



Ferrites and accessories

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

Series/Type: B66311, B66206

Date: November 2015

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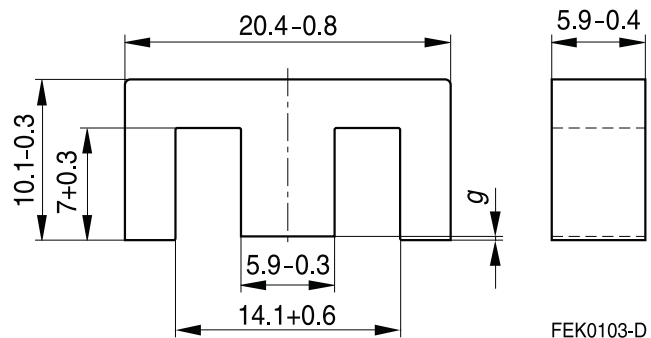
EPCOS AG is a TDK Group Company.

E 20/10/6 (EF 20)
Core
B66311

- To IEC 61246
- Delivery mode: single units

Magnetic characteristics (per set)

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



FEK0103-D

Approx. weight 7.3 g/set
Ungapped

| Material | A_L value nH | μ_e | P_V W/set | Ordering code |
|----------|-------------------|---------|----------------------------------|-----------------|
| N30 | 2150 +30/-20% | 2460 | | B66311G0000X130 |
| 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 |

Gapped

| Material | g mm | A_L value approx. nH | μ_e | Ordering code ** = 27 (N27) = 87 (N87) |
|-------------|------------|------------------------------|---------|--|
| N27, N87 | 0.09 ±0.01 | 363 | 415 | B66311G0090X1** |
| | 0.17 ±0.02 | 227 | 259 | B66311G0170X1** |
| | 0.25 ±0.02 | 171 | 195 | B66311G0250X1** |
| | 0.50 ±0.05 | 103 | 118 | B66311G0500X1** |

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

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

Valox 420-SE0® [E45329 (M)], Sabic Innovative Plastic

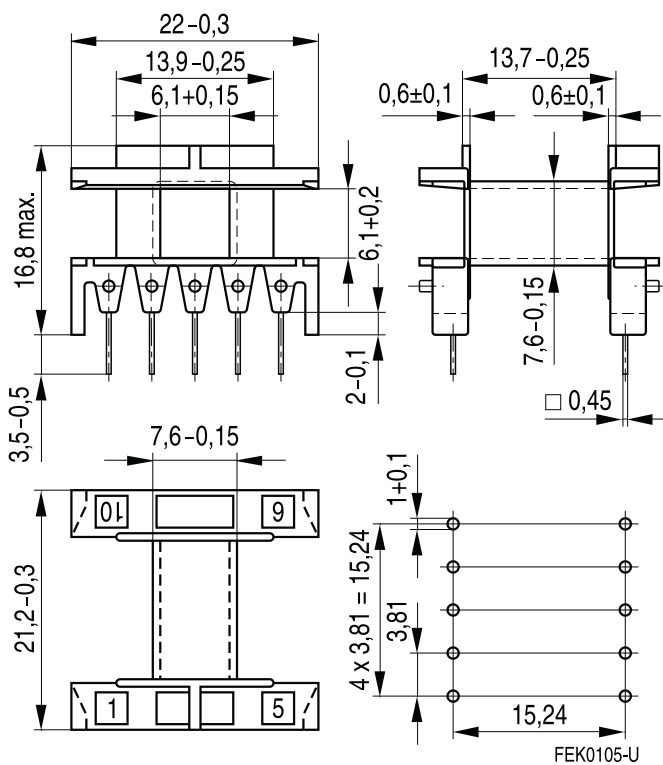
Solderability: to IEC 60068-2-20, test Ta, method 1 (aging 3): 235 °C, 2 s

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

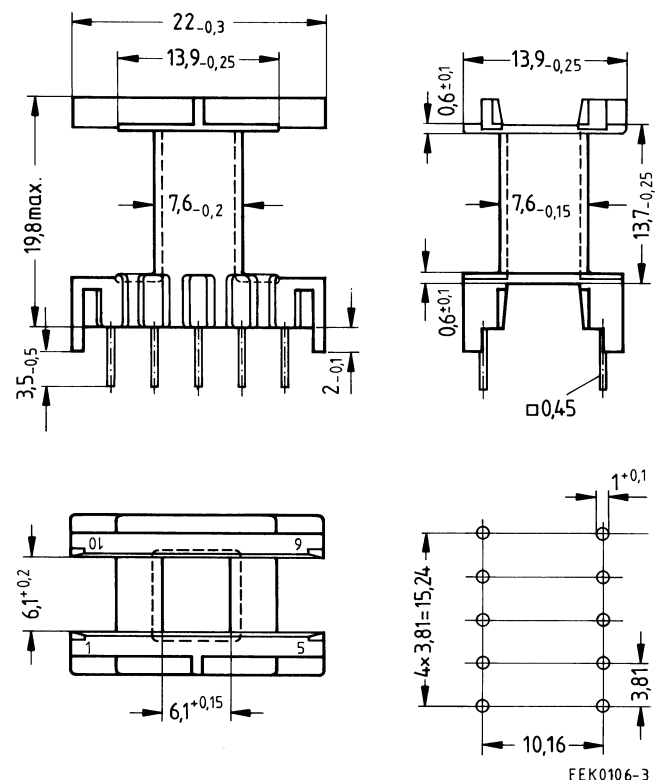
Winding: see Data Book 2013, chapter "Processing notes, 2.1"

Squared pins. For matching yoke see next page.

| Version | Sections | A _N mm ² | 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:
 $F \triangleq$ 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 Data Book 2013, chapter "Processing notes, 2.1"

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 $\mu\Omega$ | 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)

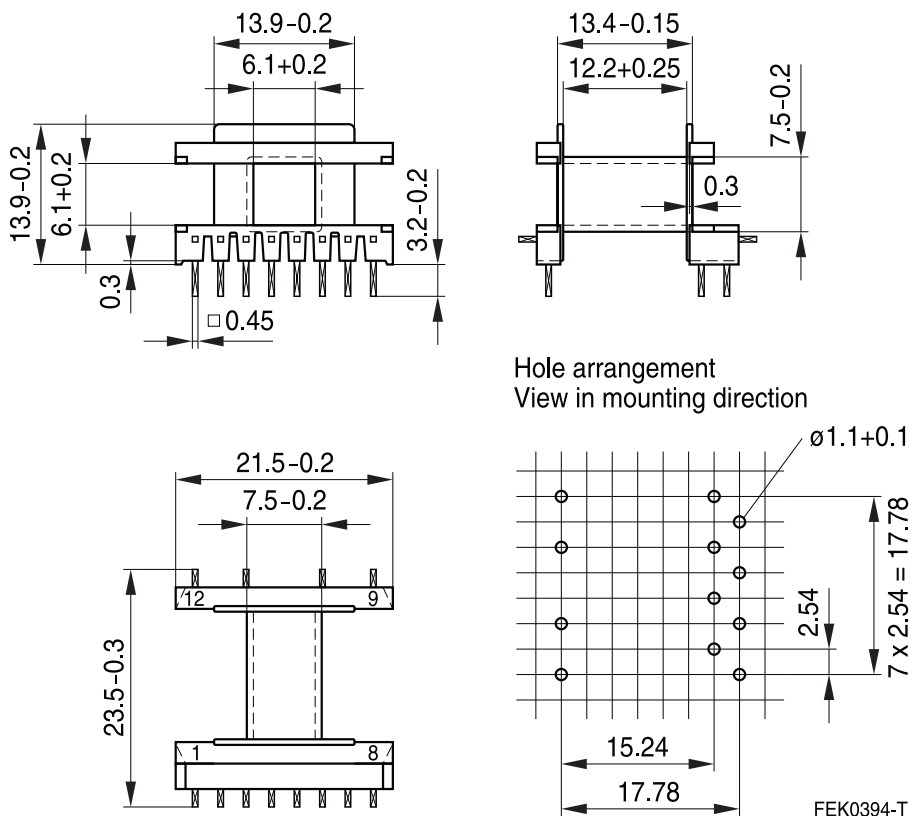


Figure 2, coil former (14 pins)

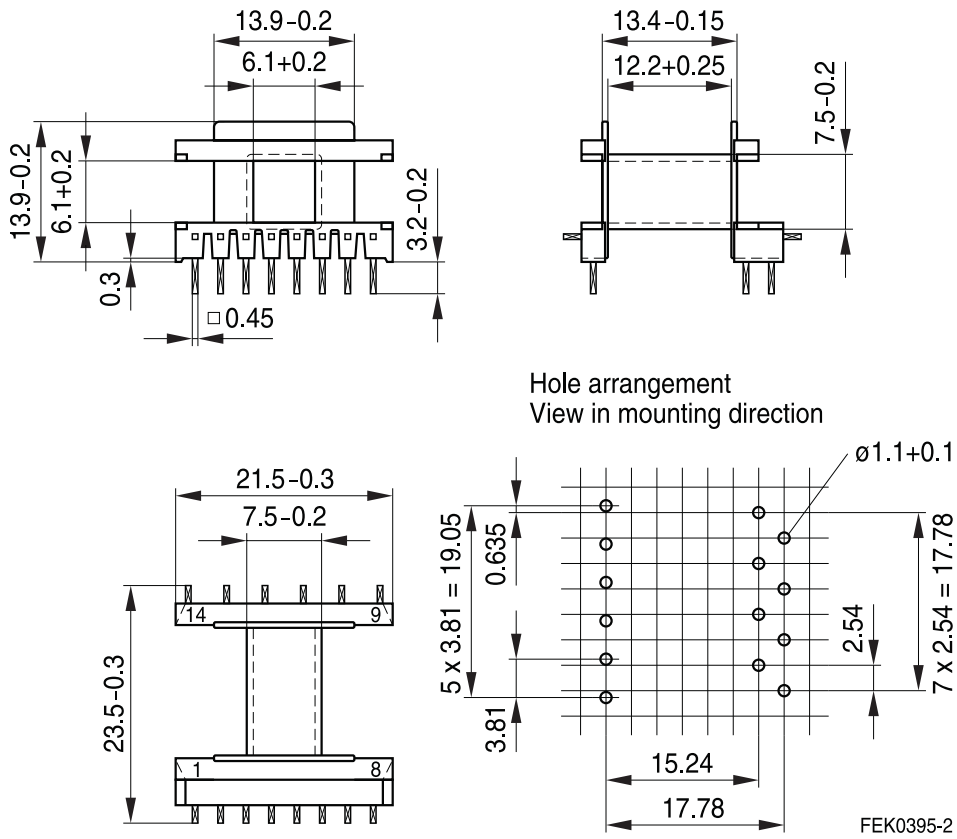
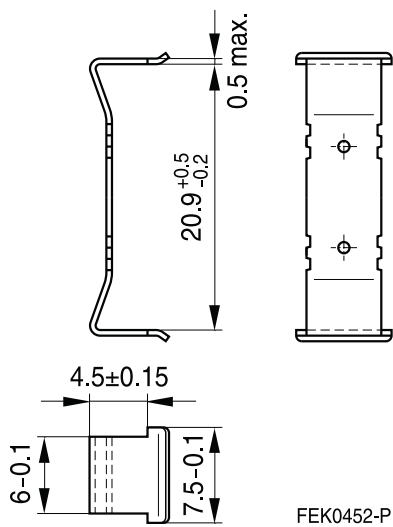


Figure 3, Yoke



Coil former for luminaires

■ Also to be used without clamps

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

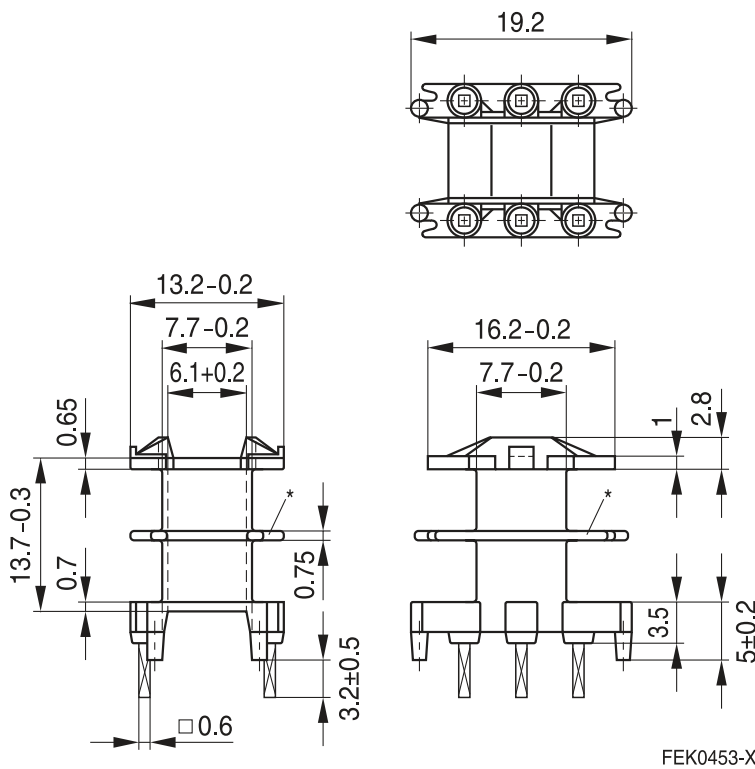
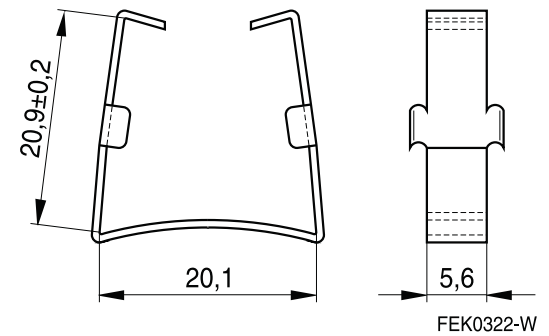
Winding: see Data Book 2013, chapter "Processing notes, 2.1"

Squared pins.

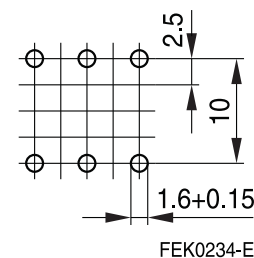
Yoke

Material: Nickel silver (0.3 mm)

| Sections | A_N mm ² | l_N mm | A_R value $\mu\Omega$ | 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 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.

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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 ($\hat{=} \mu_a$) | 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.

SMD Surface-mount device

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