

# EMI 対策用フェライトコア

EMI Suppression Ferrite Core



MAGPROST QUALITY



株式会社 マグプロスト

電子機器の高性能化と共に、外部からのノイズ及び機器自身からのノイズへの対策も必須となりました。K,L 系列材質はそれぞれ 10MHz ~ 30MHz の端子ノイズ対策と 30MHz ~ 50MHz の不要輻射対策に適用しております。本カタログでは様々なアプリケーション用途に各種形状のコアをラインアップしており、最適な材質と形状をご提案致します。

### FERRITE CORES

In recent years, electronic equipment has made phenomenal advances with regard to performance. Although much more sophisticated than before, electronic equipment has also become more susceptible to EMI (electromagnetic interference) problems. Thus growing attention is being directed to noise interference caused by external equipment and by various components inside the same equipment.

In response, JSF is developing special ferrite materials suitable for noise suppression, and is supplying a wide variety of EMI ferrite cores that feature original ferrite materials. JSF produces series of EMI ferrite cores, the Material-K and Material-L series. These series are designed to control terminal noise ranging from 10 MHz to 30MHz in frequency and suited for the control of unnecessary radiation noise from 30MHz up to 500MHz. These cores come in a wide variety of shapes to match the customers' needs.

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### 材質特性 CHARACTERISTICS OF EMI FERRITE CORES

材 質 名			K32	L51	K14	K26
初透磁率 Initial permeability	$\mu_{iac}$	—	700	350	100	40
飽和磁束密度 Saturation magnetic flux density	Bs	mT	300	340	360	350
残留磁束密度 Residual magnetic flux density	Br	mT	160	260	230	100
保磁力 Coercivity	Hc	A/m	30	40	320	750
相対損失係数 Relative loss factor	$\tan \delta / \mu$	$\times 10^{-5}$	1.7	1.5	5.5	15
		MHz	0.4	0.5	6	10
温度係数 Temperature coefficient	$\alpha \mu r$	$\times 10^{-6}$	7	20	10	10~20
キュリー温度 Curie temperature	Tc	°C	>160	>200	>300	>300
抵抗率 Resistivity	$\rho$	$\Omega \cdot m$	$10^6$	$10^6$	$10^6$	$10^6$
密度 Density	d	$\times 10^3 kg/m^3$	5.0	5.0	4.9	4.9

※上述値は室温20°C±5°Cの条件下の環状コアの基準特性です。

(FR25φ / 15φ / 5φ)

Above figures show the standard characteristics of toroidal cores at a room temperature of 20°C±5°C

#### 材料の選定

$\mu'$  のグラフ水平線値が低いほど、抵抗率|Z|のピーク値が高周波域に伸びる傾向が高く、データ伝送で不要輻射のノイズ対策の応用として、一般的に使用されているのは広い周波数範囲で衰減する特性を持つK32材( $\mu' = 700$ )ですが、高周波に適用するのはL51材 ( $\mu' = 350$ ) またはK14材( $\mu' = 100$ )です。

It is known that the lower the  $\mu'$  value of a core material, the higher the frequency at which the core impedance |Z| reaches a peak. Accordingly, K32 core materials (of  $\mu' = 700$ ) are generally used to reduce data line radiation noise, because K32 has a stable noise attenuation effect over a wide frequency range. But to suppress higher-frequency noise, L51 ( $\mu' = 350$ ) or K14 ( $\mu' = 100$ ) materials are employed.

## 材質特性 CHARACTERISTICS OF EMI FERRITE CORES

### 抵抗と材料パラメータの関係

コアの抵抗 $Z=R+jX$ の式の中、抵抗成分 $R$ は材料 $\mu''$  と比例し、電気抵抗 $X(=\omega L)$ と材料パラメータと比例します。

例：材料 $\mu'$ 、 $\mu''$  - f 曲線から分かるように高周波域で $\mu'$  成分は抵抗に対して大きな影響を与えています。  
コアの抵抗 $|Z|$ と材質パラメータ $\mu'$ 、 $\mu''$  により決められる材質抵抗 $|z|$ の関係は以下のようになります。

The impedance of a ferrite core is arrived at by the equation  $Z=R+jX$ . In this equation, the core's resistance  $R$  varies in proportion to the material constant  $\mu''$  of the core material. The core's reactance  $X \approx \omega L$  varies in proportion to the material constant  $\mu'$  of the same core material. Therefore, as is evident from the  $\mu'$  and  $\mu''$  curves shown on the next page, the  $\mu''$  value is more influential than the  $\mu'$  value in the determination of the impedance level in the high-frequency range. The core's impedance value  $|Z|$  is different from the core material's impedance value  $|z|$ . The material impedance is determined by  $\mu'$ ,  $\mu''$ . These two values have the following relation:

$$|Z| = \frac{Ae}{Le} N^2 |z|$$

$ Z $ :	コアのインピーダンス Core impedance
$Ae$ :	コアの平均断面積 Average cross-section area
$Le$ :	コアの平均磁路長 Average magnetic path length
$N$ :	巻数 Number of turns
$ z $ :	材質のインピーダンス Material impedance

即ち、材料 $|z|$ と $Ae/Le$ (及びコイル巻数の平方値)の相乗で任意の形状の抵抗値を算出できます。

リングコアの形状係数は以下の算式で計算できます:

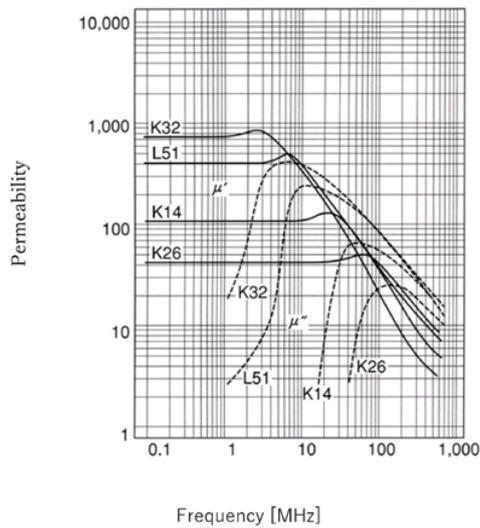
The above equation indicates that the impedance of a core to be produced can be estimated from the impedance of the core material, by deciding  $Ae, Le$  and  $N$ . In the case of a ring core, for example, the shape factor  $Ae/Le$  can be derived by the following equation to estimate the ring core's impedance:

$$\frac{Ae}{Le} = \frac{C}{2\pi} \log_e \frac{A}{B}$$

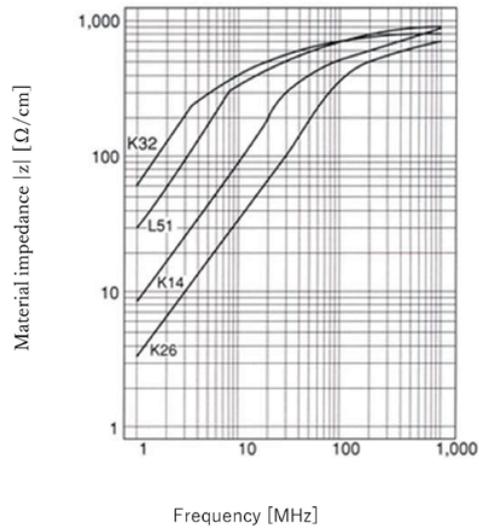
$A$ :	外径 Outer diameter
$B$ :	内径 Inner diameter
$C$ :	高さ Height

## 材質特性 CHARACTERISTICS OF EMI FERRITE CORES

$\mu'$  と  $\mu''$  の周波数特性 [  $\hat{\mu} = \mu' - j\mu''$  ]  
 Characteristics of  $\mu'$  and  $\mu''$  by frequency



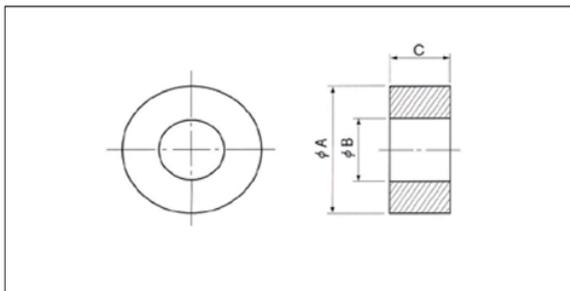
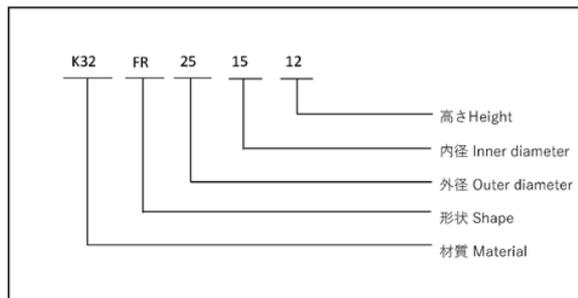
インピーダンスの周波数特性  
 Impedance characteristic frequency



- ※ 前述ように、左図の|z|の値[Ω/cm]と形状係数 $A_e/L_e$ [cm]の乗算により、K、L材質系列コアの1ターン毎に対するインピーダンス|Z|を求めることが可能です。
- ※ Supposing that the number of turns(N)is 1,the impedance|Z| of a Material-K or Material-L core be obtained by multiplying the value of the <material impedance> |z|[Ω/cm] shown in the graph by the value of the shape factor  $A_e/L_e$ [cm].

$\mu'$ 、 $\mu''$

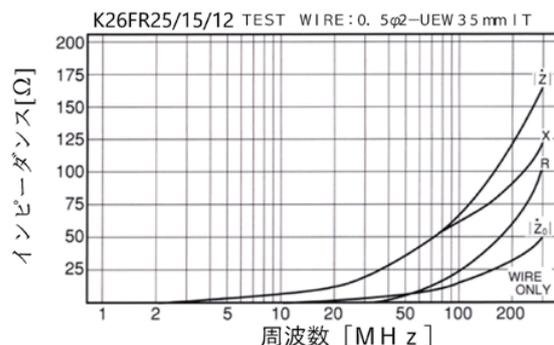
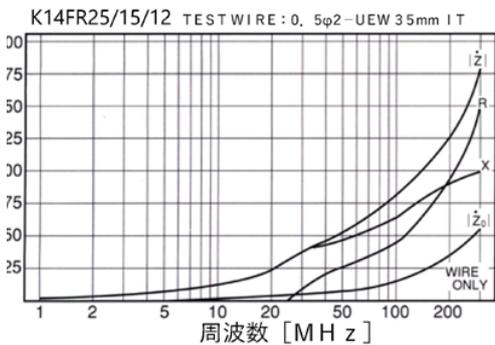
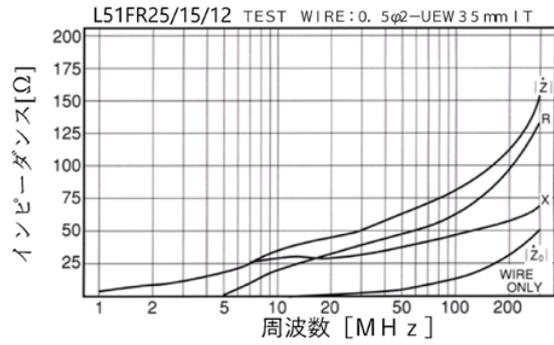
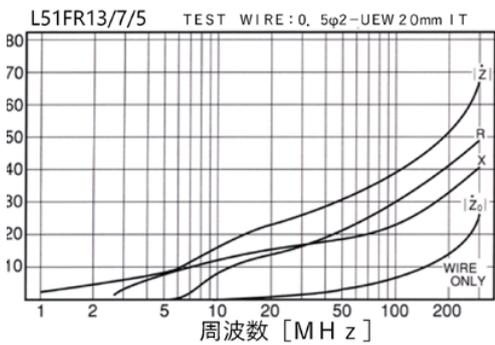
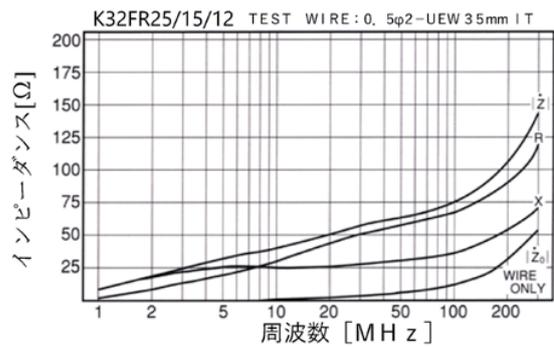
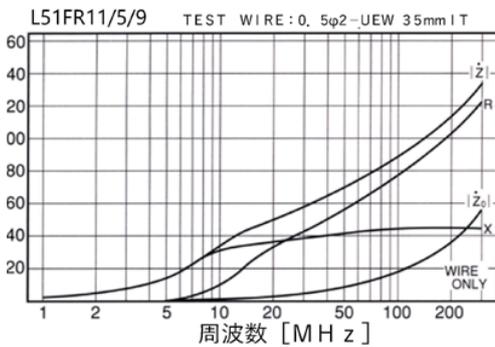
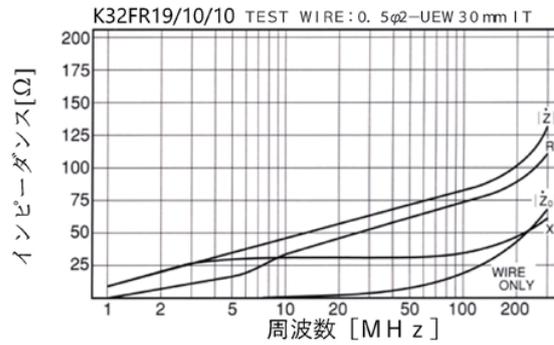
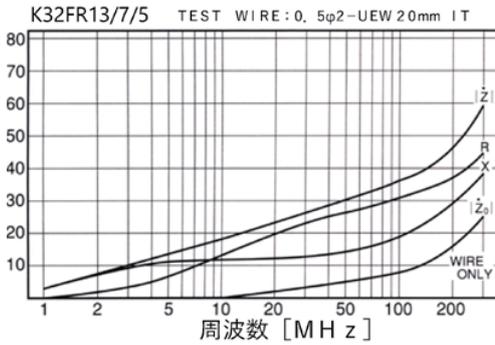
### リングコア RING CORES



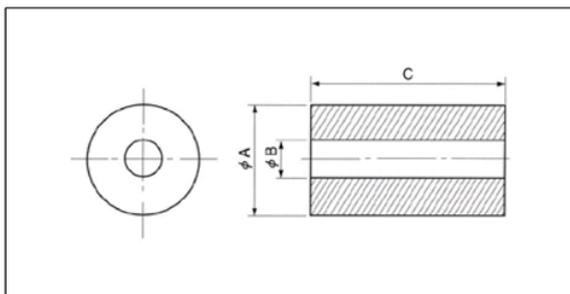
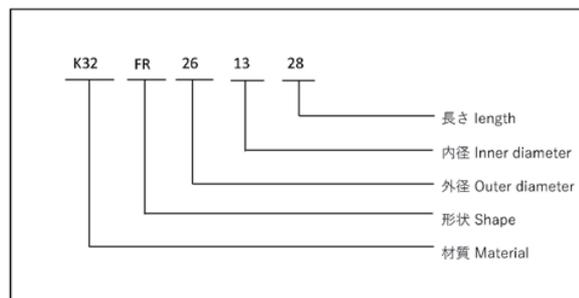
形状番号	外径A	内径B	高さC	適用材質	
FR5.1/4.1/5	5.1±0.15	4.1±0.15	5.0±0.2	K32	
FR6.9/5.5/5	6.9±0.15	5.5±0.15	5.0±0.2		
FR7.6/3.6/4.3	7.6-0.05/-0.4	3.6-0.05/-0.4	4.3±0.2		
FR7.8/4.1/4	7.8±0.3	4.1±0.2	4.0±0.2		
FR9/5.3/8	9.0±0.2	5.3±0.15	8.0±0.2		
FR10.5/7/5	10.5±0.2	7.0±0.2	5.5±0.3		
FR11/5/9	11.0±0.3	5.0±0.2	9.0±0.3		
FR13/7/5	13.0±0.4	7.0±0.3	5.0±0.3		L51
FR13/7/6	13.0±0.4	7.0±0.3	6.3±0.3		
FR16/10/7	16.0±0.5	10.0±0.4	7.0±0.3		K14
FR16/10/10	16.0±0.5	10.0±0.4	10.0±0.4		
FR16.5/8/13	16.5±0.5	8.0±0.3	13.0±0.4		K26
FR16.5/8/16	16.5±0.4	8.0±0.3	16.0±0.5		
FR19/10/10	19.0±0.5	10.0±0.4	9.9±0.3		
FR25/15/12	25±0.5	15.0±0.5	12.0±0.3		
FR28/16/13	28.0±0.5	16.0±0.5	13.0±0.4		
FR28/16/20	28.0±0.5	16.0±0.5	20.0±0.6		
FR40/27/15	40.55±0.7	27.4±0.5	15.0±0.4		

## インピーダンスの周波数特性 (巻線 1 ターン)

L 材質



### スリーブコア SLEEVE CORES



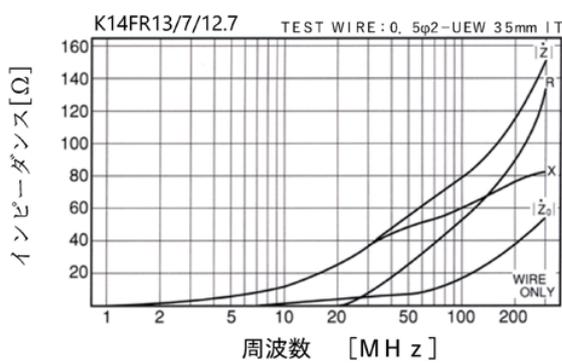
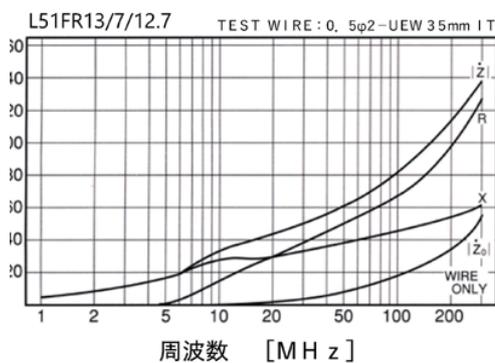
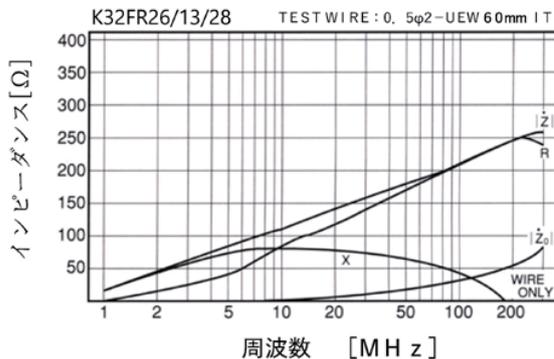
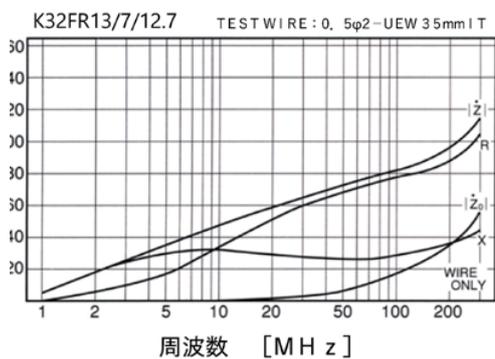
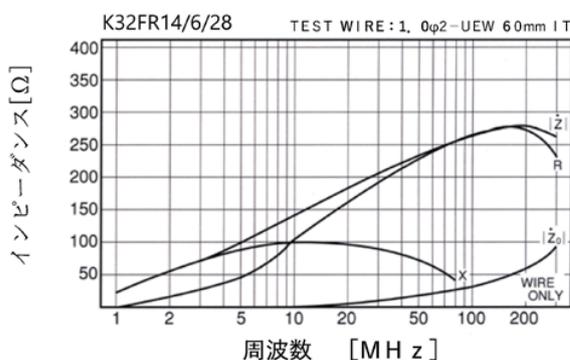
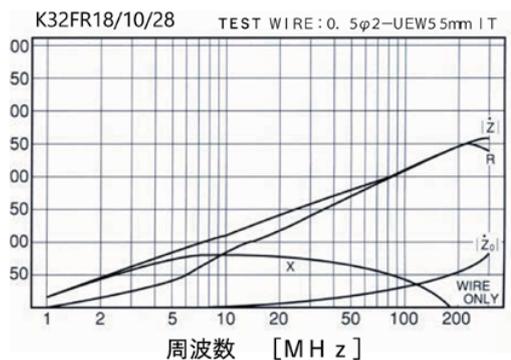
形状番号	外径A	内径B	長さC	適用材質	
FR4.2/3.2/5	4.2±0.1	3.2±0.1	5.0±0.2	K32	
FR4.5/1.6/5	4.5±0.2	1.6±0.2	5.0±0.3		
FR6.8/3.7/14	6.8±0.3	3.7±0.2	14.3±0.3		
FR11/5/18.5	11.0±0.3	5.0±0.2	18.5±0.3		
FR11/5/20	11.0±0.3	5.0±0.2	20.0±0.3		
FR11/5/25	11.0±0.3	5.0±0.2	25.0±0.4		
FR12/8.5/15A	12.0±0.3	8.5±0.3	15.0±0.3		L51
FR12/8.5/16	12.0±0.3	8.5±0.3	16.0±0.3		K14
FR13/7/12.7	13.0±0.5	7.1±0.4	12.7±0.5		
FR14/6/18	14.3±0.4	6.35±0.25	18.0±0.5		K26
FR14/6/28	14.3±0.4	6.35±0.25	28.6±0.5		
FR14/7/28A	14.3±0.5	7.3±0.4	28.6±0.7		
FR16.5/8/28	16.5±0.4	8.0±0.3	27.9+0/-1		
FR16.5/8/28	16.5±0.4	8.0±0.3	28.0±0.6		
FR18/10/28	17.5±0.5	9.5±0.3	28.5±0.5		
FR26/13/28	26.0±0.5	13.0±0.3	28.5±0.5		

# EMI 対策用フェライトコア

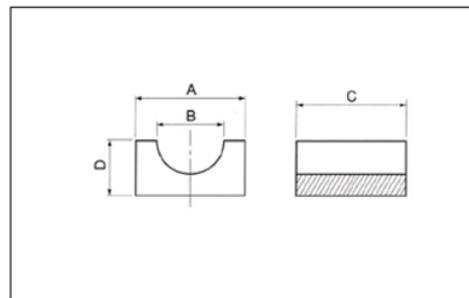
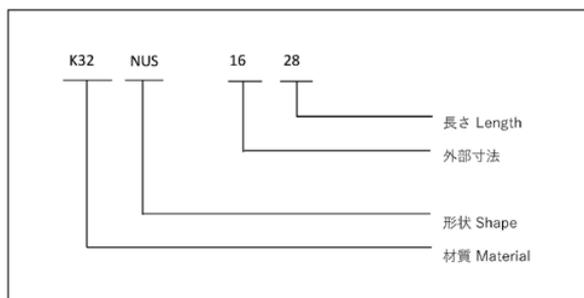
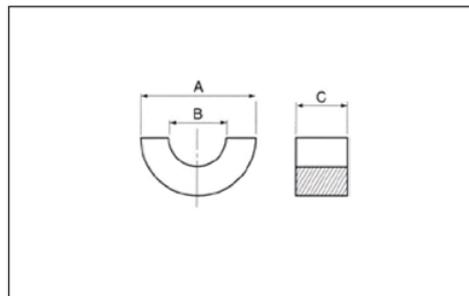
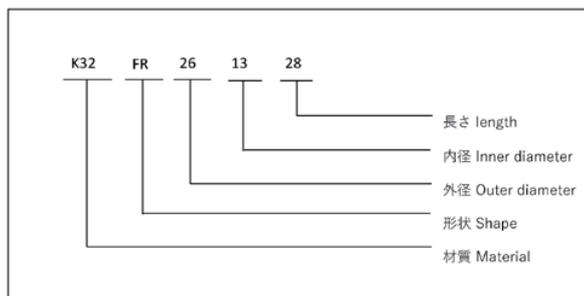
EMI Suppression Ferrite Core



## インピーダンスの周波数特性 (巻線 1 ターン)

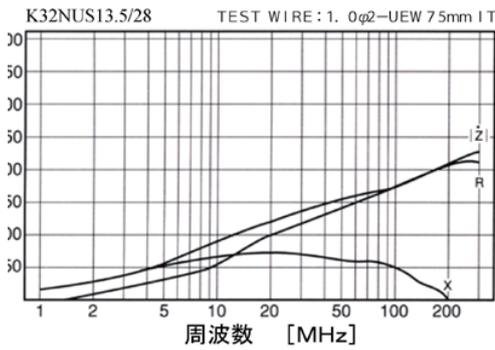
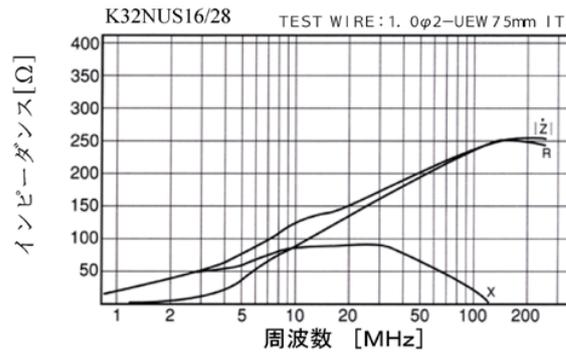
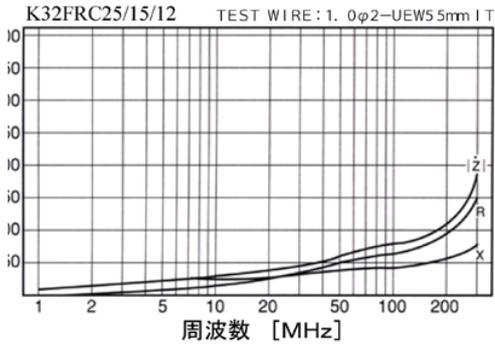


### 丸ケーブル用分割コア DIVIDED CORES FOR ROUND CABLES

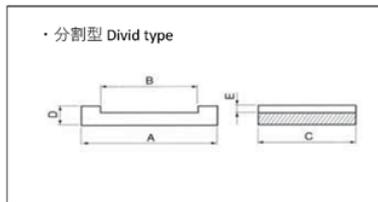
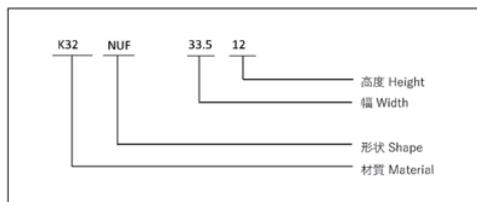
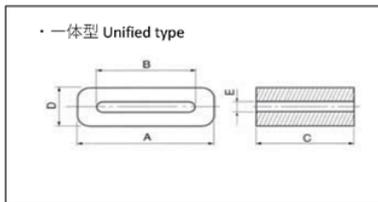
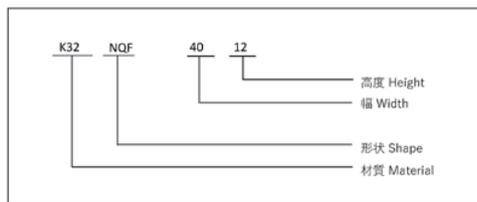


形状番号	A	B	C	D	適用材質
FRC23/11/14	23.8±0.5	11.4±0.4	14.0±0.4	/	K32
FRC25/15/12	25.0±0.4	15.0±0.4	12.0±0.3	/	
FRC28/16/13	28.5±0.4	16.3±0.4	13.0±0.3	/	
FRC28/16/20	28.5±0.4	16.3±0.4	20.0±0.5	/	
FRC40/27/15	40.5±0.7	27.4±0.5	15.0±0.4	/	
NUS10/10	10.0±0.3	5.2±0.2	10.0±0.2	5.0+0.3/-0	
NUS10/20	10.0±0.3	5.2+0.4/-0	20+0.3/-0.2	5.0+0.3/-0	
NUS11/21	11.0±0.15	5.8±0.1	21.0±0.4	5.5±0.1	
NUS13.5/28	13.5+0.4/-0.2	6.5±0.3	28.0±0.7	6.75±0.25	
NUS16/28	16.0+0.4/-0.3	9.0±0.4	28.0±0.7	8.0±0.25	
NUS16/28B	16.0±0.4	9.0±0.2	28.0±0.5	8.0±0.25	L45
NUS25/28	25.0±0.4	7.0±0.2	28.0±0.5	12.5±0.3	

### インピーダンスの周波数特性 (巻線 1 ターン)

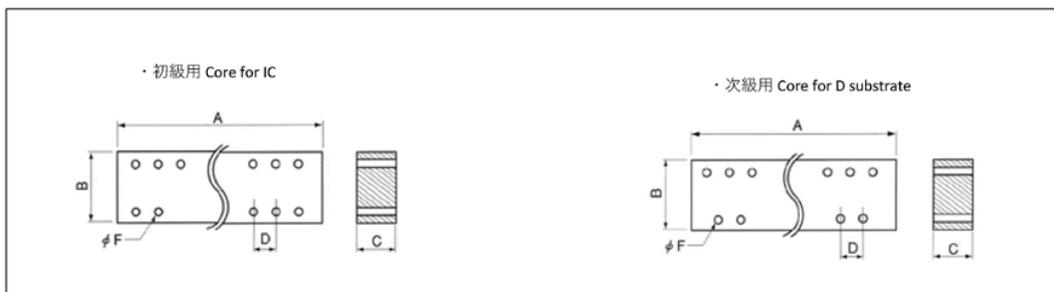
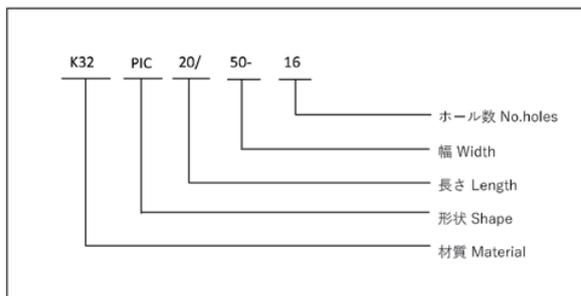


### フラットケーブル用コア CORES FOR FLAT CABLES



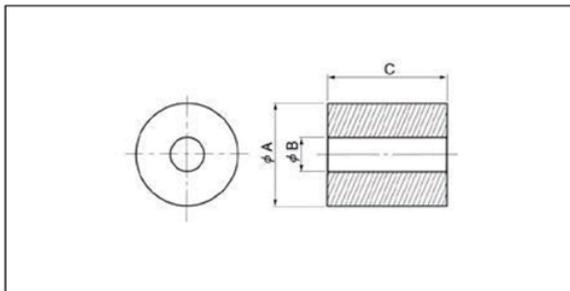
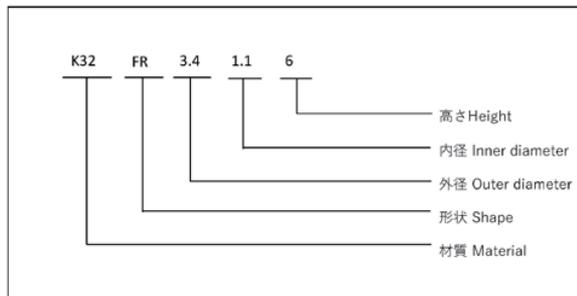
形状番号	A	B	C	D	E	適用材質
NQF11/3	11.0±0.2	9.0±0.2	3.0±0.2	2.3±0.15	0.7+0.1/-0.25	K32
NQF11/8	11.0±0.2	9.0±0.2	8.0±0.2	2.3±0.15	0.7+0.1/-0.25	
NQF16/3	15.5±0.3	12.0±0.3	3.0±0.2	2.3±0.15	0.7+0.1/-0.2	
NQF16/8	15.5±0.3	12.0±0.3	8.0±0.2	2.3±0.15	0.7+0.1/-0.2	
NQF18/3	18.0±0.3	14.5±0.3	3.0±0.2	2.3±0.15	0.7+0.1/-0.25	
NQF18/6	18.0±0.3	14.5±0.3	6.0±0.2	2.3±0.15	0.7+0.1/-0.25	
NQF18/8	18.0±0.3	14.5±0.3	8.0±0.2	2.3±0.15	0.7+0.1/-0.25	
NQF22/8	21.5±0.4	18.0±0.3	8.0±0.2	2.3±0.15	0.7+0.1/-0.2	
NQF25/10	25.0±0.7	21+0.7/-0.4	10.0±0.5	3.0±0.5	0.8+0.2/-0.3	
NQF25/10G	25.0±0.7	21.0±0.7	10.0±0.5	3.0±0.5	0.8+0.2/-0.3	
NQF25/12	24.5±0.7	20.0±0.7	12.0±0.5	5.0±0.4	0.5+0.6/-0	
NQF25/12G	24.5±0.7	20.0±0.7	12.0±0.5	5.0±0.4	0.5+0.6/-0	
NQF25/15	25.0±0.7	21.0±0.7	15.0±0.5	3.0±0.5	0.8+0.2/-0.3	
NQF25/20	24.5±0.7	20.0±0.7	20.0±0.5	5.0±0.4	0.5+0.6/-0	
NQF33.5/7.4/10	33.5±0.5	27+0.7/-0.4	10.0±0.3	7.4±0.3	2.2±0.2	K32/L45A
NQF33.5/8	33.5±0.7	27+0.7/-0.4	8.0±0.3	6.5±0.3	1.3+0.3/-0.1	
NQF33.5/10	33.5±0.7	27+0.7/-0.4	10.0±0.3	6.5±0.3	1.3+0.3/-0.1	K32
NQF33.5/10G	33.5±0.7	27+0.7/-0.4	10.0±0.3	6.5±0.3	1.4+0.2/-0.3	
NQF33.5/12	33.5±0.7	27+0.7/-0.4	12.0±0.3	6.5±0.3	1.3+0.3/-0.1	K32/L45A
NQF33.5/12A	33.5±0.4	28.4±0.4	12.0±0.3	6.5±0.3	1.4±0.2	
NQF33.5/12G	33.5±0.7	27+0.7/-0.4	12.0±0.3	6.5±0.3	1.4+0.2/-0.3	K32
NQF33.5/20	33.5±0.7	27+0.7/-0.4	20.0±0.4	6.5±0.4	1.3+0.3/-0.1	K32/L45A
NQF39/8	39.0±0.5	33.0±0.5	8.0±0.3	3.6+0.3/-0.5	1.2±0.4	
NQF40/10	40.0±0.7	34.8±0.7	10.0±0.3	6.5±0.4	1.3+0.3/-0.1	K32/L45A
NQF40/12	40.0±0.7	34.8±0.7	12.0±0.4	6.5±0.4	1.3+0.3/-0.1	
NQF40/12G	40.0±0.7	34.8±0.7	12.0±0.4	6.5±0.4	1.4+0.2/-0.3	K32
NQF45/8	45.2±0.7	40.0±0.7	8.0±0.4	6.5±0.4	1.3+0.3/-0.1	K32/L45A
NQF45/12	45.2±0.7	40.0±0.7	12.0±0.4	6.5±0.4	1.3+0.3/-0.1	
NQF50/12	49.6±0.7	44.0±0.7	12.0±0.3	6.5±0.4	1.3+0.3/-0.1	K32
NQF57.6/12	57.6±0.7	52.0±0.7	12.0±0.3	6.5±0.4	1.3+0.3/-0.1	
NQF58/12G	57.6±0.7	52.0±0.7	12.0±0.3	6.5±0.4	1.4+0.2/-0.3	K32
NQF58/12SH	57.6±0.7	52.0±0.7	12.0±0.3	5.0±0.2	1.3+0.3/-0.1	
NUF6.8/5	6.8±0.4	4.6±0.3	5.0±0.3	1.5±0.15	0.45+0.3/-0	K32/L45A
NUF10/6	10.0±0.3	6.8±0.3	6+0/-0.5	2.5+0/-0.3	0.9+0.3/-0	
NUF10/10	10.0±0.3	6.8±0.3	10+0/-0.5	2.5+0/-0.3	0.9+0.3/-0	K32
NUF23/8U	23.0±0.3	19+0.4/-0	8.0±0.2	2.8±0.2	1.10±0.2	
NUF23/8I	18.5±0.3	/	8.0±0.2	1.2±0.2	/	K32
NUF25/12U	25.0±0.3	21+0.4/-0	12.0±0.2	2.8±0.2	1.10±0.2	
NUF25/12I	20.5±0.3	/	12.0±0.2	1.2±0.2	/	K32/L45A
NUF31/12U	31.0±0.3	27+0.4/-0	12.0±0.2	2.8±0.2	1.10±0.2	
NUF31/12I	26.5±0.3	/	12.0±0.2	1.2±0.2	/	K32
NUF33.5/12	33.5±0.5	27±0.4	12.0±0.4	3.3+0.35/-0.15	0.60+0.4/-0	
NUF33.5/20	33.5±0.5	27±0.4	20.0±0.4	3.3+0.25/-0.15	0.60+0.4/-0	K32
NUF40/12	40.0±0.5	34.8±0.5	12.0±0.3	3.3+0.25/-0.15	0.60+0.4/-0	
NUF45/12	45.2±0.5	40.0±0.5	12.0±0.3	3.3+0.25/-0.15	0.60+0.4/-0	K32
NUF45/12G	45.2±0.5	40.0±0.5	12.0±0.4	3.3+0.35/-0.15	0.60+0.4/-0	

### マルチホール用コア MULTI-HOLE CORES



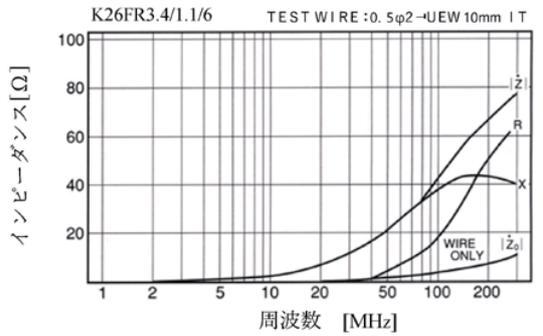
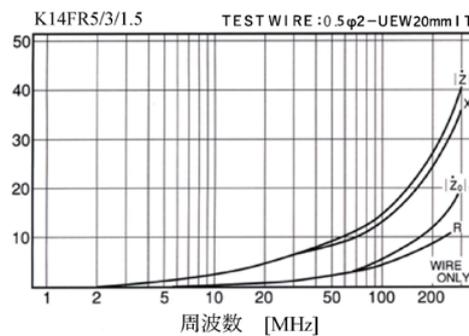
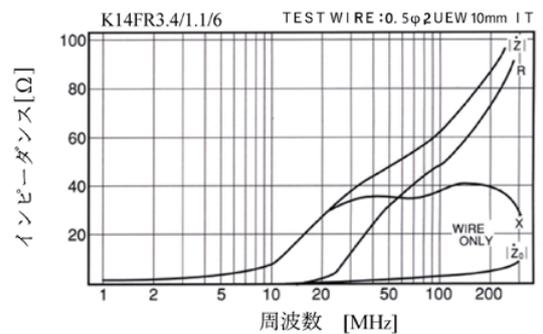
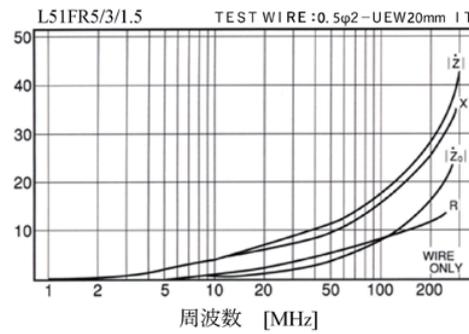
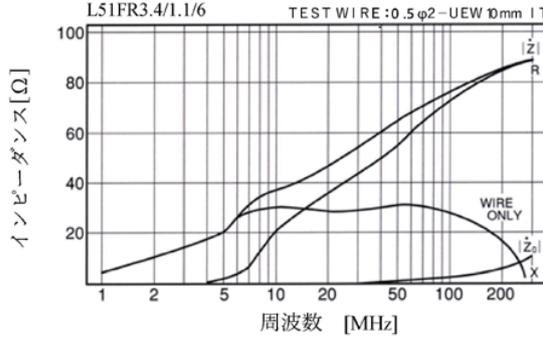
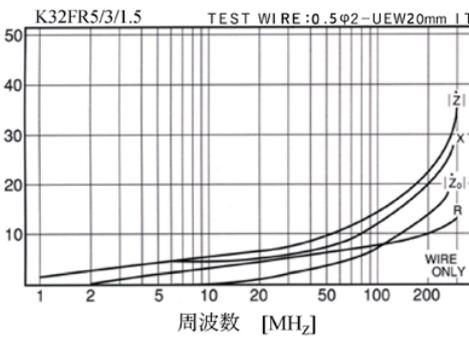
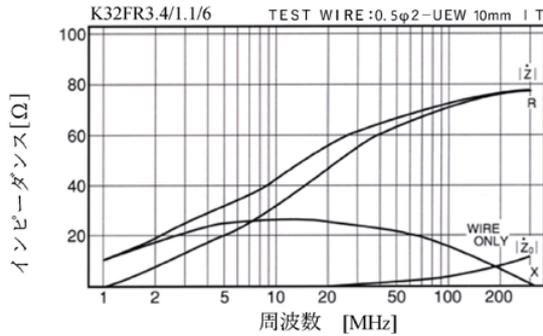
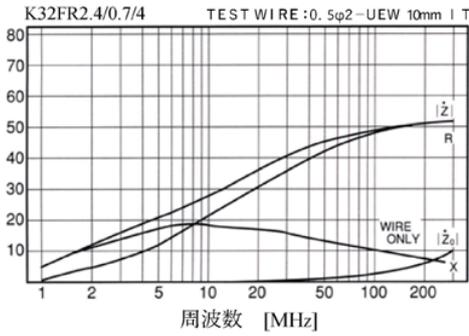
形状	A	B	C	D	φF	ホール数	適用材質	用途
PIC10/11.5-8	9.92±0.3	11.45±0.25	1.50±0.15	2.54±0.1	1.08±0.07	8	K32	初級用 ICs
PIC20/5-16	20.0±0.3	5.00±0.2	4.00±0.2	2.54±0.1	1.08±0.07	16		
PIC20/11.5-16	20.08±0.3	11.45±0.25	1.50±0.15	2.54±0.1	1.08±0.07	16		
PIC25/11.5-20	25.16±0.3	11.45±0.25	1.50±0.15	2.54±0.1	1.08±0.07	20		次級用 D substrate
PIC16/6-9	16.3±0.3	6.20±0.15	3.75±0.15	2.74±0.15	1.08±0.07	9		
PIC24/6-15	24.3±0.3	6.20±0.15	3.75±0.15	2.75±0.15	1.08±0.07	15		
PIC38/6-25	37.5±0.3	6.20±0.15	3.75±0.15	2.76±0.1	1.08±0.07	25		

### ビーズコア BEAD CORES

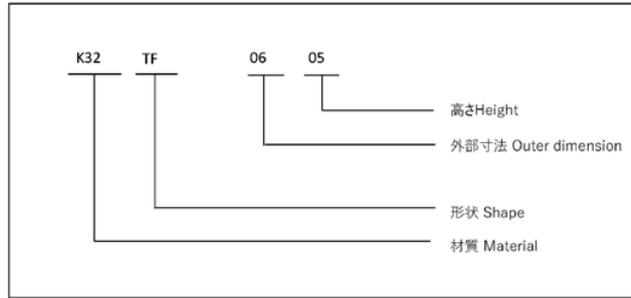


形状番号	外径A	内径B	高さC	適用材質
FR1.8/0.8/4	1.8±0.1	0.8±0.1	4.0±0.2	K32
FR2.4/0.76/4	2.4+0.05/-0.1	0.7+0.15/-0	4.0+0.3/-0.1	
FR3.4/0.8/4.4	3.4±0.2	0.8±0.2	4.4±0.3	
FR3.4/1.1/6	3.4±0.2	1.1±0.2	6.0±0.3	
FR3.5/1.3/3	3.5±0.2	1.3±0.2	3.0±0.3	
FR3.5/1.3/5	3.5±0.2	1.3±0.2	5.0±0.3	
FR4/2.7/3.5	4.0±0.1	2.7±0.1	3.5±0.2	
FR5/3/1.5	5.0±0.2	3.0±0.2	1.5±0.15	
FR6/3/2	6.0±0.3	3.0±0.2	2.0±0.15	

### インピーダンスの周波数特性 (巻線 1 ターン)



### バルンコア BALUN CORES



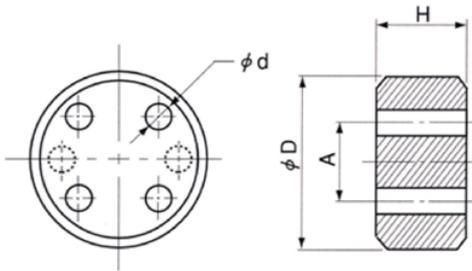
形状番号 Shape code	D	H	d	A	C	適用材質 Material used
TF0605	6.5 ± 0.3	5.5 ± 0.3	1.3 ± 0.2	2.5 ± 0.2	C0.5	K32, L51, K14, K26

形状番号 Shape code	D	H	D	A	b	E	適用材質 Material used
TF0706	6.8 ± 0.3	5.5 ± 0.2	1.5 ± 0.3	1.5 <sup>+0.3</sup> <sub>0</sub>	1.6 ± 0.2	6.4 ± 0.3	K32, L51, K14, K26

形状番号 Shape code	D	H	d	A	T	C1	C2	適用材質 Material used
TF04093	4.9 ± 0.3	3.0 ± 0.15	0.95 ± 0.15	2.5 ± 0.2	2.3 ± 0.1	—	—	K32 L51 K14 K26
TF05202	5.2 ± 0.3	2.0 ± 0.20	1.30 ± 0.20	2.5 ± 0.2	2.5 ± 0.2	—	—	
TF05204	5.2 ± 0.3	3.0 ± 0.15	1.20 ± 0.20	2.6 ± 0.3	3 ± 0.1	—	—	
TF05204	5.2 ± 0.3	1.0 ± 0.30	1.30 ± 0.20	2.5 ± 0.2	2.5 ± 0.2	—	—	
TF05302	5.2 ± 0.3	2.0 ± 0.20	1.30 ± 0.20	2.5	2.5 ± 0.3	—	—	
TF06505	6.5 ± 0.3	5.0 ± 0.30	1.00 ± 0.15	3.5 ± 0.2	3 ± 0.3	—	—	
TF06510	6.5 ± 0.3	10.0 ± 0.30	1.00 ± 0.15	3.5 ± 0.2	3 ± 0.3	—	—	
TF01204	12.0 ± 0.5	4.0 ± 0.30	3.70 ± 0.30	5.0 ± 0.3	6.5 ± 0.3	0.35	0.35	
TF01305	13.0 ± 0.5	5.0 ± 0.30	3.80 ± 0.30	5.7 ± 0.3	7.3 ± 0.3	0.5	—	
TF01506	15.0 ± 0.5	6.0 ± 0.50	5.00 ± 0.30	7.0 ± 0.3	8 ± 0.3	0.3	0.3	

## バルンコア BALUN CORES



形状番号	D	H	d	A	ホール	適用材質
TF0803	8.0±0.3	3.0±0.3	1.4±0.2	3.0±0.3	4	K32, L51
TF0805	8.0±0.3	5.0±0.3	1.4±0.2	3.0±0.3	4	
TF0610	6.0±0.2	10.0±0.4	1.0±0.2	2.5±0.2	6	K14, K26

## インピーダンスの周波数特性

