# Ferrites and accessories

E 20/10/6 (EF 20)
Cores and accessories

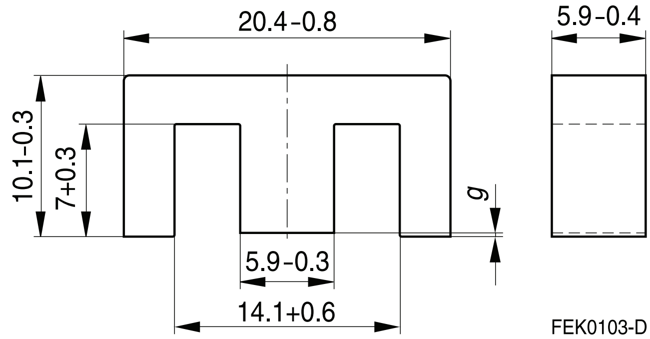
**Series/Type:** **B66311, B66206**

Date: May 2017

## E 20/10/6 (EF 20)

**Core** **B66311**

- To IEC 62317-8
- Delivery mode: single units




**Magnetic characteristics** (per set)

$\Sigma l/A$ = 1.44 mm$^{-1}$
$l_e$ = 46.3 mm
$A_e$ = 32.1 mm$^2$
$A_{min}$ = 31.9 mm$^2$
$V_e$ = 1490 mm$^3$

**Approx. weight** 7.3 g/set

**Ungapped**

| Material | $A_L$ value<br>nH | $\mu_e$ | $P_V$<br>W/set | Ordering code |
|---|---|---|---|---|
| N30 | 2150 +30/–20% | 2460 | | B66311G0000X130 |
| T46 | 7500 ±30% | 8610 | | B66311F0000X146 |
| N27 | 1300 +30/–20% | 1490 | < 0.27 (200 mT, 25 kHz, 100 °C) | B66311G0000X127 |
| N87 | 1470 +30/–20% | 1680 | < 0.75 (200 mT, 100 kHz, 100 °C) | B66311G0000X187 |
| N97 | 1500 +30/–20% | 1720 | < 0.70 (200 mT, 100 kHz, 100 °C) | B66311G0000X197 |

**Gapped** ($A_L$ values/air gaps examples)

| Material | g<br><br>mm | $A_L$ value<br>approx.<br>nH | $\mu_e$ | Ordering code<br>** = 27 (N27)<br>= 87 (N87) |
|---|---|---|---|---|
| N27, | 0.09 ±0.01 | 363 | 415 | B66311G0090X1** |
| N87 | 0.10 ±0.02 | 345 | 395 | B66311G0100X1** |
| | 0.15 ±0.02 | 250 | 290 | B66311G0150X1** |
| | 0.17 ±0.02 | 227 | 259 | B66311G0170X1** |
| | 0.25 ±0.02 | 171 | 195 | B66311G0250X1** |
| | 0.50 ±0.05 | 103 | 118 | B66311G0500X1** |
| | 1.00 ±0.05 | 60 | 70 | B66311G1000X1** |

The $A_L$ value in the table applies to a core set comprising one ungapped core (dimension g = 0 mm) and one gapped core (dimension g > 0 mm).

Other $A_L$ values/air gaps and materials available on request — see Processing remarks on page 8.

**Calculation factors** (for formulas, see *"E cores: general information"*)

| Material | Relationship between air gap – $A_L$ value | | Calculation of saturation current | | | |
|---|---|---|---|---|---|---|
| | K1 (25 °C) | K2 (25 °C) | K3 (25 °C) | K4 (25 °C) | K3 (100 °C) | K4 (100 °C) |
| N27 | 61.6 | –0.737 | 88.1 | –0.847 | 80.9 | –0.865 |
| N87 | 61.6 | –0.737 | 88.5 | –0.796 | 78.4 | –0.873 |

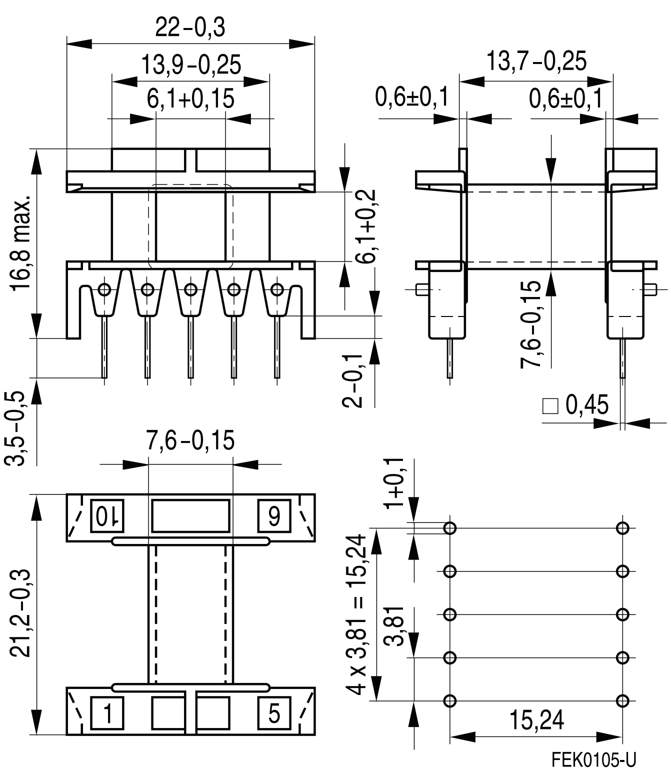
Validity range: K1, K2: 0.05 mm < s < 1.50 mm
K3, K4: 50 nH < $A_L$ < 430 nH

**Coil former (magnetic axis horizontal or vertical)**

Material: GFR polyterephthalate (UL 94 V-0, insulation class to IEC 60085: F ≙ max. operating temperature 155 °C), color code black Valox 420-SE0 [E207780 (M)] SABIC JAPAN L L C
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
Pins: Squared pins. For matching yoke see next page.

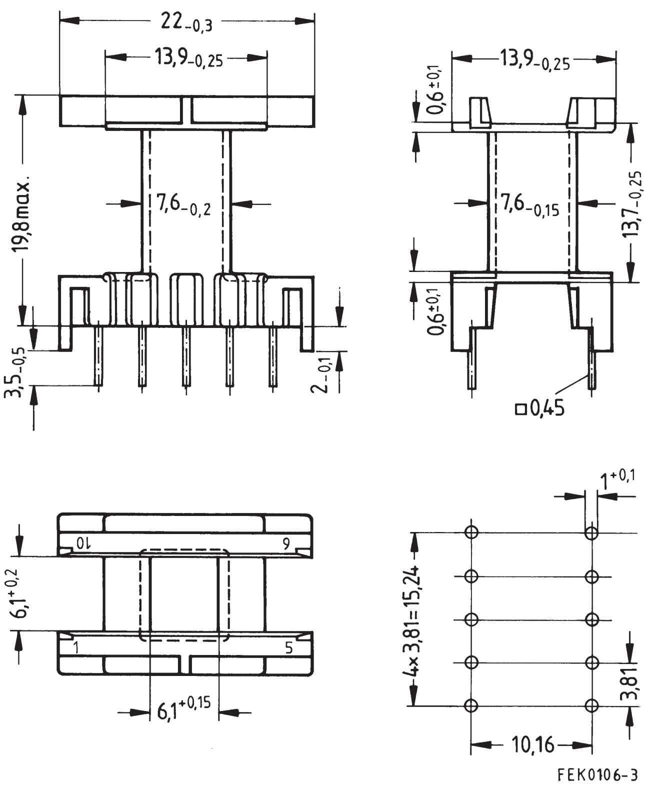
| Version | Sections | $A_N$ mm² | $l_N$ mm | $A_R$ value µΩ | Pins | Ordering code |
|---|---|---|---|---|---|---|
| Horizontal | 1 | 34 | 41.2 | 42 | 10 | B66206B1110T001 |
| Vertical | 1 | 34 | 41.2 | 42 | 10 | B66206W1110T001 |

**Horizontal version**




Hole arrangement
View in mounting direction

**Vertical version**




Hole arrangement
View in mounting direction

### Coil former (with right-angle pins)

Material: GFR polyterephthalate (UL 94 V-0, insulation class to IEC 60085:
F ≙ 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
Winding: see Processing notes, 2.1
Pins: Squared pins

### Yoke

Material: Stainless spring steel (0.2 mm)

| Coil former | | | | | | Ordering code |
|---|---|---|---|---|---|---|
| Figure | Sections | $A_N$ mm$^2$ | $l_N$ mm | $A_R$ value µΩ | Pins | |
| 1 | 1 | 34 | 41.2 | 42 | 12 | B66206C1012T001 |
| 2 | 1 | 34 | 41.2 | 42 | 14 | B66206C1014T001 |
| 3 | Yoke (ordering code per piece, 2 are required) | | | | | B66206A2010X000 |

### Figure 1, coil former (12 pins)

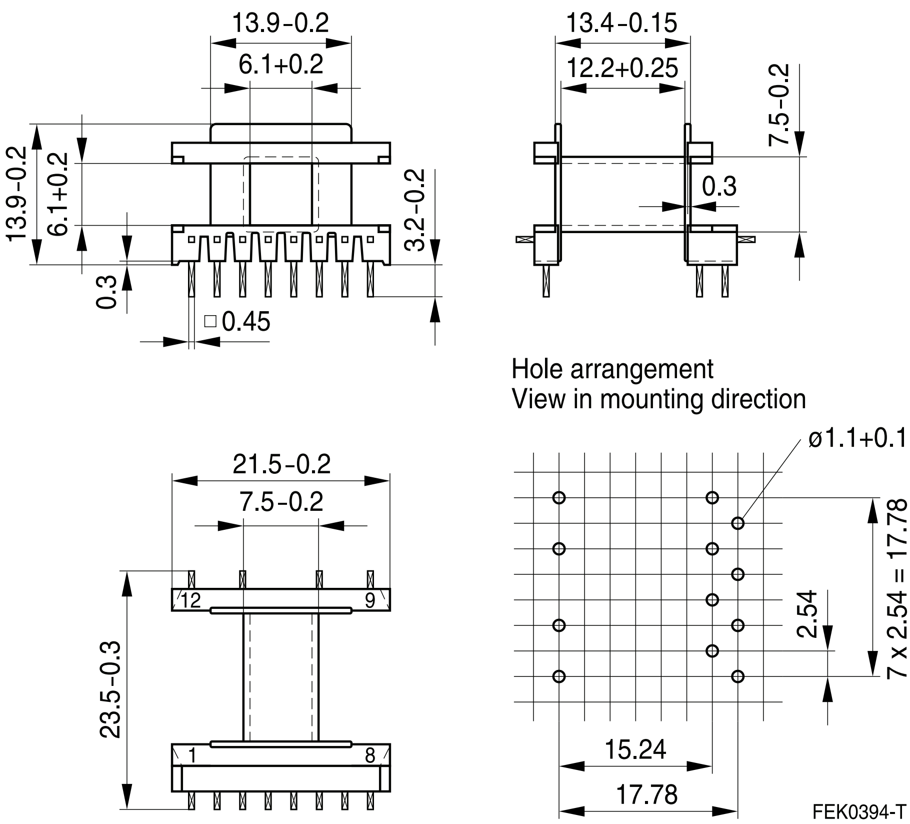


**Figure 2, coil former (14 pins)**

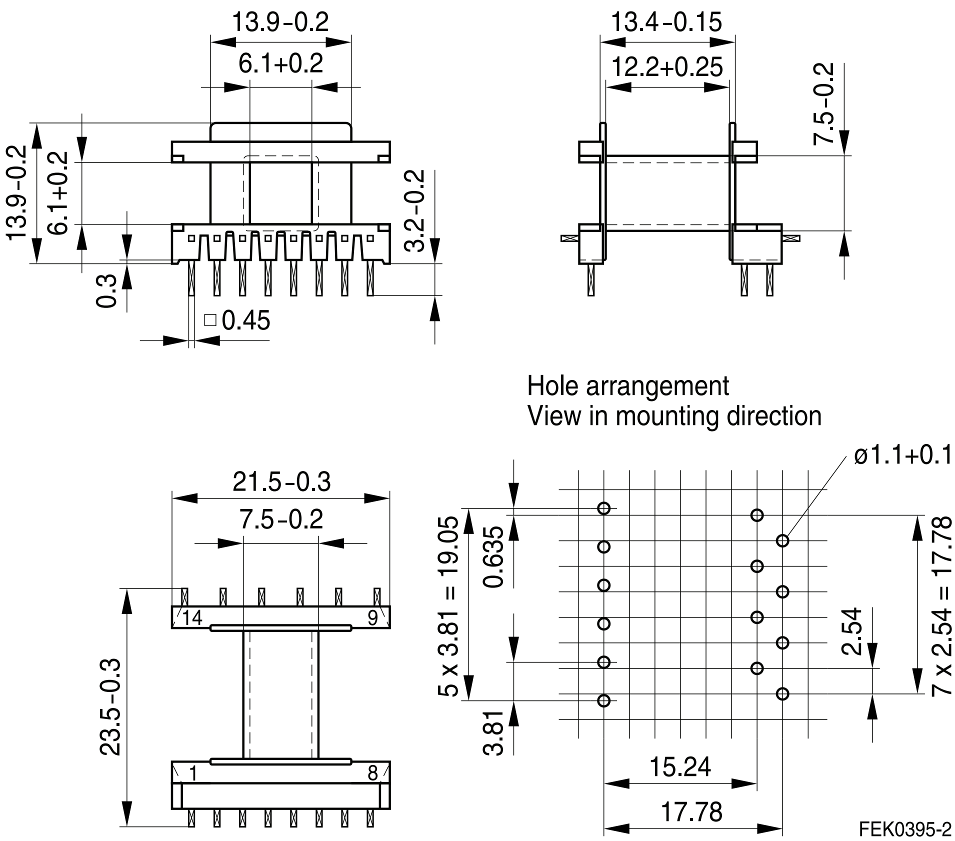
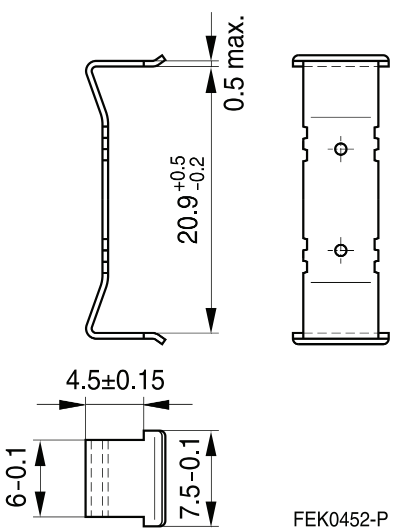



**Figure 3, Yoke**



## Coil former for luminaires

- Also to be used without clamps

Material: GFR polyterephthalate (UL 94 V-0, insulation class to IEC 60085:
H ≙ max. operating temperature 180 °C), color code black
Rynite FR 530® [E41938 (M)], E I DUPONT DE NEMOURS & CO INC

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

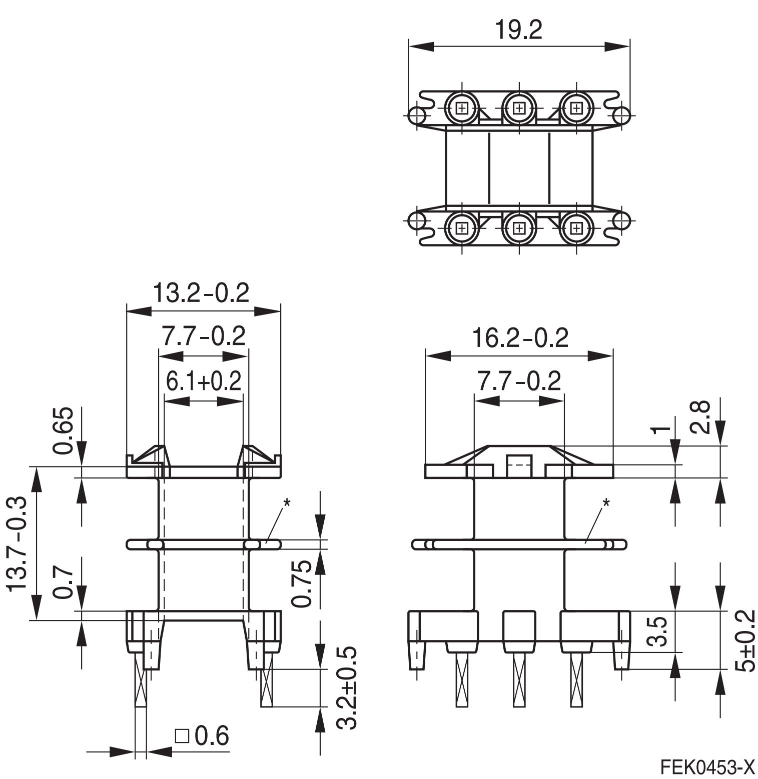
Pins: Squared pins

## Yoke

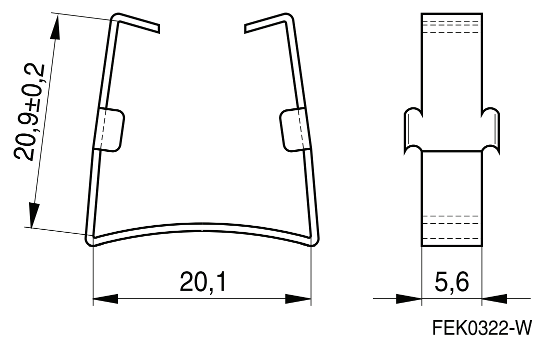
Material: Nickel silver (0.3 mm)

| Sections | $A_N$ $mm^2$ | $l_N$ mm | $A_R$ value μΩ | Pins | Ordering code |
|---|---|---|---|---|---|
| 1 | 32.7 | 42.3 | 44.5 | 6 | B66206J1106T001 |
| 2 | 30.7 | 42.3 | 34.4 | 6 | B66206K1106T002 |
| Yoke | | | | | B66206A2001X000 |

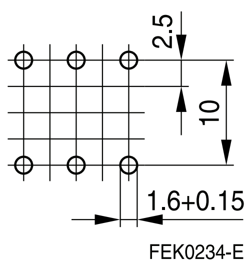
### Coil former




### Yoke




Hole arrangement
View in mounting direction




* Omitted for one-section version.

### 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.

### 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.

| 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 ($\triangleq \mu_a$) | 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 |
| $\Delta B$ | 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 |
| $h/\mu_i^2$ | 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 |

| 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 |
| $\Delta R_h$ | $R_h$ 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 | °C |
| $\Delta T$ | Temperature difference | K |
| $T_C$ | Curie temperature | °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 |

| 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 | $mT^{-1}$ |
| $\eta_i$ | Hysteresis core constant | $A^{-1}H^{-1/2}$ |
| $\lambda_s$ | 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 | $\Omega m^{-1}$ |
| $\Sigma l/A$ | Magnetic form factor | $mm^{-1}$ |
| $\tau_{Cu}$ | DC time constant $\tau_{Cu} = L/R_{Cu} = A_L/A_R$ | s |
| $\omega$ | Angular frequency; $\omega = 2\ \Pi f$ | $s^{-1}$ |

All dimensions are given in mm.

SMD Surface-mount device

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