



## **Ferrites and accessories**

EP 7  
Core and accessories

**Series/Type:** B65839, B65840

**Date:** June 2013

- To IEC 61596
- For transformers featuring high inductance and low overall height
- For power applications
- Delivery mode: sets

**Magnetic characteristics (per set)**

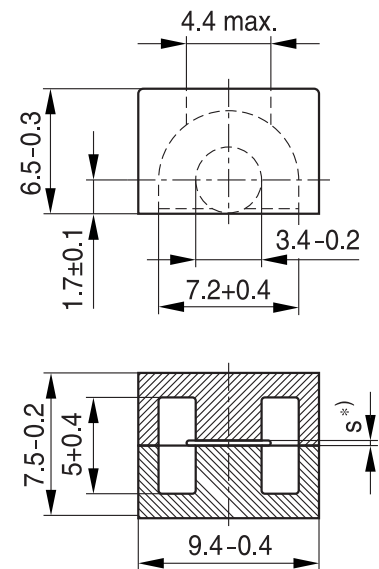
$$\Sigma l/A = 1.52 \text{ mm}^{-1}$$

$$l_e = 15.7 \text{ mm}$$

$$A_e = 10.3 \text{ mm}^2$$

$$A_{\min} = 8.5 \text{ mm}^2$$

$$V_e = 162 \text{ mm}^3$$

**Approx. weight 1.4 g/set**


\*) gapped (one-sided)

FEP0073-J-E

**Gapped**

Material	A <sub>L</sub> value nH	s approx. mm	μ <sub>e</sub>	Ordering code
T38	63 ±3%	0.20	76	B65839A0063A038
	100 ±3%	0.13	121	B65839A0100A038
	160 ±5%	0.08	194	B65839A0160J038
	200 ±6%	0.06	243	B65839A0200C038
	250 ±7%	0.05	303	B65839A0250E038
T57	63 ±3%	0.20	76	B65839A0063A057
	100 ±3%	0.13	121	B65839A0100A057
	160 ±5%	0.08	194	B65839A0160J057
	200 ±6%	0.06	243	B65839A0200C057
	250 ±7%	0.05	303	B65839A0250E057
N45	63 ±3%	0.20	76	B65839A0063A045
	100 ±3%	0.13	121	B65839A0100A045
	160 ±5%	0.08	194	B65839A0160J045
	200 ±6%	0.06	243	B65839A0200C045
	250 ±7%	0.05	303	B65839A0250E045
N87	63 ±3%	0.20	76	B65839A0063A087
	100 ±3%	0.12	121	B65839A0100A087
	160 ±5%	0.07	194	B65839A0160J087
	200 ±6%	0.06	243	B65839A0200C087
	250 ±7%	0.05	303	B65839A0250E087

**Ungapped**

Material	A <sub>L</sub> value nH	μ <sub>e</sub>	P <sub>V</sub> W/set	Ordering code
T57	1500 +30/-20%	1820		B65839A0000R057
N45	1500 +30/-20%	1820		B65839A0000R045
N30	2000 +30/-20%	2430		B65839A0000R030
T65	3000 +30/-20%	3640		B65839A0000R065
T38	5200 +40/-30%	6310		B65839A0000Y038
T66	5800 +40/-30%	7040		B65839A0000Y066
N87	1100 +30/-20%	1330	< 0.08 (200 mT, 100 kHz, 100 °C)	B65839A0000R087

**Coil former**

Material: GFR thermosetting plastic (UL 94 V-0, insulation class to IEC 60085: F  $\hat{=}$  max. operating temperature 155 °C), color code green  
 B65840B1006D001: Sumikon PM 9630® [E41429 (M)], color code black, SUMITOMO BAKELITE CO LTD  
 B65840B1006D002: Vyncolit/X611® [E167521 (M)], VYNCOLIT NV  
 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  
 Winding: see Data Book 2013, chapter "Processing notes, 2.1"

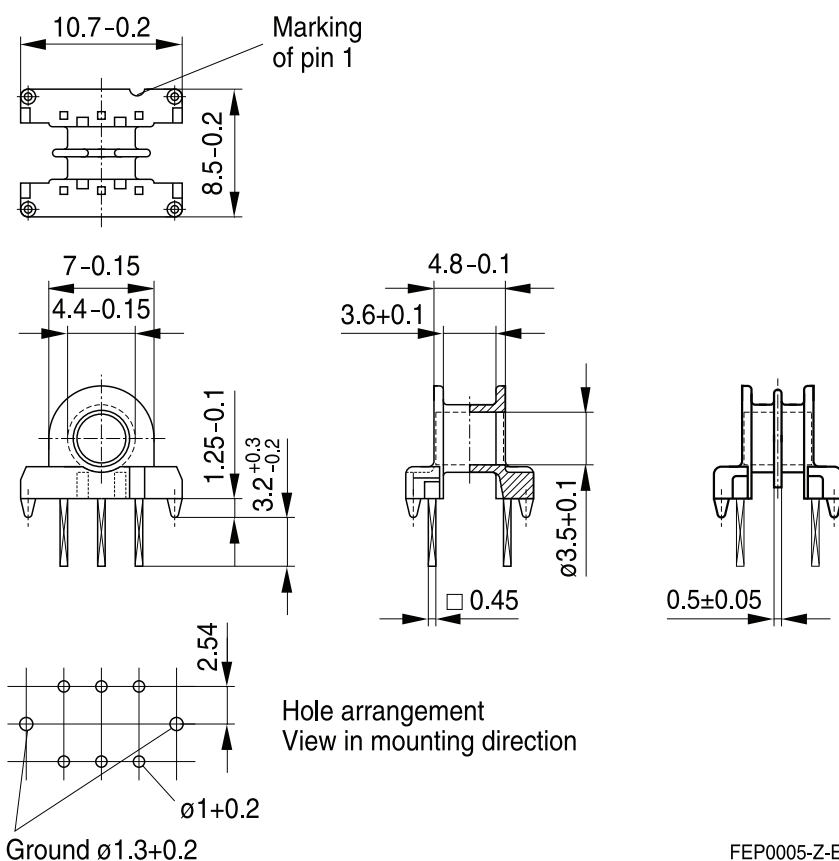
Squared pins.

**Cap yoke**

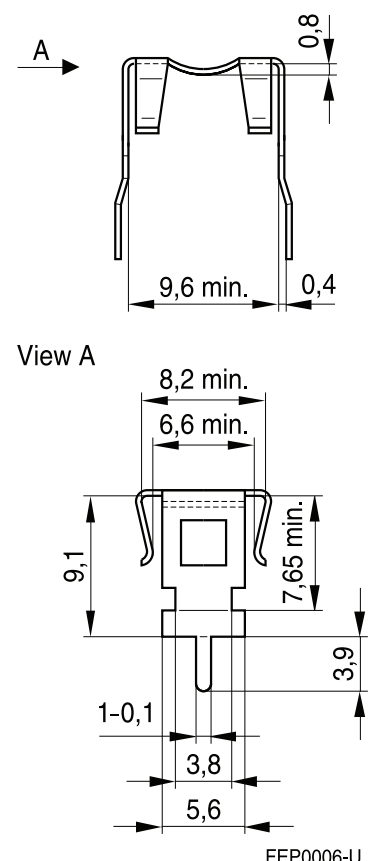
With ground terminal, made of stainless spring steel (tinned), 0.25 mm thick

Coil former					Ordering code
Sections	A <sub>N</sub> mm <sup>2</sup>	l <sub>N</sub> mm	A <sub>R</sub> value μΩ	Terminals	
1	4.7	17.7	128.7	6	B65840B1006D001
2	4.2	17.7	143.8	6	B65840B1006D002
Cap yoke					B65840D2000X000

**Coil former**



**Cap yoke**



Preliminary data



**SMD coil former with gullwing terminals**

Material: GFR liquid crystal polymer (UL 94 V-0), color code black

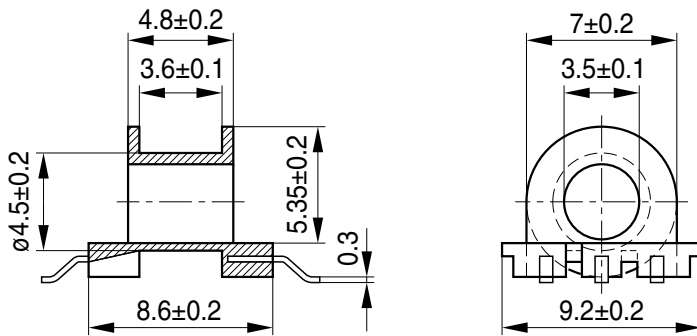
Sumika Super E4008® [E54705 (M)], SUMITOMO CHEMICAL CO LTD

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

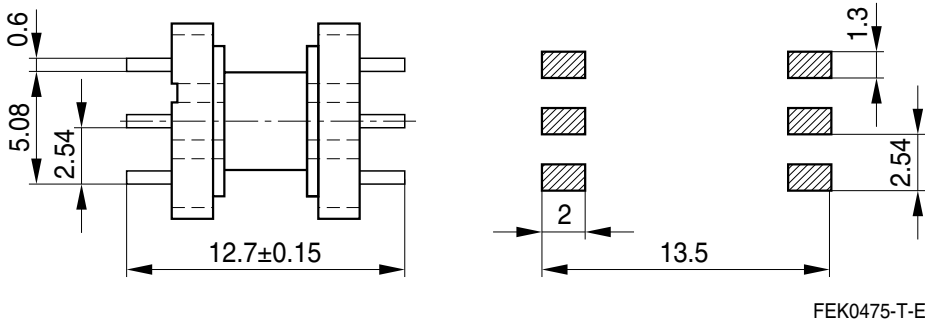
Resistance to soldering heat: to IEC 60068-2-58, test Td, method 6 (Group 3): 255 °C, 10 s

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

Sections	A <sub>N</sub> mm <sup>2</sup>	l <sub>N</sub> mm	A <sub>R</sub> value μΩ	Terminals	Ordering code
1	4.5	18.1	138.1	6	B65840N1106T001



Recommended PCB layout



### **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 mount.
- 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 \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
$\varepsilon_r$	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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