

## TOROIDAL CORES: FERRITE CORES

Ferrite Cores are available in numerous sizes and several permeabilities. Their permeability range is from 20 to more than 15,000. They are very useful for resonant circuit applications as well as wideband transformers and they are also commonly used for RFI attenuation. We can supply sizes from 0.23 inches to 2.4 inches in outer diameter directly from stock.

Ferrite toroidal cores are well suited for a variety of RF circuit applications and their relatively high permeability factors make them especially useful for high inductance values with a minimum number of turns, resulting in smaller component size.

There are two basic ferrite material groups: (1 ) Those having a permeability range from 20 to 800  $\mu$ i are of the Nickel Zinc class, and (2) those having permeabilities above 800  $\mu$ i are usually of the Manganese Zinc class.

The Nicker Zinc ferrite cores exhibit high volume resistivity, moderate temperature stability and high 'Q' factors for the 500 KHZ to 100 MHZ frequency range. They are well suited for low power, high inductance resonant circuits. Their low permeability factors make them useful for wide band transformer applications as well.

The Manganese Zinc ferrites, having permeabilities above 800  $\mu$ i, have fairly low volume resistivity and moderate saturation flux density. They can offer high 'Q' factors for the 1 KHz to 1 MHz frequency range. Cores from this group of materials are widely used for switched mode power conversion transformers operating in the 20 KHz to 100 KHz frequency range. These cores are also very useful for the attenuation of unwanted RF noise signals in the frequency range of 20 MHZ to 400 MHZ and above.

A list of Ferrite toroids, including physical dimensions,  $A_L$  values, and magnetic properties will be found on the next few pages. Use the given  $A_L$  value and the equation below to calculate a turn count for a specific inductance.

$$N = 1000 \sqrt{\frac{\text{desired 'L' (mh)}}{A_L \text{ (mh/1000 turns)}}} \quad L(\text{mh}) = \frac{A_L \times N^2}{1,000,000} \quad A_L \text{ (mh/1000 turns)} = \frac{1,000,000 \times \text{'L' (mh)}}{N^2}$$

$N$  = number of turns       $L$  = inductance (mh)       $A_L$  = inductance index (mh)/1000 turns

To improve voltage breakdown, coatings of ferrite cores are available for the F, J, W and H materials. Typical coatings are parylene C, Gray Coating and Black Lacquer. Parylene C coating has a thickness of 0.5 mils to 2 mils with a voltage breakdown of 760V. Gray coating has a thickness of 4 mils to 8 mils with voltage breakdown of 500V. Black Lacquer coating has a thickness of 0.5 mils to 2 mils with no increase in voltage breakdown.

All items in this website are standard stock items and usually can be shipped immediately. Call for availability of non-stock items.

For standard stocking items of Inductors, Chokes, Transformers and other wound ferrites, please see Multilayer Chip Beads.

For custom design of Inductors, Chokes, Transformers or Special Coil Windings, please call or fax your specifications today.

Amidon provides engineering designs, prototyping and manufacturing. Low to high volume production capability with the most competitive pricing.

**MATERIAL 33** ( $\mu = 850$ ) A manganese-zinc material having low volume resistivity. Used for low frequency antennas in the 1 KHZ to 1 MHZ frequency range. Available in rod form only.

**MATERIAL 43** ( $\mu = 850$ ) High volume resistivity. For medium frequency inductors and wideband transformers up to 50 MHZ. Optimum frequency attenuation from 40 MHZ to 400 MHZ. Available in toroidal cores, shield beads, multi-aperture cores and special shapes for RFI suppression.

**MATERIAL 61** ( $\mu = 125$ ) Offers moderate temperature stability and high 'Q' for frequencies 0.2 MHZ to 15. MHZ . Useful for wide band transformers to 200 MHZ and frequency attenuation above 200 MHZ. Available in toroids, rods, bobbins and multi-aperture cores.

**MATERIAL 67** ( $\mu = 40$ ) Similar to the 63 material. Has greater saturation flux density and very good temperature stability. For high 'Q' inductors, ( 10 MHZ to 80 Mhz ). Wideband transformers to 200 MHZ. Toroids only.

**MATERIAL 68** ( $\mu = 20$ ) High volume resistivity and excellent temperature stability. For high Q' resonant circuits 80 MHZ to 180 MHZ. For high frequency inductors. Toroids only.

\* *This item has been discontinued, please refer to [Material 61](#) or [Material 67](#).*

**MATERIAL 73** ( $\mu = 2500$ ) Primarily a ferrite bead material. Has good attenuation properties from 1 MHZ through 50 MHZ. Available in beads and some broadband multi-aperture cores.

**MATERIAL 77** ( $\mu = 2000$ ) Has high saturation flux density at high temperature. Low core loss in the 1 KHZ to 1 MHZ range. For low level power conversion and wide band transformers. Extensively used for frequency attenuation from 0.5 MHZ to 50 M Hz. Available in toroids, pot cores, E-cores, beads, broadband balun cores and sleeves. An upgrade of the former 72 material. The 72 material is still available in some sizes, but the 77 material should be used in all new design.

**MATERIAL 'F'** ( $\mu = 3000$ ) High saturation flux density at high temperature. For power conversion transformers. Good frequency attenuation 0.5 MHz to 50 MHz. Toroids only.

**MATERIAL 'J' /75** ( $\mu = 5000$ ) Low volume resistivity and low core loss from 1 KHZ to 1MHz. Used for pulse transformers and low level wide band transformers. Excellent frequency attenuation from 0.5 MHz to 20 MHz. Available in toroidal form and ferrite beads as standard off the shelf in stock. Also available in pot cores, RM cores, E & U cores as custom ordered parts with lead time for delivery.

**MATERIAL K** ( $\mu = 290$ ). Used primarily in transmission line transformers from 1.0 MHz to 50 MHz range. Available from stock in a few sizes in toroidal form only.

**MATERIAL W** ( $\mu = 10,000$ ). High permeability material used for frequency attenuation from 100 KHZ to 1 MHz in EMI/RFI filters. Also used in broadband transformers. Available in toroidal form from stock. As custom ordered parts for pot cores, EP cores, RM cores.

**MATERIAL H** ( $\mu = 15,000$ ). High h permeability material used for frequency attenuation under 200 KHz. Also used in broadband transformers. Available in toroidal form only.

### MAGNETIC PROPERTIES OF FERRITE MATERIALS

Material Type	33	43	61	64	67	68	73
Initial Perm.	800	850	125	250	40	20	2500
Max. Perm.	1380	3000	450	375	125	40	4000
Max Flux den.@ 10 oer, (gauss)	2500	2750	2350	2200	3000	2000	4000
Residual Flux density (gauss)	1350	1200	1200	1100	1000	1000	1000
Vol. Resist (ohms-cm)	$1 \times 10^2$	$1 \times 10^5$	$1 \times 10^8$	$1 \times 10^8$	$1 \times 10^7$	$1 \times 10^7$	$1 \times 10^2$
Temp. Coeff. -20°C - 70°C (%/°C)	.10%	1%	.15%	.15%	.13%	.06%	.80%
Loss Factor	$3 \times 10^{-6}$ @.2MHz	$120 \times 10^{-6}$ @.1MHz	$32 \times 10^{-6}$ @2.5MHz	$100 \times 10^{-6}$ @2.5MHz	$150 \times 10^{-6}$ @50MHz	$400 \times 10^{-6}$ @0.1MHz	$7 \times 10^{-6}$ @0.1MHz
Coercive Force (Oersteds)	.30	.30	1.6	1.4	3.0	10.	.18
Curie Temp. °C	150	130	350	210	500	500	160
Resonant Cir. Freq. (MHz)	.01 to 1 MHz	.01 to 1 MHz	.20 to 10 MHz	.05 to 4MHz	10 to 80MHz	80 to 180 MHz	1KHz to 1 MHz
Wideband Freq. (MHz)	1 to 30MHz	1 to 30MHz	10 to 200MHz	50 to 500MHz	200 to 1000MHz	.5 to 30MHz	.2 to 15MHz
Attenuation RF Noise, (Mhz)	20 to 80MHz	30 to 200MHz	30 to 10,000MHz	200 to 5,000MHz	Above 1000MHz	Above 10,000MHz	1 to 40MHz

\* Based on low power, small core application. Listed frequencies will be lower with higher power.

Material Type	77	83	F	J	K	W	H
Initial Perm.	2000	300	3000	5000	290	10,000	15,000
Max. Perm.	6000	3600	4300	9500	400	20,000	23,000
Max Flux den.@ 10 oer, (gauss)	4600	3900	4700	4300	330	4300	4200
Residual Flux density (gauss)	1150	3450	900	500	250	800	800
Vol. Resist (ohms-cm)	$1 \times 10^2$	$1.5 \times 10^3$	$1 \times 10^2$	$1 \times 10^2$	$20 \times 10^7$	$.15 \times 10^2$	$1 \times 10^2$
Temp. Coeff. -20°C - 70°C (%/°C)	.25%	.4%	.25%	.4%	.15%	.4%	.4%
Loss Factor	$4.5 \times 10^{-6}$ @0.1MHz	$50 \times 10^{-6}$ @.1MHz	$4 \times 10^{-6}$ @0.1MHz	$15 \times 10^{-6}$ @0.1MHz	$28 \times 10^{-6}$ @1MHz	$7 \times 10^{-6}$ @10 KHz	$15 \times 10^{-6}$ @10KHz
Coercive Force (Oersteds)	.22	.45	.20	.10	1	.04	.04
Curie Temp. °C	200	300	250	140	280	125	120
Resonant Cir. Freq. (MHz)	1KHz to 2MHz	1KHz to 5 MHz	1 KHz to 1 MHz	1 KHz to 1 MHz	0.1 to 30MHz	1 KHz to 250 KHz	1 KHz to 150 KHz
Wideband Freq. (MHz)	.5 to 30 MHz	1 to 15MHz	.5 to 30MHz	1 to 15MHz	50 to 500MHz	1 KHz to 1 MHz	1 KHz to 1 MHz
Attenuation RF Noise, (Mhz)	1 to 40MHz	0.5 to 20MHz	1 to 20 MHz	0.5 to 10 MHz	200 to 5,000 MHz	100 KHz to 1 MHz	1 KHz to 500KHz

\* Based on low power, small core application. Listed frequencies will be lower with higher power.

Material 43					Permeability 850		
Core Number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	(cm)	$A_e$ (cm) <sup>2</sup>	$V_e$ (cm) <sup>3</sup>	$A_L$ Value mh/1000 turns
FT-23-43	0.230	0.120	0.060	1.340	0.021	0.029	188.000

FT-37-43	0.375	0.187	0.125	2.150	0.076	0.163	420.000
FT-50-43	0.500	0.281	0.188	3.020	0.133	0.401	523.000
FT-50A-43	0.500	0.312	0.250	3.680	0.152	0.559	570.000
FT-50B-43	0.500	0.312	0.500	3.180	0.303	0.963	1140.000
FT-82-43	0.825	0.516	0.250	5.260	0.246	1.290	557.000
FT-114-43	1.142	0.750	0.295	7.420	0.375	2.790	603.000
FT-140-43	1.400	0.900	0.500	9.020	0.806	7.280	952.000
FT-240-43	2.400	1.400	0.500	14.800	1.610	23.900	1240.000

Material 67						Permeability 40	
Core Number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	(cm)	A <sub>e</sub> (cm) <sup>2</sup>	V <sub>e</sub> (cm) <sup>3</sup>	A <sub>L</sub> Value mh/1000 turns
FT-23-67	0.230	0.120	0.060	1.340	0.021	0.029	7.800
FT-37-67	0.375	0.187	0.125	2.150	0.076	0.163	19.700
FT-50-67	0.500	0.281	0.188	3.020	0.133	0.401	22.000
FT-50A-67	0.500	0.312	0.250	3.680	0.152	0.559	24.000
FT-50B-67	0.500	0.312	0.500	3.180	0.303	0.963	48.000
FT-82-67	0.825	0.516	0.250	5.260	0.246	1.290	22.400
FT-114-67	1.142	0.750	0.295	7.420	0.375	2.790	25.400
FT-140-67	1.400	0.900	0.500	9.020	0.806	7.280	45.000
FT-240-67	2.400	1.400	0.500	14.800	1.610	23.900	50.000

Material 77 (upgrade of the 72 material)						Permeability 2000	
Core Number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	(cm)	A <sub>e</sub> (cm) <sup>2</sup>	V <sub>e</sub> (cm) <sup>3</sup>	A <sub>L</sub> Value mh/1000 turns
FT-23-77	0.230	0.120	0.060	1.340	0.021	0.029	396.000
FT-37-77	0.375	0.187	0.125	2.150	0.076	0.163	884.000
FT-50-77	0.500	0.281	0.188	3.020	0.133	0.401	1100.000
FT-50A-77	0.500	0.312	0.250	3.680	0.152	0.559	1200.000
FT-50B-77	0.500	0.312	0.500	3.180	0.303	0.963	2400.000
FT-82-77	0.825	0.516	0.250	5.260	0.246	1.294	1170.000
FT-114-77	1.142	0.750	0.295	7.420	0.375	2.783	1270.000
FT-114A-77	1.142	0.750	0.545	7.420	0.690	5.120	2340.000
FT-140-77	1.400	0.900	0.500	9.020	0.806	7.270	2250.000
FT-240-77	2.400	1.400	0.500	14.400	1.570	22.608	2725

Material 'F'						Permeability 3000	
Core Number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	(cm)	A <sub>e</sub> (cm) <sup>2</sup>	V <sub>e</sub> (cm) <sup>3</sup>	A <sub>L</sub> Value mh/1000 turns
FT-87A-F	0.870	0.540	0.500	5.420	0.315	1.710	3700.000
FT-114-F	1.142	0.750	0.295	7.420	0.375	2.783	1902.000
FT-150-F	1.500	0.750	0.250	8.300	0.591	4.905	2640.000
FT-150A-F	1.500	0.750	0.500	8.300	1.110	9.213	5020.000
FT-193-F	1.932	1.250	0.625	12.310	1.360	16.742	3640.000
FT-193A-F	1.932	1.250	0.750	12.310	1.620	19.942	4460.000

Material 'J' (75)						Permeability 5000	
Core Number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	(cm)	A <sub>e</sub> (cm) <sup>2</sup>	V <sub>e</sub> (cm) <sup>3</sup>	A <sub>L</sub> Value mh/1000 turns
FT-23-J	0.230	0.120	0.060	1.340	0.021	0.029	990.000
FT-37-J	0.375	0.187	0.125	2.150	0.076	0.163	2110.000

FT-50-J	0.500	0.281	0.188	3.020	0.133	0.401	2750.000
FT-50A-J	0.500	0.312	0.250	3.680	0.152	0.559	2990.000
FT-87-J	0.870	0.540	0.250	5.420	0.261	1.414	3020.000
FT-87A-J	0.870	0.540	0.500	5.420	0.315	1.710	6040.000
FT-114-J	1.142	0.750	0.295	7.420	0.375	2.783	3170.000
FT-140A-J	1.400	0.900	0.590	9.020	0.806	7.270	6736.000
FT-150-J	1.500	0.750	0.250	8.300	0.591	4.905	4400.000
FT-150A-J	1.500	0.750	0.500	8.300	1.110	9.213	8370.000
FT-193-J	1.500	1.250	0.625	12.310	1.360	16.742	6065.000
FT-193A-J	1.932	1.250	0.750	12.310	1.620	19.942	7435.000
FT-240-J	2.400	1.400	0.500	14.400	1.570	22.608	6845.000
FT-337-J	3.375	2.187	0.500	Available on Request Only			

Material 'K'						Permeability 290	
Core Number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	(cm)	A <sub>e</sub> (cm) <sup>2</sup>	V <sub>e</sub> (cm) <sup>3</sup>	A <sub>L</sub> Value mh/1000 turns
FT-125-K	1.250	0.750	0.375	8.050	0.617	4.970	2,615.000
FT-150A-K	1.500	0.750	0.500	8.300	1.110	9.213	1,508.000
FT-200-K	2.000	1.200	0.500	12.900	1.290	16.641	5,353.000
FT-240-K	2.400	1.400	0.500	14.400	1.570	22.608	4,912.000

Material 'W'						Permeability 10000	
Core Number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	(cm)	A <sub>e</sub> (cm) <sup>2</sup>	V <sub>e</sub> (cm) <sup>3</sup>	A <sub>L</sub> Value mh/1000 turns
FT-50A-W	0.500	0.312	0.250	3.680	0.152	0.559	5936.000
FT-87-W	0.870	0.540	0.250	5.420	0.261	1.414	6040.000
FT-150A-W	1.500	0.750	0.500	8.300	1.110	9.213	16700.000
FT-193-W	1.932	1.332	0.625	12.310	1.360	16.742	11800.000
FT-240-W	2.400	1.400	0.500	14.400	1.570	22.608	13690.000

Material 'H'						Permeability 15000	
Core Number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	(cm)	A <sub>e</sub> (cm) <sup>2</sup>	V <sub>e</sub> (cm) <sup>3</sup>	A <sub>L</sub> Value mh/1000 turns
FT-23-H	0.23	0.12	0.06	1.34	0.021	0.029	2940
FT-37-H	0.375	0.187	0.125	2.15	0.076	0.163	6590