

## **Ferrites and accessories**

**P 9 × 5**

**Core and accessories**

**Series/Type:**            **B65517, B65522, B65524, B65518**

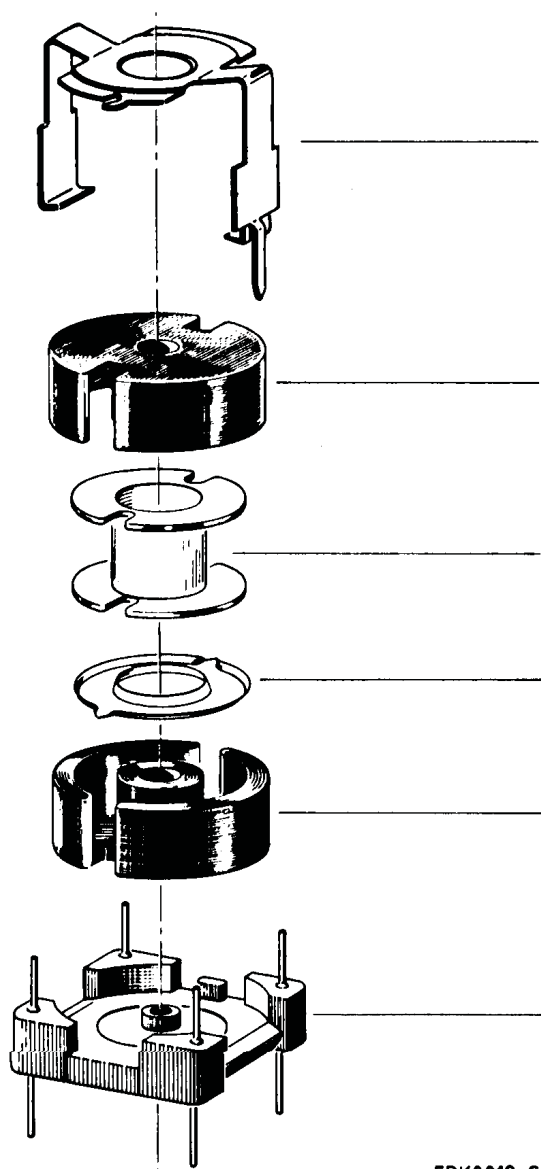
**Date:**                    July 2017

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P 9 × 5

## Core and accessories

Individual parts		Part no.	Page
 <p>FPK0019-S</p> <p>Example of an assembly set for printed circuit boards</p> <p><b>Also available:</b></p>	Yoke	B65518	6
	Core	B65517	3
	Coil former	B65522	4
	Insulating washer		
	Core	B65517	3
	Terminal carrier with thread	B65518	6
	SMD coil former	B65524	5

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Core

B65517

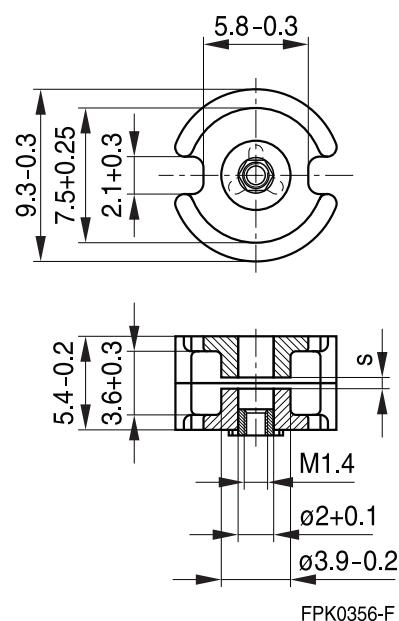
- To IEC 62317-2
- Delivery mode: sets

### Magnetic characteristics (per set)

	with center hole	without center hole	
$\Sigma l/A$	1.25	1.13	mm <sup>-1</sup>
$l_e$	12.5	13.4	mm
$A_e$	10	11.9	mm <sup>2</sup>
$A_{min}$	—	9.3	mm <sup>2</sup>
$V_e$	125	159	mm <sup>3</sup>

### Approx. weight (per set)

m	0.8	1.0	g
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### Gapped ( $A_L$ values/air gaps examples)

Material	$A_L$ value nH	s approx. mm	$\mu_e$	Ordering code <sup>1)</sup> -D with center hole -T with threaded sleeve
K1	25 ±3% 40 ±3%	0.45 0.26	25 40	B65517+0025A001 B65517+0040A001
M33	63 ±3%	0.20	63	B65517D0063A033
N48	100 ±3% 160 ±3% 200 ±3% 250 ±5%	0.10 0.06 0.04 0.03	100 159 200 249	B65517+0100A048 B65517+0160A048 B65517D0200A048 B65517D0250J048

### Ungapped

Material	$A_L$ value nH	$\mu_e$	Ordering code -D with center hole -W without center hole
N48	1300 +30/-20%	1290	B65517D0000R048
N30	2500 +30/-20%	2490	B65517D0000R030
T38	5500 +40/-30%	4930	B65517W0000Y038

Other  $A_L$  values/air gaps and materials available on request – see Processing remarks on page 7.

1) Replace the + by the code letter "D" or "T" for the required version.

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Accessories

B65522

### Coil former

Standard: to IEC 62317-2

Material: GFR polyterephthalate (UL 94 V-0, insulation class to IEC 60085:

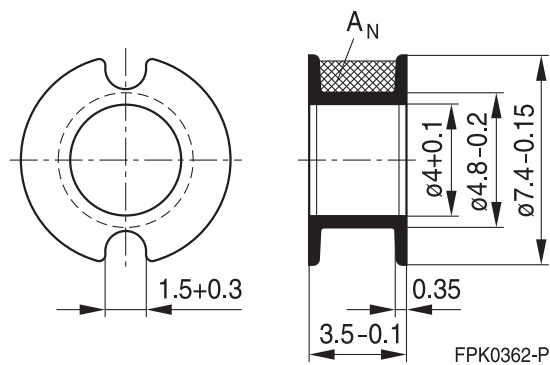
$F \triangleq$  max. operating temperature 155 °C), color code black

Valox 420-SE0® [E207780 (M)], SABIC JAPAN LLC

Winding: see Processing notes, 2.1

Coil former				Ordering code
Sections	$A_N$ mm <sup>2</sup>	$l_N$ mm	$A_R$ value $\mu\Omega$	
1	3.6	19.2	183	B65522B0000T001

### Coil former





# SMD coil former with gullwing terminals

Material: GFR liquid crystal polymer (UL 94 V-0, insulation class to IEC 60085:

F  $\triangleq$  max. operating temperature 155 °C), color code black

Sumika Super E4008® [E54705 (M)], SUMITOMO CHEMICAL CO LTD

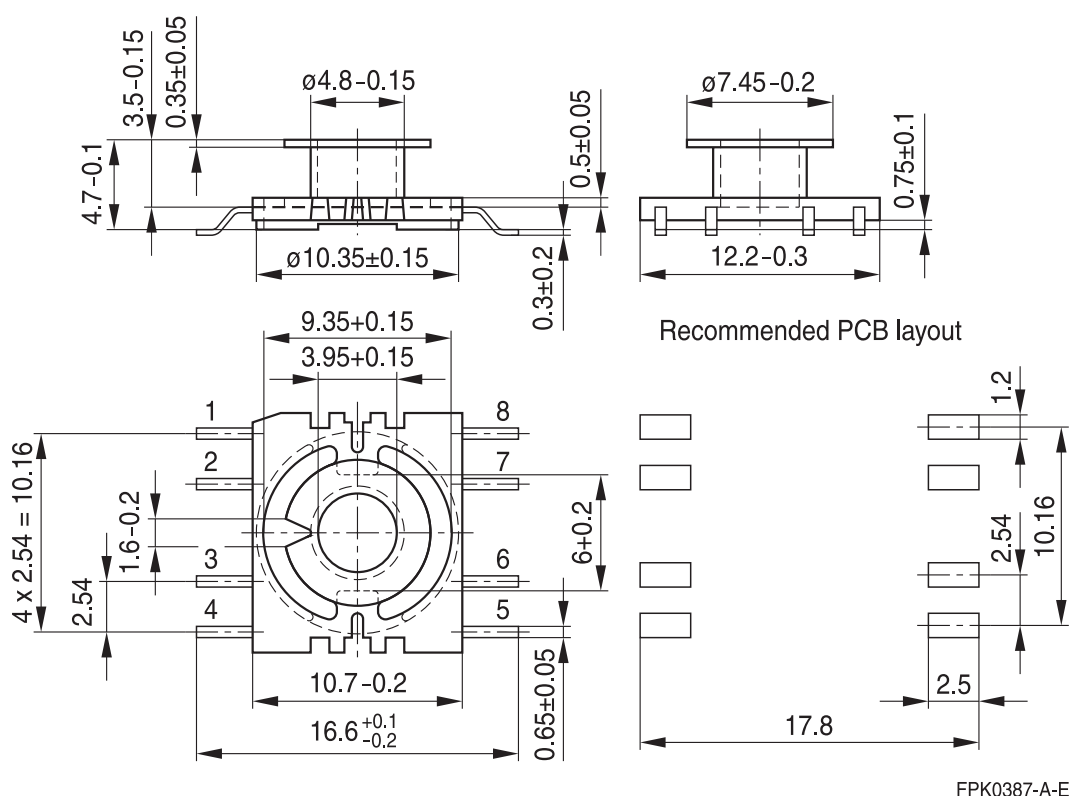
Solderability: to IEC 60068-2-58, test Td, method 6 (Group 3): 245 °C, 3 s

Resistance to soldering heat: to IEC 60068-2-58, test Td, method 6 (Group 3): 255 °C, 10 s

permissible soldering temperature for wire-wrap connection on coil former: 400 °C, 1 s

Winding: see Processing notes, 2.1

Sections	A <sub>N</sub> mm <sup>2</sup>	l <sub>N</sub> mm	A <sub>R</sub> value μΩ	Terminals	Ordering code
1	3.4	19.2	194	4	B65524C1004T001
	3.4	19.2	194	8	B65524C1008T001



In the 4-terminal version terminals 2, 3, 6 and 7 are omitted.

## Mounting assembly for printed circuit boards

- The set comprises a terminal carrier and a yoke
- For snap-in connection

### Terminal carrier

- With thread for the adjusting screw (to be combined with core version "D")

Material: GFR polyterephthalate (UL 94 V-0, insulation class to IEC 60085:

F  $\triangleq$  max. operating temperature 155 °C), color code black

Pocan B4235® [E245249 (M)], LANXESS AG

Solderability: to IEC 60068-2-20, test Ta, method 1 (aging 3): 235 °C, 2 s

Resistance to soldering heat: to IEC 60068-2-20, test Tb, method 1B: 350 °C, 3.5 s

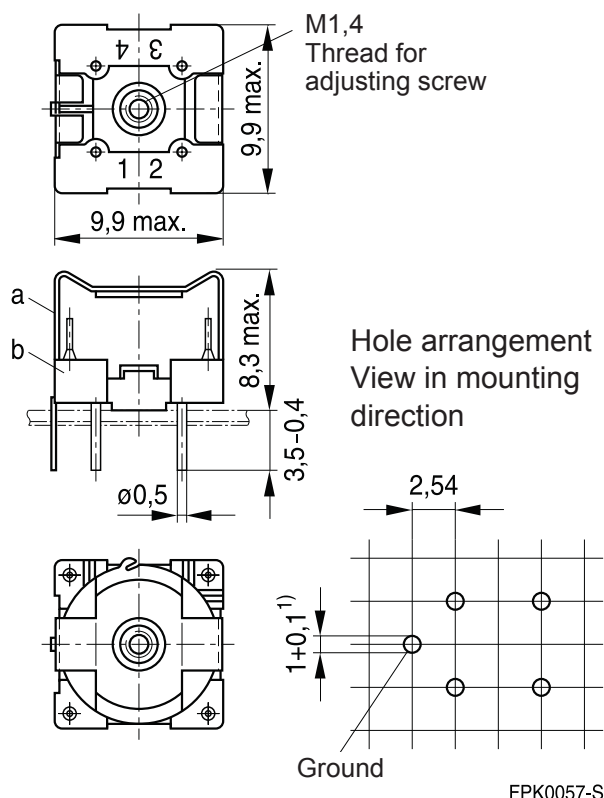
### Yoke

Spring yoke, made of tinned nickel silver (0.25 mm), with ground terminal

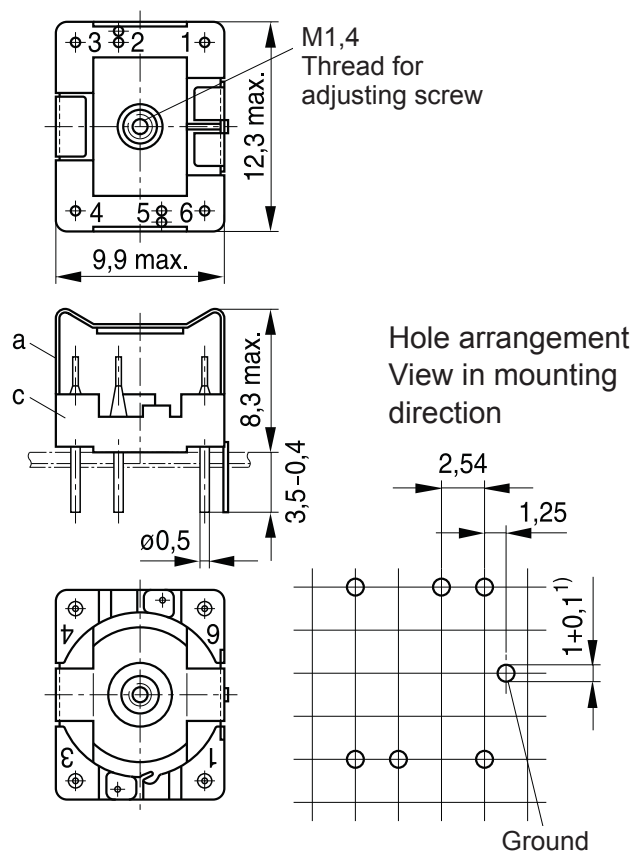
Complete mounting assembly  
(4 solder terminals)  
Ordering code: B65518D2001X000

Complete mounting assembly  
(6 solder terminals)  
Ordering code: B65518D2002X000

### 4 solder terminals



### 6 solder terminals



1) 1.3 hole also permissible

a) Yoke

b) Terminal carrier with 4 solder terminals

c) Terminal carrier with 6 solder terminals

## 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
ΔB	Flux density deviation	Vs/m <sup>2</sup> , mT
$\hat{B}$	Peak value of magnetic flux density	Vs/m <sup>2</sup> , mT
Δ $\hat{B}$	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/μ <sub>i</sub> <sup>2</sup>	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	mm <sup>3</sup>
$Z$	Complex impedance	$\Omega$
$Z_n$	Normalized impedance $ Z _n =  Z /N^2 \times \varepsilon (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
$\varepsilon_r$	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	mm <sup>-1</sup>
$\tau_{Cu}$	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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Release 2018-10

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