

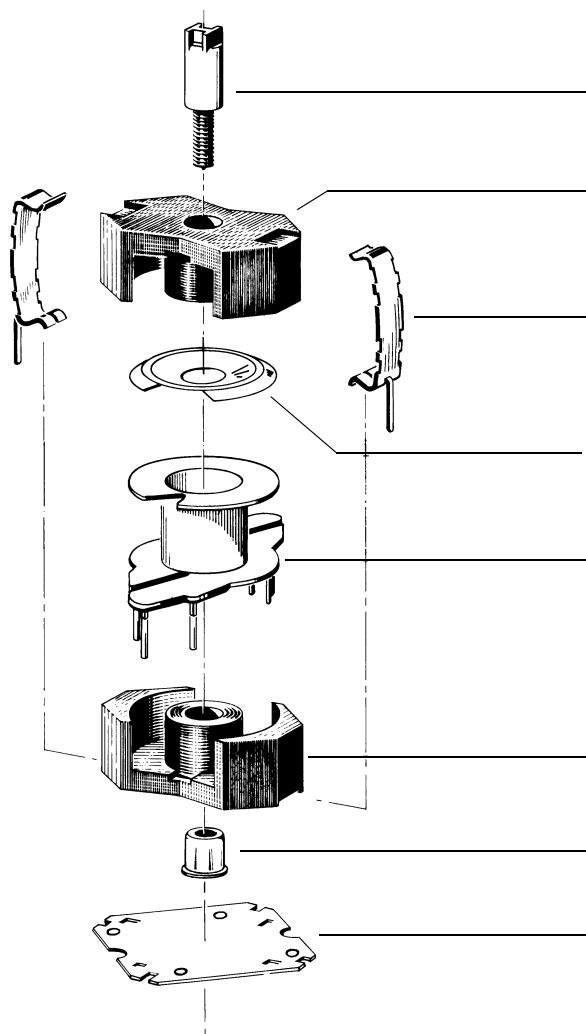


Ferrites and accessories

RM 5, RM 5 LP
Cores and accessories

Series/Type: B65805, B65806, B65822, B65539

Date: June 2013

RM 5
Core and accessories


| Individual parts | Part no. | Page |
|----------------------------|----------|------|
| Adjusting screw | B65539 | 9 |
| | B65806 | |
| Core | B65805 | 3 |
| Clamps | B65806 | 6 |
| Insulating washer 1 | B65806 | 6 |
| Coil former | B65806 | 5 |
| Core | B65805 | 3 |
| Threaded sleeve (glued-in) | | |
| Insulating washer 2 | B65806 | 6 |

FRM0005-2

Example of an assembly set

Also available:

| | | |
|--------------------------|---------|------|
| SMD coil formers | B65822 | 7, 8 |
| Clamps | B65806 | 7, 8 |
| <u>RM 5 low profile:</u> | | |
| Core | B65805P | 10 |

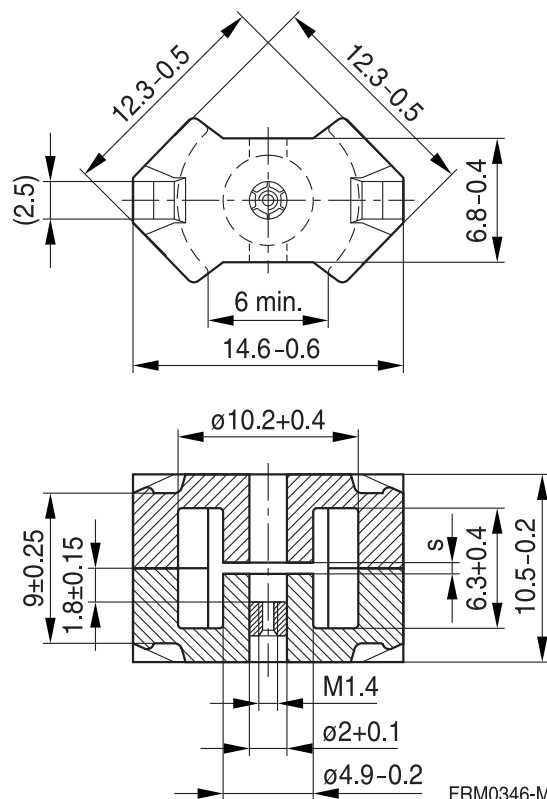
- To IEC 62317-4
- Core without center hole for transformer applications
- Delivery mode: sets

Magnetic characteristics (per set)

| | with center hole | without center hole | |
|--------------|------------------|---------------------|------------------|
| $\Sigma l/A$ | 1.0 | 0.93 | mm ⁻¹ |
| l_e | 20.8 | 22.1 | mm |
| A_e | 20.8 | 23.8 | mm ² |
| A_{min} | — | 18 | mm ² |
| V_e | 433 | 526 | mm ³ |

Approx. weight (per set)

| m | 2.9 | 3.0 | g |
|---|-----|-----|---|
| | | | |


Gapped

| Material | A_L value | s approx. mm | μ_e | Ordering code ¹⁾ -C with center hole -N with threaded sleeve |
|----------|-------------|--------------|---------|---|
| | nH | | | |
| K1 | 25 ±3% | 1.0 | 19.9 | B65805+0025A001 |
| | 40 ±3% | 0.40 | 31.8 | B65805+0040A001 |
| M33 | 63 ±3% | 0.4 | 50.2 | B65805+0063A033 |
| | 100 ±3% | 0.2 | 79.6 | B65805+0100A033 |
| N48 | 160 ±3% | 0.12 | 127 | B65805+0160A048 |
| | 250 ±3% | 0.06 | 199 | B65805+0250A048 |
| | 315 ±3% | 0.03 | 251 | B65805+0315A048 |

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

Ungapped

| Material | A _L value nH | μ _e | P _V W/set | Ordering code -C with center hole -J without center hole |
|----------|----------------------------|----------------|----------------------------------|--|
| N48 | 1800 +30/-20% | 1430 | | B65805C0000R048 |
| N45 | 2600 +30/-20% | 1920 | | B65805J0000R045 |
| N30 | 3500 +30/-20% | 2590 | | B65805J0000R030 |
| T38 | 6700 +40/-30% | 4950 | | B65805J0000Y038 |
| T66 | 9600 +40/-30% | 7090 | | B65805J0000Y066 |
| N49 | 1300 +30/-20% | 960 | < 0.06 (50 mT, 500 kHz, 100 °C) | B65805J0000R049 |
| N87 | 2000 +30/-20% | 1480 | < 0.32 (200 mT, 100 kHz, 100 °C) | B65805J0000R087 |
| N97 | 2000 +30/-20% | 1480 | < 0.24 (200 mT, 100 kHz, 100 °C) | B65805J0000R097 |
| N41 | 2600 +30/-20% | 1920 | < 0.10 (200 mT, 100 kHz, 100 °C) | B65805J0000R041 |

Coil former

Material: GFR thermosetting plastic (UL 94 V-0, insulation class to IEC 60085: H \geq max. operating temperature 180 °C), color code white
 Bakelite UP 3420® [E61040 (M)], HEXION SPECIALTY CHEMICALS GMBH

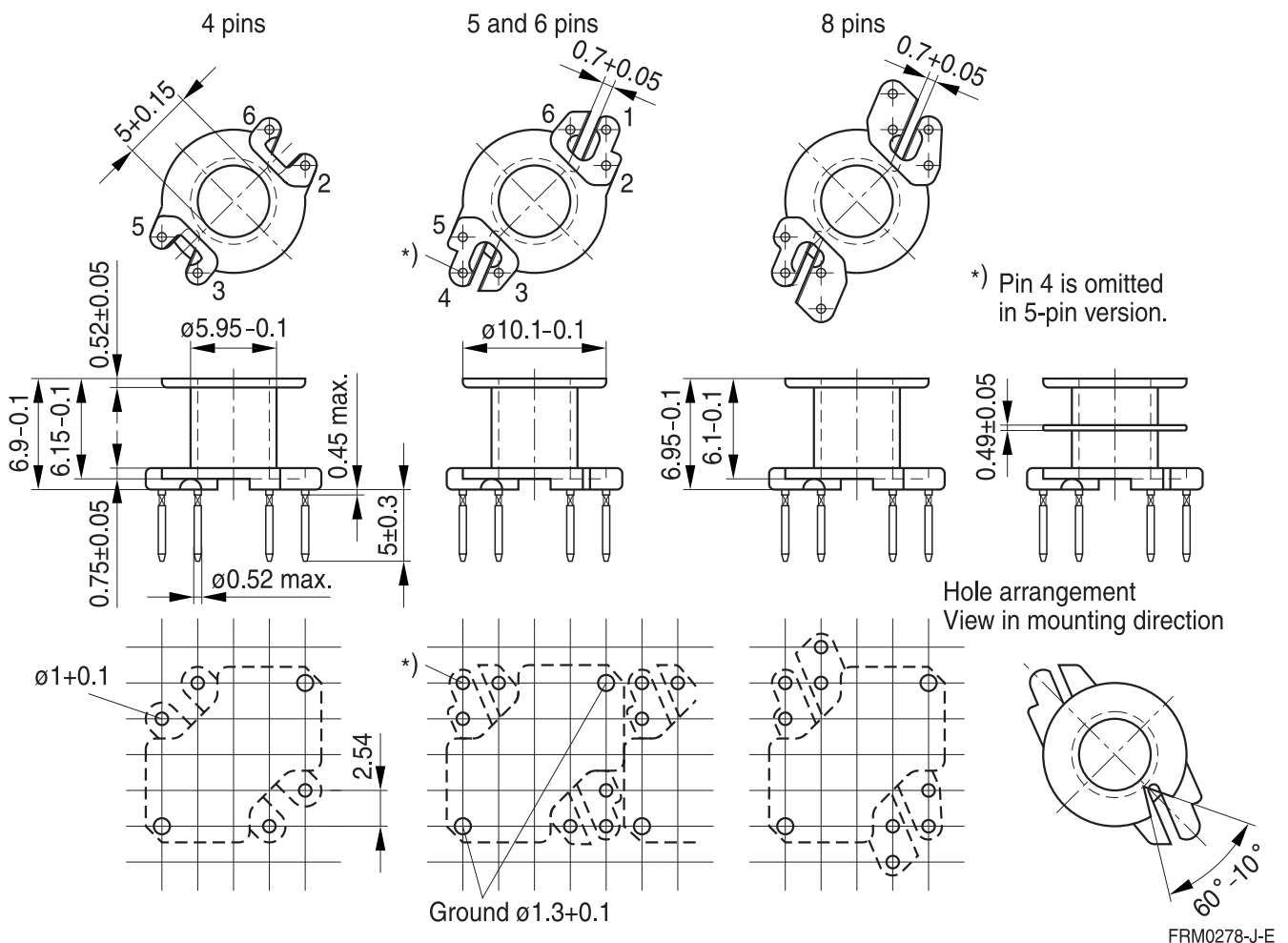
Solderability: to IEC 60068-2-20, test Ta, method 1 (aging 3): 235 °C, 2 s

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"

Pins squared in the start-of-winding area.
 For matching clamps and insulating washers see page 6.

| Sections | A _N mm ² | l _N mm | A _R value μΩ | Pins | Ordering code |
|----------|-----------------------------------|----------------------|----------------------------|------|-----------------|
| 1 | 9.5 | 25 | 90 | 4 | B65806P1004D001 |
| | | | | 5 | B65806P1005D001 |
| | | | | 6 | B65806P1006D001 |
| | | | | 8 | B65806P1008D001 |
| 2 | 8.7 | 25 | 94 | 6 | B65806P1006D002 |



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

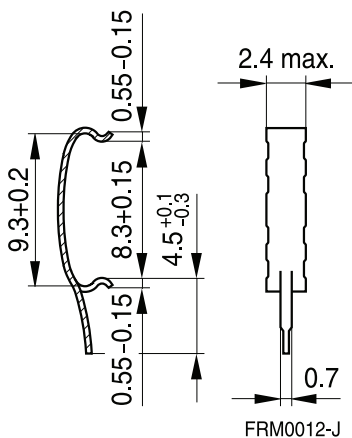
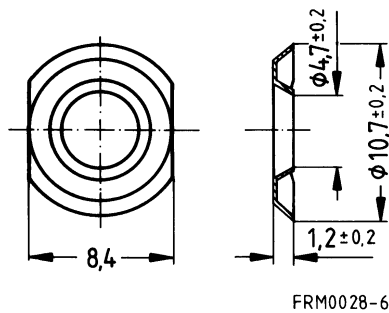
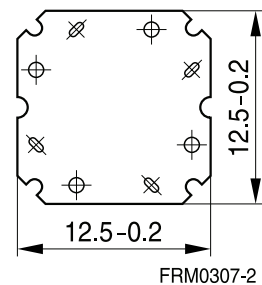
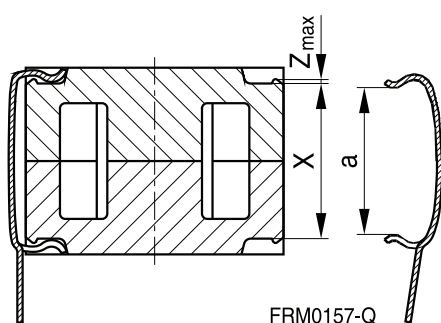
Insulating washer 1 between core and coil former

- For tolerance compensation and for insulation
- Made of polyarylate film (UL 94 V-0, insulation class to IEC 60085: E \geq 120 °C), 0.08 mm thick Aryphan F685, [E167358 (M)], natural color, LOFO HIGH TECH FILM GMBH

Insulating washer 2 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 1 (reel packing, PU = 1 reel) | B65806A5000X000 |
| Insulating washer 2 (bulk) | B65806D2005X000 |

Clamp

Insulating washer 1
(preliminary data)

Insulating washer 2

Clamping forces for RM 5


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 |


SMD coil former with gullwing 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

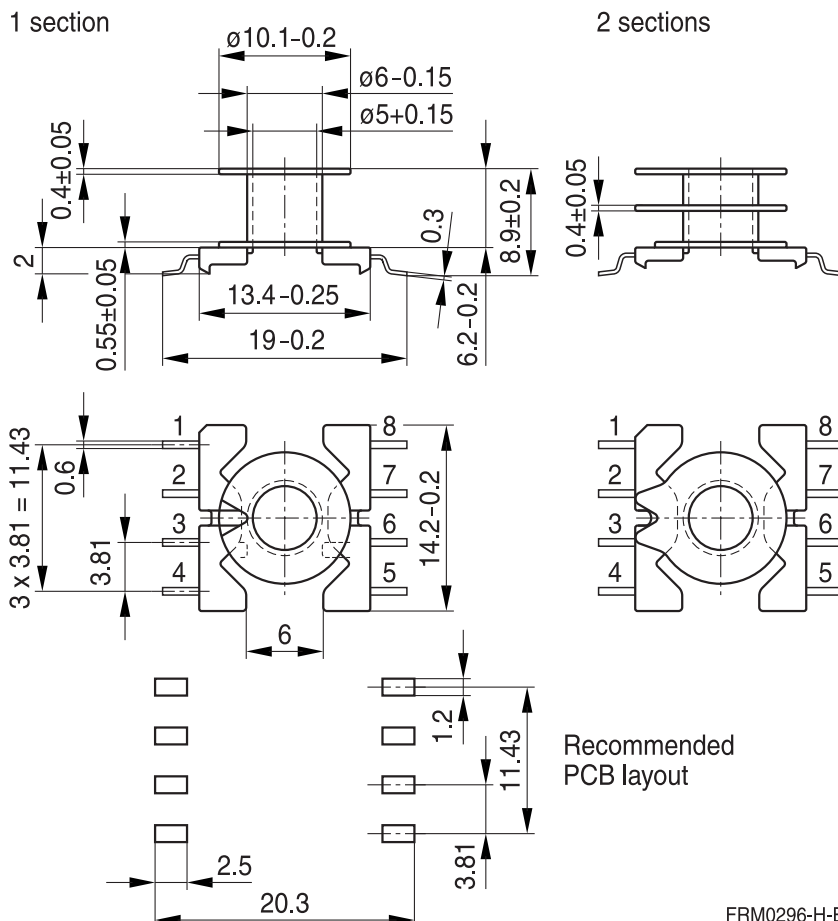
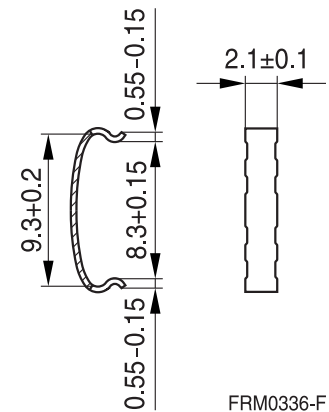
Resistance to soldering heat: to IEC 60068-2-58, test Td, method 6 (Group 3): 255 °C, 10 s
 permissible soldering temperature for wire-wrap connection on coil former: 400 °C, 1 s

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

Clamp

- Without ground terminal, made of stainless spring steel, 0.335 mm thick
- Also available as strip clamp (each carton containing 2 reels) on request

| Sections | A_N mm ² | l_N mm | A_R value $\mu\Omega$ | Terminals | Ordering code |
|---|--------------------------|-------------|----------------------------|-----------|-----------------|
| 1 | 11.1 | 25 | 77 | 8 | B65822F1008T001 |
| 2 | 10.2 | 25 | 85 | 8 | B65822F1008T002 |
| Clamp (ordering code per piece, 2 are required) | | | | | B65806J2204X000 |

Coil former

Clamp



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

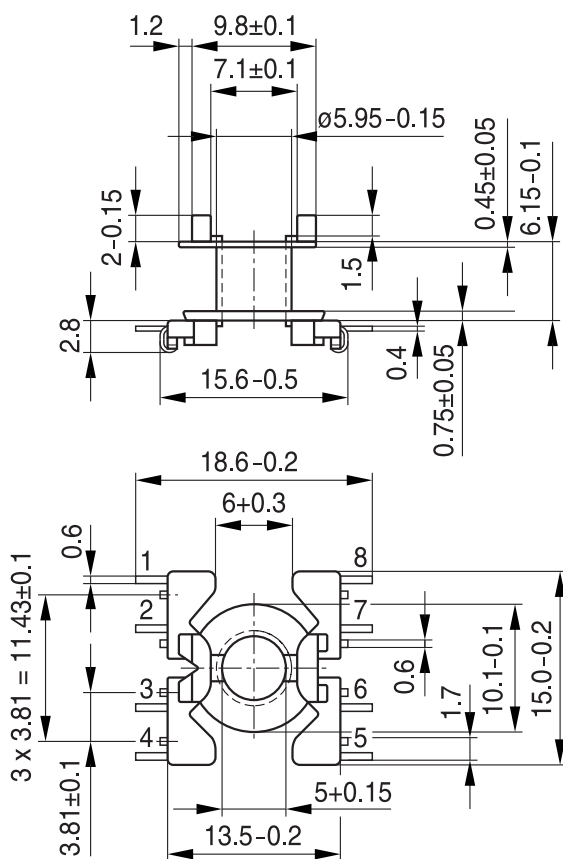
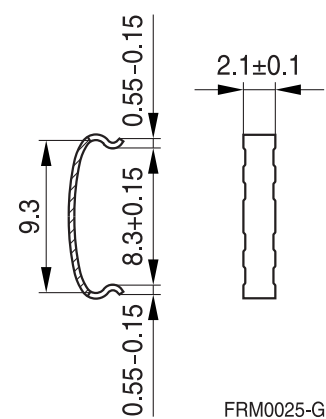
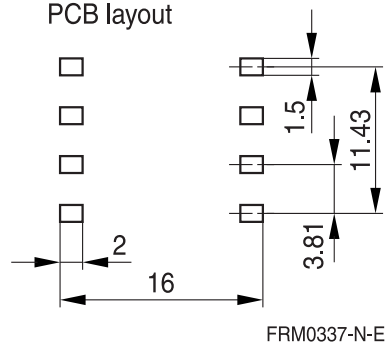
Resistance to soldering heat: to IEC 60068-2-58, test Td, method 6 (Group 3): 255 °C, 10 s
 permissible soldering temperature for wire-wrap connection on coil former: 400 °C, 1 s

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

Clamp

- Without ground terminal, made of stainless spring steel, 0.335 mm thick
- Also available as strip clamp (each carton containing 2 reels) on request

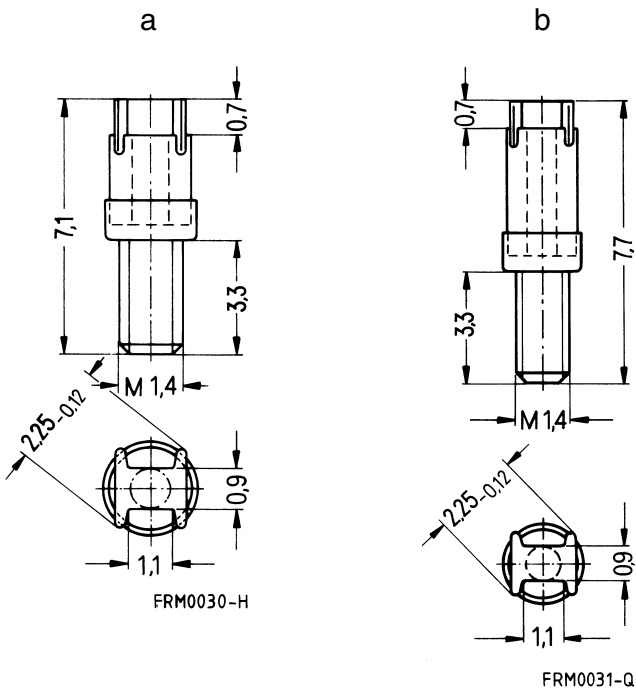
| Sections | A_N mm ² | l_N mm | A_R value $\mu\Omega$ | Terminals | Ordering code |
|---|--------------------------|-------------|----------------------------|-----------|-----------------|
| 1 | 11.1 | 25 | 73 | 8 | B65822J1008T001 |
| Clamp (ordering code per piece, 2 are required) | | | | | B65806J2204X000 |

Coil former

Clamp

Recommended PCB layout


Adjusting screw

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

| Figure | Tube core | | | Ordering code |
|--------|-----------------|----------|------------|-----------------|
| | Ø × length (mm) | Material | Color code | |
| 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 5 »Low Profile«
Core
B65805P

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

Magnetic characteristics (per set)

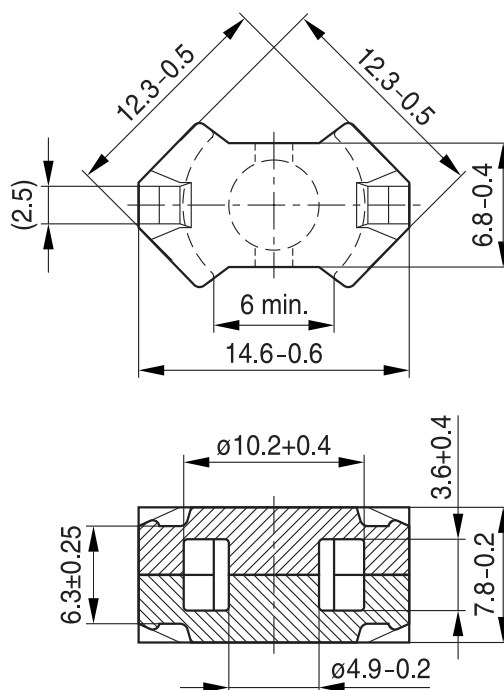
$$\Sigma l/A = 0.71 \text{ mm}^{-1}$$

$$l_e = 17.5 \text{ mm}$$

$$A_e = 24.5 \text{ mm}^2$$

$$A_{\min} = 18 \text{ mm}^2$$

$$V_e = 430 \text{ mm}^3$$

Approx. weight 2.6 g/set


FRM0347-V

Ungapped

| Material | A_L value nH | μ_e | P_V W/set | Ordering code |
|-------------------|-------------------|---------|----------------------------------|-----------------|
| T38 ¹⁾ | 7700 +40/-30% | 4380 | | B65805P0000Y038 |
| N49 | 1700 +30/-20% | 970 | < 0.09 (50 mT, 500 kHz, 100 °C) | B65805P0000R049 |
| N92 | 1900 +30/-20% | 1080 | < 0.29 (200 mT, 100 kHz, 100 °C) | B65805P0000R092 |
| N87 | 2400 +30/-20% | 1360 | < 0.26 (200 mT, 100 kHz, 100 °C) | B65805P0000R087 |

1) Preliminary data

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 mounted.
- 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 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.

SMD Surface-mount device

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