



## **Ferrites and accessories**

**P 11 × 7**  
**Core and accessories**

**Series/Type:**            **B65531, B65532, B65535, B65539, B65806**

**Date:**                    **June 2013**

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FPK0020-V

Example of an assembly set  
for printed circuit boards

**P 11 × 7**

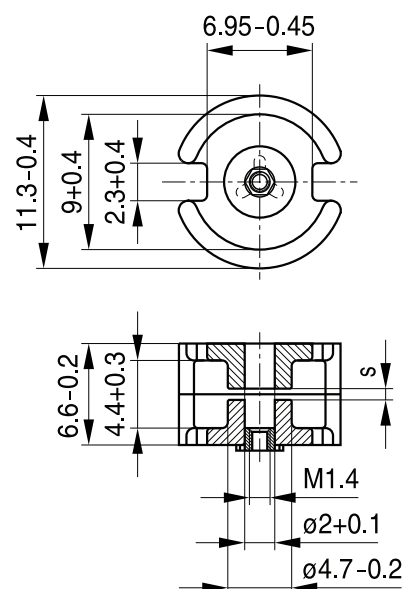
**Core**

**B65531**

- To IEC 60133
- Delivery mode: sets

**Magnetic characteristics** (per set)

	with center hole	without center hole	
$\Sigma I/A$	1.0	0.92	mm <sup>-1</sup>
$I_e$	15.9	16.3	mm
$A_e$	15.9	17.7	mm <sup>2</sup>
$A_{min}$	—	14.1	mm <sup>2</sup>
$V_e$	253	289	mm <sup>3</sup>



FPK0357-N

**Approx. weight** (per set)

m	1.7	1.8	g
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**Gapped**

Material	$A_L$ value	s approx. mm	$\mu_e$	Ordering code <sup>1)</sup> -D with center hole -T with threaded sleeve
	nH			
K1	25 ±3%	1.00	20	B65531D0025A001
	40 ±3%	0.41	32	B65531D0040A001
M33	40 ±3%	0.64	32	B65531D0040A033
	63 ±3%	0.38	50	B65531D0063A033
N48	100 ±3%	0.20	80	B65531D0100A048
	160 ±3%	0.10	127	B65531+0160A048
	250 ±3%	0.06	199	B65531+0250A048
	400 ±5%	0.03	318	B65531D0400J048

**Ungapped**

Material	$A_L$ value	$\mu_e$	$P_V$ W/set	Ordering code -D with center hole -W without center hole
	nH			
M33	780 +30/-20%	620		B65531D0000R033
N48	1800 +30/-20%	1430		B65531D0000R048
N30	3500 +30/-20%	2560		B65531W0000R030
T38	7000 +40/-30%	5130		B65531W0000Y038
N87	2000 +30/-20%	1470	< 0.12 (200 mT, 100 kHz, 100 °C)	B65531W0000R087

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

**P 11 × 7**

**Accessories**

**B65532**

**Coil former**

Standard: to IEC 60133

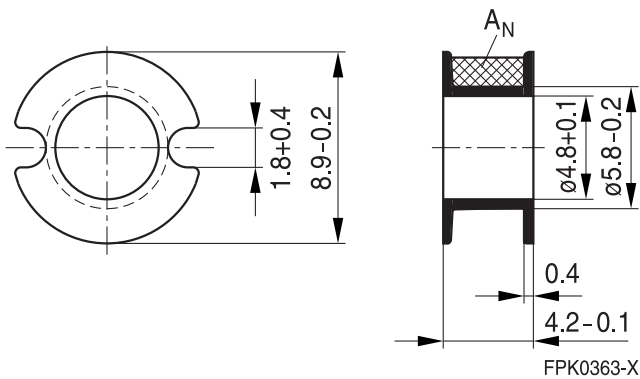
Material: GFR polyterephthalate (UL 94 V-0, insulation class to IEC 60085:

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

Valox 420-SE0® [E45329 (M)], SABIC INNOVATIVE PLASTICS

Winding: see Data Book 2013, chapter “Processing notes, 2.1”

Sections	$A_N$ mm <sup>2</sup>	$I_N$ mm	$A_R$ value $\mu\Omega$	Ordering code
1	4.2	22	180	B65532B0000T001



### 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  $\geq$  max. operating temperature + 155 °C), color code black

4 solder terminals: Rynite FR 530® [E41938 (M)], E I DUPONT DE NEMOURS & CO

8 solder terminals: 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

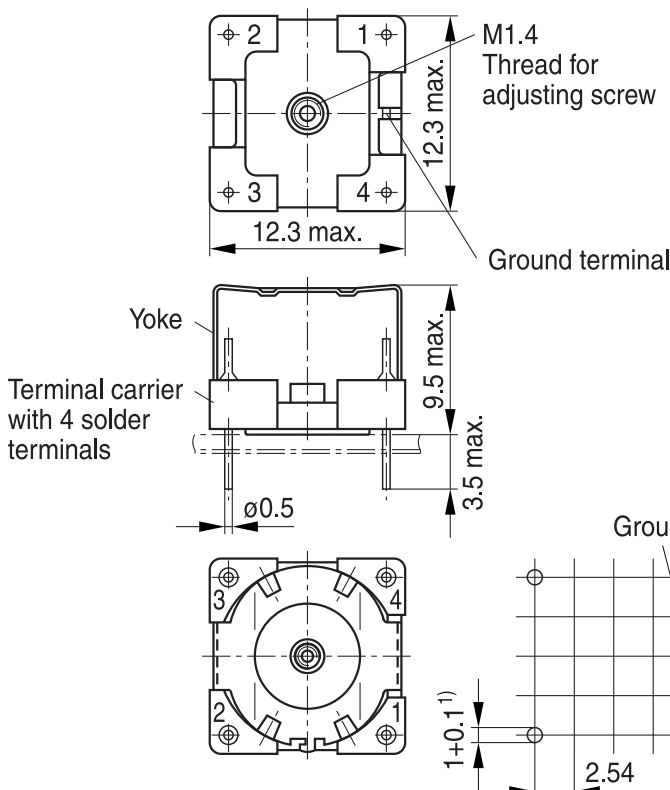
#### Yoke

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

Complete mounting assembly  
(4 solder terminals)  
Ordering code: B65535B0002X000

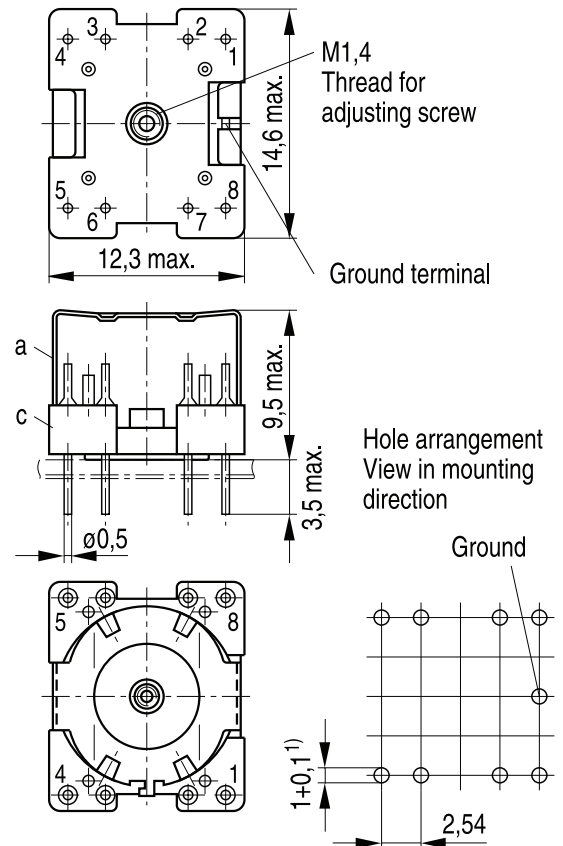
Complete mounting assembly  
(8 solder terminals)  
Ordering code: B65535B0003X000

#### 4 solder terminals



FPK0364-6-E

#### 8 solder terminals



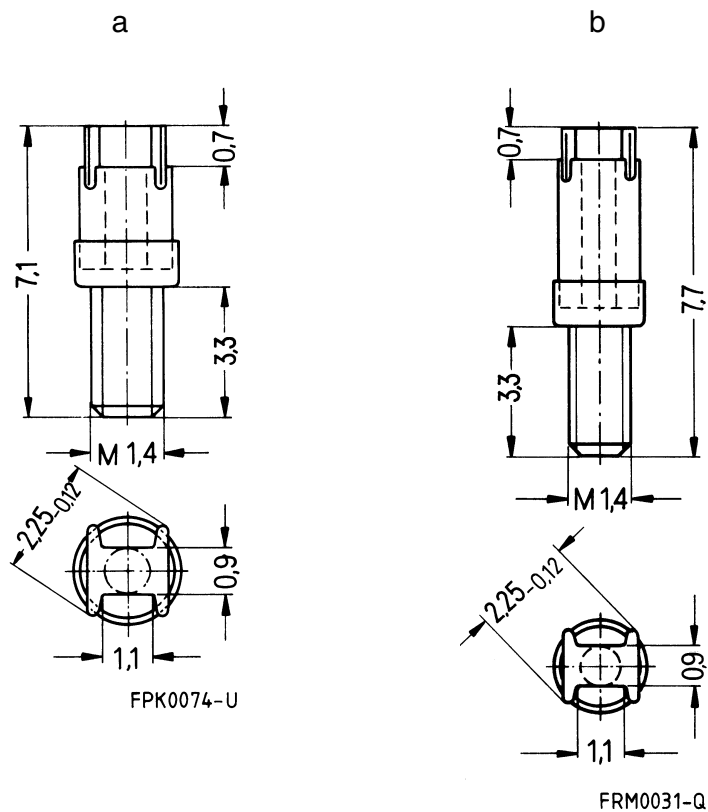
FPK0294-L-E

- 1) 1.3 hole also permissible  
a) Yoke  
c) Terminal carrier with 8 solder terminals

**Adjusting screw**

- Tube core with thread and core brake made of GFR polyterephthalate  
Pocan B3235® [E245249 (M)], LANXESS AG

Figure	Tube core Ø × length (mm)	Material	Color code	Ordering code
a	1.81 × 2.0	K1	yellow	B65539C1003X001
a	1.81 × 2.7	K1	gray	B65539C1002X001
a	1.81 × 2.7	N22	red	B65539C1002X022
b	1.81 × 3.4	N22	green	B65806C3001X022



**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 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 chapter *“Definitions”*, section 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 chapter *“Definitions”*, section 8.2.

**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.

**Processing notes**

- The start of the winding process should be soft. Else the flanges may be destroyed.
- To strong winding forces may blast the flanges or squeeze the tube that the cores can no more be mounted.
- To 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 oxyd of the tin bath or burned insulation of the wire. For detailed information see chapter *“Processing notes”*, section 8.2.
- 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.

**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 ( $\cong \mu_a$ )	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 \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
$\epsilon_r$	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	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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