technical note

Philips Magnetic Products

SMD Coil Formers and Cores

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SMD Coil Formers and Cores

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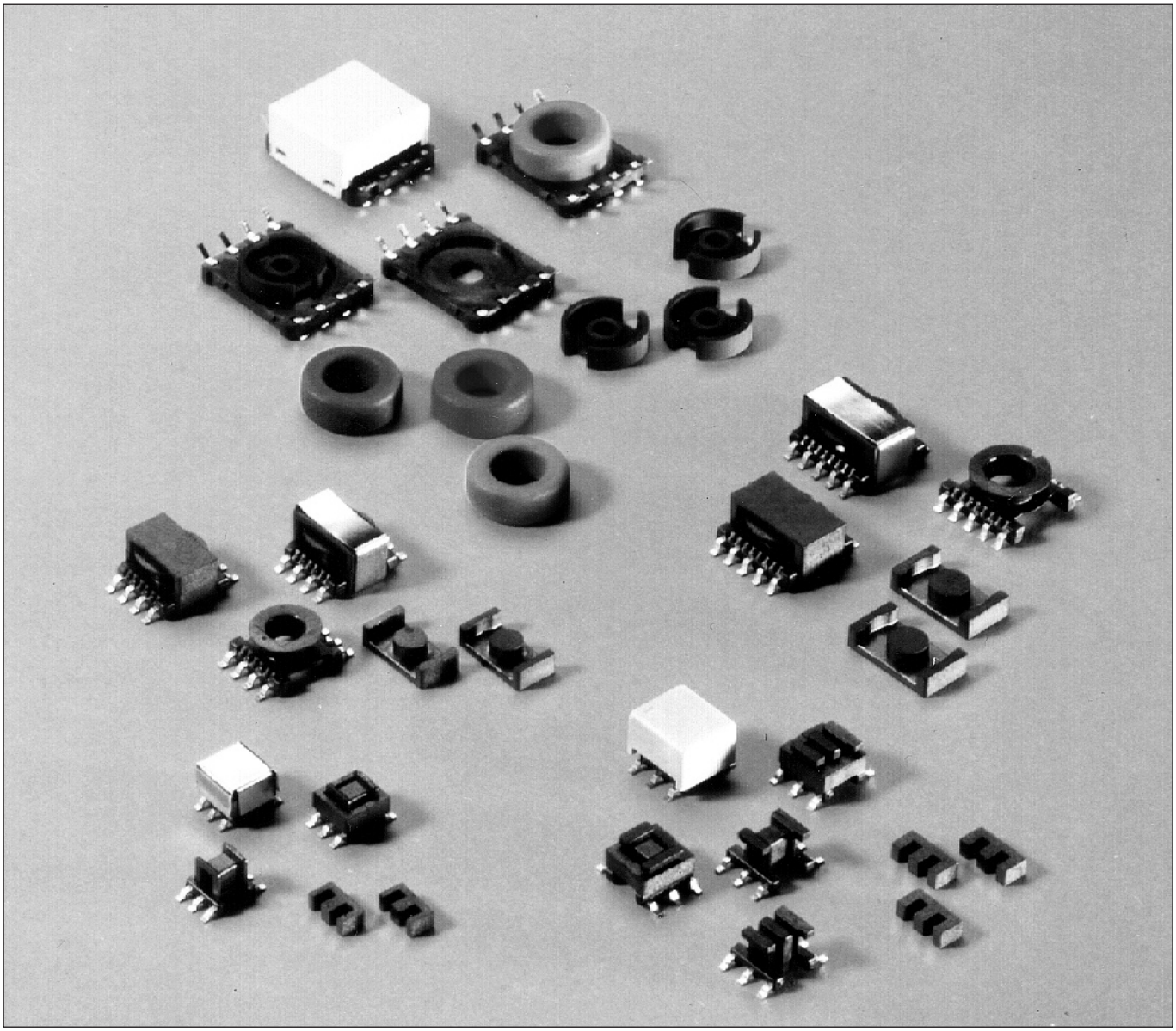


Range of SMD accessories and cores

Introduction

With its new range of surface-mount coil formers, Philips Components offers a real solution to circuit designers wishing to take maximum advantage of surface-mount technology in their designs.

The trend toward full surface-mount technology has been hampered by the problems of introducing inductive components (inductors and transformers for example) in surface-mount execution.

These devices, consisting of cores, coil-formers and windings held together by clips, were not easily converted to surface-mount versions, and former designs, based on "gull-wing" terminations (see Fig.1) have not been entirely satisfactory.

Disadvantages of "gull-wing" pins

In particular, tensions introduced by the winding wire, which is wrapped around the upper part of the gull-wing terminations, can severely degrade the coplanarity of the solder pads. The use of thin wire windings is a partial solution to this problem but this introduces limitations on coil design. Furthermore, during soldering of the winding wire to the termination, spillage of solder onto the solder pad can further degrade coplanarity. However, for very small coil formers gull-wing pins are the only possible design due to space limitations. For small to medium sized coil formers there is a better solution: U-pins.

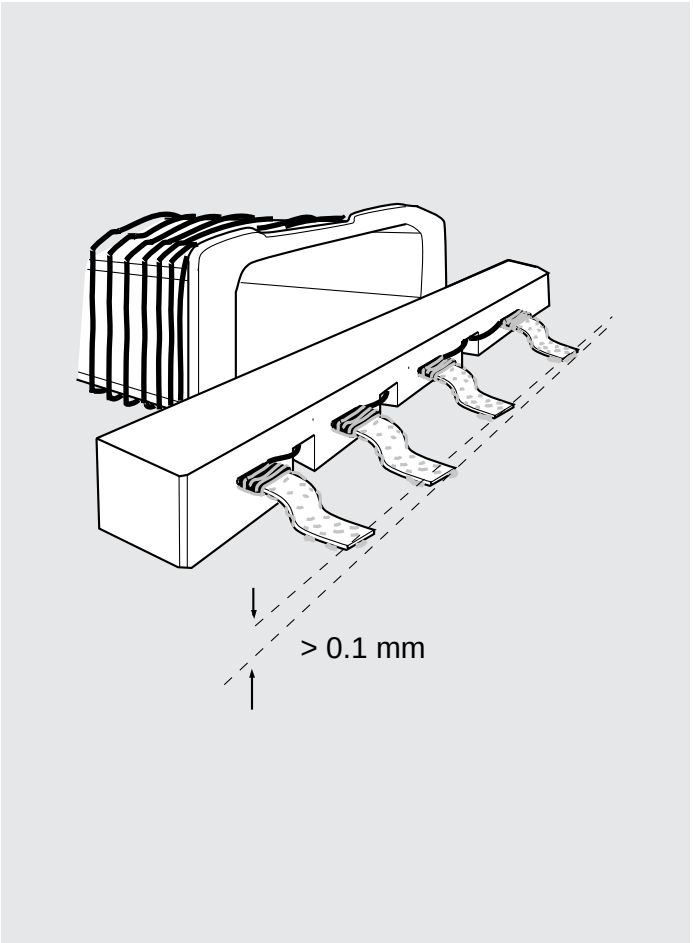


Fig.1 The "gull-wing" design.

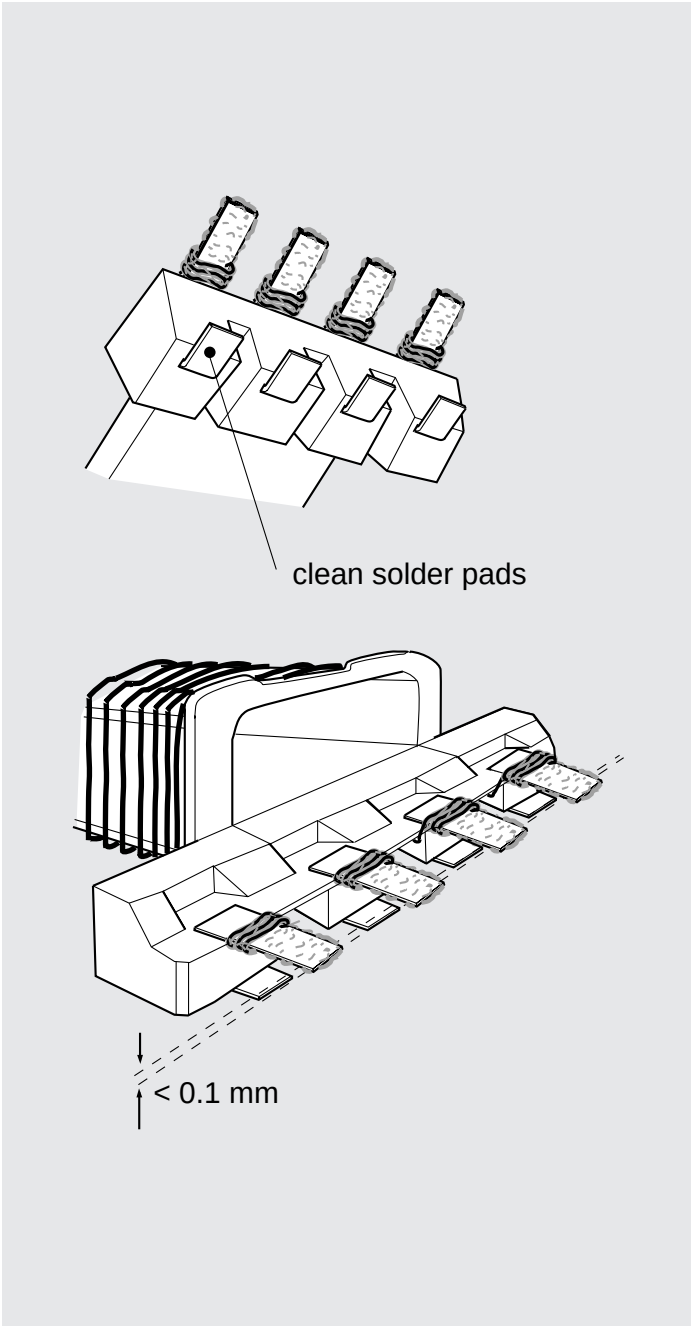


Fig.2 The U-pin design

Advantages of the U-pin design

The introduction of Philips' new range of surface-mount, coil formers, however, solves all these problems. These feature "U-pin" terminations (Fig.2) securely embedded in the plastic coil former body. These pins are thicker and wider than most gull-wing pins and therefore stronger.

The solder pads, located beneath the plastic body and in contact with it, form a rigid structure with a guaranteed coplanarity of less than 0.1 mm, according to IEC 191-2Q.

The upper part of the U-pins protrude from the plastic body and offer a large area on which to terminate the windings. Since these are physically separated from the solder pads, tension introduced by the winding wire will not affect coplanarity, and neither will solder used to attach the winding wires spill onto the solder pads. The contact surface of the pads is also much larger than typical gull-wing solder pads, making them ideal for these relatively heavy components.

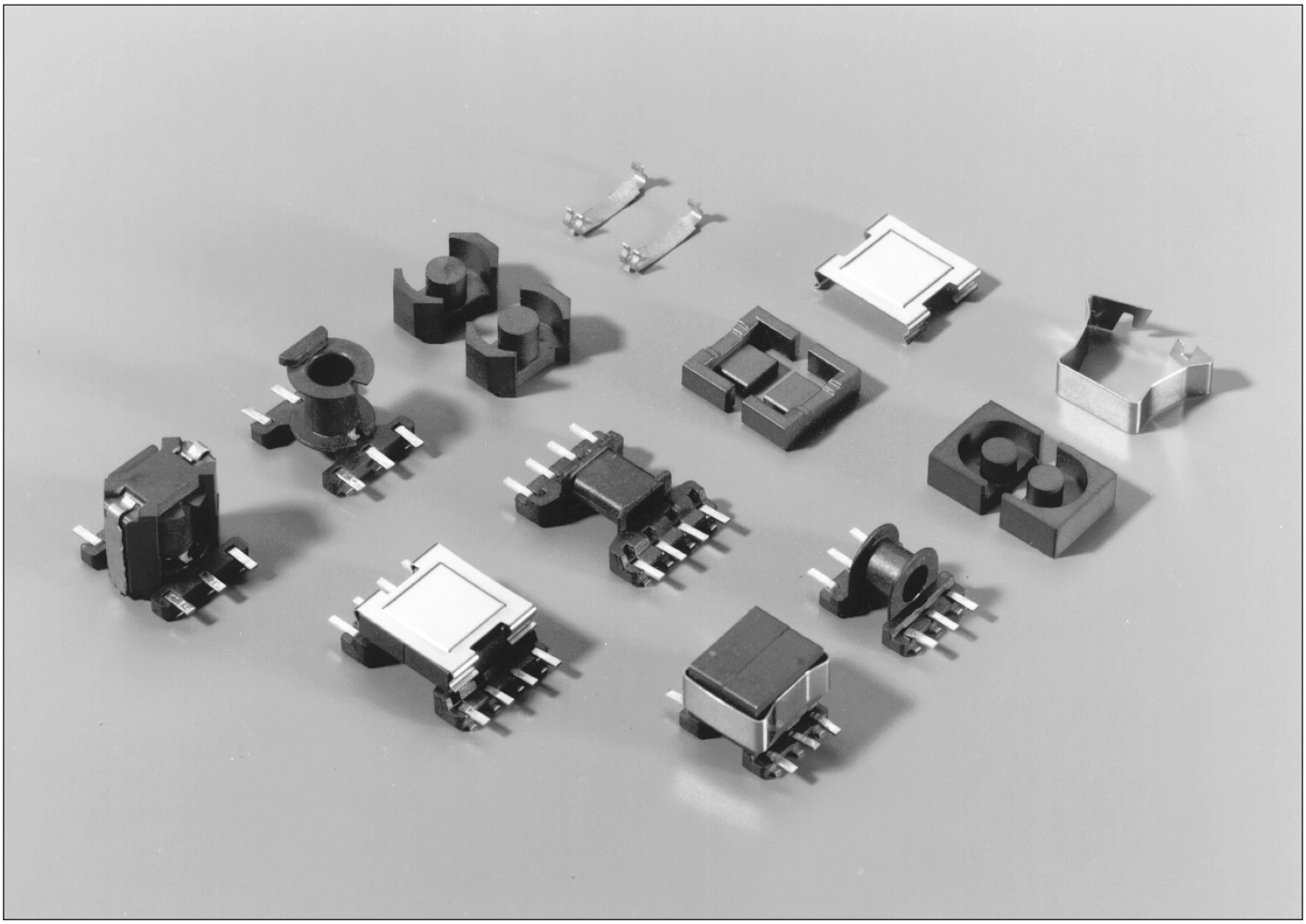
Moreover, with this design, the thickness of the winding wire is no longer a limitation, allowing circuit designers far more freedom in their choice of wire.

High-grade plastic

The coil former body is of high-grade liquid-crystal polymer (LCP) offering excellent thermal stability. The body is exceptionally tough and can withstand soldering temperatures up to 350 ºC and operating temperatures up to 180 ºC.

Excellent ferrites

In combination with Philips' extensive range of ferrite cores, these new coil formers provide surface-mount solutions in a host of applications from wide-band signal transformers to power transformers.
When assembled with windings, coil-formers, cores and a newly-designed clip with a flat upper surface (ideal for vacuum pickup), the products can easily be inserted by a pick and place assembly line.

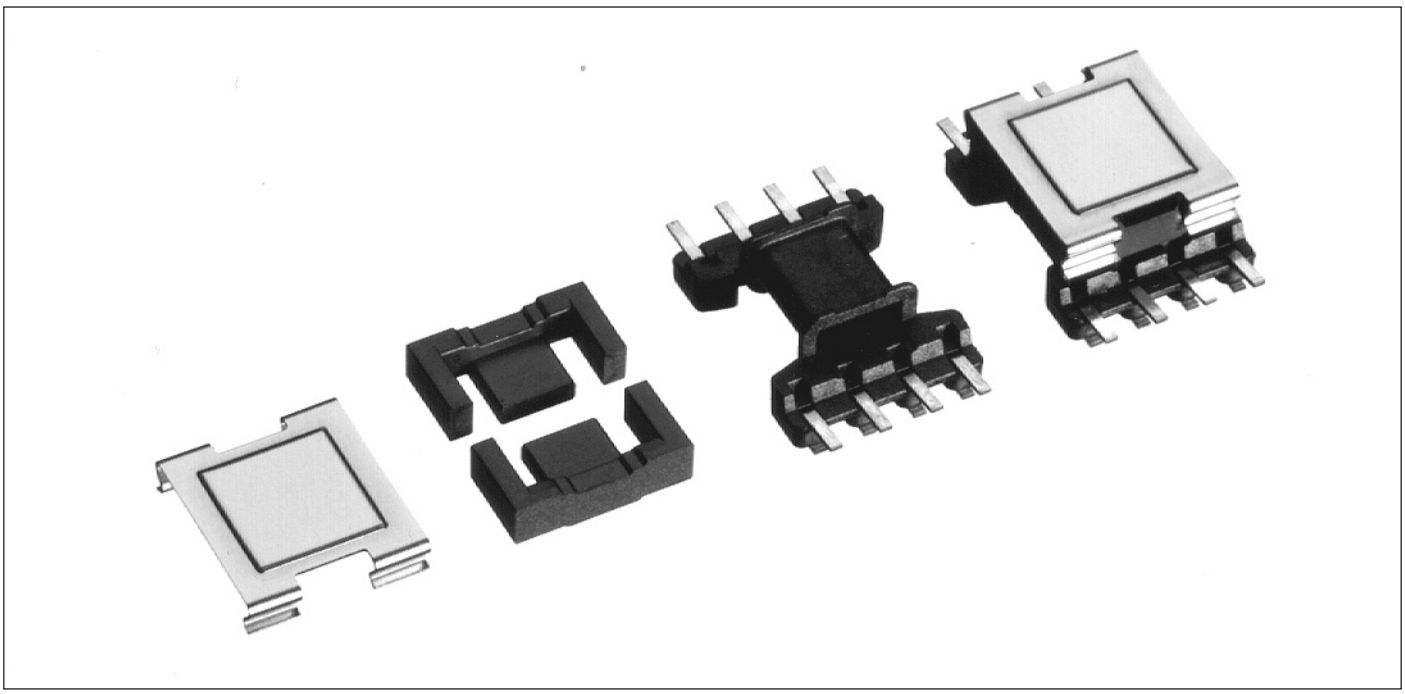


Ferrite material properties

PARAMETER	SYMBOL	UNIT	TEST CONDITIONS	3F3	3F4	4F1	3E4	3E5	3E6
Initial permeability	μ_i	-	f = ≤10 kHz, B < 0.1mT, T = 25 °C	1800	900	~80	4700	10000	12000
Saturation flux density	B_s	mT	f = 10 kHz, T = 25 °C	~500	~450	~330	~360	~360	~400
at Field strength	H	A/m		3000	3000	3000	250	250	250
Remanence	B_r	mT	T = 25 °C	~150	~150	~200	~100	~80	~100
Coercivity	H_c	A/m	T = 25 °C	~15	~60	~170	~10	~5	~4
Power loss density	P_v	kW/m^3	f = 25kHz, B = 200mT	70	-	-		-	-
(typical, sine wave			f = 100kHz, B = 100mT	50	200	-		-	-
excitation)			f = 500kHz, B = 50mT	180	180	-		-	-
			f = 1MHz, B = 30mT	300	140	300		-	-
			f = 3MHz, B = 10mT	-	240	150		-	-
Curie temperature	T_c	°C	-	≥200	≥220	≥260	≥125	≥125	≥130
Resistivity (DC)	ρ	Ωm	T = 25 °C	~2	~10	$\sim 10^5$	~1	~0.5	~0.5
Density		g/cm^3	T = 25 °C	~4.8	~4.7	~4.6	~4.8	~4.9	~4.9

Range overview

Core Type	Core materials					SMD
	3F3	3F4	3E4	3E5	3E6	coil former
E5.3/2.7/2	■	■		■	■	■
E6.3/2.9/2	■	■		■	■	■
EFD10	■	■	■	■		■
EFD12	■	■	■	■		■
EFD15	■	■	■	■		■
EFD20	■	■				■
EP7	■	■		■	■	■
ER9.5	■	■		■	■	■
ER11	■	■		■	■	■
RM4/I	■	■		■		■
RM5/I	■	■		■	■	■
RM6/I	■	■		■	■	■
RM6/ILP	■	■		■	■	■



EFD assembly

E5.3/2.7/2

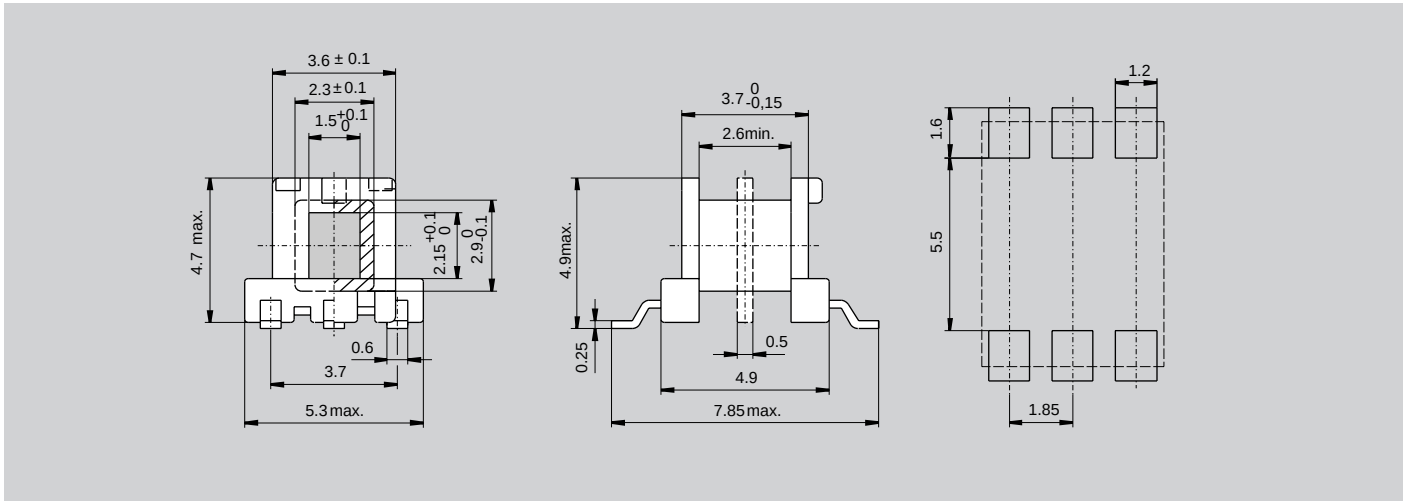


Fig. 1 SMD coil former for E5.3/2.7/2

Winding data

Number of sections	Number of solder pads	Winding area (mm^2)	Winding width (mm)	Average length of turn (mm)	Type number
1	6	1.5	2.6	12.6	CPHS E5.3/2-1S-6P
2	6	2 × 0.6	2 × 1.0	13	CPHS E5.3/2-2S-6P

Coil former data

Coil former material	Liquid crystal polymer (LCP), glass reinforced, flame retardant in accordance with UL94V-0.
Solder pad material	Copper-tin alloy (CuSn), tin-lead alloy (SnPb) plated
Maximum operating temperature	155 ºC, IEC 85 class F
Resistance to soldering heat	"IEC 68-2-20" part2, test Tb, method 1B: 350 ºC, 3.5s.
Solderability	"IEC 68-2-20" part2, test Ta, method 1: 235 ºC, 2s

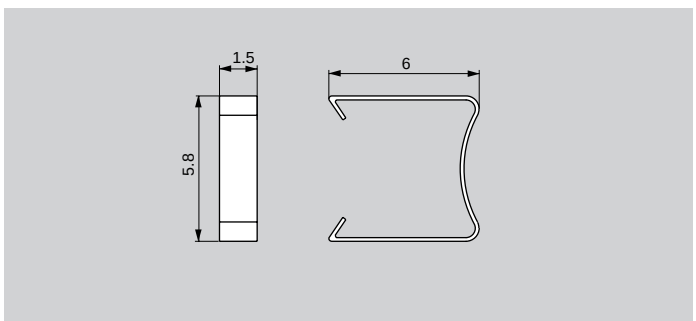


Fig. 2 Clamp for E5.3/2.7/2

Clip data

Clip material	stainless (CrNi) steel
Clamping force	~ 5N
Type number	CLM-E5.3/2

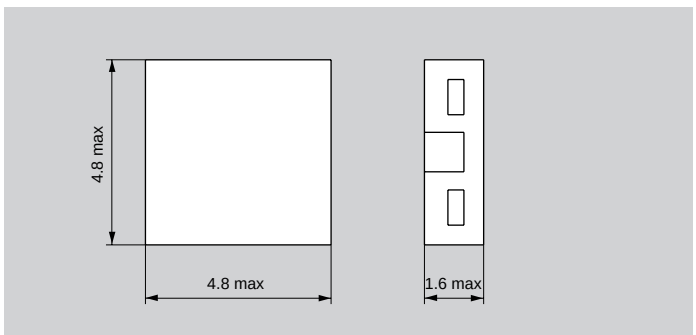


Fig. 3 Cover for E5.3/2.7/2

Cover data

Cover material	Liquid crystal polymer (LCP)
Type number	COV-E5.3/2

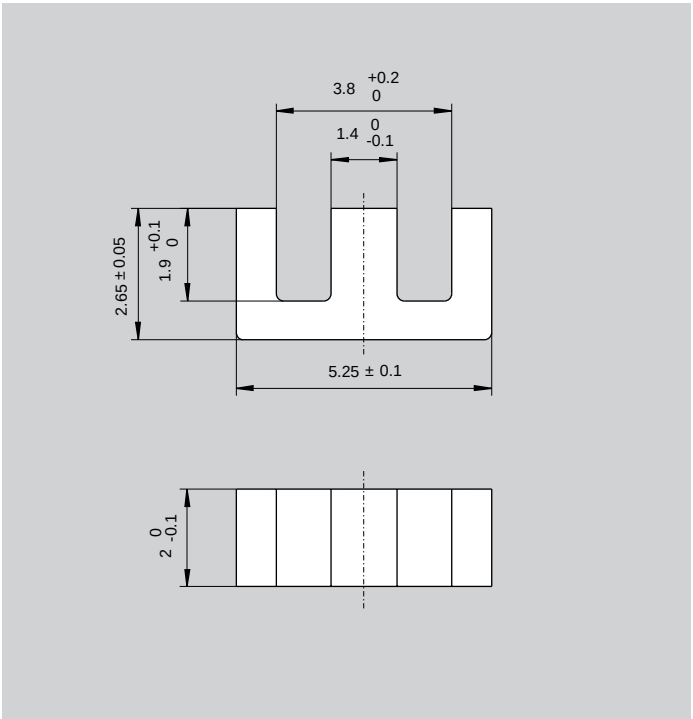


Fig. 3 E5.3/2.7/2 core half

Effective core parameters

symbol	parameter	value	unit
Σ (l/A)	core factor (C1)	5.13	mm^{-1}
V_e	effective volume	31.4	mm^3
l_e	effective length	12.7	mm
A_e	effective area	2.5	mm^2
A_{min}	minimum area	2.3	mm^2
m	mass of core half	~0.08	g

Core halves for general purpose transformers and power applications

Grade	A_L (nH)	μ_e	Airgap (μm)	Type number
3F3	265 ±25%	~1080	~0	E5.3/2.7/2-3F3
3F4	165 ±25%	~675	~0	E5.3/2.7/2-3F4
3E5	1400 +40/-30%	~5700	~0	E5.3/2.7/2-3E5
3E6	1600 +40/-30%	~6520	~0	E5.3/2.7/2-3E6

Properties of core sets under power conditions

Grade	B(mT) at H = 250 A/m f = 25kHz T = 100 °C	Core loss at f = 100 kHz B = 100mT T = 100 °C	Core loss at f = 400 kHz B = 50mT T = 100 °C	Core loss at f = 1MHz B = 30mT T = 100 °C	Core loss at f = 3MHz B = 10mT T = 100 °C
3F3	≥ 300	≤ 0.005	≤ 0.008	-	-
3F4	≥ 250	-	-	≤ 0.006	≤ 0.010

E6.3/2.9/2

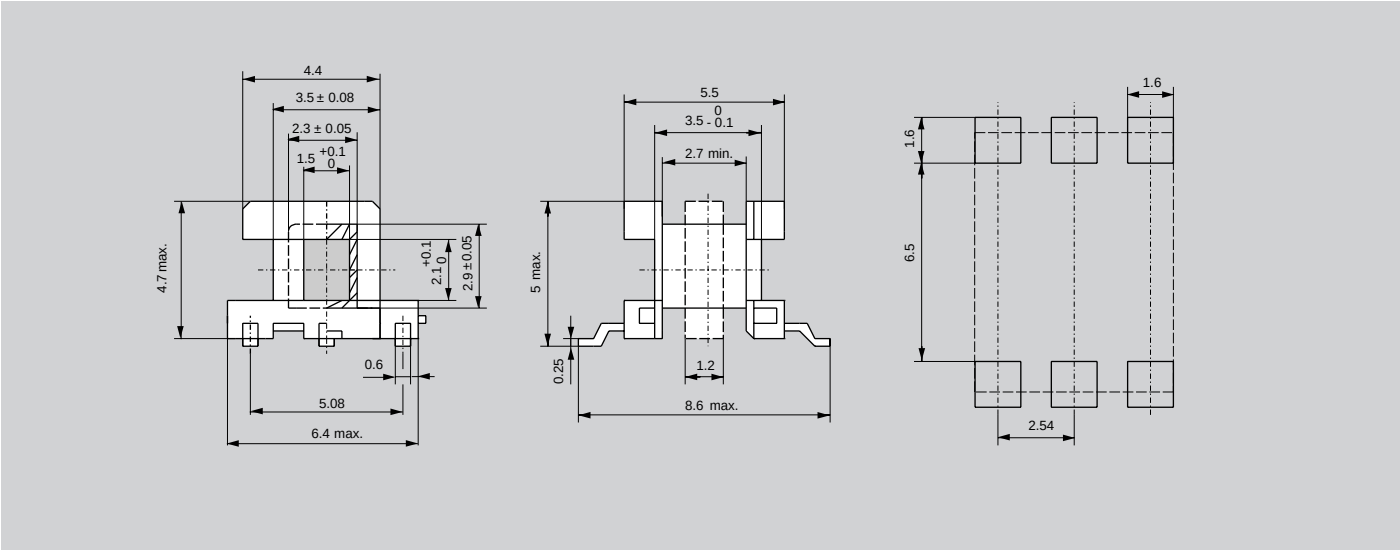


Fig. 1 SMD coil former for E6.3/2.9/2

Winding data

Number of sections	Number of solder pads	Winding area (mm^2)	Winding width (mm)	Average length of turn (mm)	Type number
1	6	1.62	2.7	12.8	CPHS-E6.3/2-1S-6P
2	6	2 × 0.45	2 × 0.75	12.8	CPHS-E6.3/2-2S-6P

Coil former data

Coil former material	Liquid crystal polymer (LCP), glass reinforced, flame retardant in accordance with UL94V-0.
Solder pad material	Copper-tin alloy (CuSn), tin-lead alloy (SnPb) plated
Maximum operating temperature	155 ºC, IEC 85 class F
Resistance to soldering heat	"IEC 68-2-20" part2, test Tb, method 1B: 350 ºC, 3.5s.
Solderability	"IEC 68-2-20" part2, test Ta, method 1: 235 ºC, 2s

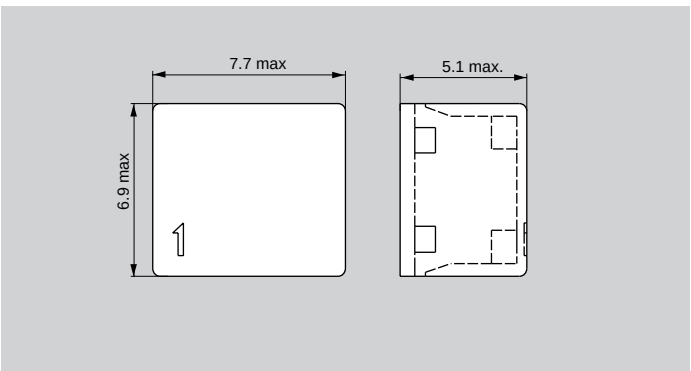


Fig. 2 Cover for E6.3/2.9/2

Cover data

Cover material	Liquid crystal polymer (LCP)
Type number	COV-E6.3/2

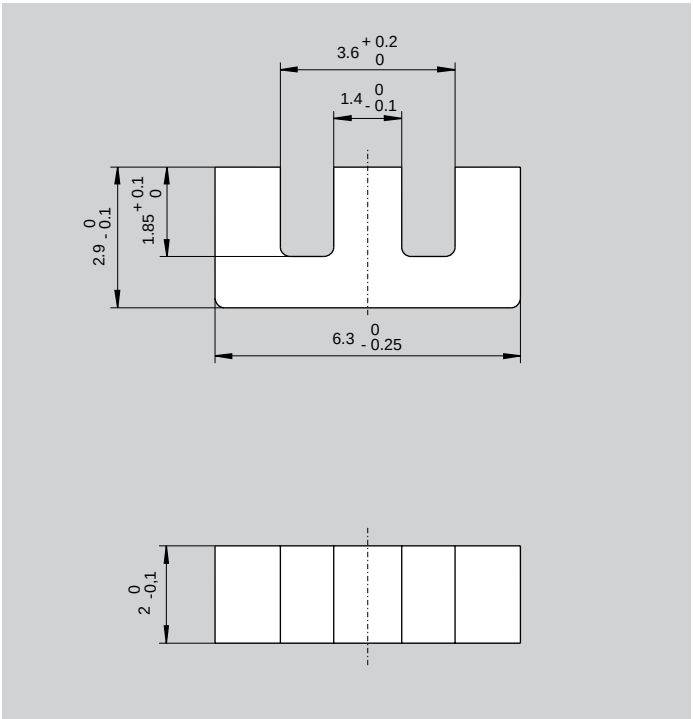


Fig. 3 E6.3/2.9/2 core half

Effective core parameters

symbol	parameter	value	unit
Σ (l/A)	core factor (C1)	3.67	mm^{-1}
V_e	effective volume	40.6	mm^3
l_e	effective length	12.2	mm
A_e	effective area	3.3	mm^2
A_{min}	minimum area	2.6	mm^2
m	mass of core half	~0.12	g

Core halves for general purpose transformers and power applications

Grade	A_L (nH)	μ_e	Airgap (μm)	Type number
3F3	360 ±25%	~ 1050	~0	E6.3/2.9/2-3F3
3F4	225 ±25%	~ 660	~0	E6.3/2.9/2-3F4
3E5	1700 +40/-30%	~ 4960	~0	E6.3/2.9/2-3E5
3E6	2100 +40/-30%	~ 6130	~0	E6.3/2.9/2-3E6

Properties of core sets under power conditions

Grade	B(mT) at H = 250 A/m f = 25kHz T = 100 °C	Core loss at f = 100 kHz B = 100mT T = 100 °C	Core loss at f = 400 kHz B = 50mT T = 100 °C	Core loss at f = 1MHz B = 30mT T = 100 °C	Core loss at f = 3MHz B = 10mT T = 100 °C
3F3	≥ 300	≤ 0.007	≤ 0.010	–	–
3F4	≥ 250	-	–	≤ 0.008	≤ 0.013

EFD10

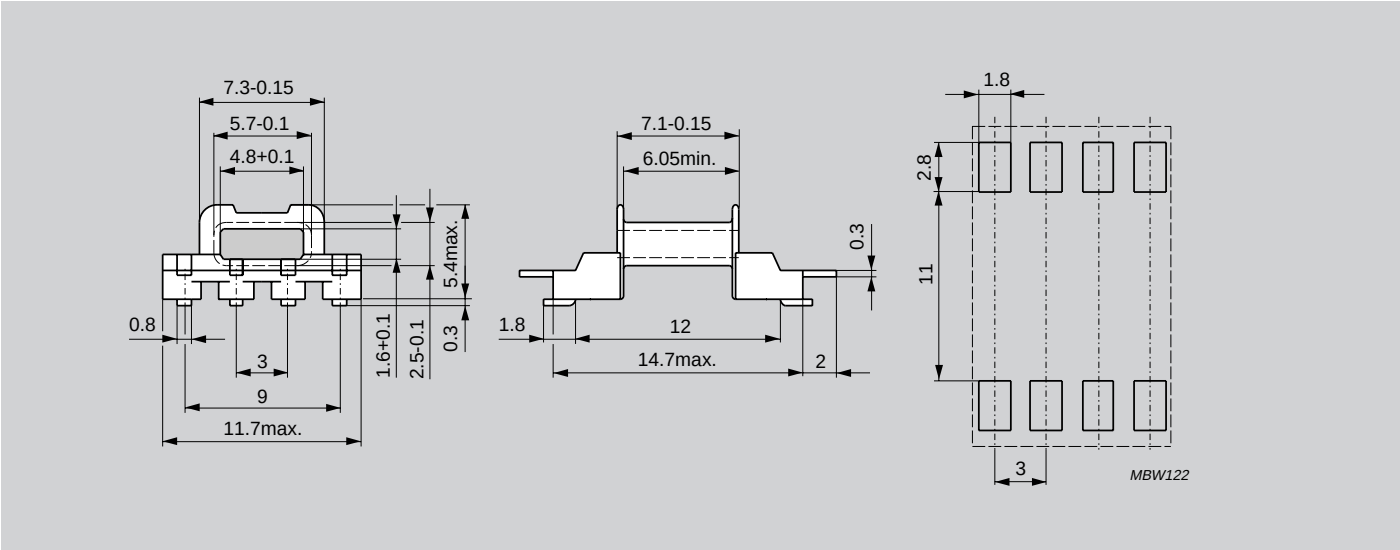


Fig. 1 SMD coil former for EFD10

Winding data

Number of sections	Number of solder pads	Winding area (mm^2)	Winding width (mm)	Average length of turn (mm)	Type number
1	8	4.2	6.05	14.8	CPHS-EFD10-1S-8P

Coil former data

Coil former material	Liquid crystal polymer (LCP), glass reinforced, flame retardant in accordance with UL94V-0.
Solder pad material	Copper-tin alloy (CuSn), tin-lead alloy (SnPb) plated
Maximum operating temperature	155 ºC, IEC 85 class F
Resistance to soldering heat	"IEC 68-2-20" part2, test Tb, method 1B: 350 ºC, 3.5s.
Solderability	"IEC 68-2-20" part2, test Ta, method 1: 235 ºC, 2s

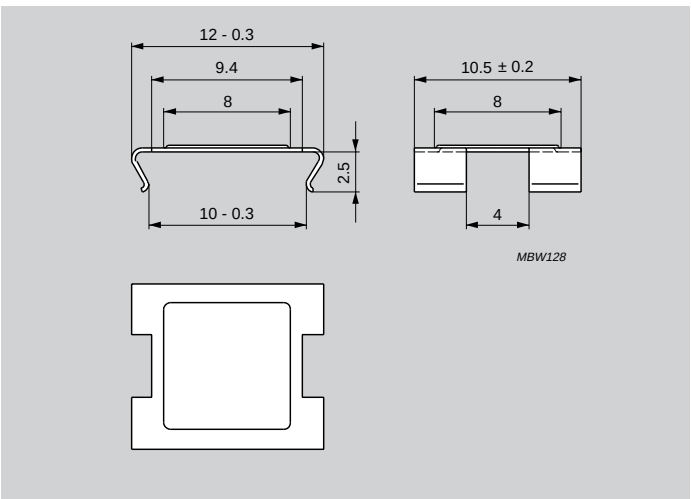


Fig. 2 Clamp for EFD10

Clamp data

Clamp material	stainless(CrNi) steel
Clamping force	~ 15N
Type number	CLM-EFD10

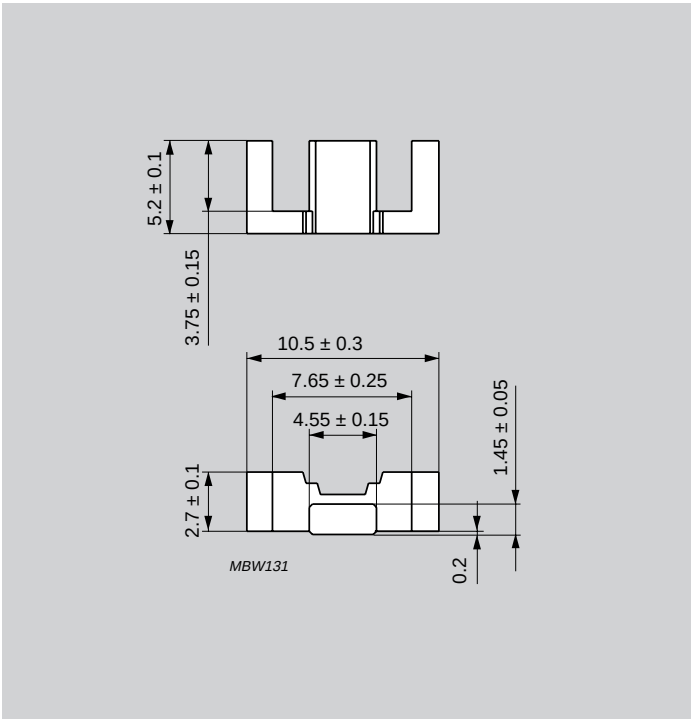


Fig. 3 EFD10 core half

Effective core parameters

symbol	parameter	value	unit
Σ (l/A)	core factor (C1)	3.29	mm^{-1}
V_e	effective volume	171	mm^3
l_e	effective length	23.7	mm
A_e	effective area	7.2	mm^2
A_{min}	minimum area	6.5	mm^2
m	mass of core half	~0.45	g

Core sets for general purpose transformers and power applications

Grade	A_L (nH)	μ_e	Airgap (μm)	Type number
3F3	25±5%	~ 66	~540	EFD10-3F3-A25-S
	40±8%	~ 105	~300	EFD10-3F3-A40-S
	63±10%	~ 165	~170	EFD10-3F3-A63-S
	500±25%	~ 1290	~0	EFD10-3F3-S
3F4	25±5%	~ 66	~520	EFD10-3F4-A25-S
	40±8%	~ 105	~280	EFD10-3F4-A40-S
	63±10%	~ 165	~150	EFD10-3F4-A63-S
	280±25%	~ 730	~0	EFD10-3F4-S
3E4	1400 +40/-30%	~ 3670	~ 0	EFD10-3E4-S
3E5	2000 +40/-30%	~ 5240	~ 0	EFD10-3E5-S

Properties of core sets under power conditions

Grade	B(mT) at H = 250 A/m f = 25kHz T = 100 °C	Core loss at f = 100 kHz B = 100mT T = 100 °C	Core loss at f = 400 kHz B = 50mT T = 100 °C	Core loss at f = 1MHz B = 30mT T = 100 °C	Core loss at f = 3MHz B = 10mT T = 100 °C
3F3	≥ 315	≤ 0.02	≤ 0.035	–	–
3F4	≥ 250	–	–	≤ 0.034	≤ 0.055

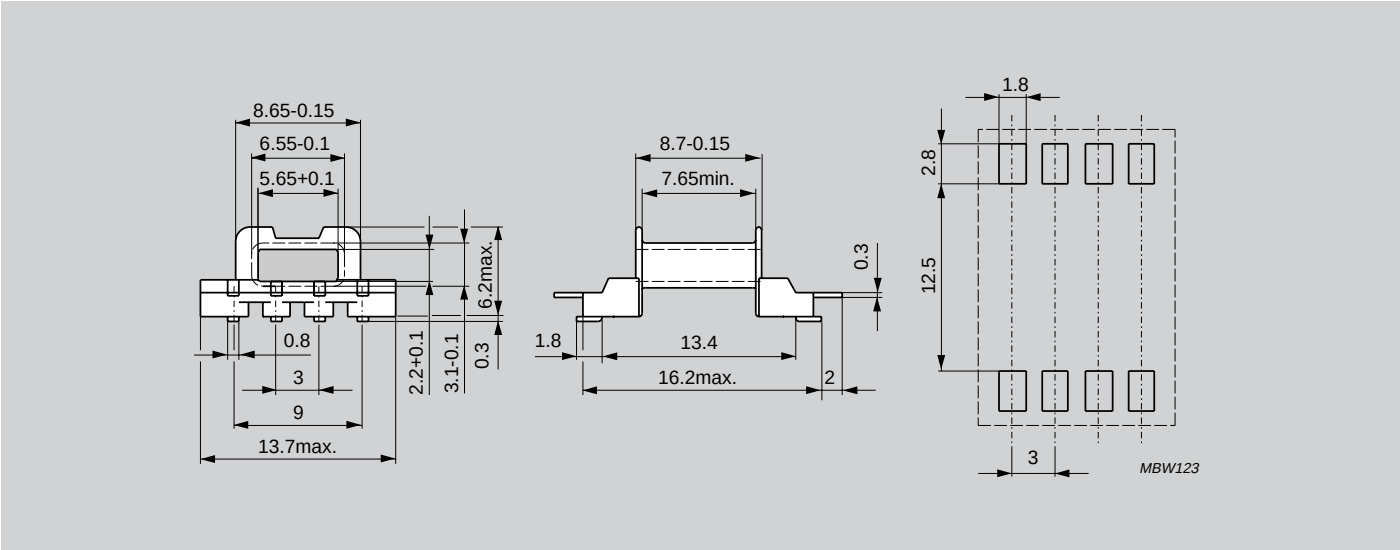


Fig. 1 SMD coil former for EFD12

Winding data

Number of sections	Number of solder pads	Winding area (mm^2)	Winding width (mm)	Average length of turn (mm)	Type number
1	8	6.5	7.65	18.6	CPHS-EFD12-1S-8P

Coil former data

Coil former material	Liquid crystal polymer (LCP), glass reinforced, flame retardant in accordance with UL94V-0.
Solder pad material	Copper-tin alloy (CuSn), tin-lead alloy (SnPb) plated
Maximum operating temperature	155 ºC, IEC 85 class F
Resistance to soldering heat	"IEC 68-2-20" part2, test Tb, method 1B: 350 ºC, 3.5s.
Solderability	"IEC 68-2-20" part2, test Ta, method 1: 235 ºC, 2s

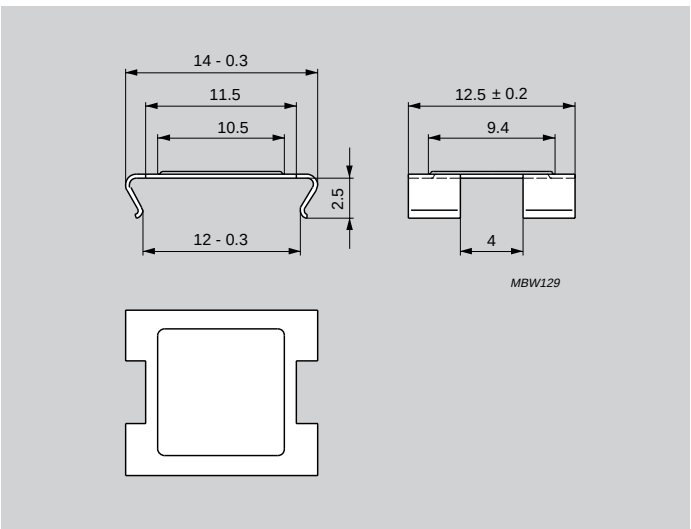


Fig. 2 clamp for EFD12

Clamp data

Clamp material	stainless(CrNi) steel
Clamping force	~ 20N
Type number	CLM-EFD12

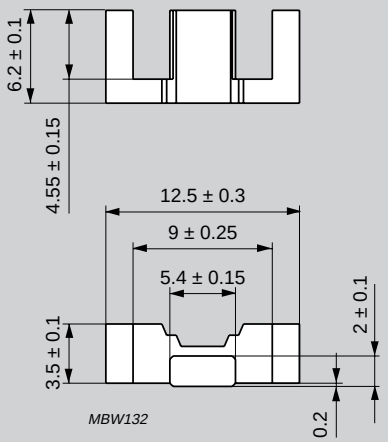


Fig. 3 EFD12 core half

Effective core parameters

symbol	parameter	value	unit
Σ (l/A)	core factor (C1)	2.50	mm^{-1}
V_e	effective volume	325	mm^3
l_e	effective length	28.5	mm
A_e	effective area	11.4	mm^2
A_{min}	minimum area	10.7	mm^2
m	mass of core half	~0.9	g

Core sets for general purpose transformers and power applications

Grade	A_L (nH)	μ_e	Airgap (μm)	Type number
3F3	40±5%	~ 80	~490	EFD12-3F3-A40-S
	63±8%	~ 125	~280	EFD12-3F3-A63-S
	100±10%	~ 200	~160	EFD12-3F3-A100-S
	700±25%	~ 1370	~0	EFD12-3F3-S
3F4	40±5%	~ 80	~470	EFD12-3F4-A40-S
	63±8%	~ 125	~260	EFD12-3F4-A63-S
	100±10%	~ 200	~140	EFD12-3F4-A100-S
	380±25%	~ 760	~0	EFD12-3F4-S
3E4	1900 +40/-30%	~ 3780	~ 0	EFD12-3E4-S
3E5	2800 +40/-30%	~ 5570	~ 0	EFD12-3E5-S

Properties of core sets under power conditions

Grade	B(mT) at H = 250 A/m f = 25kHz T = 100 °C	Core loss at f = 100 kHz B = 100mT T = 100 °C	Core loss at f = 400 kHz B = 50mT T = 100 °C	Core loss at f = 1MHz B = 30mT T = 100 °C	Core loss at f = 3MHz B = 10mT T = 100 °C
3F3	≥ 315	≤ 0.04	≤ 0.065	–	–
3F4	≥ 250	–	–	≤ 0.065	≤ 0.11

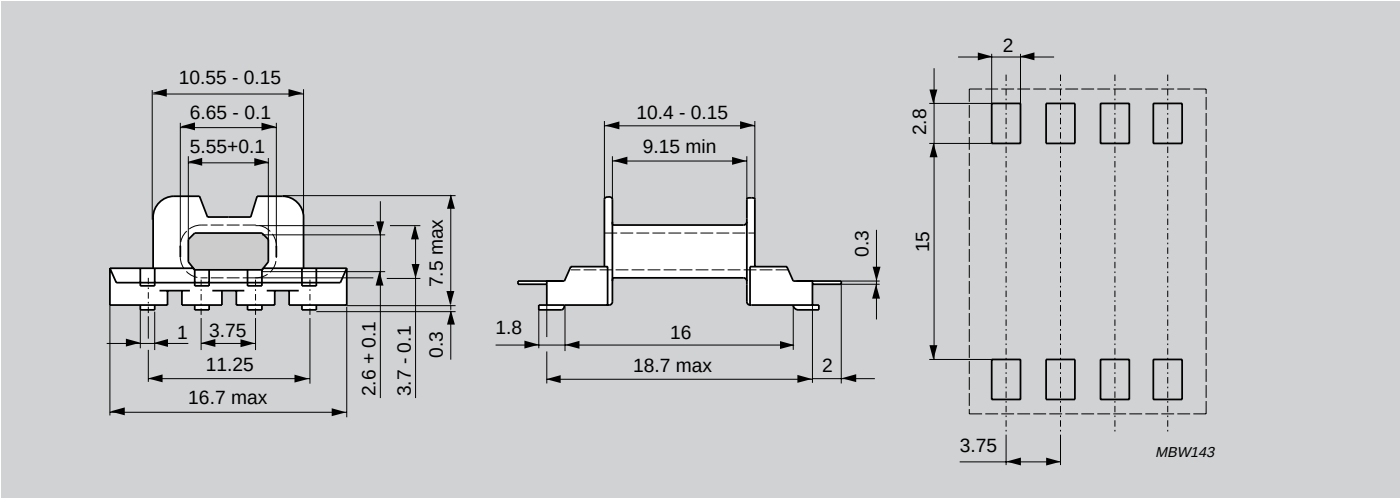


Fig. 1 SMD coil former for EFD15

Winding data

Number of sections	Number of solder pads	Winding area (mm2)	Winding width (mm)	Average length of turn (mm)	Type number
1	8	16.7	9.15	25.6	CPHS-EFD15-1S-8P

Coil former data

Coil former material	Liquid crystal polymer (LCP), glass reinforced, flame retardant in accordance with UL94V-0.
Solder pad material	Copper-tin alloy (CuSn), tin-lead alloy (SnPb) plated
Maximum operating temperature	155 ºC, IEC 85 class F
Resistance to soldering heat	"IEC 68-2-20" part2, test Tb, method 1B: 350 ºC, 3.5s.
Solderability	"IEC 68-2-20" part2, test Ta, method 1: 235 ºC, 2s

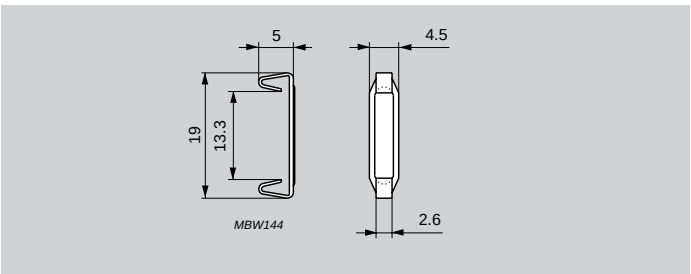


Fig. 2 Clip for EFD15

Clip data

Clip material	stainless(CrNi) steel
Clamping force	~ 12.5N each
Type number	CLI-EFD15

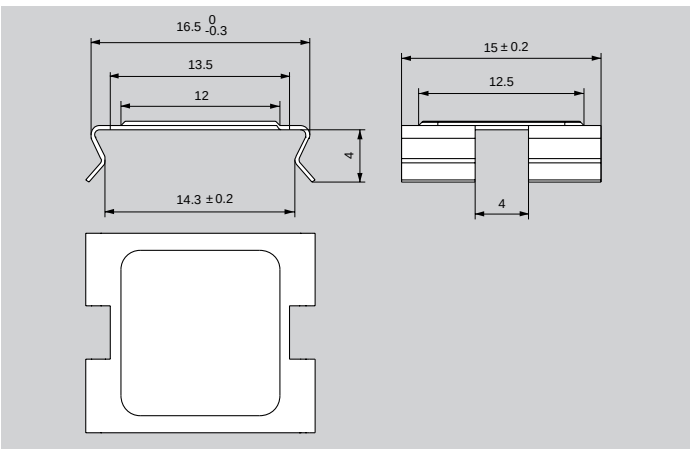


Fig. 2 Clamp for EFD15

Clamp data

Clamp material	stainless(CrNi) steel
Clamping force	~ 25N
Type number	CLM-EFD15

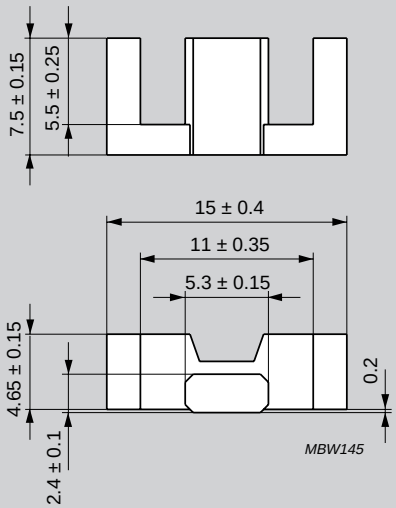


Fig. 3 EFD15 core half

Effective core parameters

symbol	parameter	value	unit
Σ (l/A)	core factor (C1)	2.27	mm^{-1}
V_e	effective volume	510	mm^3
l_e	effective length	34.0	mm
A_e	effective area	15.0	mm^2
A_{min}	minimum area	12.2	mm^2
m	mass of core half	~1.4	g

Core sets for general purpose transformers and power applications

Grade	A_L (nH)	μ_e	Airgap (μm)	Type number
3F3	63±5%	~ 115	~350	EFD15-3F3-A63-S
	100±8%	~ 180	~170	EFD15-3F3-A100-S
	160±10%	~ 290	~100	EFD15-3F3-A160-S
	780±25%	~ 1400	~0	EFD15-3F3-S
3F4	63±5%	~ 115	~350	EFD15-3F4-A63-S
	100±8%	~ 180	~160	EFD15-3F4-A100-S
	160±10%	~ 290	~90	EFD15-3F4-A160-S
	400±25%	~ 720	~0	EFD15-3F4-S
3E4	2000 +40/-30%	~ 3610	~ 0	EFD15-3E4-S
3E5	≥ 2500	≥ 4510	~ 0	EFD15-3E5-S

Properties of core sets under power conditions

Grade	B(mT) at H = 250 A/m f = 25kHz T = 100 °C	Core loss at f = 100 kHz B = 100mT T = 100 °C	Core loss at f = 400 kHz B = 50mT T = 100 °C	Core loss at f = 1MHz B = 30mT T = 100 °C	Core loss at f = 3MHz B = 10mT T = 100 °C
3F3	≥ 315	≤ 0.06	≤ 0.10	–	–
3F4	≥ 250	–	–	≤ 0.10	≤ 0.16

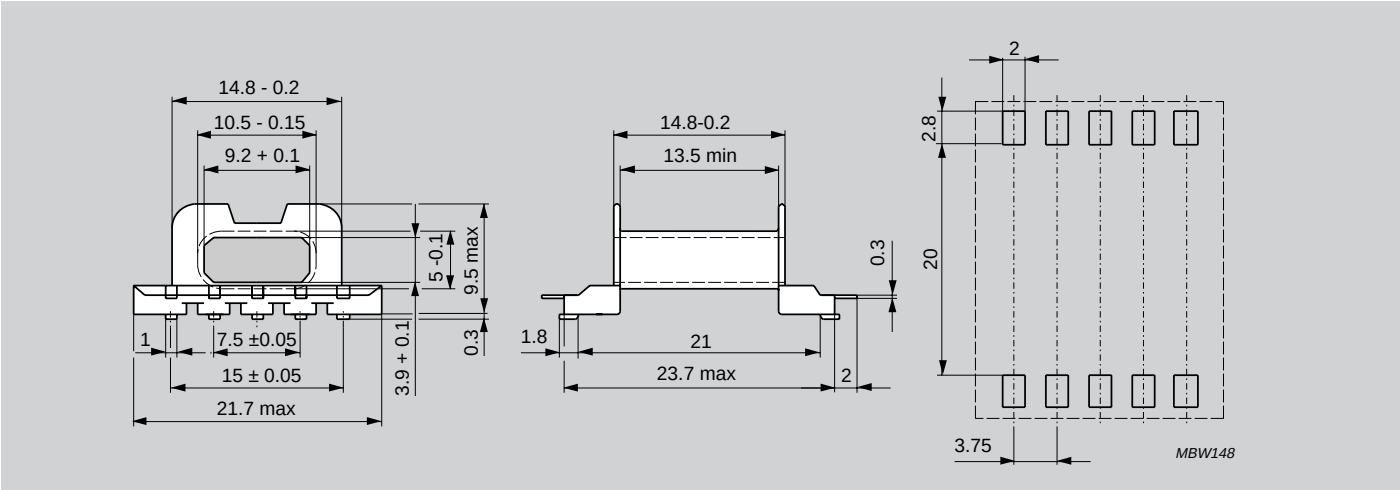


Fig. 1 SMD coil former for EFD20

Winding data

Number of sections	Number of solder pads	Winding area (mm^2)	Winding width (mm)	Average length of turn (mm)	Type number
1	10	27.7	13.5	34.1	CPHS-EFD20-1S-10P

Coil former data

Coil former material	Liquid crystal polymer (LCP), glass reinforced, flame retardant in accordance with UL94V-0.
Solder pad material	Copper-tin alloy (CuSn), tin-lead alloy (SnPb) plated
Maximum operating temperature	155 ºC, IEC 85 class F
Resistance to soldering heat	"IEC 68-2-20" part2, test Tb, method 1B: 350 ºC, 3.5s.
Solderability	"IEC 68-2-20" part2, test Ta, method 1: 235 ºC, 2s

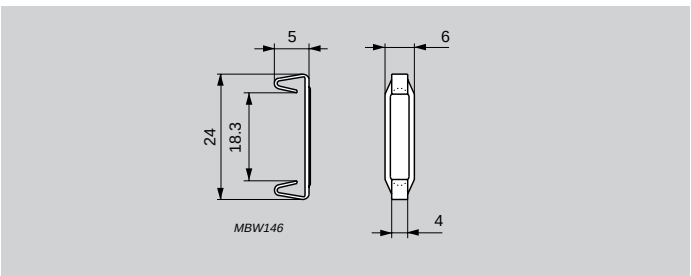


Fig. 2 Clip for EFD20

Clip data

Clip material	stainless(CrNi) steel
Clamping force	~ 20N each
Type number	CLI-EFD20

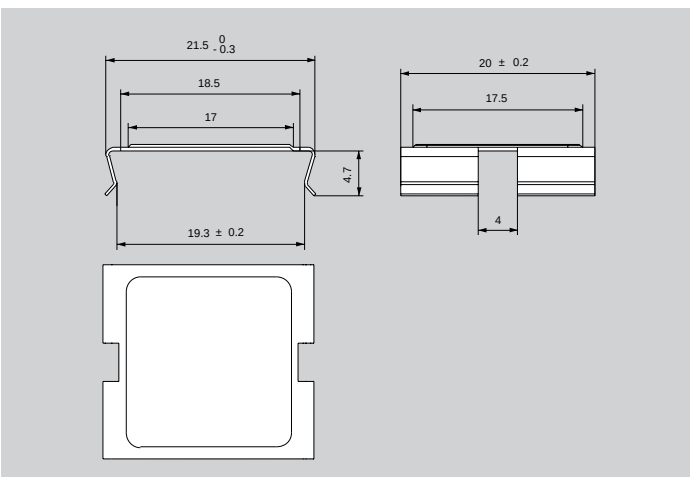


Fig. 2 Clamp for EFD20

Clamp data

Clamp material	stainless(CrNi) steel
Clamping force	~ 30N
Type number	CLM-EFD20

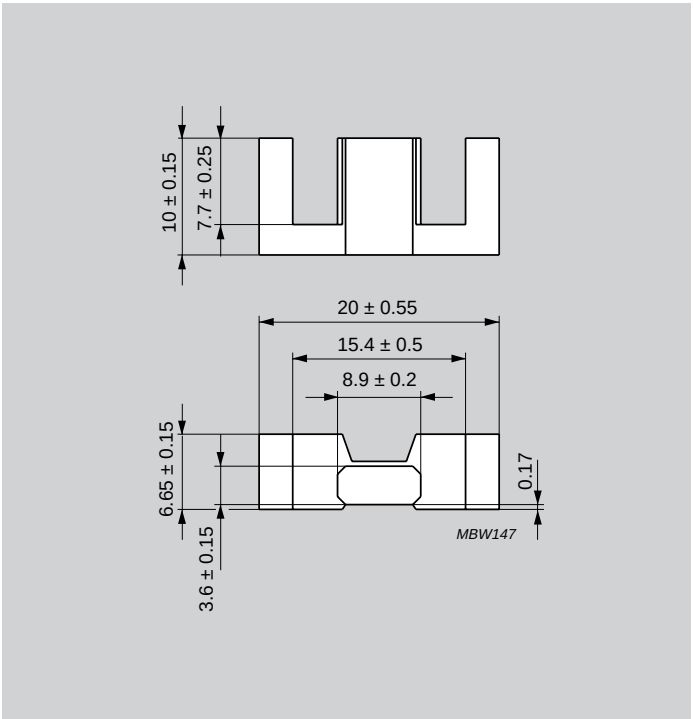


Fig. 3 EFD20 core half

Effective core parameters

symbol	parameter	value	unit
Σ (l/A)	core factor (C1)	1,52	mm^{-1}
V_e	effective volume	1460	mm^3
l_e	effective length	47.0	mm
A_e	effective area	31.0	mm^2
A_{min}	minimum area	29.0	mm^2
m	mass of core half	~3.5	g

Core halves/sets for general purpose transformers and power applications

Grade	A_L (nH)	μ_e	Airgap (μm)	Type number
3F3	63±3%	~ 75	~500	EFD20-3F3-E63-S
	100±3%	~ 120	~240	EFD20-3F3-A100-S
	160±5%	~ 195	~140	EFD20-3F3-A160-S
	250±8%	~ 300	~90	EFD20-3F3-A250-S
	315±10%	~ 425	~65	EFD20-3F3-A315-S
	1200±25%	~ 1450	~0	EFD20-3F3
3F4	63±3%	~ 75	~500	EFD20-3F4-E63-S
	100±3%	~ 120	~240	EFD20-3F4-A100-S
	160±5%	~ 195	~140	EFD20-3F4-A160-S
	250±8%	~ 300	~90	EFD20-3F4-A250-S
	315±10%	~ 425	~65	EFD20-3F4-A315-S
	650±25%	~ 785	~0	EFD20-3F4

Properties of core sets under power conditions

Grade	B(mT) at H = 250 A/m f = 25kHz T = 100 ºC	Core loss at f = 100 kHz B = 100mT T = 100 ºC	Core loss at f = 400 kHz B = 50mT T = 100 ºC	Core loss at f = 1MHz B = 30mT T = 100 ºC	Core loss at f = 3MHz B = 10mT T = 100 ºC
3F3	≥ 315	≤ 0.17	≤ 0.28	–	–
3F4	≥ 300	–	–	≤ 0.44	≤ 0.50

EP7

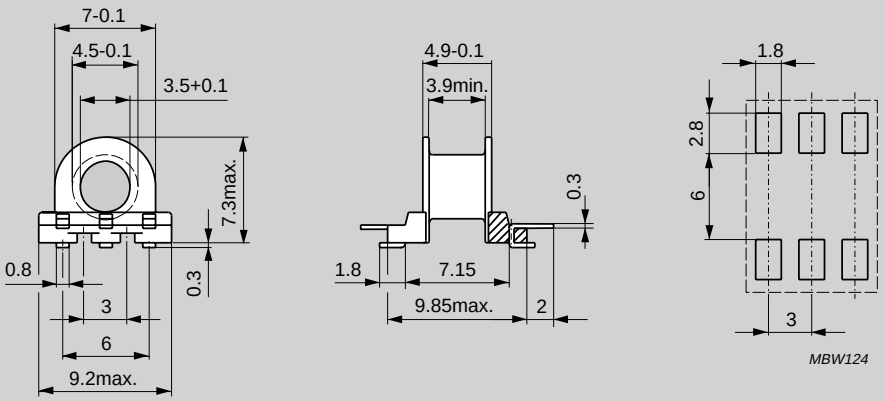


Fig. 1 SMD coil former for EP7

Winding data

Number of sections	Number of solder pads	Winding area (mm2)	Winding width (mm)	Average length of turn (mm)	Type number
1	6	4.7	3.9	17.9	CPHS-EP7-1S-6P

Coil former data

Coil former material	Liquid crystal polymer (LCP), glass reinforced, flame retardant in accordance with UL94V-0.
Solder pad material	Copper-tin alloy (CuSn), tin-lead alloy (SnPb) plated
Maximum operating temperature	155 ºC, IEC 85 class F
Resistance to soldering heat	"IEC 68-2-20" part2, test Tb, method 1B: 350 ºC, 3.5s.
Solderability	"IEC 68-2-20" part2, test Ta, method 1: 235 ºC, 2s

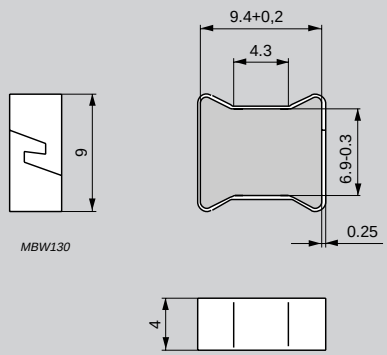


Fig. 2 clip for EP7

Clip data

Clip material	stainless(CrNi) steel
Clamping force	~ 22N
Type number	CLI-EP7

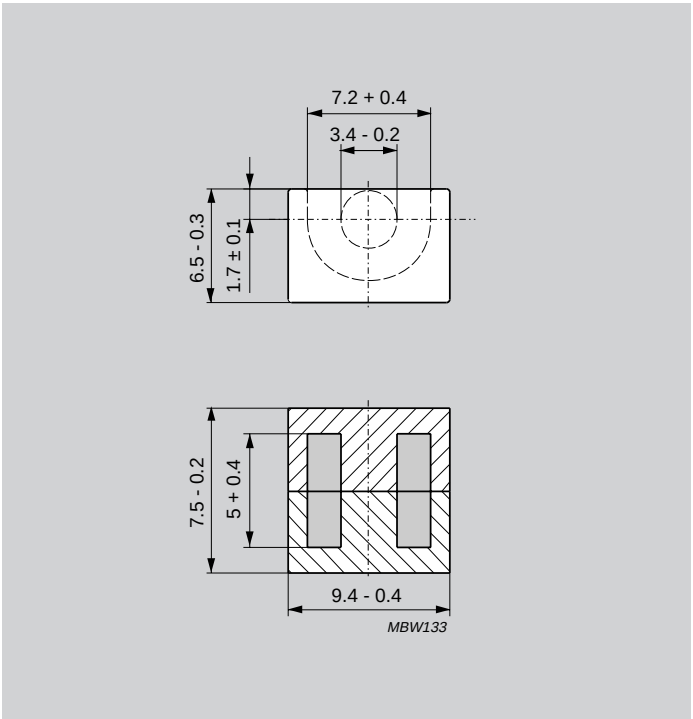


Fig. 3 EP7 core set

Effective core parameters

symbol	parameter	value	unit
Σ (l/A)	core factor (C1)	1.45	mm^{-1}
V_e	effective volume	165	mm^3
l_e	effective length	15.5	mm
A_e	effective area	10.7	mm^2
A_{min}	minimum area	8.55	mm^2
m	mass of core set	~0.8	g

Core sets for general purpose transformers and power applications

Grade	A_L (nH)	μ_e	Airgap (μm)	Type number
3F3	25±3%	~ 30	~790	EP7-3F3-E25
	40±3%	~ 48	~440	EP7-3F3-A40
	63±3%	~ 76	~260	EP7-3F3-A63
	100±3%	~ 121	~150	EP7-3F3-A100
	160±5%	~ 193	~85	EP7-3F3-A160
	1000±25%	~ 1210	~0	EP7-3F3
3F4	100±3%	~ 121	~150	EP7-3F4-A100
	160±5%	~ 193	~85	EP7-3F4-A160
	600±25%	~ 730	~0	EP7-3F4
3E5	5200 +40/-30%	~ 6300	~0	EP7-3E5
3E6	5800 +40/-30%	~ 7000	~0	EP7-3E6

Properties of core sets under power conditions

Grade	B(mT) at H = 250 A/m f = 25kHz T = 100 ºC	Core loss at f = 100 kHz B = 100mT T = 100 ºC	Core loss at f = 400 kHz B = 50mT T = 100 ºC	Core loss at f = 1MHz B = 30mT T = 100 ºC	Core loss at f = 3MHz B = 10mT T = 100 ºC
3F3	≥ 315	≤ 0.02	≤ 0.035	–	–
3F4	≥ 250	–	–	≤ 0.033	≤ 0.053

ER9.5

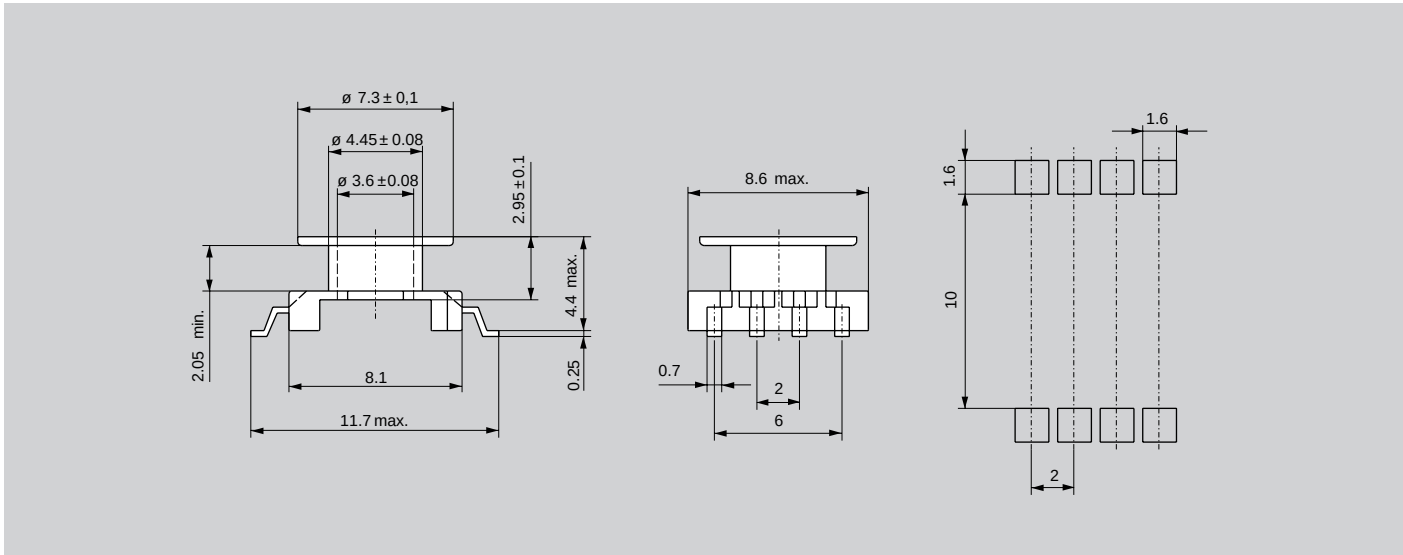


Fig. 1 SMD coil former for ER9.5

Winding data

Number of sections	Number of solder pads	Winding area (mm^2)	Winding width (mm)	Average length of turn (mm)	Type number
1	8	2.8	2.05	18.4	CPVS-ER9.5-1S-8P

Coil former data

Coil former material	Liquid crystal polymer (LCP), glass reinforced, flame retardant in accordance with UL94V-0.
Solder pad material	Copper-tin alloy (CuSn), tin-lead alloy (SnPb) plated
Maximum operating temperature	155 ºC, IEC 85 class F
Resistance to soldering heat	"IEC 68-2-20" part2, test Tb, method 1B: 350 ºC, 3.5s.
Solderability	"IEC 68-2-20" part2, test Ta, method 1: 235 ºC, 2s

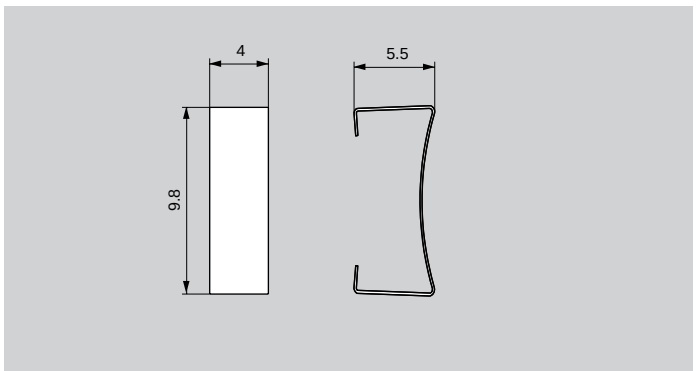


Fig. 2 clamp for ER9.5

Clamp data

Clamp material	stainless(CrNi)steel
Clamping force	~ 20N
Type number	CLM-ER9.5

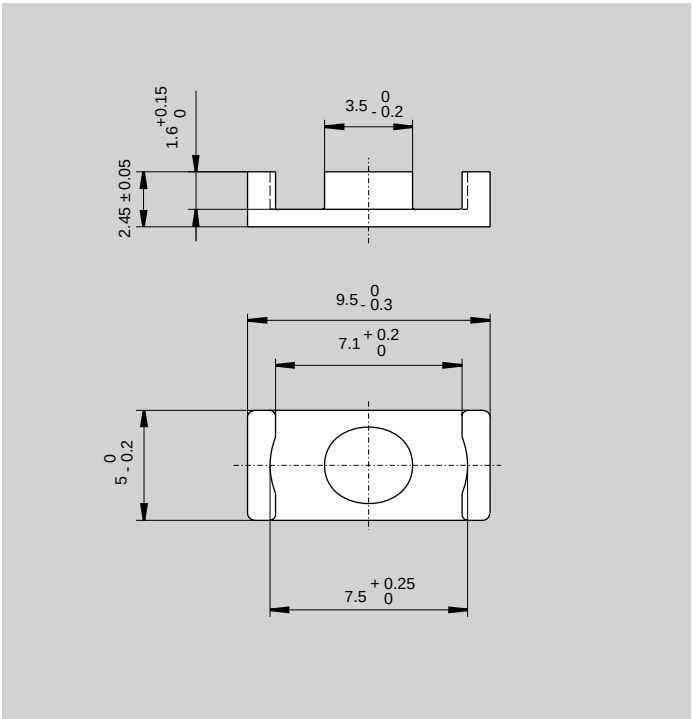


Fig. 3 ER9.5 core half

Effective core parameters

symbol	parameter	value	unit
Σ (l/A)	core factor (C1)	1.67	mm^{-1}
V_e	effective volume	120	mm^3
l_e	effective length	14.2	mm
A_e	effective area	8.47	mm^2
A_{min}	minimum area	7.60	mm^2
m	mass of core half	~0.35	g

Core sets for general purpose transformers and power applications

Grade	A_L (nH)	μ_e	Airgap (μm)	Type number
3F3	850±25%	~ 1145	~0	ER9.5-3F3-S
3F4	525±25%	~ 700	~0	ER9.5-3F4-S
3E5	3600 +40/-30%	~ 4780	~0	ER9.5-3E5-S
3E6	4800 +40/-30%	~ 6380	~0	ER9.5-3E6-S

Properties of core sets under power conditions

Grade	B(mT) at H = 250 A/m f = 25kHz T = 100 °C	Core loss at f = 100 kHz B = 100mT T = 100 °C	Core loss at f = 400 kHz B = 50mT T = 100 °C	Core loss at f = 1MHz B = 30mT T = 100 °C	Core loss at f = 3MHz B = 10mT T = 100 °C
3F3	≥ 300	≤ 0.015	≤ 0.025	–	–
3F4	≥ 250	–	–	≤ 0.024	≤ 0.038

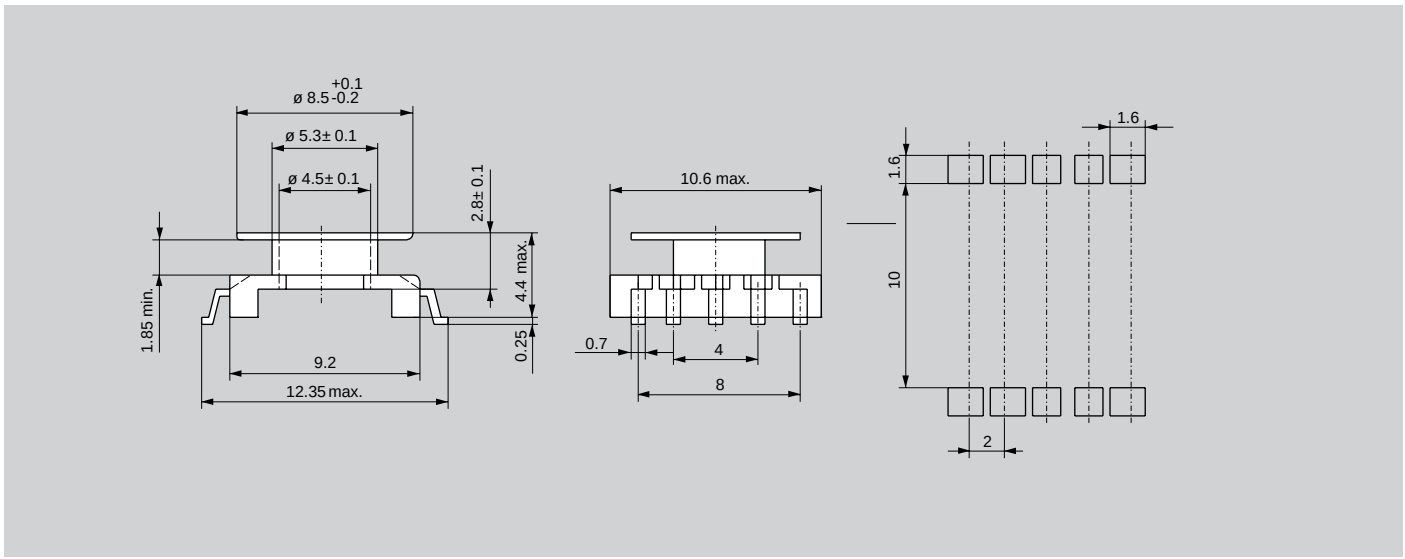


Fig. 1 SMD coil former for ER11

Winding data

Number of sections	Number of solder pads	Winding area (mm^2)	Winding width (mm)	Average length of turn (mm)	Type number
1	10	2.8	1.85	21.6	CPVS-ER11-1S-10P

Coil former data

Coil former material	Liquid crystal polymer (LCP), glass reinforced, flame retardant in accordance with UL94V-0.
Solder pad material	Copper-tin alloy (CuSn), tin-lead alloy (SnPb) plated
Maximum operating temperature	155 ºC, IEC 85 class F
Resistance to soldering heat	"IEC 68-2-20" part2, test Tb, method 1B: 350 ºC, 3.5s.
Solderability	"IEC 68-2-20" part2, test Ta, method 1: 235 ºC, 2s

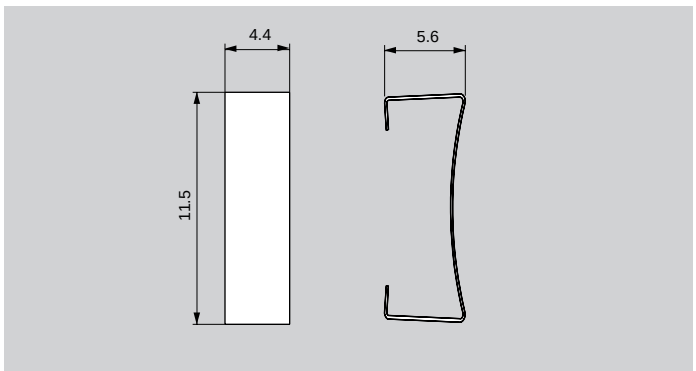


Fig. 2 clamp for ER11

Clip data

Clip material	stainless(CrNi) steel
Clamping force	~ 25N
Type number	CLM-ER11

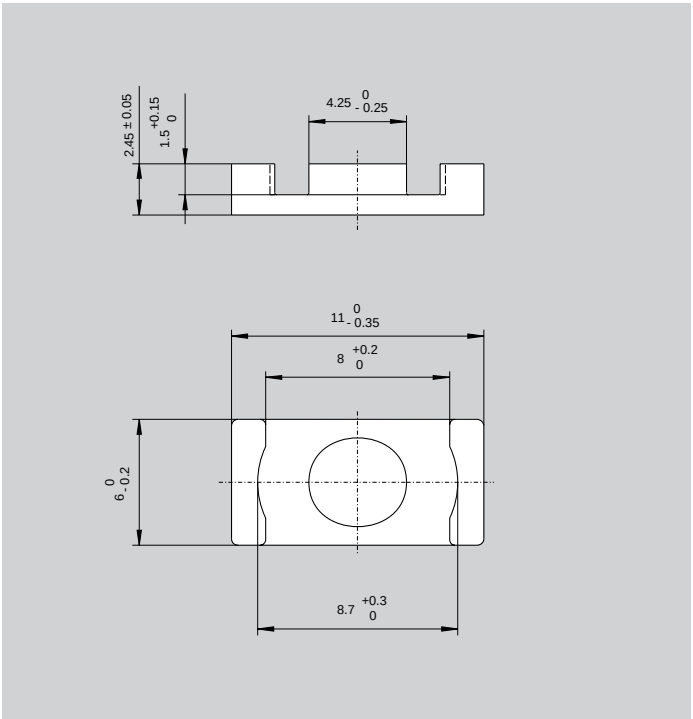


Fig. 3 ER11 core half

Effective core parameters

symbol	parameter	value	unit
Σ (l/A)	core factor (C1)	1.23	mm^{-1}
V_e	effective volume	174	mm^3
l_e	effective length	14.7	mm
A_e	effective area	11.9	mm^2
A_{min}	minimum area	10.3	mm^2
m	mass of core half	~0.5	g

Core sets for general purpose transformers and power applications

Grade	A_L (nH)	μ_e	Airgap (μm)	Type number
3F3	1200±25%	~ 1170	~0	ER11-3F3-S
3F4	725±25%	~ 710	~0	ER11-3F4-S
3E5	5000 +40/-30%	~ 4890	~0	ER11-3E5-S
3E6	6700 +40/-30%	~ 6560	~0	ER11-3E6-S

Properties of core sets under power conditions

Grade	B(mT) at H = 250 A/m f = 25kHz T = 100 °C	Core loss at f = 100 kHz B = 100mT T = 100 °C	Core loss at f = 400 kHz B = 50mT T = 100 °C	Core loss at f = 1MHz B = 30mT T = 100 °C	Core loss at f = 3MHz B = 10mT T = 100 °C
3F3	≥ 300	≤ 0.025	≤ 0.040	–	–
3F4	≥ 250	–	–	≤ 0.035	≤ 0.056

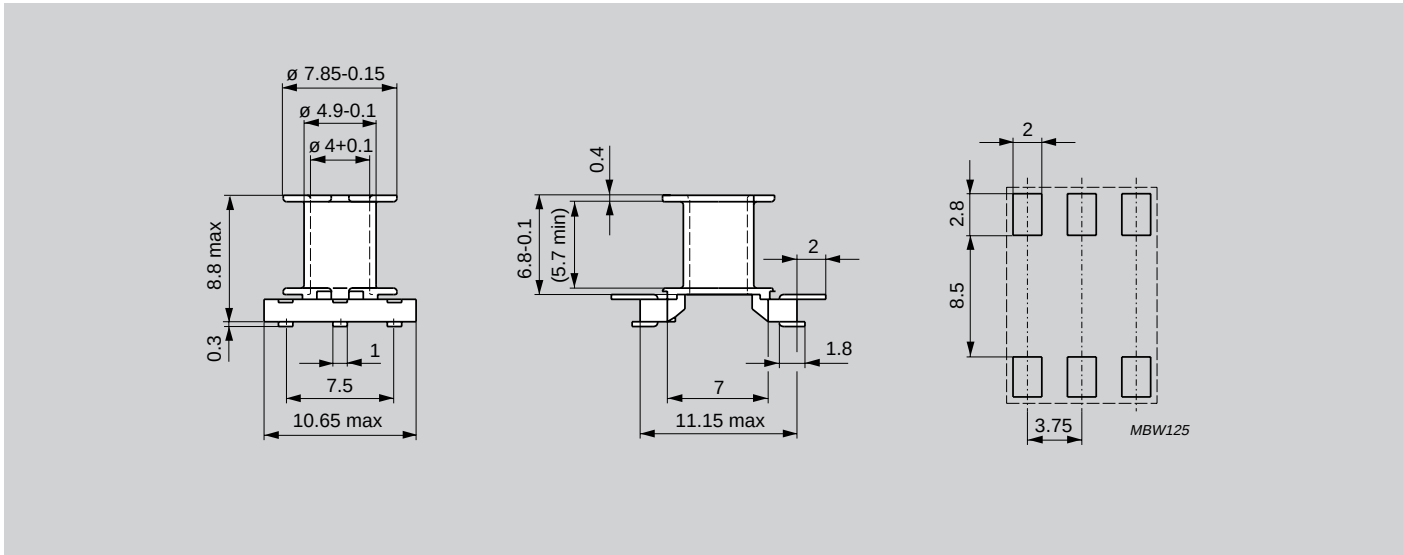


Fig. 1 SMD coil former for RM4/I

Winding data

Number of sections	Number of solder pads	Winding area (mm^2)	Winding width (mm)	Average length of turn (mm)	Type number
1	6	8.4	5.75	19.8	CPVS-RM4-1S-6P

Coil former data

Coil former material	Liquid crystal polymer (LCP), glass reinforced, flame retardant in accordance with UL94V-0.
Solder pad material	Copper-tin alloy (CuSn), tin-lead alloy (SnPb) plated
Maximum operating temperature	155 ºC, IEC 85 class F
Resistance to soldering heat	"IEC 68-2-20" part2, test Tb, method 1B: 350 ºC, 3.5s.
Solderability	"IEC 68-2-20" part2, test Ta, method 1: 235 ºC, 2s

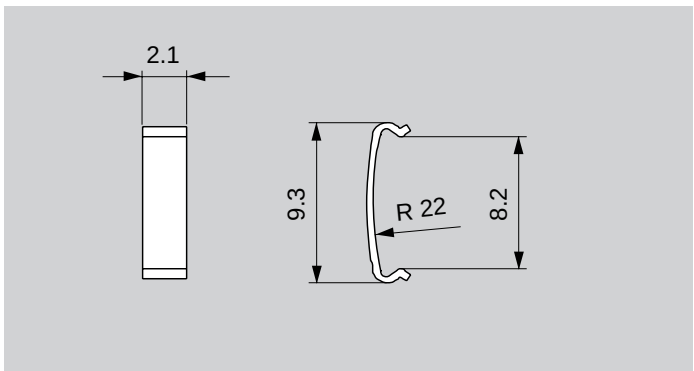


Fig. 2 Clip for RM4/I

Clip data

Clip material	stainless steel
Clamping force	~5 N each
Type number	CLI-RM4/5

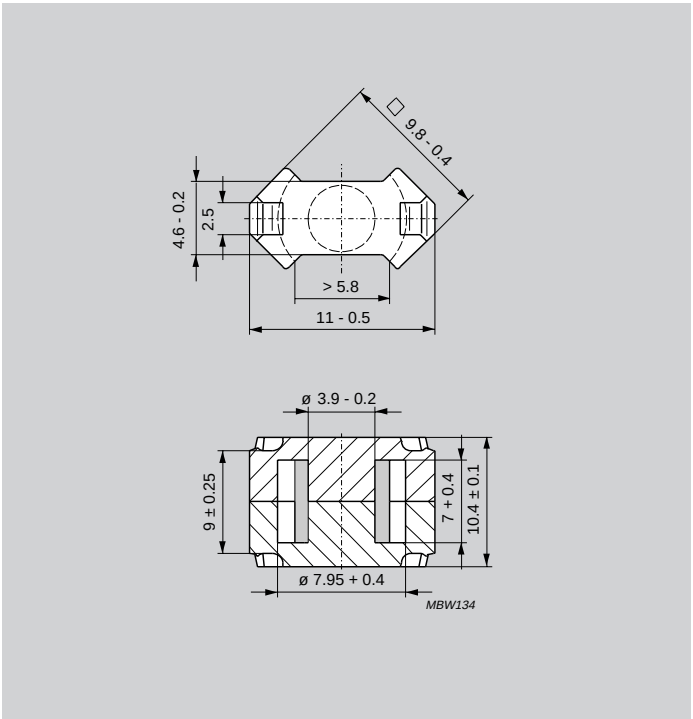


Fig. 3 RM4/I core set

Effective core parameters

symbol	parameter	value	unit
Σ (l/A)	core factor (C1)	1.69	mm^{-1}
V_e	effective volume	322	mm^3
l_e	effective length	23.3	mm
A_e	effective area	13.8	mm^2
A_{min}	minimum area	11.5	mm^2
m	mass of core set	~1.7	g

Core sets for general purpose transformers and power applications

Grade	A_L (nH)	μ_e	Airgap (μm)	Type number
3F3	100±3%	~ 134	~ 170	RM4/I-3F3-A100
	160±3%	~ 215	~ 100	RM4/I-3F3-A160
	250±10%	~ 336	~ 50	RM4/I-3F3-A250
	950±25%	~ 1280	~0	RM4/I-3F3
3F4	100±3%	~ 134	~ 150	RM4/I-3F4-A100
	160±3%	~ 215	~ 80	RM4/I-3F4-A160
	250±10%	~ 336	~ 40	RM4/I-3F4-A250
	560±25%	~ 750	~0	RM4/I-3F4
3E5	3500 +40/-30%	~ 4700	~0	RM4/I-3E5

Properties of core sets under power conditions

Grade	B(mT) at H = 250 A/m f = 25kHz T = 100 °C	Core loss at f = 100 kHz B = 100mT T = 100 °C	Core loss at f = 400 kHz B = 50mT T = 100 °C	Core loss at f = 1MHz B = 30mT T = 100 °C	Core loss at f = 3MHz B = 10mT T = 100 °C
3F3	≥ 300	≤ 0.05	≤ 0.07	–	–
3F4	≥ 250	–	–	≤ 0.065	≤ 0.11

RM5/I

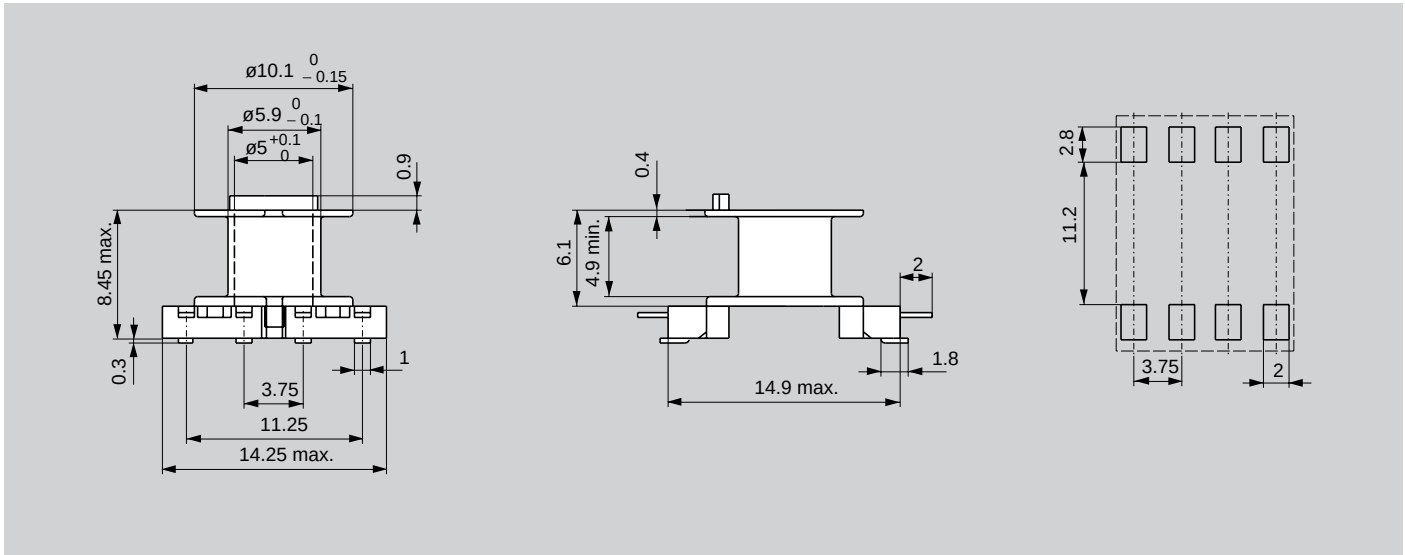


Fig. 1 SMD coil former for RM5/I

Winding data

Number of sections	Number of solder pads	Winding area (mm^2)	Winding width (mm)	Average length of turn (mm)	Type number
1	8	9.8	4.9	24.9	CPVS-RM5-1S-8P

Coil former data

Coil former material	Liquid crystal polymer (LCP), glass reinforced, flame retardant in accordance with UL94V-0.
Solder pad material	Copper-tin alloy (CuSn), tin-lead alloy (SnPb) plated
Maximum operating temperature	155 ºC, IEC 85 class F
Resistance to soldering heat	"IEC 68-2-20" part2, test Tb, method 1B: 350 ºC, 3.5s.
Solderability	"IEC 68-2-20" part2, test Ta, method 1: 235 ºC, 2s

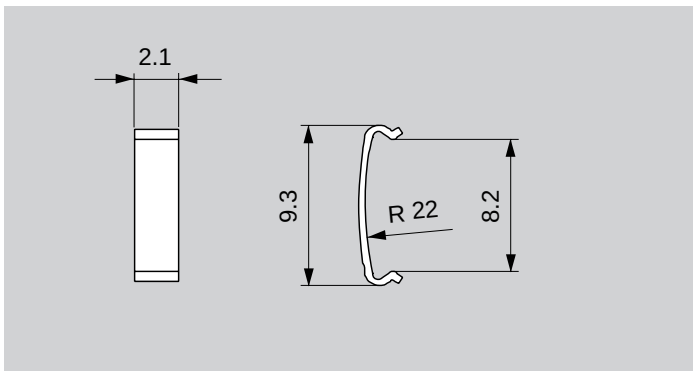


Fig. 2 Clip for RM5/I

Clip data

Clip material	stainless (CrNi)steel
Clamping force	~5 N each
Type number	CLI-RM4/5

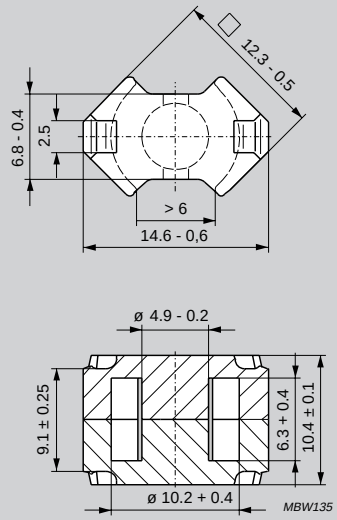


Fig. 3 RM5/I core set

Effective core parameters

symbol	parameter	value	unit
Σ (l/A)	core factor (C1)	0.935	mm^{-1}
V_e	effective volume	574	mm^3
l_e	effective length	23.2	mm
A_e	effective area	24.8	mm^2
A_{min}	minimum area	18.1	mm^2
m	mass of core set	~3.3	g

Core sets for general purpose transformers and power applications

Grade	A_L (nH)	μ_e	Airgap (μm)	Type number
3F3	100±3%	~ 74	~ 300	RM5/I-3F3-A100
	160±3%	~ 119	~ 160	RM5/I-3F3-A160
	250±3%	~ 186	~ 90	RM5/I-3F3-A250
	1700±25%	~ 1270	~0	RM5/I-3F3
3F4	100±3%	~ 74	~ 300	RM5/I-3F4-A100
	160±3%	~ 119	~ 160	RM5/I-3F4-A160
	250±3%	~ 186	~ 90	RM5/I-3F4-A250
	1000±25%	~ 750	~0	RM5/I-3F4
3E5	6700 +40/-30%	~ 4980	~0	RM5/I-3E5
3E6	9500 +40/-30%	~ 7050	~0	RM5/I-3E6

Properties of core sets under power conditions

Grade	B(mT) at H = 250 A/m f = 25kHz T = 100 °C	Core loss at f = 100 kHz B = 100mT T = 100 °C	Core loss at f = 400 kHz B = 50mT T = 100 °C	Core loss at f = 1MHz B = 30mT T = 100 °C	Core loss at f = 3MHz B = 10mT T = 100 °C
3F3	≥ 315	≤ 0.08	≤ 0.11	–	–
3F4	≥ 250	–	–	≤ 0.11	≤ 0.20

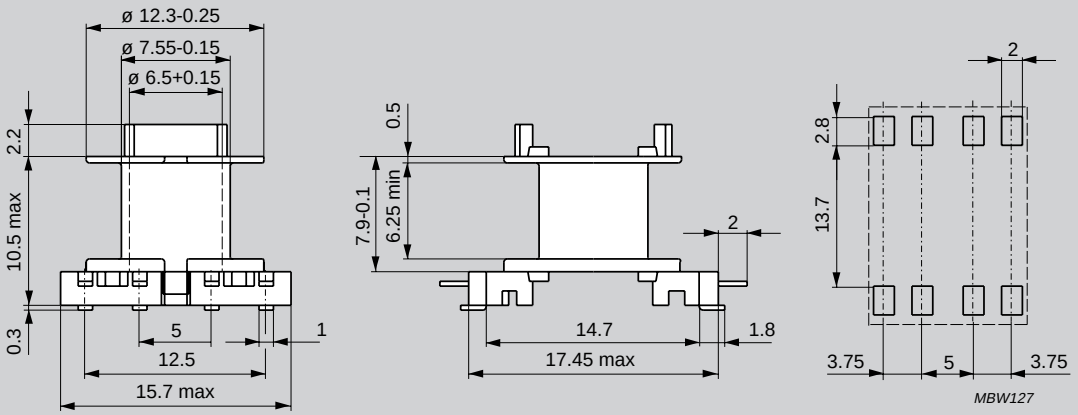


Fig. 1 SMD coil former for RM6S/I

Winding data

Number of sections	Number of solder pads	Winding area (mm^2)	Winding width (mm)	Average length of turn (mm)	Type number
1	8	14	6.25	31	CPVS-RM6S-1S-8P

Coil former data

Coil former material	Liquid crystal polymer (LCP), glass reinforced, flame retardant in accordance with UL94V-0.
Solder pad material	Copper-tin alloy (CuSn), tin-lead alloy (SnPb) plated
Maximum operating temperature	155 ºC, IEC 85 class F
Resistance to soldering heat	"IEC 68-2-20" part2, test Tb, method 1B: 350 ºC, 3.5s.
Solderability	"IEC 68-2-20" part2, test Ta, method 1: 235 ºC, 2s

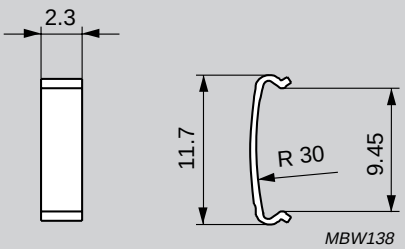


Fig. 2 Clip for RM6S/I

Clip data

Clip material	stainless (CrNi) steel
Clamping force	~10 N each
Type number	CLI-RM6

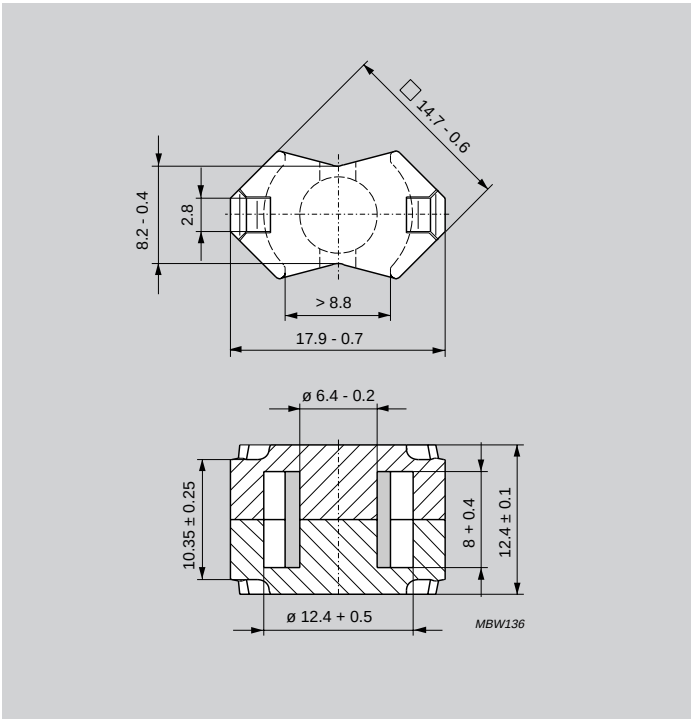


Fig. 3 RM6S/I core set

Effective core parameters

symbol	parameter	value	unit
Σ (l/A)	core factor (C1)	0.784	mm^{-1}
V_e	effective volume	1090	mm^3
l_e	effective length	29.2	mm
A_e	effective area	37.0	mm^2
A_{min}	minimum area	31.2	mm^2
m	mass of core set	~4.9	g

Core sets for general purpose transformers and power applications

Grade	A_L (nH)	μ_e	Airgap (μm)	Type number
3F3	63±3%	~ 39	~ 950	RM6S/I-3F3-A63
	100±3%	~ 62	~ 500	RM6S/I-3F3-A100
	160±3%	~ 100	~ 300	RM6S/I-3F3-A160
	250±3%	~ 156	~ 150	RM6S/I-3F3-A250
	2150±25%	~ 1350	~0	RM6S/I-3F3
3F4	63±3%	~ 39	~ 950	RM6S/I-3F4-A63
	100±3%	~ 62	~ 500	RM6S/I-3F4-A100
	160±3%	~ 100	~ 300	RM6S/I-3F4-A160
	250±3%	~ 156	~ 150	RM6S/I-3F4-A250
	1250±25%	~ 780	~0	RM6S/I-3F4
3E5	8600 +40/-30%	~ 5370	~0	RM6S/I-3E5
3E6	12500 +40/-30%	~ 6200	~0	RM6S/I-3E6

Properties of core sets under power conditions

Grade	B(mT) at H = 250 A/m f = 25kHz T = 100 °C	Core loss at f = 100 kHz B = 100mT T = 100 °C	Core loss at f = 400 kHz B = 50mT T = 100 °C	Core loss at f = 1MHz B = 30mT T = 100 °C	Core loss at f = 3MHz B = 10mT T = 100 °C
3F3	≥ 315	≤ 0.14	≤ 0.20	–	–
3F4	≥ 250	–	–	≤ 0.22	≤ 0.35

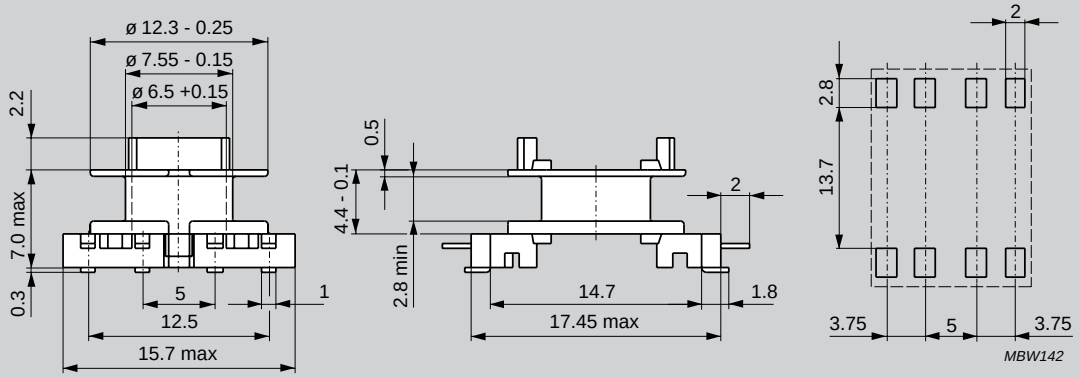


Fig. 1 SMD coil former for RM6S/ILP

Winding data

Number of sections	Number of solder pads	Winding area (mm^2)	Winding width (mm)	Average length of turn (mm)	Type number
1	8	6.4	2.8 min	31.0	CPVS-RM6S/LP-1S-8P

Coil former data

Coil former material	Liquid crystal polymer (LCP), glass reinforced, flame retardant in accordance with UL94V-0.
Solder pad material	Copper-tin alloy (CuSn), tin-lead alloy (SnPb) plated
Maximum operating temperature	155 ºC, IEC 85 class F
Resistance to soldering heat	"IEC 68-2-20" part2, test Tb, method 1B: 350 ºC, 3.5s.
Solderability	"IEC 68-2-20" part2, test Ta, method 1: 235 ºC, 2s

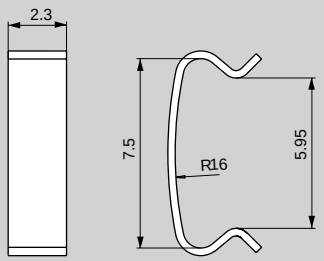


Fig. 2 Clip for RM6S/ILP

Clip data

Clip material	stainless (CrNi) steel
Clamping force	~10 N each
Type number	CLI-RM6/LP

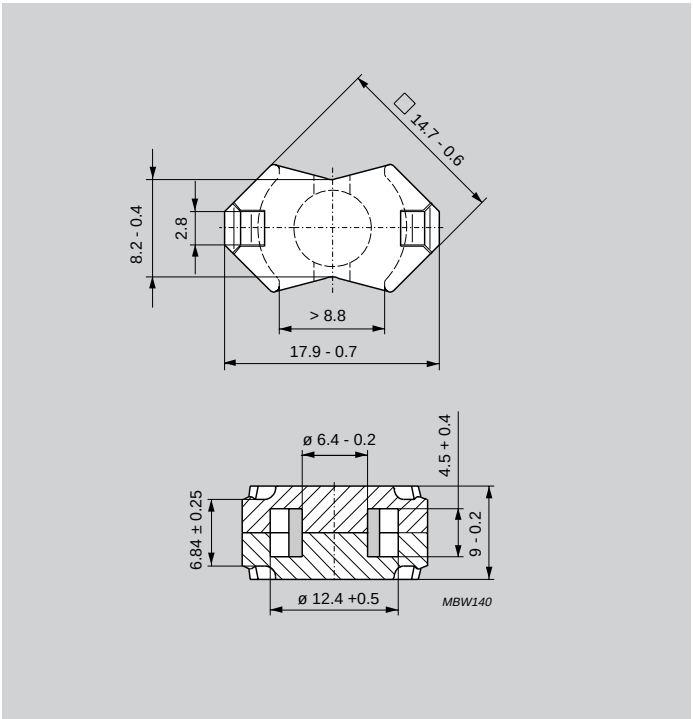


Fig. 3 RM6S/ILP core set

Effective core parameters

symbol	parameter	value	unit
Σ (l/A)	core factor (C1)	0.580	mm^{-1}
V_e	effective volume	820	mm^3
l_e	effective length	21.8	mm
A_e	effective area	37.5	mm^2
A_{min}	minimum area	31.2	mm^2
m	mass of core set	~4.2	g

Core sets for general purpose transformers and power applications

Grade	A_L (nH)	μ_e	Airgap (μm)	Type number
3F3	2700±25%	~ 1250	~ 0	RM6S/ILP-3F3
3F4	1600±25%	~ 740	~ 0	RM6S/ILP-3F4
3E5	10500 +40/-30%	~ 4850	~0	RM6S/ILP-3E5
3E6	15000 +40/-30%	~ 6930	~0	RM6S/ILP-3E6

Properties of core sets under power conditions

Grade	B(mT) at H = 250 A/m f = 25kHz T = 100 ºC	Core loss at f = 100 kHz B = 100mT T = 100 ºC	Core loss at f = 400 kHz B = 50mT T = 100 ºC	Core loss at f = 1MHz B = 30mT T = 100 ºC	Core loss at f = 3MHz B = 10mT T = 100 ºC
3F3	≥ 300	≤ 0.10	≤ 0.15	–	–
3F4	≥ 250	–	–	≤ 0.16	≤ 0.26

TGPS-9

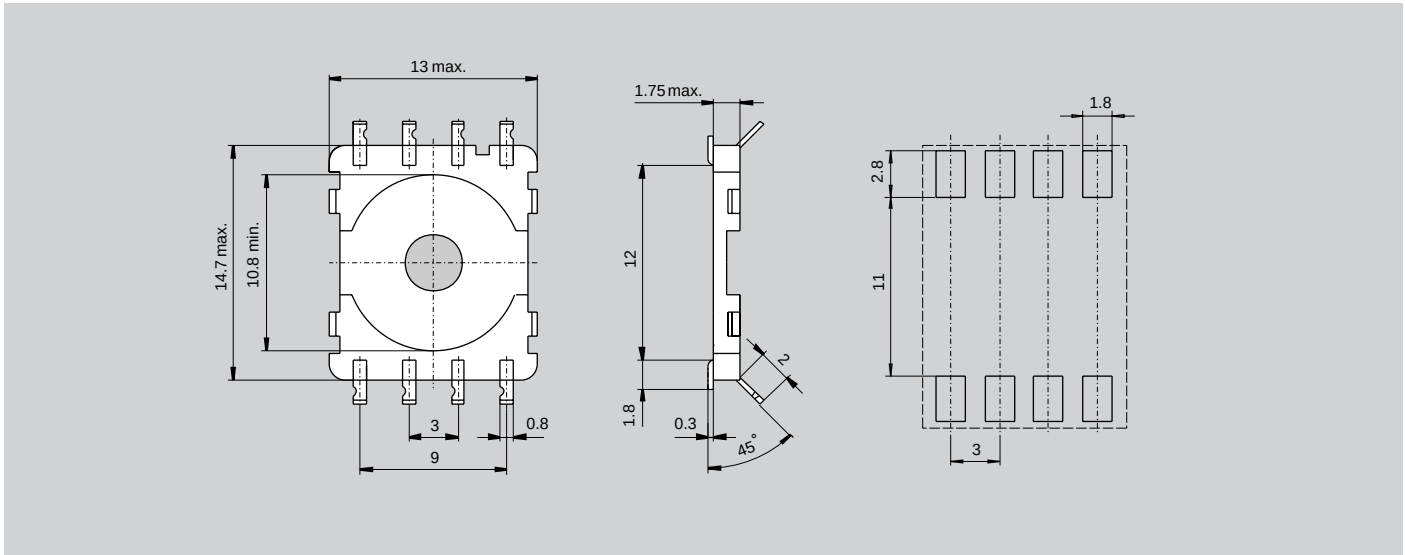


Fig. 1 Tag plate for 9mm ring cores.

Winding data

Number of sections	Number of solder pads	Winding area (mm^2)	Winding width (mm)	Average length of turn (mm)	Type number
-	8	-	-	-	TGPS-9

Coil former data

Coil former material	Liquid crystal polymer (LCP), glass reinforced, flame retardant in accordance with UL94V-0.
Solder pad material	Copper-tin alloy (CuSn), tin-lead alloy (SnPb) plated
Maximum operating temperature	155 ºC, IEC 85 class F
Resistance to soldering heat	"IEC 68-2-20" part2, test Tb, method 1B: 350 ºC, 3.5s.
Solderability	"IEC 68-2-20" part2, test Ta, method 1: 235 ºC, 2s

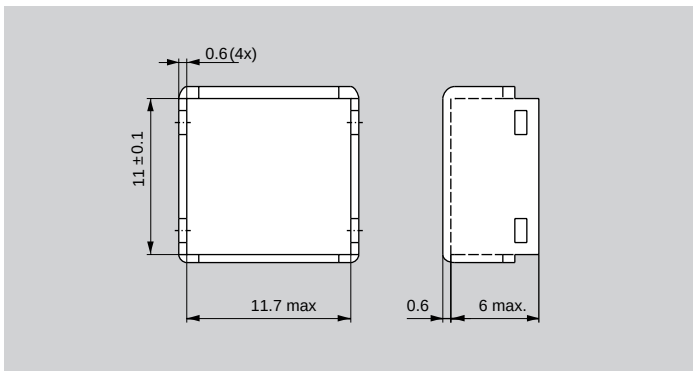


Fig. 2 Cover for TGPS-9

Cover data

Cover material	Polyamide (PA4.6) glass reinforced, flame retardant in accordance with UL94V-0.
Maximum operating temperature	130 ºC, IEC 85 class B
Type number	COV-9

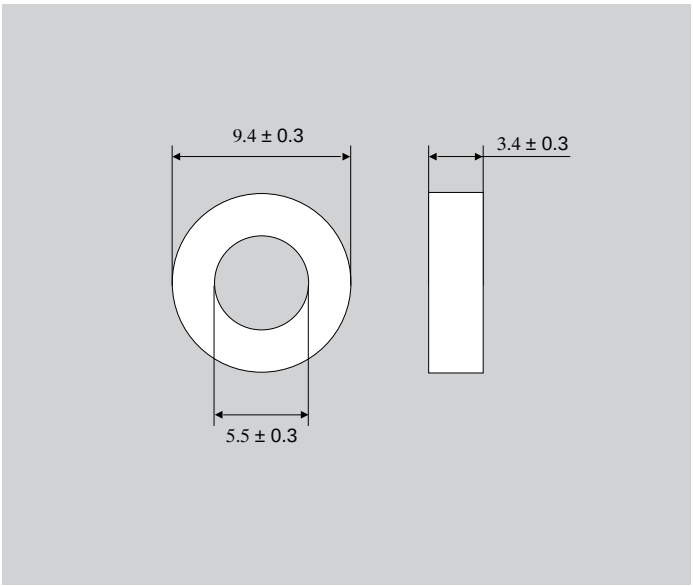


Fig. 3 TN9/6/3 ring core

Effective core parameters

symbol	parameter	value	unit
Σ (l/A)	core factor (C1)	5.17	mm^{-1}
V_e	effective volume	102	mm^3
l_e	effective length	22.9	mm
A_e	effective area	4.44	mm^2
m	mass of core	~ 0.5	g

Ring core data

Grade	A_L (nH)	μ_e	Colour code	Type number
3F3	440 ±25%	~ 1800	blue	TN9/6/3-3F3
3E5 [1)]	2070 ±30%	~ 8500	yellow/white	TL9/6/3-3E5
3E6 [2)]	2435 ±30%	~ 10000	purple/white	TC9/6/3-3E6

Note

1. Ring cores in 3E5 are lacquered and therefore have different dimensions: OD = 9.3±0.4 mm, ID = 5.75±0.3mm, H = 3.25±0.3mm.
2. Ring cores in 3E6 are coated with parylene and therefore have different dimensions: OD = 9.0±0.2 mm, ID = 6.0±0.2mm, H = 3.0±0.15mm.

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