 8,0	0,412 80	6,231 4 × 10^{-3}	27,3	66,2	1 810	64,2	
EL-PLT25 × 8,6	0,350 34	4,094 2 × 10^{-3}	30,0	85,6	2 570	83,0	

Table 2 (*continued*)

Size	C_1 mm^{-1}	C_2 mm^{-3}	l_e mm	A_e mm^2	V_e mm^3	A_{min} [a] mm^2	Remarks
EL-PLT11 × 3,0	0,701 76	42,170 × 10^{-3}	11,7	16,6	194	15,9	Combination
EL-PLT13 × 3,4	0,577 71	24,857 × 10^{-3}	13,4	23,2	312	22,4	EL-PLT refers to one thinner height EL core paired with one PLT for each size-designation.
EL-PLT15,5 × 4,3	0,502 96	15,212 × 10^{-3}	16,6	33,1	550	31,9	
EL-PLT18 × 5,3	0,445 54	10,011 × 10^{-3}	19,8	44,5	882	43,0	
EL-PLT20 × 5,7	0,392 32	7,167 9 × 10^{-3}	21,6	54,9	1 180	52,9	
EL-PLT22 × 6,0	0,350 61	5,264 5 × 10^{-3}	23,4	66,6	1 560	64,2	
EL-PLT25 × 6,6	0,302 22	3,515 6 × 10^{-3}	26,0	86,0	2 230	83,0	
[a] See 2.2 of IEC 60205.							

3.3 Dimensions of low-profile core E-core and the mating PLT-core

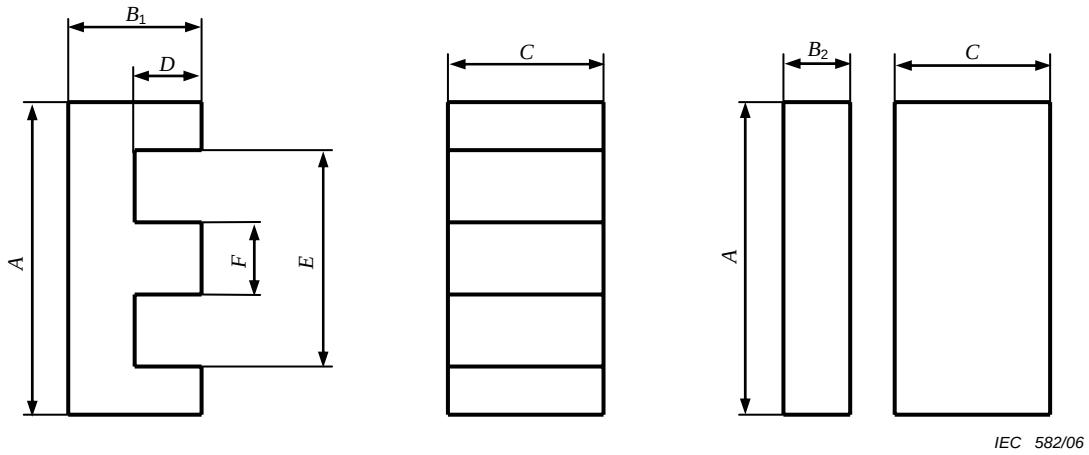

Figure 2 – Low-profile E-core and the mating PLT-core

Table 3 – Dimensions of low-profile E-core and the mating PLT-core

Dimensions in millimetres

Size		A	B_1	B_2	C	D	E	F
E14 × 3,5 × 5	min.	13,70	3,40		4,90	1,90	10,75	2,95
	max.	14,30	3,60		5,10	2,10	11,25	3,05
PLT14 × 1,5 × 5	min.	13,70		1,40	4,90			
	max.	14,30		1,60	5,10			
E18 × 4 × 10	min.	17,65	3,90		9,80	1,90	13,70	3,90
	max.	18,35	4,10		10,20	2,10	14,30	4,10
PLT18 × 2 × 10	min.	17,65		1,90	9,80			
	max.	18,35		2,10	10,20			
E22 × 6 × 16	min.	21,40	5,60		15,50	3,10	16,40	4,90
	max	22,20	5,80		16,10	3,30	17,20	5,10
PLT22 × 2,5 × 16	min.	21,40		2,40	15,50			
	max.	22,20		2,60	16,10			

Table 3 (*continued*)

Dimensions in millimetres

Size		A	B_1	B_2	C	D	E	F
E32 × 6 × 20	min.	31,10	6,20		19,90	2,95	24,90	6,20
	max.	32,40	6,50		20,75	3,40	26,10	6,50
PLT32 × 3 × 20	min.	31,10		3,00	19,90			
	max.	32,40		3,35	20,75			
E38 × 8 × 25	min.	37,30	8,10		24,85	4,30	30,20	7,40
	max.	38,90	8,40		25,95	4,60	31,40	7,80
PLT38 × 4 × 25	min.	37,30		3,65	24,85			
	max.	38,90		3,95	25,95			
E43 × 10 × 28	min.	42,30	9,35		27,30	5,25	34,70	7,90
	max.	44,10	9,65		28,50	5,55	36,30	8,30
PLT43 × 4 × 28	min.	42,30		3,95	27,30			
	max.	44,10		4,25	28,50			
E58 × 11 × 38	min.	57,20	10,35		37,30	6,35	50,00	7,90
	max.	59,60	10,75		38,90	6,65	52,20	8,30
PLT58 × 4 × 38	min.	57,20		3,85	37,30			
	max.	59,60		4,25	38,90			
E64 × 10 × 50	min.	62,70	10,05		49,70	4,95	52,50	10,00
	max.	65,30	10,35		51,90	5,25	54,70	10,40
PLT64 × 5 × 50	min.	62,70		4,95	49,70			
	max.	65,30		5,25	51,90			
E102 × 20 × 38	min.	100,0	20,10		36,50	12,90	85,00	13,70
	max.	104,0	20,50		38,50	13,40	88,60	14,30
PLT102 × 7 × 38	min.	100,0		6,95	36,50			
	max	104,0		7,35	38,50			

Table 4 – Effective parameter values and A_{min} values

Size	C_1 mm^{-1}	C_2 mm^{-3}	l_e mm	A_e mm^2	V_e mm^3	A_{min}[a)] mm^2	Remarks
E-E14	1,380 8	92,005 × 10^{-3}	20,7	15,0	311	15,0	Combination E-E
E-E18	0,607 08	15,177 × 10^{-3}	24,3	40,0	971	40,0	
E-E22	0,410 81	5,200 1 × 10^{-3}	32,5	79,0	2 560	79,0	
E-E32	0,324 58	2,525 5 × 10^{-3}	41,8	129	5 370	127	
E-E38	0,276 13	1,443 9 × 10^{-3}	52,8	191	10 100	185	
E-E43	0,274 13	1,219 7 × 10^{-3}	61,6	225	13 800	215	
E-E58	0,269 43	0,893 10 × 10^{-3}	81,3	302	24 500	278	
E-E64	0,153 67	0,295 56 × 10^{-3}	79,9	520	41 500	518	
E-E102	0,273 88	0,506 86 × 10^{-3}	148	540	80 000	525	

Table 4 (*continued*)

Size	C_1 mm^{-1}	C_2 mm^{-3}	l_e mm	A_e mm^2	V_e mm^3	A_{min} [a] mm^2	Remarks
E-PLT14	1,114 2	74,277 × 10^{-3}	16,7	15,0	251	15,0	Combination E-PLT
E-PLT18	0,507 08	12,677 × 10^{-3}	20,3	40,0	811	40,0	
E-PLT22	0,329 80	4,174 6 × 10^{-3}	26,1	79,0	2 060	79,0	
E-PLT32	0,275 28	2,138 6 × 10^{-3}	35,4	129	4 560	127	
E-PLT38	0,229 08	1,195 0 × 10^{-3}	43,9	192	8 420	185	
E-PLT43	0,225 10	0,996 95 × 10^{-3}	50,8	226	11 500	214	
E-PLT58	0,225 00	0,740 83 × 10^{-3}	68,3	304	20 800	278	
E-PLT64	0,134 18	0,258 30 × 10^{-3}	70,0	519	36 200	518	
E-PLT102	0,225 70	0,418 68 × 10^{-3}	121	539	65 600	525	

[a] See 2.2 of IEC 60205.

NOTE Values ignore the effect of radii. These may have some influence on the outcome of the calculation. They can be incorporated in the formulas as shown in IEC 60205.

3.4 Dimensions of low-profile core ER-core

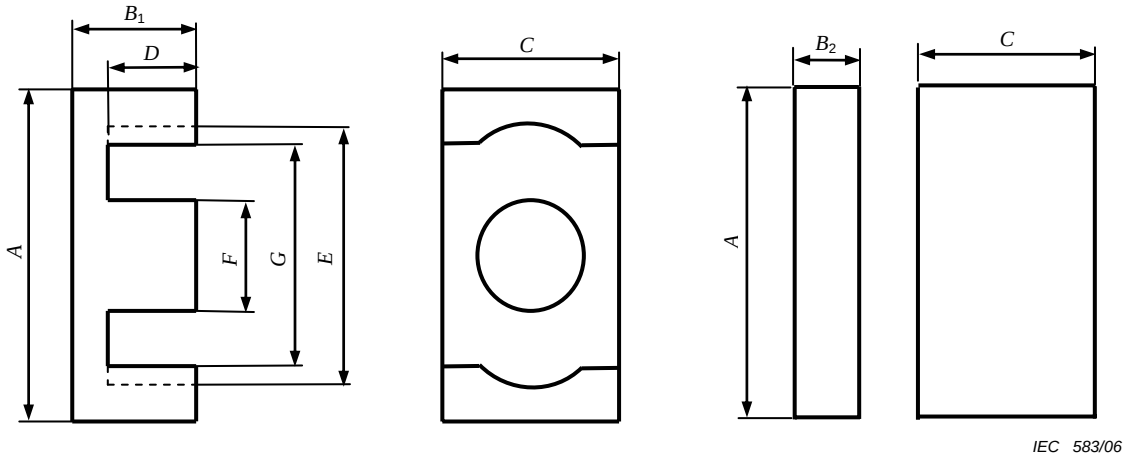

Figure 3 – Low-profile ER-core

Table 5 – Dimensions of low-profile ER-core

Dimensions in millimetres

Size		A	B_1	B_2	C	D	E	F	G
ER9,5 × 2,5 × 5	min.	9,15	2,375		4,80	1,60	7,50	3,25	7,00
	max.	9,55	2,525		5,00	1,75	7,75	3,55	7,40
PLT9,5 × 1 × 5	min.	9,15		0,70	4,80				
	max.	9,55		0,85	5,00				
ER11 × 2,5 × 6	min.	10,65	2,375		5,80	1,50	8,70	4,00	7,90
	max.	11,00	2,525		6,00	1,65	9,00	4,25	8,30
PLT11 × 1 × 6	min.	10,65		0,80	5,80				
	max.	11,00		0,95	6,00				
ER13 × 3 × 9	min.	12,5	2,775		8,45	1,625	10,9	4,85	8,75
	max.	13,1	2,925		8,95	1,875	11,5	5,15	9,35
PLT13 × 1 × 9	min.	12,5		1,00	8,45				
	max.	13,1		1,20	8,95				
ER14,5 × 3 × 7	min.	14,30	2,90		6,60	1,55	11,6	4,60	11,6
	max.	14,70	3,00		6,80	1,75	12,0	4,80	12,0
PLT14,5 × 1 × 7	min.	14,30		1,20	6,60				
	max.	14,70		1,40	6,80				
ER18 × 3 × 10	min.	17,65	3,05		9,5	1,50	15,3	6,05	13,5
	max.	18,35	3,25		9,9	1,70	15,9	6,35	14,1
PLT18 × 1,5 × 10	min.	17,65		1,45	9,5				
	max.	18,35		1,65	9,9				
ER20 × 6 × 14	min.	19,65	6,2		13,7	3,95	17,65	8,65	12,51
	max.	20,35	6,4		14,3	4,25	18,35	8,95	13,21
PLT20 × 2 × 14	min.	19,65		2,25	13,7				
	max.	20,35		2,35	14,3				
ER23 × 3,6 × 13	min.	22,75	3,50		12,25	1,50	19,8	7,8	17,5
	max.	23,65	3,70		12,75	1,70	20,6	8,2	18,2
ER23 × 5 × 13	min.	22,75	5,00		12,25	3,00	19,8	7,8	17,5
	max.	23,65	5,20		12,75	3,20	20,6	8,2	18,2
PLT23 × 2 × 13	min.	22,75		1,90	12,25				
	max.	23,65		2,10	12,75				
ER25 × 8 × 18	min.	24,6	7,90		17,7	5,00	21,6	10,8	14,5
	max.	25,4	8,10		18,3	5,30	22,4	11,2	14,9
PLT25 × 3 × 18	min.	24,6		2,75	17,7				
	max.	25,4		2,95	18,3				
ER25 × 6 × 15	min.	24,5	5,40		14,5	3,00	21,3	9,20	18,3
	max.	25,5	5,60		15,1	3,20	22,1	9,60	18,7
PLT25 × 2,4 × 15	min.	24,5		2,30	14,5				
	max.	25,5		2,50	15,1				
ER25 × 6 × 18	min.	24,6	5,55		17,7	3,05	21,6	10,8	14,5
	max.	25,4	5,65		18,3	3,35	22,4	11,2	14,9

Table 5 (*continued*)

Dimensions in millimetres

Size		*A*	B_1	B_2	*C*	*D*	*E*	*F*	*G*
PLT25 × 2 × 18	min.	24,6		2,35	17,7				
	max.	25,4		2,45	18,3				
ER30 × 8 × 20	min.	29,6	7,85		19,7	5,10	25,6	10,8	19,05
	max.	30,4	8,15		20,3	5,50	26,4	11,2	19,85
PLT30 × 3 × 20	min.	29,6		2,60	19,7				
	max.	30,4		2,80	20,3				
ER32 × 5 × 21	min.	31,4	5,0		20,6	2,6	29,2	11,0	23,0
	max.	32,6	5,2		21,4	2,8	30,2	11,4	24,2
PLT32 × 2 × 21	min.	31,4		2,3	20,6				
	max.	32,6		2,5	21,4				
ER32 × 6 × 25	min.	31,65	5,84		25,0	2,65	26,8	12,15	26,8
	max.	32,75	6,13		25,8	2,91	27,6	12,55	27,6
PLT32 × 3 × 25	min.	31,65		3,14	25,0				
	max.	32,75		3,34	25,8				
ER35 × 10 × 26	min.	34,6	9,90		25,6	5,00	29,6	14,1	26,4
	max.	35,4	10,1		26,4	5,30	30,4	14,7	27,5
PLT35 × 5 × 26	min.	34,6		4,75	25,6				
	max.	35,4		4,95	26,4				
ER40 × 10 × 28	min.	39,6	9,90		27,6	5,00	34,6	14,6	31,5
	max.	40,4	10,1		28,4	5,30	35,4	15,2	32,5
PLT40 × 5 × 28	min.	39,6		4,75	27,6				
	max.	40,4		4,95	28,4				

Table 6 – Effective parameter values and A_{min} values

Size	C_1 mm^{-1}	C_2 mm^{-3}	l_e mm	A_e mm^2	V_e mm^3	A_{min}[a] mm^2	Remarks
ER9,5 × 2,5 × 5	1,748 1	206,49 × 10^{-3}	14,8	8,47	125	7,60	Combination ER-ER
ER11 × 2,5 × 6	1,309 5	111,14 × 10^{-3}	15,4	11,8	182	10,3	
ER13 × 3 × 9	0,925 25	46,334 × 10^{-3}	18,5	20,0	369	19,1	
ER14,5 × 3 × 7	1,132 7	64,571 × 10^{-3}	19,9	17,5	348	17,3	
ER18 × 3 × 10	0,745 76	24,517 × 10^{-3}	22,7	30,4	690	30,1	
ER20 × 6 × 14	0,578 42	9,734 0 × 10^{-3}	34,4	59,4	2 040	55,4	
ER23 × 3,6 × 13	0,544 75	10,818 × 10^{-3}	27,4	50,4	1 380	50,0	
ER23 × 5 × 13	0,662 27	13,120 × 10^{-3}	33,4	50,5	1 690	50,0	
ER25 × 6 × 15	0,496 74	7,024 4 × 10^{-3}	35,1	70,7	2 480	69,4	
ER25 × 6 × 18	0,373 73	4,065 8 × 10^{-3}	34,4	91,9	3 160	86,4	
ER30 × 8 × 20	0,400 44	4,090 7 × 10^{-3}	47,4	108	5 110	95,0	
ER32 × 5 × 21	0,399 71	3,981 9 × 10^{-3}	40,1	100	4 030	98,5	
ER32 × 8 × 20	0,300 61	2,097 4 × 10^{-3}	43,1	143	6 180	121	
ER35 × 10 × 27	0,273 90	1,371 5 × 10^{-3}	54,7	200	10 900	163	
ER40 × 10 × 32	0,272 57	1,253 9 × 10^{-3}	59,2	217	12 900	174	
ER9,5 × 2,5 × 5 / PLT9,5 × 1 × 5	1,393 1	169,80 × 10^{-3}	11,5	8,25	94,9	7,60	Combination ER-PLT
ER11 × 2,5 × 6 / PLT11 × 1 × 6	1,081 3	94,593 × 10^{-3}	12,4	11,4	141	10,3	
ER13 × 3 × 9 / PLT13 × 1 × 9	0,759 96	38,478 × 10^{-3}	15,0	19,8	296	19,1	
ER14,5 × 3 × 7/ PLT14,5 × 1 × 7	0,946 33	54,047 × 10^{-3}	16,6	17,5	290	17,1	
ER18 × 3 × 10 / PLT18 × 1,5 × 10	0,642 62	21,190 × 10^{-3}	19,5	30,3	591	30,1	
ER20 × 6 × 14 / PLT20 × 2 × 14	0,433 22	7,146 5 × 10^{-3}	26,3	60,6	1 590	55,4	
ER23 × 3,6 × 13 / PLT23 × 2 × 13	0,482 08	9,590 5 × 10^{-3}	24,2	50,3	1 220	50,0	
ER23 × 5 × 13 / PLT23 × 2 × 13	0,540 83	10,742 × 10^{-3}	27,2	50,3	1 370	50,0	
ER25 × 6 × 15 / PLT25 ×2,4 ×15	0,408 79	5,776 4 × 10^{-3}	28,9	70,8	2 050	69,4	
ER25 × 6 × 18 / PLT25 × 2 × 18	0,308 89	3,407 3 × 10^{-3}	28,0	90,6	2 540	86,4	
ER30 × 8 × 20 / PLT30 × 3 × 20	0,344 98	3,206 6 × 10^{-3}	37,1	108	3 990	95,0	
ER32 × 5 × 21 / PLT32 × 2 × 21	0,345 69	3,441 3 × 10^{-3}	34,7	101	3 490	98,5	
ER32 × 6 × 25 / PLT32 × 3 × 25	0,255 38	1,729 4 × 10^{-3}	37,7	148	5 570	121	
ER35 × 10 × 26 / PLT35× 5 × 26	0,213 91	1,021 1 × 10^{-3}	44,8	209	9 390	163	
ER40 × 10 × 28 / PLT40 × 5 × 28	0,216 62	0,949 56 × 10^{-3}	49,4	228	11 300	174	

[a] See 2.2 of IEC 60205.

NOTE Values ignore the effect of radii. These may have some influence on the outcome of the calculation. They can be incorporated in the formulas as shown in IEC 60205.

Annex A
(normative)

Low-profile core design

A.1 General design

The design of low-profile cores standardized by the IEC is based on the form factors that are defined by the following core proportions:

a) $A > 2B$

b) $C > B$

c) $A > C$

where

A is the overall length of the core back;

B is the outside height of the core;

C is the core width or floor width at wire aperture.

Those cores which exhibit the planar form factor as defined above, and which were initially designed to meet the requirements of designers for low-profile, board-mounted power transformers and chokes are the ones that have been standardized here. Other cores, originally designed for other uses, are frequently modified to achieve the planar form factor in order to have application in board-mounted power. Most frequently, this is achieved by reducing the leg lengths of standard PQ, RM and pot cores. Standardization, if any, for those low-profile sizes is reflected in the relevant IEC standard for the size. (See IEC 62317-4 for RM-cores and associated parts.)

A.2 EL-core design

The design of the EL standard cores is based on the following considerations:

a) since the motherboard or multi-layer board must typically have slots cut out to accept the cores, the core shapes are designed to result in cut outs that are simple and economical;

b) with consideration of the output power of on-board type d.c.-d.c. converter for telecommunication, seven base sizes from 11 mm to 25 mm are standardised;

c) outer leg dimensions are selected to allow economical production of cores. $(A - E)/A$ = 1/6;

d) with consideration of minimizing leakage inductance, aspect ratio C is chosen as C = 0,8A;

e) the area of centre leg and outer leg are designed to be equal;

f) an oval shaped centre leg is selected so that the ratio of average wire length to cross-section of winding is minimized. Copper loss is a function of this ratio and this ratio is minimized when F_2/F_1 = 2,3;

g) the dimension of back wall thickness is designed to be equal to 1,1$(A - E)$/2, so that its minimum cross section is close to the cross section of the leg;

h) height of B_1 is designed with consideration of slot spacing for telecommunication equipment.

A.3 ER-core design

a) A_e/A_w ratio

One useful way to consider round centre pole cores is by evaluating the ratio of core cross section (A_e) to winding area (A_w). With a high A_e/A_w ratio, (e.g. $>$ 2,0) the centre pole is relatively large, favoring higher voltage/lower current applications since the increased cross section can support the high flux generated by relatively few turns at high voltage. With a lower A_e/A_w ratio (e.g. $<$2,0), the centre pole is relatively small, favoring lower voltage/higher current applications since the increased window space can fit the larger dimension of a small number of planar windings at high current. (See Table A.1 for A_e/A_w ratios for the ER-cores.)

b) Centre pole/window height ratio

A limitation of considering only the A_e/A_w ratios for planar cores is that the window area (A_w) is increased or decreased independent of the basic geometry, by adjusting the leg length (D dimension and B dimension) of the core set. This is evident when the ratios for E/E and E/I variation of any base size are compared. Generally, the D and B dimensions are easily customized without special new tooling. This is done to accommodate specifically dimensioned printed circuit board winding stacks, and it has the effect of altering the A_e/A_w ratio.

For comparison of the base E-core designs, a useful ratio is the diameter of the centre pole to the distance from the centre pole to the outside leg ($2F/(E - F) = F/0{,}5(E - F)$). In a similar fashion to the A_e/A_w ratio, for a high centre pole/window width ratio (e.g. $>$2,0) the centre pole is relatively large, favoring higher voltage/lower current applications since the increased cross section can support the high flux generated by relatively few turns at high voltage. With a lower centre pole/window height ratio (e.g. $<$2,0), the centre pole is relatively small, favoring lower voltage/higher current applications since the increased window space can fit the larger dimension of a small number of planar windings at high current. (See Table A.1 for $2F/(E - F)$ ratios.)

Table A.1 – Sizes and design ratios for ER-core

Size	A_e mm^2	A_w mm^2	Ratio A_e/A_w	Ratio $2F/(E - F)$	Remarks
ER9,5 × 2,5 × 5	8,47	7,08	1,20	1,61	Combination ER-ER
ER11 × 2,5 × 6	11,8	7,44	1,59	1,75	
ER13 × 3 × 9	20,0	10,9	1,83	1,61	
ER14,5 × 3 × 7	17,5	11,7	1,49	1,32	
ER18 × 3 × 10	30,4	15,0	2,02	1,32	
ER23 × 3,6 × 13	50,4	15,8	2,67	1,31	
ER23 × 5 × 13	50,5	37,8	1,33	1,31	
ER25 × 6 × 15	70,7	38,1	1,86	1,53	
ER25 × 6 × 18	91,9	35,2	2,60	2,00	
ER30 × 8 × 20	108	79,5	1,36	1,47	
ER32 × 6 × 20	143	41,3	3,46	1,66	
ER35 × 10 × 27	200	80,3	2,49	1,85	
ER40 × 10 × 32	217	104	2,08	1,48	

Table A.1 *(continued)*

Size	A_e mm^2	A_w mm^2	Ratio A_e/A_w	Ratio $2F/(E-F)$	Remarks
ER9,5 × 2,5 × 5 / PLT9,5 × 1 × 5	8,25	3,54	2,33	1,61	Combination ER-PLT
ER11 × 2,5 × 6 / PLT11 × 1 × 6	11,4	3,72	3,06	1,75	
ER13 × 3 × 9/ PLT13 × 1 × 9	19,8	5,43	3,65	1,61	
ER14,5 × 3 × 7 / PLT14,5 × 1 × 7	17,5	5,86	2,99	1,32	
ER18 × 3 × 10 / PLT18 × 1,5 × 10	30,3	7,52	4,03	1,32	
ER23 × 3,6 × 13 / PLT23 × 2 × 13	50,3	9,46	5,32	1,31	
ER23 × 5 × 13 / PLT23 × 2 × 13	50,3	18,1	2,78	1,31	
ER25 × 6 × 15 / PLT25 × 2,4 ×15	70,8	19,1	3,71	1,53	
ER25 × 6 × 18 / PLT25 × 2 ×18	90,6	17,6	5,15	2,00	
ER30 × 8 × 20/ PLT30 × 3 × 20	108	39,8	2,72	1,47	
ER32 × 6 × 25/ PLT32 × 3 × 25	148	20,6	7,18	1,66	
ER35 × 10 × 26 / PLT35 × 5 × 26	209	40,2	5,20	1,85	
ER40 × 10 × 28 / PLT40 × 5 × 28	228	51,8	4,41	1,48	

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