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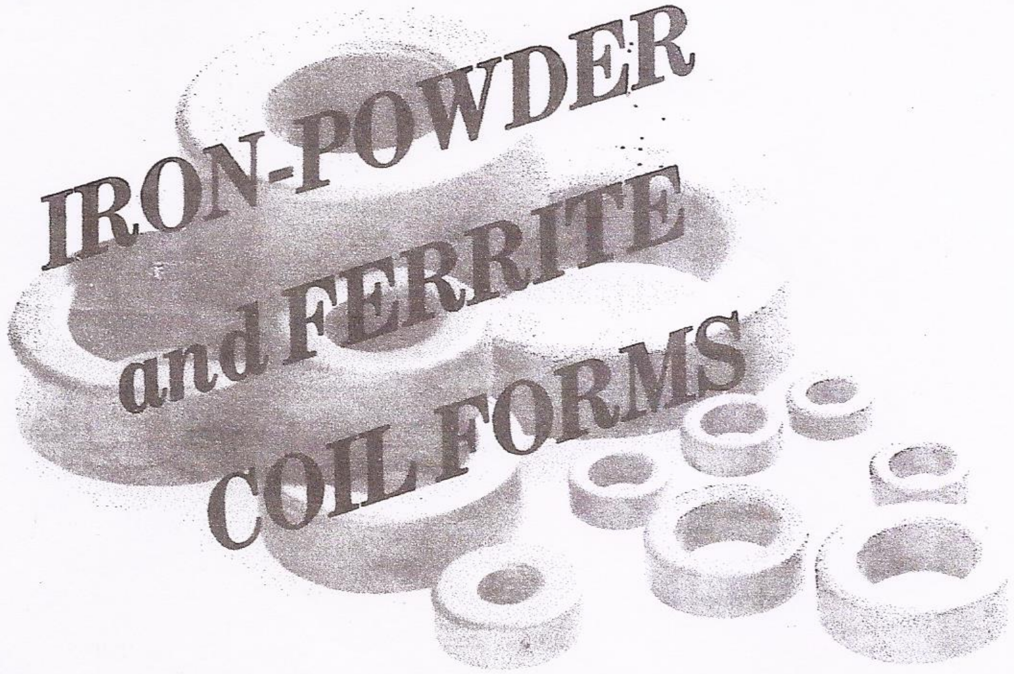
IRON-POWDER and FERRITE COIL FORMS



APRIL 1995

IRON POWDER CORES and MATERIALS

There are two basic material groups of Iron Powders cores. The Carbonyl Irons and the Hydrogen Reduced Irons.

The Carbonyl Irons are especially noted for their excellent stability over a wide range of flux levels and temperatures. Their permeability range is from one to 35 mu they can offer excellent 'Q' factors up to more than 200 MHz. They are widely used for broadband inductors, especially in higher power applications.

The Hydrogen Reduced Irons have higher permeabilities up to 90 mu. This group will have somewhat lower 'Q' and they are mainly used for EMI filters, low frequency chokes, and input and output filters for switched mode power supplies.

Toroidal cores are self shielding and it is not necessary to isolate or shield a them to prevent cross talk or feedback. Each Iron Powder core an A_L value listed in uh/100 turns and can be found elsewhere in this paper. Turns for a desired inductance may be calculated by using the given A_L value and the formula below.

Turns Formula

$$\text{Turns} = 100\sqrt{\frac{\text{desired L (uh)}}{A_L\ \text{(uh/100t)}}}$$

Key to part number

T	-	50	-	6
toroid		outer-diameter		material

MATERIAL #0 (u=1) Most commonly used for frequencies above 200 MHz. Available in toroidal form only. Inductance vs. turns may vary according to winding technique.

MATERIAL #1 (u=20) A Carbonyl 'C' material very similar to material #3 except that it has higher volume resistivity and better stability. Available in both toroidal form and shielded coil form.

MATERIAL #2 (u=10) A carbonyl 'E' iron powder material having high volume resistivity and offers high 'Q' for the 1 to 30 MHz. frequency range. Available in both toroidal and shielded coil forms.

MATERIAL #3 (u=35) A carbonyl 'HP' material having excellent stability and good 'Q' for the lower frequencies from 50 KHz. to 500 KHz. Available in toroidal and shielded coil forms.

MATERIAL #6 (u=8) A carbonyl 'SF' material very similar to #2 material but has an improved 'Q' for frequencies 20 MHz to 50 MHz. Available in toroidal core form and shielded coil form.

MATERIAL #10 (u=6) A powdered iron 'W' material. Offers good 'Q' and high stability for frequencies 40 Mhz to 100 MHz. Available in both toroidal form and shielded coil form.

MATERIAL #12 (u=3) A Synthetic Oxide material which will provide good 'Q'and moderate stability for frequencies 50 Mhz to 100 MHz. Available in toroidal form only.

MATERIAL #15 (u=25) A carbonyl 'GS6' material. Has excellent stability and good 'Q'. A good choice for commercial broadcast frequencies where good 'Q' and stability are essential. Available in toroidal form only.

MATERIAL #17 (u=3) This is a carbonyl material very similar to that of the of the #12 material. It has greater temperature stability but the cost of somewhat lower `Q'. Available in all shielded coil forms. In the toroidal form, only sizes T-12 through T-50 are available.

MATERIAL #26 (u=75) A Hydrogen Reduced material. Has highest permeability of all of the iron powder materials. Used for EMI filters and DC chokes. The #26 material is very similar to the older #41 material but provides an extended frequency range. Available in all toroidal core sizes.

IRON POWDER TOROIDAL CORES

Physical Dimensions

Core Size \/	Outer diam. (in)	Inner diam. (in)	Height (in)	Mean lgth. (cm)	Cross sect. (cm^2)	Core Size	Outer diam (in)	Inner diam (in)	Height (in)	Mean lgth. (cm)	Cross sect. (cm^2)
T- 12	.125	.062	.050	0.75	.010	T-130	1.30	.78	.437	8.29	0.73
T- 16	.160	.078	.060	0.95	.016	T-157	1.57	.95	.570	10.05	1.14
T- 20	.200	.088	.070	1.15	.025	T-184	1.84	.95	.710	11.12	2.04
T- 25	.250	.120	.096	1.50	.042	T-200	2.00	1.25	.550	12.97	1.33
T- 30	.307	.151	.128	1.83	.065	T-200A	2.00	1.25	1.000	12.97	2.42
T- 37	.375	.205	.128	2.32	.070	T-225	2.25	1.40	.550	14.56	1.50
T- 44	.440	.229	.159	2.67	.107	T-225A	2.25	1.40	1.000	14.56	2.73
T- 50	.500	.300	.190	3.20	.121	T-300	3.00	1.92	.500	19.83	1.81
T- 68	.690	.370	.190	4.24	.196	T-300A	3.00	1.92	1.000	19.83	3.58
T- 80	.795	.495	.250	5.15	.242	T-400	4.00	2.25	.650	24.93	3.66
T- 94	.942	.560	.312	6.00	.385	T-400A	4.00	2.25	1.000	24.93	7.43
T-106	1.060	.570	.437	6.50	.690	T-500	5.20	3.08	.800	33.16	5.46

A_L Values (uh / 100 turns)

For complete part number, add Mix number to Core Size number.

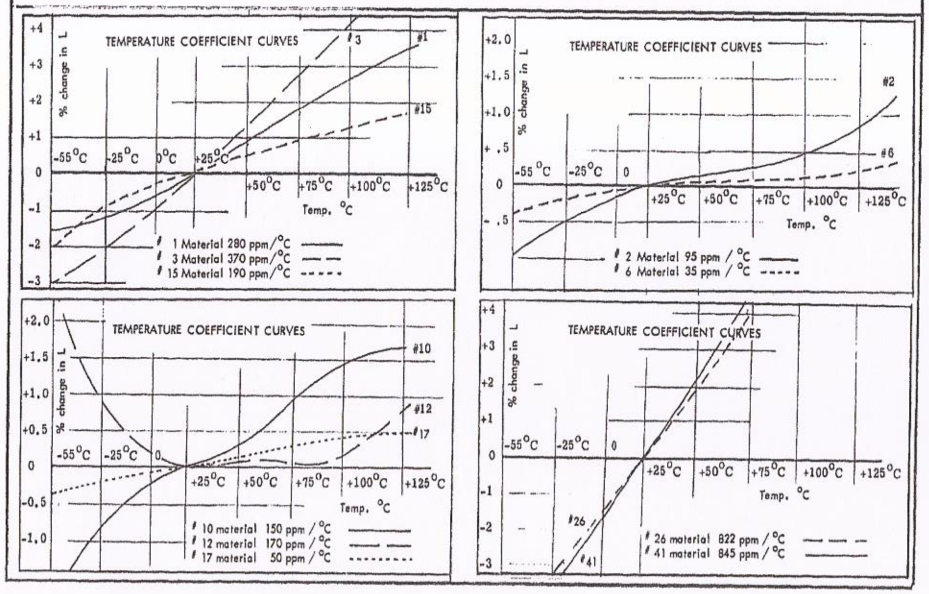
Core Size \/ Mhz >	26 Mix Yel-Wh u = 75 to 1.0	3 Mix Gray u = 35 .05 - .5	15 Mix Rd-Wh u = 25 .1 - 2.	1 Mix Blue u = 20 .5 - 5.	2 Mix Red u = 10 1 - 30	6 Mix Yellow u = 8 3 - 50	10 Mix Black u = 6 5 - 100	12/17 Mix Grn-Wh u = 3.5 20-200	0 Mix Tan u = 1 50-300
T- 12-	na	60	50	48	20	17	12	7.0	3.0
T- 16-	na	61	55	44	22	19	13	8 0	3.0
T- 20-	na	90	65	52	27	22	16	10.0	3.5
T- 25-	na	100	100	70	34	27	19	12.0	4.5
T- 30-	325	140	93	85	43	36	25	16.0	6.0
T- 37-	275	120	90	80	40	30	25	15.0	4.9
T- 44-	360	180	160	105	52	42	33	19.0	6.5
T- 50-	320	175	135	100	49	40	31	18.0	6.4
T- 68-	420	195	180	115	57	47	32	21.0	7.5
T- 80-	450	180	170	115	55	45	32	22.0	8.5
T- 94-	590	248	200	160	84	70	58	32.0	10.6
T-106-	900	450	345	325	135	116	na	na	19.0
T-130-	785	350	250	200	110	96	na	na	15.0
T-157-	970	420	360	320	140	115	na	na	na
T-184-	1640	720	na	500	240	na	na	na	na
T-200-	895	425	na	250	120	100	na	na	na
T-200A-	1550	na	na	na	218	180	na	na	na
T-225-	950	424	na	na	120	100	na	na	na
T-225A-	1600	na	na	na	215	na	na	na	na
T-300-	825	na	na	na	115	na	na	na	na
T-300A-	1600	na	na	na	228	na	na	na	na
T-400-	1320	na	na	na	185	na	na	na	na
T-400A-	2600	na	na	na	360	na	na	na	na
T-500-	1460	na	na	na	207	na	na	na	na

na - not available.

Note: #12 material will eventually be superseded by the #17 material.

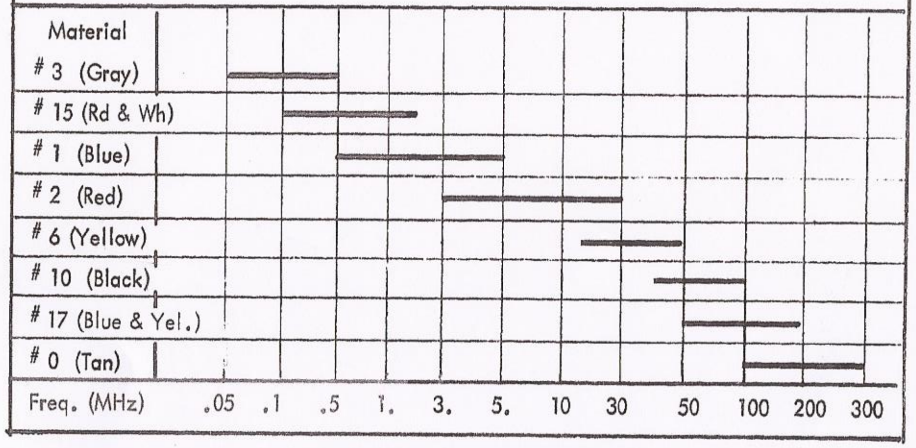
Iron Powder Toroidal Cores

TEMPERATURE COEFFICIENT CHARTS



IRON - POWDER MATERIAL vs. FREQUENCY RANGE

Higher Q will be obtained in the upper portion of a materials frequency range when smaller cores are used. Likewise, in the lower portion of a materials frequency range, higher Q can be achieved when using the larger cores.



Copper Wire Table

Wire size AWG	Diameter in inches (enamel)	Circular mil area	Turns per linear inch	Turns per sq.cm	Contineous duty current (amps) single wire,open air	Contineous duty,(amps) conduit or in wire bundles
8	.1285	16510	7.6		73	46
10	.1019	10380	10.7	13.8	55	33
12	.0808	6530	12.0	21.7	41	23
14	.0640	4107	15.0	34.1	32	17
16	.0508	2583	18.9	61.2	22	13
18	.0403	1624	23.6	79.1	16	10
20	.0319	1022	29.4	124.0	11	7.5
22	.0253	642	37.0	186.0	--	5.0
24	.0201	404	46.3	294.0	--	---
26	.0159	254	58.0	465.0	--	---
28	.0126	160	72.7	728.0	--	---
30	.0100	101	90.5	1085.0	--	---
32	.0079	63	113.0	1628.0	--	---
34	.0063	40	141.0	2480.0	--	---
36	.0050	25	175.0	3876.0	--	---
38	.0039	16	224.0	5736.0	--	---
40	.0031	10	382.0	10077.0	--	---

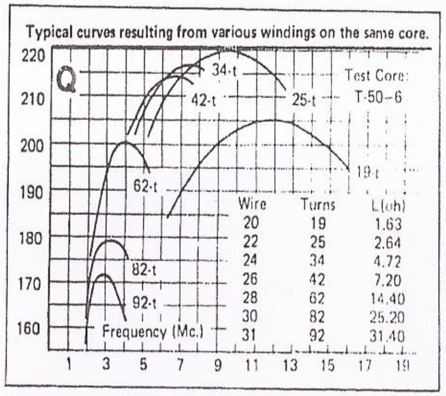
Iron Powder Core Size vs.Turns & Wire Size

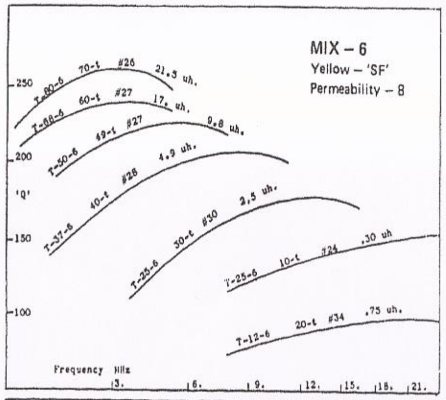
Approximate number of turns for a full single layer winding

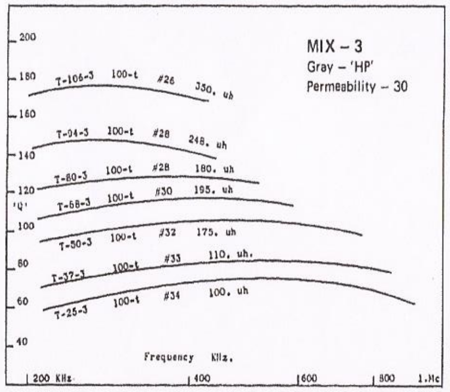
Wire Sz. / Core\/No.	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
T-12	0	0	0	1	1	1	2	4	5	8	11	15	21	29	37	47
T-16	0	0	1	1	1	3	3	5	8	11	16	21	29	38	49	63
T-20	0	1	1	1	3	4	5	6	9	14	18	25	33	43	56	72
T-25	1	1	1	3	4	5	7	11	15	21	28	37	48	62	79	101
T-30	1	1	3	4	5	7	11	15	21	28	37	48	62	78	101	129
T-37	1	3	5	7	9	12	17	23	31	41	53	67	87	110	140	177
T-44	3	5	6	7	10	15	20	27	35	46	60	76	97	124	157	199
T-50	5	6	8	11	16	21	28	37	49	63	81	103	131	166	210	265
T-68	7	9	12	15	21	28	36	47	61	79	101	127	162	205	257	325
T-80	8	12	17	23	30	39	51	66	84	108	137	172	219	276	347	438
T-94	10	14	20	27	35	45	58	75	96	123	156	195	248	313	393	496
T-106	10	14	20	27	35	45	58	75	96	123	156	195	248	313	393	496
T-130	17	23	30	40	51	66	83	107	137	173	220	275	348	439	550	693
T-157	22	29	38	50	64	82	104	132	168	213	270	336	426	536	672	846
T-184	22	29	38	50	64	82	104	132	168	213	270	336	426	536	672	846
T-200	31	41	53	68	86	109	139	176	223	282	357	445	562	707	886	1115
T-225	36	46	60	77	98	123	156	198	250	317	400	499	631	793	993	1250
T-300	52	66	85	108	137	172	217	274	347	438	553	688	870	1093	1368	1721
T-400	61	79	100	127	161	202	255	322	407	513	648	806	1018	1278	1543	2013
T-520	86	110	149	160	223	279	349	443	559	706	889	1105	1396	1753	2192	2758

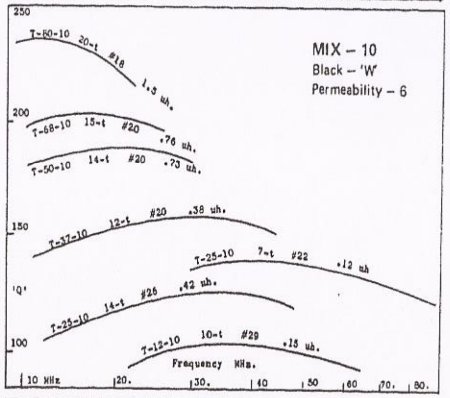
IRON POWDER TOROIDAL CORES

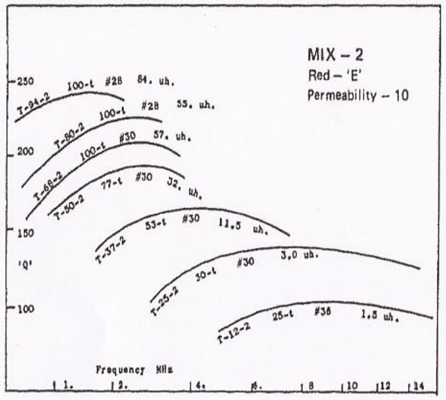
'Q' CURVES

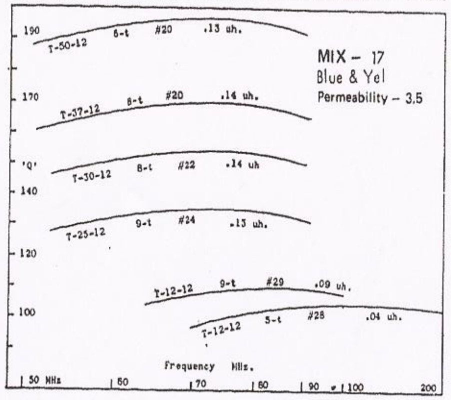












AC LINE FILTERS and DC CHOKES (# 26 Material)

High 'Q' inductors are no longer required for energy storage applications, in fact low 'Q' actually helps damp high frequency oscillations. The #26 Iron Powder material is ideally suited for these applications since it combines low 'Q', good frequency response, and high energy capabilities.

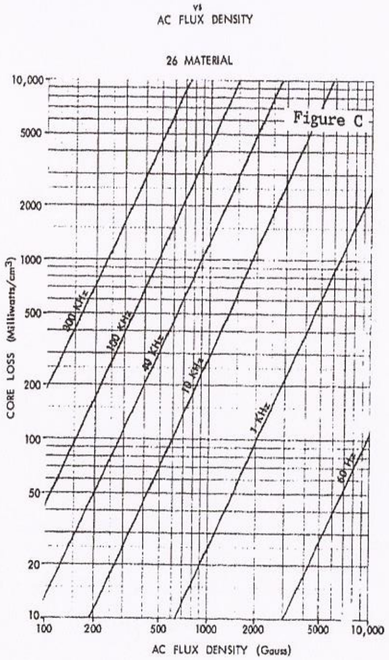
Energy storage , expressed in microjuoles, is calculated by multiplying one-half the inductance in uh times the current in amperes squared. The amount of energy that can be stored in a given inductor is limited either by saturation of the core material or temperature rise of the wound unit, resulting in copper loss and/or core loss.

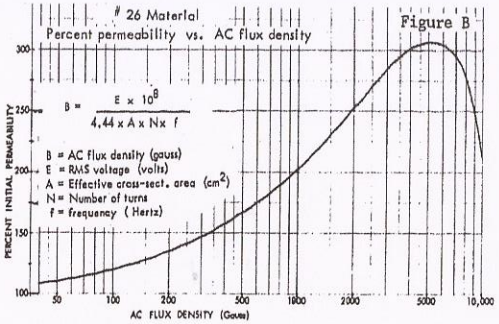
In typical DC chokes, the AC ripple flux is normally small in comparison to the DC component. Since the DC flux does not generate core loss, our primary concern becomes saturation and copper loss. The DC saturation characteristics of the #26 material are shown in Fig. A.

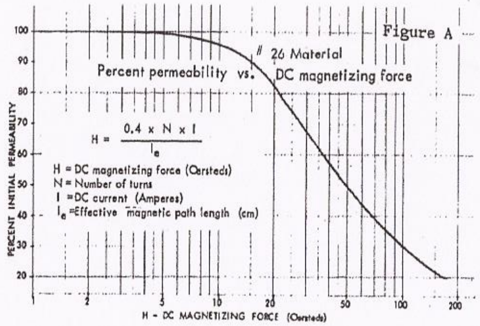
In 60 Hz. line filter applications, the high frequency to be filtered falls into two categories: (1) Common-mode noise and (2) Differential-mode noise. The common-mode noise is in relation to earth ground and is common to both lines. Differential mode noise is the noise between the two lines.

Iron Powder cores are not recommended for Common-mode noise filters. They are usually constructed on a high permeability FERRITE core with a bifilar winding. This allows the 60 Hz. flux generated by each line to cancel within the core.

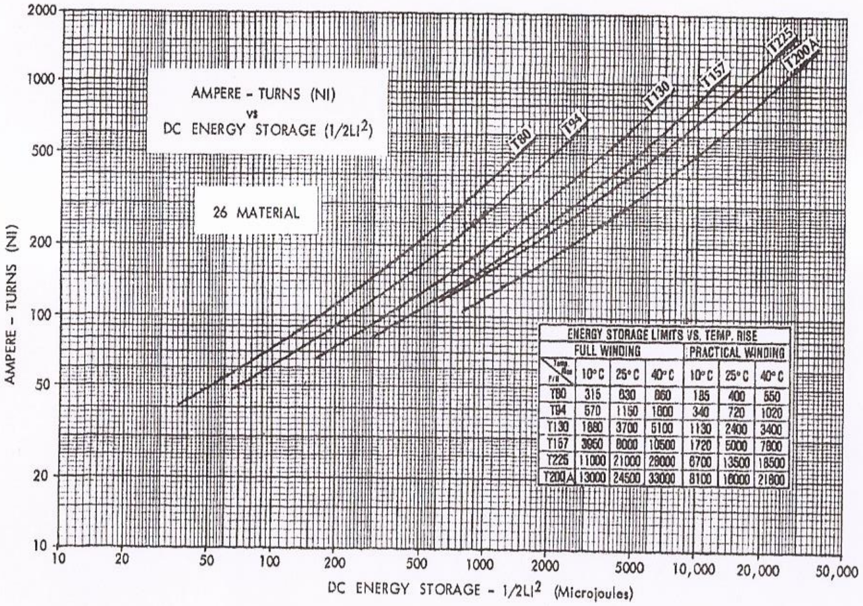
The Iron Powder #26 material is ideal for Differential-mode filters, since the core must be able to support a significant amount of 60Hz. flux without saturating. The AC saturation characteristics of the #26 material (Fig. B) and core loss information (Fig. C) can be seen below. Notice how the permeability initially increases with AC excitation. This effect allows greater energy storage in 60 Hz. applications.







Iron Powder Toroidal Cores
DC Chokes

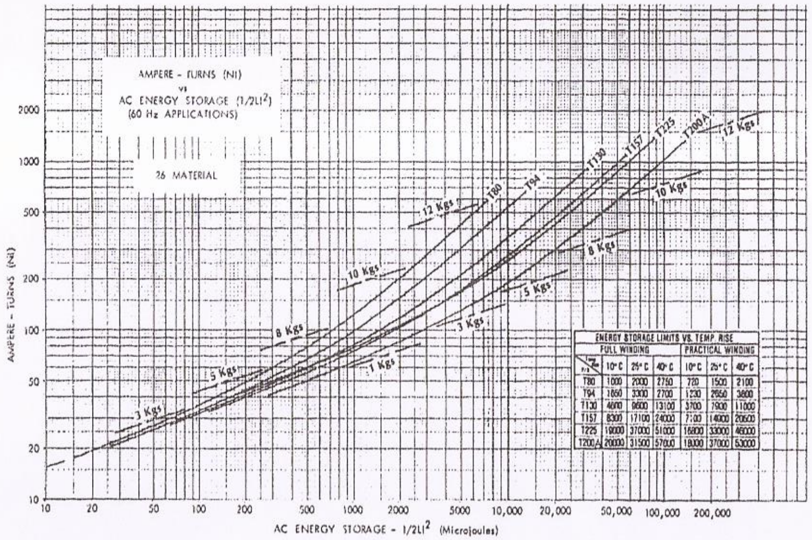


DC Choke Applications (single layer winding)

DC Amps >	1 Amp	2 Amps	4 Amps	6 Amps	10 Amps	15 Amps	20 Amps	30 Amps
Wire size >	28 AWG	24 AWG	21 AWG	19 AWG	16 AWG	14 AWG	12 AWG	10 AWG
Part\/No								
T-37-26*	35 uh 41 turns	13.5 uh 27 turns	4.0 uh 15 turns	1.8 uh 10 turns	.8 uh 7 turns	.38 uh 5 turns	.16 uh 3 turns	.012 uh 1 turn
T-50-26*	92 uh 63 turns	29.0 uh 37 turns	11.3 uh 25 turns	5.5 uh 18 turns	2.1 uh 11 turns	1.1 uh 8 turns	.59 uh 6 turns	.36 uh 5 turns
T-80-26	380 uh 108 turns	130 uh 66 turns	51.3 uh 45 turns	27.8 uh 35 turns	11.2 uh 23 turns	5.7 uh 17 turns	3 uh 12 turns	1.3 uh 8 turns
T-94-26	650 uh 123 turn	220 uh 75 turns	87.5 uh 52 turns	47.2 uh 40 turns	20.0 uh 27 turns	10.2 uh 20 turns	5.3 uh 14 turns	2.6 uh 10 turns
T-130-26	1660 uh 173 turns	575 uh 107 turns	231 uh 75 turns	127 uh 58 turns	55.0 uh 40 turns	28.0 uh 30 turns	16.5 uh 23 turns	10.4 uh 17 turns
T-157-26	3200 uh 213 turns	1100 uh 122 turns	438 uh 93 turns	244 uh 73 turns	106 uh 50 turns	55.6 uh 38 turns	32 uh 29 turns	16.4 uh 22 turns
T-184-26*	5600 uh 213 turns	1950 uh 122 turns	788 uh 93 turns	439 uh 73 turns	190 uh 50 turns	99.6 uh 38 turns	57.5 uh 29 turns	29.3 uh 22 turns
T-225-26	8600 uh 317 turns	2300 uh 198 turns	938 uh 139 turns	528 uh 110 turns	230 uh 77 turns	127 uh 60 turns	72.5 uh 46 turns	40 uh 36 turns
T-300A-26*	22.4 mh 435 turns	7850 uh 272 turns	3120 uh 190 turns	1750 uh 151 turns	760 uh 105 turns	418 uh 82 turns	250 uh 63 turns	129 uh 44 turns
T-400A-26*	51.0 mh 507 turns	17.5 mh 317 turns	7120 uh 223 turns	4000 uh 176 turns	1760 uh 122 turns	951 uh 95 turns	550 uh 73 turns	293 uh 57 turns

Note: * Size not shown on above curve chart. ** Wire size based on Max. Temp. rise 40E0 C.

Iron Powder Toroidal Cores
AC Line Filters



60 Hz. AC Line Filter Applications (single layer winding)

AC Amps >	1 Amp	2 Amps	4 Amps	6 Amps	10 Amps	15 Amps	20 Amps	30 Amps
Wire size >	28 AWG	24 AWG	21 AWG	19 AWG	15 AWG	13 AWG	11 AWG	9 AWG
Part\/No								
T-37 -26*	130 uh 41 turns	50.0 uh 27 turns	15 uh 15 turns	6.7 uh 10 turns	2.4 uh 6 turns	1.1 uh 4 turns	.60 uh 3 turns	.07 uh 1 turn
T-50 -26*	460 uh 63 turns	150 uh 37 turns	58.8 uh 25 turns	26.1 uh 17 turns	9.4 uh 10 turns	4.2 uh 7 turns	2.4 uh 5 turns	1.0 uh 3 turns
T-80 -26	1600 uh 108 turns	550 uh 66 turns	213 uh 45 turns	94.4 uh 30 turns	34.0 uh 18 turns	15.1 uh 12 turns	8.5 uh 9 turns	3.8 uh 6 turns
T-94 -26	2899 uh 123 tunrs	950 uh 75 turns	375 uh 52 turns	156 uh 33 turns	56.0 uh 20 turns	24.9 uh 13 turns	14 uh 10 turns	6.2 uh 7 turns
T-130 -26	7200 uhh 173 turns	2500 uh 107 turns	1000 uh 75 turns	444 uh 50 turns	160 uh 30 turns	71.1 uh 20 turns	40 uh 15 turns	17.8 uh 10 turns
T-157 -26	13.6 mh 213 turns	4650 uh 139 turns	1810 uh 93 turns	806 uh 62 turns	290 uh 37 turns	129 uhh 25 turns	72.5 uh 18 turns	32.2 uh 12 turns
T-184 -26*	22 mh 213 turns	7750 uh 132 turns	3130 uh 93 turns	1390 uh 62 turns	500 uh 37 turns	222 uh 25 turns	125 uh 18 turns	56.6 uh 12 turns
T-225 -26	26 mh 317 turns	9000 uh 198 turns	3500 uh 139 turns	1940 uh 110 turns	700 uh 66 turns	311 uh 44 turns	175 uh 33 turns	77.8 uh 22 turns
T-300A -26*	84 mh 435 turns	29 mh 272 turns	11.2 mh 190 turns	6390 uh 151 turns	2360 uh 93 turns	1240 uh 72 turns	750 uh 56 turns	356 uh 40 turns
T-400A -26*	180 mh 507 turns	61 mh 317 turns	25.6 mh 223 turns	14.2 mh 176 turns	5300 uh 108 turns	2800 uh 83 turns	1650 uh 65 turns	800 uh 46 turns

Note: * Size not shown on above curve chart. ** Wire size based on Max. Temp. rise 40^0 C.

POWER CONSIDERATIONS (IP and Ferrite)

How large a core is needed to handle a certain amount of power ? This is a question often asked, but unfortunately there is no simple answer.

There are several factors involved such as: cross sect. area, turns count, material, and of course the variables of applied voltage and operating frequency.

Overheating of the coil will usually take place long before saturation in most applications above 100 KHz. Now the question becomes ' How large a core must I have to prevent overheating at a given frequency and power level'? Operating frequency is one of the most important factors concerning power capability above 1 MHz. A core working well at 2 MHz may burn up at 30 MHz. with the same drive.

Overheating can be caused by both wire and core material losses. Wire heating is affected by both DC and AC currents, while core heating is affected only by the AC content of the signal. With a normal sinewave signal above 100 KHz, both the Iron Powder and Ferrite type cores will first be affected by overheating caused by core losses, rather than by saturation.

The following extrapolated AC flux density limits can be used as guide-lines for BOTH the Iron Powder and Ferrite cores to avoid excessive heating. Figures may vary slightly according to material used.

Frequency:	100 KHz	1 MHz	7 MHz	14 MHz.	21 MHz	28 MHz.
AC Flux Density:	500 gauss	150 gauss	57 gauss	42 gauss	36 gauss	30 gauss

Iron Powder cores (low permeability) are superior to the Ferrite material cores for high power inductors for this reason: Fewer turns will be required by the Ferrite type core for a given inductance. When the same voltage drop is applied across a decreased number of turns, the flux density will increase accordingly. To prevent the flux density from increasing when fewer turns are used, the flux drive will have to be decreased.

Either core material can be used for transformer applications, but both will require 'trade-offs'. Ferrite cores will require fewer turns and will couple better, whereas the Iron Powder cores will require more turns and not couple as well but will tolerate more power and are more stable.

The equation for B_{max} and a sample calculation are shown below: The sample calculation is based on a frequency of 7 MHz, a peak voltage of 25 volts, a primary winding of 15 turns, and a cross-sect. area of 0.133 cm^2 (as per data sheet). From above guide-lines, B_{max} at 7 MHz should be not more than 57 gauss,

$$B_{max} = \frac{E_{pk} \times 10^2}{4.44\, A_e\, N\, f} = \frac{25 \times 100}{4.44 \times 0.133 \times 15 \times 7} = 40 \text{ gauss}$$

E_{pk} = applied peak RMS volts
A_e = cross-sect. area (cm^2)
N = number of wire turns
f = frequency (MHz)

This hypothetical toroid core will have a flux density of 40 gauss. This is well within the above guidelines to prevent overheating.

Core saturation is affected by both AC and DC signals. Saturation will decrease the permeability of the core causing it to have impaired performance or to become inoperative. The safe operating total flux density for most Ferrites is typically 2000 gauss, while the Iron Powders can tolerate up to 5000 gauss.

Both wire heating and magnetic action within the core will contribute to the temperature rise of the coil. This can be calculated with the equation below:

$$\text{Temperature rise } ^{o}C = \left[\frac{\text{Power dissipation in milliwatts}}{\text{Surface area } (cm^2)}\right]^{.833}$$

If the operating temperature (ambient temperature + temperature rise) exceeds 100°C when used intermittently, or more that 75°C if used continuously, a larger size core or/and a heavier gauge wire should be selected.

Iron Powder Materials

SATURATION and FLUX DENSITY

Factors affecting power capability will vary with operating conditions. Core losses are lower at low frequencies and low power levels, but increase rapidly as either is increased.

Core losses can create overheating, which in turn will affect the saturation point. Maximum flux density can be calculated with the Faraday Law and Amperes Law, both of which are shown below:

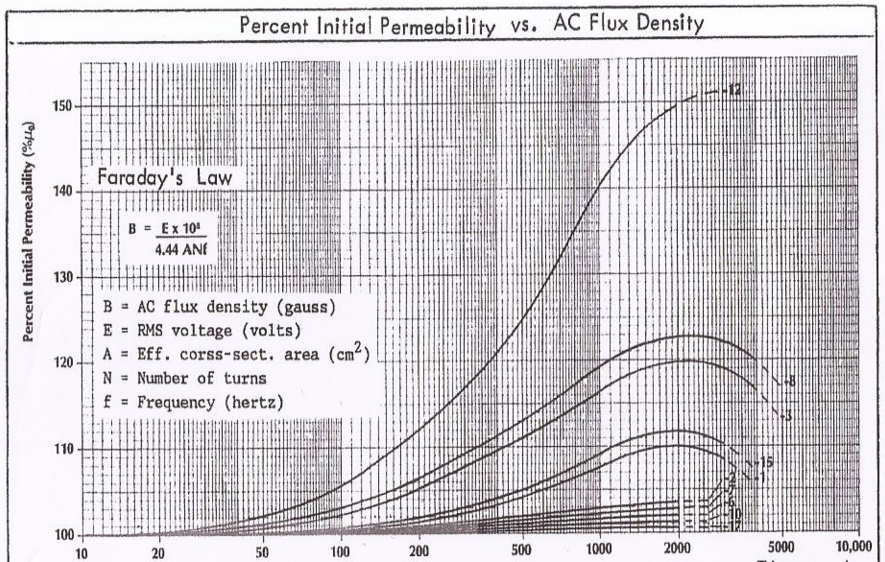


Figure A

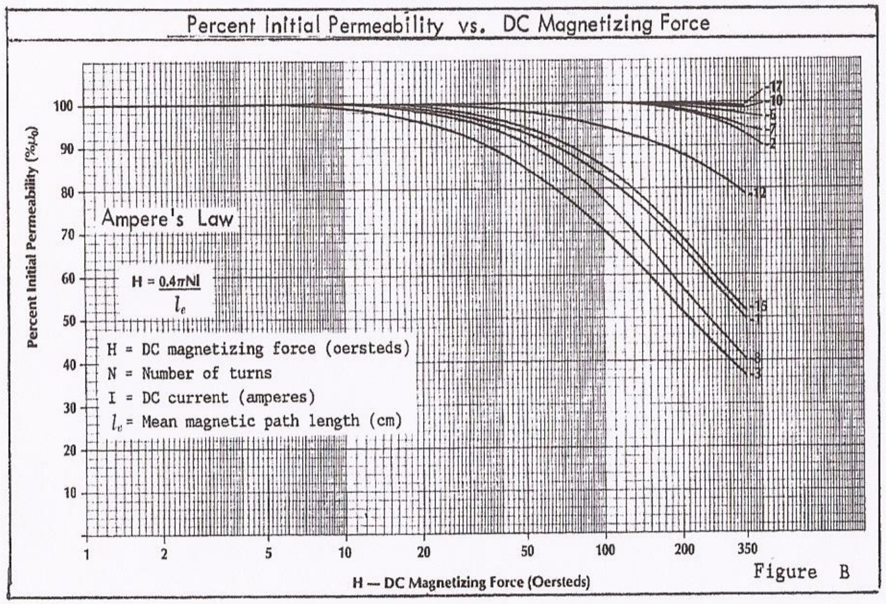
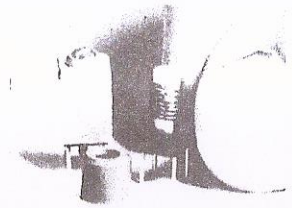


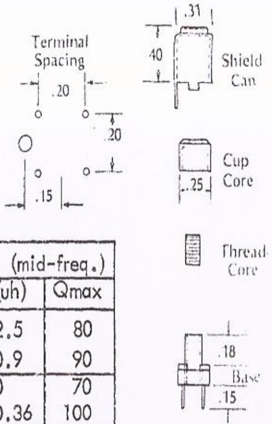
Figure B

Iron Powder Shielded Coil Forms
Slug tuning

L-33 Shielded Coil Form

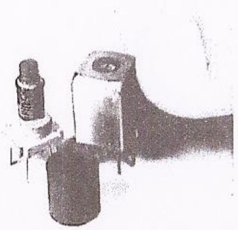


Sub miniature size
Slug tuning
Copper shield can, tin plated
Easy to wind
Good 'Q'
Frequency range: 0.2 to 200 MHz
Inductance range: .02 to 300 uh

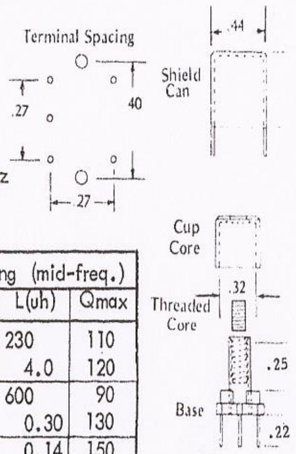


Part number	Frequency range (MHz)	A_L (uh/100t) at max L	L ratio max to min	Typical Winding (mid-freq.)			
				Wire	Turns	L(uh)	Qmax
L-33-1	0.5 - 1.1	76	1.7 - 1	3/44	75	42.5	80
L-33-2	1.0 - 10.0	68	1.5 - 1	9/44	40	10.9	90
L-33-3	0.2 - 0.6	80	1.8 - 1	3/44	150	180	70
L-33-6	9.0 - 40.0	60	1.5 - 1	26	7	0.36	100
L-33-10	30.0 - 80.0	54	1.4 - 1	26	5	0.18	120
L-33-17	70.0 - 200.0	48	1.3 - 1	26	3	0.08	130

L-43 Shielded Coil Form



Miniature in size
Slug tuning
Copper shield can, tin plated
Easy to wind
Good 'Q'
Frequency range: 0.2 to 200 MHz
Inductance range: .02 to 700 uh



Part number	Frequency range (MHz)	A_L (uh/100t) at max L	L ratio max to min	Typical Winding (mid-freq.)			
				Wire	Turns	L(uh)	Qmax
L-43-1	0.5 - 1.1	115	1.6 - 1	5/44	149	230	110
L-43-2	1.0 - 10.0	98	1.6 - 1	9/44	21	4.0	120
L-43-3	0.2 - 0.6	133	1.8 - 1	3/44	223	600	90
L-43-6	9.0 - 40.0	85	1.4 - 1	26	6	0.30	130
L-43-10	30.0 - 80.0	72	1.3 - 1	24	5	0.14	150
L-43-17	70.0 - 200.0	56	1.2 - 1	22	3	0.05	200

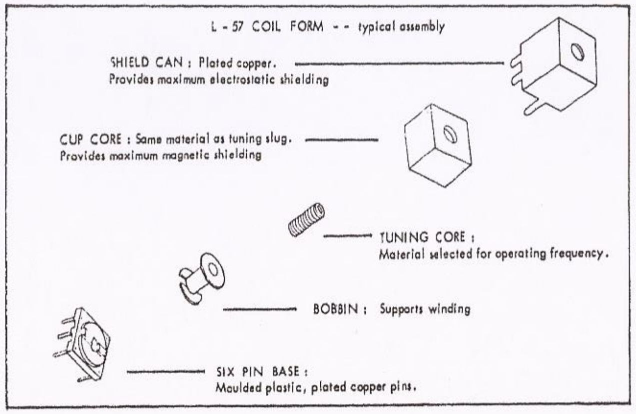
Most efficient when tuning slug is set at maximum L. For tuning flexibility, calculate so that slug will be about 90% maximum L when at operating frequency.

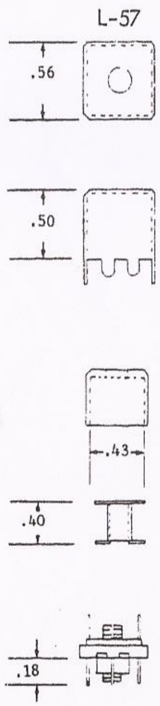
$$\text{Turns} = 100\sqrt{\frac{\text{desired L (uh)}}{90\%\ A_L\ \text{value (uh/100 t)}}}$$

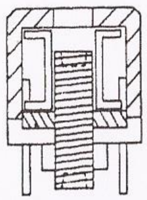
Iron Powder Shielded Coil Forms
Slug tuning

L-57 Shielded Coil Form

Part Number	Frequency Range	A_L (uh/100 t) (at max. Q)	Color Code	Tuning Range
L-57-1	.30 MHz - 1.0 MHz	175 uh	Blue	3/1
L-57-2	1.00 MHz - 10.0 MHz	125 uh	Red	2/1
L-57-3	.01 MHz - .5 MHz	204 uh	Gray	3/1
L-57-6	10.00 MHz - 50.0 MHz	115 uh	Yellow	2/1
L-57-10	25.00 MHz - 100.0 MHz	100 uh	Black	2/1
L-57-17	50.00 MHz - 150.0 MHz	67 uh	Violet	1.5/1

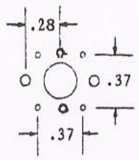






L-57

1. Available in materials 1, 2, 3, 6, 10, and 12
2. Can be tuned from both top and bottom
3. Furnished with six - pin base to accommodate center tapped coils.



Terminal Spacing

Most efficient when tuning slug is set at maximum L. For tuning flexibility, calculate so that slug will be about 90% maximum L when at operating frequency.

$$\text{Turns} = 100\sqrt{\frac{\text{desired L (uh)}}{90\%\ A_L\ \text{value (uh/100 t)}}}$$

Ferrite Cores and Materials

NICKEL ZINC ferrite cores exhibit high volume resistivity, moderate 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 and wideband applications. Permeability range 125 mu to 850 mu.

The MANGANESE ZINC group of ferrites, have permeabilities ranging from 850 to 5000 mu. They have fairly low volume resistivity and moderate saturation flux density. High 'Q' factors for the 1 KHz to 1 MHz frequency range. Widely used for switched mode power conversion transformers operating in the 20 KHz to 100 KHz frequency range. Frequency attenuation range 20 MHz. to 400 MHz and above.

Turns formula

$$\text{Turns} = 1000\sqrt{\frac{\text{desired L (mh)}}{A_L\ (\text{mh}/1000\text{t})}}$$

Key to part number

FT - 50 - 61
ferrite toroid, OD, material

MATERIAL 33 (u=850) Manganese-zinc. Low volume resistivity. Suitable for 1 KHz to 1 MHz. applications. Most commonly used for antenna rods.

MATERIAL 43 (u=850) Nickel-zinc. High volume resistivity. Widely used for medium frequency inductors and wideband transformers up to 50 MHz. Very good frequency attenuation from 30 MHz to 400 MHz. Toroids and Ferrite Beads.

MATERIAL 61 (u=125) A nickel-zinc material. Moderate temperature stability and high 'Q' for frequencies 0.2 MHz to 15 MHz. Also commonly used for wideband transformers up to 200 MHz. Toroids, Rods, and Two-hole Baluns.

MATERIAL 63 (u=40) High volume resistivity and low permeability. High 'Q' for frequency range of 15 MHz to 25 MHz. Toroidal form only.

MATERIAL 64 (u=250) A nickel-zinc material. High volume resistivity. Frequency range for resonant application up to 4 MHz. Good attenuation of unwanted frequencies up to 1000 MHz. Available in Ferrite Beads only.

MATERIAL 67 (u=40) Nickel-zinc. Very similar to the 63 material but has a greater saturation flux density. Lower volume resistivity but good temperature stability. High 'Q'applications 10 MHz to 80 Mhz. Wideband up to 200 MHz.

MATERIAL 68 (u=20) A nickel-zinc material having high volume resistivity and excellent temperature stability. High Q' resonant circuits 80 MHz.to 180 MHz, also wideband amplifiers and linear power amplifiers. Toroidal form only.

MATERIAL 72 (u=2000) Low volume resistivity. High 'Q' to 500 KHz. Very good attenuation for unwanted frequencies from 500 KHz through 50 MHz. Toroids only.

MATERIAL 73 (u=2500) Primarily a ferrite bead material. Very good attenuation properties from 0.5 MHz. through 50 MHz. Available in Ferrite Bead form only.

MATERIAL 'J'/75 (u=5000) Low volume resistivity and low core loss from 1 KHz.to 1 MHz. Pulse transformers, low level wideband transformers, and for noise attenuation from 0.5 MHz to 20 MHz. Toroids and Ferrite Beads.

MATERIAL 77 (u=2000) High saturation flux density at high temperature. Low core loss in the 1 KHz to 1 MHz range. Suited for power conversion and wideband transformers. Widely used for noise attenuation in the 0.5 Mhz. to 50 MHz. frequency range. Toroidal cores, Pot cores, E-cores, and Ferrite Beads.

MATERIAL 'F' (u=3000) Similar to the 77 material but has greater initial permeability. High saturation flux density at high temperature. Used for power conversion transformers. For noise attenuation in the 0.5 MHz. to 50 MHz. frequency range. Available in toroidal core form only.

FERRITE TOROIDAL CORES

Physical Dimensions - Ferrite Toroids

core size \/	OD inches	ID inches	Hgt inches	Mean length cm	Cross Sect cm^2	Volume cm^3
FT-23	.230	.120	.060	1.34	.021	.028
FT-37	.375	.187	.125	2.15	.076	.163
FT-50	.500	.281	.188	3.02	.133	.402
FT-50 -A	.500	.312	.250	3.18	.152	.483
FT-50 -B	.500	.312	.500	3.18	.303	.963
FT-82	.825	.520	.250	5.26	.246	1.294
FT-87 -A	.870	.540	.500	5.42	.315	1.710
FT-114	1.142	.750	.295	7.42	.375	2.783
FT-114-A	1.142	.750	.545	7.42	.690	5.120
FT-140	1.400	.900	.500	9.02	.806	7.270
FT-150	1.500	.750	.250	8.30	.591	4.905
FT-150-A	1.500	.750	.500	8.30	1.110	9.213
FT-193-A	1.932	1.250	.750	12.31	1.460	18.000
FT-240	2.400	1.400	.500	14.40	1.570	22.608

A_L Values (mH / 1000 turns) - Ferrite Toroids

To complete the part number add the Mix number to the Core size number

The 63 & 72 materials are being superseded by the 67 & 77 materials respectively.

Material > core size \/	43 u=850	61 u=125	63 u=250	67 u=40	68 u=20	72 u=2M	75 u=5M	77 u=2M	F u=3M	J u=5M
FT-23	188	24.8	7.9	7.8	4.0	396	990	356	NA	NA
FT-37	420	55.3	17.7	17.7	8.8	884	2210	796	NA	NA
FT-50	523	68.0	22.0	22.0	11.0	1100	2750	990	NA	NA
FT-50 -A	570	75.0	24.0	24.0	12.0	1200	2990	1080	NA	NA
FT-50 -B	1140	150.0	48.0	48.0	12.0	2400	NA	2160	NA	NA
FT-82	557	73.3	22.4	22.4	11.7	1170	3020	1060	NA	3020
FT-87 -A	NA	NA	NA	NA	NA	NA	NA	NA	3700	6040
FT-114	603	79.3	25.4	25.4	12.7	1270	3170	1140	1902	3170
FT-114-A	NA	146.0	NA	NA	NA	2340	NA	NA	NA	NA
FT-140	952	140.0	45.0	45.0	NA	2250	6736	2340	NA	6736
FT-150	NA	NA	NA	NA	NA	NA	NA	NA	2640	4400
FT-150-A	NA	N	NA	NA	NA	NA	NA	NA	5020	8370
FT-193-A	NA	NA	NA	NA	NA	NA	NA	NA	4460	7435
FT-240	1240	173.0	53.0	53.0	NA	3130	6845	3130	NA	6845

Magnetic Properties - Ferrite Materials

Material >	43	61	63	67	68	72	75	77	F	J
Initial Perm.	850	125	40	40	20	2000	5000	2000	3000	5000
Max Perm.	3000	450	125	125	40	3500	8000	6000	4300	9500
Max Flux den. 14 oer, gauss	2750	2350	1850	3000	2000	3500	3900	4600	4700	4300
Residual flux density,gauss	1200	1200	750	1000	1000	1500	1250	1150	900	500
Vol. Resist. ohms/cm	$1x10^5$	$1x10^8$	$1x10^8$	$1x10^7$	$1x10^7$	$1x10^2$	$5x10^2$	$1x10^2$	$1x10^2$	$1x10^2$
Temp. Co-eff. 20-70 deg. C	1%	.15%	.10%	.13%	.06%	.60%	.90%	.60%	.25%	.4%
Curie Temp. C	130	350	450	500	450	150	160	200	250	140
Resonant Cir. Freq. MHz	.01 to 1 MHz	.2 to 10 MHz	15 to 25 MHz	10 to 80 MHz	80 to 180 MHz	.001- 1 MHz	.001- 1 MHz	.001- 1 MHz	.001- 1 MHz	.001- 1 MHz
Wideband Freq. MHz. *	1 to 50 MHz	10 to 200	25 to 200	50 to 500	200- 1000	.5 to 30 MH	.2 to 15 MHz	.5 to 30 MHz	.5 to 30 MHz	1 to 15 MHz
Attenuation RF Noise, MHz	20- 600	200- 1000	500- 2000	350- 1500	1000- 5000	1 - 50	.5- 20	1 - 50	1 - 50	.5 - 20

* Based on low power, small core applications: Listed frequencies will be lower with high power.

FERRITE BEADS

A Ferrite bead is a dowel-like device which has a center hole and is composed of ferromagnetic material. When placed on to a current carrying conductor it will act as an RF choke. It offers a convenient, inexpensive, yet a very effective means of RF shielding, parasitic suppression and RF decoupling.

The most common noise generating suspects in high frequency circuits are power supply leads, ground leads and connections, and interstage connections. Adjacent leads and unshielded conductors can also provide a convenient path for the transfer of energy from one circuit to another. A few ferrite beads of the appropriate material placed on these leads can greatly reduce or completely eliminate the problem. Best of all, they can be added to most any existing electronic circuit.

The amount of impedance is a function of both the material and the frequency, as well as the size of the bead. As the frequency increases, the permeability will decline causing the losses to rise to a peak. With a rise in frequency the bead will present a series resistance with very little reactance. Since reactance is low there is little chance of resonance which could destroy the attenuation effect. Impedance is directly proportional to the length of the bead, therefore impedance will be additive as each similar bead is slipped onto the conductor. Since the magnetic field is totally contained within, it does not matter if the beads are touching or separated. Ferrite beads do not have to be grounded and they cannot be detuned by external magnetic fields.

We recommend the #73 or the #77 ferrite bead material for the attenuation of RFI resulting from transmissions in the amateur band. The #43 material will provide best RFI attenuation from 30 to 400 MHz, and the #64 material is most effective above 400 MHz. The #75 material is recommended for RFI from 1 to 20 MHz, but they can also be very effective even below the AM broadcast band.

Ferrite beads are usually quite small and as a result only one pass, or a small number of turns are possible. On the other hand, a toroidal core usually has a much larger ID and will accept a greater number of turns. If a large amount of impedance is required the ferrite core can be used to advantage, since the impedance increases as to the number of turns squared.

The number of turns on a single hole Ferrite bead or a toroidal core is identified by the number of times the conductor passes through the center hole. To physically complete one turn it would be necessary to cause the wires to meet on the outside of the device, however the bead or core does not care about the termination of each end of the wire and considers each pass through the center hole as one turn. (This does not apply to multihole beads)

When winding a six-hole bead, the impedance depends upon the exact winding pattern. For instance, it can be wound clock-wise or counter clock-wise progressively from hole to hole, or criss-crossed from side to side, or each turn can be completed around the outside of the bead. Each type of winding will produce very different results. The impedance figures for the six-hole bead in our chart is based on the current industry standard, which is two and one half turns threaded through the holes, criss-crossing from one side to the other.

Temperature rise above the Curie point will cause the bead to become non-magnetic, rendering it useless as a noise attenuating device. Depending on the material, Curie temperature can run anywhere from 120°C to 500°C . See 'Magnetic Properties' chart for specifics.

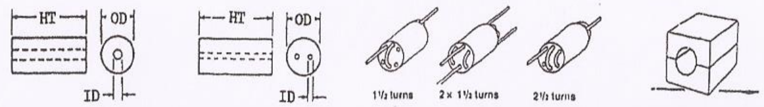
The #73 and #75 materials, as well as other very high permeability materials are semi-conductive and care should be taken not to position the cores or beads in such a manner that they would be able to short uninsulated leads together, or to ground. Other lower permeability materials with higher resistivity are non-conductive and this precaution is not necessary.

Ferrite Shielding Beads

Part number	Bead type	Dimensions (inches) OD	ID	Hgt	A_L of Materials (mh/1000 turns) 43	64	73	75	77	Impedance factor*
FB-(--)-101	1	.138	.051	.128	510	150	1500	3000	----	1.00
FB-(--)-201	1	.076	.043	.150	360	110	1100	----	----	0.70
FB-(--)-301	1	.138	.051	.236	1020	300	3000	----	----	2.00
FB-(--)-801	1	.296	.094	.297	1300	390	3900	----	----	2.60
FB-(64}-901	2	.250	.050	.417	----	1130	----	----	----	7.50 **
FB-(--)-1801	1	.200	.062	.437	2000	590	5900	----	----	3.90
FB-(--)-2401	1	.380	.197	.190	520	----	1530	----	----	1.02
FB-(--)-5111	3	.236	.032	.394	3540	1010	----	----	----	6.70 ***
FB-(--)-5621	1	.562	.250	1.125	3800	----	----	----	9600	6.40
FB-(--)-6301	1	.375	.194	.410	1100	----	----	----	2600	1.70
FB-(43)-1020	1	1.000	.500	1.112	3200	----	----	----	----	6.20
FB-(77)-1024	1	1.000	.500	.825	----	----	----	----	5600	3.70
2X-(43)-151	4	1.020	.500	1.125	Split bead, 43 Mat. Z=159 @ 25 MHz.					Z=245 @ 100 MHz
2X-(43)-251	4	.590	.250	1.125	Split bead, 43 mat. Z=171 @ 25 Mhz.					Z=275 @ 100 MHz.

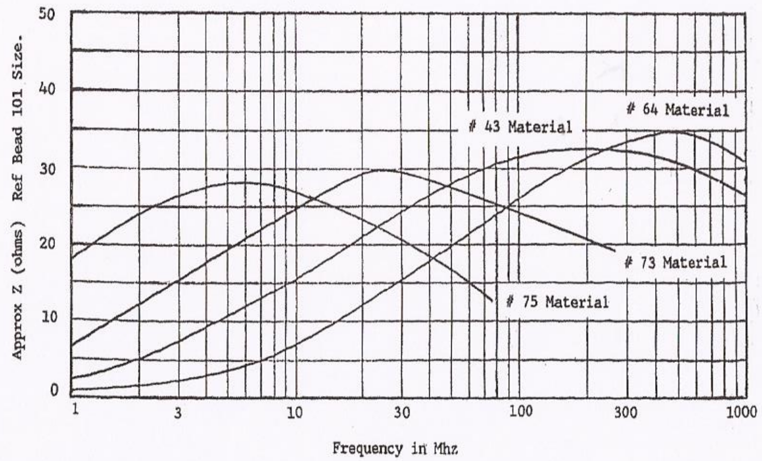
Notes: Complete the part number by adding material number in space (--) provided.
A_L values based on low frequency measurements. (mh/1000 turns) = nanohenries/turns^2
** Based on a single 'U-turn' winding. *** Based on a 2 1/2 turn, side to side winding.

Type 1 Type 2 Type 3 Type 4



Material vs Frequency vs Impedance

* Impedance Factor: This chart is based upon the `101' size bead. Impedances for other size beads may be approximated as follows: Find the `Z' of the same material at your operating frequency in the chart below. Multiply that `Z' by the Impedance Factor shown above.



Ferrites for RFI

Ferrite toroidal cores, as well as beads, can be very useful in attenuation of unwanted RF signals but we do not claim them to be a cure-all for all RFI problems. There are different types of noise sources, each of which may require a different approach. When dealing with any noise problem it is helpful to know the frequency of the interference. This is valuable when trying to determine the correct material as well as the maximum turns count.

RFI emanating from such sources as computers, flashing signs, switching devices, diathermy machines, etc. are very rich in harmonics and can create noise in the high and very high frequency regions. For this type of interference, the #43 material is probably the best choice since it has very good attenuation in the 20 MHz to 400 MHz. region. Some noise problems may require additional filtering with hi-pass or lo-pass filters. If the noise is of the differential-mode type, an AC line filter may be required. See section on AC line filters and DC chokes.

In some cases the selected core will allow only one pass of the conductor, which is considered to be one turn. In other cases it may be possible to wind several turns on to the core. When installing additional cores on the same conductor, impedance will be additive. When multiple turns are passed through a core, the impedance will increase in relation to the number of turns squared.

Keep in mind that because of the wide overlap in frequency range of the various materials, more than one material can provide acceptable results. Normally, the 43 material is recommended for frequency attenuation above 30 MHz., the 77, and 'F' materials for the amateur band, and the 'J' or materials for everything lower than the amateur band.

Computers are notorious for RF radiation, especially some of the older models which were made when RFI requirements were quite minimal. RFI can radiate from inter-connecting cables, AC power cords and even from the cabinet itself. ALL of these sources must be eliminated before complete satisfaction can be achieved. First, examine the computer cabinet to make sure that good shielding and grounding practices have been followed. If not, do what you can to correct it. If you suspect that RF is feeding back into the AC power system from your computer, wrap the power cord through an FT-240-77 toroidal core 6 to 9 times. This will act as an RF choke on the power cord and should prevent RF from feeding back into the power system where it can affect other electronic devices.

It is possible for an unwanted RF signal to enter a piece of equipment by more than one path, If so, ALL of these paths must be blocked before there will be noticeable effect. Don't overlook the fact that RFI may be entering the equipment by radiation directly from your antenna feed line due to high SWR. This, of course, can be checked with an SWR meter, and can be corrected by installing an antenna balun, or by placing a few ferrite beads, or sleeves, over the transmission line at the antenna feed point. This should prevent RF reflection back into the outside shield of the coax feed line, which could radiate RFI.

Split bars are especially designed for computer flat ribbon cables. Two or more cores can be placed on the same cable, in which case the impedance will be additive. See following page for more specific information.

RFI in telephones can be substantially reduced with the insertion of an RF choke in each side of the talk circuit. Wind two FT-50A-75 cores with about 20 turns each of #26 enamelled wire. If possible, place one in each side of the talk circuit within the telephone base. If this is not possible, try mounting them in a small box with phone modular input and output jacks mounted in each end. This can now be used 'in-line' between the phone and the wall jack. Similar results can be achieved by winding 6 to 9 turns of the telephone-to-wall cable through an FT-140-J ferrite toroidal core.

FERRITE CORES FOR RFI SUPPRESSION

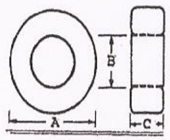
Following is a list of a few of the larger Ferrite Beads (FB), Ferrite Toroidal Cores (FT), and Split Ferrite Cores (2X), all of which are extensively used for RFI problems involving multiple wire bundles, coaxial cables, microphone cables, AC power cords, telephone cables, computer cables, etc.

The 43 material is a good all around material for most RFI problems. However the lower frequencies from .5 to 10 MHz. can best be served with the 'J' or 75 material. The 77 material can provide excellent attenuation of RFI caused by amateur radio frequencies from 2 to 30 MHz. and the 43 material is best for everything above 30 MHz. however, it is still very effective across the entire amateur band but not quite as good as the 77 material. The 73 material is specifically a small ferrite bead material having a permeability of 2500 and can provide RF attenuation very similar to the 77 ferrite core material.

When a number cores are strung on the same conductor, the total impedance will be the sum impedance of all cores. When a conductor is passed through the center hole of a toroidal core a number of times, the impedance will increase in proportion to the number of turns squared.

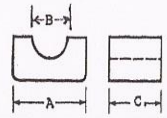
Split beads and bars (2X) are now available and can be installed without removing the end connector from the cable. Split bars are especially designed for computer ribbon cables. They are presently available for 1.3", 2.0" and 2.5" computer ribbon cables. For greater attenuation use additional cores.

Below are a few of the most widely used cores for RFI, showing typical `Z' in ohms for one turn at 25 MHz and 100 MHz. Most sizes are available in 43, and 77 materials. Those sizes availabale in the J material are marked with *

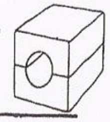


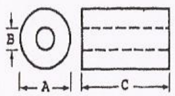
Part number	A dim. (in)	B dim. (in)	C dim. (in)	25 MHz	100 MHz
* FT-50A-75	.500	.312	.250	below 10 MHz	
FT-50B-43	.500	.312	.500	56	90
FT-50B-77	.500	.312	.500	74	60
* FT-87A-75	.870	.540	.500	below 10 MHz	
* FT-114-43	1.142	.750	.295	27	47
FT-114-77	1.142	.750	.295	35	29
* FT-140-43	1.400	.900	.500	47	75
FT-140-77	1.400	.900	.500	62	50
* FT-193- J	1.930	1.250	.625	below 10 MHz	
* FT-240-43	2.400	1.400	.500	58	108
FT-240-77	2.400	1.400	.500	76	66

Two turns Illustrated

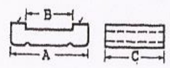


2X-43-251	.590	.250	1.125.	171	275
2X-43-151	1.020	.500	1.125	159	245

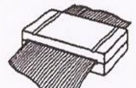




FB-43-1020	1.000	.500	1.120	155	235
FB-77-1024	1.000	.500	.825	166	135
FB-43-5621	.562	.250	1.125	171	250
FB-77-5621	.562	.250	1.125	270	215
FB-43-6301	.375	.194	.410	55	48
FB-77-6301	.375	.194	.410	73	59

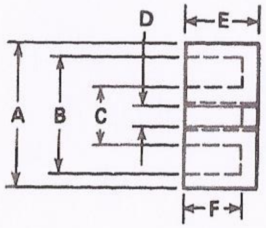


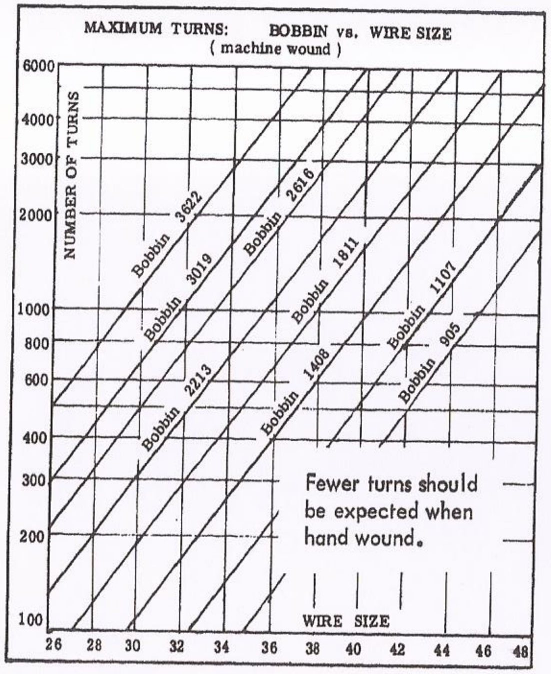
2X-43-651	for 1.3" ribbon cable			97	200
2X-43-951	for 2.0" ribbon cable			105	285
2X-43-051	for 2.5" ribbon cable			90	250



Ferrite POT Cores

Ferrite Material #77, 2000 Permeability





$$\text{Turns} = \sqrt{\frac{\text{desired L (mh)}}{A_L\ (\text{mh}/1000\text{t})}} \times 1000$$

Physical Dimensions
(In millimeters)

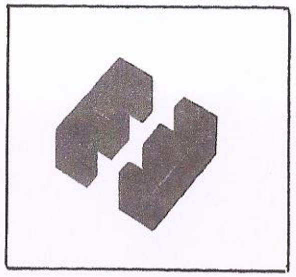
part number	A	B	C	D	E	F
PC-1107-77	11.10	9.20	4.60	2.10	3.21	2.27
PC-1408-77	14.05	11.80	5.90	3.10	4.18	2.90
PC-1811-77	18.00	15.25	7.45	3.10	5.27	3.70
PC-2213-77	21.60	18.70	9.25	4.55	6.70	4.70
PC-2616-77	25.50	21.60	11.30	5.55	8.05	5.60
PC-3019-77	30.00	25.40	13.30	5.55	9.40	6.60
PC-3622-77	35.60	30.40	15.90	5.55	10.85	7.40

Magnetic Dimensions

part number	A_e mm^2	l_e mm	V_e mm^3	A_L mh/1000-t	Power Based on 20 KHz
PC-1107-77	15.9	15.9	252	1420	Max 3 watts
PC-1408 77	25.0	20.0	500	1960	Max 5 watts
PC-1811-77	43.0	25.9	1120	2880	Max 10 watts
PC-2213-77	63.0	31.6	2000	3660	Max 20 watts
PC-2616-77	93.0	37.2	3460	4700	Max 50 watts
PC-3019-77	136.0	45.0	6100	5900	Max 70 watts
PC-3622-77	202.0	53.0	10600	7680	Max 90 watts

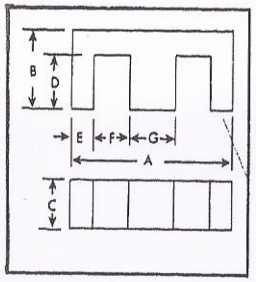
Note: Power ratings are conservative, based on 20 KHz. switching frequency.

FERRITE 'E' CORES



TYPE 77 FERRITE MATERIAL
permeability 2000

These cores are ideally suited for low power applications up to 200 watts. A nylon bobbin is supplied for easy winding.



E-Core Physical Dimensions (inches)

Part No. \/	A	B	C	D	E	F	G	Power
EA-77-188	.760	.318	.187	.225	.093	.192	.187	10 watts
EA-77-250	1.000	.380	.250	.255	.125	.250	.250	20 watts
EA-77-375	1.375	.562	.375	.375	.187	.312	.375	70 watts
EA-77-500	1.625	.650	.500	.405	.250	.312	.500	100 watts
EA-77-625	1.680	.825	.605	.593	.234	.375	.468	200 watts

E-Core Magnetic Properties

Part No. \/	A_e mm^2	I_e mm	Ve mm^3	A_s mm^2	A_w mm^2	$A_c \times A_w$ mm^4	A_L value mh/1000 turns
E-77-188	22.5	40.1	900	1050	55.7	1250	1290
E-77-250	40.4	48.0	1930	1700	80.6	3250	1520
E-77-375	90.3	68.8	6240	3630	151.0	13700	2540
E-77-500	160.0	76.7	12300	5410	163.0	26100	4090
E-77-625	184.0	98.0	18000	7550	287.0	52900	5210

Wire size vs. Number of turns

Part No. \/	18	20	22	24	26	28	30	32	34	36	38
EA-77-188	21	33	50	79	125	196	293	439	669	1046	1548
EA-77-250	34	62	93	147	232	364	532	814	1240	1938	----
EA-77-375	63	94	149	235	372	582	868	1302	1984	----	----
EA-77-500	50	141	212	335	532	829	1236	1855	----	----	----
EA-77-625	159	250	375	593	939	1470	2191	----	----	----	----

Switched Mode Power Supplies

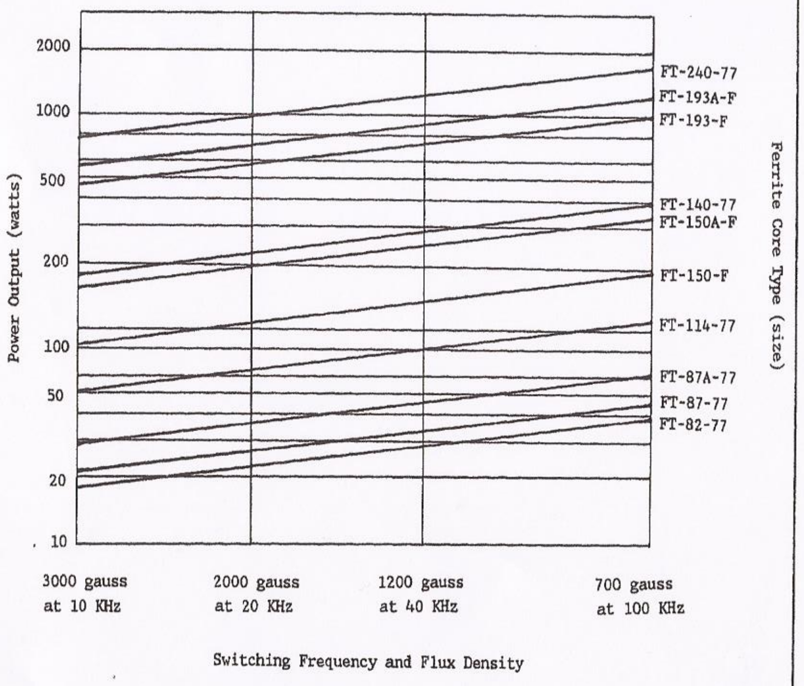
Guide to select the proper size ferrite core

Switching power supplies require the use of high permeability Ferrite type cores, rather than high permeability Iron Powder cores. High permeability Iron Powder cores will be to lossy.

Toroidal cores may be used, however 'E' type cores are generally preferred because of greater winding ease. We stock both the Toroidal Ferrite cores and the 'E' cores in the #77 material, which is ideal for switching at frequencies of 20 KHz or higher.

See other pages in this brochure on 'E' cores for size vs. power. The chart at the bottom of this page will provide data on an approximate size toroidal core to be used for a given amount of power.

Core Size vs. Power Output



BALUNS and WIDEBAND CORES

The two-hole balun is commonly used for wideband transformers and impedance matching devices. The primary concern, when designing a wideband transformer, is to extend the banddwidth with a minimum of loss. The limiting factors are inductive reactance and core loss.

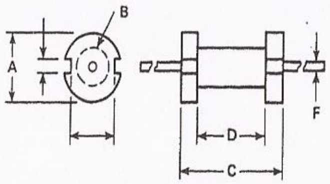
By winding through both holes of the binocular type two hole balun, a higher inductance per turn can be obtained than would otherwise be possible with a single hole core.

Dimensions in inches; A_L value in mh/1000 turns based on hole to hole winding

Part No.	OD	ID	Hgt	Th	Type	A_L	Part No.	OD	ID	Hgt	Th	Type	A_L
BN-43-202	.525	.150	.550	.295	one	2890	BN-61-2302	.136	.035	.093	.080	one	100
BN-43-2302	.136	.035	.093	.080	one	680	BN-61-2402	.280	.070	.240	.160	one	280
BN-43-2402	.280	.070	.240	.160	one	1277	BN-61-1702	.250	.050	.470	---	two	420
BN-43-3312	.765	.187	1.000	.375	one	5400	BN-61-1802	.250	.050	.240	---	two	310
BN-43-7051	1.130	.250	1.130	.560	one	6000	BN-73-202	.525	.150	.550	.295	one	8500
BN-61-202	.525	.150	.550	.295	one	425	BN-73-2402	.275	.070	.240	.160	one	3750

Ferrite Bobbin Cores

Ferrite bobbins provide a convenient means of winding RF chokes. Because of their open magnetic path, they can handle more current than toroids of similar size. To aid in the design of such chokes, we have provided A_L values, a winding table, and ampere-turn ratings for each bobbin.



Winding table: number of turns to completely fill bobbin.

wire size	20	22	24	26	28	30	32	34	36
B-72-1111	9	14	23	35	56	88	164	205	400
wire size	20	22	24	26	28	30	32	34	36
B-72-1011	24	39	60	93	148	230	425	535	1050

B O B B I N D I M E N S I O N S A_L value in mh/1000 turns

part number	A	B	C	D	F	A_L	NI
Bobbin # B-72-1111	.196"	.107"	.500"	.400"	#22	17	60
Bobbin # B-72-1011	.372"	.187"	.750"	.500"	#20	39	130

BOBBIN # B-72-1111 A_L = 17 NI = 60

Inductance	wire turns	wire size	I (max)
10 uh	24	24	2.50
25 uh	38	26	1.60
50 uh	54	28	1.10
100 uh	77	30	.78
250 uh	121	31	.50
500 uh	171	32	.35
1.0 mh	243	34	.25
2,5 mh	383	36	.16
5.0 mh	542	37	.11
10.0 mh	762	38	.08

BOBBIN # B-72-1011 A_L = 39 NI = 130

Inductance	wire turns	wire size	I (max)
25 uh	25	20	5.20
50 uh	36	22	3.60
100 uh	50	24	2.60
250 uh	80	26	1.60
500 uh	113	27	1.10
1.0 mh	160	28	.80
2.5 mh	253	30	.50
5.0 mh	358	32	.36
10.0 mh	506	34	.25
25.0 mh	800	36	.16

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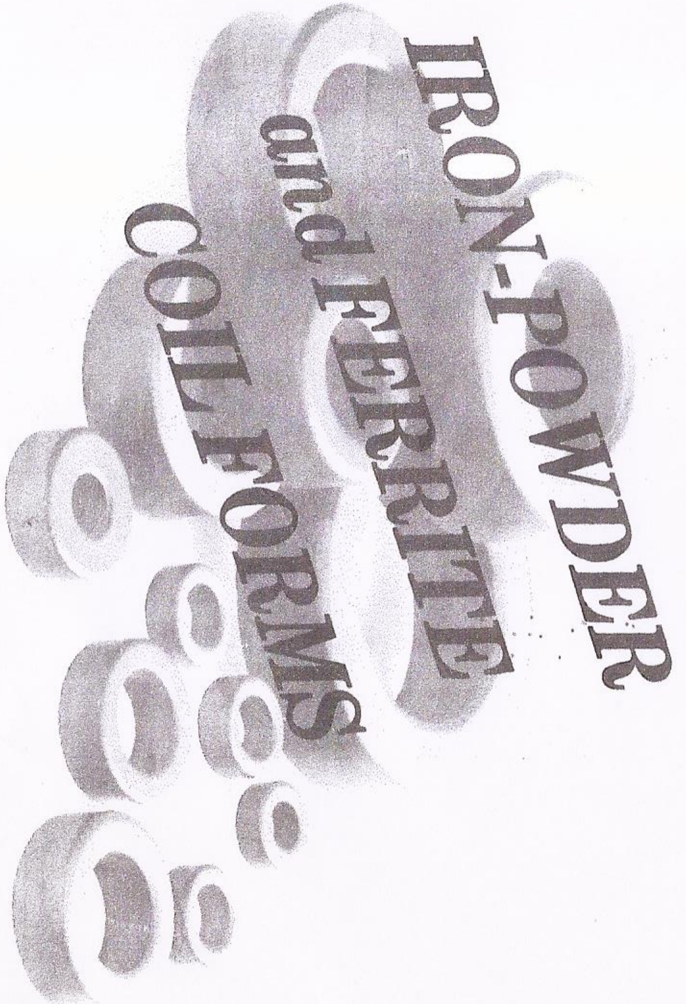

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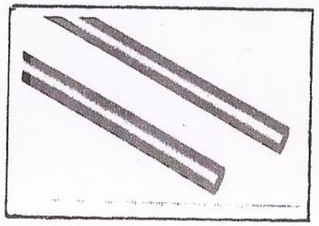

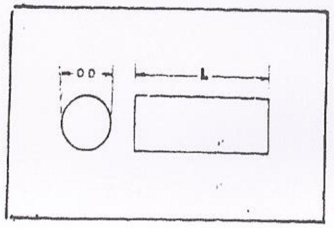

Part number	Material	Perme-ability	Diameter (in)	Length (in)	Al value mh/1000 t	Ampere turns
R61-025-400	61	125	.25	4.0	26	110
R61-033-400	61	125	.50	4.0	32	185
R61-050-400	61	125	.50	4.0	43	575
R61-050-750	61	125	.50	7.5	49	260
R33-037-400	33	800	.37	4.0	62	290
R33-050-200	33	800	.50	2.0	51	465
R33-050-400	33	800	.50	4.0	59	300
R33-050-750	33	800	.50	7.5	70	200

FERRITE RODS are available in various sizes of both the #33 and #61 materials, which are standard stock items here at Amidon. The most common use of a ferrite rods is for antennas and choke applications.

ANTENNAS: The #61 material rods are widely used for commercial AM radio antennas and on up to 10 MHz. The #33 material rods are more suitable for the VLF frequency range.

CHOKE APPLICATIONS; Both the #33 and the #61 material rods are extensively used in choke applications. The #33 material should be selected for the 40 and 80 meter bands and the #61 material is most suitable for 10 through 40 meters. The #33 material rods are also often used in speaker cross-over networks. Due to the open magnetic structure of the rod configuration, considerable current can be tolerated before it will saturate.

There are several factors that have a direct bearing on the effective permeability of a ferrite rod, which in turn will effect inductance and 'Q', as well as the A_L value of the rod and its ampere-turns rating. These are: (1) Length to diameter ratio of the rod, (2) Placement of the coil on the rod , (3) Spacing between turns and, (4) Air space between the coil and the rod. In some cases the effective permeability of the rod will be influenced more by a change in the length to diameter ratio than by a change in the initial permeability of the rod. At other times, just the reverse will be true.

Greatest inductance and A_L value will be obtained when the winding is centered on the rod, rather than placed at either end. The best 'Q' will be obtained when the winding covers the entire length of the rod.

Because of all of the above various conditions it is very difficult to provide workable A_L values, however we have attempted to provide a set of A_L and NI values for various types of rods in our stock. These figures are based on a closely wound coil of #22 wire, placed in the center of the rod and covering nearly the entire length. Keep in mind that there are many variables and that the inductance will vary according to winding technique.