



## **Ferrites and accessories**

ELP 32/6/20 with I 32/3/20

Cores and accessories (with and without clamp recess)

**Series/Type:**            **B66287G, B65808, B66287K, B66288, B66457G, B66457K**

**Date:**                    May 2017

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**ELP 32/6/20**
**Core (with clamp recess)**
**B66287**
**Core set EELP 32**
**Combination: ELP 32/6/20 with ELP 32/6/20**

- To IEC 62317-9
- Delivery mode: single units

**Magnetic characteristics (per set)**

$\Sigma l/A = 0.32 \text{ mm}^{-1}$   
 $l_e = 41.4 \text{ mm}$   
 $A_e = 130 \text{ mm}^2$   
 $A_{\min} = 128 \text{ mm}^2$   
 $V_e = 5390 \text{ mm}^3$

**Approx. weight 28 g/set**
**ELP 32/6/20**


FEK0520-S

**Ungapped**

Material	$A_L$ value nH	$\mu_e$	$B_S^*$ mT	$P_V$ W/set	Ordering code (per piece)
N49	3900 ±25%	990	250	< 1.40 ( 50 mT, 500 kHz, 100 °C)	B66287G0000X149
N92	4300 ±25%	1090	350	< 3.70 (200 mT, 100 kHz, 100 °C)	B66287G0000X192
N87	5700 ±25%	1450	300	< 3.40 (200 mT, 100 kHz, 100 °C)	B66287G0000X187
N97	5700 ±25%	1440	310	< 2.60 (200 mT, 100 kHz, 100 °C)	B66287G0000X197
N95	6900 ±25%	1740	310	< 3.40 (200 mT, 100 kHz, 25 °C) < 3.10 (200 mT, 100 kHz, 100 °C)	B66287G0000X195

 \*  $H = 250 \text{ A/m}$ ;  $f = 10 \text{ kHz}$ ;  $T = 100 \text{ °C}$ 
**Gapped ( $A_L$  values/air gaps examples)**

Material	g mm	$A_L$ value approx. nH	$\mu_e$	Ordering code
N87	0.26 ±0.02	625	155	B66287G0260X187
	0.40 ±0.02	440	112	B66287G0400X187

 Other  $A_L$  values/air gaps and materials available on request – see Processing remarks on page 8.

**Calculation factors** (for formulas, see “E cores: general information”)

**EELP 32:**

Material	Relationship between air gap – $A_L$ value		Calculation of saturation current			
	K1 (25 °C)	K2 (25 °C)	K3 (25 °C)	K4 (25 °C)	K3 (100 °C)	K4 (100 °C)
N87	208	-0.819	367	-0.796	322	-0.873

Validity range: K1, K2: 0.10 mm < s < 1.50 mm  
 K3, K4: 150 nH <  $A_L$  < 1000 nH

**Clamp**

Ordering code per piece, 2 pieces required

Ordering code: B65808J2204X000



**ELP 32/6/20 with I 32/3/20**

**Core (with clamp recess)**

**B66287**

**Core set EILP 32**

**Combination:**

**ELP 32/6/20 with I 32/3/20**

- To IEC 62317-9
- Delivery mode: single units

**Magnetic characteristics (per set)**

$\Sigma l/A = 0.27 \text{ mm}^{-1}$

$l_e = 35.1 \text{ mm}$

$A_e = 130 \text{ mm}^2$

$A_{\min} = 128 \text{ mm}^2$

$V_e = 4560 \text{ mm}^3$

**Approx. weight 24 g/set**

**Ungapped**



Mate- rial	$A_L$ value nH	$\mu_e$	$B_S^*$ mT	$P_V$ W/set	Ordering code (per piece)
N49	4400 $\pm 25\%$	950	250	< 1.20 ( 50 mT, 500 kHz, 100 °C)	B66287G0000X149 (ELP core) B66287K0000X149 (I core)**
N92	4800 $\pm 25\%$	1031	350	< 3.20 (200 mT, 100 kHz, 100 °C)	B66287G0000X192 (ELP core) B66287K0000X192 (I core)**
N87	6300 $\pm 25\%$	1350	300	< 2.90 (200 mT, 100 kHz, 100 °C)	B66287G0000X187 (ELP core) B66287K0000X187 (I core)**
N97	6300 $\pm 25\%$	1350	310	< 2.20 (200 mT, 100 kHz, 100 °C)	B66287G0000X197 (ELP core) B66287K0000X197 (I core)**
N95	7550 $\pm 25\%$	1618	310	< 2.90 (200 mT, 100 kHz, 25 °C) < 2.60 (200 mT, 100 kHz, 100 °C)	B66287G0000X195 (ELP core) B66287K0000X195 (I core)**

\*  $H = 250 \text{ A/m}$ ;  $f = 10 \text{ kHz}$ ;  $T = 100 \text{ °C}$

\*\* Plate-type tool

Other  $A_L$  values/air gaps and materials available on request – see Processing remarks on page 8.

**Calculation factors** (for formulas, see “E cores: general information”)

**EILP 32:**

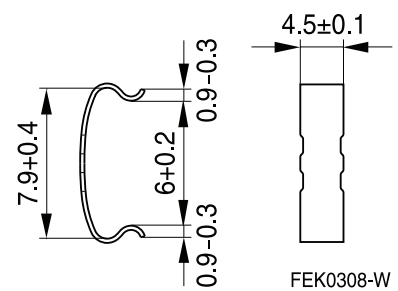
Material	Relationship between air gap – $A_L$ value		Calculation of saturation current			
	K1 (25 °C)	K2 (25 °C)	K3 (25 °C)	K4 (25 °C)	K3 (100 °C)	K4 (100 °C)
N87	234	-0.777	379	-0.796	329	-0.873

Validity range: K1, K2: 0.10 mm < s < 1.50 mm  
 K3, K4: 150 nH <  $A_L$  < 1000 nH

**Clamp**

Ordering code per piece, 2 pieces required

Ordering code: B66288F2204X000



**ELP 32/6/20**
**Core (without clamp recess)**
**B66457**
**Core set EELP 32**
**Combination: ELP 32/6/20 with ELP 32/6/20**

- To IEC 62317-9
- Delivery mode: single units

**Magnetic characteristics (per set)**

$\Sigma l/A = 0.32 \text{ mm}^{-1}$   
 $l_e = 41.4 \text{ mm}$   
 $A_e = 130 \text{ mm}^2$   
 $A_{\min} = 128 \text{ mm}^2$   
 $V_e = 5390 \text{ mm}^3$

**Approx. weight 28 g/set**


FEK0403-W

**Ungapped**

Material	$A_L$ value nH	$\mu_e$	$B_S^*$ mT	$P_V$ W/set	Ordering code (per piece)
N49	3900 ±25%	990	250	< 1.40 ( 50 mT, 500 kHz, 100 °C)	B66457G0000X149
N92	4300 ±25%	1090	350	< 3.70 (200 mT, 100 kHz, 100 °C)	B66457G0000X192
N87	5700 ±25%	1450	300	< 3.40 (200 mT, 100 kHz, 100 °C)	B66457G0000X187
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N95	6900 ±25%	1740	310	< 3.40 (200 mT, 100 kHz, 25 °C) < 3.10 (200 mT, 100 kHz, 100 °C)	B66457G0000X195

 \*  $H = 250 \text{ A/m}$ ;  $f = 10 \text{ kHz}$ ;  $T = 100 \text{ °C}$ 

 Other  $A_L$  values/air gaps and materials available on request – see Processing remarks on page 8.

**Calculation factors (for formulas, see “E cores: general information”)**
**EELP 32:**

Material	Relationship between air gap – $A_L$ value		Calculation of saturation current			
	K1 (25 °C)	K2 (25 °C)	K3 (25 °C)	K4 (25 °C)	K3 (100 °C)	K4 (100 °C)
N87	208	-0.819	367	-0.796	322	-0.873

Validity range:     K1, K2:  $0.10 \text{ mm} < s < 1.50 \text{ mm}$   
                           K3, K4:  $150 \text{ nH} < A_L < 1000 \text{ nH}$

**ELP 32/6/20 with I 32/3/20**
**Core (without clamp recess)**
**B66457**
**Core set EILP 32**
**Combination:**
**ELP 32/6/20 with I 32/3/20**

- To IEC 62317-9
- Delivery mode: single units

**Magnetic characteristics (per set)**

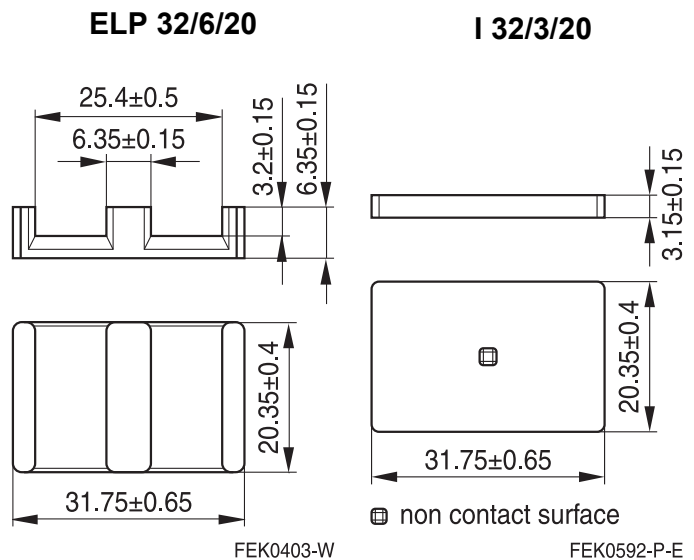
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N97	6300 ±25%	1350	310	< 2.20 (200 mT, 100 kHz, 100 °C)	B66457G0000X197 (ELP core) B66457K0000X197 (I core)**
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\*  $H = 250 \text{ A/m}$ ;  $f = 10 \text{ kHz}$ ;  $T = 100 \text{ °C}$

\*\* Plate-type tool

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**Calculation factors (for formulas, see “E cores: general information”)**
**EILP 32:**

Material	Relationship between air gap – $A_L$ value		Calculation of saturation current			
	K1 (25 °C)	K2 (25 °C)	K3 (25 °C)	K4 (25 °C)	K3 (100 °C)	K4 (100 °C)
N87	234	-0.777	379	-0.796	329	-0.873

Validity range: K1, K2:  $0.10 \text{ mm} < s < 1.50 \text{ mm}$   
K3, K4:  $150 \text{ nH} < A_L < 1000 \text{ nH}$

## Ferrites and accessories

### Cautions and warnings

#### Mechanical stress and mounting

Ferrite cores have to meet mechanical requirements during assembling and for a growing number of applications. Since ferrites are ceramic materials one has to be aware of the special behavior under mechanical load.

As valid for any ceramic material, ferrite cores are brittle and sensitive to any shock, fast temperature changing or tensile load. Especially high cooling rates under ultrasonic cleaning and high static or cyclic loads can cause cracks or failure of the ferrite cores.

For detailed information see data book, chapter “*General - Definitions, 8.1*”.

#### Effects of core combination on $A_L$ value

Stresses in the core affect not only the mechanical but also the magnetic properties. It is apparent that the initial permeability is dependent on the stress state of the core. The higher the stresses are in the core, the lower is the value for the initial permeability. Thus the embedding medium should have the greatest possible elasticity.

For detailed information see data book, chapter “*General - Definitions, 8.1*”.

#### Heating up

Ferrites can run hot during operation at higher flux densities and higher frequencies.

#### NiZn-materials

The magnetic properties of NiZn-materials can change irreversible in high magnetic fields.

#### Ferrite Accessories

EPCOS ferrite accessories have been designed and evaluated only in combination with EPCOS ferrite cores. EPCOS explicitly points out that EPCOS ferrite accessories or EPCOS ferrite cores may not be compatible with those of other manufacturers. Any such combination requires prior testing by the customer and will be at the customer's own risk.

EPCOS assumes no warranty or reliability for the combination of EPCOS ferrite accessories with cores and other accessories from any other manufacturer.

#### Processing remarks

The start of the winding process should be soft. Else the flanges may be destroyed.

- Too strong winding forces may blast the flanges or squeeze the tube that the cores can not be mounted any more.
- Too long soldering time at high temperature (>300 °C) may effect coplanarity or pin arrangement.
- Not following the processing notes for soldering of the J-leg terminals may cause solderability problems at the transformer because of pollution with Sn oxyde of the tin bath or burned insulation of the wire. For detailed information see chapter “*Processing notes*”, section 2.2.
- The dimensions of the hole arrangement have fixed values and should be understood as a recommendation for drilling the printed circuit board. For dimensioning the pins, the group of holes can only be seen under certain conditions, as they fit into the given hole arrangement. To avoid problems when mounting the transformer, the manufacturing tolerances for positioning the customers' drilling process must be considered by increasing the hole diameter.



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**Ferrites and accessories**
**Symbols and terms**

Symbol	Meaning	Unit
A	Cross section of coil	mm <sup>2</sup>
A <sub>e</sub>	Effective magnetic cross section	mm <sup>2</sup>
A <sub>L</sub>	Inductance factor; $A_L = L/N^2$	nH
A <sub>L1</sub>	Minimum inductance at defined high saturation ( $\hat{=} \mu_a$ )	nH
A <sub>min</sub>	Minimum core cross section	mm <sup>2</sup>
A <sub>N</sub>	Winding cross section	mm <sup>2</sup>
A <sub>R</sub>	Resistance factor; $A_R = R_{Cu}/N^2$	$\mu\Omega = 10^{-6} \Omega$
B	RMS value of magnetic flux density	Vs/m <sup>2</sup> , mT
$\Delta B$	Flux density deviation	Vs/m <sup>2</sup> , mT
$\hat{B}$	Peak value of magnetic flux density	Vs/m <sup>2</sup> , mT
$\Delta \hat{B}$	Peak value of flux density deviation	Vs/m <sup>2</sup> , mT
B <sub>DC</sub>	DC magnetic flux density	Vs/m <sup>2</sup> , mT
B <sub>R</sub>	Remanent flux density	Vs/m <sup>2</sup> , mT
B <sub>S</sub>	Saturation magnetization	Vs/m <sup>2</sup> , mT
C <sub>0</sub>	Winding capacitance	F = As/V
CDF	Core distortion factor	mm <sup>-4.5</sup>
DF	Relative disaccommodation coefficient $DF = d/\mu_i$	
d	Disaccommodation coefficient	
E <sub>a</sub>	Activation energy	J
f	Frequency	s <sup>-1</sup> , Hz
f <sub>cutoff</sub>	Cut-off frequency	s <sup>-1</sup> , Hz
f <sub>max</sub>	Upper frequency limit	s <sup>-1</sup> , Hz
f <sub>min</sub>	Lower frequency limit	s <sup>-1</sup> , Hz
f <sub>r</sub>	Resonance frequency	s <sup>-1</sup> , Hz
f <sub>Cu</sub>	Copper filling factor	
g	Air gap	mm
H	RMS value of magnetic field strength	A/m
$\hat{H}$	Peak value of magnetic field strength	A/m
H <sub>DC</sub>	DC field strength	A/m
H <sub>c</sub>	Coercive field strength	A/m
h	Hysteresis coefficient of material	10 <sup>-6</sup> cm/A
$h/\mu_i^2$	Relative hysteresis coefficient	10 <sup>-6</sup> cm/A
I	RMS value of current	A
I <sub>DC</sub>	Direct current	A
$\hat{I}$	Peak value of current	A
J	Polarization	Vs/m <sup>2</sup>
k	Boltzmann constant	J/K
k <sub>3</sub>	Third harmonic distortion	
k <sub>3c</sub>	Circuit third harmonic distortion	
L	Inductance	H = Vs/A

## Ferrites and accessories

### Symbols and terms

Symbol	Meaning	Unit
$\Delta L/L$	Relative inductance change	H
$L_0$	Inductance of coil without core	H
$L_H$	Main inductance	H
$L_p$	Parallel inductance	H
$L_{rev}$	Reversible inductance	H
$L_s$	Series inductance	H
$l_e$	Effective magnetic path length	mm
$l_N$	Average length of turn	mm
$N$	Number of turns	
$P_{Cu}$	Copper (winding) losses	W
$P_{trans}$	Transferrable power	W
$P_V$	Relative core losses	mW/g
PF	Performance factor	
$Q$	Quality factor ( $Q = \omega L/R_s = 1/\tan \delta_L$ )	
$R$	Resistance	$\Omega$
$R_{Cu}$	Copper (winding) resistance ( $f = 0$ )	$\Omega$
$R_h$	Hysteresis loss resistance of a core	$\Omega$
$\Delta R_h$	$R_h$ change	$\Omega$
$R_i$	Internal resistance	$\Omega$
$R_p$	Parallel loss resistance of a core	$\Omega$
$R_s$	Series loss resistance of a core	$\Omega$
$R_{th}$	Thermal resistance	K/W
$R_V$	Effective loss resistance of a core	$\Omega$
$s$	Total air gap	mm
$T$	Temperature	$^{\circ}\text{C}$
$\Delta T$	Temperature difference	K
$T_C$	Curie temperature	$^{\circ}\text{C}$
$t$	Time	s
$t_v$	Pulse duty factor	
$\tan \delta$	Loss factor	
$\tan \delta_L$	Loss factor of coil	
$\tan \delta_r$	(Residual) loss factor at $H \rightarrow 0$	
$\tan \delta_e$	Relative loss factor	
$\tan \delta_h$	Hysteresis loss factor	
$\tan \delta/\mu_i$	Relative loss factor of material at $H \rightarrow 0$	
$U$	RMS value of voltage	V
$\hat{U}$	Peak value of voltage	V
$V_e$	Effective magnetic volume	$\text{mm}^3$
$Z$	Complex impedance	$\Omega$
$Z_n$	Normalized impedance $ Z _n =  Z /N^2 \times \epsilon (l_e/A_e)$	$\Omega/\text{mm}$

## Ferrites and accessories

### Symbols and terms

Symbol	Meaning	Unit
$\alpha$	Temperature coefficient (TK)	1/K
$\alpha_F$	Relative temperature coefficient of material	1/K
$\alpha_e$	Temperature coefficient of effective permeability	1/K
$\epsilon_r$	Relative permittivity	
$\Phi$	Magnetic flux	Vs
$\eta$	Efficiency of a transformer	
$\eta_B$	Hysteresis material constant	mT <sup>-1</sup>
$\eta_i$	Hysteresis core constant	A <sup>-1</sup> H <sup>-1/2</sup>
$\lambda_s$	Magnetostriction at saturation magnetization	
$\mu$	Relative complex permeability	
$\mu_0$	Magnetic field constant	Vs/Am
$\mu_a$	Relative amplitude permeability	
$\mu_{app}$	Relative apparent permeability	
$\mu_e$	Relative effective permeability	
$\mu_i$	Relative initial permeability	
$\mu_p'$	Relative real (inductive) component of $\bar{\mu}$ (for parallel components)	
$\mu_p''$	Relative imaginary (loss) component of $\bar{\mu}$ (for parallel components)	
$\mu_r$	Relative permeability	
$\mu_{rev}$	Relative reversible permeability	
$\mu_s'$	Relative real (inductive) component of $\bar{\mu}$ (for series components)	
$\mu_s''$	Relative imaginary (loss) component of $\bar{\mu}$ (for series components)	
$\mu_{tot}$	Relative total permeability derived from the static magnetization curve	
$\rho$	Resistivity	$\Omega\text{m}^{-1}$
$\Sigma l/A$	Magnetic form factor	$\text{mm}^{-1}$
$\tau_{Cu}$	DC time constant $\tau_{Cu} = L/R_{Cu} = A_L/A_R$	s
$\omega$	Angular frequency; $\omega = 2 \Pi f$	s <sup>-1</sup>

All dimensions are given in mm.

**SMD** Surface-mount device

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1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application**. As a rule we are either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether a product with the properties described in the product specification is suitable for use in a particular customer application.
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