

Ferrites and accessories

RM 4, RM 4 LP Core and accessories

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

Date: May 2017

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RM 4

Core and accessories

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FRM0009-Z

Example of an assembly set

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RM 4
Core
B65803
Ungapped

Material	A _L value nH	μ _e	P _V W/set	Ordering code -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

Other A_L values/air gaps and materials available on request — see Processing remarks on page 12.

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

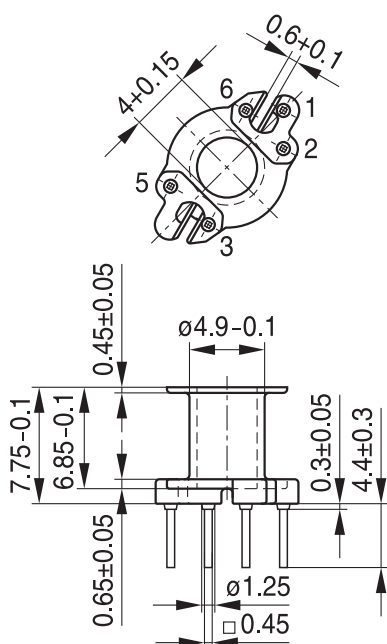
Resistance to soldering heat: to IEC 60068-2-20, test Tb, method 1B: 350 °C, 3.5 s

Winding: see Processing notes, 2.1

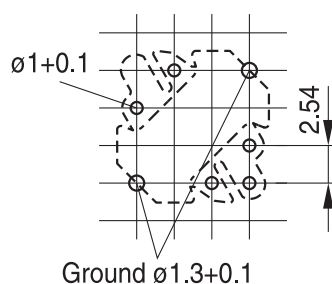
For matching clamp and insulating washers see page 6.

Sections	A_N mm ²	l_N mm	A_R value $\mu\Omega$	Pins	Ordering code
1	7.7	20	89	5 6	B65804N1105D001 B65804N1106D001

5 pins

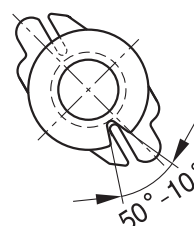
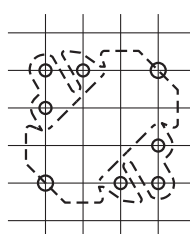
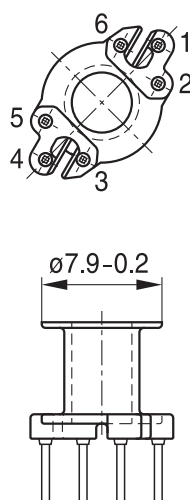


Hole arrangement
View in mounting direction



Ground $\varnothing 1.3 \pm 0.1$

6 pins



FRM0334-Y-E

RM 4

Accessories

B65804, B65806

Clamp

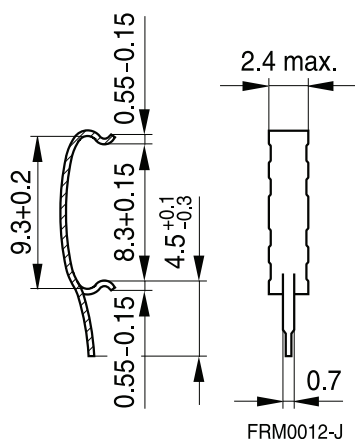
- With ground terminal, made of stainless spring steel (tinned), 0.3 mm thick
- Solderability to IEC 60068-2-20, test Ta, method 1 (aging 3): 235 °C, 2 s

Insulating washer for double-clad PCBs

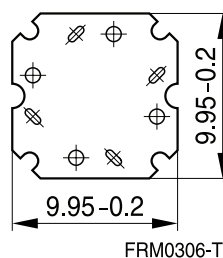
- Made of polyarylate film (UL 94 V-0, insulation class to IEC 60085: E $\geq$ 120 °C), 0.25 mm thick Makrofol FR7-2 [E168120 (M)], COVESTRO AG

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

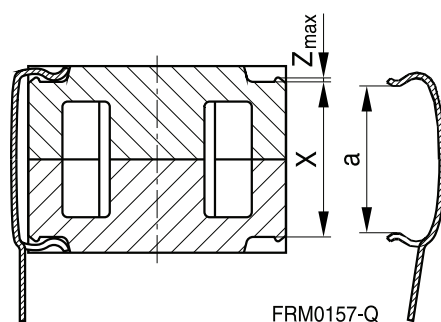
Clamp



Insulating washer



Clamping forces for RM 4



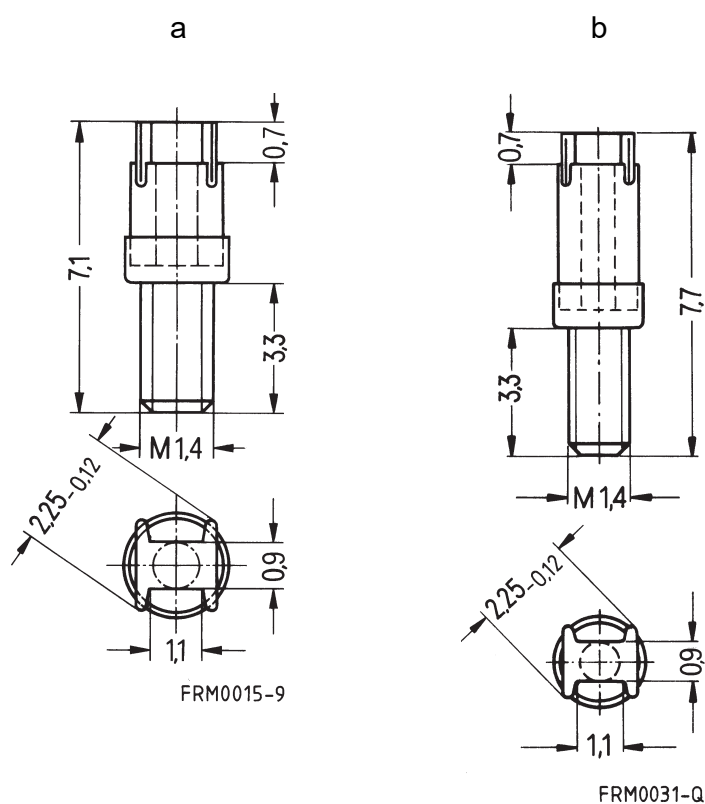
F_{min} : Extension of clamp from a to $a_2 = X_{min}$
 F_{max} : Extension of clamp from a to $a_1 = X_{max}$

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
	Ø × 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)

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

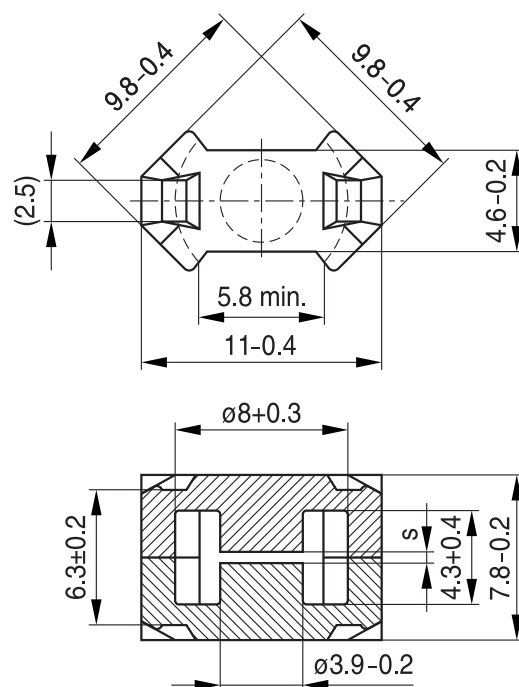
$$l_e = 17.3 \text{ mm}$$

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

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

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

Approx. weight 1.2 g/set



FRM0345-E

Ungapped

Material	A_L value nH	μ_e	P_V W/set	Ordering code
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

Other A_L values/air gaps and materials available on request – see Processing remarks on page 12.

RM 4 »Low Profile«

Accessories

B65804

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

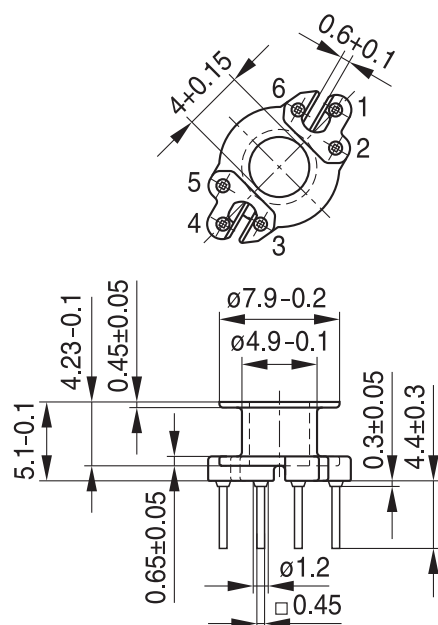
permissible soldering temperature for wire-wrap connection on coil former: 400 °C, 1 s

Winding: see Processing notes, 2.1

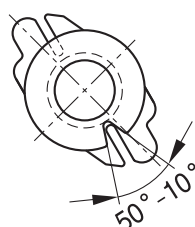
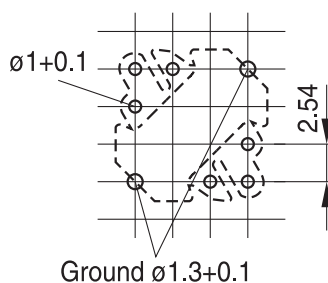
For matching clamp and insulating washers, see page 11.

Sections	A_N mm ²	l_N mm	A_R value $\mu\Omega$	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)], CELANESE INTERNATIONAL CORP.

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

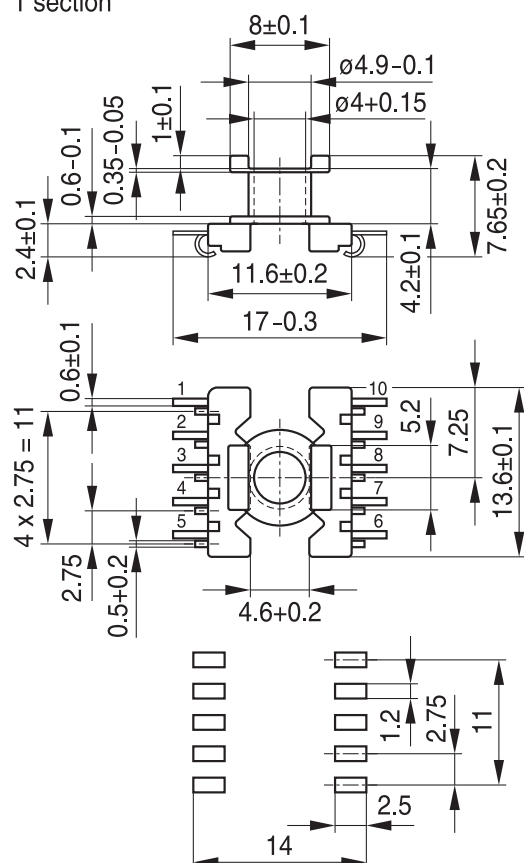
Winding: see Processing notes, 2.1

For matching clamp, see page 11.

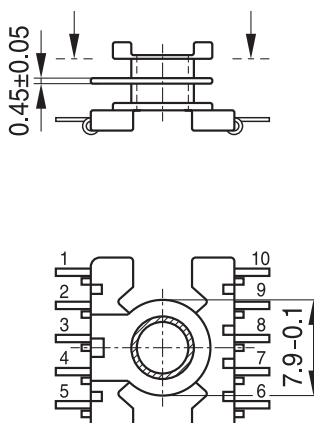
Sections	A _N mm ²	l _N mm	A _R value μΩ	Terminals ¹⁾	Ordering code
1	5.0	20.1	138	10	B65804B6010T001
2	4.4	20.1	157	10	B65804B6010T002

Coil former

1 section



2 sections



Recommended
PCB layout

FRM0258-5-E

1) 6 and 8 terminals on request

RM 4 »Low Profile«

Accessories

B65804

Clamp

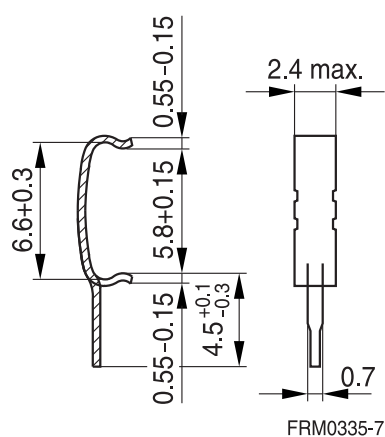
- With ground terminal, made of stainless spring steel (tinned), 0.3 mm thick,
Without ground terminal, made of stainless spring steel, 0.3 mm thick
- Solderability to IEC 60068-2-20, test Ta, method 1 (aging 3): 235 °C, 2 s

Insulating washer for double-clad PCBs

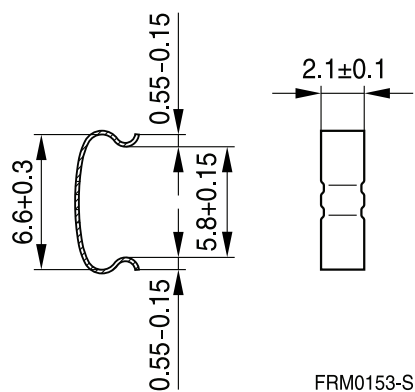
- Made of polyarylate film (UL 94 V-0, insulation class to IEC 60085: E $\geq$ 120 °C), 0.25 mm thick
Makrofol FR7-2 [E168120 (M)], COVESTRO AG

	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

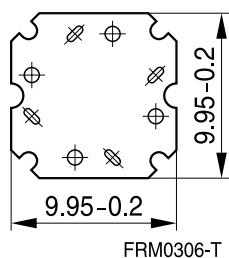
Clamp with ground terminal



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 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.

Ferrites and accessories

Cautions and warnings

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.

Ferrites and accessories

Symbols and terms

Symbol	Meaning	Unit
A	Cross section of coil	mm ²
A _e	Effective magnetic cross section	mm ²
A _L	Inductance factor; $A_L = L/N^2$	nH
A _{L1}	Minimum inductance at defined high saturation ($\cong \mu_a$)	nH
A _{min}	Minimum core cross section	mm ²
A _N	Winding cross section	mm ²
A _R	Resistance factor; $A_R = R_{Cu}/N^2$	$\mu\Omega = 10^{-6} \Omega$
B	RMS value of magnetic flux density	Vs/m ² , mT
ΔB	Flux density deviation	Vs/m ² , mT
$\hat{B}$	Peak value of magnetic flux density	Vs/m ² , mT
$\Delta \hat{B}$	Peak value of flux density deviation	Vs/m ² , mT
B _{DC}	DC magnetic flux density	Vs/m ² , mT
B _R	Remanent flux density	Vs/m ² , mT
B _S	Saturation magnetization	Vs/m ² , mT
C ₀	Winding capacitance	F = As/V
CDF	Core distortion factor	mm ^{-4.5}
DF	Relative disaccommodation coefficient $DF = d/\mu_i$	
d	Disaccommodation coefficient	
E _a	Activation energy	J
f	Frequency	s ⁻¹ , Hz
f _{cutoff}	Cut-off frequency	s ⁻¹ , Hz
f _{max}	Upper frequency limit	s ⁻¹ , Hz
f _{min}	Lower frequency limit	s ⁻¹ , Hz
f _r	Resonance frequency	s ⁻¹ , Hz
f _{Cu}	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 _{DC}	DC field strength	A/m
H _c	Coercive field strength	A/m
h	Hysteresis coefficient of material	10 ⁻⁶ cm/A
h/ μ_i^2	Relative hysteresis coefficient	10 ⁻⁶ cm/A
I	RMS value of current	A
I _{DC}	Direct current	A
$\hat{I}$	Peak value of current	A
J	Polarization	Vs/m ²
k	Boltzmann constant	J/K
k ₃	Third harmonic distortion	
k _{3c}	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	Ω
R_{Cu}	Copper (winding) resistance ($f = 0$)	Ω
R_h	Hysteresis loss resistance of a core	Ω
ΔR_h	R_h change	Ω
R_i	Internal resistance	Ω
R_p	Parallel loss resistance of a core	Ω
R_s	Series loss resistance of a core	Ω
R_{th}	Thermal resistance	K/W
R_V	Effective loss resistance of a core	Ω
s	Total air gap	mm
T	Temperature	$^{\circ}\text{C}$
ΔT	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 ³
Z	Complex impedance	Ω
Z_n	Normalized impedance $ Z _n = Z /N^2 \times \varepsilon (l_e/A_e)$	Ω/mm

Ferrites and accessories

Symbols and terms

Symbol	Meaning	Unit
α	Temperature coefficient (TK)	1/K
α_F	Relative temperature coefficient of material	1/K
α_e	Temperature coefficient of effective permeability	1/K
ϵ_r	Relative permittivity	
Φ	Magnetic flux	Vs
η	Efficiency of a transformer	
η_B	Hysteresis material constant	mT ⁻¹
η_i	Hysteresis core constant	A ⁻¹ H ^{-1/2}
λ_s	Magnetostriction at saturation magnetization	
μ	Relative complex permeability	
μ_0	Magnetic field constant	Vs/Am
μ_a	Relative amplitude permeability	
μ_{app}	Relative apparent permeability	
μ_e	Relative effective permeability	
μ_i	Relative initial permeability	
μ_p'	Relative real (inductive) component of $\bar{\mu}$ (for parallel components)	
μ_p''	Relative imaginary (loss) component of $\bar{\mu}$ (for parallel components)	
μ_r	Relative permeability	
μ_{rev}	Relative reversible permeability	
μ_s'	Relative real (inductive) component of $\bar{\mu}$ (for series components)	
μ_s''	Relative imaginary (loss) component of $\bar{\mu}$ (for series components)	
μ_{tot}	Relative total permeability derived from the static magnetization curve	
ρ	Resistivity	Ωm^{-1}
$\Sigma l/A$	Magnetic form factor	mm ⁻¹
τ_{Cu}	DC time constant $\tau_{Cu} = L/R_{Cu} = A_L/A_R$	s
ω	Angular frequency; $\omega = 2 \pi f$	s ⁻¹

All dimensions are given in mm.



Surface-mount device

Important notes

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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.
2. We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified**. In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or life-saving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.
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5. We constantly strive to improve our products. Consequently, **the products described in this publication may change from time to time**. The same is true of the corresponding product specifications. Please check therefore to what extent product descriptions and specifications contained in this publication are still applicable before or when you place an order.

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Release 2018-10