



## **Ferrites and accessories**

RM 4, RM 4 LP  
Core and accessories

**Series/Type:** B65803, B65804, B65806, B65539

**Date:** February 2016

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RM 4

Core and accessories

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| Core                       | B65803           | 3    |
| Threaded sleeve (glued-in) |                  |      |
| Insulating washer          | B65804           | 6    |

FRM0009-Z

Example of an assembly set

**Also available:**

RM 4 low profile:

|                                     |        |    |
|-------------------------------------|--------|----|
| Core                                | B65803 | 8  |
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|             |               |
|-------------|---------------|
| <b>RM 4</b> |               |
| <b>Core</b> | <b>B65803</b> |

- To IEC 62317-4
- Core without center hole for transformer applications
- Delivery mode: sets

**Magnetic characteristics (per set)**

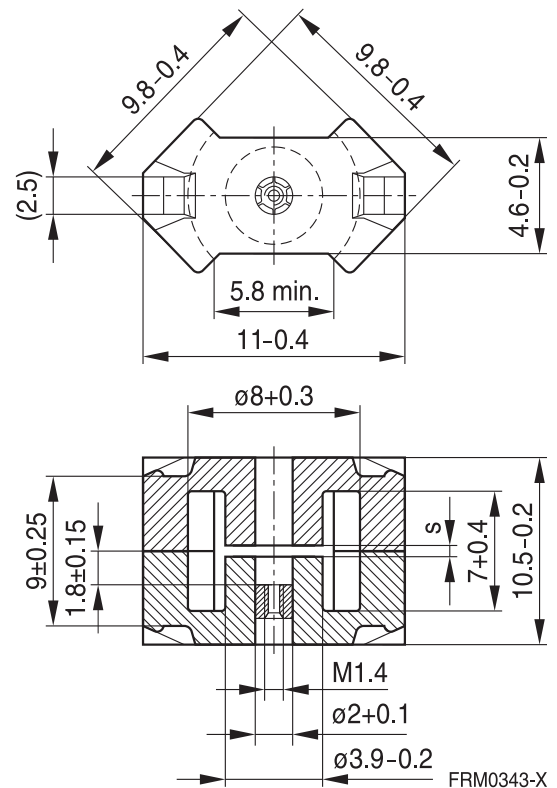
|                  | with center hole | without center hole |                  |
|------------------|------------------|---------------------|------------------|
| $\Sigma l/A$     | 1.9              | 1.7                 | $\text{mm}^{-1}$ |
| $l_e$            | 21               | 22                  | mm               |
| $A_e$            | 11               | 13                  | $\text{mm}^2$    |
| $A_{\text{min}}$ | —                | 11.3                | $\text{mm}^2$    |
| $V_e$            | 231              | 286                 | $\text{mm}^3$    |

**Approx. weight (per set)**

| m | 1.45 | 1.65 | g |
|---|------|------|---|
|   |      |      |   |

**Gapped**

| Material | $A_L$ value | s approx. mm | $\mu_e$ | Ordering code <sup>1)</sup><br>-A with center hole<br>-N with threaded sleeve |
|----------|-------------|--------------|---------|---|
|          | nH          |              |         |   |
| K1       | 16 ±3%      | 1.0          | 24.2    | B65803+0016A001   |
|          | 25 ±3%      | 0.40         | 37.8    | B65803+0025A001   |
| M33      | 40 ±3%      | 0.36         | 60.4    | B65803+0040A033   |
|          | 63 ±3%      | 0.18         | 96      | B65803+0063A033   |
| N48      | 63 ±3%      | 0.16         | 96      | B65803+0063A048   |
|          | 100 ±3%     | 0.10         | 152     | B65803+0100A048   |
|          | 160 ±3%     | 0.06         | 243     | B65803+0160A048   |



1) Replace the + by the code letter "A" or "N" for the required version.

**RM 4**
**Core**
**B65803**
**Ungapped**

| Material | A <sub>L</sub> value<br>nH | μ <sub>e</sub> | P <sub>V</sub><br>W/set          | Ordering code<br>-J without center hole |
|----------|----------------------------|----------------|----------------------------------|---|
| N45      | 1700 +30/-20%              | 2290           |                                  | B65803J0000R045                         |
| N30      | 1900 +30/-20%              | 2560           |                                  | B65803J0000R030                         |
| T35      | 2800 +40/-30%              | 3770           |                                  | B65803J0000Y035                         |
| T38      | 3700 +40/-30%              | 4980           |                                  | B65803J0000Y038                         |
| N49      | 750 +30/-20%               | 1010           | < 0.04 ( 50 mT, 500 kHz, 100 °C) | B65803J0000R049                         |
| N87      | 1100 +30/-20%              | 1480           | < 0.20 (200 mT, 100 kHz, 100 °C) | B65803J0000R087                         |
| N97      | 1100 +30/-20%              | 1480           | < 0.15 (200 mT, 100 kHz, 100 °C) | B65803J0000R097                         |

**Coil former**

Material: GFR thermosetting plastic (UL 94 V-0, insulation class to IEC 60085:  
 $H \triangleq$  max. operating temperature 155 °C), color code black  
 Sumikon PM 9630® [E41429 (M)], SUMIMOTO BAKELITE CO LTD

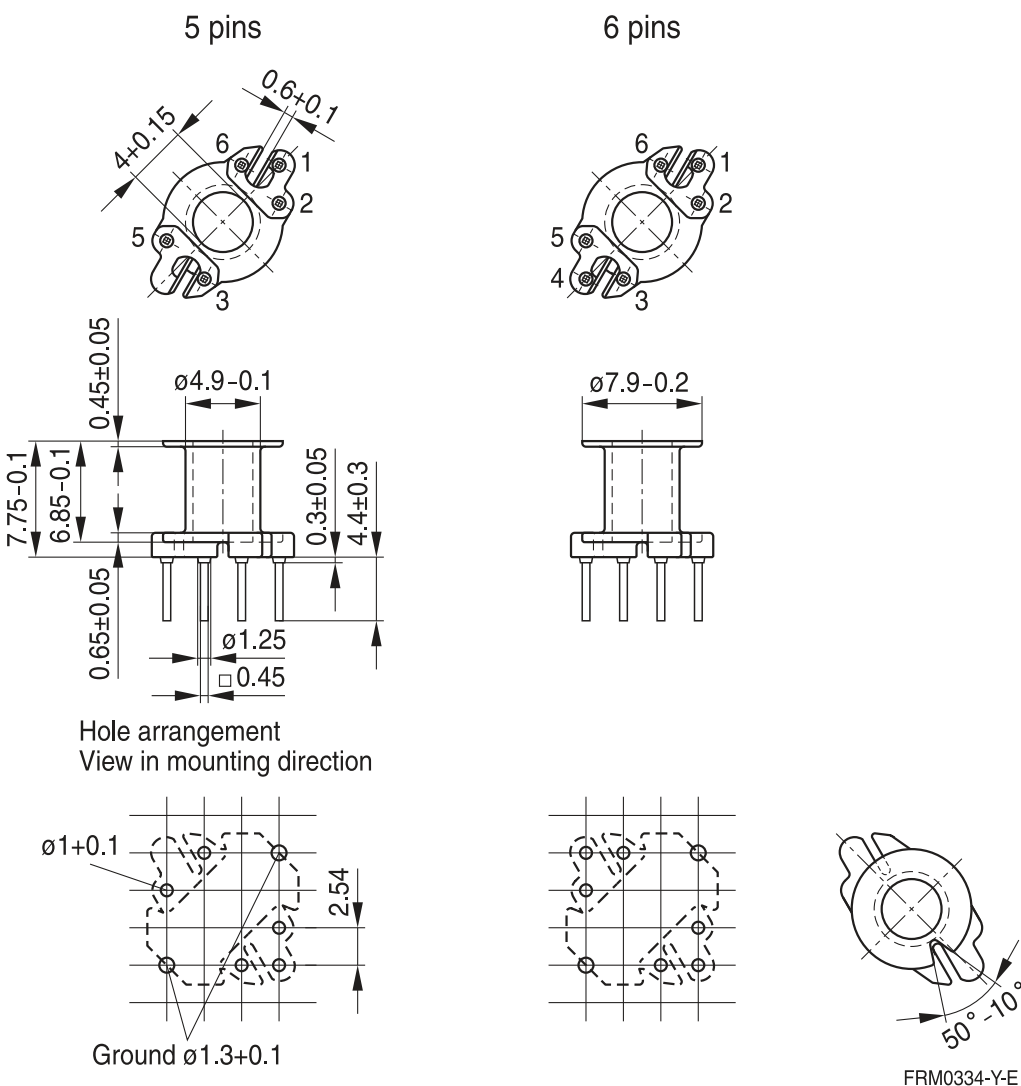
Solderability: to IEC 60068-2-20, test Ta, method 1 (aging 3): 235 °C, 2 s

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"

For matching clamp and insulating washers see page 6.

| Sections | $A_N$<br>mm <sup>2</sup> | $l_N$<br>mm | $A_R$ value<br>$\mu\Omega$ | Pins   | Ordering code                      |
|----------|--------------------------|-------------|----------------------------|--------|------------------------------------|
| 1        | 7.7                      | 20          | 89                         | 5<br>6 | B65804N1105D001<br>B65804N1106D001 |



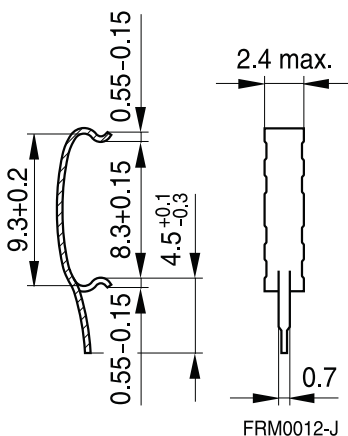
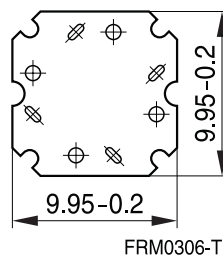
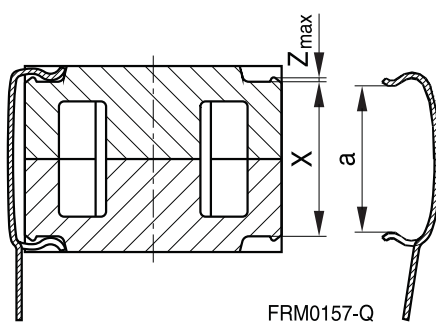
**RM 4**
**Accessories**
**B65804, B65806**
**Clamp**

- With ground terminal, made of stainless spring steel (tinned), 0.3 mm thick
- Solderability to IEC 60068-2-20, test Ta, method 1 (aging 3): 235 °C, 2 s
- Also available as strip clamp on reels on request

**Insulating washer for double-clad PCBs**

- Made of polycarbonate (UL 94 V-0, insulation class to IEC 60085: E  $\geq$  120 °C), 0.25 mm thick Makrofol FR7-2, [E118859 (M)], natural color, BAYER MATERIALSCIENCE AG

|   | Ordering code   |
|---|-----------------|
| Clamp (ordering code per piece, 2 are required) | B65806B2203X000 |
| Insulating washer (bulk)                        | B65804C2005X000 |

**Clamp**

**Insulating washer**

**Clamping forces for RM 4**


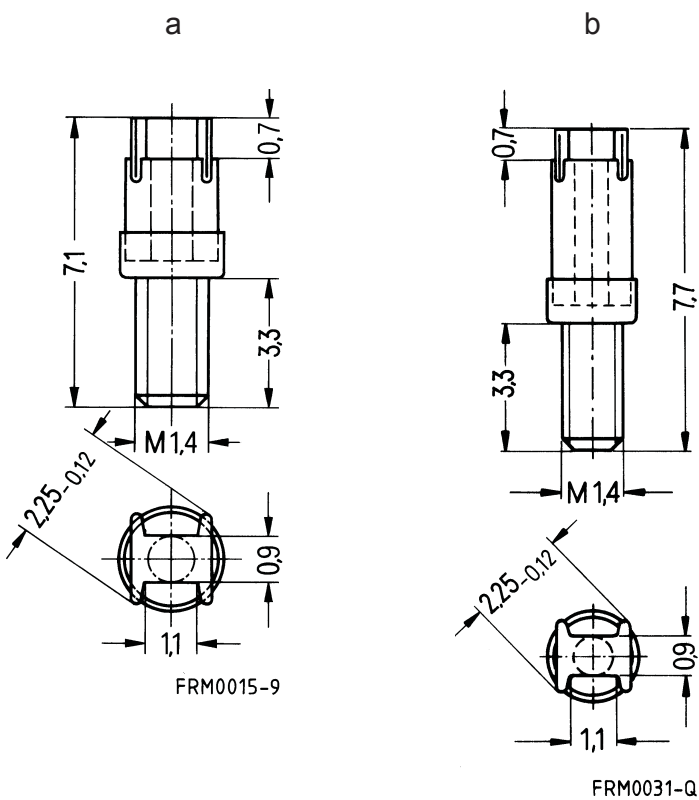
$F_{\min}$ : Extension of clamp from  $a$  to  $a_2 = X_{\min}$   
 $F_{\max}$ : Extension of clamp from  $a$  to  $a_1 = X_{\max}$

|                              |            |           |
|------------------------------|------------|-----------|
| Clamp opening $a$ (mm)       |            | 8.3 +0.15 |
| Core nose $Z_{\max}$ (mm)    |            | 0.15      |
| Height of core pair $X$ (mm) | $X_{\min}$ | 8.75      |
|                              | $X_{\max}$ | 9.25      |
| Clamping force $F$ (N)       | $F_{\min}$ | 5         |
|                              | $F_{\max}$ | 40        |

**Adjusting screw**

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

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



**RM 4 »Low Profile«**
**Core**
**B65803**

- To IEC 62317-4
- For compact transformers with high inductance
- Without center hole
- Delivery mode: sets

**Magnetic characteristics (per set)**

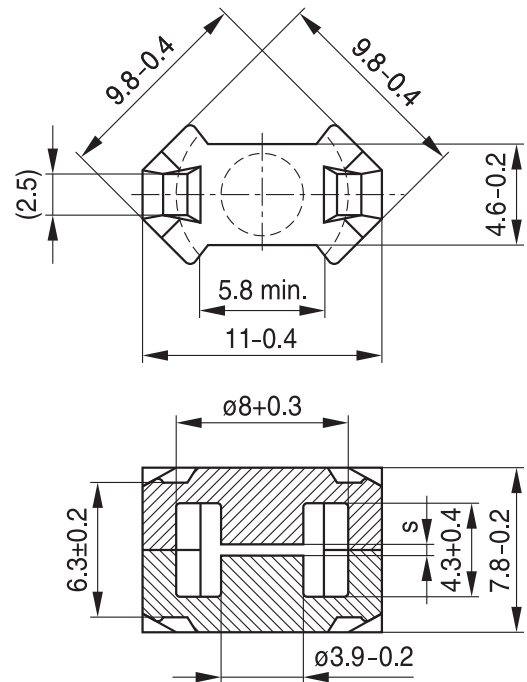
$$\Sigma l/A = 1.2 \text{ mm}^{-1}$$

$$l_e = 17.3 \text{ mm}$$

$$A_e = 14.5 \text{ mm}^2$$

$$A_{\min} = 11.3 \text{ mm}^2$$

$$V_e = 251 \text{ mm}^3$$

**Approx. weight 1.2 g/set**


FRM0345-E

**Ungapped**

| Material | $A_L$ value   | $\mu_e$ | $P_V$                            | Ordering code   |
|----------|---------------|---------|----------------------------------|-----------------|
|          | nH            |         | W/set                            |                 |
| T38      | 5000 +40/-30% | 4750    |                                  | B65803P0000Y038 |
| N49      | 950 +30/-20%  | 900     | < 0.04 ( 50 mT, 500 kHz, 100 °C) | B65803P0000R049 |
| N92      | 1000 +30/-20% | 950     | < 0.14 (200 mT, 100 kHz, 100 °C) | B65803P0000R092 |
| N87      | 1300 +30/-20% | 1230    | < 0.12 (200 mT, 100 kHz, 100 °C) | B65803P0000R087 |



**Coil former**

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

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

Sumikon PM 9630® [E41429 (M)], SUMIMOTO BAKELITE CO LTD

Solderability: to IEC 60068-2-58, test Ta, method 1 (aging 3): 235 °C, 2 s

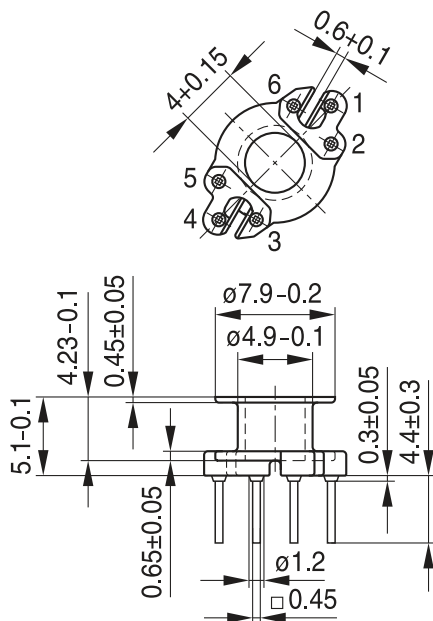
Resistance to soldering heat: to IEC 60068-2-20, test Tb, method 1B: 350 °C, 2 s

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

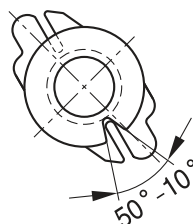
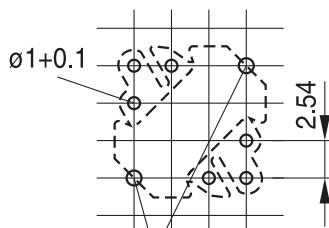
Winding: see Data Book 2013, chapter "Processing notes, 2.1"

For matching clamp and insulating washers, see page 11.

| Sections | $A_N$<br>mm <sup>2</sup> | $l_N$<br>mm | $A_R$ value<br>$\mu\Omega$ | Terminals | Ordering code   |
|----------|--------------------------|-------------|----------------------------|-----------|-----------------|
| 1        | 4.7                      | 20.1        | 147                        | 6         | B65804N1206D001 |

**Coil former**


Hole arrangement  
View in mounting direction



FRM0364-K-E


**SMD coil former with J 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  
 Vectra C 130 [E83005 (M)], TICONA

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

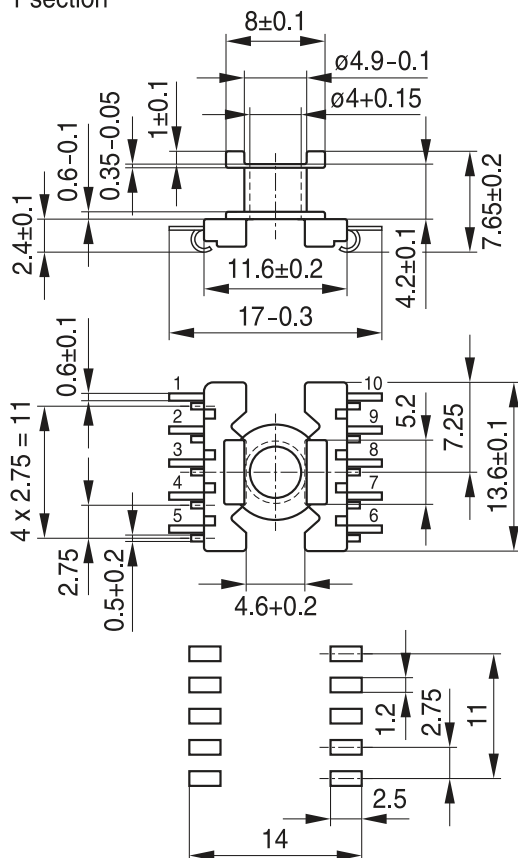
Winding: see Data Book 2013, chapter "Processing notes, 2.1"

For matching clamp, see page 11.

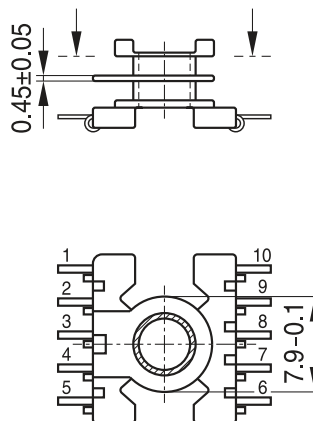
| Sections | $A_N$<br>mm <sup>2</sup> | $l_N$<br>mm | $A_R$ value<br>$\mu\Omega$ | Terminals <sup>1)</sup> | Ordering code   |
|----------|--------------------------|-------------|----------------------------|-------------------------|-----------------|
| 1        | 5.0                      | 20.1        | 138                        | 10                      | B65804B6010T001 |
| 2        | 4.4                      | 20.1        | 157                        | 10                      | B65804B6010T002 |

**Coil former**

1 section



2 sections


 Recommended  
 PCB layout

FRM0258-5-E

1) 6 and 8 terminals on request

### Clamp

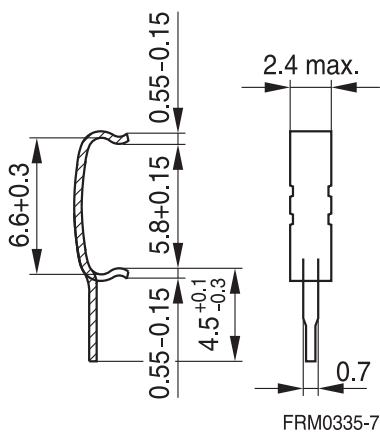
- With ground terminal, made of stainless spring steel (tinned), 0.3 mm thick, Without ground terminal, made of stainless spring steel, 0.3 mm thick
- Solderability to IEC 60068-2-20, test Ta, method 1 (aging 3): 235 °C, 2 s
- Also available as strip clamp on reels on request

### Insulating washer for double-clad PCBs

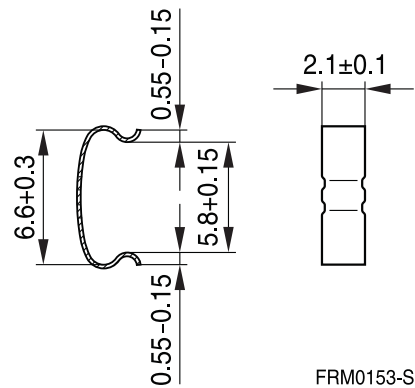
- Made of polycarbonate (UL 94 V-0, insulation class to IEC 60085: E  $\geq$  120 °C), 0.25 mm thick Makrofol FR7-2, [E118859 (M)], natural color, BAYER MATERIALSCIENCE AG

|   | Ordering code   |
|---|-----------------|
| Clamp with ground terminal (ordering code per piece, 2 are required)    | B65804P2203X000 |
| Clamp without ground terminal (ordering code per piece, 2 are required) | B65804P2204X000 |
| Insulating washer (bulk)  | B65804C2005X000 |

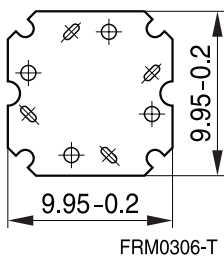
### Clamp with ground terminal



### Clamp without ground terminal



### Insulating washer



## 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 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.
- 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 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.

#### Display of ordering codes for EPCOS products

The ordering code for one and the same product can be represented differently in data sheets, data books, other publications and the website of EPCOS, or in order-related documents such as shipping notes, order confirmations and product labels. **The varying representations of the ordering codes are due to different processes employed and do not affect the specifications of the respective products.** Detailed information can be found on the Internet under [www.epcos.com/orderingcodes](http://www.epcos.com/orderingcodes).

**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 \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<br>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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