Ferrite For Telecommunication

INTRODUCTION

Ferrite is a polycrystal, sintered material with high electrical resistivity. The high resistance of ferrite makes eddy current losses extremely low at high frequencies. Therefore, unlike other magnetic components, ferrite can be used at considerably high frequencies. Manganese-zinc(Mn-Zn) ferrites can be used at frequencies up to several megahertz.

The basic ferrite materials are obtained in an extremely high purity. These materials are mixed, calcined, milled, granulated, formed by pressing, and sintered at a temperature of 1000°C to 1400°C, then machined. The electrical and mechanical properties of a particular ferrite material are obtained by the material formulation and the processing applied. Extraordinary exacting process controls are required to assure the high uniformity of product for which TDK ferrites are well known. Through the above processes, ferrite materials can be optimized for specific applications.

Each of these materials can be produced in cores of various shapes. Shapes which are popular for the listed applications are:

APPLICATIONS, CHARACTERISTICS AND TDK CORE TYPE

Applications	Ferrite characteristics	TDK core type
Filters	Low loss, magnetic stability, high permeability	Pot and RM cores
Signal transformers	High saturation flux density, high permeability	EP, EE, Pot and RM cores
Power conversion transformers	High saturation flux density, low power loss	EI, EC, Pot and RM cores

TDK produces a very large variety of cores and magnetic properties. Nearly every requirement can be satisfied among these products.

TYPICAL TECHNICAL DATA

Dielectric constant	Mn-Zn ferrite	240 to 300
	Ni-Zn ferrite	10 to 13
Specific heat		800(J/kg • °C)
Thermal conductivity		1 to 5(Wm • °C)
Coefficient of thermal linear expansion		7 to 10(ppm/°C)
Modulus of elasticity		1.2×10^{11}(N/m^2)
Vickers hardness		550
Tensile strength		100(kg/cm^2)
Bending strength(50mm span)		100(kg/cm^2)
Young's modulus		11×10^3(kg/mm^2)

• These values are typical at room temperature.

TERMS DEFINITIONS AND EXPLANATIONS

1. PERMEABILITY

1.1 INITIAL PERMEABILITY, μ_i

The initial permeability of a material is determined by the following formula, on the basis of the effective self-inductance exhibited by a test coil for a low AC magnetic field induced(approx.: 0.4A/m max.) in the toroidal core which is made of that material and on which the test coil is wound: (Fig. 1)

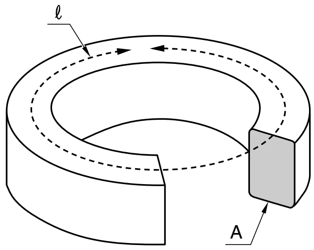


Fig. 1

$$\mu_i = \frac{L}{4\pi N^2} \cdot \frac{\ell}{A} \cdot 10^{10}$$

where, L = effective self-inductance(H)
N = number of turns
ℓ = average length of magnetic path in the core(mm)
A = cross-sectional area of toroidal cores(mm^2)

1.2 INCREMENTAL PERMEABILITY, μ_Δ, AND REVERSIBLE PERMEABILITY, μ_{rev}

Incremental permeability is determined by the following formula and is defined as the permeability of a material to a low AC magnetic field superposed on a larger DC magnetic field:

$$\mu_\Delta = \frac{\Delta B}{\Delta H}$$

where, ΔB = incremental flux density(gauss)
ΔH = incremental field intensity(oersted)

Reversible permeability is defined as the limiting value of incremental permeability occurring at the zero amplitude of the alternating magnetic field. It is a function of the DC flux density B and takes the maximum value when B is the zero. Its value decreases as B increases.
Since the DC flux density varies with the core shape and also with the magnitude of the gap, it is not proper to apply a reversible permeability determined on a toroidal core to cores of other shapes such as E type, P type, etc. Hence, values of reversible permeability are determined separately for individual core shapes and gaps.

1.3 EFFECTIVE PERMEABILITY, μ_e

The effective permeability is determined by the following formula:

$$\mu_e = \frac{L \times 10^{10}}{4\pi N^2} \cdot \Sigma \frac{\ell}{A}$$

where, L = effective self-inductance(H)
N = number of turns
$\Sigma \frac{\ell}{A}$ = C_1 = core constant(mm^{-1})

This formula is used also when some leakage flux exists in the magnetic circuit due to an air gap introduced in it.*

Note* :Magnetic-core loss coefficient, temperature coefficient, disaccommodation and other magnetic characteristics due to an air gap in the magnetic circuit very nearly directly with effective permeability, as long as the leakage flux at the air gap is not appreciably large. If the leakage is not negligible, a correction must be made on these characteristics for the leakage flux.

1.4 APPARENT PERMEABILITYM, μ_{app}

Apparent permeability is defined as the ratio of the two inductance values measured. One on the test coil only(L_0), the other on coil and core(L). This is determined by the following formula:

$$\mu_{app} = \frac{L}{L_0}$$

where, L = inductance of test coil with core(H)
L_0 = inductance of test coil without core(H)

Normally, an apparent effective permeability refers to an open magnetic circuit.

2. MAGNETIZATION CURVE

2.1 STATIC MAGNETIZATION CURVES

In magnetic material that has been completely demagnetized, the curve traced by the rising value of flux density B as a function of the field intensity H being raised from the point of origin(0) is referred to as INITIAL MAGNETIZATION CURVE.

If field intensity is raised further, a point will be reached where the material becomes saturated with flux and the curve levels off: the SATURATION FLUX DENSITY, B_{sat}, refers to that value of flux. As the field intensity is reduced to zero from the saturation point, the flux density decreases and settles at a certain value above zero: this value of remaining flux density is referred to as REMANENCE, B_r. To reduce the remanence to zero, field intensity must be increased in the negative(reverse) direction: the level of this reversed field intensity required for reducing remanence to zero is termed COERCIVITY, H_{CB}.

2.2 RELATIONSHIP BETWEEN HYSTERESIS LOOP AND PERMEABILITY

Graphic models of initial permeability and reversible permeability as concepts are given on the magnetization curve in Fig.2.

The constants relative to magnetization curve are graphically represented in Fig.3.

$$\mu_{rev} = \lim_{\Delta H \to 0} \frac{\Delta B}{\Delta H} = \tan\theta_r$$

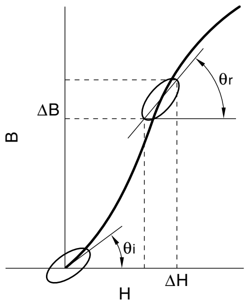


Fig. 2

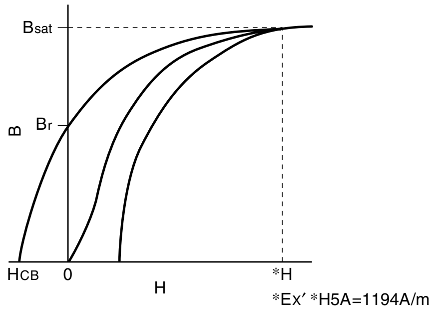


Fig. 3

3. CORE LOSS

3.1 LOSS FACTOR, tanδ

Core-loss factor, tanδ, is defined as the ratio of core-loss resistance to reactance, and consists of three components; namely, hysteresis loss, eddy-current loss and residual loss, and is expressed by the following formula:

$$\tan\delta = \frac{R_m}{\omega L} = h_1 \sqrt{\frac{L}{V}}\, i + e_1 f + c_1$$

where, R_m = core-loss resistance(Ω)

- ω = 2πf, angular velocity(radians/sec.)
- L = inductance of test coil with core(H)
- V = volume of core(cm^3)
- f = frequency of test current(Hz)
- h_1 = hysteresis loss coefficient
- e_1 = eddy-current loss coefficient
- c_1 = residual loss coefficient
- i = current(A)

The loss factor is normally determined by effecting measurement with a small magnetic field, and is treated as a loss distinct and apart from the hysteresis loss. In other words, the loss coefficient is defined by the following formula:

$$\tan\delta = e_1 f + c_1$$

3.2 RELATIVE LOSS FACTOR, tanδ/μi

Addition of an air gap to a magnetic circuit changes the values of its loss factor and effective permeability. The amounts of change are nearly proportional to each other, so that the loss factor per unit effective permeability may be used as a coefficient which, as defined as $\tan\delta/\mu_i$, indicates a characteristic of the magnetic material.

$$\tan\delta/\mu_i = \frac{1}{\mu_i}(e_1 f + c_1)$$

It follows therefore that the loss factor for a practical core can be expressed in the following formula:

$$(\tan\delta)_c = \tan\delta/\mu_i \times \mu_e$$

Where $(\tan\delta)_c$ represents the particular loss factor.

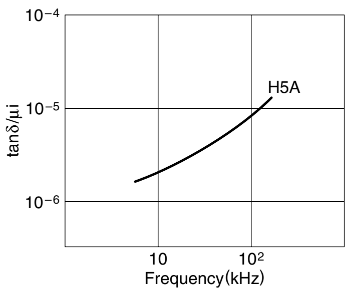


Fig. 4

TDK

3.3 RELATIVE HYSTERESIS LOSS COEFFICIENT, h_{10}*

When an air gap is introduced into a magnetic circuit, its hysteresis loss coefficient, h_1, changes approximately as 3/2 power of the effective permeability. On the basis of this fact, relative hysteresis loss coefficient, h_{10}, is defined as the value of this loss h_1 corrected to the condition of μ+1000. The value of h_{10} for different magnetic materials can be compared for comparative evaluation of the materials. For this purpose, the relative hysteresis loss coefficient is determined for and assigned to each material.

$$h_{10}=h_1\cdot\left(\frac{1000}{\mu_i}\right)^{3/2}$$

Thus, the hysteresis loss coefficient, $\tan\delta_h$, for a practical core is expressed by the following formula:

$$\tan\delta_h=h_{10}\cdot\left(\frac{\mu_i}{1000}\right)^{3/2}\cdot\sqrt{\frac{L}{V}}\cdot i$$

Note* : h_{10} is read "h one-zero."

The relationship between η_B and other constants are as follows:

$$\eta_B=19.9h_{10}\times10^{-6}$$
$$\eta_B=1.12\times h'/\mu^2$$
$$\eta_B=896\times h/\mu^2$$
$$h_{10}=50.3\eta_B\times10^3$$

where, η_B = hysteresis material constant in IEC

$\frac{h'}{\mu^2}$ = hysteresis constant in DIN

$\frac{h}{\mu^2}$ = hysteresis constant in Jordan

3.4 QUALITY FACTOR, Q

Quality factor is defined as the reciprocal of the loss coefficient, as follows:

$$Q=\frac{1}{\tan\delta}=\frac{\omega L}{R_m}$$

3.5 EFFECTIVE QUALITY FACTOR, Q_e

The effective quality factor refers to the loss coefficient of a coil complete with a ferrite core, and is the reciprocal of that coefficient:

$$Q_e=\frac{\omega L}{R_{eff}}$$

Where R_{eff} is the effective loss resistance of the coil.

3.6 APPARENT QUALITY FACTOR, Q_{app}

This factor is the ratio of the two values of effective quality factor measured on a test coil, one(Q_e) is coil with core, and the other(Q_0) is coil without core.

$$Q_{app}=\frac{Q_e}{Q_0}$$

where, Q_e = coil with core

Q_0 = coil without core

4. TEMPERATURE CHARACTERISTICS

4.1 TEMPERATURE COEFFICIENT OF INITIAL PERMEABILITY, $\alpha_{\mu i}$

This temperature coefficient is defined as the change of initial permeability per degree C over a prescribed temperature range. This change is expressed in terms of fraction of the original value of initial permeability. It is determined by the following formula:

$$\alpha_{\mu i}=\frac{\mu_{i2}-\mu_{i1}}{\mu_{i1}}\cdot\frac{1}{T_2-T_1}$$

where, μ_{i1} = initial permeability at temperature T_1

μ_{i2} = initial permeability at temperature T_2

The value of T_1 is normally taken at 20°C. The coefficient is expressed in units of 10^{-6}.

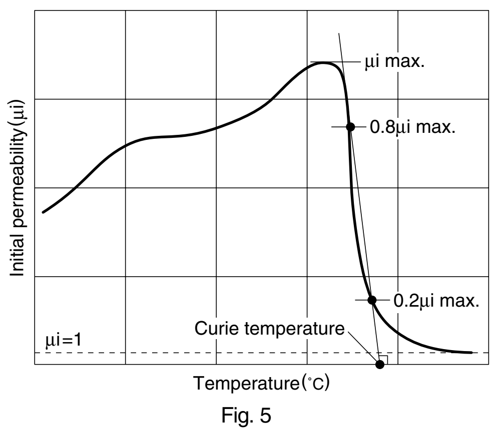


Fig. 5

4.2 TEMPERATURE FACTOR OF INITIAL PERMEABILITY, α_F

The change of temperature coefficient, $\alpha\mu$, due to an air gap added to a magnetic circuit is nearly proportional to the change of effective permeability. On the basis of this fact, temperature factor of permeability, αF, is defined as the value of temperature coefficient, $\alpha\mu_i$, per unit permeability, and is determined by the following formula:

$$\alpha_F = \frac{\alpha\mu}{\mu_i} = \frac{\mu_{i2}-\mu_{i1}}{\mu_{i1}^2} \cdot \frac{1}{T_2-T_1}$$

The value so determined is assigned to each material as its characteristic. For the temperature coefficient of a practical core, the following formula is used.

$$\alpha\mu = \alpha_F \times \mu_e$$

4.3 CURIE TEMPERATURE Tc

The critical temperature at which a core transfers from ferromagnetism to paramagnetism.

Note: There are many ways to determine the Curie temperature. At TDK, however, it is determined as shown in Fig.5.

5. PHENOMENON OF GRADUAL DECREASE IN PERMEABILITY

5.1 SPONTANEOUS DECREASE OF PERMEABILITY

In ferrite cores, the permeability begins to decrease upon formation by sintering and continues to decrease with the lapse of time. This property is referred to as the spontaneous decrease of permeability.

In general, the rate of spontaneous permeability decrease is approximately linear when it is related to the logarithm of time(log t) and, therefore, becomes negligibly small in about a month's time after sintering. The magnitude of this decrease in terms of μ_e/μ_i can be reduced substantially with increasing air gap.

5.2 DISACCOMMODATION, D

Disaccommodation, as will be noted in the following formula which determines its value: The time rate of initial permeability changes at normal temperature in a core that has just been AC demagnetized, where the core is kept free from mechanical or thermal stress of any kind.

$$D = \frac{\mu_1-\mu_2}{\mu_1} \times 100(\%)$$

where, μ_1 = initial permeability noted immediately after the material is AC demagnetized.
μ_2 = initial permeability noted some time after the material is AC demagnetized.

Disaccommodation and spontaneous decrease are two distinct concepts but some correlation is noted to exist between the two. The disaccommodation of a material is considered suggestive of its property of spontaneous decrease and also the permeability change that the material would exhibit when subjected to mechanical or magnetic shocks.

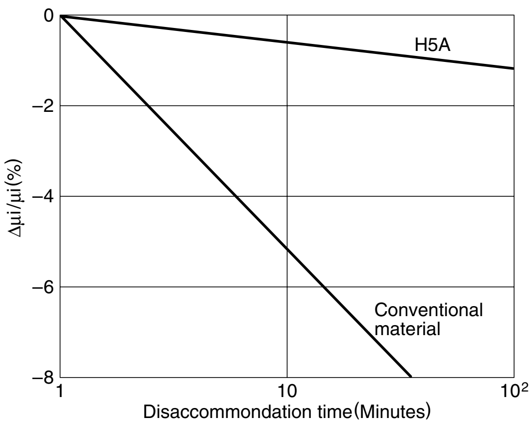


Fig. 6

5.3 DISACCOMMODATION FACTOR, D_F

For cores with air gap, the disaccommodation of the material in the circuit is nearly proportional to its effective permeability. The value of disaccommodation per unit permeability is designated as the disaccommodation factor(D_F)-one of the characteristics-and is determined for each material.

$$D_F = \frac{\mu_1-\mu_2}{\log_{10}\frac{t_2}{t_1}} \cdot \frac{1}{\mu_1^2} (t_2 > t_1)$$

where, μ_1 = initial permeability noted at time t_1 after the material is AC demagnetized.
μ_2 = initial permeability noted at time t_2 after the material is AC demagnetized.

Normally t_1, is 1 minute, and t_2 is 10 minutes; but up to 10 and 100 minutes, respectively, are occasionally used.
For a practical magnetic core, the following formula is used to determine its disaccommodation:

$$D = D_F \times \mu_e$$

6. INDUCTANCE COEFFICIENT, A_L

Inductance coefficient is defined as the self-inductance per unit turn of a coil of a given shape and dimensions wound on a magnetic core, and is determined by the following formula:

$$A_L = \frac{L}{N^2}$$

where, L = self-inductance of coil with core(H)
N = number of turns

This coefficient is normally expressed in units of 10^{-9}H(1nH).
Shapes and dimensions are separately prescribed for test coils to be used in the measurement for A_L.

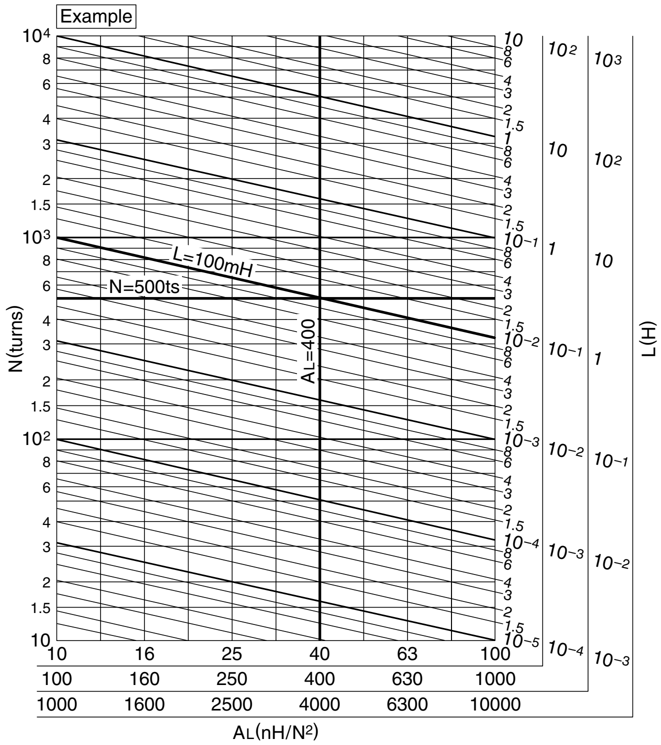


Fig. 7

7. WINDING COEFFICIENT, α

Winding coefficient is defined as the number of coil turns required for producing unit self-inductance in a coil of a given shape and dimensions wound on a core, and is determined by the following formula:

$$\alpha = \frac{N}{\sqrt{L}}$$

where, L = self-inductance of coil with core(H)
N = number of turnsl

Normally 1mH is taken for the L in this case.

8. ELECTRICAL RESISTIVITY, ρ_v

Electrical resistivity is the resistance measured by means of direct voltage of a body of ferromagnetic material having a constant cross-sectional area.

9. DENSITY, d_b

Specific gravity of a magnetic core is calculated from its volume and mass, as shown in below.

$$d_b = W/V(kg/m^3)$$

where, W = mass of the magnetic core
V = volume of the magnetic core

Note: The symbol and the catalog of this data are in accordance with IEC Publication 60401-3.

TDK

MATERIAL CHARACTERISTICS

For Telecommunication

Material				H5A	H5B2	H5C2	H5C3	H5C4
Initial permeability	μi			$3300^{+40\%}_{-0\%}$	7500±25%	10000±30%	15000±30%	12000±30% ≧9000(–20°C)
Relative loss factor	tanδ/μi	×10–6		<2.5(10kHz) <10(100kHz)	<6.5(10kHz)	<7.0(10kHz)	<7.0(10kHz)	<8(10kHz)
Temperature factor of initial permeability	αμir	×10–6	–30 to +20°C 0 to 20°C 20 to 70°C	–0.5 to 2.0 –0.5 to 2.0	0 to 1.8 0 to 1.8	–0.5 to 1.5 –0.5 to 1.5	–0.5 to 1.5 –0.5 to 1.5	
Saturation magnetic flux density* [H=1194A/m]	Bs	mT	25°C	410	420	400	360	380
Remanent flux density*	Br	mT	25°C	100	40	90	105	100
Coercive force*	Hc	A/m	25°C	8.0	5.6	7.2	4.4	4.4
Curie temperature	Tc	°C		>130	>130	>120	>105	>110
Hysteresis material constant	ηB	10–6/mT		<0.8	<1.0	<1.4	<0.5	<2.8
Disaccommodation factor	DF	×10–6		<3	<3	<2	<2	<3
Density*	db	kg/m3		4.8×103	4.9×103	4.9×103	4.95×103	4.95×103
Electrical resistivity*	ρv	Ω • m		1	0.1	0.15	0.15	0.15

Material				H5C5	HP5	DNW45	DN40	DN70
Initial permeability	μi			30000±30%	5000±20%	4200±25%	4000±25%	7500±25%
Relative loss factor	tanδ/μi	×10–6	25°C, 10kHz	<15	<3.5	<3.5	<2.5	<2.0
Temperature factor of initial permeability	αμir	×10–6	–30 to +20°C 0 to 20°C 20 to 70°C	–0.5 ~ 1.5 –0.5 ~ 1.5	 ±12.5% ±12.5%		–0.5 ~ 2.0 –0.5 ~ 2.0	–0.5 ~ 1.5 –0.5 ~ 1.5
Saturation magnetic flux density* [H=1194A/m]	Bs	mT	25°C	380	400	450	405	390
Remanent flux density*	Br	mT	25°C	120	65	50	95	45
Coercive force*	Hc	A/m	25°C	4.2	7.2	6.5	8.0	3.5
Curie temperature	Tc	°C		>110	>140	>150	>130	>105
Hysteresis material constant	ηB	10–6/mT		<1.5	<0.4	<0.8	<0.8	<0.2
Disaccommodation factor	DF	×10–6		<2	<3	<3	<3	<2.5
Density*	db	kg/m3		4.95×103	4.8×103	4.85×103	4.8×103	5.0×103
Electrical resistivity*	ρv	Ω • m		0.15	0.15	0.65	1.0	0.3

* *Average value*

For Transformer and Choke

Material					PC40	PC44	PC47	PC50
Initial permeability	μi				2300±25%	2400±25%	2500±25%	1400±25%
Amplitude permeability	μa				3000 min.	3000 min.		
Core loss volume density (Core loss)* [B=200mT]	Pcv	kW/m3	25kHz sine wave	25°C	120			
				60°C	80			
				100°C	70			
				120°C	85			
			100kHz sine wave	25°C	600	600	600	130**
				60°C	450	400	400	80**
				100°C	410	300	250	80**
				120°C	500	380	360	110**
Saturation magnetic flux density* [H=1194A/m]	Bs	mT		25°C	510	510	530	470
				60°C	450	450	480	440
				100°C	390	390	420	380
				120°C	350	350	390	350
Remanent flux density*	Br	mT		25°C	95	110	180	140
				60°C	65	70	100	110
				100°C	55	60	60	98
				120°C	50	55	60	100
Coercive force	Hc	A/m		25°C	14.3	13	13	36.5
				60°C	10.3	9	9	31.0
				100°C	8.8	6.5	6	27.2
				120°C	8	6	7	26.0
Curie temperature*	Tc	°C			>215	>215	>230	>240
Density*	db	kg/m3			4.8×10³	4.8×10³	4.9×10³	4.8×10³
Electrical resistivity*	ρv	Ω • m			6.5	6.5	4.0	30

Material					PC45	PC46	PC33	PC95
Initial permeability	μi				2500±25%	3200±25%	1400±25%	3300±25%
Amplitude permeability	μa							
Core loss volume density (Core loss)* [B=200mT]	Pcv	kW/m3	100kHz sine wave	25°C	570	350	1100	350
				60°C	250(75°C)	250(45°C)	800	
				100°C	460	660	600	290
				120°C	650	760	680	350
Saturation magnetic flux density* [H=1194A/m]	Bs	mT		25°C	530	520	510	530
				60°C	480	470	490	480
				100°C	420	410	440	410
				120°C	390	380	420	380
Remanent flux density*	Br	mT		25°C	120	80	220	85
				60°C	80	80	150	70
				100°C	80	130	100	60
				120°C	110	140	100	55
Coercive force*	Hc	A/m		25°C	12	10	23	9.5
				60°C	9	9	17	7.5
				100°C	8	10	14	6.5
				120°C	9	9	14	6.0
Curie temperature	Tc	°C			>230	>230	>290	>215
Density*	db	kg/m3			4.8×10³	4.8×10³	4.8×10³	4.9×10³
Electrical resistivity*	ρv	Ω • m			3.0	3.0	2.5	6.0

* *Average value*
** *500kHz, 50mT*

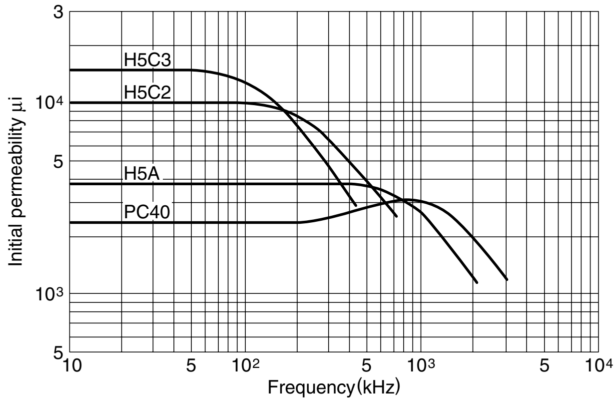
For Common mode Choke

Material				HS52	HS72	HS10
Initial permeability	μi			5500±25%	7500±25% (2000min. at 500kHz)	10000±25%
Relative loss factor	tanδ/μi	×10⁻⁶		10(100kHz)	30(100kHz)	30(100kHz)
Saturation magnetic flux density* [H=1194A/m]	Bs	mT	25°C	410	410	380
Remanent flux density*	Br	mT	25°C	70	80	120
Coercive force*	Hc	A/m	25°C	6	6	5
Curie temperature	Tc	°C		>130	>130	>120
Density*	db	kg/m3		4.9×10³	4.9×10³	4.9×10³
Electrical resistivity*	ρv	Ω • m		1	0.2	0.2

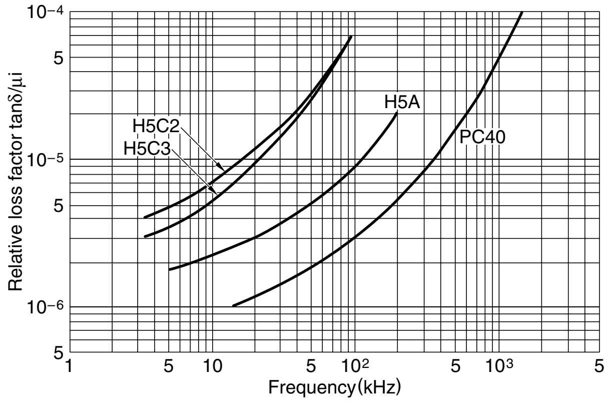
* *Average value*

• All specifications are subject to change without notice.

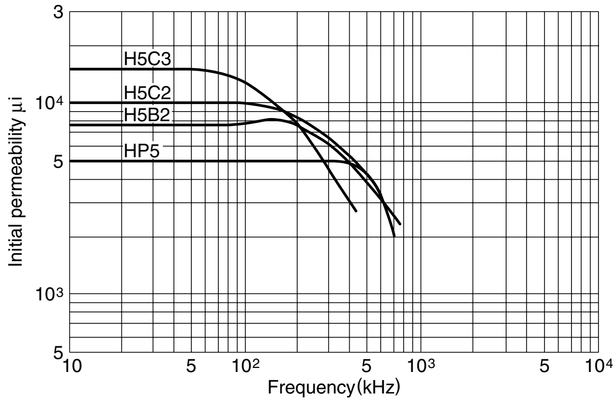
INITIAL PERMEABILITY, μi vs. FREQUENCY CHARACTERISTICS
Mn-Zn FERRITE



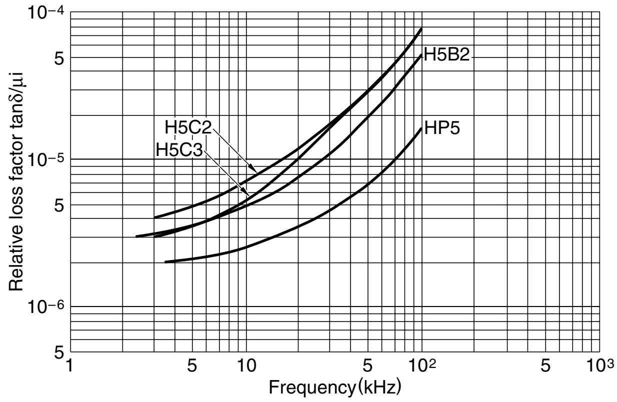
RELATIVE LOSS FACTOR, tanδ/ μi vs. FREQUENCY CHARACTERISTICS
Mn-Zn FERRITE



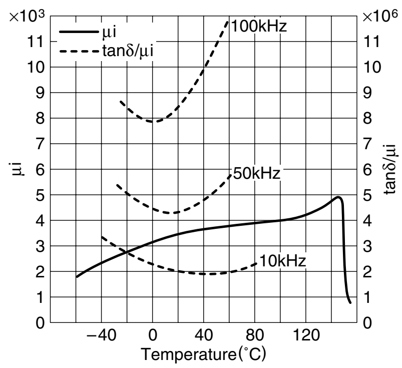
FERRITE FOR PULSE TRANSFORMERS



FERRITE FOR PULSE TRANSFORMERS

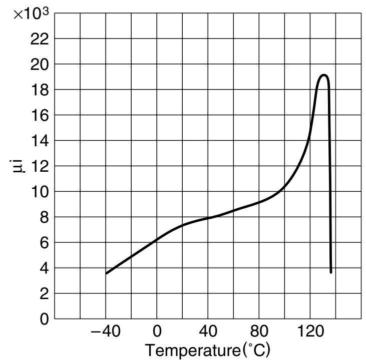


INITIAL PERMEABILITY, μi, RELATIVE LOSS FACTOR, tanδ/μi vs. TEMPERATURE CHARACTERISTICS
H5A

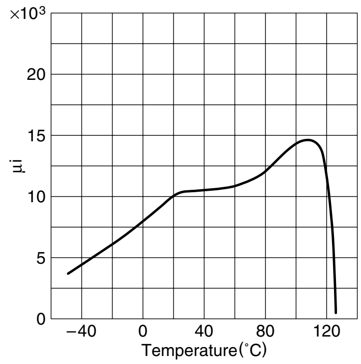


INITIAL PERMEABILITY, μi vs. TEMPERATURE CHARACTERISTICS

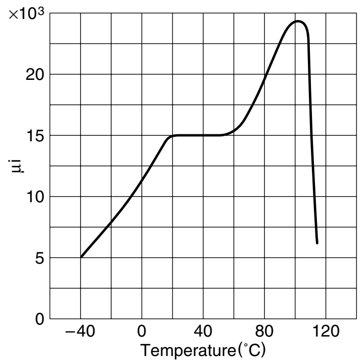
H5B2



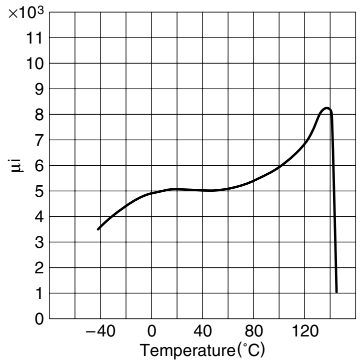
H5C2



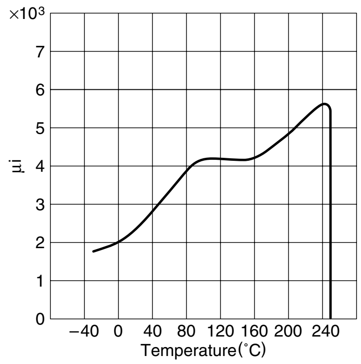
H5C3



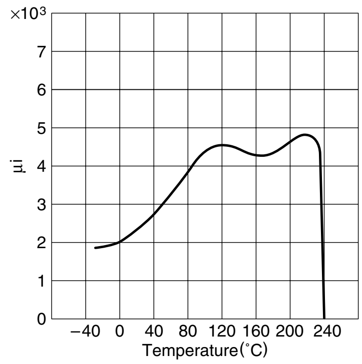
HP5



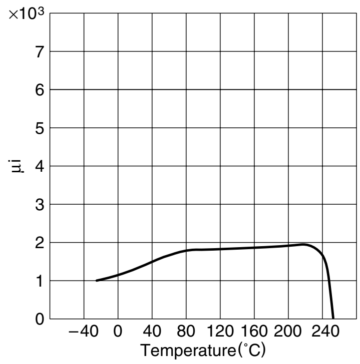
PC40



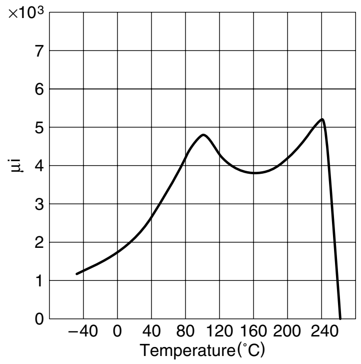
PC44



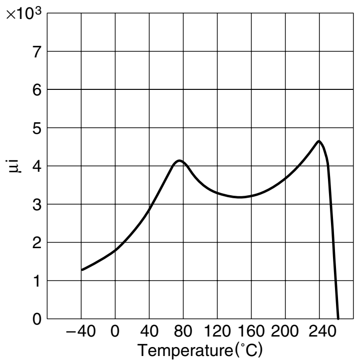
PC50



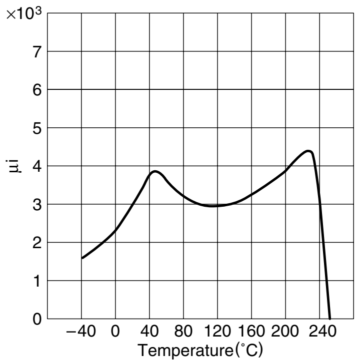
PC47



PC45

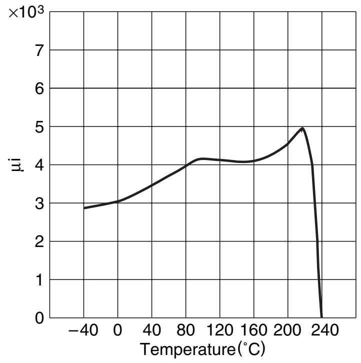


PC46



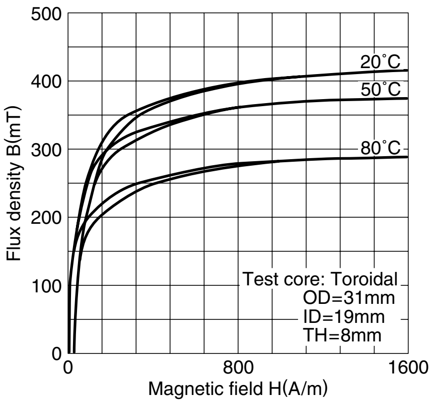
INITIAL PERMEABILITY, μi vs. TEMPERATURE CHARACTERISTICS

PC95

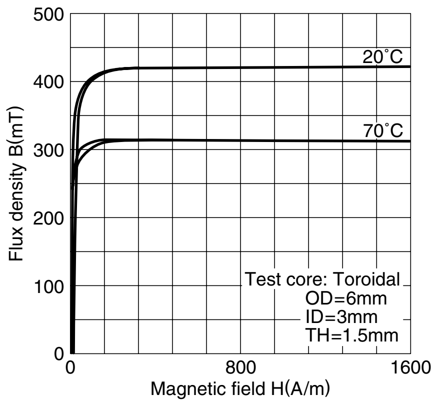


STATIC MAGNETIZATION CURVES

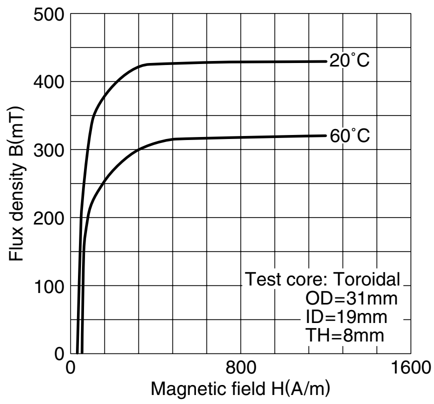
H5A



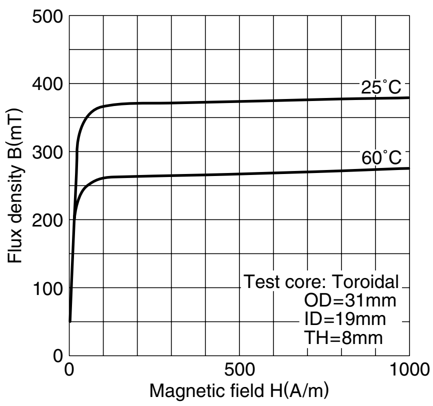
H5B2



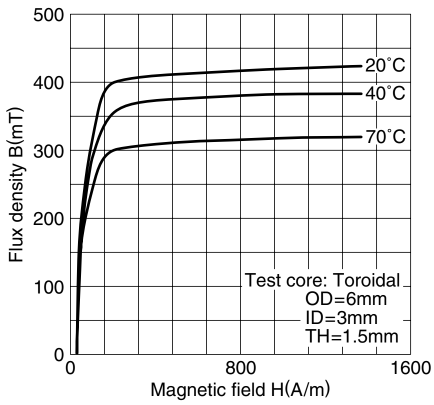
H5C2



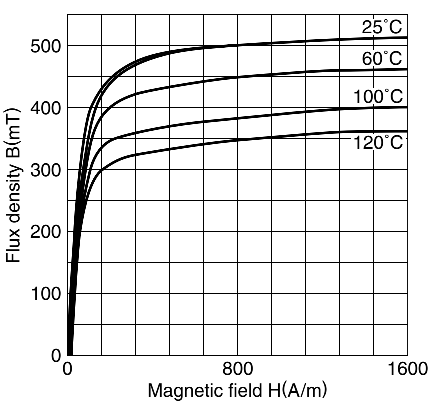
H5C3



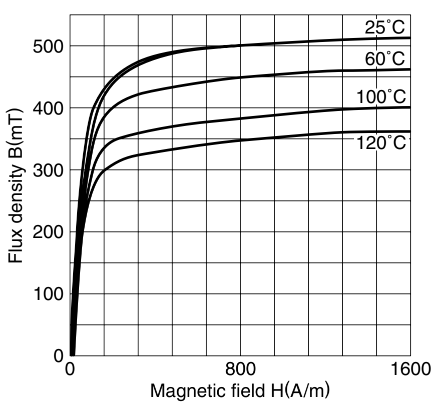
HP5



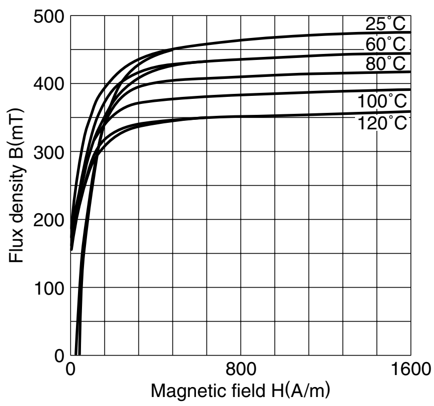
PC40



PC44



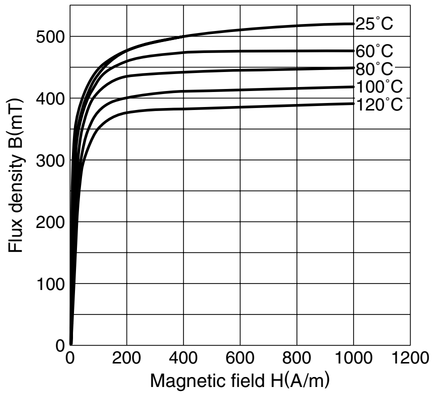
PC50



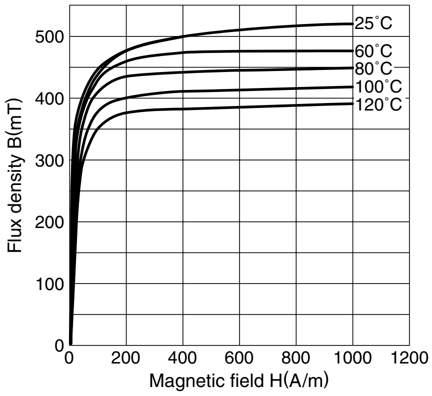
Note: The static magnetization curves were obtained by TYPE 3257 Hysteresis-Loop-tracer.

STATIC MAGNETIZATION CURVES

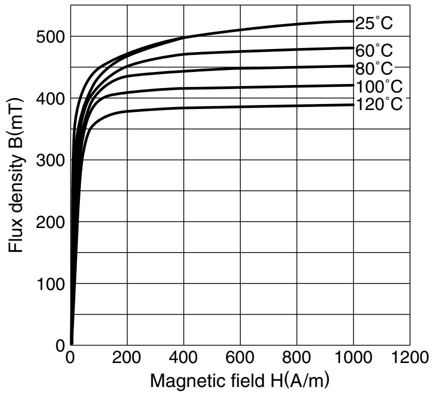
PC45



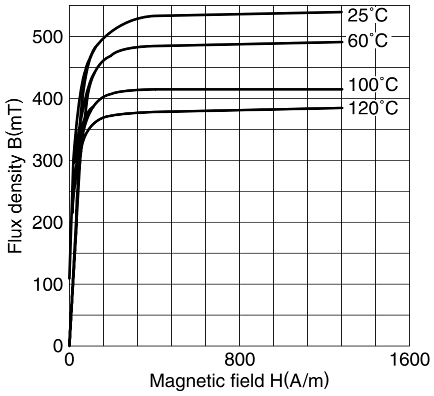
PC46



PC47



PC95



• All specifications are subject to change without notice.

TDK

HIGH PERMEABILITY MATERIAL H5C5

This material has accomplished initial permeability(μi) to 30,000, that is two times of existing best material H5C3, thus it enables transformers to be more compact and thinner. We offer it as troidal cores for pulse transformers currently, however, the cores for communicating devices such as EP cores and RM cores will be available in the future.

FEATURES

- Initial permeability(μi)=30,000
- Tansformers can be more compact and thinner. In addition, the numbers of winding turn can be reduced.
- Toroidal cores are available. Also shaped cores are programed.

APPLICATION

- Pulse transformers for LAN devices.
- Common mode chokes for LAN devices.

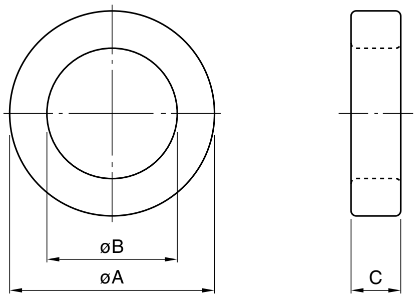
MATERIAL CHARACTERISTICS

Material			H5C5
Initial permeability [10kHz, 10mV, 10Truns]	μi		30000±30%
Relative loss factor	tanδ/μi		$<15\times10^{-6}$
Saturation magnetic flux density* [1194A/m]	Bs	mT	380
Remanent flux density*	Br	mT	100
Coercive force*	Hc	A/m	4.2
Curie temperature*	Tc	°C	>110
Disaccommodation factor [10 to 100min.]	DF		$<2\times10^{-6}$
Density	db	kg/m³	5.0×10^{3} typ.
Resistivity	ρv	Ω•m	0.15

* Average value

- The values were obtained with toroidal cores temperature unless otherwise.
- Only toroidal cores from OD: 2.54mm to OD: 6mm.

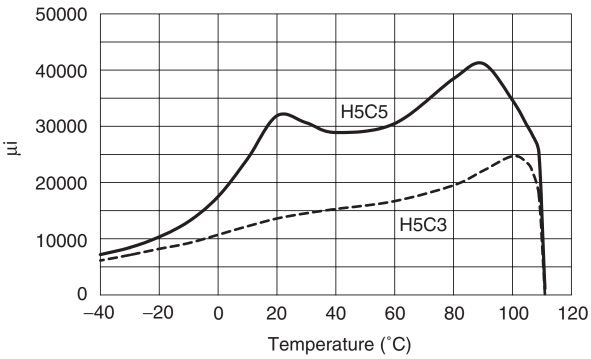
SHAPES AND DIMENSIONS



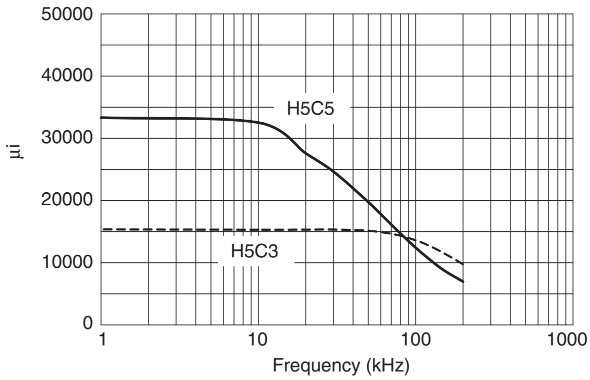
Dimensions inmm

	H5C5T3.05×1.27×1.27	H5C5T4×2×2	H5C5T6×1.5×3
øA	3.05±0.2	4.0±0.2	6.0±0.3
øB	1.27±0.2	2.0±0.2	3.0±0.25
C	1.27±0.2	2.0±0.2	1.5±0.2

INITIAL PERMEABILITY vs. TEMPERATURE CHARACTERISTICS



INITIAL PERMEABILITY vs. FREQUENCY CHARACTERISTICS



- All specifications are subject to change without notice.

WIDE TEMPERATURE RANGE, HIGH PERMEABILITY MATERIAL H5C4

As ISDN, PHS, etc. quickly become widespread in the data communication market, communication devices are increasingly being installed outdoors. TDK developed wide temperature range, high permeability material H5C4 by taking full advantage of TDK's ferrite materials experience and precise manufacturing process control technology. An initial permeability $\mu i \geqq 9000$ is maintained at temperatures above –20°C. This material has the optimum characteristics for the design of ISDN pulse transformers, etc. used by outdoor installations of communication equipment requiring the maintenance of characteristics down to low temperatures.

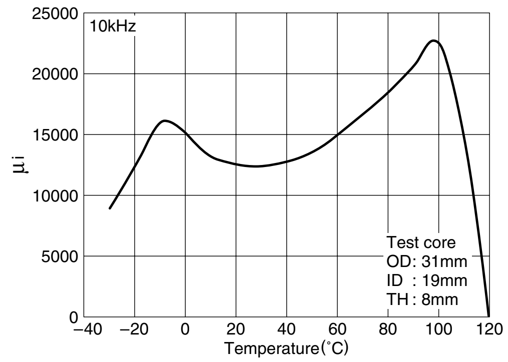
MATERIAL CHARACTERISTICS

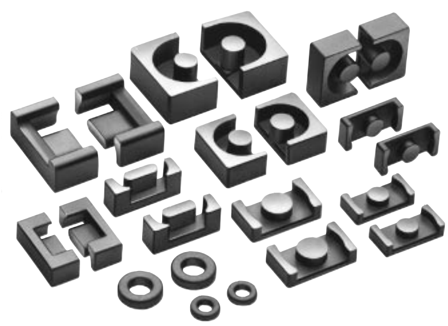
Material				**H5C4**
Initial permeability	μi		[–20°C] [25°C]	≧9000 12000±25%
Relative loss factor [10kHz]	tanδ/μi	×10⁻⁶		≦8
Saturation magnetic flux density	Bs	mT		380
Remanent flux density	Br	mT		100
Coercive force	Hc	A/m		4.4
Disaccommodation factor [1 to 10min, 10kHz]	DF	×10⁻⁶		≦3
Curie temperature	Tc	°C		≦110

STANDARD SHAPES

ER CORE:ER9.5/5, ER11/3.9, ER11/5, ER14.5/6
EPC CORE:EPC10, EPC13
EEM CORE:EEM8/8, EEM10/10, EEM12.7/13.7, EEM13/13
EE CORE:EE8.9/8
RM CORE:RM5, RM6
EP CORE:EP7, EP10, EP13
T CORE:T3.05, T3.94, T4, T4.83, T6

INITIAL PERMEABILITY vs. TEMPERATURE CHARACTERISTICS





TDK

FERRITE MATERIAL FOR LAN PULSE TRANSFORMERS DNW45

With the growing popularity of high-speed Ethernet, the demand for ferrite material that is optimally suited for pulse transformers in LAN systems is rising. In particular, LAN systems that are subjected to the harsh operating environments found in industrial applications are required to operate at wider temperature ranges compared to existing materials.
To meet such demands, TDK has developed the DNW45, a product dedicated to small toroidal forms used in high-speed LANs, which delivers high inductance and excellent DC superposition characteristics at a wide temperature range (–40 to +85°C).

FEATURES

- Delivers high inductance over a wide temperature range (–40 to +85°C).
- This ferrite material delivers excellent DC superposition characteristics and was designed for small toroidal cores.
- DC superposition characteristics in the –40 to +85°C temperature range has been improved by 23% compared to DN45, one of previous materials.

APPLICATIONS

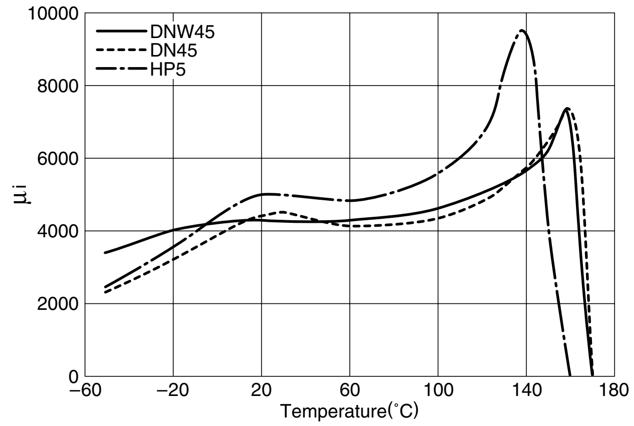
Ferrite core for pulse transformers in Ethernet (100Base-T) LAN systems.
• Please consult us for on-vehicle applications.

MATERIAL CHARACTERISTICS
COMPARISON TO PREVIOUS MATERIAL

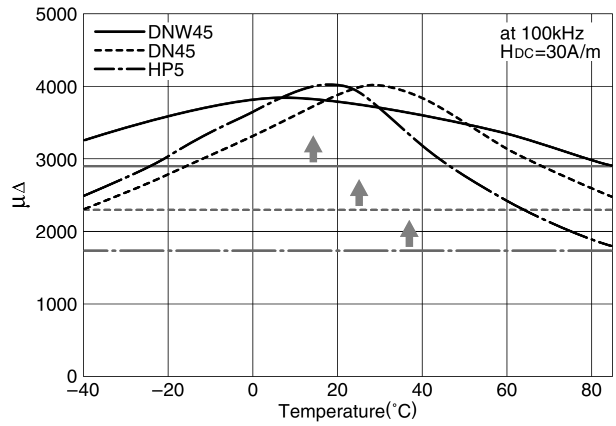
Material				DNW45	HP5
Initial permeability	μi		25°C	4200±25%	5000±25%
Relative loss factor	$\tan\delta/\mu i$	$\times 10^{-6}$	25°C, 10kHz	<3.5	<3.5
Saturation magnetic flux density	Bs	mT	25°C, 1000A/m	450	400
Curie temperature	Tc	°C	min.	150	140
Density	db	kg/m^3		4.85×10^3	4.8×10^3
Electrical resistivity	ρv	$\Omega \cdot m$	25°C	0.65	0.15

• Measured with toroidal core(OD10×ID5×T2.5mm).
• Various toroidal cores of small sizes are available. Please contact us for details.

μi vs. TEMPERATURE CHARACTERISTICS



μΔ vs. TEMPERATURE CHARACTERISTICS



LOW THD MATERIALS FOR xDSL MODEM TRANSFORMERS DN40 AND DN70

The use of xDSL technique becomes wide spread as a high broad-band access to the internet. In order to utilize such network access as sufficient as possible, low THD (Total Harmonic Distortion) of transformer for xDSL modem is quite important to transfer the significant signals.
Materials DN40 and DN70, TDK achieved such requirements recently, are developed to meet low THD over a wide temperature range(0 to 85°C) and wide frequency range(≧ 5kHz).
Therefore, They are suitable for the high performance transformer design for xDSL modem applications.
Standardization of AL-value will help you to select the optimum core at the transformer design.

FEATURES

- Meet low THD over a wide temperature range(0 to 85°C) and wide frequency range (≧ 5kHz).

APPLICATIONS

- Transformer for xDSL modem

APPLIED CORE TYPE AND AL-value

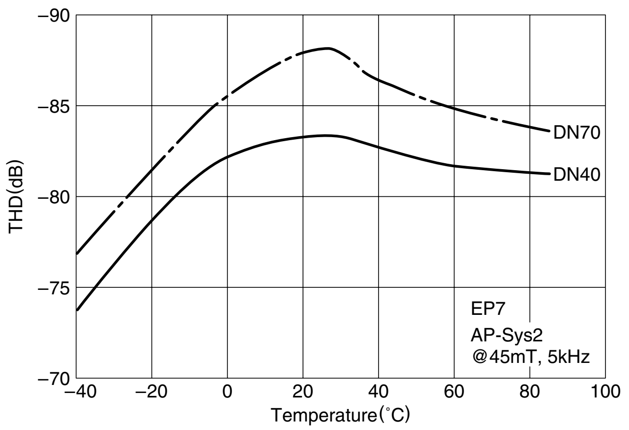
Core	Type	AL-value
EP	EP7	40, 63, 100, 160, 250
	EP10	40, 63, 100, 160, 250
	EP13	63, 100, 160, 250, 400, 500

MATERIAL CHARACTERISTICS

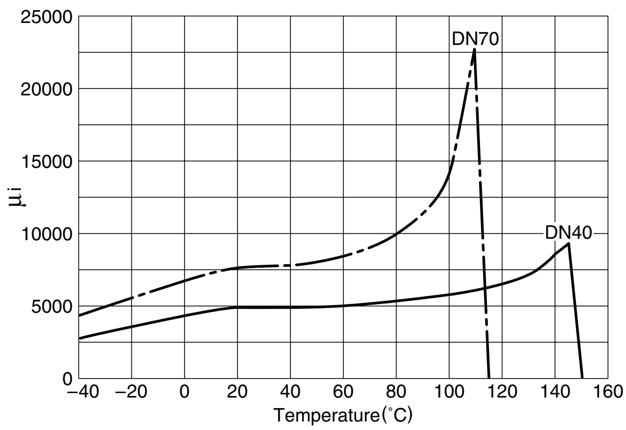
Material				**DN70**	**DN40**
Initial permeability	μi		25°C	7500±25%	4000±25%
Relative loss factor [10kHz]	tanδ/μi	$\times 10^{-6}$	25°C	<2.0	<2.5
Temperature factor of intial permeability	αμir		–30 to +20°C 20 to 70°C	–0.5 to +1.5 –0.5 to +1.5	–0.5 to 2.0 –0.5 to 2.0
Saturation magnetic flux density [1000A/m]	Bs	mT	25°C	390	405
Hysteresis material constant [25°C, 1.5 to 3.0mT, 10kHz]	ηB	$\frac{10^{-6}}{mT}$		<0.2	<0.8
Curie temperature	Tc	°C	min.	105	130
Density	db	kg/m³		5.0×10^3	4.8×10^3
Electrical resistivity	ρv	Ω • m		0.3	1.0

• Unless otherwise specify the tolerance, the values are shown as a typical.

THD TEMPERATURE DEPENDENCE CHARACTERISTICS (Typical)



μi vs. TEMPERATURE CHARACTERISTICS (Typical)

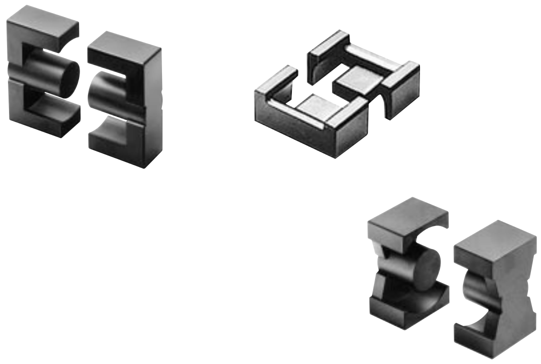


WIDE TEMPERATURE RANGE, LOW LOSS POWER MATERIAL PC95

Based on TDK's ferrite technologies, PC95 is a high-performance ferrite material that achieves low loss over a wide range of temperatures.
This material delivers the same level of saturated magnetic flux density as our existing PC44 and also delivers minimal loss (under 350kW/m^3) at temperatures ranging from 25 to 120°C.
PC95 can be used at a near-optimum state regardless of temperature. Owing to this characteristic, transformers based on the material PC95 are optimally suited for use in DC to DC converters in electric vehicle applications, such as HEVs and FCEVs, in which components are exposed to a wide range of temperatures. It can also be used in switching power supply transformers.

FEATURES

- Low loss: <350kW/m^3(100kHz, 200mT) from 25 to 120°C.
- If used in DC to DC converters for electric vehicles, fuel efficiency can be improved due to the improved power efficiency over a wide temperature ranges.
- The materials offer about the same saturation magnetic flux density as PC44 from room temperature up to high temperatures.
- The materials can be shaped into standard as well as original shapes.



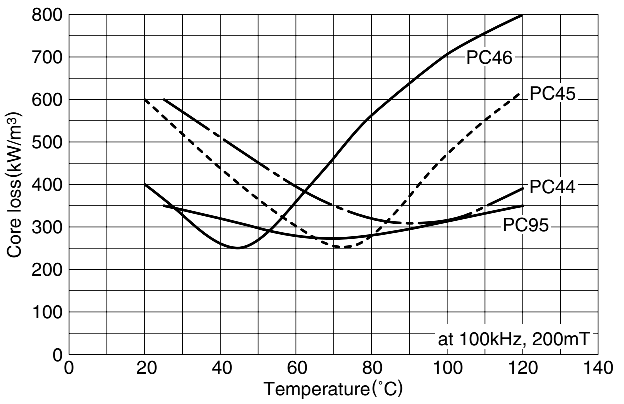
APPLICATIONS

- DC to DC converters for automobiles
- Main transformers for various switching power supplies
- Inverter transformers for LCD backlight
- AC adapters and chargers

MATERIAL CHARACTERISTICS

Material		PC95	PC44
Core loss Pcv kW/m^3 [100kHz, 200mT]	25°C	350	600
	80°C	280	320
	120°C	350	400

CORE LOSS vs. TEMPERATURE CHARACTERISTICS



TDK

LOW LOSS FERRITE MATERIAL FOR POWER SUPPLY PC47

PC47 has the best properties for transformers of power supplies, adapters and chargers.
The core loss and saturation magnetic flux density of PC47 are far better than PC44 and PC40 which are currently in use.

FEATURES

- Core loss: 250kW/m³ at 100kHz, 200mT, 100°C.
- Low core loss at wide frequency range 100kHz to 300kHz.
- Higher saturation flux density than PC44.

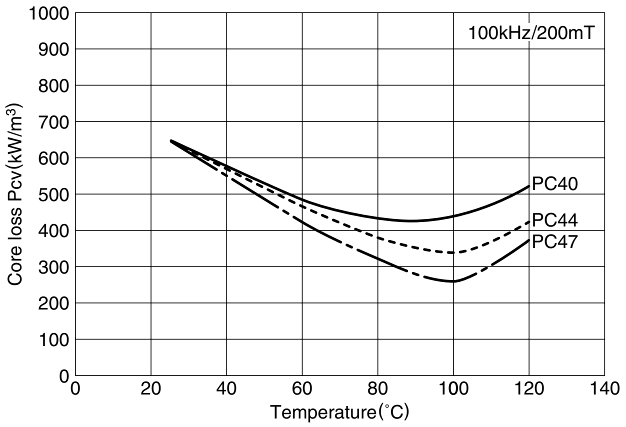
APPLICATIONS

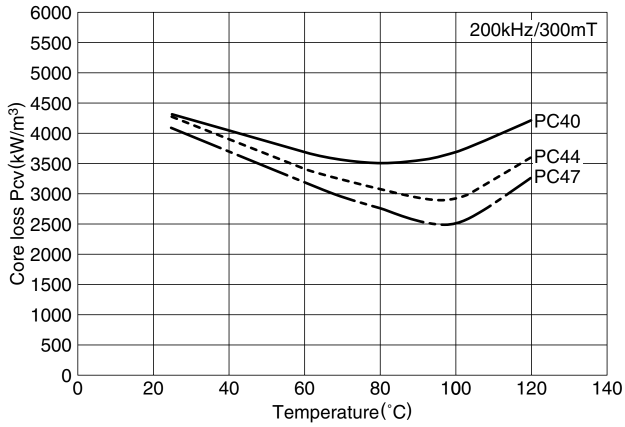
- Switching power supplies
- Adapters and chargers for notebook type pc
- CCFL LCD backlight

MATERIAL CHARACTERISTICS

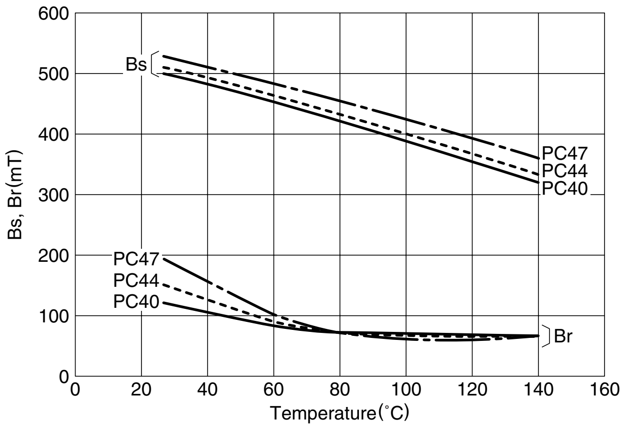
Material				PC47	PC44	PC40
Initial permeability	μi		25°C	2500±25%	2400±25%	2300±25%
Core loss volume density [100kHz, 200mT]	Pcv	kW/m³	25°C	600	600	600
			60°C	400	400	450
			100°C	250	300	410
Saturation magnetic flux density [1000A/m]	Bs	mT	25°C	530	510	510
			100°C	420	390	390
Remanent flux density	Br	mT	25°C	180	110	95
			100°C	60	60	55
Curie temperature	Tc	°C	min.	230	215	215
Density	db	kg/m³		4.9×10^3	4.8×10^3	4.8×10^3

Pcv TEMPERATURE DEPENDENCE CHARACTERISTICS (Typical)

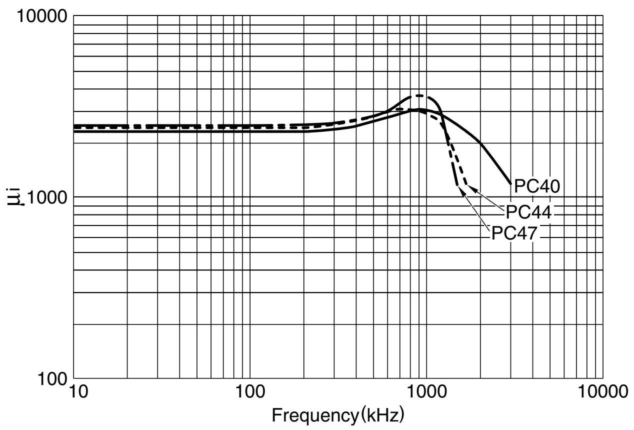




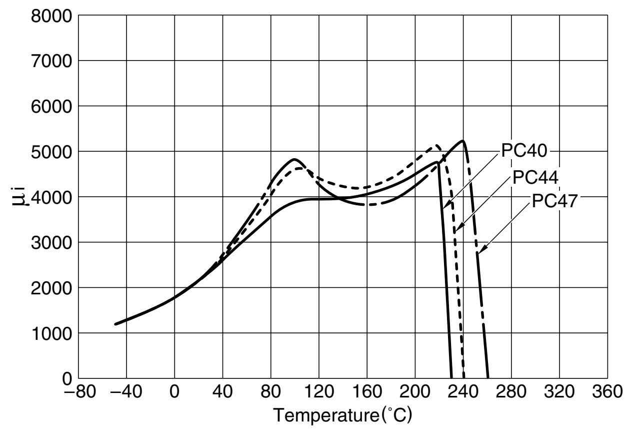
Bs and Br TEMPERATURE DEPENDENCE CHARACTERISTICS (Typical)



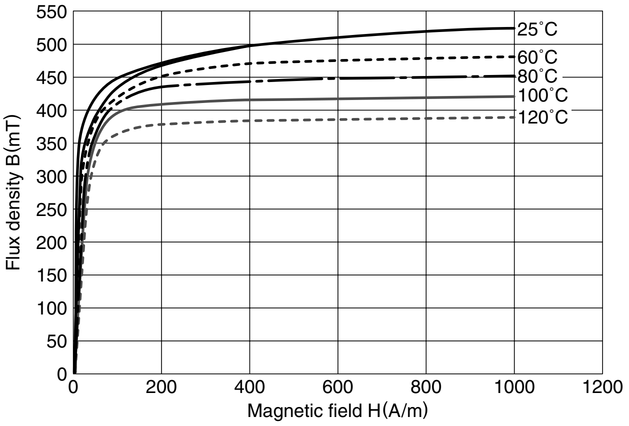
μi vs. FREQUENCY CHARACTERISTICS (Typical)



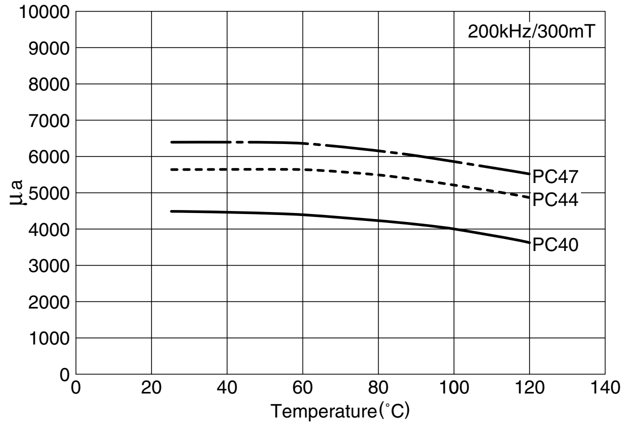
μi vs. TEMPERATURE CHARACTERISTICS (Typical)



MAGNETIZATION CURVES (Typical)
MATERIAL:PC47



μa TEMPERATURE DEPENDENCE CHARACTERISTICS (Typical)



LOW LOSS FERRITE MATERIALS FOR POWER SUPPLY PC45 AND PC46

In recent years, with the advent of notebook type pc, VCR's, digital camera's and mobile communication devices, technological demands have risen for higher performance CCFL LCD backlight units that have smaller sizes, lower profiles and higher efficiency.
The PC45 and PC46 are materials developed to achieve higher efficiency in designing minimize core loss at practical temperature ranges (PC45: 60 to 80°C and PC46: 40 to 50°C) and high saturation flux density.
They are also suitable for the transformers of DC to DC converters and adapters of notebook type pc.

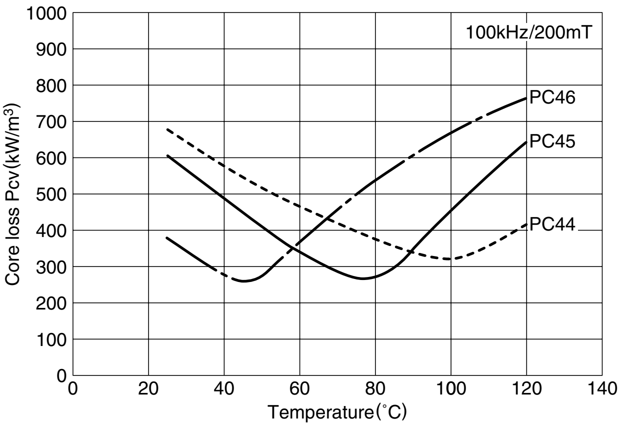
APPLICATIONS

- Switching power supplies
- Adapters and chargers for notebook type pc
- CCFL LCD backlight

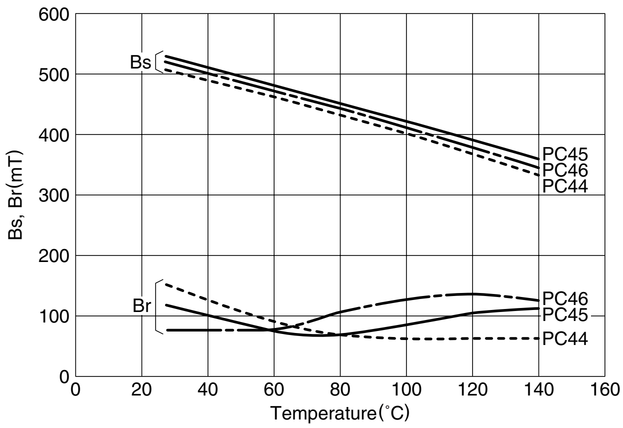
MATERIAL CHARACTERISTICS

Material				PC45	PC46	PC44
Initial permeability	µi		25°C	2500±25%	3200±25%	2400±25%
Core loss volume density [100kHz, 200mT]	Pcv	kW/m³	25°C	570	350	600
			60°C	250(75°C)	250(45°C)	400
			100°C	460	660	300
Saturation magnetic flux density [1000A/m]	Bs	mT	25°C	530	530	510
			100°C	420	410	390
Remanent flux density	Br	mT	25°C	120	80	110
			100°C	80	115	60
Curie temperature	Tc	°C	min.	230	230	215
Density	db	kg/m³		4.8×10^3	4.8×10^3	4.8×10^3

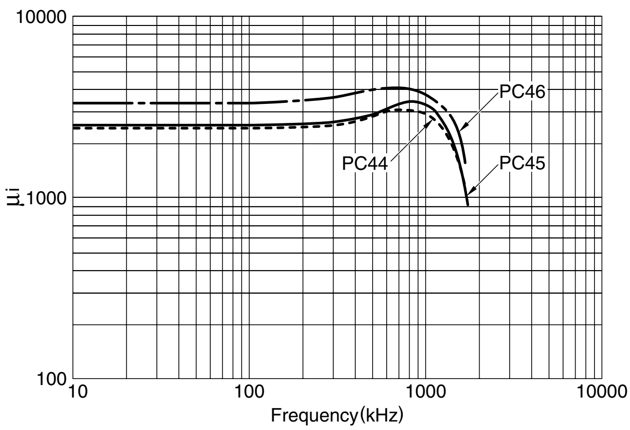
Pcv TEMPERATURE DEPENDENCE CHARACTERISTICS (Typical)



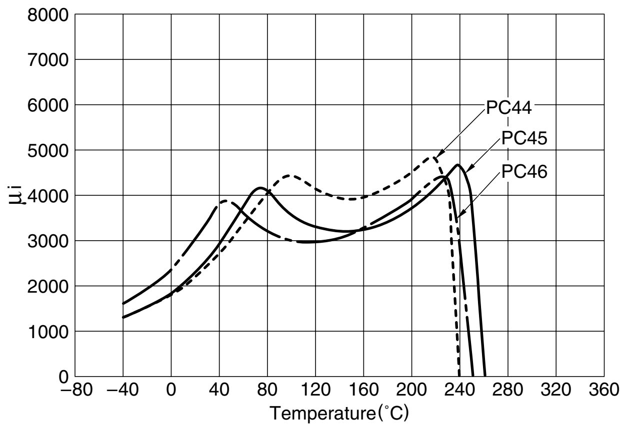
Bs and Br TEMPERATURE DEPENDENCE CHARACTERISTICS (Typical)



µi vs. FREQUENCY CHARACTERISTICS (Typical)



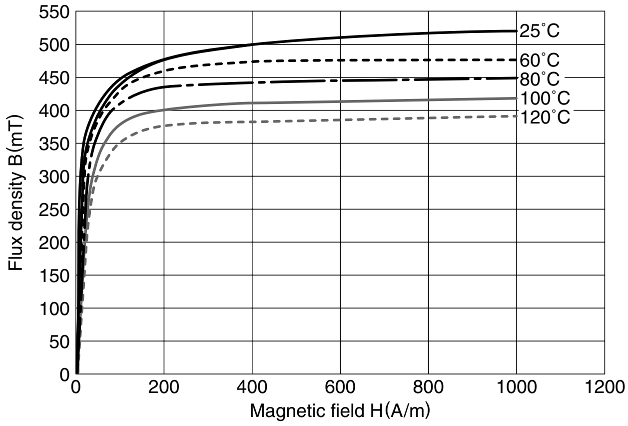
µi vs. TEMPERATURE CHARACTERISTICS (Typical)



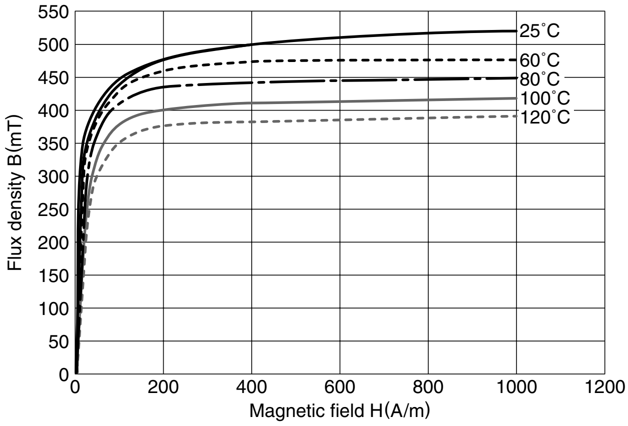
TDK

MAGNETIZATION CURVES

MATERIAL:PC45



MATERIAL:PC46



TDK

HIGH SATURATION FLUX DENSITY MATERIAL FOR CHOKE COIL PC33

PC33 has the best properties for smoothing choke coil of power supplies.
The saturation magnetic flux density of PC33 is far better than PC44 and PC40 which are currently in use.

FEATURES

- Higher saturation flux density than PC44 and PC40.
- Most suitable ferrite material for choke coils.
- Maintain high saturation magnetic flux density at high temperature.

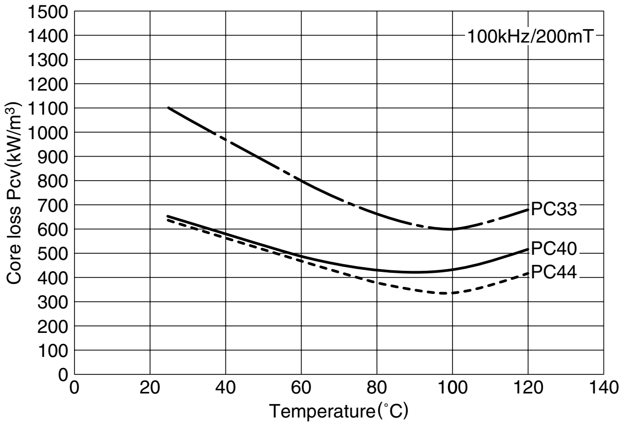
APPLICATIONS

- Power choke coils for switching power supplies
- Power choke coils for notebook type pc

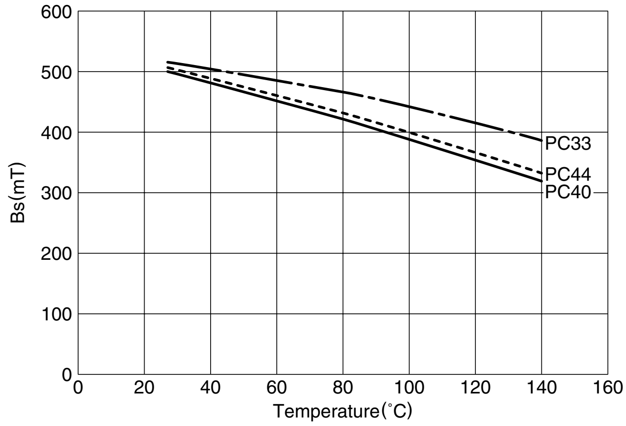
MATERIAL CHARACTERISTICS

Material				**PC33**	**PC44**	**PC40**
Saturation magnetic flux density [1000A/m]	Bs	mT	25°C	510	510	510
			100°C	440	390	390
Initial permeability	μi		25°C	1400±25%	2400±25%	2300±25%
Core loss volume density [100kHz, 200mT]	Pcv	kW/m³	25°C	1100	600	600
			60°C	800	400	450
			100°C	600	300	410
Curie temperature	Tc	°C	min.	290	215	215
Density	db	kg/m³		4.8×10^3	4.8×10^3	4.8×10^3

Pcv TEMPERATURE DEPENDENCE CHARACTERISTICS (Typical)



Bs TEMPERATURE DEPENDENCE CHARACTERISTICS (Typical)



APPLICATION EXAMPLES OF TDK'S FERRITE CORES

Application examples		Features	Material name	Core shape
Carrier (transmission) circuit	Conversion filter for frequency division multiplex system Input/output transformers for repeater For multifrequency code signal oscillator of touch-tone telephone Various modulator/demodulator circuits Matching transformers for filter Matching transformers for various signal circuit	Low loss High stability	H5A H5C2 H5C3 HS72 PC40 PC44 PC50	T(Toroidal) EP EPC EE EER EC P(Pot)
Data transmission circuit	Hybrid transformers for FDM Pulse transformers for PCM Input/output transformers of memory unit Pulse transformers for electronic switching system Input/output transformers for repeater	High permeability Wideband and low loss High stability High saturation magnetic flux density	HP5 H5B2 H5A H5C2 H5C3 PC40 PC44	T(Toroidal) EP EE EPC P(Pot) RM EER EC
Power supply circuit	High output transformers High voltage transformers Main transformers for switching regulator Smoothing choke coils for switching regulator Power transformers for inverter Power transformers for converter Step-up transformers Saturable reactors	High saturation magnetic flux density High permeability Low loss Low temperature rise	H5A H5C2 H5C3 HS72 PC40 PC44 PC50	T(Toroidal) EP EPC EE EER EC P(Pot)
For EMC countermeasure	Common mode choke coils for power circuit Common mode choke coils for signal line Line choke coils Beads for prevention of parasitic oscillation For electromagnetic shield For EMI filters	High permeability High saturation magnetic flux density	HS72 HS52 HS10 HP5 H5A H5B2 H5C2 H5C3	T(Toroidal) EE Rod type Cylindrical type ET UU FT
Examples of application circuit and equipment	Filters for railway signal Medical equipment Measuring and testing equipment Magnetic sensors Road traffic control systems Coils and transformers for watch Transformers and coils for acoustic sounder Acoustic equipment networks	High permeability High stability High saturation magnetic flux density	H5A H5C2 PC40 Others	P(Pot) Miniature pot EE EI EER EC Rod type C(Cup) type Square type Disc type Cylindrical type

PRECAUTIONS

1. INTRODUCTION

1.1 CORES WITHOUT AIR GAP

TDK manufactures various ferrite core shapes, such as Pot cores, RM cores, E cores, EP cores, etc. There is a broad selection of materials, so optimum combinations of high permeability, high flux density and low losses can be chosen. Therefore, the user can specify the combination of shape and material for use in inductors, transformers, and many other applications.

TDK is able to process cores with very smooth, mirror-like contact surfaces. Such exacting smoothness enables the initially-high core permeability to be retained after core assembly. Therefore, such high-polished cores are the optimum choice for precision and minimum-sized coils.

When cores are employed without air gaps, remove any outer particles(contamination, grease, etc.) from the contacting surfaces prior to assembly. It is recommended that the contacting surfaces be rubbed against each other several times in order to make intimate contact. This will assure that the highest effective permeability is obtained.

1.2 CORES WITH AIR GAP

TDK provides ferrite cores with a preset, machined, air gap. Such cores are ideal for precision inductors. Gapped cores permit minimum inductor tolerances, and provide best stability during temperature variations or aging. The gap size is determined by the required A_L-value. Users need to specify only the A_L-value. TDK will automatically select the required gap dimension.

If the gap is large, then the gap is evenly distributed on both sides of the core. However, if the gap size is less than 0.4mm approx., then the gap machined on only one of the core pair. In the case of small gaps, the gapped core is marked to differentiate between the gapped and ungapped parts.

1.3 EFFECTIVE PARAMETER FOR CORES

In this catalog, the effective parameters related to the magnetic circuits of cores are shown on the page on which the core dimension is mentioned. These parameters are used for calculating the measured value of effective permeability, flux density and magnetic field intensity of the cores.

Core factor $\Sigma \ell / A = C_1$ (mm^{-1})
Effective cross-sectional area A_e (mm^2)
Effective magnetic path length ℓ_e (mm)
Effective volume V_e (mm^3)

The formulas for calculating these four parameters are stated in “IEC Publication 205”, and the calculated values shown in this catalog are also based on them. These values are calculated on the assumption that the path of magnetic flux is an ideal magnetic path, and do not always coincide with the purely geometrical calculation. Especially, as when the magnetic flux density in the uneven and complex shaped cores is examined, the use of the minimum cross-sectional area geometrically calculated may be more practical.

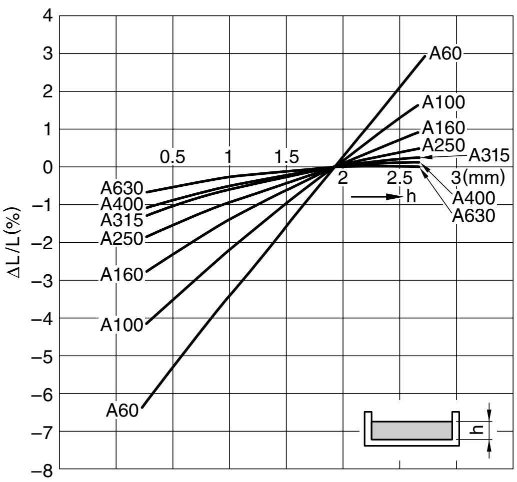
2. DESIGN CONSIDERATION

2.1 RELATIONSHIP BETWEEN WINDING SPACE USED AND INDUCTANCE

The Fig.1 shows the dependence of inductance with regards to the actual height of the winding. Inductance increases as winding height increases. This effect is particularly prominent for cores with large air gap(i.e. low AL-value). The AL-value therefore is a value to be determined and guaranteed under specified winding conditions.

RELATIONSHIP BETWEEN WINDING SPACE USED AND INDUCTANCE

H5AP22/13-52H



H5AP26/16-52H

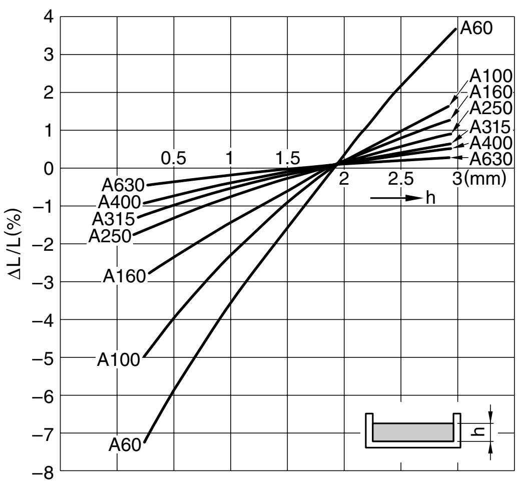


Fig. 1

2.2 EFFECTS OF DISTRIBUTED CAPACITY ON INDUCTANCE

Any coils have also a capacitive effect, called distributed capacity, because of closeness of the windings. This capacitive effect is particularly harmful for coils with several hundred to several thousand turns and the result is that a significant deviation from the calculated inductance may occur.

The distributed capacity and its influence can be reduced by the following methods:

(a) Separate the first layer of winding from the last(outermost) layer as much as possible; for instance, by insulation tape.

(b) Use a bobbin with multiple sections.

(c) Connect the beginning of winding with the low potential(ground) in the circuit.

2.3 STABILITY OF INDUCTANCE

Design of stability

For a highly reliable filter used in communications equipment, stability extending for a long period of time is required, such as ten years, twenty years, etc. The three items to be considered in designing coils for filters are as follows:

(a) Disaccommodation factor of the ferrite core

(b) Temperature coefficient of the ferrite core

(c) Safety margin for assembling the coil

As for item(a), coils can be designed by a method described in the following paragraph by determining the core shape, material and AL-value.

As for item(b), the values are specified in this catalog according to the core sizes, material and AL-value. These values should be used.

As for item(c), such a safety margin is a constant based on the experience of users who actually carry out assembly operation of coils.

Calculation of aging

One general characteristic of ferrite cores is that their permeability starts to decline with the passing of time immediately after sintering. The factor indicating the rate of this aging is known as the “disaccommodation factor D_F” and this factor is described on the “Terms Definitions and Explanations” in the explanatory part of this catalog. Each material used for the ferrite core gives the disaccommodation factor of its own. The resulting factors are given in the material characteristics table.

When designing inductance elements to a precision of estimating the amount of change in the inductance in ten years’ or twenty years’ time, the disaccommodation factor can be used to gauge in advance just how much this inductance will vary. The changes in the permeability, or in other words the inductance, vary almost linearly with respect to the logarithm of the time involved. This can be expressed in the following formula using the disaccommodation factor D_F.

$$\frac{\Delta L}{L} = D_F \times \mu_e \log_{10}\frac{t_2}{t_1} \quad (t_2 > t_1)$$

where, $\Delta L/L$ = the variation rate of the inductance from t_1 to t_2

D_F = the disaccommodation factor

μ_e = the effective permeability(permeability “μ_i” is used for closed magnetic circuits without joins such as ring-shaped cores.)

t_1 = the initial time(the point in time when the core is manufactured is set as the starting point.)

t_2 = the targeted end time(the point in time when the core is manufactured is set as the starting point.)

Calculation example:
Material: H5A
$D_F = 3\times10^{-6}$ maximum(according to the material characteristics table)
Effective permeability= 200
t_1 = coil assembly in the second month after the manufacture of core
t_2 = twenty years later(12×20= 240 months)

with the above conditions, the variation rate of the inductance in twenty years’ time will be as follows:

$$\Delta L/L = 3\times10^{-6}\times200\times\log_{10}\frac{240}{2}$$
$$=1247.5\times10^{-6}$$
$$=0.125\%$$

In other words, the inductance will decline 0.125% in twenty years’ time.

Note:The same kind of phenomenon occurs as soon as, for instance, a core is exposed to a temperature exceeding the Curie temperature, exposed to a strong magnetic shock whereby the saturation magnetic flux density is reached, or as soon as a core is affected by violent stress.

If the above incidents are taken as the starting point of the decline in inductance t_1 and t_2 are then set, it is then possible, as in the above example, to predict how much the inductance will vary.

Apart form the extreme instances given above, there are other variations caused by various shocks incurred in general handling of the core. These, however, are minimal with cores a few months after their manufacture and they do not therefore pose any problems.

2.4 DC PRE-MAGNETIZATION CHARACTERISTICS
H5A P30/19

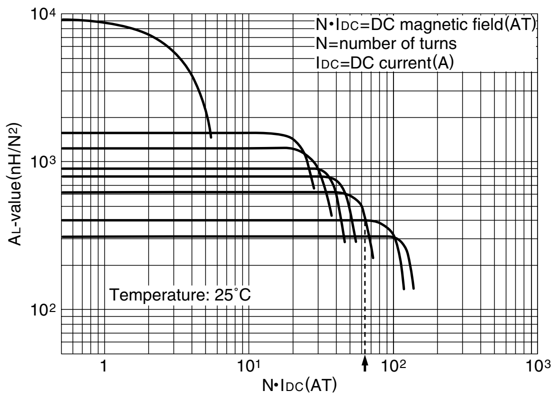


Fig. 2

Fig.2 shows the characteristics in terms of changes of the A_L-value with respect to the DC magnetic field. When designing a transformer using an EE or Pot core, these are the characteristics which are required for ascertaining the limits of stable use without causing any changes in inductance with respect to the DC pre-magnetization.

Usually in the design of transformers which pre-magnetize the DC an air gap is provided in the magnetic circuit of the core and this is used with the A_L-value(nH/N^2) which is necessary. The standard A_L specifications are listed under the items for the EE and Pot cores.

Example:
Pot core: H5AP30/19A400-52H
Material: H5A
A_L-value: 400(nH/N^2)

The limit by which the permeability does not drop due to the DC magnetic field is NI=65AT(indicated by an arrow in the Fig.2) on the figure illustrating the DC pre-magnetization characteristics of the P30/19 core of material H5A .
Therefore, with a single turn, a transformer can be used stably up to 65A.

2.5 CALCULATION OF FLUX DENSITY

In the graphs of the B-H curve and the power loss used this catalog, flux density is used as parameter. Also there are many convenient cases in which the level applied to the core is expressed by use of flux density. In case of sine wave, this flux density can be obtained from the following formulas:

$$\hat{B} = \frac{E}{\sqrt{2}\pi \cdot f \cdot N \cdot Ae} \times 10^9 (mT)$$

where, V = voltage applied to coil(Vrms)
f = frequency(Hz)
N = number of turns (turns)
A_e = effective area (mm^2)
$\hat{B}$ = peak value of flux density

3. PRECAUTIONS FOR COIL ASSEMBLY

TO OBTAIN A STABLE COIL

There should be no contamination or grease on mating surface as these become obstacles in obtaining the inductance desired. These also can be cause of instability. Either on outside or inside of the core, should there not be contamination or grease since these can make gluing of cores and/or accessories difficult.

When gluing coilformer to the core, adhesive materials and the point to glue should be carefully selected, and the quantity of the adhesive should also be limited to the minimum necessary, because the thermal expansion coefficient is very different between ferrite cores and adhesive materials, thus causing mechanical stress which gives undesirable effects on electrical performance.

3.1 ADHESIVE AND ITS PREPARATION

The following adhesives are recommended depending on the parts to be glued.

3.1.1 For coilformer

Adhesive: Synthetic rubber adhesive(Example: Sony Bond, SC12N)

This adhesive gets cured in about 12 hours at room temperature. If the coil must be sealed within a case, it is advised that the coil be put outside about 24 hours after usage of the adhesive so organic solvents contained in the adhesive be sufficiently volatilized.

Note:Synthetic rubber adhesive is the adhesive made Chloroprene Rubber dissolved by organic solvents. This kind of adhesive is usually dried after spreading to such extent as fingers do not get too sticky so this glues well. If not dried enough, adhesive spreads too wide when pressed tight which is undesirable.

3.1.2 For cores

Adhesive: Mixture of Araldite AW106(100 grams) and Hardener HV953U(80 grams)

Pot life: About 2 hours(at 20°C)

At room temperature, curing time of about 12 hours is necessary. To expedite curing, it is advisable to cure at 70°C for 2 hours approximately.

Note:Mix Araldite AW106 and Hardener HV953U at the weight ratio, 5:4. As the pot life of this adhesive is about 2 hours, this mixing should be done only to the minimum quantity necessary.

3.2 ASSEMBLING

3.2.1 Preparation

Remove contamination from inside and outside of the core using a dry brush. Grease on the mating surfaces of the core should be wiped away. For this purpose, a stamp pad soaked in alcohol or other organic solvents is recommended, but the surface of this stamp pad should be with a non-fluffy nylon coated cloth. The usage of the dry second stamp pad to remove moisture may be useful.

3.2.2 Assembling of coilformer

Apply a dot of adhesive per Clause 3.1.1 onto the inside bottom of the core and insert the coilformer to glue as Fig.3(refer to Note 1). It is not desirable to spread adhesive all over the bottom surface. Leave the glued parts 12 hours approximately at room temperature so the adhesive cures completely. Then, put the core into the mounting assemblies, rotate core halves against each other 2 or 3 times, and match the core halves to the center using a jig or visually(refer to Note 2).

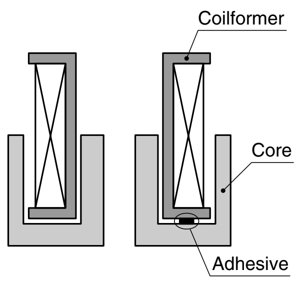


Fig. 3

Note 1: The reason why the adhesive is applied in one dot only is that difference of thermal expansion coefficient causes mechanical stress inside the ferrite core, thus affecting various characteristics especially Temperature Coefficient of coil.

Note 2: The jig is not available from us, but its drawings are available upon your request.

3.2.3 Gluing of cores

To glue the core set fitted inside the mounting assemblies, it is advisable to be aligned the cores properly and to glue the two points on the outside of the cores as Fig.4.
Gluing the core with the mounting assemblies is not preferable and so should be avoided. Here, epoxy adhesive per Clause 3.1.2 is recommended.
In case mounting assemblies are not used, outer circumferential matting surface(ring) can be glued as Fig.5. In this case, the core halves should be rotated to each other several times, so that adhesive spreads all over the matting surfaces as thin as possible.
Then the core halves should be matted and kept under pressure of 0.2N/mm^2 until the adhesive cures. Slug of the core should not be glued.
For curing this glued core, approximately 12 hours at room temperature is necessary. To expedite curing, it is advised to put the core into the oven and heat at 70°C for 2 hours approximately.

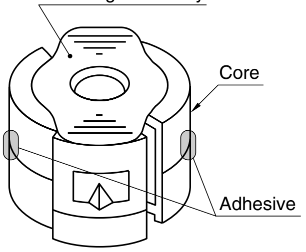


Fig. 4

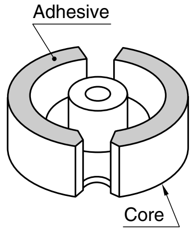


Fig. 5

3.3 IMPREGNATION OF COIL

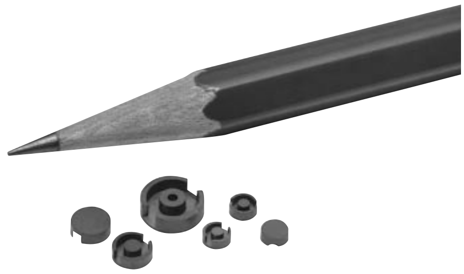
In case there is a demand to minimize effect of humidity, vacuum impregnation by wax should be done only on coilformer and not on the core. A good electrical quality wax herewith should be used and the temperature during impregnation should be kept below the maximum allowable temperature of the coilformer.
When inserting the coilformer, care should be taken that wax does not stick onto the matting surfaces of the core.
In case higher electrical stability is required, hermetic sealing is recommended which not only keep off humidity but also has the effect of electrostatic shielding.

3.4 TEMPERATURE CYCLING FOR STABILIZATION

Temperature cycling for stabilization is the treatment aimed at relieving the mechanical stresses of the assembled inductor.
It is advised that the assembled inductor should be subjected to 0 to 70°C heat cycle of 3 consecutive times minimum. 8 hours minimum per cycle is recommended. This temperature cycle should be performed on the assembled inductor to which the trimmer is inserted and the rough tuning is finished.

MINIATURE POT CORES P SERIES

TDK produces a miniature pot core series. These tiny pot cores are used in a variety of applications, including inductors for wristwatches, special choke coils, and pulse transformers. Some have even been used in miniature power supplies.
Bobbins are available for P5.8/3.3 and P7/4 cores.
Adhesives are usually employed to joint the two halves of the pot core.



ORDERING CODE SYSTEMS

1. Cores

H5A P5.8/3.3 Z — 5 2 S

- H5A: Material
- P5.8/3.3: Size of Pot core
- Z: Z: Without air gap or A_L-value: With air gap
- 5: Type of Pot core
- 2: Number of lead slot
- S: Shape of lead slot

2. Bobbins

B P5.8/3.3 — 6 1 2

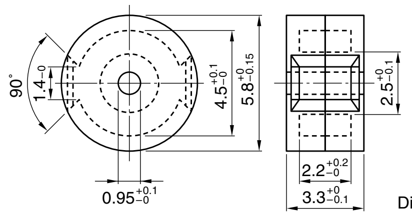
- B: Symbol of bobbin
- P5.8/3.3: Size of Pot core
- 6: Code of bobbin material
- 1: Number of section
- 2: Number of lead slot

TDK

P5.8/3.3 POT CORES

CORES

Based on IEC Publication 60133.



Dimensions in mm

Parameter

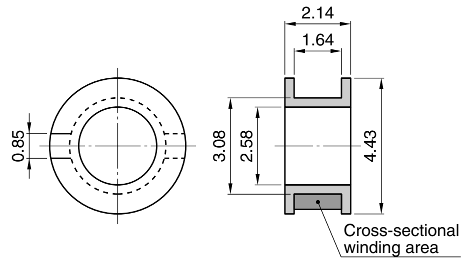
Core factor	C1	mm⁻¹	1.68
Effective magnetic path length	ℓe	mm	7.9
Effective cross-sectional area	Ae	mm²	4.7
Effective core volume	Ve	mm³	37
Cross-sectional center pole area	Acp	mm²	4.08
Minimum cross-sectional area	Acp min.	mm²	3.66
Cross-sectional winding area of core	Acw	mm²	2.42
Weight (approx.)		g	0.2

TYPICAL CHARACTERISTICS

Part No.	AL-value (nH/N²)	Effective permeability (µe)
Without air gap		
H5AP5.8/3.3Z-52S	870±25%	1163
H5C2P5.8/3.3Z-52S	2660 min.	3556

Measuring conditions:
Coil ø0.08mm, 2UEW, 70Ts (for material H5C2), 100Ts(for others)
Frequency 1kHz
Current level 0.5mA

BOBBINS



Dimensions in mm

Part No.	Number of sections	Material (Heat deflection temperature)	Available winding cross section (mm²)	Average length of turns (mm)	Weight (g) approx.
BP5.8/3.3-612	1	Polyacetal (110°C)*	0.95	11.7	0.03

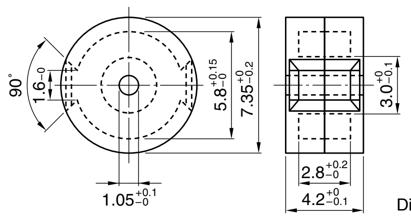
* 4.6kg/cm² force.

- Maximum number of turns N that can be wound on bobbins, see section of "Maximum number of Turns on Bobbins".

P7/4 POT CORES

CORES

Based on IEC Publication 60133.



Dimensions in mm

Parameter

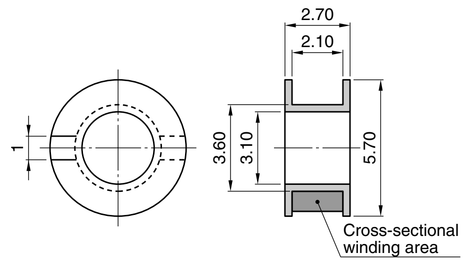
Core factor	C1	mm⁻¹	1.43
Effective magnetic path length	ℓe	mm	10
Effective cross-sectional area	Ae	mm²	7.0
Effective core volume	Ve	mm³	70
Cross-sectional center pole area	Acp	mm²	6.05
Minimum cross-sectional area	Acp min.	mm²	5.57
Cross-sectional winding area of core	Acw	mm²	4.31
Weight (approx.)		g	0.5

TYPICAL CHARACTERISTICS

Part No.	AL-value (nH/N²)	Effective permeability (µe)
Without air gap		
H5AP7/4Z-52S	1200±25%	1366
H5C2P7/4Z-52S	4970±30%	5656

Measuring conditions:
Coil ø0.1mm, 2UEW, 70Ts (for material H5C2), 100Ts(for others)
Frequency 1kHz
Current level 0.5mA

BOBBINS



Dimensions in mm

Part No.	Number of sections	Material (Heat deflection temperature)	Available winding cross section (mm²)	Average length of turns (mm)	Weight (g) approx.
BP7/4-612	1	Polyacetal (110°C)*	2.2	14.6	0.04

* 4.6kg/cm² force.

- Maximum number of turns N that can be wound on bobbins, see section of "Maximum number of Turns on Bobbins".

TYPE 5 POT CORES P SERIES

ORDERING CODE SYSTEMS

1. Cores

PC40 P14/8 A100—5 2 B

- Material (PC40)
- Size of Pot core (P14/8)
- AL-value (Z: without air gap) (A100)
- Type of Pot core (5)
- Number of lead slot (2)
- Shape of lead slot (B)

2. Bobbins

B P14/8—6 2 2

- Symbol of bobbin (B)
- Size of Pot core (P14/8)
- Code of bobbin material (6)
- Number of section (2)
- Number of terminal pin, or number of lead slot (without terminal pins) (2)

3. Accessories

F P14/8—6C

- Symbol of accessory (F)
- Size of Pot core (P14/8)
- Type of accessory (6C)

METHOD OF ASSEMBLING

Spring

Pot core

Bobbin

Pot core

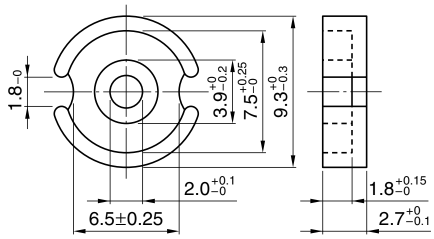
Yoke

• All specifications are subject to change without notice.

P9/5 POT CORES

CORES

Based on IEC Publication 60133 and JIS C 2516.



Dimensions in mm

Parameter

Core factor	C1	mm−1	1.24
Effective magnetic path length	ℓe	mm	12.4
Effective cross-sectional area	Ae	mm2	10.0
Effective core volume	Ve	mm3	124
Cross-sectional center pole area	Acp	mm2	8.04
Minimum cross-sectional area	Acp min.	mm2	7.29
Cross-sectional winding area of core	Acw	mm2	7.17
Weight (approx.)		g	0.8

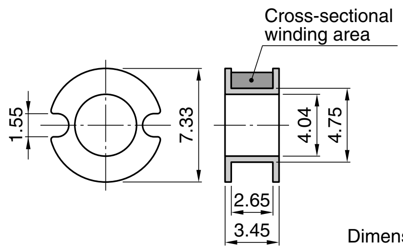
TYPICAL CHARACTERISTICS

Part No.	AL-value (nH/N2)	Effective permeability (μe)
Without air gap		
H5AP9/5Z-52H	1570±25%	1562
H5C2P9/5Z-52H	6030±30%	5998
PC40P9/5Z-52H	825 min.	821 min.
With air gap		
PC40P9/5A63-52H	63±3%	63
PC40P9/5A100-52H	100±3%	100
PC40P9/5A160-52H	160±5%	160

Measuring conditions:
Coil ø0.1mm, 2UEW, 70Ts (for material H5C2), 100Ts(for others)
Frequency 1kHz
Current level 0.5mA

BOBBINS

Based on IEC Publication 133 and JIS C 2516.



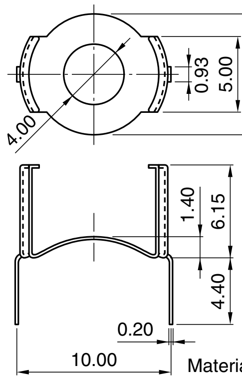
Dimensions in mm

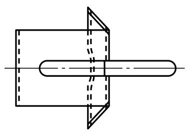
Part No.	Number of sections	Material (Heat deflection temperature)	Available winding cross section (mm2)	Average length of turns (mm)	Weight (g) approx.
BP9/5-612	1	Polyacetal (110°C)*	2.8	18.5	0.05

* 4.6kg/cm2 force.

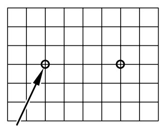
- Maximum number of turns N that can be wound on bobbins, see section of "Maximum number of Turns on Bobbins".

ACCESSORIES





CONNECTING PIN PATTERNS



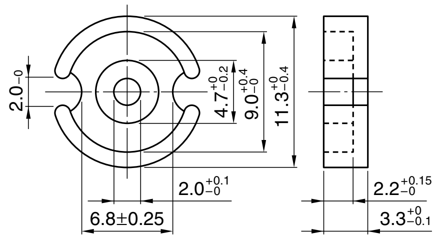
Material thickness=0.20 Dimensions in mm

Part No.	Parts	Material	Plating	Weight (g) approx.
FP9/5-6BFR	Spring	Phosphor bronze	Solder	0.4

P11/7 POT CORES

CORES

Based on IEC Publication 60133 and JIS C 2516.



Dimensions in mm

Parameter

Core factor	C1	mm^{-1}	0.969
Effective magnetic path length	ℓe	mm	15.5
Effective cross-sectional area	Ae	mm^2	16.0
Effective core volume	Ve	mm^3	248
Cross-sectional center pole area	Acp	mm^2	13.3
Minimum cross-sectional area	Acp min.	mm^2	12.4
Cross-sectional winding area of core	Acw	mm^2	10.5
Weight (approx.)		g	1.8

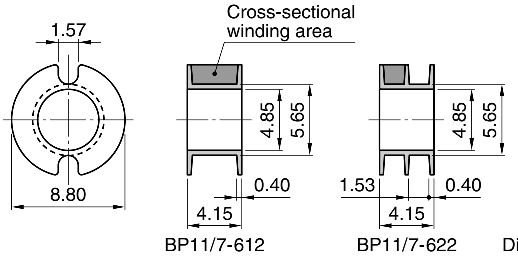
TYPICAL CHARACTERISTICS

Part No.	AL-value (nH/N2)	Effective permeability (μe)
Without air gap		
H5AP11/7Z-52H	2320±25%	1765
H5C2P11/7Z-52H	8220±30%	6253
PC40P11/7Z-52H	1250 min.	951 min.
With air gap		
PC40P11/7A63-52H	63±3%	48
PC40P11/7A100-52H	100±3%	75
PC40P11/7A160-52H	160±3%	120

Measuring conditions:
Coil ø0.18mm, 2UEW, 100Ts
Frequency 1kHz
Current level 0.5mA

BOBBINS

Based on IEC Publication 133 and JIS C 2516.



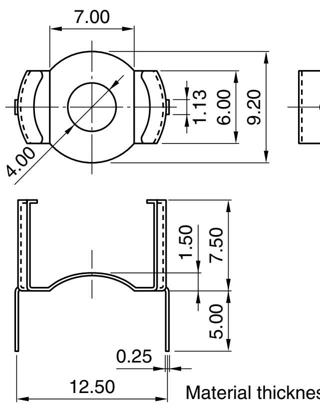
Dimensions in mm

Part No.	Number of sections	Material (Heat deflection temperature)	Available winding cross section (mm^2)	Average length of turns (mm)	Weight (g) approx.
BP11/7-612	1	Polyacetal	4.2	22	0.1
BP11/7-622	2	(110°C)*	1.9×2	22	0.1

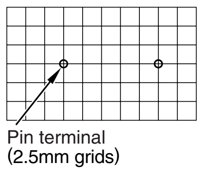
* 4.6kg/cm^2 force.

- Maximum number of turns N that can be wound on bobbins, see section of "Maximum number of Turns on Bobbins".

ACCESSORIES



CONNECTING PIN PATTERNS



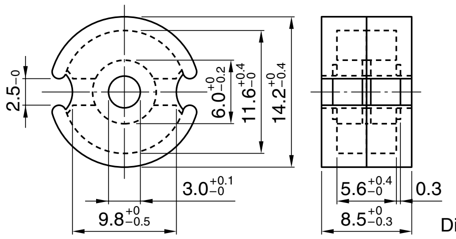
Material thickness=0.25 Dimensions in mm

Part No.	Parts	Material	Plating	Weight (g) approx.
FP11/7-6BFR	Spring	Phosphor bronze	Solder	0.6

P14/8 POT CORES

CORES

Based on IEC Publication 60133 and JIS C 2516.



Dimensions in mm

Parameter

Core factor	C1	mm−1	0.789
Effective magnetic path length	ℓe	mm	19.8
Effective cross-sectional area	Ae	mm2	25.1
Effective core volume	Ve	mm3	497
Cross-sectional center pole area	Acp	mm2	19.8
Minimum cross-sectional area	Acp min.	mm2	18.4
Cross-sectional winding area of core	Acw	mm2	17.1
Weight (approx.) per set		g	3.2

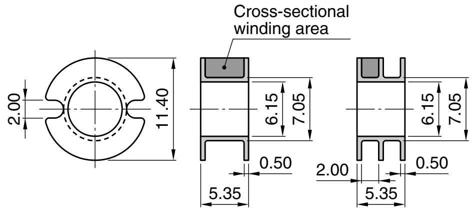
TYPICAL CHARACTERISTICS

Part No.	AL-value (nH/N2)	Effective permeability (μe)
Without air gap		
H5AP14/8Z-52B	3000±25%	1884
H5C2P14/8Z-52B	11500±30%	7221
PC40P14/8Z-52B	1610 min.	1011 min.
With air gap		
PC40P14/8A100-52B	100±3%	63
PC40P14/8A160-52B	160±3%	101
PC40P14/8A250-52B	250±3%	157

Measuring conditions:
Coil ø0.18mm, 2UEW, 100Ts
Frequency 1kHz
Current level 0.5mA

BOBBINS

Based on IEC Publication 133 and JIS C 2516 (for Bobbin without pin).



BP14/8-612 BP14/8-622 Dimensions in mm

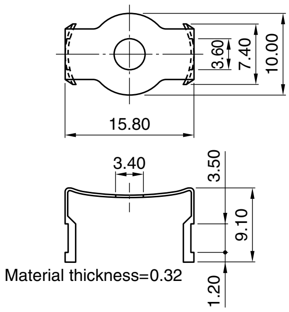
Part No.	Number of sections	Material (Heat deflection temperature)	Available winding cross section per section (mm2)	Average length of turns (mm)	Weight (g) approx.
BP14/8-612	1	Polyacetal (110°C)*	9.1	29	0.2
BP14/8-622	2		4.2×2	29	0.3

* 4.6kg/cm2 force.

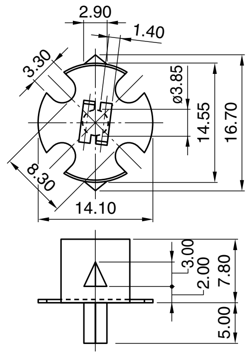
- Maximum number of turns N that can be wound on bobbins, see section of "Maximum number of Turns on Bobbins".

ACCESSORIES

SPRING

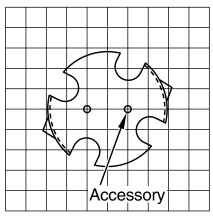


YOKE



Dimensions in mm

CONNECTING PIN PATTERNS(Bottom view)



(2.5mm grids, view in opposite direction for mounting side)

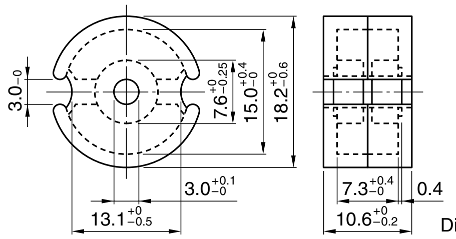
Part No.	Parts	Material	Weight (g) approx.
FP14/8-6C	Spring	Nickel silver	1.43
	Yoke	Nickel silver	1.43

TDK

P18/11 POT CORES

CORES

Based on IEC Publication 60133 and JIS C 2516.



Dimensions in mm

TYPICAL CHARACTERISTICS

Part No.	AL-value (nH/N2)	Effective permeability (μe)
Without air gap		
H5AP18/11Z-52B	4500±25%	2138
H5C2P18/11Z-52B	16000±30%	7601
PC40P18/11Z-52B	2400 min.	1140 min.
With air gap		
PC40P18/11A100-52B	100±3%	48
PC40P18/11A160-52B	160±3%	76
PC40P18/11A250-52B	250±3%	120

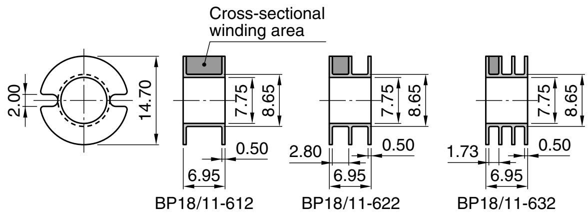
Measuring conditions:
Coil ø0.30mm, 2UEW, 100Ts
Frequency 1kHz
Current level 0.5mA

Parameter

Core factor	C1	mm^{-1}	0.596
Effective magnetic path length	ℓe	mm	25.8
Effective cross-sectional area	Ae	mm^2	43.3
Effective core volume	Ve	mm^3	1117
Cross-sectional center pole area	Acp	mm^2	36.3
Minimum cross-sectional area	Acp min.	mm^2	34.4
Cross-sectional winding area of core	Acw	mm^2	29.0
Weight (approx.)		g	6.7

BOBBINS

Based on IEC Publication 133 and JIS C 2516 (for Bobbin without pin).



Dimensions in mm

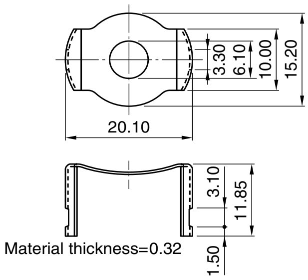
Part No.	Number of sections	Material (Heat deflection temperature)	Available winding cross section per section (mm^2)	Average length of turns (mm)	Weight (g) approx.
BP18/11-612	1	Polyacetal (110°C)*	14.2	37	0.2
BP18/11-622	2		6.8×2	37	0.3
BP18/11-632	3		4.3×3	37	0.4

* 4.6kg/cm2 force.

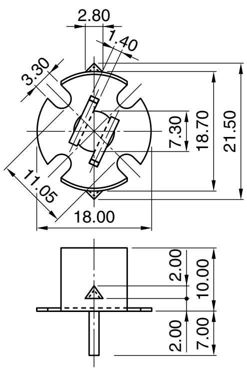
- Maximum number of turns N that can be wound on bobbins, see section of "Maximum number of Turns on Bobbins".

ACCESSORIES

SPRING

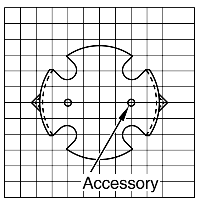


YOKE



Dimensions in mm

CONNECTING PIN PATTERNS(Bottom view)



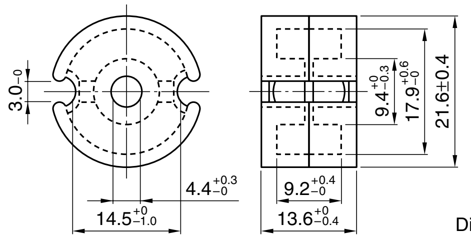
(2.5mm grids, view in opposite direction for mounting side)

Part No.	Parts	Material	Weight (g) approx.
FP18/11-6C	Spring	Nickel silver	2.61
	Yoke	Nickel silver	2.61

P22/13 POT CORES

CORES

Based on IEC Publication 60133 and JIS C 2516.



Dimensions in mm

Parameter

Core factor	C1	mm^{-1}	0.497
Effective magnetic path length	ℓe	mm	31.5
Effective cross-sectional area	Ae	mm^2	63.4
Effective core volume	Ve	mm^3	1997
Cross-sectional center pole area	Acp	mm^2	51.6
Minimum cross-sectional area	Acp min.	mm^2	47.7
Cross-sectional winding area of core	Acw	mm^2	42.1
Weight (approx.)		g	12.7

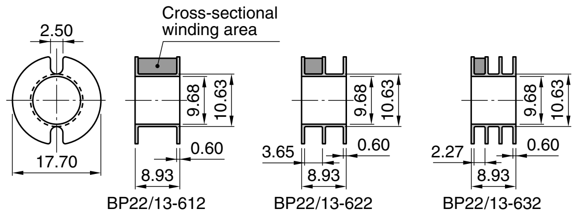
TYPICAL CHARACTERISTICS

Part No.	AL-value (nH/N²)	Effective permeability (μe)
Without air gap		
H5AP22/13Z-52H	5900±25%	2333
H5C2P22/13Z-52H	19500±30%	7700[at 21.7mT]
	16000+40/–30%	6318*[at 0.5mT]
PC40P22/13Z-52H	2990 min.	1182 min.
With air gap		
PC40P22/13A100-52H	100±3%	39.6
PC40P22/13A160-52H	160±3%	63
PC40P22/13A250-52H	250±3%	99

* Reference specification when 0.5mT is applied to cores.
Measuring conditions:
Coil ø0.35mm, 2UEW, 100Ts
Frequency 1kHz
Current level 0.5mA

BOBBINS

Based on IEC Publication 133 and JIS C 2516 (for Bobbin without pin).



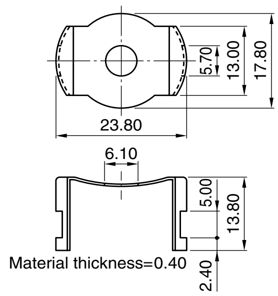
Dimensions in mm

Part No.	Number of sections	Material (Heat deflection temperature)	Available winding cross section per section (mm²)	Average length of turns (mm)	Weight (g) approx.
BP22/13-612	1	Polyacetal (110°C)*	25.0	44	0.4
BP22/13-622	2		12.0×2	44	0.5
BP22/13-632	3		7.9×3	44	0.6

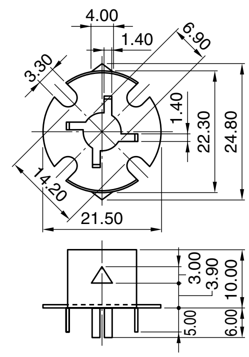
* 4.6kg/cm² force.
- Maximum number of turns N that can be wound on bobbins, see section of "Maximum number of Turns on Bobbins".

ACCESSORIES

SPRING

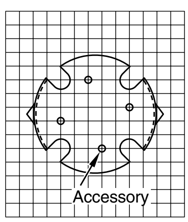


YOKE



Dimensions in mm

CONNECTING PIN PATTERNS(Bottom view)



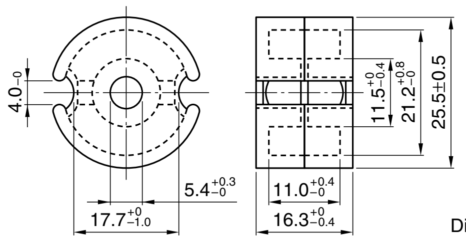
(2.5mm grids, view in opposite direction for mounting side)

Part No.	Parts	Material	Weight (g) approx.
FP22/13-6C	Spring	Nickel silver	4.07
	Yoke	Nickel silver	4.07

P26/16 POT CORES

CORES

Based on IEC Publication 60133 and JIS C 2516.



Dimensions in mm

Parameter

Core factor	C1	mm^{-1}	0.40
Effective magnetic path length	ℓe	mm	37.6
Effective cross-sectional area	Ae	mm^2	94
Effective core volume	Ve	mm^3	3534
Cross-sectional center pole area	Acp	mm^2	76.1
Minimum cross-sectional area	Acp min.	mm^2	71.3
Cross-sectional winding area of core	Acw	mm^2	57.7
Weight (approx.)		g	21.1

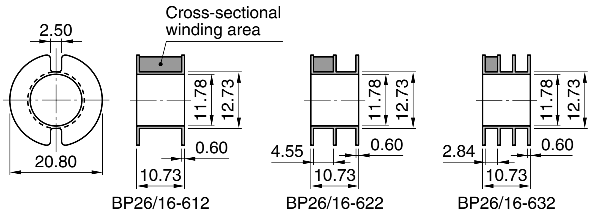
TYPICAL CHARACTERISTICS

Part No.	AL-value (nH/N2)	Effective permeability (μe)
Without air gap		
H5AP26/16Z-52H	7800±25%	2483
H5C2P26/16Z-52H	24500±30%	7800[at 18.4mT]
	20000+40/–30%	6367*[at 0.5mT]
PC40P26/16Z-52H	3810 min.	1213 min.
With air gap		
PC40P26/16A160-52H	160±3%	51
PC40P26/16A250-52H	250±3%	79.7
PC40P26/16A400-52H	400±3%	127.5

* Reference specification when 0.5mT is applied to cores.
Measuring conditions:
Coil ø0.40mm, 2UEW, 100Ts
Frequency 1kHz
Current level 0.5mA

BOBBINS

Based on IEC Publication 133 and JIS C 2516 (for Bobbin without pin).



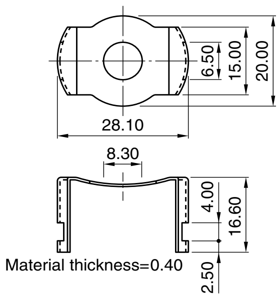
Dimensions in mm

Part No.	Number of sections	Material (Heat deflection temperature)	Available winding cross section per section (mm^2)	Average length of turns (mm)	Weight (g) approx.
BP26/16-612	1	Polyacetal (110°C)*	35.0	54	0.4
BP26/16-622	2		16.8×2	54	0.5
BP26/16-632	3		11.0×3	54	0.6

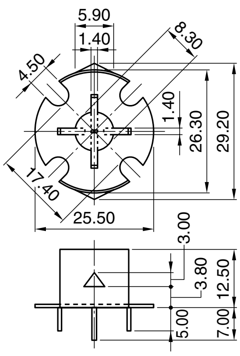
* 4.6kg/cm^2 force.
- Maximum number of turns N that can be wound on bobbins, see section of "Maximum number of Turns on Bobbins".

ACCESSORIES

SPRING

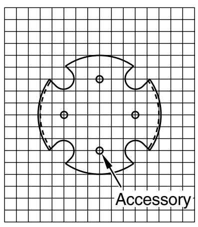


YOKE



Dimensions in mm

CONNECTING PIN PATTERNS(Bottom view)



(2.5mm grids, view in opposite direction for mounting side)

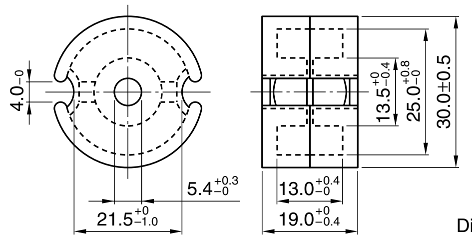
Part No.	Parts	Material	Weight (g) approx.
FP26/16-6C	Spring	Nickel silver	6.34
	Yoke	Nickel silver	6.34

TDK

P30/19 POT CORES

CORES

Based on IEC Publication 60133 and JIS C 2516.



Dimensions in mm

Parameter

Core factor	C_1	mm^{-1}	0.33
Effective magnetic path length	ℓe	mm	45.2
Effective cross-sectional area	Ae	mm^2	137
Effective core volume	Ve	mm^3	6192
Cross-sectional center pole area	Acp	mm^2	115
Minimum cross-sectional area	Acp min.	mm^2	109
Cross-sectional winding area of core	Acw	mm^2	79.9
Weight (approx.)		g	35.3

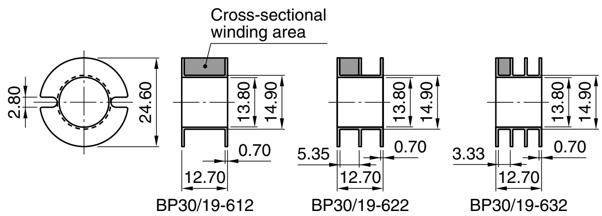
TYPICAL CHARACTERISTICS

Part No.	AL-value (nH/N2)	Effective permeability (μe)
Without air gap		
H5AP30/19Z-52H	9800±25%	2573
H5C2P30/19Z-52H	32000±30%	8400[at 16.5mT]
	25000+40/–30%	6563*[at 0.5mT]
PC40P30/19Z-52H	7300±25%	1917 min.
With air gap		
PC40P30/19A250-52H	250±3%	66
PC40P30/19A400-52H	400±3%	105
PC40P30/19A630-52H	630±3%	165

* Reference specification when 0.5mT is applied to cores.
Measuring conditions:
Coil ø0.40mm, 2UEW, 100Ts
Frequency 1kHz
Current level 0.5mA

BOBBINS

Based on IEC Publication 133 and JIS C 2516 (for Bobbin without pin).



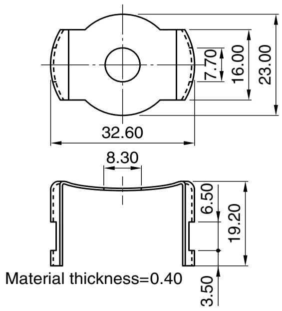
Dimensions in mm

Part No.	Number of sections	Material (Heat deflection temperature)	Available winding cross section per section (mm^2)	Average length of turns (mm)	Weight (g) approx.
BP30/19-612	1	Polyacetal (110°C)*	51.5	62	0.6
BP30/19-622	2		24.9×2	62	0.7
BP30/19-632	3		15.9×3	62	0.8

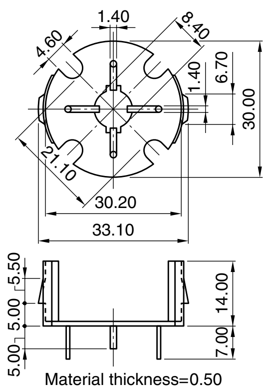
* 4.6kg/cm2 force.
- Maximum number of turns N that can be wound on bobbins, see section of “Maximum number of Turns on Bobbins”.

ACCESSORIES

SPRING

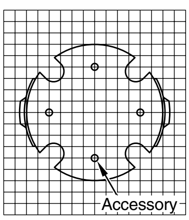


YOKE



Dimensions in mm

CONNECTING PIN PATTERNS(Bottom view)



(2.5mm grids, view in opposite direction for mounting side)

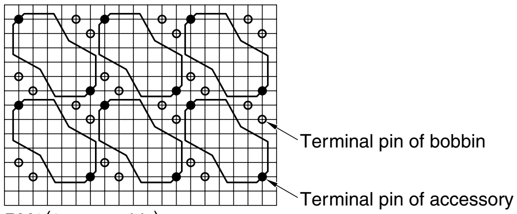
Part No.	Parts	Material	Weight (g) approx.
FP30/19-6C	Spring	Nickel silver	7.77
	Yoke	Nickel silver	7.77

• All specifications are subject to change without notice.

RM SERIES

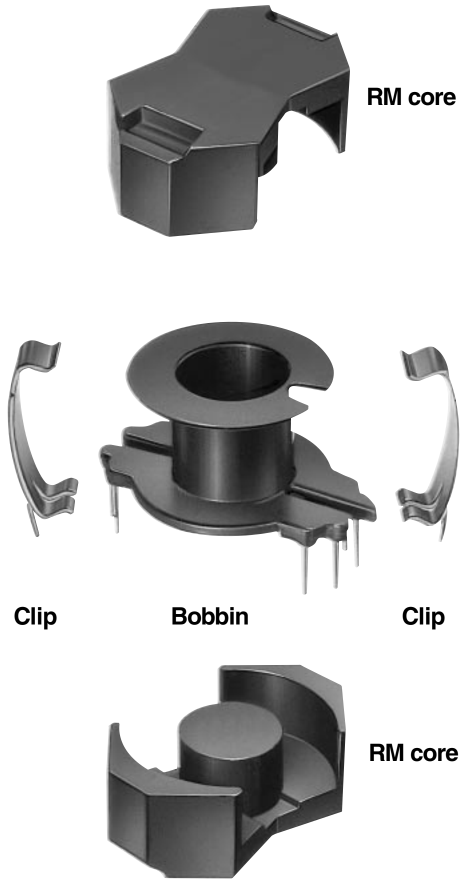
RM cores are popularly used in place of pot cores where high-density mounting is required. RM cores follow the recommendations of IEC publication 60431.
As shown is figure, the RM core effectively utilizes the mounting area on the PC-board. The bobbin is designed for convenient PC-board mounting.

MOUNTING ALIGNMENT OF RM6 CORES ON A PC-BOARD



RM6(2.5mm grids)

METHOD OF ASSEMBLING



ORDERING CODE SYSTEMS

1. Cores

PC40 RM6 A160 — 2 2

- Material (PC40)
- Size of RM core (RM6)
- AL-value: (Z: without air gap) (A160)
- Type of RM core (2)
- Number of lead slot (2)

2. Bobbins

B RM6 — 7 2 5 CPFR

- Symbol for bobbin (B)
- Size of RM core (RM6)
- Code of bobbin material (7)
- Number of section (2)
- Number of terminal pin (5)
- Type of terminal pin (CPFR)

3. Accessories

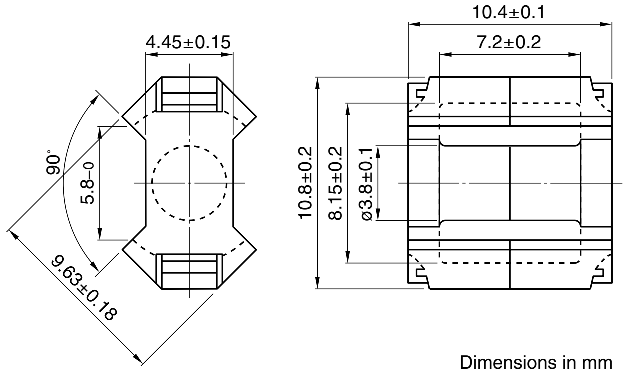
F RM6 — AFR

- Symbol of accessory (F)
- Size of RM Core (RM6)
- Type of accessory (AFR)

RM4 CORES

CORES

Based on IEC Publication 60431, DIN 41980 and JIS C 2516.



Dimensions in mm

Parameter

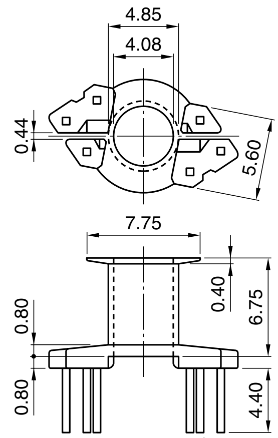
Core factor	C_1	mm^{-1}	1.62
Effective magnetic path length	ℓe	mm	22.7
Effective cross-sectional area	Ae	mm^2	14.0
Effective core volume	Ve	mm^3	318
Cross-sectional center pole area	Acp	mm^2	11.3
Minimum cross-sectional area	Acp min.	mm^2	10.8
Cross-sectional winding area of core	Acw	mm^2	15.7
Weight (approx.)		g	1.7

TYPICAL CHARACTERISTICS

Part No.	AL-value (nH/N²)	Effective permeability (μe)
Without air gap		
H5ARM4Z-12	1240±25%	1599
H5C2RM4Z-12	4950±30%	6381[at 32.4mT]
	3000+40/–30%	3870*[at 0.5mT]
PC40RM4Z-12	680 min.	877 min.
PC50RM4Z-12	960±25%	1238
With air gap		
PC40RM4A63-22	63±3%	81
PC40RM4A100-22	100±3%	129
PC40RM4A160-22	160±3%	206
PC50RM4A63-22	63±3%	81
PC50RM4A100-22	100±3%	129
PC50RM4A160-22	160±3%	206

* Reference specification when 0.5mT is applied to cores.
Measuring conditions:
Coil ø0.18mm, 2UEW, 100Ts
Frequency 1kHz
Current level 0.5mA

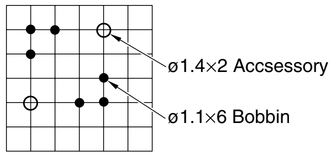
BOBBINS



□0.45 Phosphor bronze(solder plated)

CONNECTING PIN PATTERNS

(Top view)



(2.54mm grids)

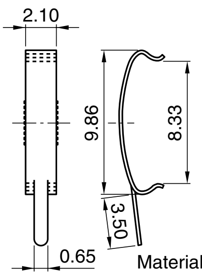
Dimensions in mm

Part No.	Number of sections	Number of terminal pins	Material (Heat deflection temperature)	Available winding cross section (mm^2)	Average length of turns (mm)	Weight (g) approx.
BRM4-716SDFR	1	6	FR phenol (235°C)*	8.05	19.8	0.23

* 18.6kg/cm² force.
- Maximum number of turns N that can be wound on bobbins, see section of "Maximum number of Turns on Bobbins".

ACCESSORIES

CLIP



Material thickness=0.30
Dimensions in mm

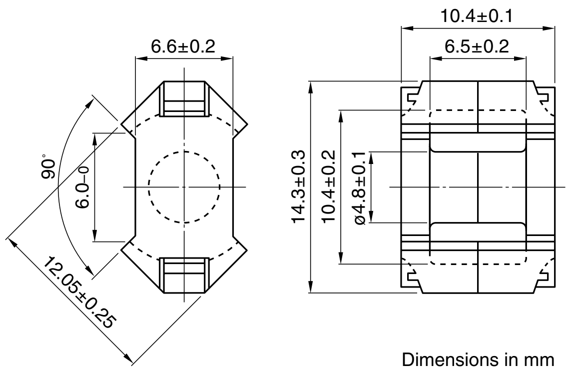
Part No.	Parts	Material	Plating	Weight (g)
FRM4-AFR	Clip	Stainless steel	Solder	0.16

TDK

RM5 CORES

CORES

Based on IEC Publication 60431, DIN 41980 and JIS C 2516.



Dimensions in mm

TYPICAL CHARACTERISTICS

Part No.	AL-value (nH/N2)	Effective permeability (μe)
Without air gap		
H5ARM5Z-12	2220±25%	1661
H5C3RM5Z-12	7700 min.*	5760 min.*
PC40RM5Z-12	1250 min.	935 min.
PC50RM5Z-12	1340±25%	1002
With air gap		
PC40RM5A63-22	63±3%	47
PC40RM5A100-22	100±3%	75
PC40RM5A160-22	160±3%	120
PC50RM5A63-22	63±3%	47
PC50RM5A100-22	100±3%	75
PC50RM5A160-22	160±3%	120

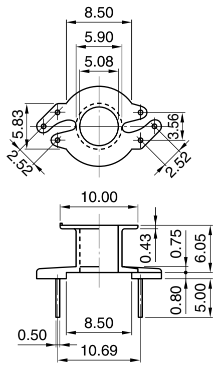
Measuring conditions:
Coil ø0.20mm, 2UEW, 100Ts
Frequency 1kHz
Current level 0.5mA
* 100Ts, 10kHz, 10mV (for H5C3 only)

Parameter

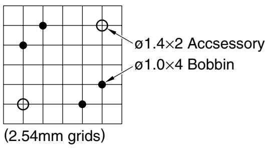
Core factor	C1	mm–1	0.94
Effective magnetic path length	ℓe	mm	22.4
Effective cross-sectional area	Ae	mm2	23.7
Effective core volume	Ve	mm3	530
Cross-sectional center pole area	Acp	mm2	18.1
Minimum cross-sectional area	Acp min.	mm2	17.3
Cross-sectional winding area of core	Acw	mm2	18.2
Weight (approx.)		g	3.0

BOBBINS

BRM5-714CPFR

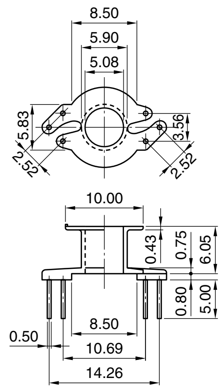


CONNECTING PIN PATTERNS (Top view)

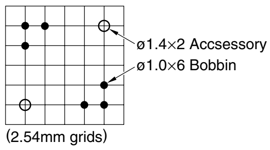


Dimensions in mm

BRM5-716CPFR



CONNECTING PIN PATTERNS (Top view)



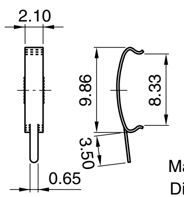
Dimensions in mm

Part No.	Number of sections	Number of terminal pins	Material (Heat deflection temperature)	Available winding cross section per section (mm2)	Average length of turns (mm)	Weight (g) approx.
BRM5-714CPFR	1	4	FR phenol	10.1	25	0.24
BRM5-716CPFR	1	6	(235°C)*	10.1	25	0.26

* 18.6kg/cm2 force.
- Maximum number of turns N that can be wound on bobbins, see section of “Maximum number of Turns on Bobbins”.

ACCESSORIES

CLIP



Material thickness=0.30
Dimensions in mm

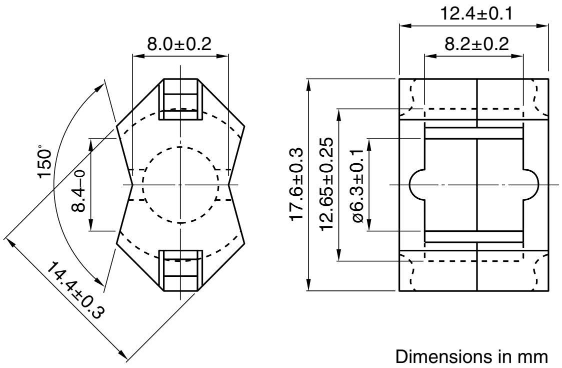
Part No.	Parts	Material	Plating	Weight (g)
FRM5-AFR	Clip	Stainless steel	Solder	0.16

• All specifications are subject to change without notice.

RM6 CORES

CORES

Based on IEC Publication 60431, DIN 41980 and JIS C 2516.



Dimensions in mm

TYPICAL CHARACTERISTICS

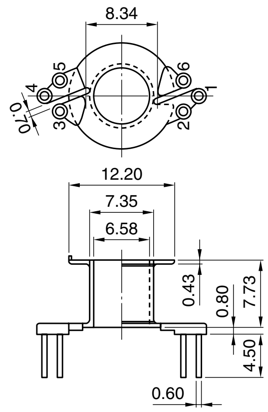
Part No.	AL-value (nH/N2)	Effective permeability (µe)
Without air gap		
H5ARM6Z-12	3300±25%	2258
H5C3RM6Z-12	9100 min.*	5648 min.*
PC40RM6Z-12	1600 min.	1520
PC50RM6Z-12	1700±25%	1055
With air gap		
PC40RM6A100-22	100±3%	62
PC40RM6A160-22	160±3%	99
PC40RM6A250-22	250±3%	155
PC50RM6A100-22	100±3%	62
PC50RM6A160-22	160±3%	99
PC50RM6A250-22	250±3%	155

Measuring conditions:
Coil ø0.26mm, 2UEW, 100Ts
Frequency 1kHz
Current level 0.5mA
* 100Ts, 10kHz, 10mV (for H5C3 only)

Parameter

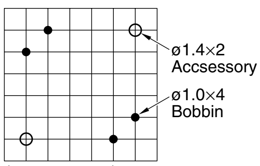
Core factor	C1	mm^{-1}	0.78
Effective magnetic path length	ℓe	mm	28.6
Effective cross-sectional area	Ae	mm^2	36.6
Effective core volume	Ve	mm^3	1050
Cross-sectional center pole area	Acp	mm^2	31.2
Minimum cross-sectional area	Acp min.	mm^2	30.2
Cross-sectional winding area of core	Acw	mm^2	26.0
Weight (approx.)		g	5.5

BOBBINS



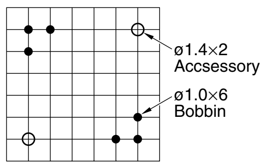
Dimensions in mm

CONNECTING PIN PATTERNS(Top view)



(2.54mm grids)

BRM6-714CPFR



(2.54mm grids)

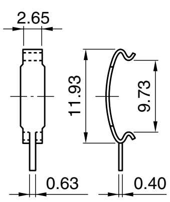
BRM6-716CPFR

Part No.	Number of sections	Number of terminal pins	Material (Heat deflection temperature)	Available winding cross section per section (mm^2)	Average length of turns (mm)	Weight (g) approx.
BRM6-714CPFR	1	4	FR phenol (235°C)*	16.8	30	0.3
BRM6-716CPFR	1	6		15.8	30	0.43

* 18.6kg/cm2 force.
- Maximum number of turns N that can be wound on bobbins, see section of “Maximum number of Turns on Bobbins”.

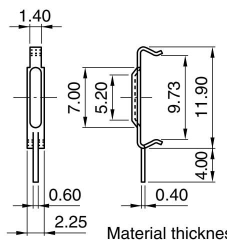
ACCESSORIES

CLIP



Material thickness=0.40
Dimensions in mm

FRM6-AFR



Material thickness=0.40
Dimensions in mm

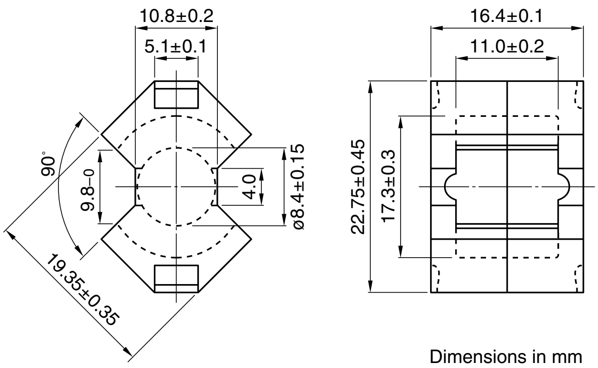
FRM6-BFR

Part No.	Parts	Material	Plating	Weight (g)
FRM6-AFR	Clip	Stainless steel	Solder	0.19
FRM6-BFR	Clip	Stainless steel	Solder	0.2

RM8 CORES

CORES

Based on IEC Publication 60431, DIN 41980 and JIS C 2516.



Dimensions in mm

TYPICAL CHARACTERISTICS

Part No.	AL-value (nH/N2)	Effective permeability (μe)
Without air gap		
H5ARM8Z-12	4300±25%	2019
H5C2RM8Z-12	17100±30%	8029[at 20.3mT]
	15200+40/–30%	7137*[at 0.5mT]
PC40RM8Z-12	1950 min.	916 min.
With air gap		
PC40RM8A100-22	100±3%	47
PC40RM8A160-22	160±3%	75
PC40RM8A250-22	250±3%	117

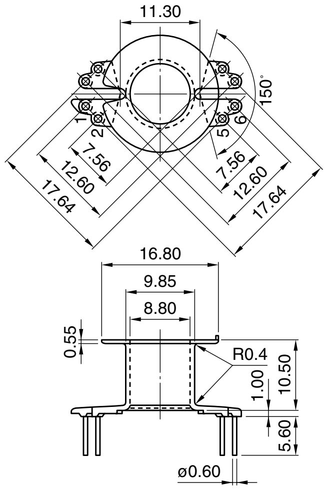
* Reference specification when 0.5mT is applied to cores.

Measuring conditions:
Coil ø0.40mm, 2UEW, 100Ts
Frequency 1kHz
Current level 0.5mA

Parameter

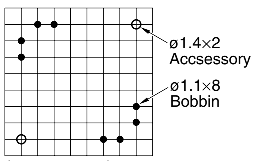
Core factor	C_1	mm^{-1}	0.59
Effective magnetic path length	ℓe	mm	38
Effective cross-sectional area	Ae	mm^2	64
Effective core volume	Ve	mm^3	2430
Cross-sectional center pole area	Acp	mm^2	55
Minimum cross-sectional area	Acp min.	mm^2	53
Cross-sectional winding area of core	Acw	mm^2	49
Weight (approx.)		g	13

BOBBINS



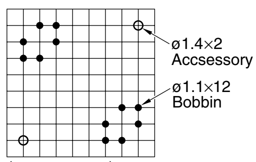
Dimensions in mm

CONNECTING PIN PATTERNS(Top view)



(2.54mm grids)

BRM8-718CPFR



(2.54mm grids)

BRM8-7112CPFR

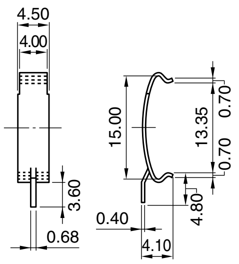
Part No.	Number of sections	Number of terminal pins	Material (Heat deflection temperature)	Available winding cross section per section (mm^2)	Average length of turns (mm)	Weight (g) approx.
BRM8-718CPFR	1	8	FR phenol	31	42	1.00
BRM8-7112CPFR	1	12	(235°C)*	31	42	0.7

* 18.6kg/cm^2 force.

- Maximum number of turns N that can be wound on bobbins, see section of "Maximum number of Turns on Bobbins".

ACCESSORIES

CLIP



Material thickness=0.40
Dimensions in mm

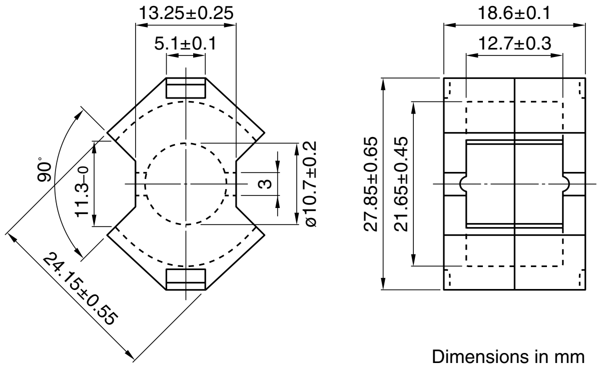
Part No.	Parts	Material	Plating	Weight (g)
FRM8-AFR	Clip	Stainless steel	Solder	0.55

- All specifications are subject to change without notice.

RM10 CORES

CORES

Based on IEC Publication 60431, DIN 41980 and JIS C 2516.



Dimensions in mm

Parameter

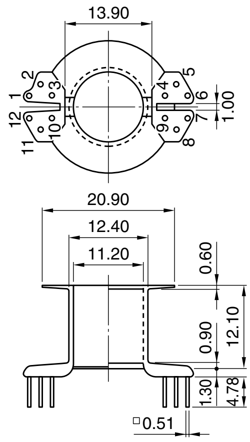
Core factor	C1	mm⁻¹	0.45
Effective magnetic path length	ℓe	mm	44
Effective cross-sectional area	Ae	mm^2	98
Effective core volume	Ve	mm^3	4310
Cross-sectional center pole area	Acp	mm^2	97
Minimum cross-sectional area	Acp min.	mm^2	87
Cross-sectional winding area of core	Acw	mm^2	71
Weight (approx.)		g	23

TYPICAL CHARACTERISTICS

Part No.	AL-value (nH/N²)	Effective permeability (μe)
Without air gap		
H5ARM10Z-12	6220±25%	2475
H5C2RM10Z-12	20900±30%	8316[at 17.8mT]
	17500+40/–30%	6963*[at 0.5mT]
PC40RM10Z-12	4850±25%	1737
With air gap		
PC40RM10A160-22	160±3%	57
PC40RM10A250-22	250±3%	90
PC40RM10A400-22	400±3%	143

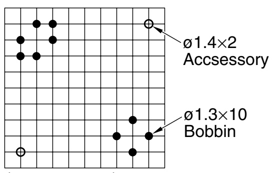
* Reference specification when 0.5mT is applied to cores.
Measuring conditions:
Coil ø0.40mm, 2UEW, 100Ts
Frequency 1kHz
Current level 0.5mA

BOBBINS



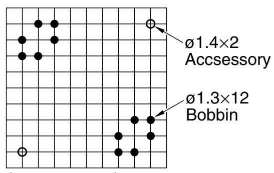
Dimensions in mm

CONNECTING PIN PATTERNS(Top view)



(2.54mm grids)

BRM10-7110SDFR



(2.54mm grids)

BRM10-7112SDFR

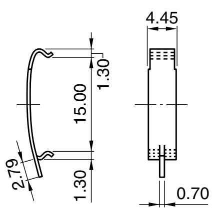
Part No.	Number of sections	Number of terminal pins	Material (Heat deflection temperature)	Available winding cross section per section (mm^2)	Average length of turns (mm)	Weight (g) approx.
BRM10-7110SDFR	1	10	FR phenol	45.7	53	1.4
BRM10-7112SDFR	1	12	(235°C)*	45.7	53	1.6

* 18.6kg/cm² force.

- Maximum number of turns N that can be wound on bobbins, see section of "Maximum number of Turns on Bobbins".

ACCESSORIES

CLIP



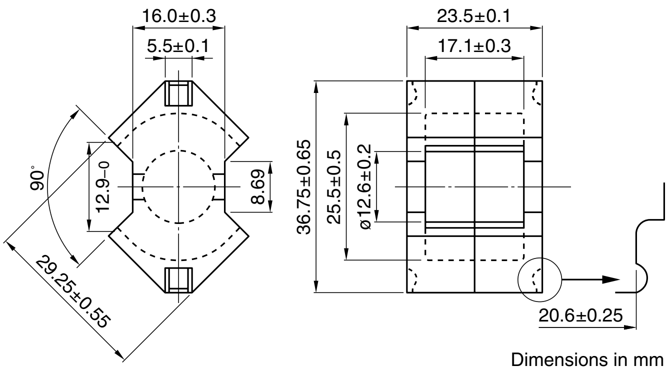
Material thickness=0.40 Dimensions in mm

Part No.	Parts	Material	Plating	Weight (g)
FRM10-AFR	Clip	Stainless steel	Solder	0.8

RM12 CORES

CORES

Based on IEC Publication 60431 and JIS C 2516.



Dimensions in mm

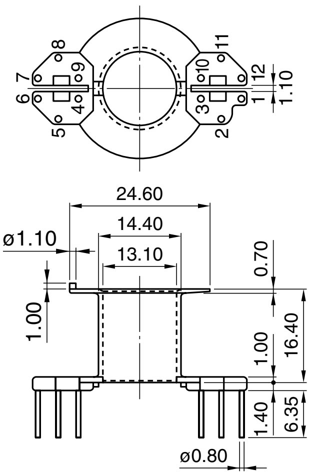
Parameter

Core factor	C1	mm^{-1}	0.4
Effective magnetic path length	ℓe	mm	56.9
Effective cross-sectional area	Ae	mm^2	140
Effective core volume	Ve	mm^3	7960
Cross-sectional center pole area	Acp	mm^2	125
Minimum cross-sectional area	Acp min.	mm^2	121
Cross-sectional winding area of core	Acw	mm^2	109
Weight (approx.)		g	42

TYPICAL CHARACTERISTICS

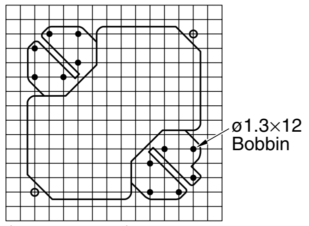
Part No.	AL-value (nH/N2)	Effective permeability (μe)
Without air gap		
PC40RM12Z-12	4150 min.	1321 min.
With air gap		
PC40RM12A160-22	160±3%	51
PC40RM12A250-22	250±3%	80
PC40RM12A400-22	400±3%	127

BOBBINS



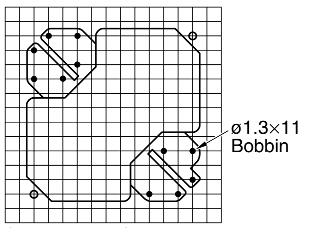
Dimensions in mm

CONNECTING PIN PATTERNS (Top view)



(2.54mm grids)

BRM12-7112CPFR



(2.54mm grids)

BRM12-7111CPFR

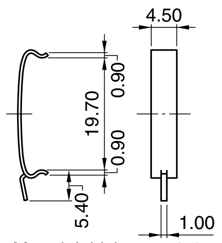
Part No.	Number of sections	Number of terminal pins	Material (Heat deflection temperature)	Available winding cross section (mm^2)	Average length of turns (mm)	Weight (g) approx.
BRM12-7111CPFR	1	11	FR phenol	75.5	55	2.5
BRM12-7112CPFR	1	12	(235°C)*	75.5	55	2.70

* 18.6kg/cm² force.

- Maximum number of turns N that can be wound on bobbins, see section of "Maximum number of Turns on Bobbins".

ACCESSORIES

CLIP



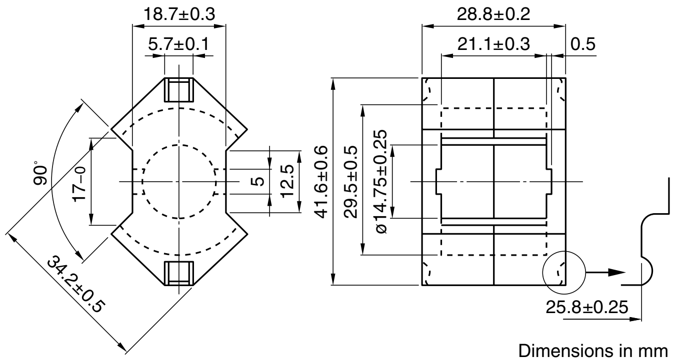
Material thickness=0.45 Dimensions in mm

Part No.	Parts	Material	Plating	Weight (g)
FRM12-AFR	Clip	Stainless steel	Solder	0.8

RM14 CORES

CORES

Based on IEC Publication 60431, DIN 41980 and JIS C 2516.



Dimensions in mm

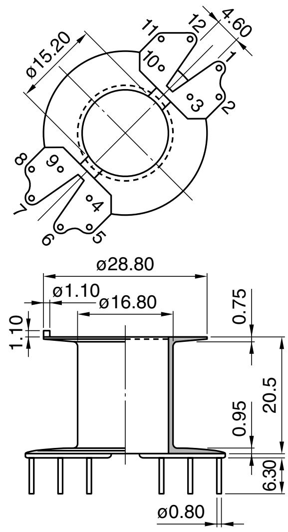
Parameter

Core factor	C_1	mm^{-1}	0.37
Effective magnetic path length	ℓe	mm	69
Effective cross-sectional area	Ae	mm^2	188
Effective core volume	Ve	mm^3	13000
Cross-sectional center pole area	Acp	mm^2	171
Minimum cross-sectional area	Acp min.	mm^2	165
Cross-sectional winding area of core	Acw	mm^2	156
Weight (approx.)		g	70

TYPICAL CHARACTERISTICS

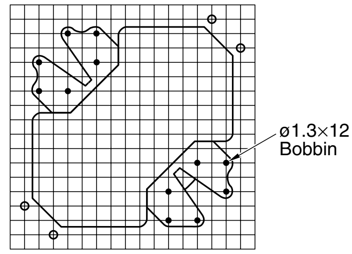
Part No.	AL-value (nH/N^2)	Effective permeability (μe)
Without air gap		
PC40RM14Z-12	4600 min.	1354 min.
With air gap		
PC40RM14A160-22	160±3%	47
PC40RM14A250-22	250±3%	74
PC40RM14A400-22	400±3%	118

BOBBINS



Dimensions in mm

CONNECTING PIN PATTERNS
(Top view)



(2.54mm grids)

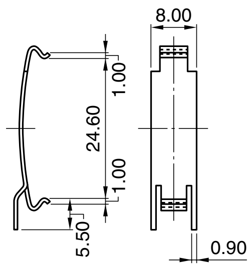
BRM14-7112CPFR

Part No.	Number of sections	Number of terminal pins	Material (Heat deflection tempera-ture)	Available winding cross section (mm^2)	Average length of turns (mm)	Weight (g) approx.
BRM14-7110CPFR	1	10	FR phenol	113	72	3.5
BRM14-7112CPFR	1	12	(235°C)*	113	72	3.80

* 18.6kg/cm^2 force.

- Maximum number of turns N that can be wound on bobbins, see section of “Maximum number of Turns on Bobbins”.

ACCESSORIES
CLIP



Material thickness=0.50

Dimensions in mm

Part No.	Parts	Material	Plating	Weight (g)
FRM14-AFR	Clip	Spring steel	Solder	2.2

TDK

EP SERIES

ORDERING CODE SYSTEMS

1. Cores

H5A EP10 — Z

- Material: H5A
- Size of EP core: EP10
- AL-value (Z: without air gap): Z

2. Bobbins

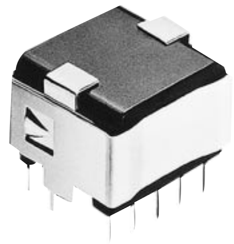
B EP10 — 3 1 8 DFR

- Symbol of bobbin: B
- Size of EP core: EP10
- Code of bobbin material: 3
- Number of section: 1
- Number of terminal pin: 8
- Type of terminal pin: DFR

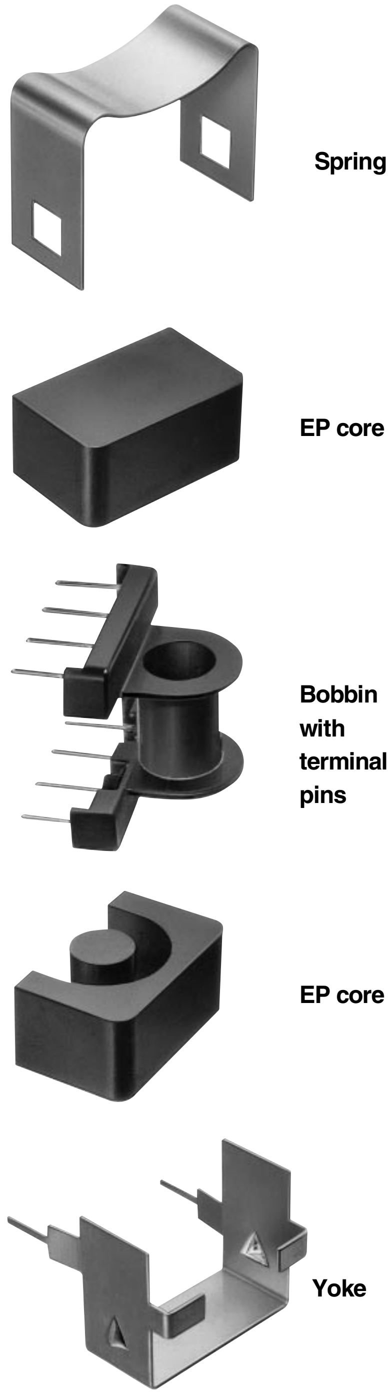
3. Accessories

F EP-10 — C

- Symbol of accessory: F
- Size of EP core: EP-10
- Type of accessory: C



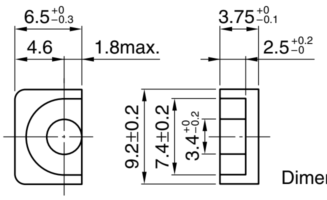
METHOD OF ASSEMBLING



EP7 CORES

CORES

Based on JIS C 2516.



Dimensions in mm

TYPICAL CHARACTERISTICS

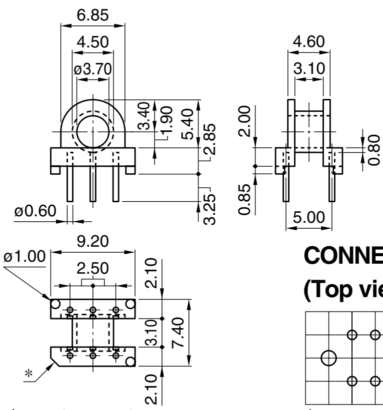
Part No.	AL-value (nH/N2) min.	Effective permeability (μe)
Without air gap		
H5AEP7-Z	1100	1331
H5C3EP7-Z	4200*	5080*
PC40EP7-Z	830	1004
With air gap		
PC40EP7A63	63±3%	76
PC40EP7A100	100±4%	121

Measuring conditions:
Coil ø0.13mm, 2UEW, 100Ts
Frequency 1kHz
Current level 0.5mA
* 100Ts, 10kHz, 10mV (for H5C3 only)

Parameter

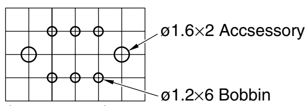
Core factor	C1	mm−1	1.52
Effective magnetic path length	ℓe	mm	15.7
Effective cross-sectional area	Ae	mm2	10.3
Effective core volume	Ve	mm3	162
Cross-sectional center pole area	Acp	mm2	8.55
Minimum cross-sectional area	Acp min.	mm2	8.04
Cross-sectional winding area of core	Acw	mm2	10.7
Weight (approx.)		g	1.4

BOBBINS



* Identification of pin No. 1
Dimensions in mm

CONNECTING PIN PATTERNS (Top view)



(2.5mm grids)

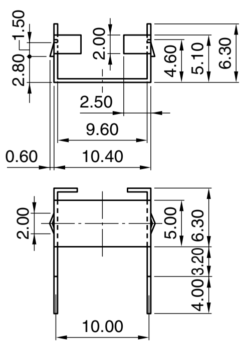
Part No.	Number of sections	Material: Bobbin (Heat deflection temperature)	Material: Pin	Available winding cross section (mm2)	Average length of turns (mm)	Weight (g) approx.
BEP7-316DFR	1	FR phenol (235°C)*	Solder plated Phosphor bronze	3.85	18.1	0.3

* 18.6kg/cm2 force.

- Maximum number of turns N that can be wound on bobbins, see section of “Maximum number of Turns on Bobbins”.

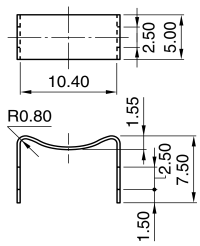
ACCESSORIES

YOKE



Material thickness=0.40
Dimensions in mm

SPRING



Material thickness=0.32
Dimensions in mm

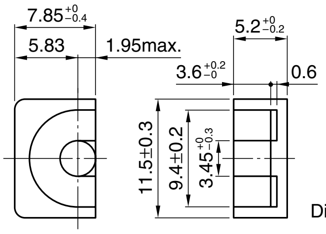
Part No.	Parts	Material	Weight (g) approx.
FEP-7-C	Yoke	Nickel silver	0.8
	Spring	Nickel silver	0.8

• All specifications are subject to change without notice.

EP10 CORES

CORES

Based on JIS C 2516.



Dimensions in mm

Parameter

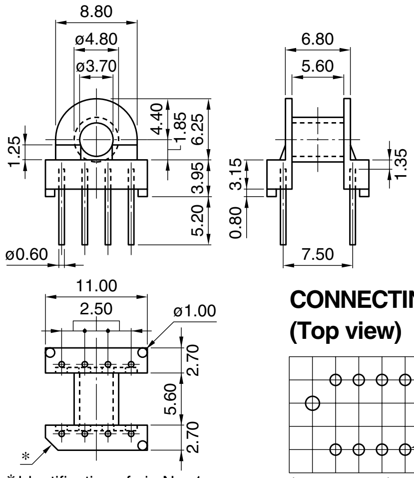
Core factor	C1	mm−1	1.7
Effective magnetic path length	ℓe	mm	19.2
Effective cross-sectional area	Ae	mm2	11.3
Effective core volume	Ve	mm3	217
Cross-sectional center pole area	Acp	mm2	8.55
Minimum cross-sectional area	Acp min.	mm2	7.79
Cross-sectional winding area of core	Acw	mm2	22.6
Weight (approx.)		g	2.8

TYPICAL CHARACTERISTICS

Part No.	AL-value (nH/N2) min.	Effective permeability (μe)
Without air gap		
H5AEP10-Z	1080	1461
H5C3EP10-Z	3850*	5208*
PC40EP10-Z	800	1082
PC50EP10-Z	800±25%	1082
With air gap		
PC40EP10A63	63±3%	85
PC40EP10A100	100±4%	135
PC50EP10A63	63±3%	85
PC50EP10A100	100±4%	135

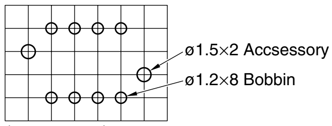
Measuring conditions:
Coil ø0.2mm, 2UEW, 100Ts
Frequency 1kHz
Current level 0.5mA
* 100Ts, 10kHz, 10mV (for H5C3 only)

BOBBINS



*Identification of pin No. 1

CONNECTING PIN PATTERNS (Top view)



(2.5mm grids)

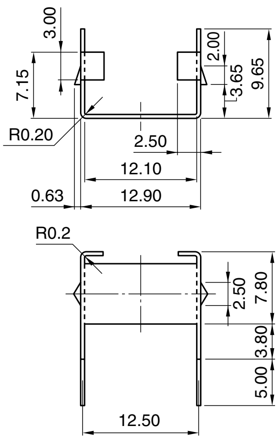
Dimensions in mm

Part No.	Number of sections	Material: Bobbin (Heat deflection temperature)	Material: Pin	Available winding cross section per section (mm2)	Average length of turns (mm)	Weight (g) approx.
BEP10-318DFR	1	FR phenol (235°C)	Solder plated Phosphor bronze	11.7	21.7	0.65

* 18.6kg/cm2 force.
- Maximum number of turns N that can be wound on bobbins, see section of "Maximum number of Turns on Bobbins".

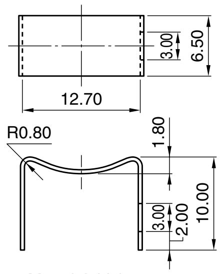
ACCESSORIES

YOKE



Material thickness=0.40
Dimensions in mm

SPRING



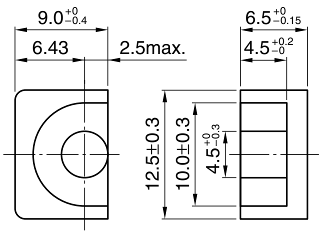
Material thickness=0.32
Dimensions in mm

Part No.	Parts	Material	Weight (g) approx.
FEP-10-C	Yoke	Nickel silver	1.43
	Spring	Nickel silver	1.43

EP13 CORES

CORES

Based on JIS C 2516.



Dimensions in mm

Parameter

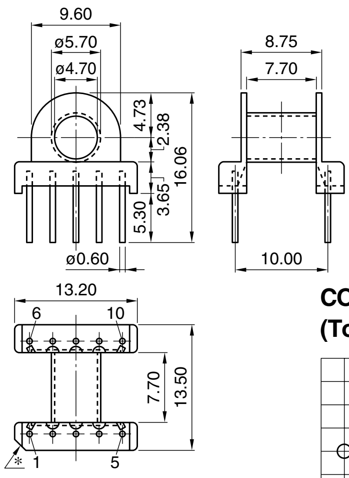
Core factor	C_1	mm^{-1}	1.24
Effective magnetic path length	ℓe	mm	24.2
Effective cross-sectional area	Ae	mm^2	19.5
Effective core volume	Ve	mm^3	472
Cross-sectional center pole area	Acp	mm^2	14.9
Minimum cross-sectional area	Acp min.	mm^2	13.9
Cross-sectional winding area of core	Acw	mm^2	13
Weight (approx.)		g	5.1

TYPICAL CHARACTERISTICS

Part No.	AL-value (nH/N²) min.	Effective permeability (μe)
Without air gap		
H5AEP13-Z	1700	1677
H5C3EP13-Z	5600*	5526*
PC40EP13-Z	1170	1155
PC50EP13-Z	1100±25%	1085
With air gap		
PC40EP13A100	100±3%	99
PC40EP13A160	160±3%	158
PC50EP13A100	100±3%	99
PC50EP13A160	160±3%	158

Measuring conditions:
Coil ø0.2mm, 2UEW, 100Ts
Frequency 1kHz
Current level 0.5mA
* 100Ts, 10kHz, 10mV (for H5C3 only)

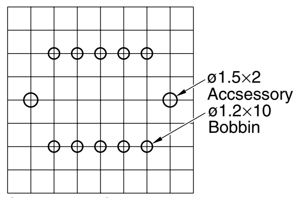
BOBBINS



*Identification of pin No. 1

Dimensions in mm

CONNECTING PIN PATTERNS (Top view)



(2.5mm grids)

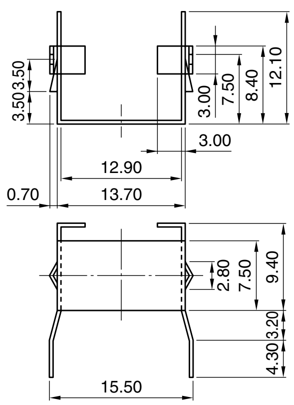
Part No.	Number of sections	Material: Bobbin (Heat deflection temperature)	Material: Pin	Available winding cross section per section (mm²)	Average length of turns (mm)	Weight (g) approx.
BEP13-3110DFR	1	FR phenol (235°C)*	Solder plated Phosphor bronze	16.6	23.9	0.74

* 18.6kg/cm² force.

- Maximum number of turns N that can be wound on bobbins, see section of "Maximum number of Turns on Bobbins".

ACCESSORIES

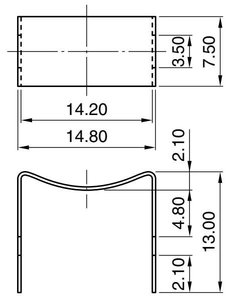
YOKE



Material thickness=0.40

Dimensions in mm

SPRING



Material thickness=0.32
Dimensions in mm

Part No.	Parts	Material	Weight (g) approx.
FEP-13-C	Yoke	Nickel silver	1.93
	Spring	Nickel silver	1.93

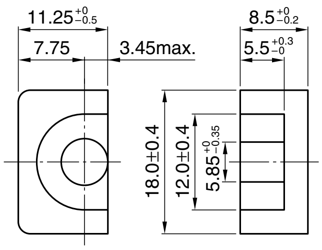
- All specifications are subject to change without notice.

TDK

EP17 CORES

CORES

Based on JIS C 2516.



Dimensions in mm

TYPICAL CHARACTERISTICS

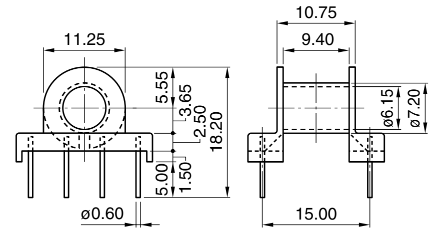
Part No.	AL-value (nH/N2) min.	Effective permeability (μe)
Without air gap		
H5AEP17-Z	2500	1672
H5C2EP17-Z	8000	5350
PC40EP17-Z	1840	1230
With air gap		
PC40EP17A100	100±5%	67
PC40EP17A250	250±7%	167

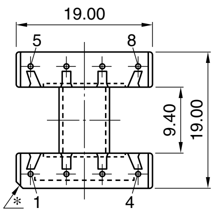
Measuring conditions:
Coil ø0.2mm, 2UEW, 100Ts
Frequency 1kHz
Current level 0.5mA

Parameter

Core factor	C1	mm^{-1}	0.84
Effective magnetic path length	ℓe	mm	28.5
Effective cross-sectional area	Ae	mm^2	33.9
Effective core volume	Ve	mm^3	966
Cross-sectional center pole area	Acp	mm^2	25.3
Minimum cross-sectional area	Acp min.	mm^2	23.8
Cross-sectional winding area of core	Acw	mm^2	33.8
Weight (approx.)		g	11.8

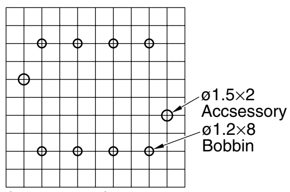
BOBBINS





*Identification of pin No. 1
Dimensions in mm

CONNECTING PIN PATTERNS (Top view)



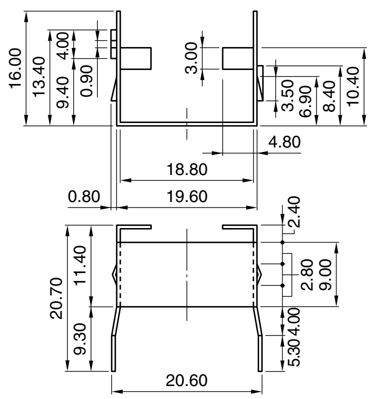
(2.5mm grids)

Part No.	Number of sections	Material Bobbin (Heat deflection temperature)	Material Pin	Available winding cross section per section (mm^2)	Average length of turns (mm)	Weight (g) approx.
BEP17-318DFR	1	FR phenol (235°C)*	Solder plated Phosphor bronze	19	29.1	1.30

* 18.6kg/cm2 force.
- Maximum number of turns N that can be wound on bobbins, see section of “Maximum number of Turns on Bobbins”.

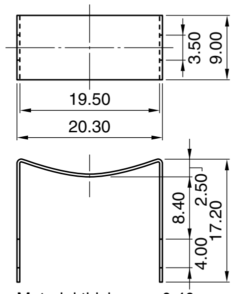
ACCESSORIES

YOKE



Material thickness=0.40
Dimensions in mm

SPRING



Material thickness=0.40
Dimensions in mm

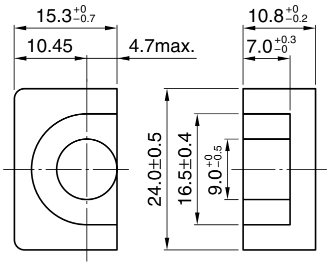
Part No.	Parts	Material	Weight (g) approx.
FEP-17-C	Yoke	Nickel silver	3.6
	Spring	Nickel silver	3.6

TDK

EP20 CORES

CORES

Based on JIS C 2516.



Dimensions in mm

Parameter

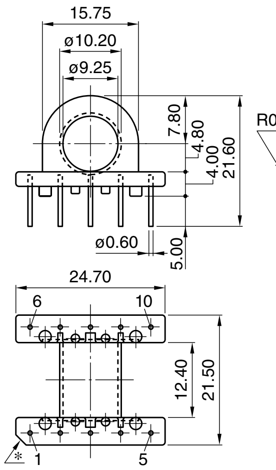
Core factor	C_1	mm^{-1}	0.508
Effective magnetic path length	ℓe	mm	39.8
Effective cross-sectional area	Ae	mm^2	78
Effective core volume	Ve	mm^3	312
Cross-sectional center pole area	Acp	mm^2	60.1
Minimum cross-sectional area	Acp min.	mm^2	56.7
Cross-sectional winding area of core	Acw	mm^2	55.4
Weight (approx.)		g	27.6

TYPICAL CHARACTERISTICS

Part No.	A_L-value (nH/N²) min.	Effective permeability (μe)
Without air gap		
H5AEP20-Z	4200	1698
H5C2EP20-Z	13500	5457
PC40EP20-Z	3200	1294
With air gap		
PC40EP20A100	100±5%	40
PC40EP20A250	250±7%	101

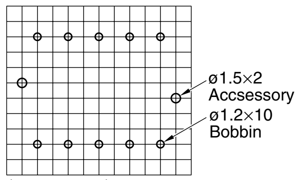
Measuring conditions:
Coil ø0.35mm, 2UEW, 100Ts
Frequency 1kHz
Current level 0.5mA

BOBBINS



* Identification of pin No. 1
Dimensions in mm

CONNECTING PIN PATTERNS (Top view)



(2.5mm grids)

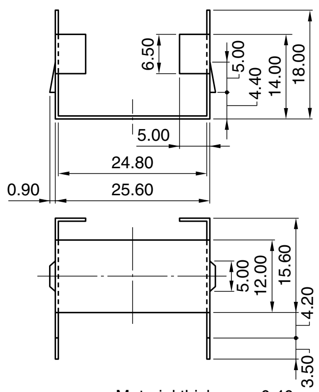
Part No.	Number of sections	Material: Bobbin (Heat deflection temperature)	Material: Pin	Available winding cross section per section (mm²)	Average length of turns (mm)	Weight (g) approx.
BEP20-8110DFR	1	FR phenol (235°C)*	Solder plated Phosphor bronze	33.2	40.8	1.8

* 18.6kg/cm² force.

- Maximum number of turns N that can be wound on bobbins, see section of "Maximum number of Turns on Bobbins".

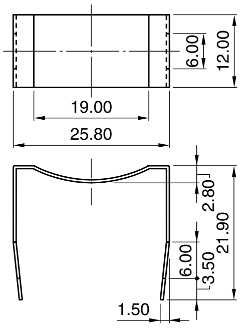
ACCESSORIES

YOKE



Material thickness=0.40
Dimensions in mm

SPRING



Material thickness=0.40
Dimensions in mm

Part No.	Parts	Material	Weight (g) approx.
FEP-20-C	Yoke	Nickel silver	5.68
	Spring	Nickel silver	5.68

- All specifications are subject to change without notice.

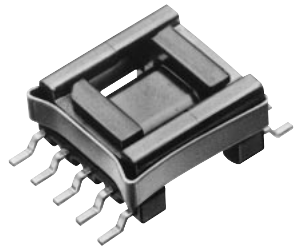
SMD CORES

ORDERING CODE SYSTEMS

1. Cores

PC44 EPC10 — Z

- Material: PC44
- Size of E core: EPC10
- AL-value (Z: without air gap): Z



2. Bobbins

B EPC10 — 1 1 8 GFR

- Symbol of bobbin: B
- Size of E core: EPC10
- Code of bobbin material: 1
- Number of section: 1
- Number of terminal pin: 8
- Type of terminal pin: GFR

3. Accessories

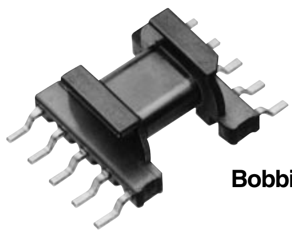
F EPC10 — A

- Symbol of accessory: F
- Size of E core: EPC10
- Type of accessory: A

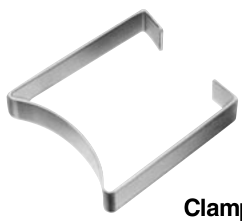
METHOD OF ASSEMBLING

EPC core

EPC core



Bobbin

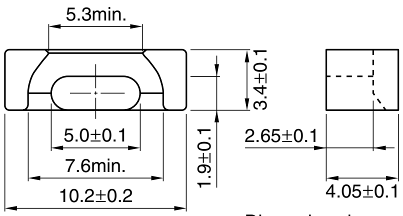


Clamp

TDK

EPC10 CORES

CORES



Dimensions in mm

Parameter

Core factor	C1	mm⁻¹	1.89
Effective magnetic path length	ℓe	mm	17.8
Effective cross-sectional area	Ae	mm^2	9.39
Effective core volume	Ve	mm^3	167
Cross-sectional center pole area	Acp	mm^2	8.73
Minimum cross-sectional area	Acp min.	mm^2	8.13
Cross-sectional winding area of core	Acw	mm^2	7.69
Weight (approx.)		g	1.1

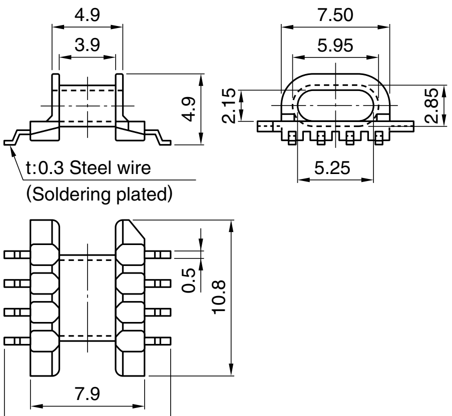
TYPICAL CHARACTERISTICS

Part No.	AL-value(nH/N2) [1kHz, 0.5mA, 100Ts] Without air gap	With air gap	Core loss (W) [at 100°C] 100kHz 200mT	500kHz 50mT
PC44EPC10-□□□*1	1000±25%	40±7% 63±10%	0.072	
PC50EPC10-□□□	660±25%	40±7% 63±10%		0.025
H5C3EPC10-Z*2	2660 min.			

*1 Including AL-value
*2 10kHz, 10mV, 100Ts

BOBBINS

BEPC10-118GAFR

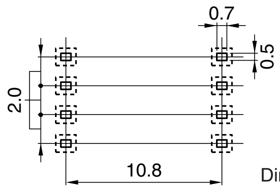


Dimensions in mm

Part No.	Material	Heat deflection temperature (°C)*1	UL standard	Available winding cores section Aw(mm^2)	Average length of turns ℓw(mm)	Minimum thickness t(mm)*2	Weight (g)
BEPC10-118GAFR	FR phenol	235	94V-0	3.2	17.5	0.35	0.14

*1 With 18.6kg/cm^2 force
*2 Minimum thickness of bobbin

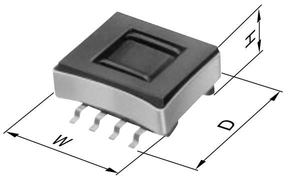
CONNECTING PIN PATTERNS



Dimensions in mm

ASSEMBLY

SURFACE MOUNT TYPE

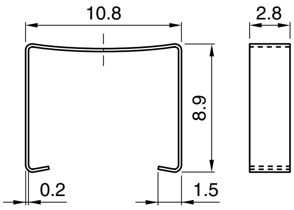


Dimensions in mm

W	11.0
D	11.7
H	5.2

ACCESSORIES

CLAMP

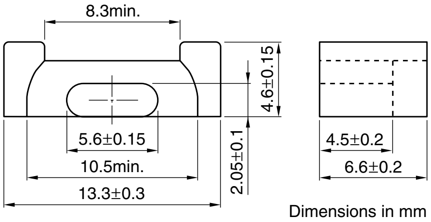


Dimensions in mm

Part No.	Material	Weight (g)
FEPC-10-A	Stainless steel	0.1

EPC13 CORES

CORES



Dimensions in mm

Parameter

Core factor	C1	mm^{-1}	2.46
Effective magnetic path length	ℓe	mm	30.6
Effective cross-sectional area	Ae	mm^2	12.5
Effective core volume	Ve	mm^3	382
Cross-sectional center pole area	Acp	mm^2	10.6
Minimum cross-sectional area	Acp min.	mm^2	9.71
Cross-sectional winding area of core	Acw	mm^2	23.0
Weight (approx.)		g	2.1

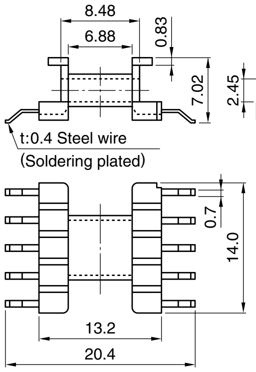
TYPICAL CHARACTERISTICS

Part No.	AL-value(nH/N^2) [1kHz, 0.5mA, 100Ts] Without air gap	With air gap	Core loss (W) [at 100°C] 100kHz 200mT	500kHz 50mT
PC44EPC13-□□□*1	870±25%	40±4% 63±5%	0.14	
PC50EPC13-□□□	560±25%	40±4% 63±5%		0.039
H5C3EPC13-Z*2	2450 min.			

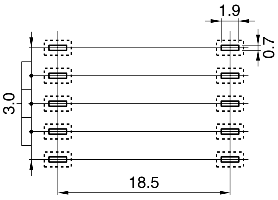
*1 Including AL-value
*2 10kHz, 10mV, 100Ts

BOBBINS

BEPC13-1110GAFR

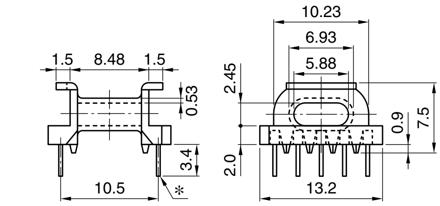
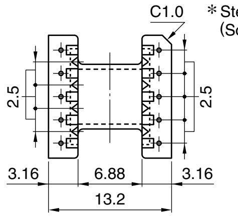


CONNECTING PIN PATTERNS



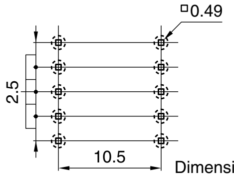
Dimensions in mm

BEPC13-1110CPHFR

* Steel wire
(Soldering plated)

CONNECTING PIN PATTERNS



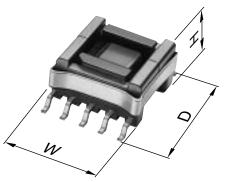
Dimensions in mm

Part No.	Material	Heat deflection temperature (°C)*1	UL standard	Available winding cores section Aw(mm^2)	Average length of turns ℓw(mm)	Minimum thickness t(mm)*2	Weight (g)
BEPC13-1110GAFR	FR phenol	195	94V-0	11.2	23.0	0.5	0.6
BEPC13-1110CPHFR	FR phenol	195	94V-0	11.2	23.0	0.5	0.57

*1 With 18.6kg/cm^2 force
*2 Minimum thickness of bobbin

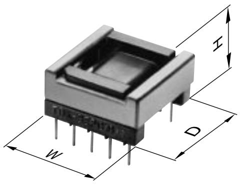
ASSEMBLY

SURFACE MOUNT TYPE LEAD THROUGH TYPE



Dimensions in mm

W	14.2
D	20.6
H	7.3

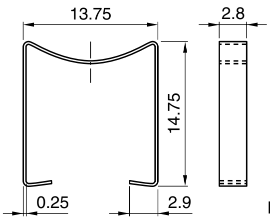


Dimensions in mm

W	13.9
D	14.8
H	7.7

ACCESSORIES

CLAMP

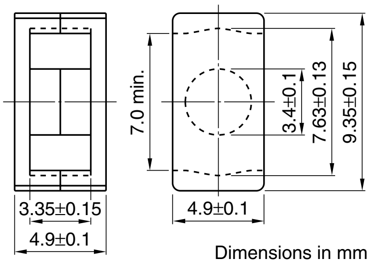


Dimensions in mm

Part No.	Material	Weight (g)
FEPC-13-A	Stainless steel	0.3

ER9.5/5 CORES

CORES



Dimensions in mm

Parameter

Core factor	C1	mm⁻¹	1.67
Effective magnetic path length	ℓe	mm	14.2
Effective cross-sectional area	Ae	mm^2	8.47
Effective core volume	Ve	mm^3	120
Cross-sectional center pole area	Acp	mm^2	9.08
Minimum cross-sectional area	Acp min.	mm^2	8.55
Cross-sectional winding area of core	Acw	mm^2	7.1
Weight (approx.)		g	0.6

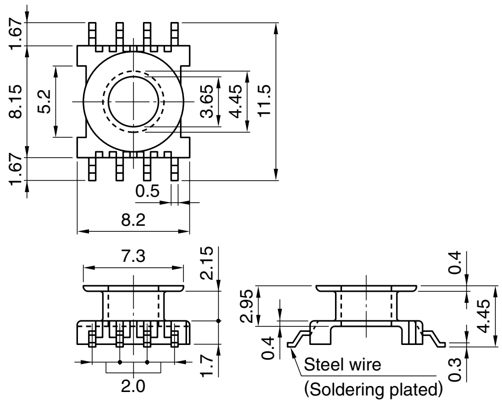
TYPICAL CHARACTERISTICS

Part No.	AL-value(nH/N^2) [1kHz, 0.5mA, 100Ts] Without air gap	With air gap	Core loss (W) [at 100°C] 100kHz 200mT	500kHz 50mT
PC44ER9.5/5-□□□*1	610 min.	63±5% 100±7%		
PC50ER9.5/5-□□□	750±25%	63±5% 100±7%		0.015
H5C3ER9.5/5-Z*2	3500 min.			

*1 Including AL-value
*2 10kHz, 10mV, 100Ts

BOBBINS

BER9.5/5-118GAFR

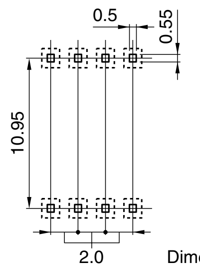


Dimensions in mm

Part No.	Material	Heat deflection temperature (°C)*1	UL standard	Available winding cores section Aw(mm^2)	Average length of turns ℓw(mm)	Minimum thickness t(mm)*2	Weight (g)
BER9.5/5-118GAFR	FR phenol	235	94V-0	3.06	18.5	0.4	0.16

*1 With $18.6kg/cm^2$ force
*2 Minimum thickness of bobbin

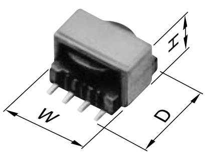
CONNECTING PIN PATTERNS



Dimensions in mm

ASSEMBLY

SURFACE MOUNT TYPE

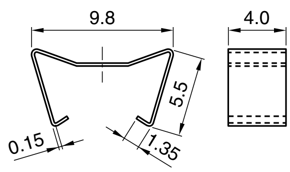


Dimensions in mm

W	9.9
D	11.7
H	5.8

ACCESSORIES

CLAMP



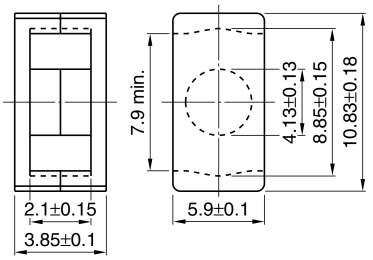
Dimensions in mm

Part No.	Material	Weight (g)
FER9.5/5-A	Stainless steel	0.1

• All specifications are subject to change without notice.

ER11/3.9 CORES

CORES



Dimensions in mm

Parameter

Core factor	C1	mm−1	1.08
Effective magnetic path length	ℓe	mm	12.6
Effective cross-sectional area	Ae	mm2	11.7
Effective core volume	Ve	mm3	147
Cross-sectional center pole area	Acp	mm2	13.4
Minimum cross-sectional area	Acp min.	mm2	12.6
Cross-sectional winding area of core	Acw	mm2	4.96
Weight (approx.)		g	0.8

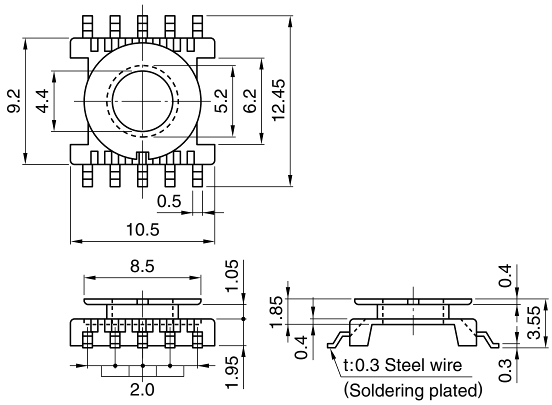
TYPICAL CHARACTERISTICS

Part No.	AL-value(nH/N2) [1kHz, 0.5mA, 100Ts]		Core loss (W) [at 100°C]	
	Without air gap	With air gap	100kHz 200mT	500kHz 50mT
PC44ER11/3.9-□□□*1	1040 min.	63±5% 100±7%		
PC50ER11/3.9-□□□	1100±25%	63±5% 100±7%		0.017
H5C3ER11/3.9-Z*2	4900 min.			

*1 Including AL-value
*2 10kHz, 10mV, 100Ts

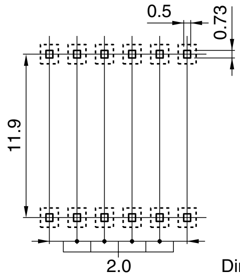
BOBBINS

BER11/3.9-1110GAFR



Dimensions in mm

CONNECTING PIN PATTERNS



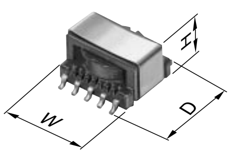
Dimensions in mm

Part No.	Material	Heat deflection temperature (°C)*1	UL standard	Available winding cores section Aw(mm2)	Average length of turns ℓw(mm)	Minimum thickness t(mm)*2	Weight (g)
BER11/3.9-1110GAFR	FR phenol	235	94V-0	1.73	21.5	0.4	0.21

*1 With 18.6kg/cm2 force
*2 Minimum thickness of bobbin

ASSEMBLY

SURFACE MOUNT TYPE

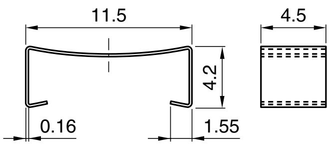


Dimensions in mm

W	11.0
D	12.6
H	4.7

ACCESSORIES

CLAMP

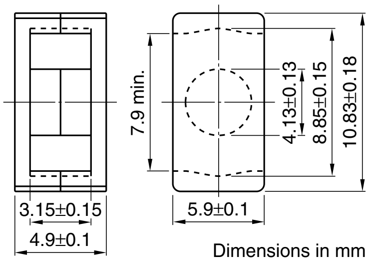


Dimensions in mm

Part No.	Material	Weight (g)
FER11/3.9-A	Stainless steel	0.13

ER11/5 CORES

CORES



Dimensions in mm

Parameter

Core factor	C1	mm^{-1}	1.23
Effective magnetic path length	ℓe	mm	14.7
Effective cross-sectional area	Ae	mm^2	11.9
Effective core volume	Ve	mm^3	174
Cross-sectional center pole area	Acp	mm^2	13.4
Minimum cross-sectional area	Acp min.	mm^2	12.6
Cross-sectional winding area of core	Acw	mm^2	7.44
Weight (approx.)		g	1.0

TYPICAL CHARACTERISTICS

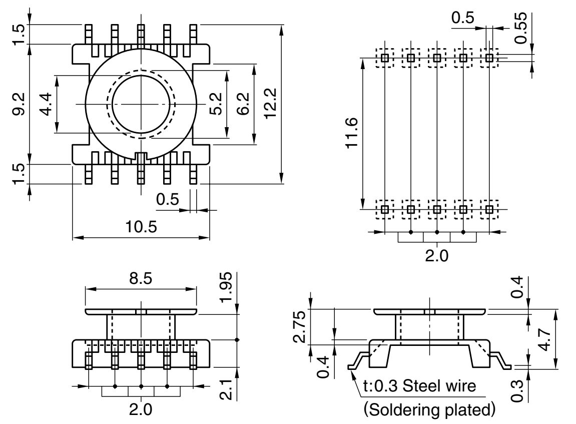
Part No.	AL-value(nH/N^2) [1kHz, 0.5mA, 100Ts]		Core loss (W) [at 100°C]	
	Without air gap	With air gap	100kHz 200mT	500kHz 50mT
PC44ER11/5-□□□*1	870 min.	63±5% 100±7%		
PC50ER11/5-□□□	960±25%	63±5% 100±7%		0.019
H5C3ER11/5-Z*2	4760 min.			

*1 Including AL-value
*2 10kHz, 10mV, 100Ts

BOBBINS

BER11/5-1110GAFR

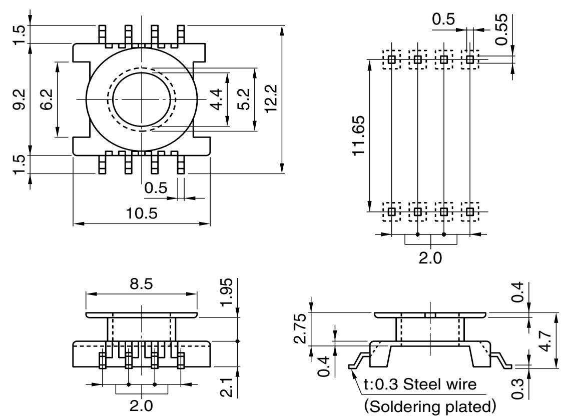
CONNECTING PIN PATTERNS



Dimensions in mm

BER11/5-118GAFR

CONNECTING PIN PATTERNS



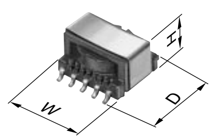
Dimensions in mm

Part No.	Material	Heat deflection temperature (°C)*1	UL standard	Available winding cores section Aw(mm^2)	Average length of turns ℓw(mm)	Minimum thickness t(mm)*2	Weight (g)
BER11/5-118GAFR	FR phenol	235	94V-0	3.22	21.5	0.4	0.21
BER11/5-1110GAFR	FR phenol	235	94V-0	3.22	21.5	0.4	0.21

*1 With 18.6kg/cm^2 force
*2 Minimum thickness of bobbin

ASSEMBLY

SURFACE MOUNT TYPE

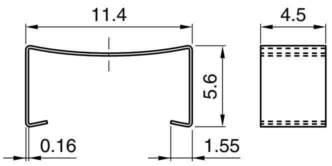


Dimensions in mm

W	11.5
D	12.3
H	6.4

ACCESSORIES

CLAMP



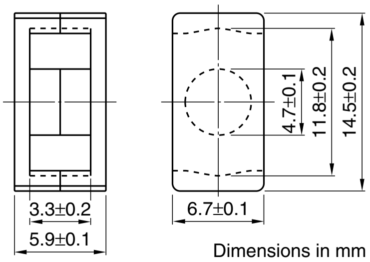
Dimensions in mm

Part No.	Material	Weight (g)
FER11/5-A	Stainless steel	0.13

TDK

ER14.5/6 CORES

CORES



Dimensions in mm

Parameter

Core factor	C1	mm^{-1}	1.08
Effective magnetic path length	ℓe	mm	19.0
Effective cross-sectional area	Ae	mm^2	17.6
Effective core volume	Ve	mm^3	333
Cross-sectional center pole area	Acp	mm^2	17.3
Minimum cross-sectional area	Acp min.	mm^2	16.6
Cross-sectional winding area of core	Acw	mm^2	11.7
Weight (approx.)		g	1.8

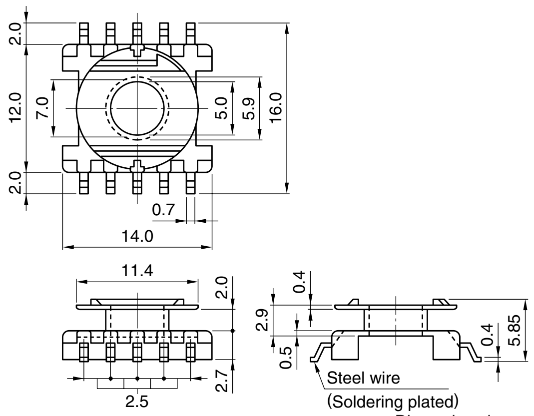
TYPICAL CHARACTERISTICS

Part No.	AL-value(nH/N2) [1kHz, 0.5mA, 100Ts]		Core loss (W) [at 100°C]	
	Without air gap	With air gap	100kHz 200mT	500kHz 50mT
PC44ER14.5/6-□□□ *1	1280 min.	100±5% 160±7%		
PC50ER14.5/6-□□□	1150±25%	100±5% 160±7%		0.044
H5C3ER14.5/6-Z *2	5950 min.			

*1 Including AL-value
*2 10kHz, 10mV, 100Ts

BOBBINS

BER14.5/6-1110GAFR

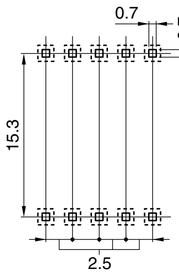


Dimensions in mm

Part No.	Material	Heat deflection temperature (°C)*1	UL standard	Available winding cores section Aw(mm2)	Average length of turns ℓw(mm)	Minimum thickness t(mm)*2	Weight (g)
BER14.5/6-1110GAFR	FR phenol	235	94V-0	5.50	27.2	0.4	0.55

*1 With 18.6kg/cm2 force
*2 Minimum thickness of bobbin

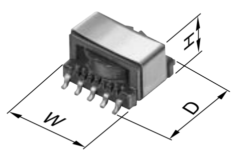
CONNECTING PIN PATTERNS



Dimensions in mm

ASSEMBLY

SURFACE MOUNT TYPE

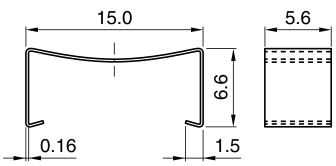


Dimensions in mm

W	15.1
D	16.2
H	7.3

ACCESSORIES

CLAMP



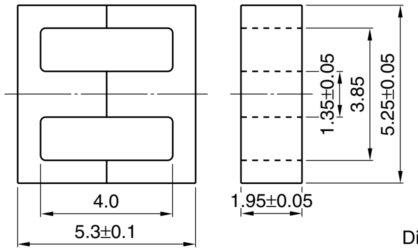
Dimensions in mm

Part No.	Material	Weight (g)
FER14.5/6-A	Stainless steel	0.2

• All specifications are subject to change without notice.

EE5 CORES

CORES



Dimensions in mm

Parameter

Core factor	C1	mm^{-1}	4.72
Effective magnetic path length	ℓe	mm	12.6
Effective cross-sectional area	Ae	mm^2	2.67
Effective core volume	Ve	mm^3	33.6
Cross-sectional center pole area	Acp	mm^2	2.63
Minimum cross-sectional area	Acp min.	mm^2	2.47
Cross-sectional winding area of core	Acw	mm^2	5.0
Weight (approx.)		g	0.2

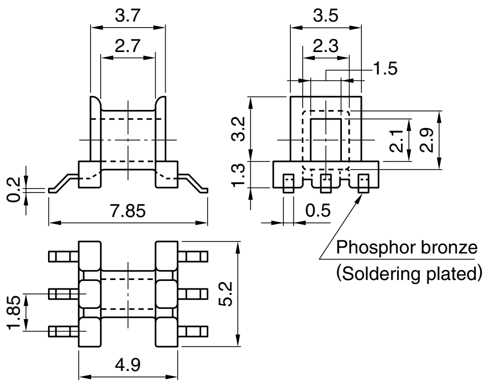
TYPICAL CHARACTERISTICS

Part No.	AL-value(nH/N^2) [1kHz, 0.5mA, 100Ts]	Core loss (W) [at 100°C] 100kHz 200mT	500kHz 50mT
PC44EE5-Z	200 min.		
H5C3EE5-Z*	980 min.		

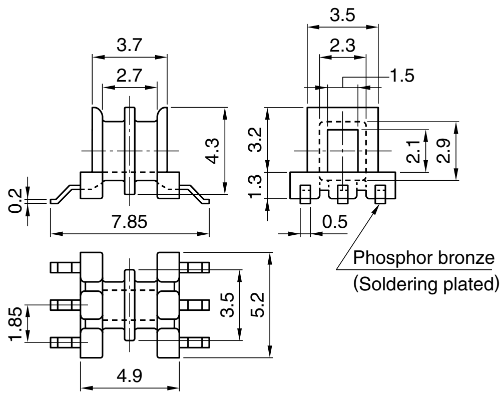
* 10kHz, 10mV, 100Ts

BOBBINS

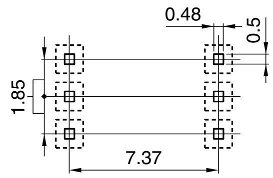
BE5-916FFR



BE5-926FFR



CONNECTING PIN PATTERNS



Dimensions in mm

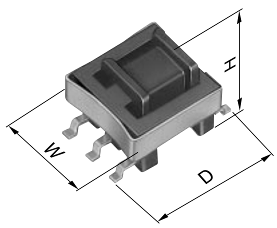
Part No.	Material	Heat deflection temperature (°C)*1	UL standard	Available winding cores section Aw(mm^2)	Average length of turns ℓw(mm)	Minimum thickness t(mm)*2	Weight (g)
BE5-916FFR	Diallylphtalate	180	94V-0	1.62	12.4	0.4	0.03
BE5-926FFR	Diallylphtalate	180	94V-0	0.67×2	12.4	0.4	0.07

*1 With 18.6kg/cm^2 force

*2 Minimum thickness of bobbin

ASSEMBLY

SURFACE MOUNT TYPE

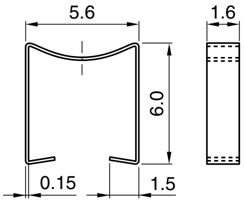


Dimensions in mm

W	5.7
D	7.8
H	4.8

ACCESSORIES

CLAMP

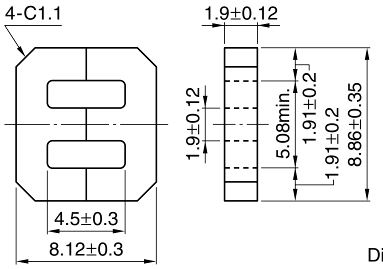


Dimensions in mm

Part No.	Material	Weight (g)
FE-5-A	Stainless steel	0.04

EE8.9/8 CORES

CORES



Dimensions in mm

Parameter

Core factor	C1	mm–1	3.15
Effective magnetic path length	ℓe	mm	15.6
Effective cross-sectional area	Ae	mm^2	4.96
Effective core volume	Ve	mm^3	77.4
Cross-sectional center pole area	Acp	mm^2	3.61
Minimum cross-sectional area	Acp min.	mm^2	3.17
Cross-sectional winding area of core	Acw	mm^2	7.07
Weight (approx.)		g	0.6

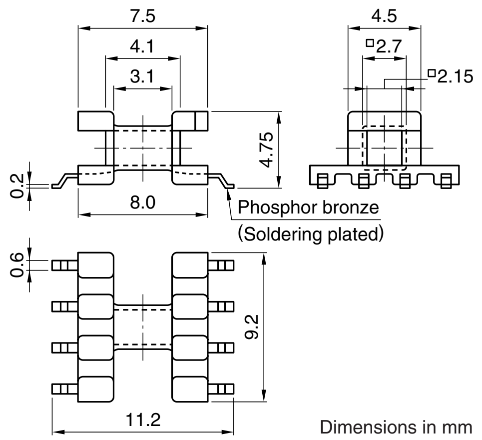
TYPICAL CHARACTERISTICS

Part No.	AL-value(nH/N2) [1kHz, 0.5mA, 100Ts]	Core loss (W) [at 100°C] 100kHz 200mT	500kHz 50mT
PC44EE8.9/8-Z	480±25%	0.026	
H5C3EE8.9/8-Z*	2000 min.		

* 10kHz, 10mV, 100Ts

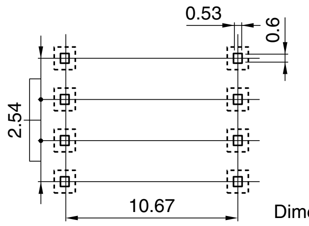
BOBBINS

BE8.9/8-118GFR



Dimensions in mm

CONNECTING PIN PATTERNS



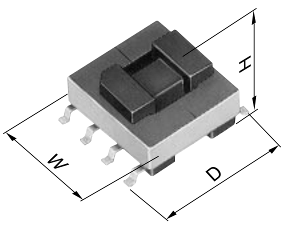
Dimensions in mm

Part No.	Material	Heat deflection temperature (°C)*1	UL standard	Available winding cores section Aw(mm^2)	Average length of turns ℓw(mm)	Minimum thickness t(mm)*2	Weight (g)
BE8.9/8-118GFR	FR phenol	235	94V-0	2.79	14.4	0.275	0.17

*1 With 18.6kg/cm^2 force
*2 Minimum thickness of bobbin

ASSEMBLY

SURFACE MOUNT TYPE

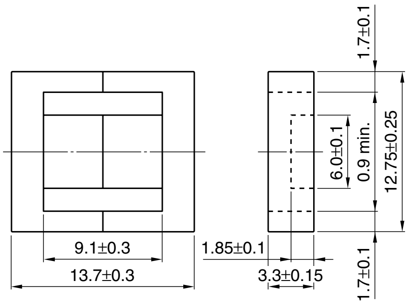


Dimensions in mm

W	9.3
D	11.3
H	4.75

EEM12.7/13.7 CORES

CORES



Dimensions in mm

Parameter

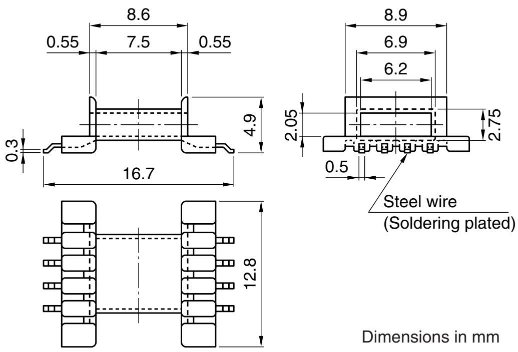
Core factor	C1	mm^{-1}	2.27
Effective magnetic path length	ℓe	mm	27.3
Effective cross-sectional area	Ae	mm^2	12.0
Effective core volume	Ve	mm^3	328
Cross-sectional center pole area	Acp	mm^2	11.1
Minimum cross-sectional area	Acp min.	mm^2	10.3
Cross-sectional winding area of core	Acw	mm^2	15.2
Weight (approx.)		g	1.9

TYPICAL CHARACTERISTICS

Part No.	AL-value(nH/N^2) [1kHz, 0.5mA, 100Ts]		Core loss (W) [at 100°C]	
	Without air gap	With air gap	100kHz 200mT	500kHz 50mT
PC44EEM12.7/13.7-□□□[*1]	820±25%	40±5% 63±7%	0.14	
PC50EEM12.7/13.7-□□□	580±25%	40±5% 63±7%		0.038
H5C3EEM12.7/13.7-Z[*2]	3000 min.			

*1 Including AL-value
*2 10kHz, 10mV, 100Ts

BOBBINS
BEM12.7-118GAFR

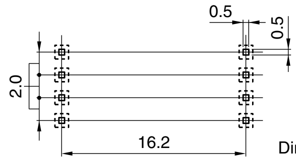


Dimensions in mm

Part No.	Material	Heat deflection temperature (°C)[*1]	UL standard	Available winding cores section Aw(mm^2)	Average length of turns ℓw(mm)	Minimum thickness t(mm)[*2]	Weight (g)
BEM12.7-118GAFR	FR phenol	235	94V-0	7.5	22.4	0.35	0.31

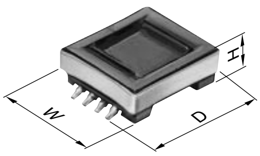
*1 With 18.6kg/cm^2 force
*2 Minimum thickness of bobbin

CONNECTING PIN PATTERNS



Dimensions in mm

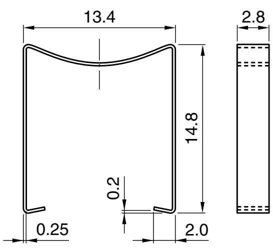
ASSEMBLY
SURFACE MOUNT TYPE



Dimensions in mm

W	13.55
D	16.8
H	5.0

ACCESSORIES
CLAMP



Dimensions in mm

Part No.	Material	Weight (g)
FEM12.7/13.7-A	Stainless steel	0.25

• All specifications are subject to change without notice.

TDK

TOROIDAL CORES T SERIES

TDK toroidal cores find use in many kinds of device—pulse transformers, delay lines, R. F. coils, converter transformers, wideband transformers, impedance—matching transformers and the like. The variety of TDK materials, of which the TDK cores are made, provides a truly wide range of cores for the user's selection.
The core meeting user's requirement for duty anywhere between the audio range and about 20MHz will be readily found in the TDK toroidal core line.

ORDERING CODE SYSTEMS

For general use

H5B2 T 4 × 1 × 2

- H5B2: Toroidal core material
- T: Symbol of Toroidal core
- 4: Outside diameter A
- 1: Thickness C
- 2: Inside diameter B

For LAN pulse transformers
(This ordering code system is used for only DNW45 items.)

DNW45 T 3.05 × 2.54 A - A W P

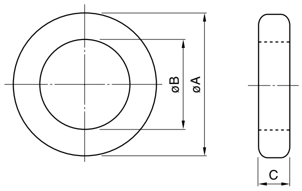
- DNW45: Toroidal core material
- T: Symbol of Toroidal core
- 3.05: Outside diameter A
- 2.54: Thickness C
- A: Inside diameter code
  - A: 1.27mm
  - B: 1.70mm
  - C: 1.78mm
  - D: 2.00mm
  - E: 2.23mm
  - F: 2.29mm
- A: Inductance code
  - A: 300μH min.
  - B: 350μH min.
  - C: 400μH min.
  - D: 450μH min.
- W: Temperature range code
  - N: 0 to +70°C
  - W: –40 to +85°C
- P: Paraxylylene-coated(If necessary)

• All specifications are subject to change without notice.

TDK

FOR GENERAL USE

DIMENSIONS/PARAMETERS AND AL-VALUE



Type (ø A×C×ø B)	Dimensions in mm / inches øA	øB	C	Parameters C_1 (mm^{-1})	Ae (mm^2)	ℓe (mm)
T3.05×1.27×1.27	3.05 .120	1.27 .050	1.27 .050	5.65	1.06	5.99
T4×1×2	4.00 .157	2.00 .079	1.00 .039	9.06	0.961	8.71
T3.94×1.27×2.23	3.94 .155	2.23 .088	1.27 .050	8.69	1.06	9.19
T4.83×1.27×2.29	4.83 .190	2.29 .090	1.27 .050	6.63	1.54	10.2
T6×1.5×3	6.00 .236	3.00 .118	1.50 .059	6.04	2.16	13.1
T5.84×1.52×3.05	5.84 .230	3.05 .120	1.52 .060	6.34	2.05	13.0
T8×2×4	8.00 .315	4.00 .157	2.00 .079	4.53	3.84	17.4
T10×2.5×5	10.0 .394	5.00 .197	2.50 .098	3.63	6.01	21.8
T12×3×6	12.0 .472	6.00 .236	3.00 .118	3.02	8.65	26.1
T14×3.5×7	14.0 .551	7.00 .276	3.50 .138	2.59	11.8	30.5

Type (ø A×C×ø B)	AL-value (nH/N²) HP5	H5B2	H5C3	PC40	H5A	H5C2
T3.05×1.27×1.27	1100±20%	1700±25%	3340±30%			
T4×1×2	670±20%	1000±25%	2000±30%			
T3.94×1.27×2.23	720±20%	1080±25%	2170±30%			
T4.83×1.27×2.29	950±20%	1400±25%	2840±30%			
T6×1.5×3	1000±20%	1500±25%	3000±30%			
T5.84×1.52×3.05	990±20%	1480±25%	2960±30%			
T8×2×4	1330±20%	2000±25%	4000±30%			
T10×2.5×5	1670±20%	2500±25%	5000±30%			
T12×3×6				1020±25%	1400±25%	3600±25%
T14×3.5×7				1200±25%	1650±25%	4200±25%

- Can be coated with epoxy or paraxylylene.
- If epoxy or paraxylylene-coated products are desired, please suffix P or E to part No. when ordering.
  Above T10 (outside diameter 10mm min.): Epoxy Coating “E”
  Up to T8 (outside diameter 8mm max.): Paraxylylene “P”
- Insulation withstanding voltage of coating product: DC.1000V min. for 1 second.
- Measuring conditions:
  HP5, H5B2, H5C2, H5C3: 10kHz, 10mV, 10Ts
  PC40: 100kHz, 10mV, 10Ts
  H5A: 50kHz, 10mV, 10Ts

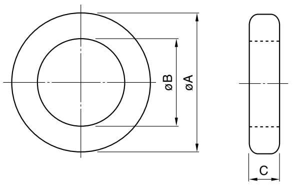
Type (ø A×C×ø B)	Dimensions in mm / inches			Parameters		
	øA	**øB**	**C**	**C_1 (mm^{-1})**	**Ae (mm^2)**	**ℓe (mm)**
T20×5×10	20.0 .787	10.0 .394	5.00 .197	1.81	24.0	43.6
T20×7.5×14.5	20.0 .787	14.5 .571	7.50 .295	2.61	20.4	53.3
T28×13×16	28.0 1.102	16.0 .630	13.0 .512	0.864	76.0	65.6
T31×8×19	31.0 1.220	19.0 .748	8.00 .315	1.60	47.1	75.5
T38×14×22	38.0 1.496	22.0 .866	14.0 .551	0.821	109	89.7
T44.5×13×30	44.5 1.752	30.0 1.181	13.0 .512	1.23	93.0	114

Type (ø A×C×ø B)	A_L-value (nH/N^2)					
	HP5	**H5B2**	**H5C3**	**PC40**	**H5A**	**H5C2**
T20×5×10				1750±25%	2350±25%	6000±30%
T20×7.5×14.5				1050±25%	1800±25%	4100±30%
T28×13×16						14000±30%
T31×8×19						7700±30%
T38×14×22						13160±30%
T44.5×13×30						10000±30%

- Can be coated with epoxy or paraxylylene.
- If epoxy or paraxylylene-coated products are desired, please suffix P or E to part No. when ordering.
  Above T10 (outside diameter 10mm min.): Epoxy Coating "E"
  Up to T8 (outside diameter 8mm max.): Paraxylylene "P"
- Insulation withstanding voltage of coating product: DC.1000V min. for 1 second.
- Measuring conditions:
  HP5, H5B2, H5C2, H5C3: 10kHz, 10mV, 10Ts
  PC40: 100kHz, 10mV, 10Ts
  H5A: 50kHz, 10mV, 10Ts

FOR LAN PULSE TRANSFORMERS

DIMENSIONS/PARAMETERS AND AL-VALUE



Type (ø A×C×ø B)	Dimensions in mm / inches			Parameters		
	øA	**øB**	**C**	**C_1 (mm^{-1})**	**Ae (mm^2)**	**ℓe (mm)**
T3.05×1.27A	3.05±0.2 .120±.008	1.27±0.2 .050±.008	1.27±0.2 .050±.008	5.65	1.06	5.99
T3.05×2.54A	3.05±0.2 .120±.008	1.27±0.2 .050±.008	2.54±0.2 .100±.008	2.82	2.12	5.99
T3.4×1.5B	3.40±0.2 .134±.008	1.70±0.2 .067±.008	1.50±0.2 .059±.008	6.04	1.23	7.40
T3.4×2.5B	3.40±0.2 .134±.008	1.70±0.2 .067±.008	2.50±0.2 .098±.008	3.63	2.04	7.40
T3.94×1.27C	3.94±0.2 .155±.008	1.78±0.2 .070±.008	1.27±0.2 .050±.008	6.23	1.30	8.10

Part No.	Number of turns								AL-value (nH/N2)
	Temperature range code: N [0 to 70°C]				Temperature range code: W [–40 to +85°C]				
	Inductance code[at DC.8mA]				Inductance code[at DC.8mA]				
	A:300μH min.	B:350μH min.	C:400μH min.	D:450μH min.	A:300μH min.	B:350μH min.	C:400μH min.	D:450μH min.	
DNW45T3.05×1.27A-AN	26Ts	—	—	—					930±25%
DNW45T3.05×1.27A-BN	—	30Ts	—	—					
DNW45T3.05×1.27A-AW					30Ts	—	—	—	
DNW45T3.05×2.54A-AN	16Ts	—	—	—					1870±25%
DNW45T3.05×2.54A-BN	—	18Ts	—	—					
DNW45T3.05×2.54A-DN	—	—	—	20Ts					
DNW45T3.05×2.54A-AW					16Ts	—	—	—	
DNW45T3.05×2.54A-BW					—	18Ts	—	—	
DNW45T3.05×2.54A-CW					—	—	20Ts	—	
DNW45T3.05×2.54A-DW					—	—	—	22Ts	
DNW45T3.4×1.5B-AN	24Ts	—	—	—					870±25%
DNW45T3.4×1.5B-BN	—	26Ts	—	—					
DNW45T3.4×1.5B-CN	—	—	30Ts	—					
DNW45T3.4×1.5B-DN	—	—	—	32Ts					
DNW45T3.4×1.5B-AW					26Ts	—	—	—	
DNW45T3.4×1.5B-BW					—	28Ts	—	—	
DNW45T3.4×1.5B-CW					—	—	32Ts	—	
DNW45T3.4×2.5B-AN	18Ts	—	—	—					1460±25%
DNW45T3.4×2.5B-BN	—	20Ts	—	—					
DNW45T3.4×2.5B-DN	—	—	—	22Ts					
DNW45T3.4×2.5B-AW					18Ts	—	—	—	
DNW45T3.4×2.5B-BW					—	20Ts	—	—	
DNW45T3.4×2.5B-CW					—	—	22Ts	—	
DNW45T3.4×2.5B-DW					—	—	—	24Ts	
DNW45T3.94×1.27C-AN	24Ts	—	—	—					850±25%
DNW45T3.94×1.27C-BN	—	26Ts	—	—					
DNW45T3.94×1.27C-CN	—	—	30Ts	—					
DNW45T3.94×1.27C-DN	—	—	—	32Ts					
DNW45T3.94×1.27C-AW					24Ts	—	—	—	
DNW45T3.94×1.27C-BW					—	28Ts	—	—	
DNW45T3.94×1.27C-CW					—	—	30Ts	—	
DNW45T3.94×1.27C-DW					—	—	—	34Ts	

- Test conditions Inductance: 100kHz, Erms 100mV, DC.8mA,
  AL-value: 100kHz, Erms 100mV, 10Ts, DC.0A, 25°C
- Can be coated with paraxylylene(Thickness of coating: 12.5μm typ.). Please sutfix “P” to the part numuber when ordering.
- Insulation withstanding voltage of coated product: DC.1000V min. for 1 second.

Type (ø A×C×ø B)	Dimensions in mm / inches			Parameters		
	øA	**øB**	**C**	**C_1 (mm^{-1})**	**Ae (mm^2)**	**ℓe (mm)**
T3.94×1.78C	3.94±0.2 .155±.008	1.78±0.2 .070±.008	1.78±0.2 .070±.008	4.44	1.82	8.10
T3.94×1.27E	3.94±0.2 .155±.008	2.23±0.2 .088±.008	1.27±0.2 .050±.008	8.69	1.06	9.19
T3.94×1.78E	3.94±0.2 .155±.008	2.23±0.2 .088±.008	1.78±0.2 .070±.008	6.20	1.48	9.19
T4×1D	4.0±0.2 .157±.008	2.0±0.2 .079±.008	1.0±0.15 .039±.006	9.06	0.96	8.71
T4×2D	4.0±0.2 .157±.008	2.0±0.2 .079±.008	2.0±0.2 .079±.008	4.53	1.92	8.71
T4.83×1.27F	4.83±0.3 .190±.012	2.29±0.2 .090±.008	1.27±0.2 .050±.008	6.63	1.54	10.2

Part No.	Number of turns								AL-value (nH/N2)
	Temperature range code: N [0 to 70°C]				Temperature range code: W [–40 to +85°C]				
	Inductance code [at DC.8mA]				Inductance code [at DC.8mA]				
	A:300μH min.	B:350μH min.	C:400μH min.	D:450μH min.	A:300μH min.	B:350μH min.	C:400μH min.	D:450μH min.	
DNW45T3.94×1.78C-AN	20Ts	—	—	—					1190±25%
DNW45T3.94×1.78C-BN	—	22Ts	—	—					
DNW45T3.94×1.78C-CN	—	—	24Ts	—					
DNW45T3.94×1.78C-DN	—	—	—	26Ts					
DNW45T3.94×1.78C-AW					20Ts	—	—	—	
DNW45T3.94×1.78C-BW					—	22Ts	—	—	
DNW45T3.94×1.78C-CW					—	—	24Ts	—	
DNW45T3.94×1.78C-DW					—	—	—	26Ts	
DNW45T3.94×1.27E-AN	30Ts	—	—	—					610±25%
DNW45T3.94×1.27E-BN	—	34Ts	—	—					
DNW45T3.94×1.27E-CN	—	—	36Ts	—					
DNW45T3.94×1.27E-DN	—	—	—	40Ts					
DNW45T3.94×1.27E-AW					30Ts	—	—	—	
DNW45T3.94×1.27E-BW					—	34Ts	—	—	
DNW45T3.94×1.27E-CW					—	—	40Ts	—	
DNW45T3.94×1.78E-AN	24Ts	—	—	—					850±25%
DNW45T3.94×1.78E-BN	—	26Ts	—	—					
DNW45T3.94×1.78E-CN	—	—	28Ts	—					
DNW45T3.94×1.78E-DN	—	—	—	30Ts					
DNW45T3.94×1.78E-AW					26Ts	—	—	—	
DNW45T3.94×1.78E-BW					—	28Ts	—	—	
DNW45T3.94×1.78E-CW					—	—	30Ts	—	
DNW45T3.94×1.78E-DW					—	—	—	32Ts	
DNW45T4×1D-AN	30Ts	—	—	—					580±25%
DNW45T4×1D-BN	—	34Ts	—	—					
DNW45T4×1D-CN	—	—	38Ts	—					
DNW45T4×1D-AW					32Ts	—	—	—	
DNW45T4×1D-BW					—	36Ts	—	—	
DNW45T4×2D-AN	20Ts	—	—	—					1160±25%
DNW45T4×2D-BN	—	22Ts	—	—					
DNW45T4×2D-CN	—	—	24Ts	—					
DNW45T4×2D-DN	—	—	—	26Ts					
DNW45T4×2D-AW					20Ts	—	—	—	
DNW45T4×2D-BW					—	22Ts	—	—	
DNW45T4×2D-CW					—	—	24Ts	—	
DNW45T4×2D-DW					—	—	—	26Ts	
DNW45T4.83×1.27F-AN	24Ts	—	—	—					800±25%
DNW45T4.83×1.27F-BN	—	26Ts	—	—					
DNW45T4.83×1.27F-CN	—	—	28Ts	—					
DNW45T4.83×1.27F-DN	—	—	—	30Ts					
DNW45T4.83×1.27F-AW					26Ts	—	—	—	
DNW45T4.83×1.27F-BW					—	28Ts	—	—	
DNW45T4.83×1.27F-CW					—	—	30Ts	—	
DNW45T4.83×1.27F-DW					—	—	—	32Ts	

- Test conditions Inductance: 100kHz, Erms 100mV, DC.8mA,
  AL-value: 100kHz, Erms 100mV, 10Ts, DC.0A, 25°C
- Can be coated with paraxylylene(Thickness of coating: 12.5μm typ.). Please sutfix “P” to the part numuber when ordering.
- Insulation withstanding voltage of coated product: DC.1000V min. for 1 second.

TDK

The attached diagram indicates the relationship between flux density (ΔB) and field intensity (H) under impressed pulse voltage. Therefore, pulse inductance (L_p), pulse permeability (μ_p) and core shape values are obtainable as shown on the diagram.

HOW TO OBTAIN PULSE INDUCTANCE(L_p) AND PERMEABILITY (μ_p):

Given the impressed voltage E(V), pulse width τ(sec.) and number of turns N(t), the excitation current i_p(A) is obtained if the core shape is determined. Next, as the excitation current i_p is now known, the values for L_p and μ_p are obtained from the following formulas. Here, the values for ΔB and H are obtained from the attached graph:

$$\Delta B=\frac{E\cdot\tau}{N\cdot Ae}\times 10^{9}(mT) \qquad i_p=\frac{H\cdot \ell e}{N}(A) \qquad \mu_p=\frac{L_P\cdot\ell e}{4\pi N^2 Ae}\times 10^{10}$$

$$H=\frac{N\cdot ip}{\ell e}\times 10^{3}(A/m) \qquad L_p=\frac{E\cdot\tau}{i_p}(H)$$

Example: Pulse inductance L_p and pulse permeability μ_p will be obtained as follows if pulse impression voltage E equals 5V, pulse width τ equals 2μsec., number of turns N equals 20 turns, and assuming the Toroidal core T6×1.5×3 of 5000 permeability is used. (A_e=2.16mm^2, l_e=13.1mm)

$$\Delta B=\frac{5\times 2\times 10^{-6}}{20\times 2.2}\times 10^{9}=227mT$$

Therefore, H equals 51A/m can be read from the intersection of the curves for ΔB equals 227mT and HP5. Consequently, the excitation current ip will be:

$$i_p=\frac{51\times 13.1}{20}=33.4mA$$

The values for L_p and μ_p will then be: $L_p=\frac{5\times 2\times 10^{-6}}{33.4\times 10^{-3}}=330\mu H$ $\mu_p=\frac{0.30\times 10^{-3}\times 13.1}{4\pi\cdot 20^2\cdot 2.2}\times 10^{10}=3555$

HOW CORE IS SHAPED:

Assuming, from the design standpoint, that the magnetic flux value ΔB has been confirmed; if material of known qualities is used, the field intensity H can be obtained from the graph. If the values of impressed voltage E(V), pulse width τ(sec.) and excitation current i_p are known, optimum core shape is obtained through the value of $\ell e/Ae$ as given by the following formula as long as the number or turns N is determined.

$$\frac{\ell e}{Ae}=\frac{N^2\cdot i_p}{E\cdot\tau}\cdot\frac{\Delta B}{H}\cdot 10^{-6}$$

When magnetic flux density ΔB equals 227mT, field intensity H equals 51A/m, E equals 5V, τ equals 2μsec., i_p equals 33.4mA and N equals 20 turns, and if Toroidal HP 4,000 cores are used, the value $\ell e/Ae$ for optimum cores will be:

$$\frac{\ell e}{Ae}=\frac{20^2\times 33.4\times 10^{-3}}{5\times 2\times 10^{-6}}\times\frac{227\times 10^{-6}}{51}=5.95mm^{-1}$$

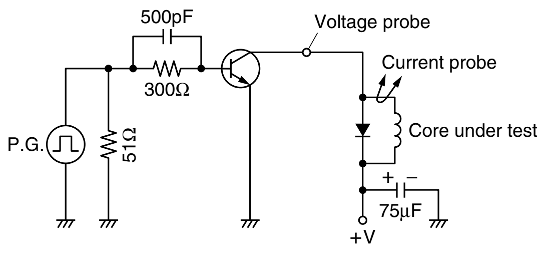


Fig.1 Test circuit

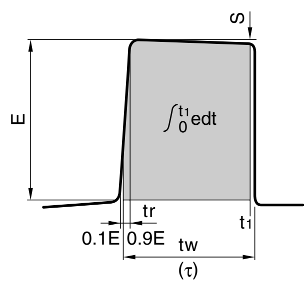


Fig.2 Pulse waveform

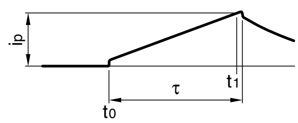
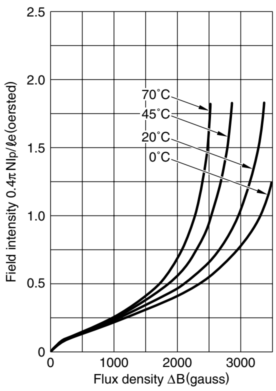


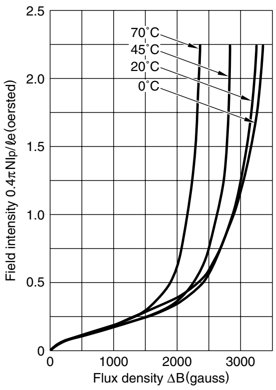
Fig.3 Current waveform

TYPICAL PULSE DRIVED CHARACTERISTICS

HP5

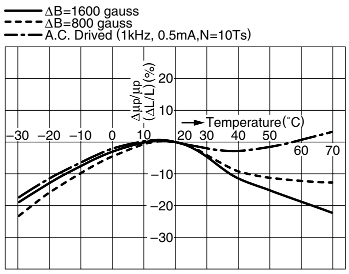


H5B2



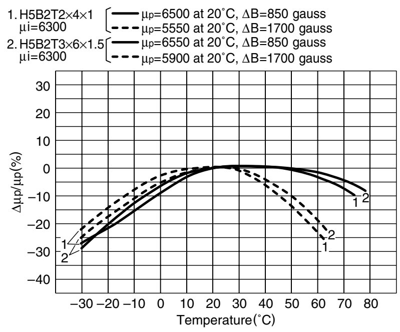
TYPICAL TEMPERATURE CHARACTERISTICS OF PULSE DRIVING

HP5



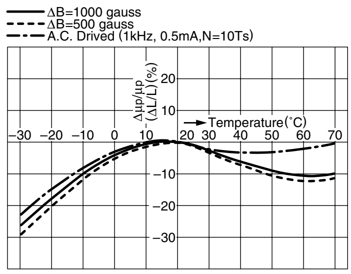
Test condition
Pulse width: 2μsec.
Repetition frequency 10kHz

H5B2



Test condition
Pulse width: 2μsec.
Repetition frequency 5kHz

H5C2



Test condition
Pulse width: 2μsec.
Repetition frequency 10kHz

This is indicated as the standardized value per turn of the typical frequency characteristic of the parallel resistance. Parallel resistance Rp of a chosen material and core size at certain frequency can be calculated by the following formula:

$$Rp = \frac{\text{Reading from the graph of } C_1 \cdot Rp/N^2}{C_1 \text{ of the chosen core}} \times N^2 (\Omega)$$

And C_1 means core factor ℓ_e/A_e (mm^{-1}). Those for non-standard cores are calculated by the following formula:

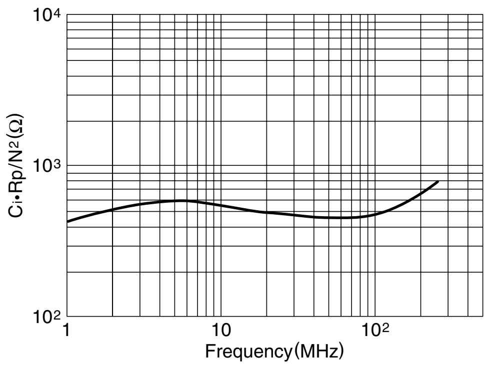
$$C_1 = \frac{2\pi}{C \cdot \ell n \frac{A}{B}}$$

where, A : outside diameter (mm)
B : inside diameter (mm)
C : thickness (mm)

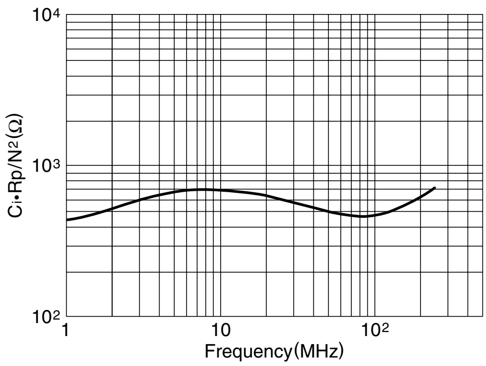
Parallel resistance is related to series resistance by the following formula.

$$Rs = \frac{Rp}{(I+2)} (\Omega)$$

H5B2

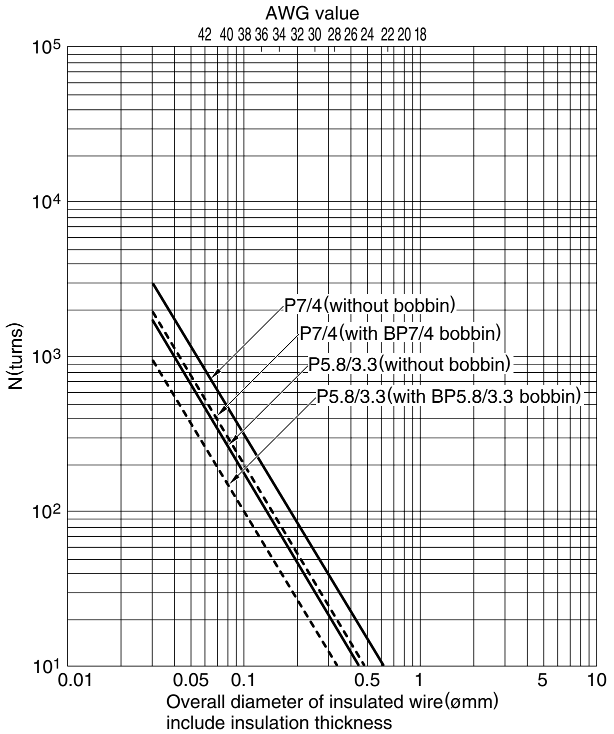


HP5

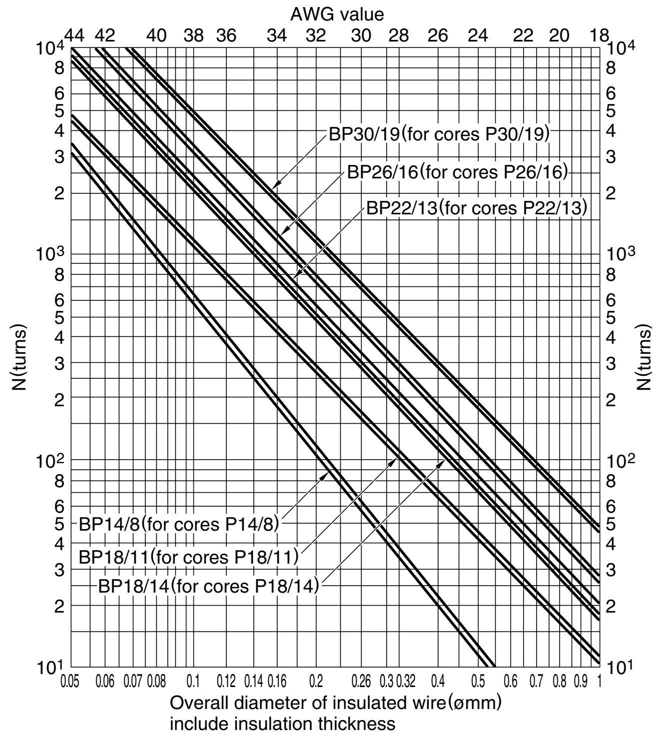


MAXIMUM NUMBER OF TURNS ON BOBBINS

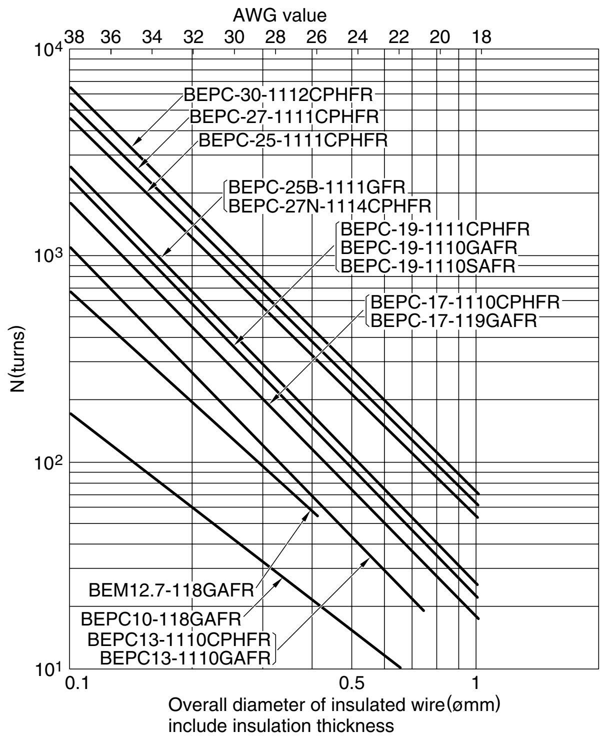
MINIATURE POT CORES



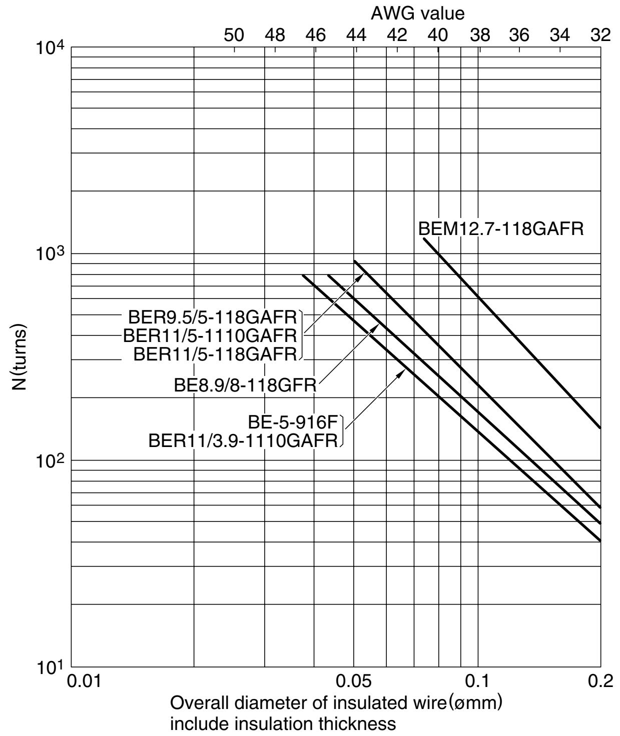
POT CORES



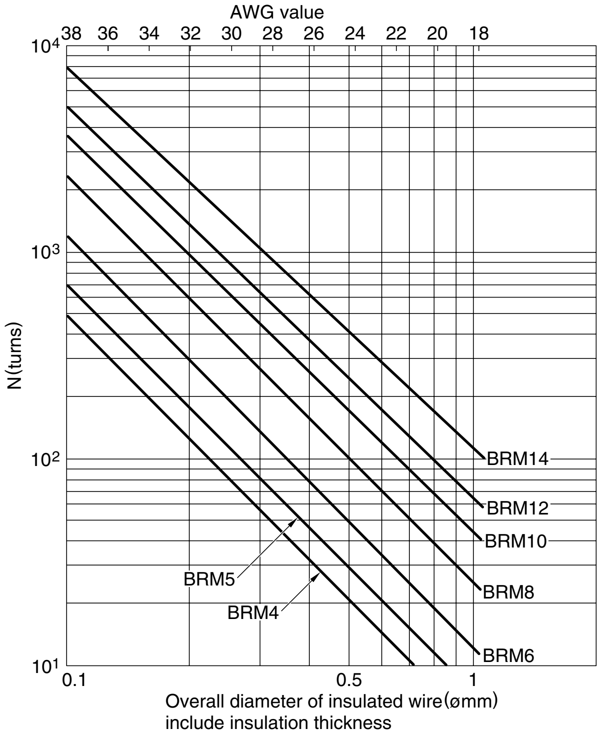
EPC CORES



SMD CORES



RM CORES



EP CORES