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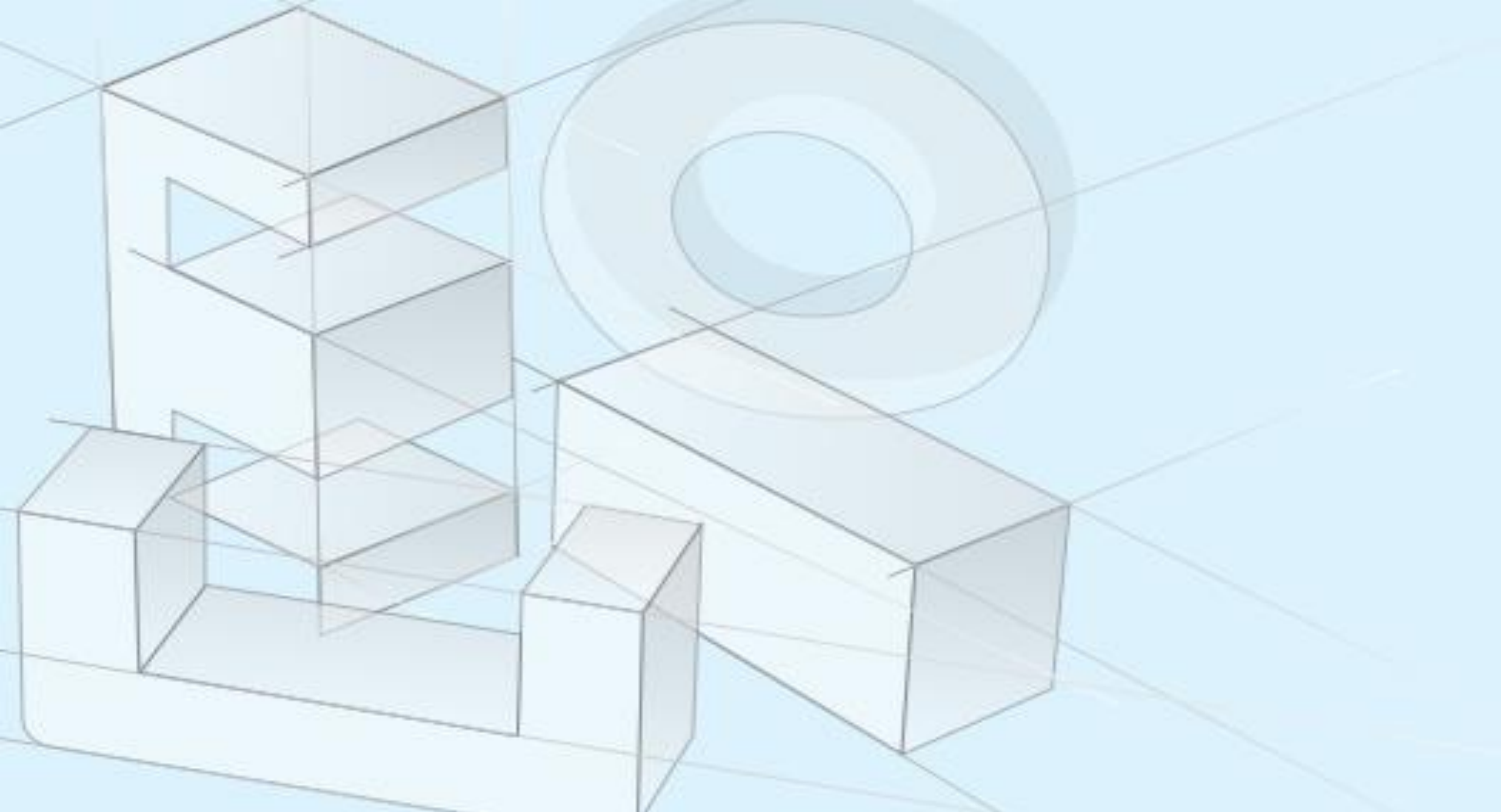
AMOGREENTECH High Efficiency Magnetic Powder Cores

AMOGREENTECH PRODUCES ADVANCED MATERIAL-BASED COMPONENTS

AMO
AMOGREENTECH



Advanced Powder Core

High Performance and Cost Effective PFC & DC Output Choke Core

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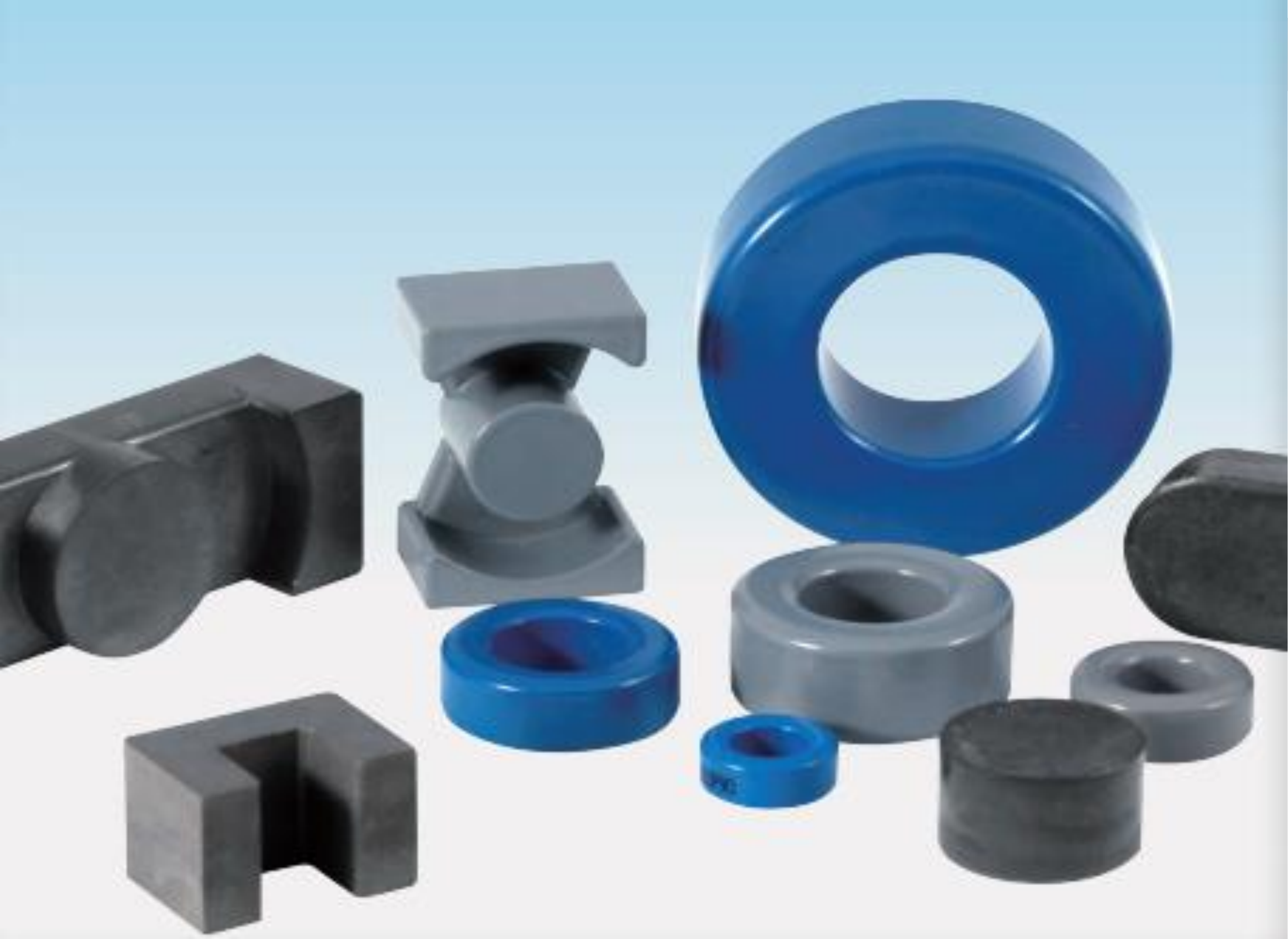


General Information

Specification of AMOGREENTECH's Powder Cores

| APH Series |

| APM Series |

| APD Series |

| APK Series |

APH™

- **Material : Amorphous alloy**
- **Permeability : 60 ~ 90µ**

- APH-series have the excellent magnetic properties.
- High saturation magnetic flux density value (1.56Tesla).
- Excellent DC Bias and core loss characteristic.
- No crystal magnetic anisotropy of the crystal grains This causes the powder has a low core loss benefits.

APM™

- **Material : Nano-crystalline alloy**
- **Permeability : 60 ~ 125µ**

- APM™ is consist of Nano-crystalline alloy powder .
- It have lowest core loss.
- Do not generate audible noise, zero magnetostriction.
- Good temperature stability in the operation.

APD™

- **Material : Fe based metal**
- **Permeability : 26 ~ 90μ**

- APD™ have a good formability.
- It is possible to make various form core.
- Magnetic properties are improved more than SENDUST.
- It have low cost more than amorphous materials.

APK™

- **Material : Fe based metal**
- **Permeability : 26 ~ 90μ**

- APK™ have a excellent flux density.
- It is possible to make various form core.
- Excellent DC Bias property
- It have low cost more than amorphous materials.

Application



- PFC chokes for PC power supplies
- PFC chokes for Server/Workstation power supplies
- PFC chokes for Industrial PC
- PFC chokes for LCD/PDP TV power supplies
- Output chokes for General Industrial power supplies

Feature

- Reduce overall component cost than other solution
- High efficiency
- Lowest temperature rise among the powder materials

➢ General material properties

	APH	APM	APD	APK
Material alloy	Amorphous	Nano-crystalline	Fe-based metal	Fe-based metal
Composition	Fe-Si-B	Fe-Si-B-Nb-Cu	Fe-Si-Al	Fe-Si
Permeability	60 ~ 90 µ	60 ~ 125 µ	26 ~ 90 µ	26 ~ 90 µ
Magnetic flux density	1.5 T	1.2 T	1.2 T	1.6 T
Curie Temp.	≈ 395 ^{o}C	≈ 570 ^{o}C	≈ 500 ^{o}C	≈ 700 ^{o}C

Unit and Conversions

cgs units	mks units
$\mathbf{B = H + 4\pi M}$	$\mathbf{B = \mu_0 H + M}$
B in gauss	B in webers / meter^2 (tesla)
H in oersteds	H in amperes / meter
M in emu/cm^3	M in webers/m^2
M_0(vacuum)=1	μ_0(vacuum) = $4\pi \times 10^{-7}$ (weber / ampere meter)

cgs to mks	mks to cgs
B : 1gauss=10^{-4} weber / meter^2	1weber/meter^2=10^4 gauss
H : 1oersted=79.58 amperes / meter	1ampere/meter=12.57×10^{-3} Oe
M : 1emu/cm^3=12.57×10^{-4} weber / meter^2	1weber/meter^2=796 emu/cm^3
Φ : 1maxwell = 10^{-8} weber	1weber = 10^8 maxwells

Permeability (μ)

In magnetics, permeability is the ability of a material to conduct flux. The magnitude of the permeability at a given induction is a measure of the ease with which a core material can be magnetized to that induction. It is defined as the ratio of the flux density B to the magnetizing force H.

$$\mu = \frac{B}{H}$$

μ = permeability
B = flux density(gauss)
H = magnetizing force (oersteds)

Flux Density, B [Gauss ; Tesla]

The corresponding parameter for the induced magnetic field in an area perpendicular to the flux path.
Flux density is determined by the field strength permeability of the medium in which it is measured.
1T = 10^4 Gauss

$$B_{max} = \frac{E_{rms} \times 10^8}{4.44fAN}$$ **: Faraday's Law**

B_{max}= maximum flux density(gauss)
E_{rms} = voltage across coil(volts)
f = frequency(hertz)
A = effective cross section area (cm^2)
N = number of turns

Inductance of Wound core

The inductance of a wound core at a given number of turns is calculated using the following formula.

$$L = \frac{0.4\pi\mu N^2 A \times 10^{-2}}{\ell}$$

$$L_N = A_L \times N^2 \times 10^{-3}$$

L = inductance (μH)
μ = permeability
N = number of turns
A = effective cross section area (cm^2)
ℓ = mean magnetic path length (cm)
L_N= Inductance at n turns (μH)
A_L=nominal Inductance (nH/N^2)

Magnetizing Force, H [Oe ; A/m]

The magnetic field strength which produces magnetic flux. The mmf per unit length. H can be considered to be a measure of the strength or effort that the magnetomotive force applies to magnetic circuit to establish a magnetic field. H may be expressed as H=NI/ℓ, where ℓ is the mean length of the magnetic circuit in meters.
1 Oersted = 79.58A/m

$$H = \frac{0.4\pi NI}{\ell}$$ **: Ampere's Law**

H = magnetizing force (oersteds)
N = number of turns
I = peak magnetizing current (amperes)
ℓ = mean magnetic path length(cm)

Core Loss

Powder cores have low hysteresis loss, minimizing signal distortion, and low residual loss. The total core loss at low flux densities is the sum of three frequency dependent losses of hysteresis loss, residual loss,and eddy current loss. The core loss is calculated from the following Legg's equation.

$$\frac{R_{ac}}{\mu L} = aB_{max}f + cf + ef^2$$

$R_{ac}/\mu L$: Total loss factor
$aB_{max}f$: Hysteresis loss
cf : Residual loss
ef^2 : Eddy current loss

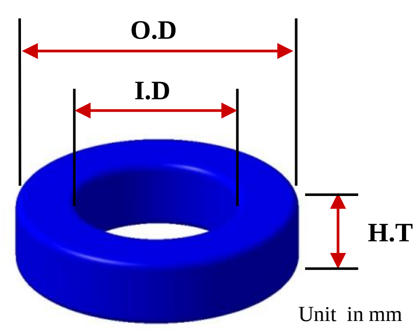
R_{ac}= core loss resistance (ohms)
a = hysteresis loss coefficient
c =residual loss coffefficient
e = eddy current loss cofficient
μ = permeability
L = inductance (μH)
Bmax= maximum flux density(gauss)
f = frequency(hertz)

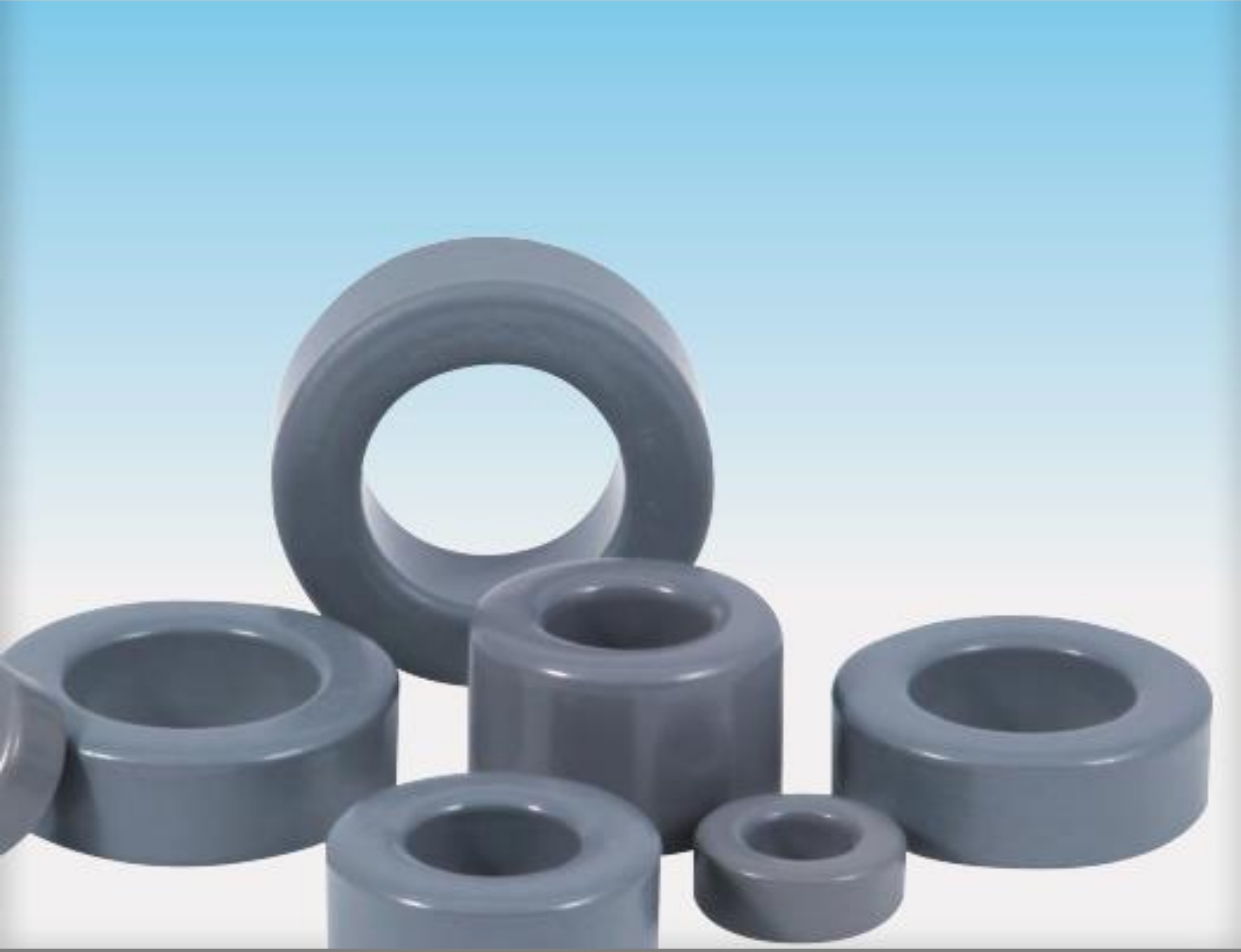
Specification of Powder cores

Model	Size (Finished) (OD×ID×HT)	A_L (nH/N^2)				L_e (cm)	A_c (cm^2)	Vol (cm^3)
		26	60	90	125			
18PXX	18.0 × 9.0 × 7.1	19	43	64	89	4.14	0.23	0.96
20PXX	21.1×12.1× 7.1	14	32	49	68	5.09	0.23	1.15
23PXX	23.6 × 13.4 × 8.4	19	43	65	90	5.67	0.33	1.88
24PXX	24.3 × 13.8 × 9.7	22	51	76	105	5.88	0.39	2.28
27PXX	27.7 × 14.1 × 12.0	32	75	113	157	6.35	0.65	4.15
33PXX	33.8× 19.3 × 11.6	28	61	92	127	8.15	0.67	5.48
36PXX	36.7 × 21.5 × 11.3	24	56	84	117	8.98	0.68	6.09
40PXX	40.7 × 23.3 × 15.4	35	81	122	168	9.84	1.07	10.55
43PXX	44.0 × 23.3 × 17.2	47	108	161	224	10.22	1.48	15.74
46PXX	47.6 × 23.3 × 18.9	59	135	203	281	10.74	1.99	21.37
50PXX	51.7 × 30.9 × 14.4	32	73	109	152	12.73	1.25	15.93
57PXX	58.0 × 25.6 × 16.1	60	138	207	287	12.50	2.29	28.60

AP X XX P 60

- *60* → *Perm. Value*
- *P* → *Permeability*
- *XX* → *Size of Core*
- *X* → *Material*
  - *H : Amorphous powder*
  - *M : Nano-crystalline powder*
  - *D : Fe-Si-Al powder*
  - *K : Fe-Si powder*
- *AP* → *Advanced Powder Core*





Technical Data

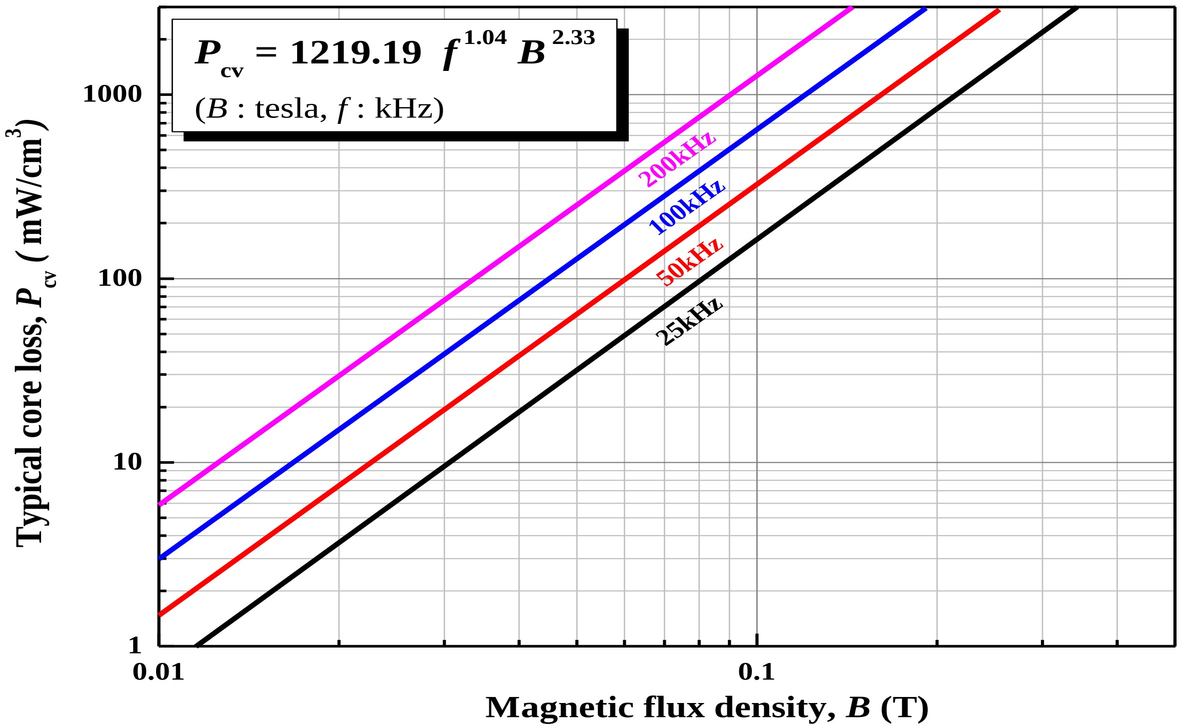
Magnetic Characteristics (Core loss, DC Bias Curves)

DC Bias Curve fit formula

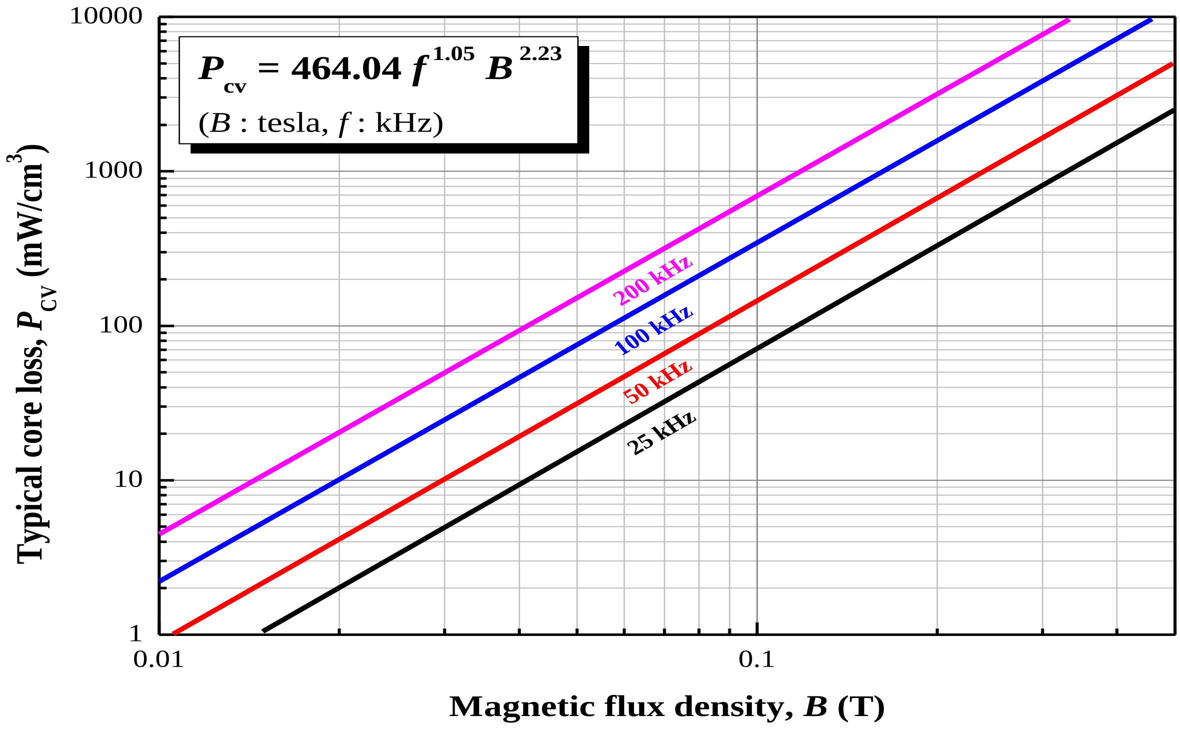
Temperature Stability

Core Loss Curves

>>> APH (60, 90μ)

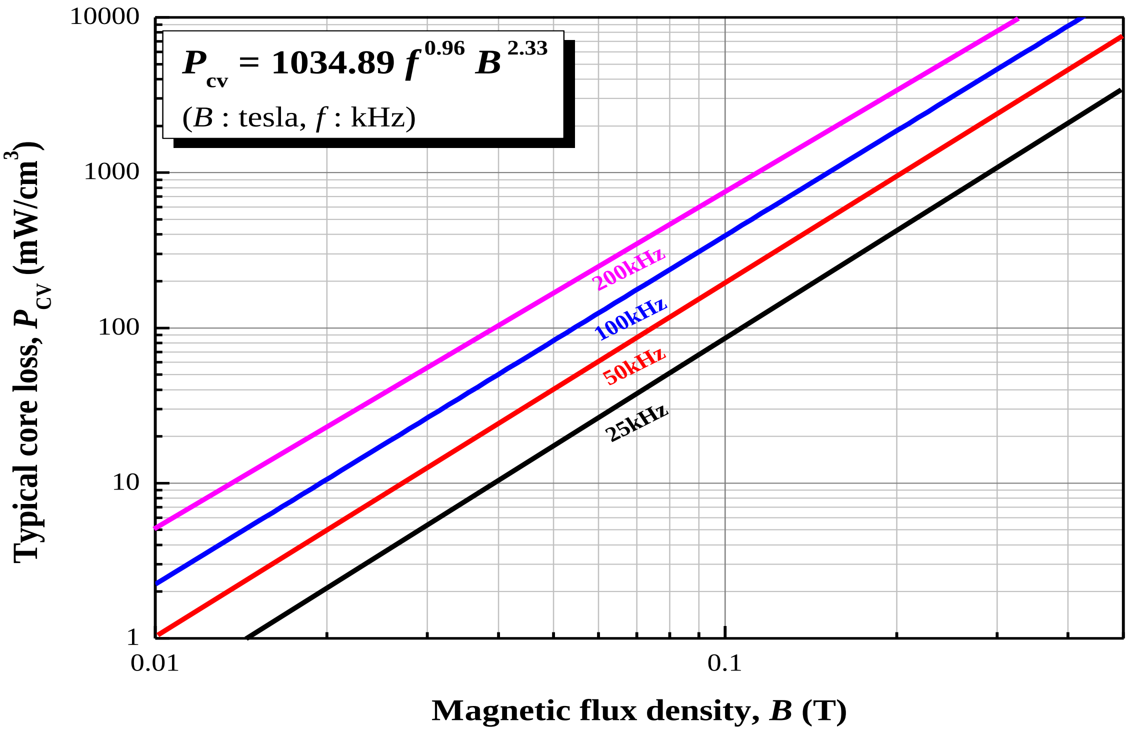


>>> APM (60μ)



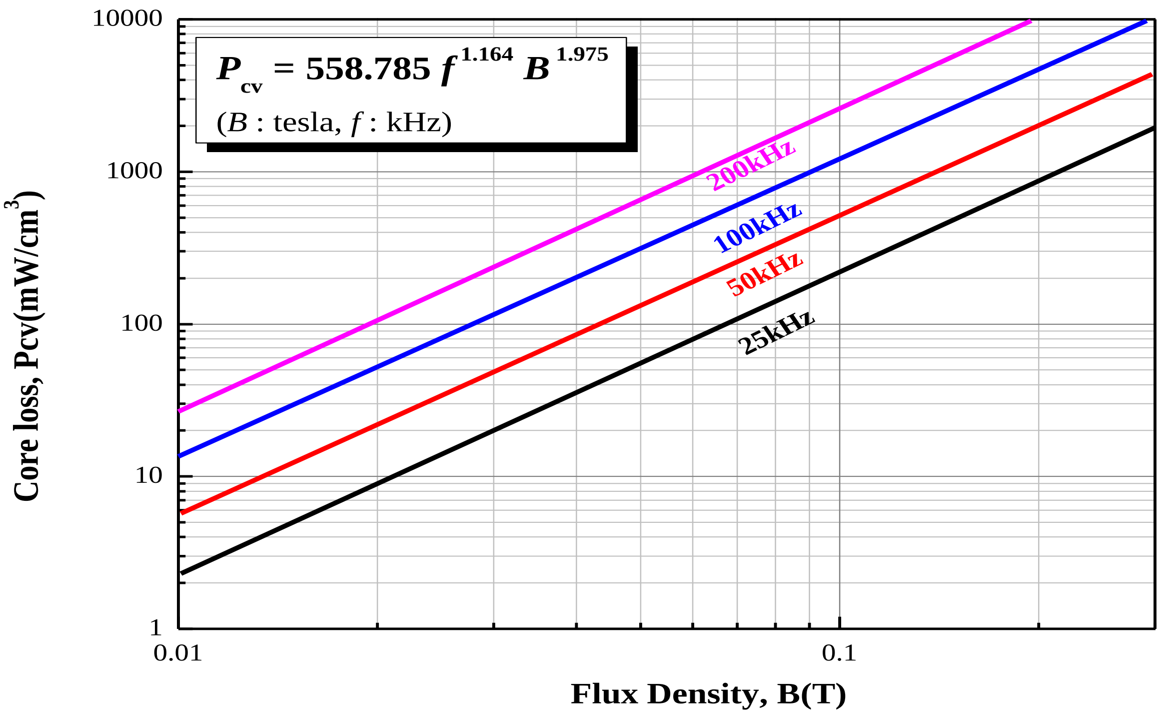
Core Loss Curves

>>> APM (90, 125μ)

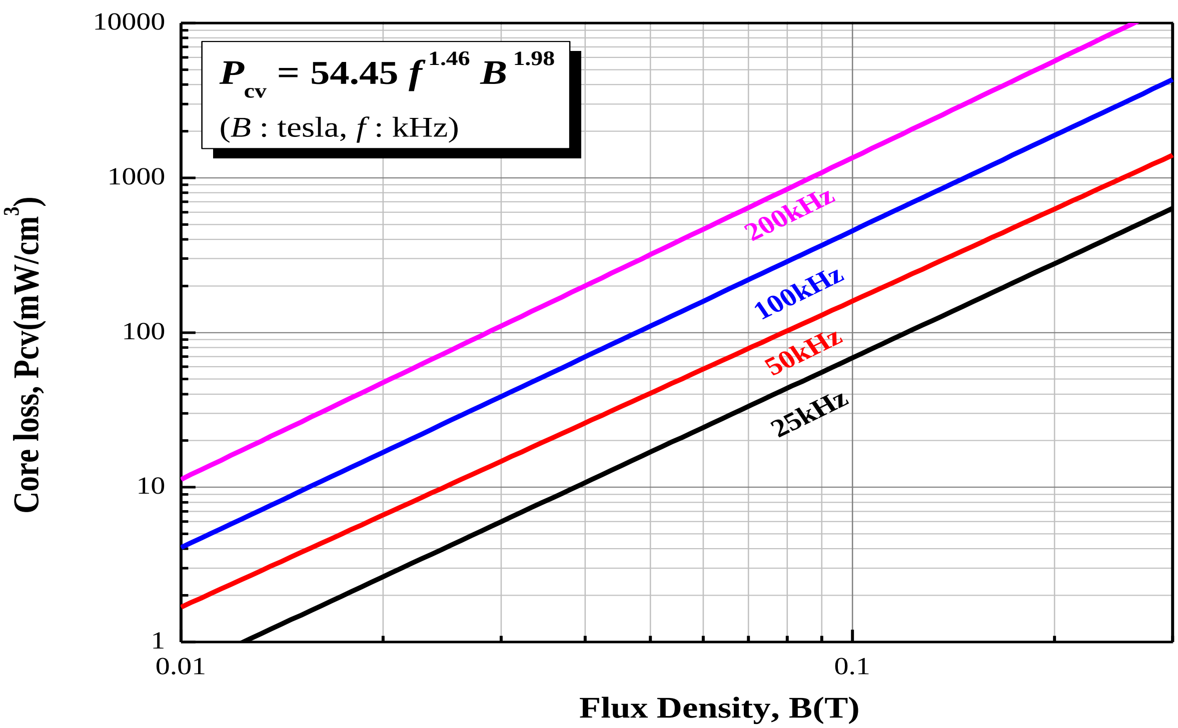


Core Loss Curves

>>> APD (26μ)

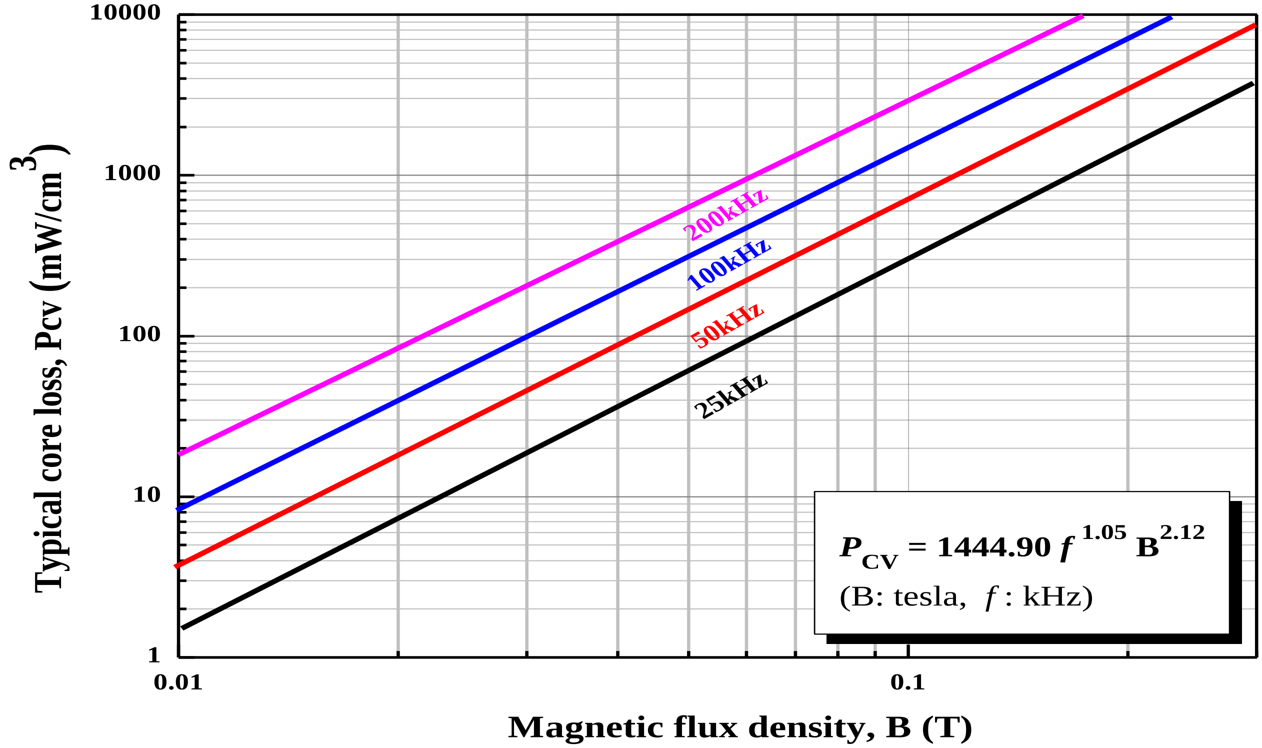


>>> APD (60, 90μ)

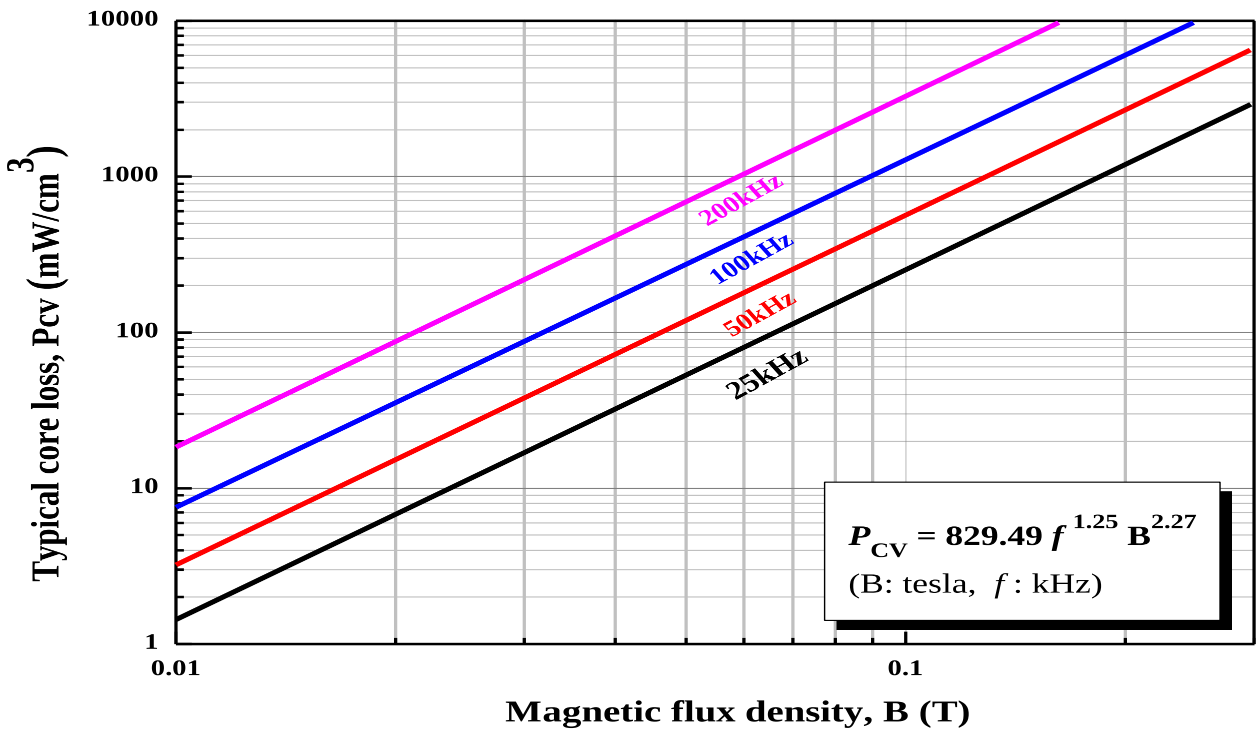


Core Loss Curves

>>> APK (26, 40μ)

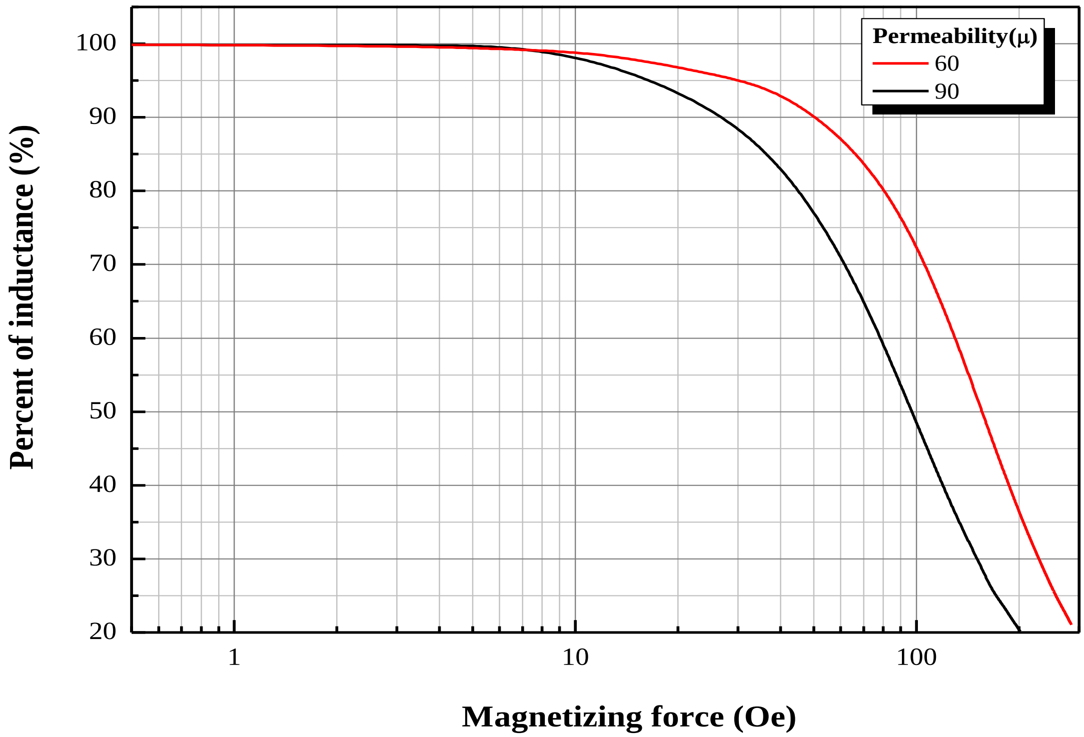


>>> APK (60 ~ 90μ)

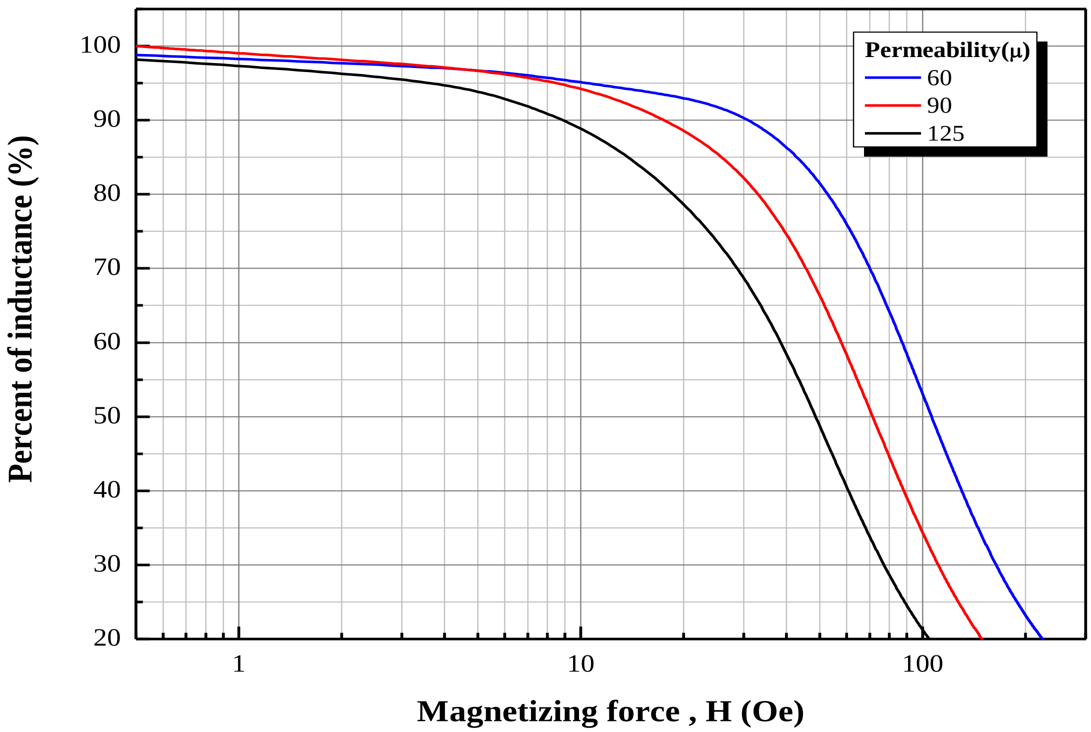


DC Bias curves

>>> APH

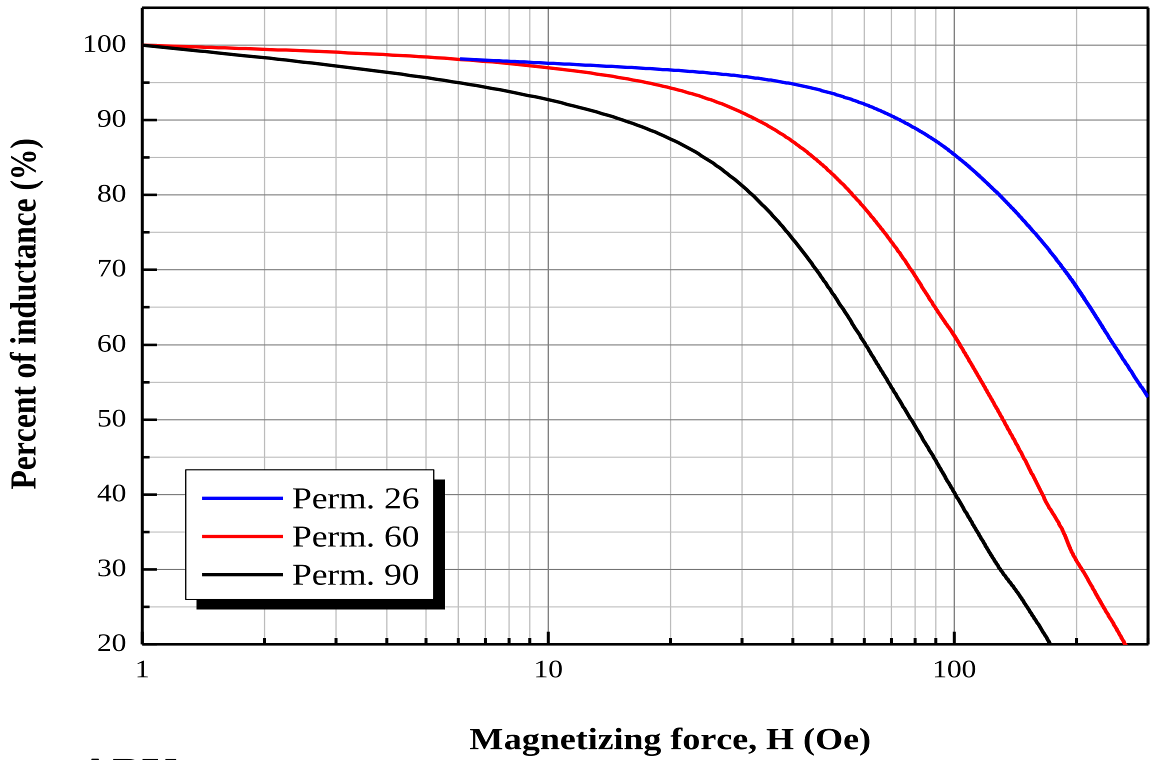


>>> APM

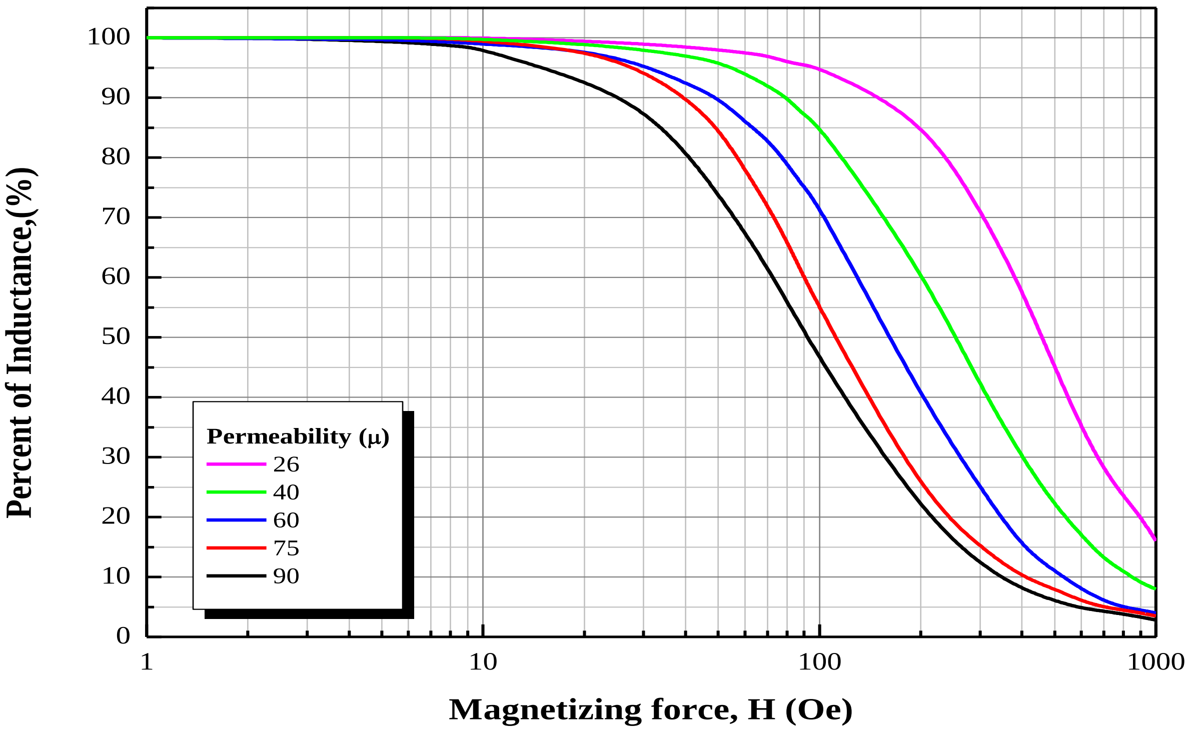


DC Bias curves

>>> APD



>>> APK



DC Bias Curve Fit Formula

$$\mu(percent) = a + bT + cT^2 + dT^3 + eT^4$$

(T : Oersted)

	Perm.	a	b	c	d	e
APH	60	99.68943	-0.00353	-0.00424	$1.78655E^{-5}$	$-2.22151E^{-8}$
	90	100.38168	-0.26561	-0.00678	$5.17094E^{-5}$	$-1.06979E^{-7}$

(T : Oersted)

	Perm.	a	b	c	d	e
APM	60	98.8205	-0.16712	-0.0065	$4.21658E^{-5}$	$-7.5827E^{-8}$
	90	99.51141	-0.33827	-0.0108	$1.01991E^{-4}$	$-2.56184E^{-7}$
	125	99.33194	-0.83789	-0.01006	$1.65295E^{-4}$	$-5.91882E^{-7}$

DC Bias Curve Fit Formula

$$\mu(percent) = a + bT + cT^2 + dT^3 + eT^4$$

(T : Oersted)

	Perm.(μ)	a	b	c	d	e
APD	26	99.21869	-0.07971	-8.32332E-4	2.74658E-6	-2.70374E-9
	60	101.46332	-0.35306	-9.94E-4	6.71985E-6	-9.04104E-9
	90	102.18006	-0.8243	0.00229	-1.1575E-6	-3.55616E-9

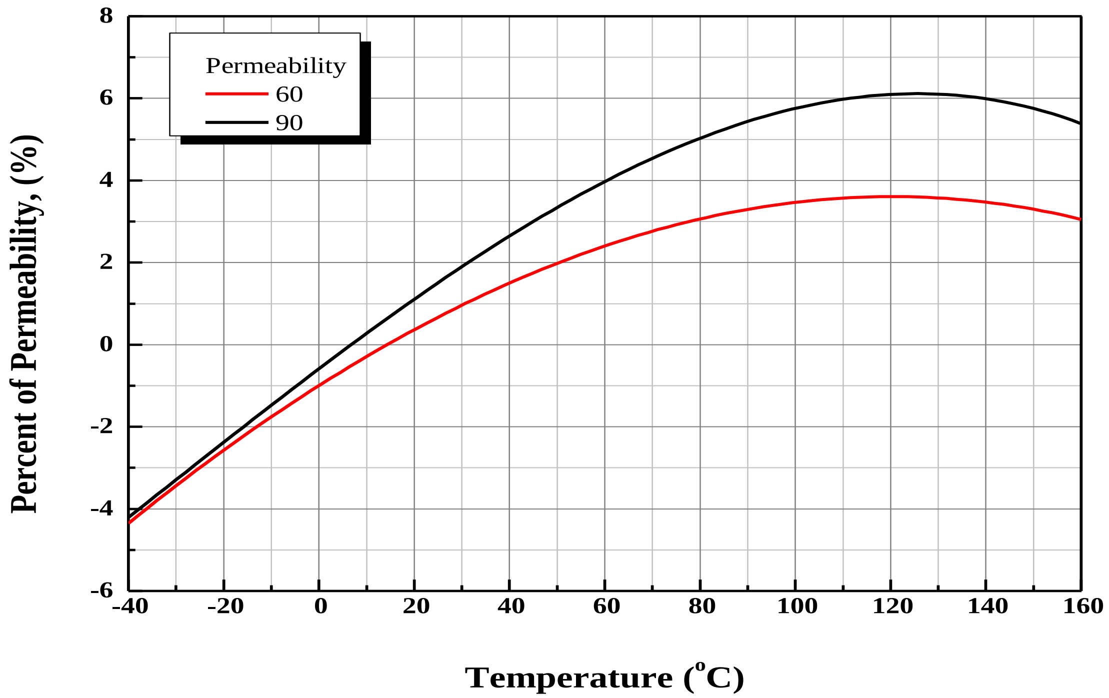
$$\mu(percent) = a + bT + cT^2 + dT^3 + eT^4 + fT^5$$

(T : Oersted)

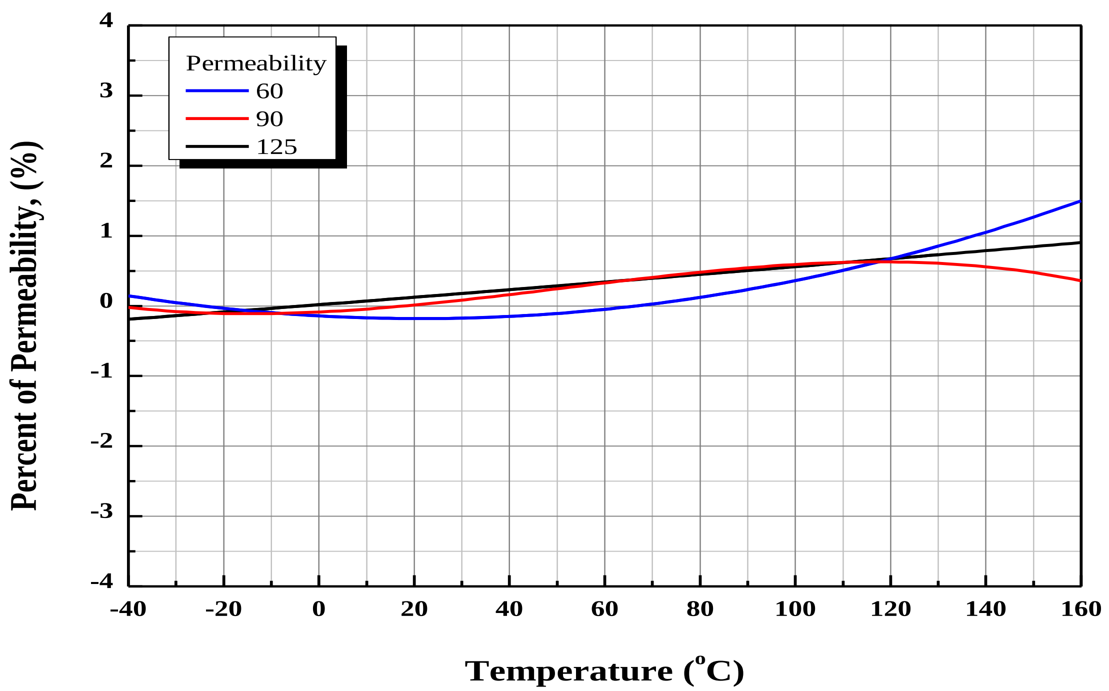
	Perm.(m)	a	b	c	d	e	f
APK	26	99.7629	-0.0036	-4.8000E^{-4}	6.79E^{-7}	-2.7900E^{-10}	-
	40	100.5012	-0.0622	-0.0011	3.44E^{-6}	-3.6003E^{-9}	1.3300E^{-12}
	60	101.4019	-0.2477	-6.3500E^{-4}	2.98E^{-6}	-3.6500E^{-9}	1.4500E^{-12}
	75	103.4721	-0.5038	6.0200E^{-4}	7.12E^{-7}	-1.8000E^{-9}	8.9500E^{-13}
	90	102.7848	-0.6708	0.0016	-1.81E^{-6}	6.9400E^{-10}	-

Temperature Stability

>>> APH

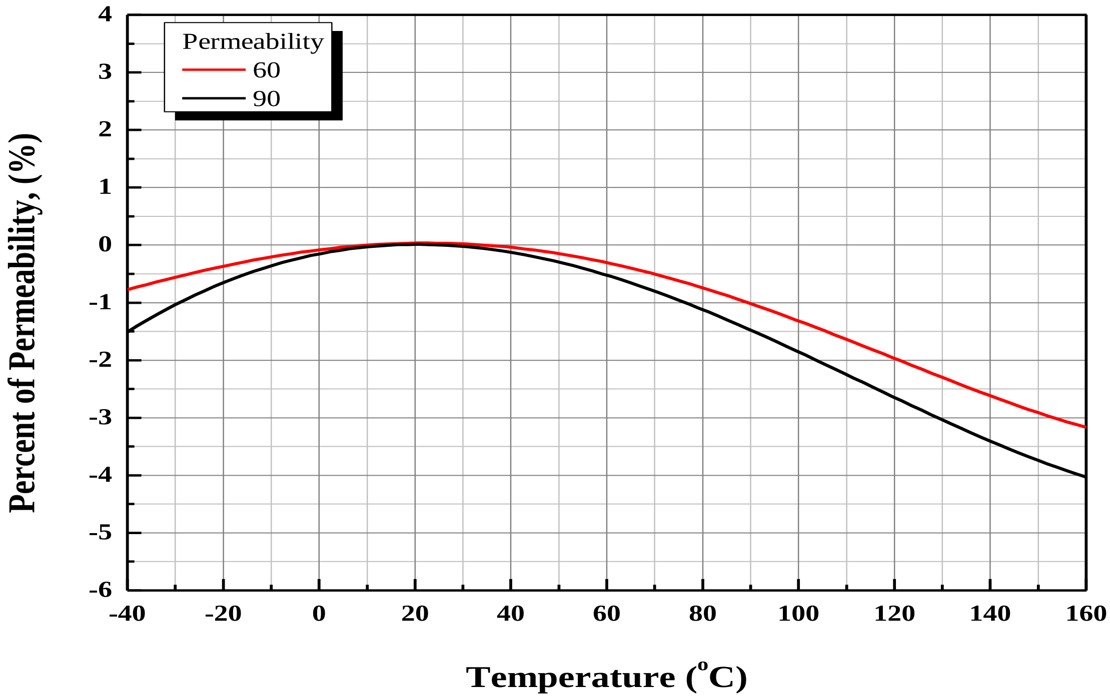


>>> APM

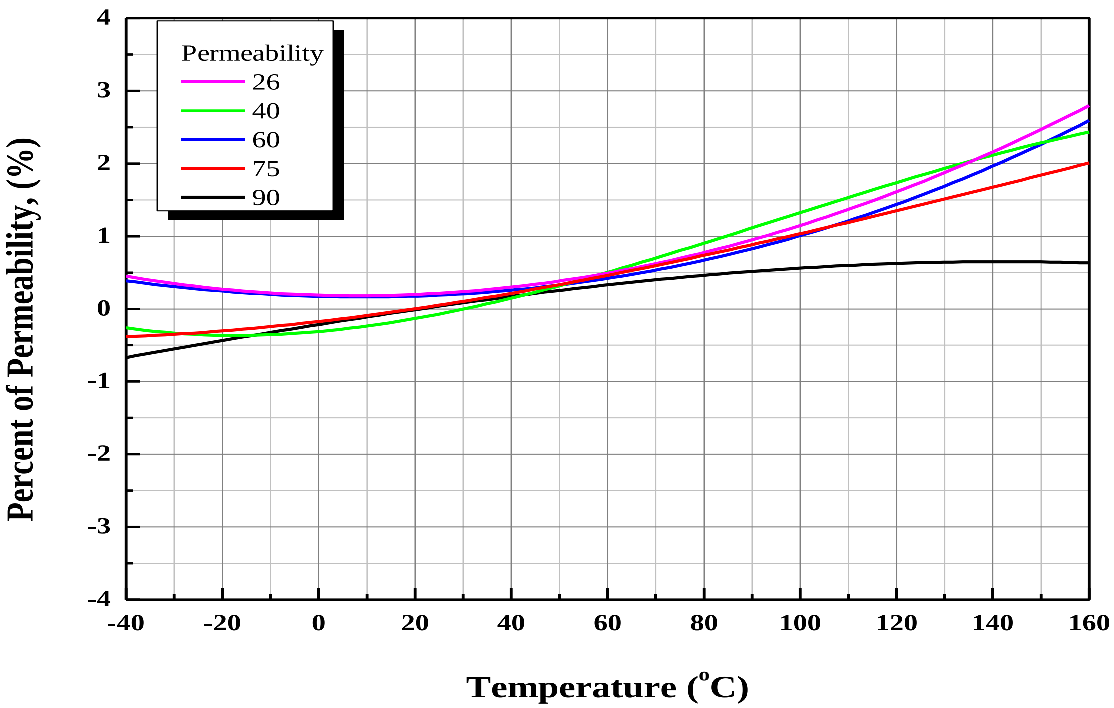


Temperature Stability

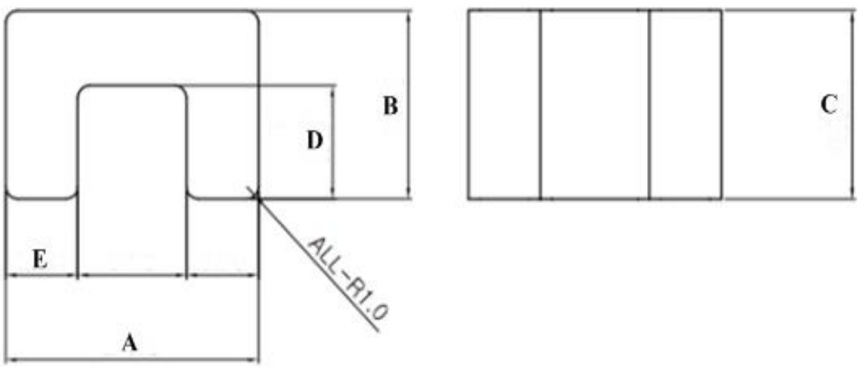
>>> APD

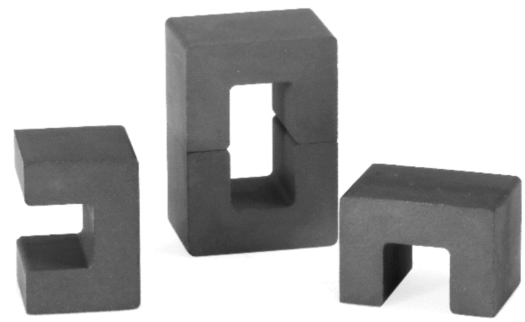


>>> APK



U core





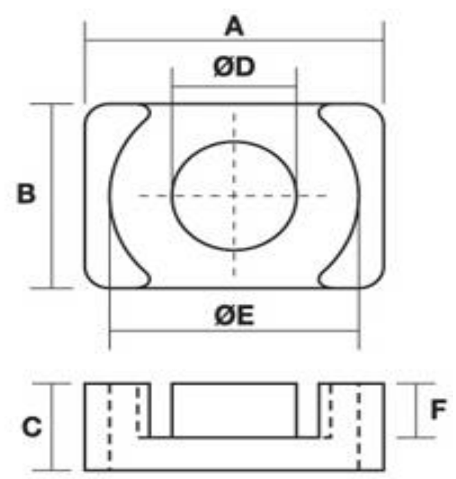
AU X XX XX XX - 60

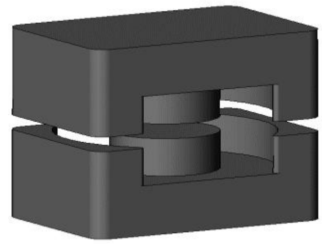
- ***Perm. Value***
- ***Height***
- ***Width***
- ***Length***
- ***Material***
  - *D : Fe-Si-Al powder*
  - *K : Fe-Si powder*
- ***Advanced Powder U Core***

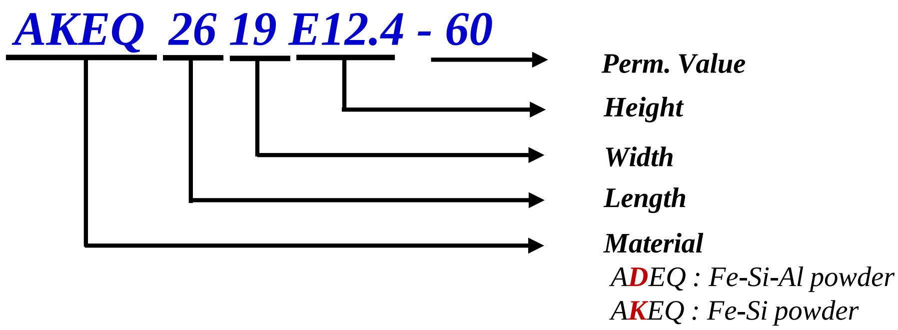
Core dimensions & magnetic specification

Part No.	Dimension (mm)					Path Length (mm)	Cross Section Area (mm^2)	Volume (mm^3)	AL Value (nH ±10%)		
	A	B	C	D	E				26µ	40µ	60µ
AUM353620-60	35.0	36.0	20.0	25.0	11.0	169.0	220.0	37180	43	65	98
AUM353625-60	35.0	36.0	25.0	25.0	11.0	169.0	275.0	46475	53	82	123
AUM414120-60	41.0	41.0	20.0	28.0	13.0	193.0	260.0	50180	44	68	102
AUM414125-60	41.0	41.0	25.0	28.0	13.0	193.0	325.0	62725	55	85	127
AUM414130-60	41.0	41.0	30.0	28.0	13.0	193.0	390.0	75270	66	102	152

EQ core







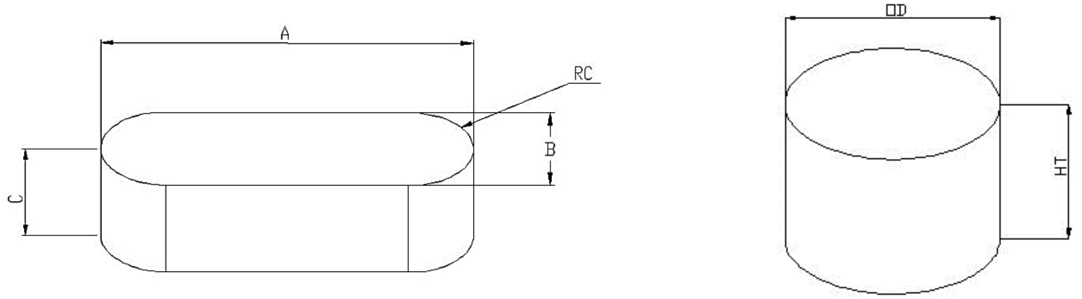
Core dimensions

P/N	Core Dimension (mm) ± 0.3mm					
	A	B	C	D	E	F
AEQ2619	26.5	19.0	10.1	12.0	22.6	6.8
AEQ3222	32.0	22.0	10.3	13.5	27.6	6.6
AEQ3626	36.0	26.0	17.4	14.4	32.0	15.4

Magnetic specification

P/N	Path Length L_m (mm)	Cross Section Area A_C (mm^2)	Volume (mm^3)	A_L ±10% (nH)	
				40μ	60μ
AEQ2619	54.7	119.8	6553.1	110	165
AEQ3222	60.3	152.3	9183.7	127	190
AEQ3626	94.7	180.8	17121.8	96	144

Round block / Cylinder core



Core dimensions

P/N	Core Dimension (mm)			
	A ± 0.2	B± 0.2	C± 0.3	RC± 0.2
ARB8331	82.8	31.1	12.1	15.55
ARB10035	100.5	35.0	28.0	17.5

Core dimensions

P/N	Core Dimension (mm) ± 0.3mm	
	OD± 0.2	HT± 0.3
AC31	31.1	35.3
AC35	35.0	25.5

Magnetic specification

P/N	Path Length Lm (mm)	Cross Section Area Ac (mm2)	AL ± 10% (nH)		
			26µ	40µ	60µ
ARBC8331	179.6	759.3	138.0	212.3	318.5
ARBC10035	312.9	971.1	101.4	156.0	234.0