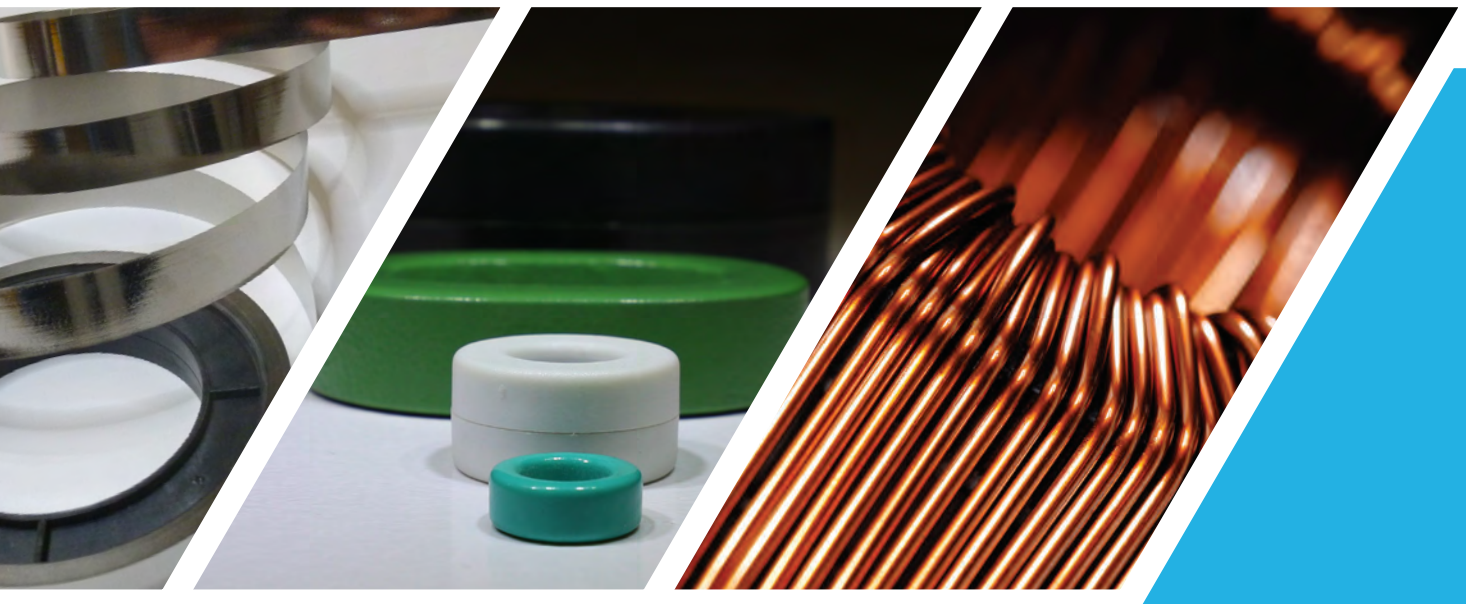
acal bfi

Acal BFi kOr

Amorphous and Nanocrystalline soft magnetic cores



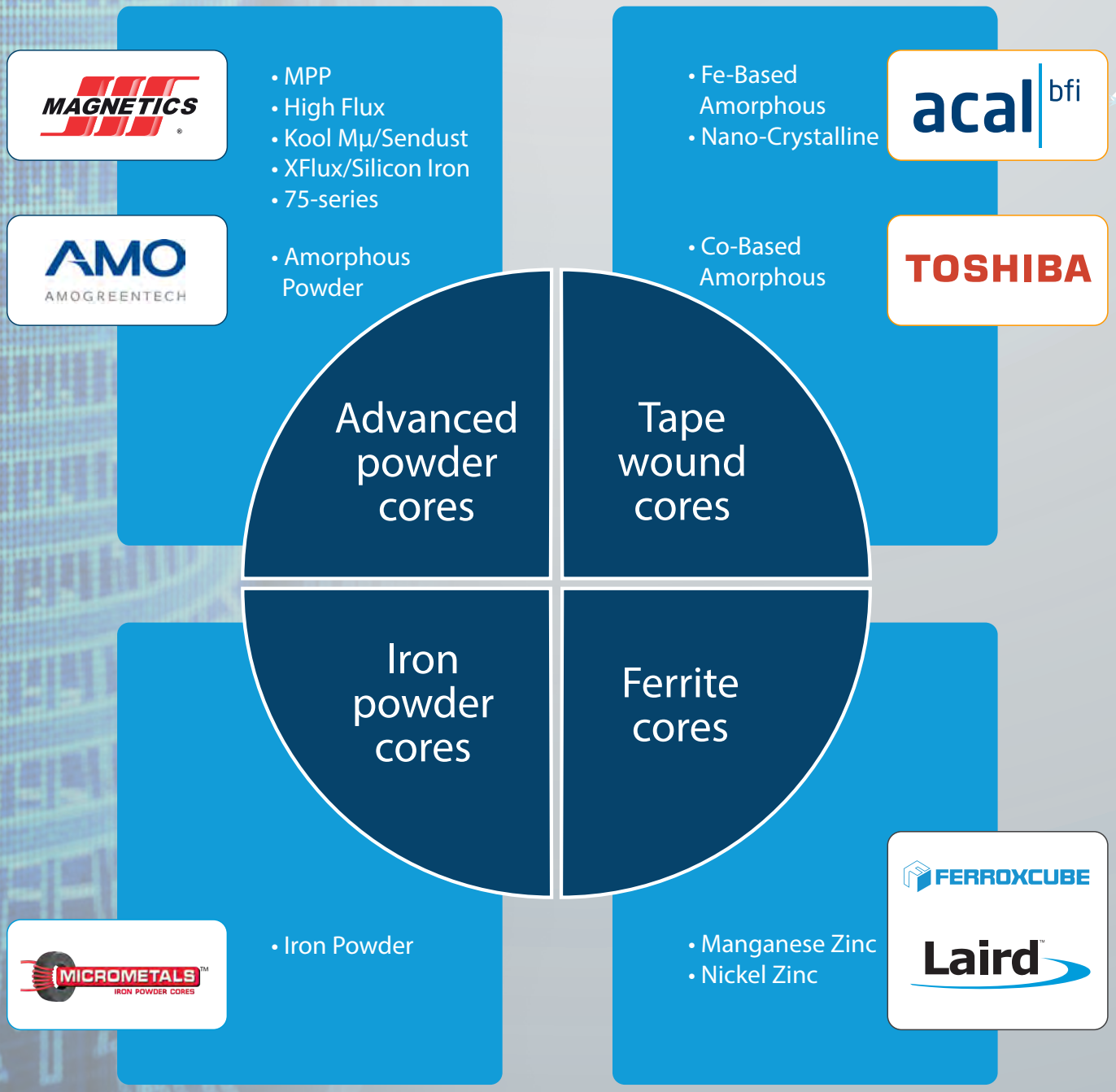
consult. design. integrate.

Introducing Acal BFi

More than just advanced technology solutions

Acal BFi are more than a distributor. We are a group of technical specialists who use leading-edge technology to create custom solutions for your designs and applications, supporting hundreds of customers across Europe.

Our engineers are subject-matter specialists who combine their technology expertise with sector experience to find the right solution for your situation and application.



Whether you take this brochure for inspiration, are evaluating our offer or only just discovering us for the first time, this is just a sample of how we can help you succeed.

The most important thing for us is to find or create the right solution for your requirements. So, when you are ready, simply contact any of our offices across Europe, and we will be happy to help you with your next challenge.

Design and consultancy

From concept to production, we design, test and manufacture soft magnetic cores to meet your specific applications exact requirements. Put simply, we offer a specialist range of products and services to help you bring better products to market faster

Technical support

Our engineers offer a complete service built on specialist knowledge and expertise, to act as expert extensions of your in-house teams. Our experience, technical expertise, flexible approach and rapid response let you concentrate on fulfilling your customer's brief with confidence.

Products and solutions

Our close relationship with raw material manufacturers and core manufacturers enable us to help you select, source, customise, stock and integrate Amorphous and Nanocrystalline soft magnetic cores for your application.

Consistant high-quality core materials

Product management for kOr Amorphous and Nanocrystalline products is executed by our Acal BFi Custom Services for Magnetic Components team. Using our long-term expertise in designing, testing, manufacturing and integrating Amorphous and Nanocrystalline cores, we provide customers with maximum product quality and fit.

We are committed to providing consistent and high-quality cores through a reliable materials base, stable production processes and rigorous testing from our in-house engineering team and using modern test equipment for impedance analysis, high-current/ high-voltage testing, power loss and climate-chamber measurement.

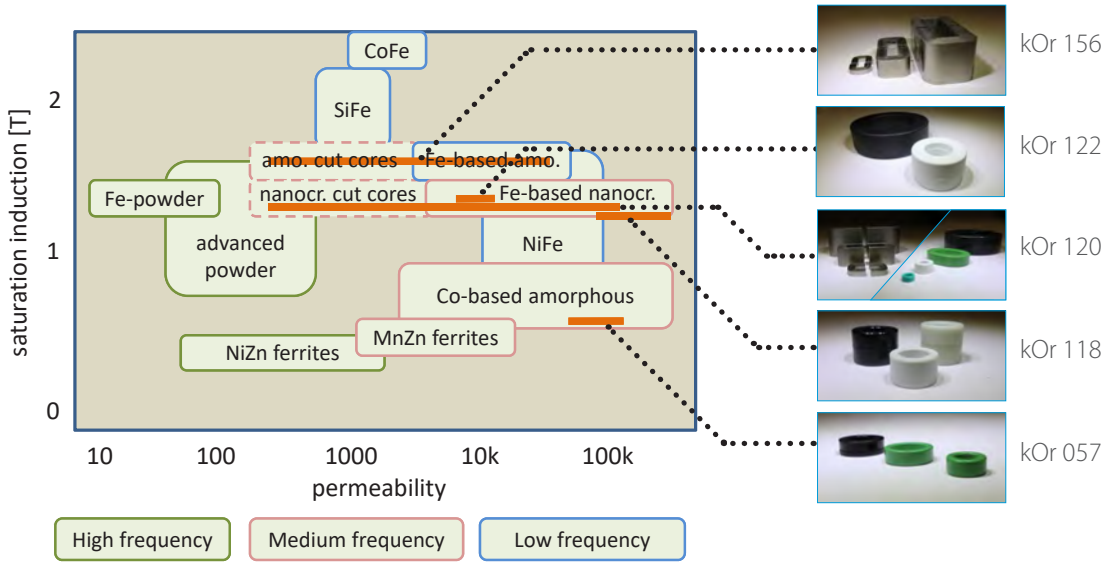
We exclusively source our tape material from world-leading suppliers including Hitachi Metals, VACUUMSCHMELZE®, Metglas®, and AT&M, to determine core quality and reproducibility, following our strategy to provide competitively priced, high-quality products.

Acal BFi kOr
– consistent, high-quality soft magnetic materials

Acal BFi are a specialist provider of amorphous and nanocrystalline cores through our kOr brand. Acal BFi kOr – like our entire Acal BFi offer – focuses on customised solutions to provide an exceptionally broad range of options.

However, where there are de-facto standard products established in the market, we offer a standard product series to meet these requirements.

Materials



Materials base / reference materials

		materials base	B_s [T]	λ_s [ppm]	tape thickness [µm]*	reference materials		
						Hitachi Metals / Metglas	VAC	AT&M
	kOr 057	Co-based amorphous	0.57	<0.5	ca. 20	2714A	VC 6025	-
	kOr 118	Fe-base nanocrystalline	1.18	<1	ca. 22	-	VP800/850	1K107
	kOr 120	Fe-base nanocrystalline	1.20	<1	17-20	FT-3	VP500/800	1K107B
	kOr 122	Fe-base nanocrystalline	1.22	2-4	ca. 20	-	VP250	-
	kOr 156	Fe-base amorphous	1.56	27	ca. 23	2605SA1	-	1K101

* mean width, measured by weight and density; geometrical width is about 15% higher

kOr 057 (Co-based Amorphous)

Specification for soft magnetic material - kOr 057

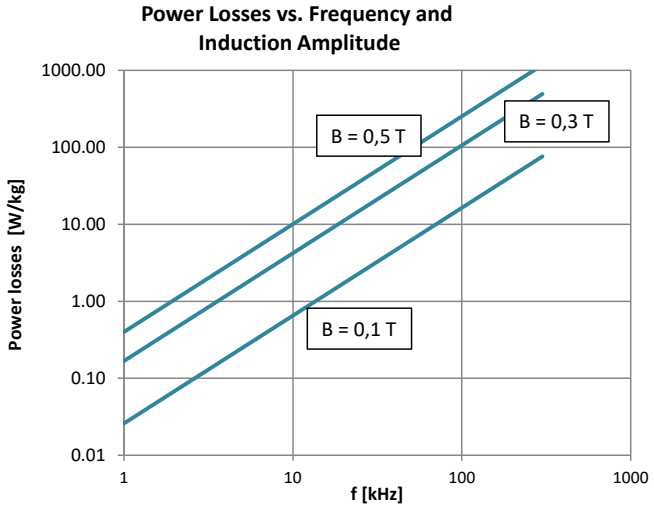
kOr 057

kOr 057 is a Co-based amorphous material with superior soft magnetic properties like small coercivity and zero magnetostriction. B(H) characteristics can be tailored: With linear F-loop, kOr 057 reach permeabilities of 100.000 – 200.000. These cores are perfect for communication applications like signal transformers. With rectangular Z-loop, they are mainly used in switching applications like MagAmps, when low losses are required or low saturation induction of 570 mT and hence small flux swing provide advantages.

Nominal data:

	Symbol	Unit		Conditions	
Initial permeability	μ_i		100.000 - 200.000 N/A	for F-loop for Z-loop	25°C
Saturation flux density	B_{sat}	mT	570 480	H > 3000 mA/cm H > 3000 mA/cm	25°C 100°C
Curie temperature	T_c	°C	225		
Resistance		µΩm	1.4		
Density	d	g / cm³	7.6		
Saturation magnetostriction	λ_S	ppm	<0.3		
Chemical composition		at%	$\sim Co_{80}Mo_2(Si,B)_{18}$		
Tape thickness	d	µm	18		
Tape width	b	mm	5-20		
Filling factor (stacking factor)	FF	%	>80		
Recommended max. storage and operational temperature		°C	85		

Cores with rectangular hysteresis loop (Z-loop), for MagAmp application or similar



	Symbol	Unit		Conditions
Coercivity	H_c	mA/ cm	3	25°C, static, 500 mA/cm

Notes:

Typical losses are given for toroidal cores in plastic housing, excited with sinusoidal voltage of an amplitude corresponding to the indicated peak induction.

kOr 118 (Fe-based Nanocrystalline)

Specification for soft magnetic material - kOr 118

kOr 118

kOr 118 is a nanocrystalline material specifically optimised for very high permeability at low frequencies (50 Hz). This material has been developed especially for RCCB applications, and can also be used for CTs or CMCs where no DC parts (as common mode current in case of CMCs) are present. For RCCB, highest linearity can be achieved, for example B_{dyn}/B_{sin} > 0,85 at μ_{max} = 150.000 and >0,80 at μ_{max} = 200.000. kOr 118 cores show good linearity and remanence even at highest permeabilities, where a F-loop is still achievable. Cores are packed in plastic cases; Epoxy coating is possible with minor influence on linearity for μ_{max} up to 150.000.

Nominal data:

	Symbol	Unit		Conditions	
Initial permeability	μ_i μ_{max}		80.000 - 150.000 100.000 - 250.000	50 Hz, adjustable	
Saturation flux density	B_{sat}	mT	1180 1080	H > 1000 mA/cm H > 1000 mA/cm	25°C 100°C
Remanence	B_r	mT	60 100	μmax = 100.000, static μmax = 200.000, static	
Curie temperature	T_c	°C	600		
Resistance		μΩm	1.15		
Density	d	g / cm^3	7.3	annealed	
Saturation magnetostriction	λ_S	ppm	<1	annealed	
Chemical composition		at%	$Fe_{73,5}Cu_1Nb_3Si_{15,5}B_7$		
Tape thickness	d	μm	25		
Tape width	b	mm	3-50		
Filling factor (stacking factor)	FF	%	>80 >76	b ≤ 25 mm b > 25 mm	
Recommended max. storage and operational temperature		°C	120		

kOr 120 (Fe-based Nanocrystalline)

Specification for soft magnetic material - kOr 120

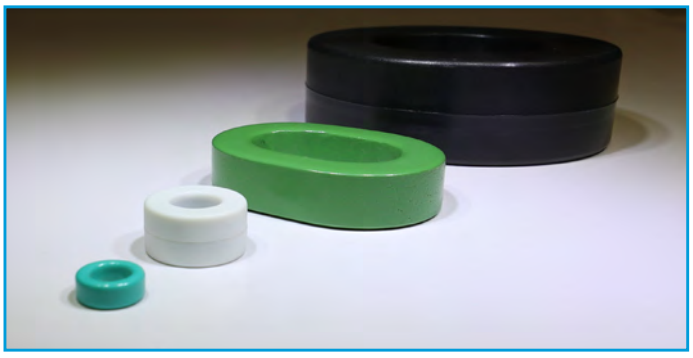
kOr 120

kOr 120 products are made of an iron-based nanocrystalline material optimised for power and EMI applications, they have high saturation flux density, low losses, high permeability up to 100kHz and low magnetostriction. Different B(H) characteristics are available.

With flat hysteresis loop (F-loop), low remnant flux B_r and adjustable permeability between 25.000 and 120.000 (at 10kHz), they are the preferred choice for mid-frequency power applications and common mode chokes with wideband attenuation. Our standard 120-TB-series (page 8) includes selected core sizes in plastic cases with a lower limit of specified A_L-range between 25.000 and 80.000 (10 kHz). With the option of a broader variety of customised magnetic characteristics, shapes and finishings (see below).

For example:

- For flat hysteresis loop, higher permeabilities with μ_i up to 200.000 are available even for Epoxy coated cores
- Rectangular hysteresis characteristics (Z-loop) for switching applications like MagAmps
- Rectangular or toroid shaped cut cores with effective permeabilities of typically 2500



Nominal data:

	Symbol	Unit		Conditions	
Initial permeability (uncoated)	μ_i		20.000-100.000	adjustable	25°C
Saturation flux density	B_{sat}	mT	1200 1100	H > 1000 mA/cm H > 1000 mA/cm	25°C 100°C
Remanence	B_r	mT	50 150	μ = 30.000, 50 Hz μ = 100.000, 50 Hz	
Curie temperature	T_c	°C	600		
Resistance		μΩm	1,15		
Density	d	g / cm³	7,35		
Saturation magnetostriction	λ_S	ppm	<1		
Chemical composition		at%	$Fe_{73,5}Cu_1Nb_3Si_{15,5}B_7$		
Tape thickness	d	μm	20		
Tape width	b	mm	3-50		
Filling factor (stacking factor)	FF	%	>80 >76	b ≤ 25 mm b ≤ 25 mm	

Special grades with higher permeability at 100 kHz?

With our kOr 120 material we are able to offer permeabilities of 30.000 at 100 kHz as standard, not part of a special grade. Lower limit will be specified accordingly to be 25.000.

Premium quality for nanocrystalline cut cores

We also offer premium quality options with typical effective permeability of 10.000, minimum 6.000.

kOr 120 (Fe-based Nanocrystalline)

Standard core sizes

120-TB-Series: toroids of kOr 120 material in a plastic case, adjustable permeability

	Nominal geometrical data of the bare core						Nominal geometrical data in plastic case		
	OD [mm]	ID [mm]	H [mm]	A_{Fe} [mm²]	l_{Fe} [mm]	wt [g]	OD [mm]	ID [mm]	H [mm]
120-TB-100705-	10	6,5	4,5	6,3	25,9	1,2	11,2	5,1	5,8
120-TB-120805-	12	8	4,5	7,2	31,4	1,7	14,1	6,6	6,3
120-TB-161006-	16	10	6	14,4	40,8	4,3	17,8	8,6	8,0
120-TB-201208-	20	12	8	25,6	50,3	9,5	22,5	10,0	10,1
120-TB-252010-	25	20	10	20	70,7	10,4	27,9	17,1	13,2
120-TB-261610-	26	16	10	40	66,0	19,4	27,8	14,0	12,5
120-TB-322010-	32	20	10	48	81,7	28,8	34,3	17,9	13,0
120-TB-322015-	32	20	15	72	81,7	43	34,5	17,7	18,5
120-TB-403215-	40	32	15	48	113,1	40	43,1	28,7	18,5
120-TB-402515-	40	25	15	90	102,1	68	43,1	22,5	18,5
120-TB-462720-	46	27	20	152	114,7	128	49,0	24,0	22,8
120-TB-504020-	50	40	20	80	141,4	83	53,5	36,3	23,4
120-TB-655025-	65	50	25	143	180,6	189	68,0	46,3	28,6
120-TB-805020-	80	50	20	240	204,2	360	83,5	46,3	24,5
120-TB-906020-	90	60	20	240	235,6	416	95,4	56,1	24,7
120-TB-1027625-	102	76	25	260	279,6	534	108,0	70,0	30,3
120-TB-1008020-	100	80	20	160	282,7	333	104,0	76,0	25,0
120-TB-13010030-	130	100	30	342	361,3	908	135,0	95,0	35,0

	Magnetic data for lowest perm. (part no: 120-TB-xxxxxx-**25**-)			Magnetic data for highest perm. (part no: 120-TB-xxxxxx-**80**-)		
	min A_L [µH]	max A_L [µH]	max I_{Bias} [mA]	min A_L [µH]	max A_L [µH]	max I_{Bias} [mA]
120-TB-100705-	7,6	13,2	424	24,4	54,5	103
120-TB-120805-	7,2	12,5	519	23,0	51,4	126
120-TB-161006-	11,1	19,2	658	35,4	79,1	160
120-TB-201208-	16,0	27,7	798	51,2	114,2	194
120-TB-252010-	8,9	15,4	1262	28,4	63,5	306
120-TB-261610-	19,0	33,0	1057	61,0	136,0	257
120-TB-322010-	18,5	32,0	1316	59,1	131,8	320
120-TB-322015-	27,7	48,0	1316	88,6	197,7	320
120-TB-403215-	13,3	23,1	2019	42,7	95,2	490
120-TB-402515-	27,7	48,0	1645	88,6	197,7	400
120-TB-462720-	41,6	72,2	1805	133,3	297,3	438
120-TB-504020-	17,8	30,8	2523	56,9	126,9	613
120-TB-655025-	24,8	43,0	3169	79,3	176,9	770
120-TB-805020-	36,9	64,0	3291	118,2	263,6	799
120-TB-906020-	32,0	55,5	3894	102,4	228,4	946
120-TB-1027625-	29,2	50,6	4839	93,5	208,5	1175
120-TB-1008020-	17,8	30,8	5047	56,9	126,9	1225
120-TB-13010030-	29,7	51,5	6339	95,2	212,3	1539

Remarks

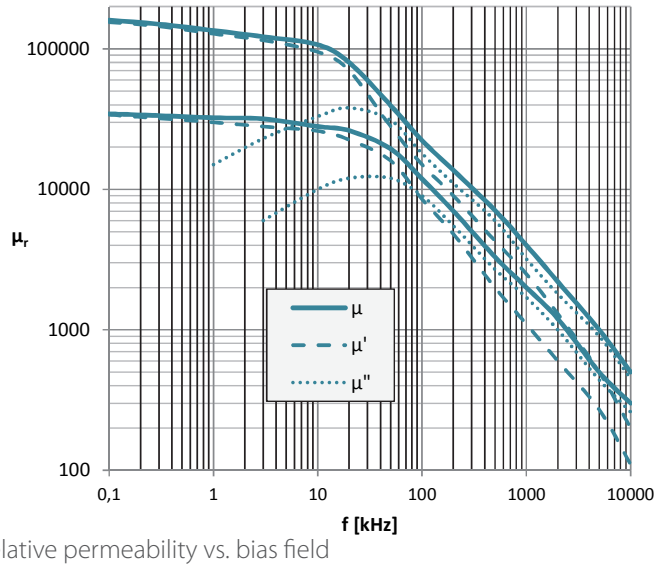
A_L is given for 10kHz, 100mV. permeability level of kOr 120 material is adjustable and is indicated by the fourth block of the part number: eg 30 means the lowest permeability of tolerance range for this core is 30.000. However, 25 and 80 are the lowest and highest available permeability levels respectively as standard. Any level (in steps of 5) is possible, but 30, 50 and 70 are preferred.

The value max I_{Bias} is an indicator (no specification) for the current (based on one wire turn) where the core saturates and A_L drops significantly.

kOr 120 (Fe-based Nanocrystalline)

Material bahaviour curves

Complex permeability vs. frequency

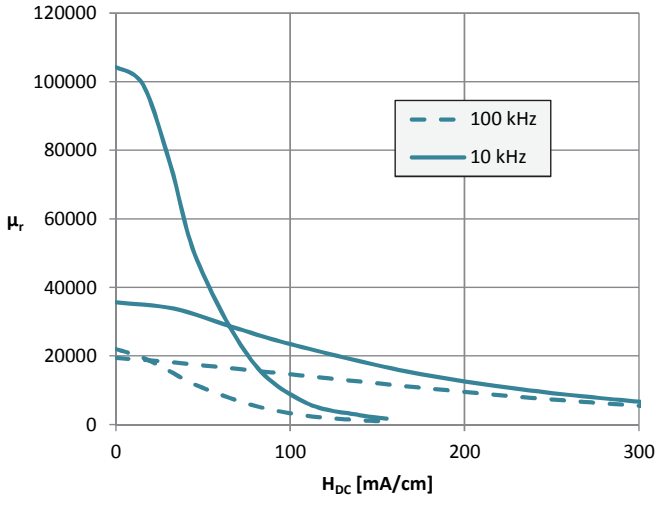


Notes:

N = 1, U_{eff} = 100mV

Typical curves are given for cores with nominal permeability (10kHz) of 30.000 and 100.000. Other permeabilities can be approximated using this data.

Relative permeability vs. bias field

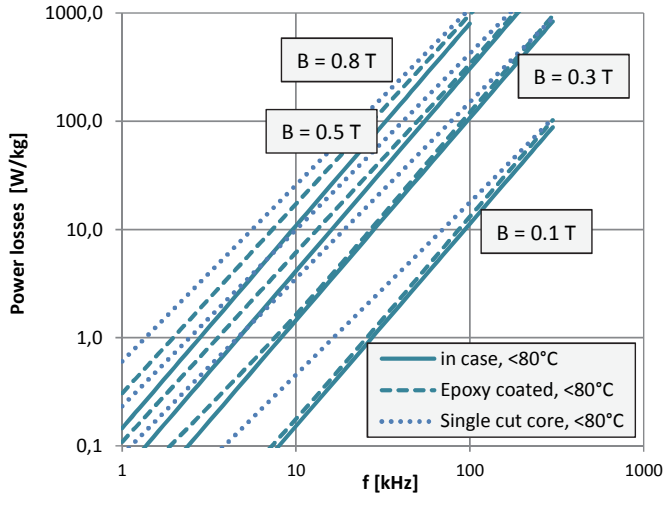


Notes:

N = 1, U_{eff} = 100mV
$I_{DC} = H_{DC} \cdot l_{Fe}$

Typical curves are given for cores with nominal permeability (10kHz) of 30.000 and 100.000. Other permeabilities can be approximated using this data.

Power losses vs. frequency and induction



Notes:

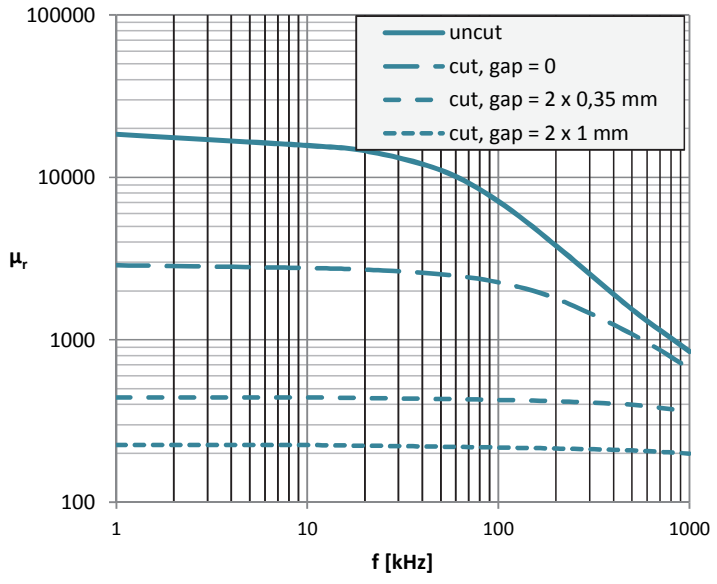
Losses don't depend on permeability level.

Excitation with sinusoidal voltage of an amplitude corresponding to the indicated peak induction. Losses of cores in plastic cases are nearly temperature independent, also at >80°C. Losses of coated cores converge towards those of cores in cases between 80 and 130°C. Power losses of impregnated cores might be higher than losses of coated cores, esp. <30 kHz. Additional losses occur when cutting impregnated cores.

kOr 120 (Fe-based Nanocrystalline)

Curves for standard cut cores (single cut)

Effective permeability vs. frequency



Notes:

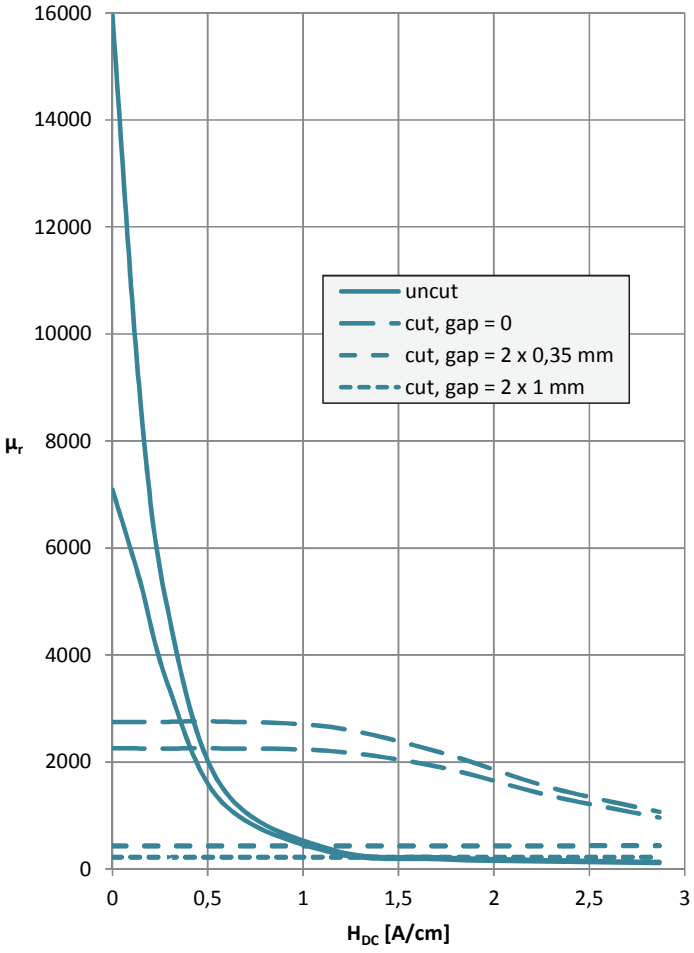
Typical curves are shown.

Cores are impregnated with epoxy

N = 1, U_{eff} = 100mV

Influence of the gap depends on the ratio of magnetic path length and gap width. The displayed example refers to a magnetic path length of 280mm.

Effective permeability vs. bias field



Notes:

Cores are impregnated with epoxy

N = 1, U_{eff} = 100mV
$I_{DC} = H_{DC} \cdot I_{Fe}$
Upper curves: 10kHz
Lower curves: 100kHz

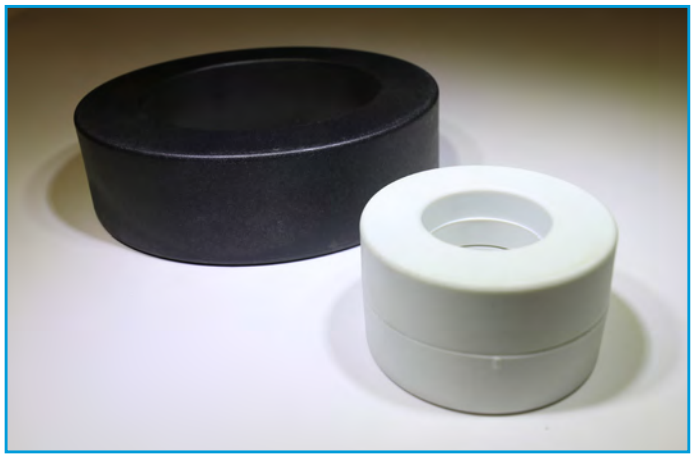
Influence of the gap depends on the ratio of magnetic path length and gap width. The displayed example refers to a magnetic path length of 280mm.

kOr 122 (Fe-based Nanocrystalline)

Specification for soft magnetic material - kOr 122

kOr 122

kOr 122 extends our nanocrystalline material cores range down to a low permeability of 5000. Cores are ideal for use in transformers and CMCs with medium non-balanced common mode current. Therefore, size is rather big, preferred dimensions are between 60 x 45 x 20 and 200 x 160 x 30 mm (net core size). They show high linearity $\mu(I_{DC})$ and frequency behavior $\mu(f)$, so permeability at 100 kHz is very close to 10-kHz value. These cores are offered in plastic case.



Nominal data:

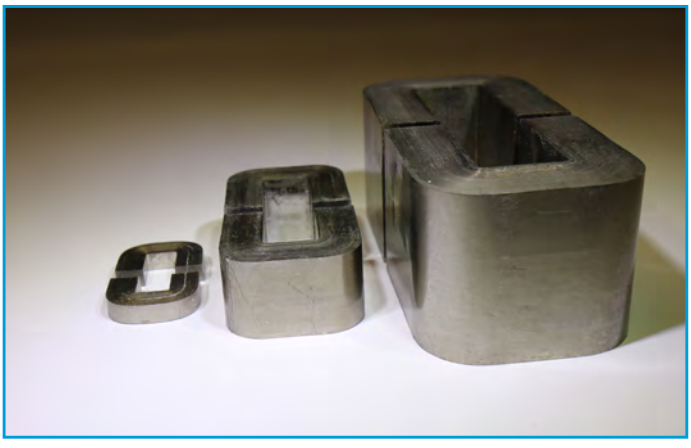
	Symbol	Unit		Conditions	
Initial permeability	μ_i		5.000 - 18.000	10 kHz, adjustable	
Saturation flux density	B_{sat}	mT	1220 1120	H > 1000 mA/cm H > 1000 mA/cm	25°C 100°C
Remanence	B_r	mT	40	Static	
Curie temperature	T_c	°C	600		
Resistance		µΩm	1.15		
Density	d	g / cm³	7.4	annealed	
Saturation magnetostriction	λ_S	ppm	2-4	annealed	
Tape thickness	d	µm	20		
Tape width	b	mm	3-50		
Filling factor (stacking factor)	FF	%	>80 >76	b ≤ 25 mm b > 25 mm	

kOr 156 (Fe-based Amorphous)

Specification for soft magnetic material - kOr 156

kOr 156

kOr 156 products are made of an iron-based Amorphous material which has been developed as a contemporary replacement for electrical steel. Thanks to its small tape thickness and high-saturation induction, it is possible to reduce losses as well as weight and dimensions, especially in low-frequency applications. This makes components highly efficient in both purchasing and operational costs. We offer standard cut cores and a broad variety of customised shapes and finishings.



Nominal data:

	Symbol	Unit		Conditions	
Initial permeability	μ_i		3000-15 000 1500-5000	in protection case Impregnated	25°C 25°C
Saturation flux density	B_{sat}	mT	1560 1470	H > 3000 mA/cm H > 3000 mA/cm	25°C 100°C
Curie temperature	T_c	°C	400		
Resistance		µΩm	1,3		
Density	d	g / cm^3	7,18		
Saturation magnetostriction	λ_s	ppm	27		
Chemical composition		at%		~$Fe_{80}Si_7B_{13}$	
Tape thickness	d	µm	25		
Tape width	b	mm	5-130		
Filling factor (stacking factor)	FF	%	>85 >80	b ≤ 25 mm b ≤ 25 mm	

kOr 156(Fe-based Amorphous)

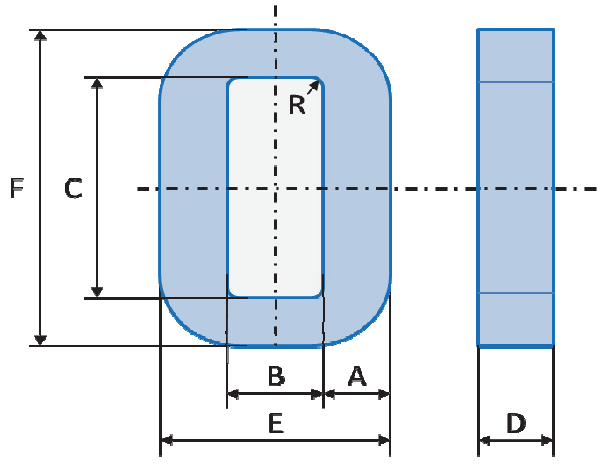
Standard core sizes

156-RI-Series: rectangular impregnated cores of kOr 156 material, with optional cuts

	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	A_{Fe} [mm²]	l_{Fe} [mm]	wt [g]
156-RI-0001-	6,5	7,1	14,5	25	20,1	28,2	138	64	64
156-RI-0004-	9	10,5	33	15	28,5	50,4	115	115	97
156-RI-0008-	11	13,5	31	20	35,5	52,6	187	124	169
156-RI-0010-	11	13,5	41	20	35,5	62,6	187	144	197
156-RI-016A-	11	13,5	41	25	35,5	62,6	234	144	246
156-RI-016B-	11	13	51	25	35,5	72,5	234	163	278
156-RI-0020-	11	13,5	51	30	35,5	72,6	281	164	336
156-RI-0025-	13	15,5	57	25	41,5	82,8	276	186	376
156-RI-0032-	13	15,5	57	30	41,5	82,8	332	186	451
156-RI-0040-	13	15,5	57	35	41,5	82,8	387	186	526
156-RI-0050-	16	20,5	71	25	52,5	103,4	340	233	581
156-RI-0063-	16	20,5	71	30	52,5	103,4	408	233	697
156-RI-0080-	16	20,5	71	40	52,5	103,4	544	233	929
156-RI-0100-	16	20,5	71	45	52,5	103,4	576	233	984
156-RI-0125-	19	25,5	84	35	63,5	122,7	565	279	1154
156-RI-0160-	19	25,5	84	40	63,5	122,7	646	279	1318
156-RI-0200-	19	25,5	84	50	63,5	122,7	760	279	1551
156-RI-0250-	19	25,5	91	60	63,5	129,7	912	293	1955
156-RI-0320-	22	35,5	86	50	79,5	131	880	312	2012
156-RI-0400-	22	35,5	86	65	79,5	131	1144	312	2615
156-RI-0500-	25	40,5	86	55	90,5	135,8	1100	332	2671
156-RI-0630-	25	40,5	86	70	90,5	135,8	1400	332	3399
156-RI-800A-	25	40,5	86	85	90,5	135,8	1700	332	4128
156-RI-800B-	30	40,5	96	85	100,5	156,3	2040	367	5487
156-RI-1000-	33	40,5	106	85	106,5	172,6	479	397	6519

Remarks

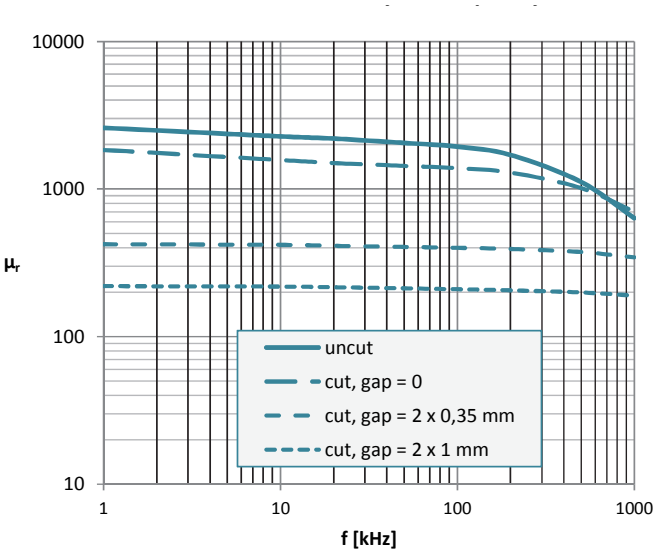
- Nominal dimensions are given for impregnated cores without reinforcement with tape
- When cut, actual window and total length are reduced by trend.
- Number of cuts is indicated as the fourth block of the part number, eg 1C.
- The weight includes 2% epoxy.



kOr 156 (Fe-based Amorphous)

Material behaviour curves

Complex pemeability vs. Frequency



Notes:

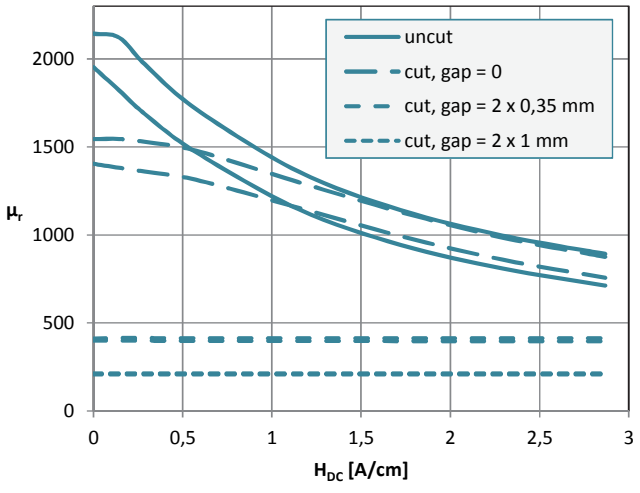
Typical curves are shown.

Cores are impregnated with Epoxy

N = 1, U_{eff} = 100mV

Influence of gap depends on the ratio of magnetic path length and gap width. Displayed example refers to magnetic path length of 280 mm.

Relative pemeability vs. Bias field



Notes:

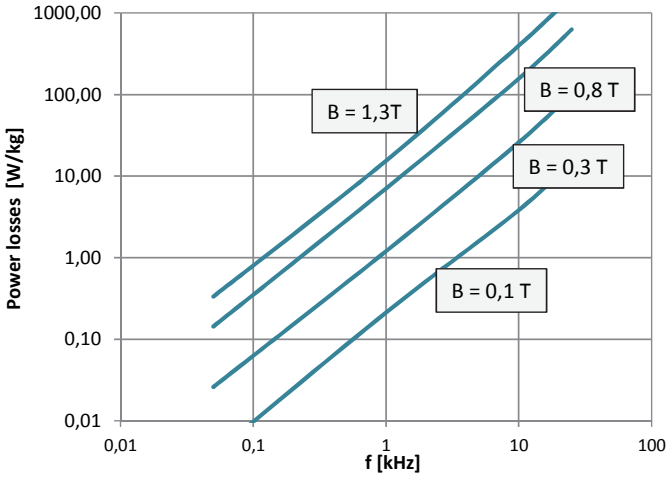
Cores are impregnated with epoxy

N = 1, U_{eff} = 100mV
$I_{DC} = H_{DC} \cdot l_{Fe}$

upper curves: 10 kHz
lower curves: 100 kHz

Influence of gap depends on the ratio of magnetic path length and gap width. Displayed example refers to magnetic path length of 280 mm.

Power losses vs. Frequency and induction amplitude



Notes:

Typical losses are given for uncut cores without impregnation or coating, excited with sinusoidal voltage of an amplitude corresponding to the indicated peak induction.

Losses increase under mechanical stress, e.g. coating, impregnation, and wire winding without sufficient protection.

Additional losses occur when cutting and introducing gaps.

Options & part numbering

Options for shapes, cuts and sizes

We offer toroids, E-, U- and I-cores in standard types (toroids for kOr 120, rectangular cores or U-core sets for kOr 156) as well as in customised sizes. The number and position of cuts can be adapted to the application. For development purposes, uncut cores or different variants are available to enable developers to optimise their design.

Several different terminologies are used globally to define the dimensions and geometrical tolerances of cores or core pieces. We offer sizes according to all relevant standards.

In most cases, nominal dimensions are given for bare cores, not including the finishing.

Options for finishings

Depending on shape and size of the core, as well as the application requirements (UL classes, mechanical and thermal conditions), we can provide different finishings (standard temperature classes in brackets):

- Plastic core boxes in different materials/shapes and optional winding spacers, cores are fixed by silicone (min. E: 120°C)
- Epoxy coating (min. B: 130°C)
- Impregnation with resin (F: 155°C)
- Enforcement with fibre tape and impregnation (F: 155°C)

All materials and components are conformal with UL, RoHS and REACH regulations. Further information about these materials is provided in our data sheets.

Part numbering system

120	**T B**	**25 20 10**	**70**	**1**
Specific material	Shape and finish	Size/dimensions	Cuts/permeability	Variant of core
Indicates the saturation induction e.g. 120 means B_s = 1.20 T for a certain Fe-Nanocrystalline material	**Shape (1st letter):** T = toroid R = rectangular O = oval E = E-core U = U-core I = I-core (bar) **Finish (2nd letter):** B = plastic boxing E = epoxy coating P = parylene coating I = epoxy impregnated T = tape reinforced and impregnated G = impregnated and gapped	**Toroids:** OD ID H (outer diam, inner diam, height) or **Rectangular cores:** common size descriptions (Asian or European standard series) or **Dimensions**	**For cut-cores:** number of cuts, e.g. 2C for 2 cuts **For non-cut cores:** material's minimum permeability level (μ_{min} @ 50/60 Hz or 10 kHz) in 1000, e.g. 70 for 70,000 **For rectangular hysteresis loop:** Z	A one-digit number to indicate different types of cores with the same shape, size and material, for example to indicate different coatings or positions of cuts

Examples:

120-TB-252010-70-1	Nanocrystalline toroid in plastic boxing with OD = 25mm, ID = 20mm, H = 10mm and μ_{min} = 70,000
156-RI-0125-1C-1	Amorphous rectangular impregnated core with 1 cut equivalent to AMCC-0125

Lead times

If **in stock** we deliver quickly from our logistics hub near Frankfurt (Main), Germany within **2 days**. If not stocked:

Production time: Samples = 5 - 10 working days
Volume = 15 working days for toroids, 25 working days for special shapes and cut cores

Transport time: <100 kg = 1 – 2 weeks by air freight, >100 kg = 7 weeks by sea freight

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