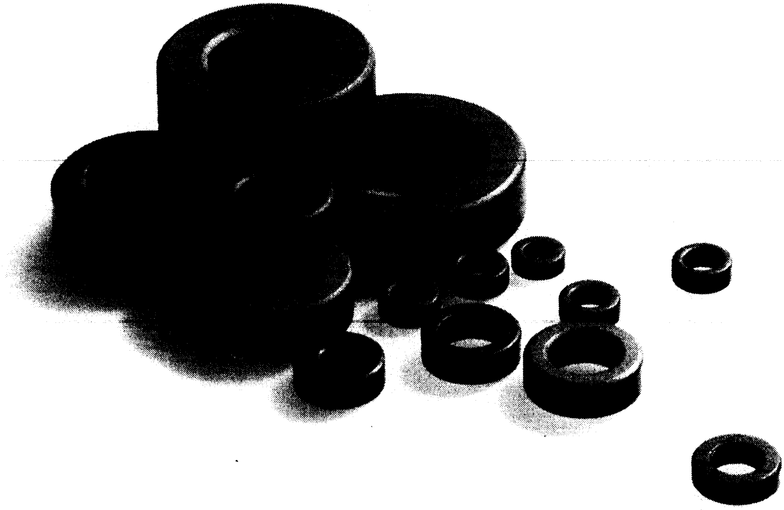
IRON-POWDER and FERRITE

COIL FORMS



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MAY 1991

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Iron Powder Cores

Iron Powder Cores are made in numerous shapes and sizes, such as Toroidal Cores, E-cores, Shielded Coil Forms, Sleeves etc. each of which are available in many different materials. There are two basic groups of iron powder material: (1) The Carbonyl Iron and, (2) The Hydrogen Reduced Iron.

The Carbonyl Iron cores are especially noted for their stability over a wide range of temperatures and flux levels. Their permeability range is from less than 3 mu to 35 mu and can offer excellent 'Q' factors from 50 KHz to 200 MHz. They are ideally suited for a variety of RF applications where good stability and good 'Q' are essential, also very much in demand for broadband inductors especially where high power is concerned.

The Hydrogen Reduced Iron cores have higher permeabilities ranging from 35 mu to 90 mu. Somewhat lower 'Q' can be expected from this group of cores. They are mainly used for EMI filters and low frequency chokes. They are also very much in demand for input and output filters for switched mode power supplies.

The next several pages are devoted to iron powder materials and the toroidal core configuration in particular, showing physical dimensions of available items, their A_L values and other magnetic properties, as well as how to select the proper core for your application.

In general, toroidal cores are the most efficient of any core configuration. They are highly self-shielding since most of the flux lines are contained within the core. The flux lines are essentially uniform over the entire length of the magnetic path and consequently stray magnetic fields will have very little effect on a toroidal inductor. It is seldom necessary to shield a toroidal inductor.

The A_L value of each iron powder core will be found in the charts on the next several pages. Use this A_L value and the formula found at the end of the charts to calculate the number of turns needed for your application.

Iron Powder Materials

MATERIAL #0 (u=1) Most commonly used for frequencies above 100 MHz. Available in toroidal form only. Note: Due to the nature of this material the inductance resulting from the use of the given A_L value may not be as accurate as we would like. The inductance vs. number of turns will vary greatly depending upon the 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 toroidal form and shielded coil form.

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

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 form and shielded coil form.

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

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

MATERIAL #12 (u=4) A synthetic oxide material which can provide good 'Q'and moderate stability for frequencies 50 MHz to 200 MHz. If high 'Q' is of prime importance this material is a good choice. If stability is of prime importance consider the #17 material. The #12 material is available in all toroidal sizes up to T-94. Not available in shielded coil form.

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=4) This is a new carbonyl material which is practically the same as the #12 material except that it has better temperature stability. However, as compared to the #12 material, there will be a slight `Q' loss of about 10% from 50 MHz to 100 MHz. Above 100 MHz the `Q' will slowly deteriorate up to approximately 20% lower. In toroidal form, this material is available only in sizes from T-12 through T-50. Available in all shielded coil forms.

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 is very similar to the older #41 material but can provide an extended frequency range. Available in Toroidal core sizes from T-30 through T-520 only.

IRON POWDER TOROIDAL CORES
For Resonant Circuits

MATERIAL 0 Perm. 1 Freq. Range 100 MHz - 300 MHz Color -tan

Core number \/	O.D. (inches)	I.D. (inches)	Hgt. (inches)	l_e (cm)	A_e $(cm)^2$	V_e $(cm)^3$	A_L Value uh/100 turns
T-12-0	.125	.062	.050	0.74	.010	.007	3.0
T-16-0	.160	.078	.060	0.95	.016	.015	3.0
T-20-0	.200	.088	.070	1.15	.025	.029	3.5
T-25-0	.255	.120	.096	1.50	.042	.063	4.5
T-30-0	.307	.151	.128	1.83	.065	.119	6.0
T-37-0	.375	.205	.128	2.32	.070	.162	4.9
T-44-0	.440	.229	.159	2.67	.107	.286	6.5
T-50-0	.500	.303	.190	3.03	.121	.367	6.4
T-68-0	.690	.370	.190	4.24	.196	.831	7.5
T-80-0	.795	.495	.250	5.15	.242	1.246	8.5
T-94-0	.942	.560	.312	6.00	.385	2.310	10.6
T-106-0	1.060	.570	.437	6.50	.690	4.485	19.0
T-130-0	1.300	.780	.437	8.29	.730	6.052	15.0

Due to the nature of the `0' material, the inductance may vary greatly depending upon your winding technique. This may cause some discrepancy between calculated and measured inductance.

MATERIAL 1 Perm 20 Freq. Range 0.5 MHz- 5. MHz Color - Blue

Core number \/	O.D. (inches)	I.D. (inches)	Hgt. (inches)	l_e (cm)	A_e $(cm)^2$	V_e $(cm)^3$	A_L Value uh/100 turns
T-12-1	.125	.062	.050	0.74	.010	.007	48
T-16-1	.160	.078	.060	0.95	.016	.015	44
T-20-1	.200	.088	.070	1.15	.025	.029	52
T-25-1	.255	.120	.096	1.50	.042	.063	70
T-30-1	.307	.151	.128	1.83	.065	.119	85
T-37-1	.375	.205	.128	2.32	.070	.162	80
T-44-1	.440	.229	.159	2.67	.107	.286	105
T-50-1	.500	.303	.190	3.03	.121	.367	100
T-68-1	.690	.370	.190	4.24	.196	.831	115
T-80-1	.795	.495	.250	5.15	.242	1.246	115
T-94-1	.942	.560	.312	6.00	.385	2.310	160
T-106-1	1.060	.570	.437	6.50	.690	4.485	325
T-130-1	1.300	.780	.437	8.29	.730	6.052	200
T-157-1	1.570	.950	.570	10.05	1.140	11.457	320
T-184-1	1.840	.950	.710	11.12	2.040	22.685	500
T-200-1	2.000	1.250	.550	12.97	1.330	17.250	250

Note: Most cores can be very useful well below the lower frequency limit shown above.

IRON POWDER TOROIDAL CORES
For Resonant Circuits

MATERIAL 2 Perm. 10 Freq. Range 2 MHz - 30 MHz Color Red

Core number \/	O.D. (inches)	I.D. (inches)	Hgt. (inches)	I_e (cm)	A_e $(cm)^2$	V_e $(cm)^3$	A_L Value uh/100 turns
T-12-2	.125	.062	.050	0.74	.010	.007	20
T-16-2	.160	.078	.060	0.95	.016	.015	22
T-20-2	.200	.088	.070	1.15	.025	.029	25
T-25-2	.255	.120	.096	1.50	.042	.063	34
T-30-2	.307	.151	.128	1.83	.065	.119	43
T-37-2	.375	.205	.128	2.32	.070	.162	40
T-44-2	.440	.229	.159	2.67	.107	.286	52
T-50-2	.500	.303	.190	3.03	.121	.367	49
T-68-2	.690	.370	.190	4.24	.196	.831	57
T-80-2	.795	.495	.250	5.15	.242	1.246	55
T-94-2	.942	.560	.312	6.00	.385	2.310	84
T-106-2	1.060	.570	.437	6.50	.690	4.485	135
T-130-2	1.300	.780	.437	8.29	.730	6.052	110
T-157-2	1.570	.950	.570	10.05	1.140	11.457	140
T-184-2	1.840	.950	.710	11.12	2.040	22.685	240
T-200-2	2.000	1.250	.550	12.97	1.330	17.250	120
T-200A-2	2.000	1.250	1.000	12.97	2.240	29.050	218
T-225 -2	2.250	1.405	.550	14.56	1.508	21.956	120
T-225A-2	2.250	1.485	1.000	14.56	2.730	39.749	215
T-300 -2	3.058	1.925	.500	19.83	1.810	35.892	114
T-300A-2	3.048	1.925	1.000	19.83	3.580	70.991	228
T-400 -2	4.000	2.250	.650	24.93	3.660	91.244	180
T-400A-2	4.000	2.250	1.300	24.93	7.432	185.280	360
T-520 -2	5.200	3.080	.800	33.16	5.460	181.000	207

MATERIAL 3 Perm 35 Freq. Range .05 MHz - 5. MHz Color - Gray

Core number \/	O.D. (inches)	I.D. (inches)	Hgt. (inches)	I_e (cm)	A_e $(cm)^2$	V_e $(cm)^3$	A_L Value uh/100 turns
T-12-3	.125	.062	.050	0.74	.010	.007	60
T-16-3	.160	.078	.060	0.95	.016	.015	61
T-20-3	.200	.088	.070	1.15	.025	.029	76
T-25-3	.255	.120	.096	1.50	.042	.063	100
T-30-3	.307	.151	.128	1.83	.065	.119	140
T-37-3	.375	.205	.128	2.32	.070	.162	120
T-44-3	.440	.229	.159	2.67	.107	.286	180
T-50-3	.500	.303	.190	3.03	.121	.367	175
T-68-3	.690	.370	.190	4.24	.196	.831	195
T-80-3	.795	.495	.250	5.15	.242	1.246	180
T-94-3	.942	.560	.312	6.00	.385	2.310	248
T-106-3	1.060	.570	.437	6.50	.690	4.485	450
T-130-3	1.300	.780	.437	8.29	.730	6.052	350
T-157-3	1.570	.950	.570	10.05	1.140	11.457	420
T-184-3	1.840	.950	.710	11.12	2.040	22.685	720
T-200-3	2.000	1.250	.550	12.97	1.330	17.250	425
T-200A-3	2.000	1.250	1.000	12.97	2.240	29.050	460
T-225 -3	2.250	1.405	.550	14.56	1.508	21.956	425

IRON POWDER TOROIDAL CORES
For Resonant Circuits

MATERIAL 6 Perm. 8 Freq. Range 10 MHz - 50 MHz Color - Yellow

Core number \/	O.D. (inches)	I.D. (inches)	Hgt. (inches)	l_e (cm)	A_e $(cm)^2$	V_e $(cm)^3$	A_L Value uh/100 turns
T-12-6	.125	.062	.050	0.74	.010	.007	17
T-16-6	.160	.078	.060	0.95	.016	.015	19
T-20-6	.200	.088	.070	1.15	.025	.029	22
T-25-6	.255	.120	.096	1.50	.042	.063	27
T-30-6	.307	.151	.128	1.83	.065	.119	36
T-37-6	.375	.205	.128	2.32	.070	.162	30
T-44-6	.440	.229	.159	2.67	.107	.286	42
T-50-6	.500	.303	.190	3.03	.121	.367	46
T-68-6	.690	.370	.190	4.24	.196	.831	47
T-80-6	.795	.495	.250	5.15	.242	1.246	45
T-94-6	.942	.560	.312	6.00	.385	2.310	70
T-106-6	1.060	.570	.437	6.50	.690	4.485	116
T-130-6	1.300	.780	.437	8.29	.730	6.052	96
T-157-6	1.570	.950	.570	10.05	1.140	11.457	115
T-184-6	1.840	.950	.710	11.12	2.040	22.685	195
T-200-6	2.000	1.250	.550	12.97	1.330	17.250	100
T-200A-6	2.000	1.250	1.000	12.97	2.240	29.050	180
T-225 -6	2.250	1.405	.550	14.56	1.508	21.956	100

MATERIAL 7 Perm 9 Freq. Range 3 MHz - 35 Mhz. Color - White

Core number \/	O.D. (inches)	I.D. (inches)	Hgt. (inches)	l_e (cm)	A_e $(cm)^2$	V_e $(cm)^3$	A_L Value uh/100 turns
T-25-7	.255	.120	.096	1.50	.042	.063	29
T-37-7	.375	.205	.128	2.32	.070	.162	32
T-50-7	.500	.303	.190	3.03	.121	.367	43
T-68-7	.690	.370	.190	4.24	.196	.831	52

MATERIAL 10 Perm 6 Freq. Range 30 MHz - 100 MHz Color - Black

Core number \/	O.D. (inches)	I.D. (inches)	Hgt. (inches)	l_e (cm)	A_e $(cm)^2$	V_e $(cm)^3$	A_L Value uh/100 turns
T-12-10	.125	.062	.050	0.74	.010	.007	12
T-16-10	.160	.078	.060	0.95	.016	.015	13
T-20-10	.200	.088	.070	1.15	.025	.029	16
T-25-10	.255	.120	.096	1.50	.042	.063	19
T-30-10	.307	.151	.128	1.83	.065	.119	25
T-37-10	.375	.205	.128	2.32	.070	.162	25
T-44-10	.440	.229	.159	2.67	.107	.286	33
T-50-10	.500	.303	.190	3.03	.121	.367	31
T-68-10	.690	.370	.190	4.24	.196	.831	32
T-80-10	.795	.495	.250	5.15	.242	1.246	32
T-94-10	.942	.560	.312	6.00	.385	2.310	58

IRON POWDER TOROIDAL CORES
For Resonant Circuits

MATERIAL 12 Perm 4 Freq. range 50 MHz - 200 MHz. Grn & Wh.

Core number \/	O.D. (inches)	I.D. (inches)	Hgt. (inches)	I_e (cm)	A_e $(cm)^2$	V_e $(cm)^3$	A_L Value uh/100 turns
T-12-12	.125	.062	.050	0.74	.010	.007	7.5
T-16-12	.160	.078	.060	0.95	.016	.015	8.0
T-20-12	.200	.088	.070	1.15	.025	.029	10.0
T-25-12	.255	.120	.096	1.50	.042	.063	12.0
T-30-12	.307	.151	.128	1.83	.065	.119	16.0
T-37-12	.375	.205	.128	2.32	.070	.162	15.0
T-44-12	.440	.229	.159	2.67	.107	.286	18.5
T-50-12	.500	.303	.190	3.03	.121	.367	18.0
T-68-12	.690	.370	.190	4.24	.196	.831	21.0
T-80-12	.795	.495	.250	5.15	.242	1.246	22.0
T-94-12	.942	.560	.312	6.00	.385	2.310	32.0

Note: If greater stability is desired ask for #17 material, but 'Q' will be sacrificed. See material description and temperature chart. Sizes available only T-12 through T-50. Color code for material #17 - Blue and Yellow.

MATERIAL 15 Perm 25 Freq. 0.1 MHz - 2. MHz Color - Rd & Wh

Core number \/	O.D. (inches)	I.D. (inches)	Hgt. (inches)	I_e (cm)	A_e $(cm)^2$	V_e $(cm)^3$	A_L Value uh/100 turns
T-12-15	.125	.062	.050	0.74	.010	.007	50
T-16-15	.160	.078	.060	0.95	.016	.015	55
T-20-15	.200	.088	.070	1.15	.025	.029	65
T-25-15	.255	.120	.096	1.50	.042	.063	85
T-30-15	.307	.151	.128	1.83	.065	.119	93
T-37-15	.375	.205	.128	2.32	.070	.162	90
T-44-15	.440	.229	.159	2.67	.107	.286	160
T-50-15	.500	.303	.190	3.03	.121	.367	135
T-68-15	.690	.370	.190	4.24	.196	.831	180
T-80-15	.795	.495	.250	5.15	.242	1.246	170
T-94-15	.942	.560	.312	6.00	.385	2.310	200
T-106-15	1.060	.570	.437	6.50	.690	4.485	345
T-130-15	1.300	.780	.437	8.29	.730	6.052	250
T-157-15	1.570	.950	.570	10.05	1.140	11.457	360

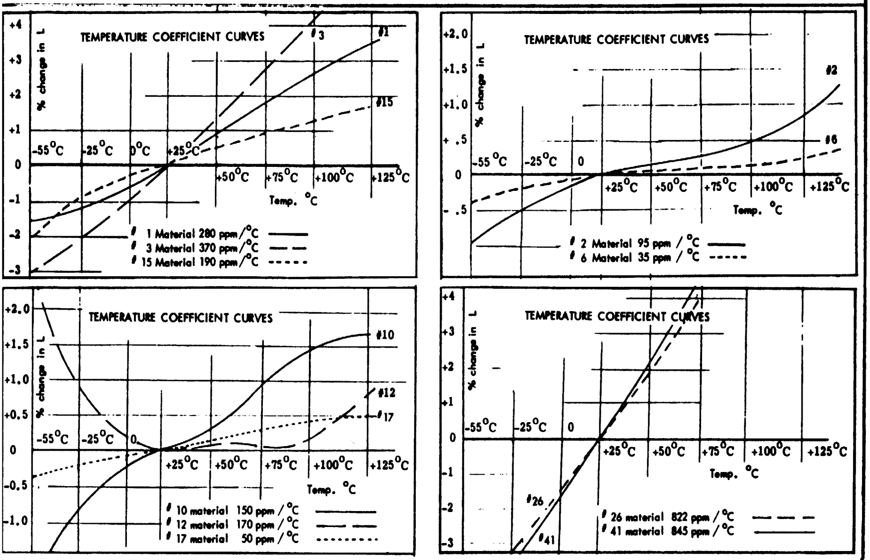
MATERIAL 26 See AC Line Filter and DC Choke section.

The following equations are useful for calculating number of turns, inductance or the A_L value of any Iron Powder toroidal core. Each core has been assigned an A_L value which will be found in the preceding Iron Powder toroidal core charts.

$$N = 100\sqrt{\frac{\text{desired 'L' (uh)}}{A_L \text{ (uh/100 turns)}}} \qquad L\text{ (uh)} = \frac{A_L \times N^2}{10{,}000} \qquad A_L \text{ (uh /100 turns)} = \frac{10{,}000 \times \text{'L' (uh}}{N^2}$$

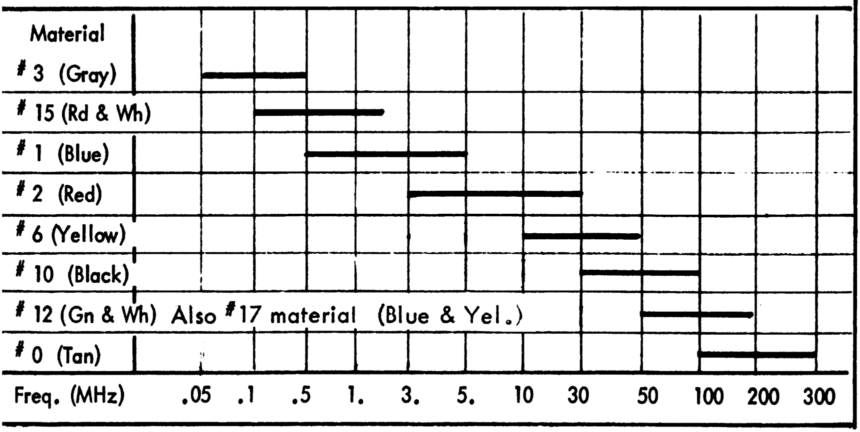
N = number of turns: L = inductance (uh) A_L = inductance index (uh / 100 turns

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.



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)

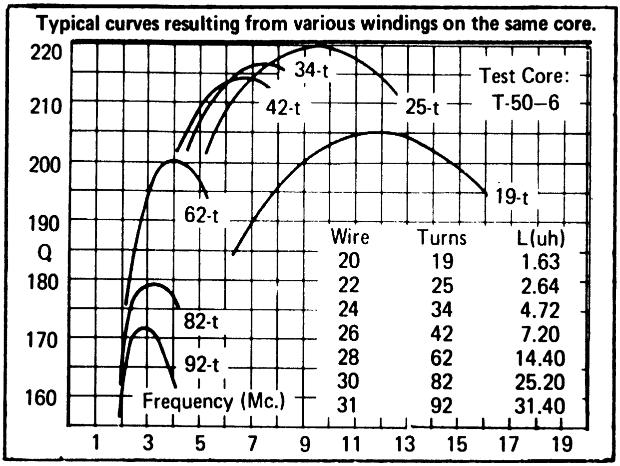
For complete part number, add Mix number to Core Size number.

Core Size \/ Mhz>	26 Mix Yel-Wh u = 75 Pwr Frq	3 Mix Gray u = 35 .05 -0.5	15 Mix Rd-Wh u = 25 0.1 - 2.	1 Mix Blue u = 20 0.5 - 5.	2 Mix Red u = 10 2 - 30	6 Mix Yellow u = 8 10 - 50	10 Mix Black u = 6 30-100	12 Mix Grn-Wh u = 4 50-200	0 Mix Tan u = 1 100-300
T- 12-	na	60	50	48	20	17	12	7.5	3.0
T- 16-	145	61	55	44	22	19	13	8 0	3.0
T- 20-	180	76	65	52	27	22	16	10.0	3.5
T- 25-	235	100	85	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	18.5	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	195	na	na	na
T-200-	895	425	na	250	120	100	na	na	na
T-200A-	1550	760	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-	800	na	na	na	114	na	na	na	na
T-300A-	1600	na	na	na	228	na	na	na	na
T-400-	1300	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.

IRON-POWDER TOROIDAL CORES

TYPICAL 'Q' CURVES
various windings, same core



The above chart shows typical curves resulting from a number of various windings on the same core. The test core was a T-50-6.

The following pages contain a number of curves which were measured and plotted from actual windings, therefore there may be a slight variation from a mathematical calculation.

IRON POWDER TOROIDAL CORES

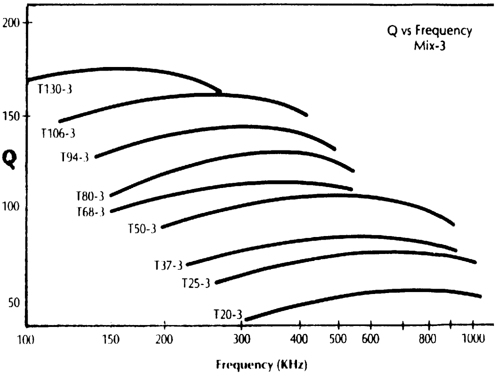
'Q' vs. Frequency 100 KHz - 30 MHz

All coils are single layer magnetic wire, not necessarily optimum values.

MIX-3

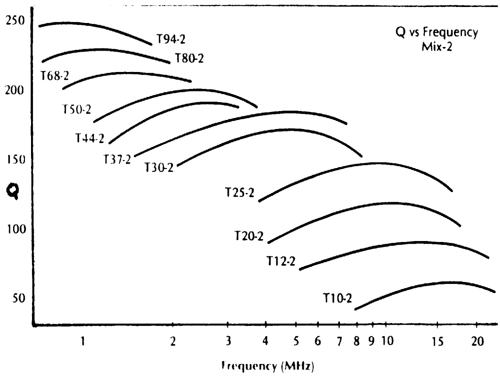
	Turns	Wire	L (uh)
T130-3*	200	#28	1400
T106-3	100	#26	450
T94-3	100	#28	248
T80-3	100	#28	180
T68-3	100	#30	195
T50-3	100	#32	175
T44-3	100	#34	180
T37-3*	100	#33	120
T30-3*	100	#32	140
T25-3*	100	#34	100
T20-3*	100	#38	76

*Not Single Layers



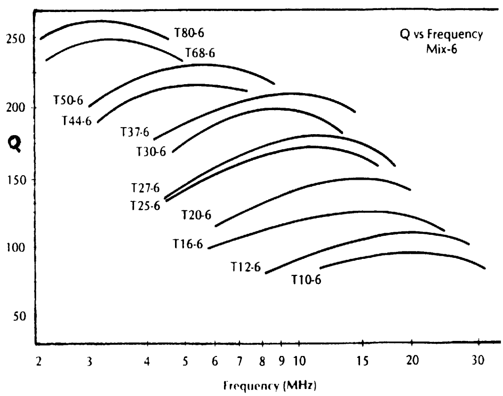
MIX-2

	Turns	Wire	L (uh)
T 94-2	100	#28	84
T 80-2	100	#28	55
T 68-2	100	#30	57
T 50-2	77	#30	29
T 44-2	66	#30	23
T 37-2	53	#30	11.5
T 30-2	47	#32	9.3
T 25-2	30	#30	3.0
T 20-2	30	#33	2.4
T 12-2	25	#36	1.3
T 10-2	25	#40	.9



MIX-6

	Turns	Wire	L (uh)
T 80-6	70	#26	22
T 68-6	60	#27	17
T 50-6	50	#27	10
T 44-6	47	#28	9.3
T 37-6	40	#28	4.8
T 30-6	37	#30	4.9
T 27.6	32	#30	2.8
T 25-6	30	#30	2.5
T 20-6	30	#33	2.0
T 16-6	25	#33	1.2
T 12-6	22	#34	.7
T 10-6	17	#36	.3



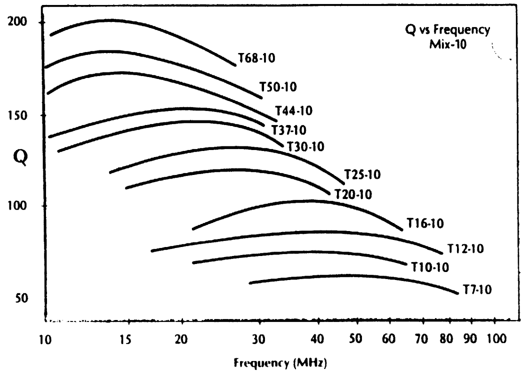
IRON POWDER TOROIDAL CORES

'Q' vs. Frequency 10 MHz - 200 MHz

All coils are single layer magnetic wire, not necessarily optimum values.

MIX-10

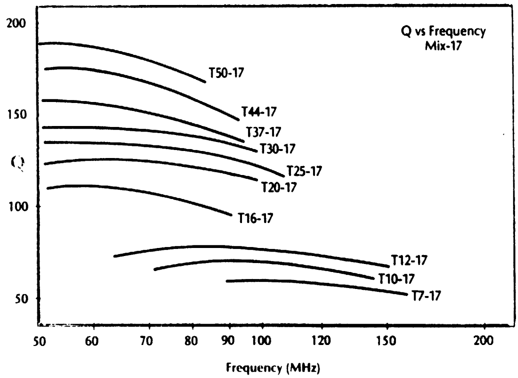
	Turns	Wire	L (uh)
68-10	15	#20	.80
50-10	14	#20	.70
44-10	13	#20	.65
37-10	12	#20	.40
30-10	14	#24	.55
25-10	14	#26	.45
20-10	13	#27	.30
16-10	11	#27	.20
12-10	10	#29	.15
10-10	10	#32	.10
7-10	10	#36	.10



MIX-17

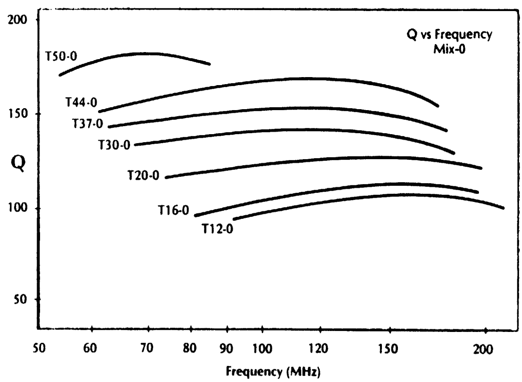
	Turns	Wire	L (uh)
50-17	9	#20	.14
44-17	7	#20	.13
37-17	8	#20	.12
30-17	8	#22	.13
25-17	9	#24	.12
20-17	9	#26	.10
16-17	9	#28	.08
12-17	9	#30	.08
10-17	7	#32	.07
7-17	7	#35	.05

TE: Mix 12 will yield slightly higher Q than Mix 17 but is not recommended for applications requiring good stability.



MIX-0

	Turns	Wire	L (uh)
50-0	10	#20	.12
44-0	8	#20	.08
37-0	8	#22	.07
30-0	8	#22	.07
20-0	8	#24	.06
16-0	7	#26	.04
12-0	7	#26	.03



INDUCTANCE CHARTS
Iron Powder Toroids

IRON POWDER TOROIDAL CORES

MATERIAL #0 — Inductance (uh) vs. Size, Material and Number of Turns

Turns>	10	20	30	40	50	60	70	80	90	100	110	120	130	140
Size														
T-106	.19	.76	1.7	3.0	4.8	6.8	9.3	12	15	19	23	27	32	37
T-94	.10	.40	.90	1.7	2.7	3.8	5.2	6.8	8.6	10.	13	15	18	21
T-80	.08	.34	.77	1.4	2.1	3.0	4.2	5.4	6.9	8.5	10	12	14	-
T-68	.07	.30	.67	1.2	1.9	2.7	3.7	4.8	6.0	7.5	-	-	-	-
T-50	.06	.26	.57	1.0	1.6	2.3	3.1	4.1	-	-	-	-	-	-
T-37	.05	.20	.44	.7	1.2	-	-	-	-	-	-	-	-	-
T-25	.04	.18	.41	-	-	-	-	-	-	-	-	-	-	-
T-20	.03	.14	-	-	-	-	-	-	-	-	-	-	-	-
T-16	.03	.12	-	-	-	-	-	-	-	-	-	-	-	-
T-12	.03	-	-	-	-	-	-	-	-	-	-	-	-	-

IRON POWDER TOROIDAL CORES

MATERIAL #1 — Inductance (uh) vs. Size, Material and Number of Turns

Turns>	10	20	30	40	50	60	70	80	90	100	110	120	130	140
Size														
T-106	3.2	13	29	52	81	117	159	208	263	325	393	468	549	637
T-94	1.6	6.4	14	25	40	57	78	102	130	160	194	230	270	304
T-80	1.2	4.6	10	18	28	41	56	73	93	115	139	166	194	-
T-68	1.2	4.6	10	18	28	41	56	73	93	115	139	166	194	-
T-50	1.0	4.0	9	16	25	36	49	64	-	-	-	-	-	-
T-37	.8	3.2	7	13	20	-	-	-	-	-	-	-	-	-
T-25	.7	2.8	6	-	-	-	-	-	-	-	-	-	-	-
T-20	.5	2.0	-	-	-	-	-	-	-	-	-	-	-	-
T-16	.4	1.7	-	-	-	-	-	-	-	-	-	-	-	-
T-12	.4	-	-	-	-	-	-	-	-	-	-	-	-	-

IRON POWDER TOROIDAL CORES

MATERIAL # 2 — Inductance (uh) vs. Size, Material and Number of Turns

Turns>	10	20	30	40	50	60	70	80	90	100	110	120	130	140
Size														
T-106	1.4	5	12	22	34	49	66	86	109	135	163	194	228	265
T-94	.8	3	8	13	21	30	41	54	68	84	101	120	131	142
T-80	.6	2	5	9	14	20	27	35	45	55	66	79	93	-
T-68	.6	2	5	9	15	21	29	38	48	59	-	-	-	-
T-50	.5	2	2	8	12	18	24	31	-	-	-	-	-	-
T-37	.4	2	4	6	10	-	-	-	-	-	-	-	-	-
T-25	.3	1	3	-	-	-	-	-	-	-	-	-	-	-
T-20	.3	1	-	-	-	-	-	-	-	-	-	-	-	-
T-16	.2	-	-	-	-	-	-	-	-	-	-	-	-	-
T-12	.1	-	-	-	-	-	-	-	-	-	-	-	-	-

INDUCTANCE CHARTS

Iron Powder Toroids

IRON POWDER TOROIDAL CORES

MATERIAL #3 — Inductance (uh) vs. Size, Material and Number of Turns

Turns>	10	20	30	40	50	60	70	80	90	100	110	120	130	140
Size														
T-106	5	18	41	72	113	182	221	288	365	450	545	648	761	882
T-94	2	10	22	40	62	89	121	159	200	248	300	357	419	486
T-80	2	7	16	29	45	65	88	115	146	180	218	259	304	-
T-68	3	8	18	31	49	70	96	125	158	185	-	-	-	-
T-50	2	7	16	26	44	63	86	112	-	-	-	-	-	-
T-37	1	5	9	-	-	-	-	-	-	-	-	-	-	-
T-25	1	4	9	-	-	-	-	-	-	-	-	-	-	-
T-20	.9	4	-	-	-	-	-	-	-	-	-	-	-	-
T-16	.6	2	-	-	-	-	-	-	-	-	-	-	-	-
T-12	.6	-	-	-	-	-	-	-	-	-	-	-	-	-

IRON POWDER TOROIDAL CORES

MATERIAL #6 — Inductance (uh) vs. Size, Material and Number of Turns

Turns>	10	20	30	40	50	60	70	80	90	100	110	120	130	140
Size														
T-106	1.1	5	10	19	30	42	57	74	94	116	140	167	196	227
T-94	.7	3	6	11	18	25	34	45	57	70	85	100	118	137
T-80	.5	2	4	7	11	16	22	29	36	45	54	64	76	-
T-68	.5	2	4	7	11	17	23	30	38	47	-	-	-	-
T-50	.4	2	3	6	10	14	20	26	-	-	-	-	-	-
T-37	.4	1	3	5	7	-	-	-	-	-	-	-	-	-
T-25	.3	1	2	-	-	-	-	-	-	-	-	-	-	-
T-20	.2	.8	1	-	-	-	-	-	-	-	-	-	-	-
T-16	.2	-	-	-	-	-	-	-	-	-	-	-	-	-
T-12	.1	-	-	-	-	-	-	-	-	-	-	-	-	-

IRON POWDER TOROIDAL CORES

MATERIAL #10 — Inductance (uh) vs. Size, Material and Number of Turns

Turns>	10	20	30	40	50	60	70	80	90	100	110	120	130	140
Size>														
T-94	.6	2	5	9	15	21	28	37	47	58	70	84	98	113
T-80	.3	1	3	5	8	12	16	21	27	33	40	48	54	-
T-68	.3	1	2	5	8	12	16	20	26	32	-	-	-	-
T-50	.3	1	3	5	8	11	15	20	-	-	-	-	-	-
T-37	.3	1	2	4	6	-	-	-	-	-	-	-	-	-
T-25	.2	.8	2	-	-	-	-	-	-	-	-	-	-	-
T-20	.1	.6	-	-	-	-	-	-	-	-	-	-	-	-
T-16	.1	.5	-	-	-	-	-	-	-	-	-	-	-	-
T-12	.1	-	-	-	-	-	-	-	-	-	-	-	-	-

INDUCTANCE CHARTS

Iron Powder Toroids

IRON POWDER TOROIDAL CORES

MATERIAL #15 Inductance (uh) vs. Size, Material and Number of Turns

Turns> / Size	10	20	30	40	50	60	70	80	90	100	110	120	130	140
T-106	4	14	31	55	86	124	169	221	279	345	417	497	583	676
T-94	2	8	18	32	50	72	98	128	162	200	242	288	338	392
T-80	2	7	15	27	43	61	83	109	138	170	206	245	287	-
T-68	2	7	16	29	45	65	88	115	146	180	-	-	-	-
T-50	1	5	12	22	34	49	66	86	-	-	-	-	-	-
T-37	1	4	8	14	23	-	-	-	-	-	-	-	-	-
T-25	1	3	8	-	-	-	-	-	-	-	-	-	-	-
T-20	.5	3	-	-	-	-	-	-	-	-	-	-	-	-
T-16	.5	3	-	-	-	-	-	-	-	-	-	-	-	-
T-12	.5	-	-	-	-	-	-	-	-	-	-	-	-	-

IRON POWDER TOROIDAL CORES

MATERIAL #17 Inductance (uh) vs. Size, Material and Number of Turns

Turns> / Size	10	20	30	40	50	60	70	80	90	100	110	120	130	140
T-94	.3	1	3	5	8	12	16	20	30	32	39	46	54	63
T-80	.2	.8	2	4	6	6	11	14	18	22	27	32	37	-
T-68	.2	.8	2	3	5	7	10	13	17	21	-	-	-	-
T-50	.2	.7	2	3	5	7	9	12	-	-	-	-	-	-
T-37	.1	.6	1	2	4	-	-	-	-	-	-	-	-	-
T-25	.1	.5	1	-	-	-	-	-	-	-	-	-	-	-
T-20	.1	.4	-	-	-	-	-	-	-	-	-	-	-	-
T-16	.08	.3	-	-	-	-	-	-	-	-	-	-	-	-
T-12	.07	-	-	-	-	-	-	-	-	-	-	-	-	-

IRON POWDER TOROIDAL CORES

MATERIAL #26 Inductance (uh) vs. Size, Material and Number of Turns

Turns> / Size	10	20	30	40	50	60	70	80	90	100	110	120	130	140
T-106	9	36	81	144	245	324	441	576	729	900	089	1296	1521	1764
T-94	6	24	53	94	148	212	289	378	478	590	714	850	997	1156
T-80	5	18	41	72	113	162	221	288	365	450	545	648	761	882
T-68	4	17	38	67	105	151	206	269	340	420	508	605	710	823
T-50	3	13	29	51	80	115	157	205	259	320	387	461	541	627
T-37	2.7	11	25	44	69	135	176	223	-	-	-	-	-	-

INDUCTANCE CHART
Iron Powder Toroids

Inductance (uh) vs. Size, Material and Number of Turns

Turns>	10	20	30	40	50	60	70	80	90	100	110	120	130
Core Number													
T-520-26	15	58	131	233	365	526	715	934	1182	1460	1767	2102	2467
T-520-2	2	8	18	33	51	74	101	132	167	207	250	298	349
T-400A-26	26	104	324	416	650	936	1274	1664	2106	2600	3146	3744	4394
T-400A-2	4	14	32	57	90	130	176	230	292	360	436	518	608
T-400-26	13	53	119	211	330	475	646	845	1069	1320	1597	1900	2231
T-400-2	2	7	17	27	46	67	91	118	150	185	224	266	313
T-300A-26	16	64	144	256	400	576	784	1024	1296	1600	1936	2304	2704
T-300A-2	2	9	20	36	57	82	118	146	185	228	276	328	385
T-300-26	8	33	74	132	06	297	404	528	668	825	998	188	1394
T-300-2	1	5	10	18	29	41	56	74	93	115	139	166	194
T-225A-26	16	64	144	256	400	576	784	1024	1296	1600	1936	2304	2704
T-225A-2	2	9	19	34	54	77	105	138	174	215	276	310	385
T-225-26	10	38	86	152	238	342	466	608	770	950	1150	1368	1607
T-225-2	1	5	11	19	30	43	59	79	97	120	145	173	203
T-225-3	4	17	38	68	106	153	208	272	344	425	514	612	718
T-225-6	1	4	9	16	25	36	49	64	81	100	121	144	169
T-200A-26	16	62	136	248	388	558	760	992	1256	1550	1875	2418	2619
T-200A-1	5	18	41	73	114	164	223	291	369	455	551	655	764
T-200A-2	2	9	19	35	55	78	107	140	177	218	264	314	368
T-200A-3	5	18	41	74	115	165	225	294	373	460	557	662	777
T-200A-6	2	7	16	29	45	65	88	115	146	180	218	259	304
T-200-26	9	36	81	143	224	322	439	573	725	895	1082	1289	1513
T-200-1	3	10	23	40	63	90	123	160	203	250	303	360	423
T-200-2	1	5	11	19	30	43	59	79	97	120	145	173	203
T-200-3	4	17	38	68	106	153	208	272	344	425	514	612	718
T-200-6	1	4	9	16	25	36	49	64	81	100	121	144	169
T-184-26	16	66	148	262	410	590	804	1049	1328	1640	1984	2362	2772
T-184-1	5	20	45	80	125	180	245	320	405	500	605	720	845
T-184-2	2	10	22	38	60	86	118	154	194	240	290	396	406
T-184-3	7	29	65	115	180	259	353	461	583	720	871	1039	1217
T-184-6	2	8	18	31	49	70	96	125	158	195	236	281	330
T-157-26	10	34	87	155	243	349	475	621	786	970	1174	1397	1639
T-157-1	3	13	29	51	80	115	157	205	259	320	387	461	541
T-157-2	1	6	13	22	35	50	69	90	113	140	169	202	237
T-157-3	4	17	38	67	105	151	206	269	340	420	508	605	710
T-157-6	1	5	10	18	29	41	56	74	93	115	139	166	194
T-157-15	4	14	32	58	90	130	176	230	292	360	436	518	608
T-130-26	8	31	71	126	196	283	385	502	636	785	950	1130	1327
T-130-1	2	8	18	32	50	72	98	128	162	200	242	288	334
T-130-2	1	4	10	18	28	40	54	70	89	110	133	158	186
T-130-3	4	13	36	56	88	127	172	224	284	350	424	504	592
T-130-6	1	4	9	15	24	35	47	61	78	96	116	138	162
T-130-15	3	10	23	40	63	90	123	160	203	250	303	360	423

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 ir 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	111
T-225	36	46	60	77	98	123	156	198	250	317	400	499	631	793	993	125
T-300	52	66	85	108	137	172	217	274	347	438	553	688	870	1093	1368	172
T-400	61	79	100	127	161	202	255	322	407	513	648	806	1018	1278	1543	201
T-520	86	110	149	160	223	279	349	443	559	706	889	1105	1396	1753	2192	275

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 sectional area of the core, core material, turns count, 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' ?

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 saturation.

The following extrapolated AC flux density limits can be used for BOTH Iron Powder and Ferrite type cores as a guide-line to avoid excessive heating. These figures may vary slightly according to material being used.

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

Operating frequency is one of the most important factors in power capability above 100 KHz. A core that works well at 2 MHz. may burn up at 30 MHz. with the same amount of drive.

Core saturation, a secondary cause of coil failure, 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 level for most Ferrite materials is typically 2000 gauss, while Iron Powder materials can tolerate up to 5000 gauss without significant saturation effects.

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. In order 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 have 'trade-offs'. Ferrite type cores will require fewer turns, will give more impedance per turn and will couple better, whereas the Iron Powder cores will require more turns, will give less impedance per turn, will not couple as well but will tolerate more power and are more stable.

POWER CONSIDERATIONS (CONT)

The equation for determining the maximum flux density of a given toroidal core is as follows:

$$B_{max} = \frac{E \times 10^8}{4.44 \times A_e \times N \times F}$$

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

The safety factor may be increased by using the peak AC voltage in the equation. This is standard practice among many RF engineers who design broadband RF power transformers.

The above equation may be changed as shown below to make it more convenient during calculations of B_{max} at radio frequencies.

$$B_{max} = \frac{E \times 10^2}{4.44 \times A_e \times N \times F}$$

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

The sample calculation below is based on a frequency of 7 MHz, a peak voltage of 25 volts and a primary winding of 15 turns. The cross-sectional area of the sample core is 0.133 cm^2 From previous guidelines we know that the maximum flux density at 7 MHz should be not more than 57 gauss.

$$B_{max} = \frac{25 \times 100}{4.44 \times 0.133 \times 15 \times 7} = 40.3 \text{ gauss}$$

This hypothetical toroid core will have a flux density of 40 gauss according to the above formula and when operated under the above conditions. This is well within the limits as shown above.

Temperature rise can be the result of using an undersized wire gauge for the amount of current involved as well as magnetic action within the core. Both will contribute to the overall temperature rise of the transformer. This can be calculated with the following equation :

$$\text{Temperature Rise } (^\circ C) = \left[\frac{\text{Total Power Dissipation (Milliwatts)}}{\text{Available Surface Area } (cm^2)}\right]^{.833}$$

If the operating temperature (ambient temperature + temperature rise) is more than $100^\circ C$ when used intermittently, or more than $75^\circ C$ if used continuously, a larger size core and/or a heavier gauge wire should be selected.

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:

Percent Initial Permeability vs. AC Flux Density

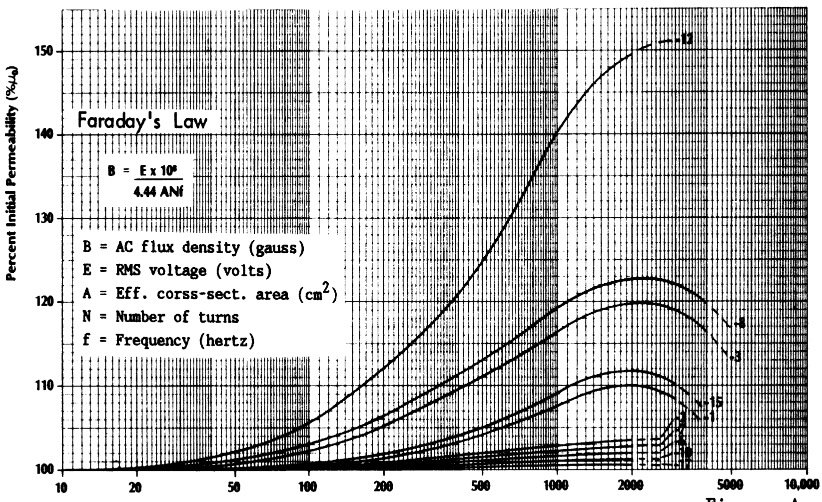


Figure A

Percent Initial Permeability vs. DC Magnetizing Force

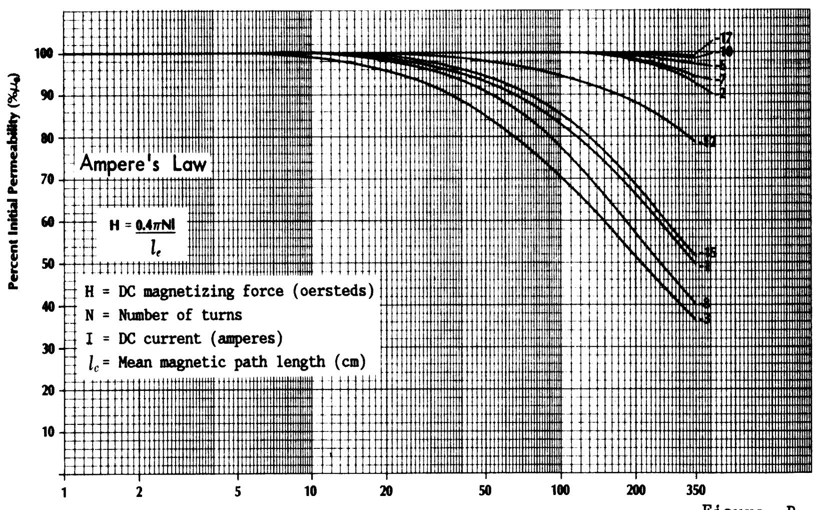
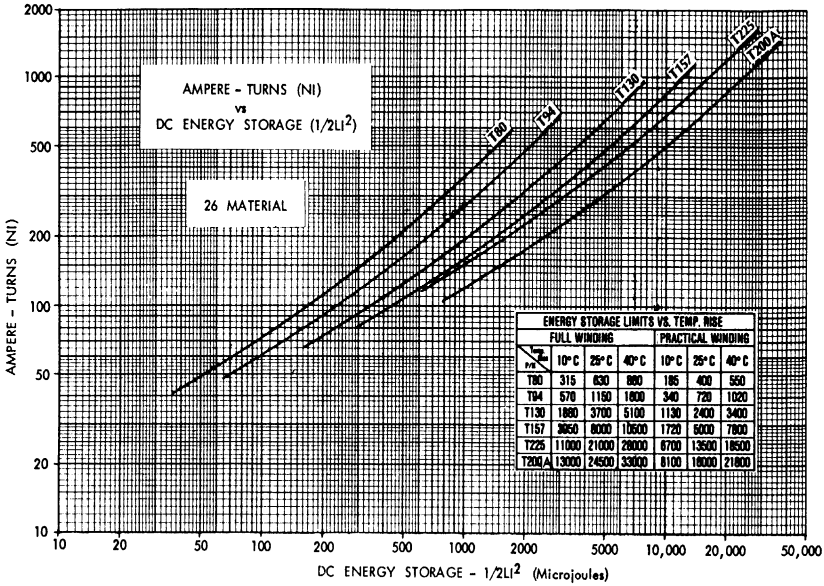


Figure B

Iron Powder Toroidal Cores

DC Chokes



ENERGY STORAGE LIMITS VS. TEMP. RISE						
	FULL WINDING			PRACTICAL WINDING		
Temp. Rise / P/N	10° C	25° C	40° C	10° C	25° C	40° C
T80	315	630	880	185	400	550
T94	570	1150	1600	340	720	1020
T130	1880	3700	5100	1130	2400	3400
T157	3950	8000	10500	1720	5000	7800
T225	11000	21000	28000	6700	13500	18500
T200A	13000	24500	33000	8100	16000	21800

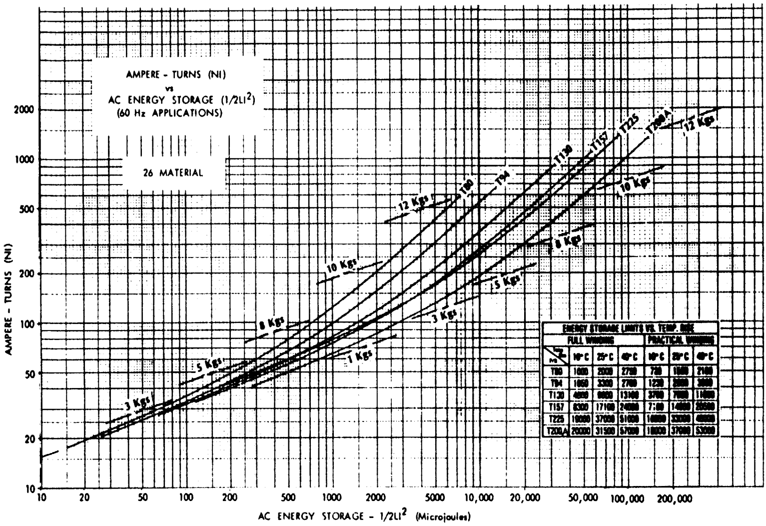
DC Choke Applications (single layer winding)

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 40°C

Iron Powder Toroidal Cores

AC Line Filters



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

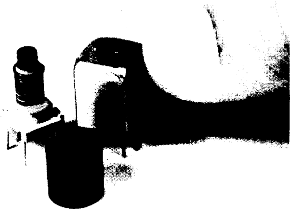
AC Amps >	1 Amp	2 Amps	4 Amps	6 Amps	10 Amps	15 Amps	20 Amps	30 Amps
Wire size >	28 AWG	24 AWG	21 AWG	19 AWG	15 AWG	13 AWG	11 AWG	9 AWG
Part\/No								
T-37 -26*	130 uh 41 turns	50.0 uh 27 turns	15 uh 15 turns	6.7 uh 10 turns	2.4 uh 6 turns	1.1 uh 4 turns	.60 uh 3 turns	.07 uh 1 turn
T-50 -26*	460 uh 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

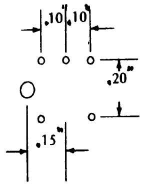
Note: * Size not shown on above curve chart. Wire size based on Max. Temp. rise 40^0 C.

Iron Powder Shielded Coil Forms

Adjustable/ Slug Tuned

L-33 Coil Forms (Specify material)





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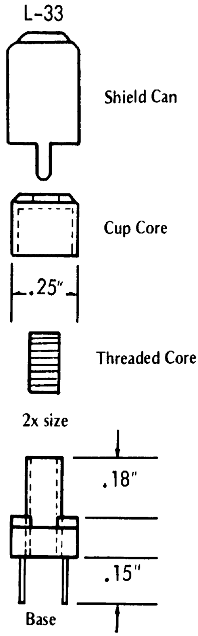
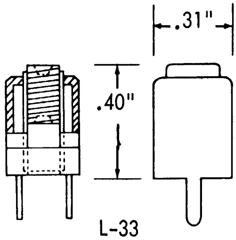




- Sub miniture size
- Slug tuning
- Copper shield, tin plated
- Easy to wind
- Good Q
- Freq. range 10 KHz - 200 MHz
- Inductance range .08 - 180 uh

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	0.30 - 1.0	76	1.7 - 1	3/44	75	42.5	80
L-33-2	1.00 - 10.0	68	1.5 - 1	9/44	40	10.9	90
L-33-3	0.01 - 0.5	80	1.8 - 1	3/44	150	180	70
L-33-6	10.00 - 50.0	60	1.5 - 1	26	7	0.36	100
L-33-10	25.00 - 100.0	54	1.4 - 1	26	5	0.18	120
L-33- 17	50.00 - 200.0	48	1.3 - 1	26	3	0.08	130

Solid magnet wire may be substituted for the Litz wire, but somewhat lower Q may result.

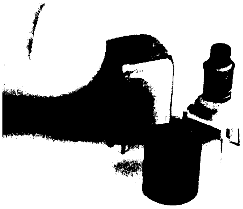
Most efficient when tuning slug is set at maximum L. For tuning flexibility calculate so that slug will be about 90% maximum L when at operating frequency.

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

Iron Powder Shielded Coil Forms

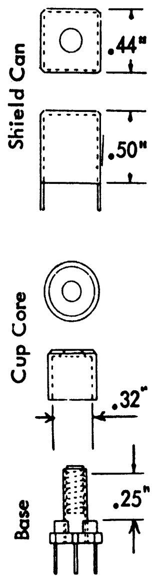
Adjustable/ Slug Tuned

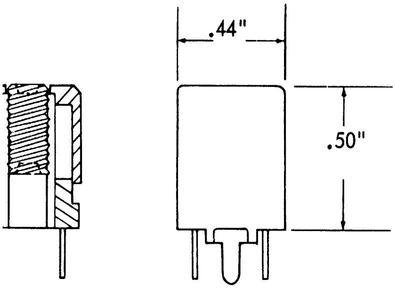
L-43 Coil Forms (Specify material)



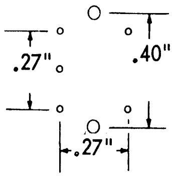
Miniature in size
Slug tuning
Copper shield can, tin plated
Easy to wind
Good Q
Frequency range .2 to 200 MHz.
Inductance range .02 to 700 uh.

L-43





L-43



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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	0.30 - 1.0	115	1.6 - 1	5/44	149	230	110
L-43-2	1.00 - 10.0	98	1.6 - 1	9/44	21	4.0	120
L-43-3	0.01 - 0.5	133	1.8 - 1	3/44	223	600	90
L-43-6	10.00 - 50.0	85	1.4 - 1	26	6	0.30	130
L-43-10	25.00 - 100.0	72	1.3 - 1	24	5	0.14	150
L-43-17	50.00 - 200.0	56	1.2 - 1	22	3	0.05	200

Solid magnet wire may be substituted for the Litz wire, but somewhat lower Q may result.

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.

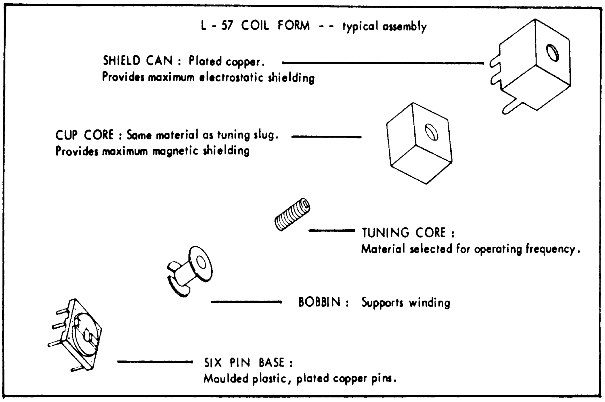
$$\text{Turns} = 100\sqrt{\frac{\text{desired 'L' (uh)}}{90\%\ A_L\ \text{(uh/100 turns)}}}$$

Iron Powder Shielded Coil Forms

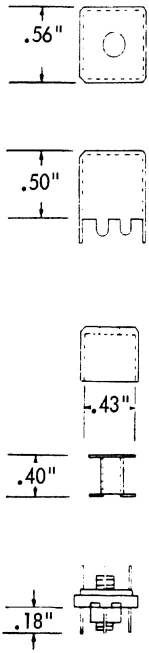
Adjustable/ Slug Tuned

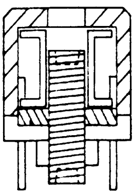
L-57 Coil Forms (Specify material)

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



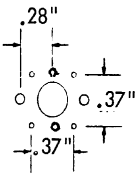
L-57





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.



pin 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.

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

Ferrite Cores

Ferrite Cores are available in numerous sizes and several perme-abilities. Their permeability range is from 125 to more than 5000. They are very useful for resonant circuit applications as well as wideband transformers. and they are also very useful for RFI attenuation. We can supply sizes from .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: those having a permeability range from 20 to 800 mu are of the NICKEL ZINC class and those having permeabilities above 800 mu are usually of the Manganese Zinc class.

The 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 their permeability factors make them useful for wide band transformer applications.

The MANGANESE ZINC group of ferrites, having permeabilities from 800 mu to 5000 mu 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, magnetic properties, and the turns count formula for ferrite toroidal cores will be found on the next few pages. All items in this booklet are standard stock items and can be shipped immediately.

Ferrite Materials

MATERIAL 33 (u = 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 (u = 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, balun cores and special shapes for RFI suppression.

MATERIAL 61 (u = 125) Offers moderate temperature stability and high 'Q' for frequencies 0.2 MHz to 15 MHz. Useful for wideband transformers to 200 MHz. and frequency attenuation above 200 MHz. Available in toroids, rods, bobbins and some two-hole baluns.

MATERIAL 63 (u = 40) For high 'Q' inductors in the 15 MHz to 25 MHz. frequency range. Available in toroidal form only.

MATERIAL 64 (u = 250) Primarily a bead material having high volume resistivity. Excellent temperature stability and very good shielding properties above 400 MHz.

MATERIAL 67 (u 40) Similar to the 63 material. Has greater saturation flux density and lower volume resistivity. Very good temperature stability. For high 'Q' inductors, (10 MHz to 80 Mhz.). Wideband transformers to 200 MHz. Toroids only.

MATERIAL 68 (u = 20) High volume resistivity and excellent temperature stability. For high Q' resonant circuits 80 MHz.to 180 MHz. For high frequency inductors. Toroids only.

MATERIAL 73 (u = 2500) Primarily a ferrite bead material, Has good attenuation properties from 1 MHz. through 50 MHz. Available in beads and some broadband balun cores.

MATERIAL 77 (u = 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 wideband transformers. Extensively used for frequency attenuation from 0.5 Mhz. to 50 MHz. 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' (u = 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 (perm 5000) Low volume resistivity & low core loss from 1 KHz.to 1 MHz. Used for pulse transformers and low level wideband transformers. Excellent frequency attenuation from 0.5 MHz to 20 MHz. Toroids and ferrite beads only.

FERRITE TOROIDAL CORES

MATERIAL 43 — Permeability 850

Core\/number	O.D. (in)	I.D. (in)	Hgt (in)	l_e cm	A_e cm^2	V_e cm^3	A_L value mh/1000 t
FT-23 -43	.230	.120	.060	1.34	.021	.029	188
FT-37 -43	.375	.187	.125	2.15	.076	.163	420
FT-50 -43	.500	.281	.188	3.02	.133	.401	523
FT-50A-43	.500	.312	.250	3.68	.152	.559	570
FT-50B-43	.500	.312	.500	3.18	.303	.963	1140
FT-82 -43	.825	.520	.250	5.26	.246	1.294	557
FT-114-43	1.142	.750	.295	7.42	.375	2.783	603
FT-140-43	1.400	.900	.500	9.02	.806	7.270	952
FT-240-43	2.400	1.40	.500	14.40	1.570	22.608	1240

MATERIAL 61 — Permeability 125

Core\/number	O.D. (in)	I.D. (in)	Hgt (in)	l_e cm	A_e cm^2	V_e cm^3	A_L value mh/1000 t
FT-23 -61	.230	.120	.060	1.34	.021	.029	24.8
FT-37 -61	.375	.187	.125	2.15	.076	.163	55.3
FT-50 -61	.500	.281	.188	3.02	.133	.401	68.0
FT-50A -61	.500	.312	.250	3.68	.152	.559	75.0
FT-50B -61	.500	.312	.500	3.18	.303	.963	150.0
FT-82 -61	.825	.520	.250	5.26	.246	1.294	73.3
FT-114 -61	1.142	.750	.295	7.42	.375	2.783	79.3
FT-114A-61	1.142	.750	.545	7.42	.690	5.120	146.0
FT-140 -61	1.400	.900	.500	9.02	.806	7.270	140.0
FT-240 -61	2.400	1.40	.500	14.40	1.570	22.608	173.0

MATERIAL 63/67 — Permeability 40

Core\/number	O.D. (in)	I.D. (in)	Hgt (in)	l_e cm	A_e cm^2	V_e cm^3	A_L value mh/1000 t
FT-23 -63/67	.230	.120	.060	1.34	.021	.029	7.8
FT-37 -63/67	.375	.187	.125	2.15	.076	.163	17.7
FT-50 -63/67	.500	.281	.188	3.02	.133	.401	22.0
FT-50A-63/67	.500	.312	.250	3.68	.152	.559	24.0
FT-50B-63/67	.500	.312	.500	3.18	.303	.963	48.0
FT-82 -63/67	.825	.520	.250	5.26	.246	1.294	22.4
FT-114-63/67	1.142	.750	.295	7.42	.375	2.783	25.4
FT-140- /67	1.400	.900	.500	9.02	.806	7.270	45.0
FT-240- /67	2.400	1.400	.500	14.40	1.570	22,608	53.0

MATERIAL 68 — Permeability 20

Core\/number	O.D. (in)	I.D. (in)	Hgt (in)	l_e cm	A_e cm^2	V_e cm^3	A_L value mh/1000 t
FT-23 -68	.230	.120	.060	1.34	.021	.029	4.0
FT-37 -68	.375	.187	.125	2.15	.076	.163	8.8
FT-50 -68	.500	.281	.188	3.02	.133	.401	11.0
FT-50A-68	.500	.312	.250	3.68	.152	.559	12.0
FT-82 -68	.825	.520	.250	5.26	.246	1.294	11.7
FT-114-68	1.142	.750	.295	7.42	.375	2.783	12.7

FERRITE TOROIDAL CORES

MATERIAL 77 (72) — Permeability 2000

Core number	O.D. (in)	I.D. (in)	Hgt (in)	l_e cm	A_e cm^2	V_e cm^3	A_L value mh/1000 t
FT-23 -77	.230	.120	.060	1.34	.021	.029	396
FT-37 -77	.375	.187	.125	2.15	.076	.163	884
FT-50 -77	.500	.281	.188	3.02	.133	.401	1100
FT-50A -77	.500	.312	.250	3.68	.152	.559	1200
FT-50B -77	.500	.312	.500	3.18	.303	.963	2400
FT-82 -77	.825	.520	.250	5.26	.246	1.294	1170
FT-114 -77	1.142	.750	.295	7.42	.375	2.783	1270
FT-114A -77	1.142	.750	.545	7.42	.690	5.120	2340
FT-140 -77	1.400	.900	.500	9.02	.806	7.270	2250
FT-240 -77	2.400	1.400	.500	14.40	1.570	22.608	3130

MATERIAL 'F ' — Permeability 3000

Core number	O.D. (in)	I.D. (in)	Hgt (in)	l_e cm	A_e cm^2	V_e cm^3	A_L value mh/1000 t
FT-87A -F	.870	.540	.500	5.42	.315	1.710	3700
FT-114 -F	1.142	.750	.295	7.42	.375	2.783	1902
FT-150 -F	1.500	.750	.250	8.30	.591	4.905	2640
FT-150A-F	1.500	.750	.500	8.30	1.110	9.213	5020
FT-193 -F	1.932	1.250	.625	12.31	1.360	16.742	3640
FT-193A-F	1.932	1.250	.750	12.31	1.620	19.942	4460

MATERIAL 'J'(75) — Permeability 5000

Core number	O.D. (in)	I.D. (in)	Hgt (in)	l_e cm	A_e cm^2	V_e cm^3	A_L value mh/1000 t
FT-23 -J	.230	.120	.060	1.34	.021	.029	990
FT-37 -J	.375	.187	.125	2.15	.076	.163	2110
FT-50 -J	.500	.281	.188	3.02	.133	.401	2750
FT-50A -J	.500	.312	.250	3.68	.152	.559	2990
FT-87 -J	.870	.540	.250	5.42	.250	1.360	3020
FT-87A -J	.870	.540	.500	5.42	.315	1.710	6040
FT-114 -J	1.142	.750	.295	7.42	.375	2.783	3170
FT-140 -J	1.400	.900	.500	9.02	.806	7.270	6736
FT-150 -J	1.500	.750	.250	8.30	.591	4.905	4400
FT-150A-J	1.500	.750	.500	8.30	1.110	9.213	8370
FT-193 -J	1.500	1.250	.625	12.31	1.360	16.742	6065
FT-193A-J	1.932	1.250	.750	12.31	1.620	19 942	7435
FT-240 -J	2.400	1.400	.500	14.40	1.570	22.608	6845

The following equations are useful for calculating the number of turns, the inductance or the A_L value of any Ferrite toroidal core. Each core has been assigned its own A_L value which is found in the preceding Ferrite toroidal core charts.

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

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

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	.029
FT-37	.375	.187	.125	2.15	.076	.163
FT-50	.500	.281	.188	3.02	.133	.401
FT-50 -A	.500	.312	.250	3.68	.152	.559
FT-50 -B	.500	.312	.500	3.18	.303	.963
FT-82	.825	.520	.250	5.26	.246	1.294
FT-87	.870	.540	.250	5.41	.261	1.414
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	1.932	1.250	.625	12.31	1.360	16.742
FT-193-A	1.932	1.250	.750	12.31	1.620	19.942
FT-240	2.400	1.400	.500	14.40	1.570	22.608

A_L Values (mh / 1000 turns) - Ferrite Toroids

For complete part number add mix number to core size below.

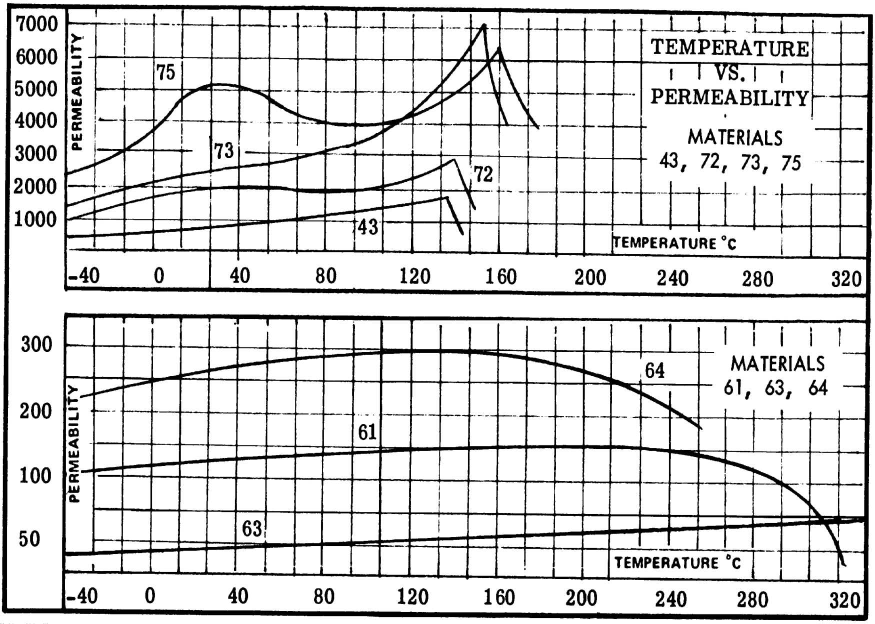
Material > / core size	43 u=850	61 u=125	63 u=250	67 u=40	68 u=20	72 u=2000	75 u=5000	77 u=2000	F u=3000	J u=5000
FT-23 ( )	188	24.8	7.9	7.8	4.0	396	990	356	NA	NA
FT-37 ( )	420	55.3	17.7	17.7	8.8	884	2210	796	NA	NA
FT-50 ( )	523	68.0	22.0	22.0	11.0	1100	2750	990	NA	NA
FT-50A-( )	570	75.0	24.0	24.0	12.0	1200	2990	1080	NA	NA
FT-50B-( )	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	NA
FT-87 ( )	NA	NA	NA	NA	NA	NA	NA	NA	180	3020
FT-87A-( )	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-114A( )	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-150A( )	NA	NA	NA	NA	NA	NA	NA	NA	5020	8370
FT-193-( )	NA	NA	NA	NA	NA	NA	NA	NA	3640	6065
FT-193A( )	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. @ 4 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 application. Listed frequencies will be lower with higher power.

Temperature Curves - Ferrite Materials

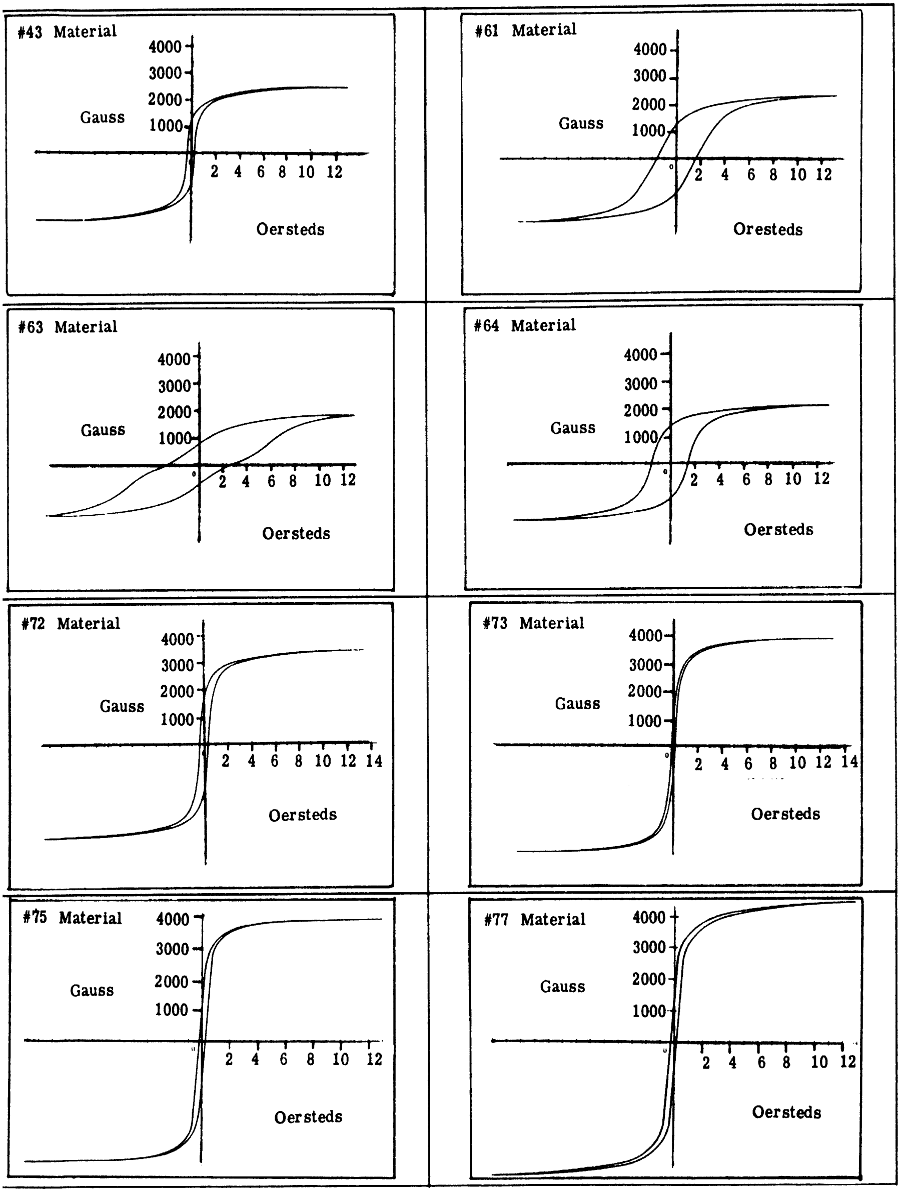


Ferrite core size vs. Wire turns

Awg wire> Core\/No.	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
FT-23	0	0	0	0	2	4	7	11	15	21	28	37	48	62	79	101
FT-37	0	0	2	4	7	11	15	21	28	36	48	61	79	100	127	161
FT-50	2	4	7	10	14	19	26	34	45	58	75	95	121	154	194	245
FT-50 -A	3	5	8	13	19	22	30	39	51	66	84	106	135	171	216	273
FT-50 -B	3	5	8	13	19	22	30	39	51	65	84	106	135	171	216	273
FT-82	9	13	18	22	32	41	53	69	88	112	143	180	228	288	362	456
FT-87A	10	14	19	25	34	43	56	72	92	118	150	188	239	302	374	478
FT-114	16	22	29	38	49	63	80	100	131	166	211	263	334	420	527	665
FT-114-A	16	22	29	38	49	63	80	100	131	166	211	263	334	420	527	665
FT-140	20	27	36	42	60	77	97	125	158	201	255	318	403	507	636	801
FT-150	16	22	29	38	49	63	80	100	131	166	211	263	334	420	527	665
FT-150-A	16	22	29	38	49	63	80	100	131	166	211	263	334	420	527	665
FT-193	31	41	53	68	86	109	139	176	223	282	357	445	562	707	886	1115
FT-193-A	31	41	53	68	86	109	139	176	223	282	357	445	562	707	886	1115
FT-240	36	46	60	77	98	123	156	198	250	317	400	499	631	793	993	1250

Approximate number of turns for full single layer winding on Ferrite Toroids.

FERRITE MATERIAL HYSTERESIS LOOPS



Inductance-Turns Chart, Ferrite Toroids

MATERIAL #43

turns count > core\/number	A_L*	10	20	30	40	50	60	70	80	90	100
				inductance in millihenries							
FT-23 -43	188	.018	.075	.169	.300	.470	.677	.921	1.20	1.52	1.88
FT-37 -43	420	.042	.168	.378	.672	1.05	1.51	2.06	2.69	3.40	4.20
FT-50 -43	523	.052	.209	.471	.836	1.30	1.88	2.56	3.35	4.24	5.23
FT-50A -43	570	.057	.228	.513	.912	1.43	2.05	2.79	3.65	4.62	5.70
FT-50B -43	1140	.110	.456	1.03	1.82	2.85	4.10	5.59	7.30	9.23	11.4
FT-82 -43	557	.056	.224	.503	.894	1.40	2.01	2.74	3.58	4.53	5.59
FT-114 -43	603	.060	.241	.543	.965	1.51	2.17	2.95	3.86	4.88	6.03
FT-140 -43	953	.095	.380	.857	1.52	2.38	3.43	4.66	6.09	7.71	9.52
FT-240 -43	1239	.123	.494	1.11	1.97	3.09	4.44	6.05	7.90	9.96	12.3

MATERIAL #61

turns count > core\/number	A_L*	10	20	30	40	50	60	70	80	90	100
				inductance in millihenries							
FT-23 -61	24.8	.002	.010	.022	.040	.063	.089	.122	.159	.201	.248
FT-37 -61	55.3	.006	.022	.050	.088	.138	.199	.271	.354	.448	.553
FT-50 -61	68.8	.007	.028	.062	.110	.172	.248	.337	.440	.557	.688
FT-50A -61	75.0	.008	.030	.068	.120	.186	.270	.366	.480	.608	.750
FT-50B -61	150.0	.015	.060	.135	.240	.375	.540	.735	.960	1.22	1.50
FT-82 -61	73.3	.007	.029	.066	.117	.183	.264	.359	.469	.594	.733
FT-114 -61	79.3	.008	.032	.071	.127	.198	.285	.389	.508	.642	.793
FT-114A-61	146.0	.015	.058	.131	.233	.365	.526	.715	.934	1.18	1.46
FT-140 -61	140.0	.014	.056	.126	.224	.350	.504	.686	.896	1.13	1.40
FT-240 -61	171.0	.017	.068	.154	.274	.428	.616	.838	1.09	1.39	1.71

MATERIAL #63/67

turns count > core\/number	A_L*	10	20	30	40	50	60	70	80	90	100
				inductance in millihenries							
FT-23 -63/67	7.9	----	.003	.007	.013	.020	.028	.038	.051	.064	.079
FT-37 -63/67	19.7	.002	.008	.018	.032	.049	.071	.097	.126	.160	.197
FT-50 -63/67	22.0	.002	.009	.020	.035	.055	.079	.108	.141	.178	.220
FT-50A-63/67	24.0	.002	.020	.033	.038	.060	.086	.112	.154	.194	.240
FT-50B-63/67	48.0	.005	.019	.043	.077	.120	.173	.235	.307	.389	.480
FT-82 -63/67	22.4	.002	.009	.020	.036	.056	.081	.110	.143	.181	.224
FT-114-63/67	25.4	.003	.010	.023	.041	.064	.091	.124	.163	.206	.254
FT-140-63/67	45.0	.005	.018	.041	.072	.118	.162	.220	.288	.365	.450
FT-240-63/67	53.0	.005	.021	.048	.084	.133	.199	.260	.339	.430	.530

MATERIAL #68

turns count > core\/number	A_L*	10	20	30	40	50	60	70	80	90	100
				inductance in millihenries							
FT-23 -68	4.0	----	.002	.004	.006	.010	.014	.020	.026	.032	.040
FT-37 -68	8.8	----	.006	.008	.014	.022	.032	.043	.056	.071	.088
FT-50 -68	11.0	.001	.004	.010	.018	.028	.040	.054	.070	.089	.110
FT-50A -68	12.0	.001	.005	.011	.019	.030	.043	.059	.077	.097	.117
FT-82 -68	11.7	.001	.005	.011	.019	.029	.042	.057	.075	.095	.117
FT-114 -68	12.7	.001	.005	.011	.020	.032	.046	.062	.081	.123	.127

* A_L value in mh/1000 turns

Inductance-Turns Chart, Ferrite Toroids

MATERIAL #77

turns count > core\/number	A_L*	10	20	30	40	50	60	70	80	90	100
					inductance in millihenries						
FT-23 -77	396	.040	.158	.356	.634	.990	1.43	1.94	2.53	3.21	3.96
FT-37 -77	884	.088	.354	.796	1.41	2.21	3.18	4.33	5.66	7.16	8.84
FT-50 -77	1100	.110	.440	.990	1.76	2.75	3.96	6.39	7.04	8.91	11.0
FT-50A -77	1200	.120	.480	1.08	1.92	3.00	4.32	5.88	7.68	9.72	12.0
FT-50B -77	2400	.240	.960	2.16	3.84	6.00	8.64	11.7	15.4	19.4	24.0
FT-82 -77	1170	.117	.467	1.05	1.87	2.93	4.21	5.73	7.49	9.48	11.9
FT-114 -77	1270	.127	.508	1.14	2.03	3.18	4.57	6.22	8.13	10.3	12.7
FT-114A-77	2340	.234	.936	2.13	3.74	5.85	8.42	11.4	15.0	21.4	23,4
FT-140 -77	2250	.225	.900	2.03	3.60	5.63	8.10	11.3	14.4	18.2	22.5
FT-240 -77	2740	.274	1.10	2.47	4,38	6.85	9.86	13.4	17.5	22.2	27.4

MATERIAL F

turns count > Core\/number	A_L*	10	20	30	40	50	60	70	80	90	100
					inductance in millihenries						
FT-87A - F	3624	.362	1.45	3.26	5.80	9.06	13.0	17.8	23.2	29.4	36.2
FT-114 - F	1902	.190	.761	1.71	3.04	4.76	6.84	9.32	12.2	15.4	19.0
FT-150 - F *	2640	.264	1.06	2.38	4.22	6.60	9.50	12.9	16.9	21.4	26.4
FT-150A- F	5020	.502	2.00	4.52	8.03	12.6	18.1	24.6	32.1	40.7	50.2
FT-193 - F *	3640	.364	1.46	3.28	5.82	9.10	13.1	17.8	23.3	29.5	36.4
FT-193A- F	4460	.446	1.78	4.01	7.14	11.1	16.0	21.9	28.5	36.4	44.6

MATERIAL J/75

turns count > core\/number	A_L*	10	20	30	40	50	60	70	80	90	100
					inductance in millihenries						
FT-23 - J	980	.098	.394	.883	1.57	2.45	3.53	4.80	6.28	7.95	9.81
FT-37 - J	2196	.219	.878	1.98	3.51	5.49	7.90	10.8	14.1	17.8	21.9
FT-50 - J	2715	.278	1.89	2.44	4.34	6.74	8.77	13.3	17.3	22.0	27.1
FT-50A - J	2968	.296	1.19	2.69	4.75	7.42	10.7	14.5	19.0	24.0	29.6
FT-87 - J	3020	.302	1.21	2.72	4.83	7.55	10.9	14.8	19.3	24.5	30.2
FT-87A - J	6040	.604	2.42	5.44	9.66	12.6	21.7	29.6	38.7	48.9	60.4
FT-114 - J	3170	.317	1.27	2.85	5.07	7.93	11.4	15.5	20.3	25.7	31.7
FT-140 - J	6736	.674	2.69	6.06	10.8	16.8	24.2	33.0	43.1	54.6	67.4
FT-150 - J	4400	.440	1.76	3.96	7.04	11.0	15.8	21.6	28.1	35.6	44.0
FT-150A- J	8365	.837	3.35	7.53	13.4	20.9	30.1	41.0	53.5	67.8	83.7
FT-193 - J	6065	.607	2.43	5.46	9.70	15.2	21.8	29.7	38.8	49.1	60.7
FT-193A- J	7435	.743	2.97	6.69	11.8	18.5	26.7	36.4	47.5	60.2	74.3
FT-240 - J	6845	.684	2.34	6.16	11.8	17.1	24.6	33.5	43.8	55.4	68.4

* (A_L values in mh/1000 turns)

Switched Mode Power Supplies

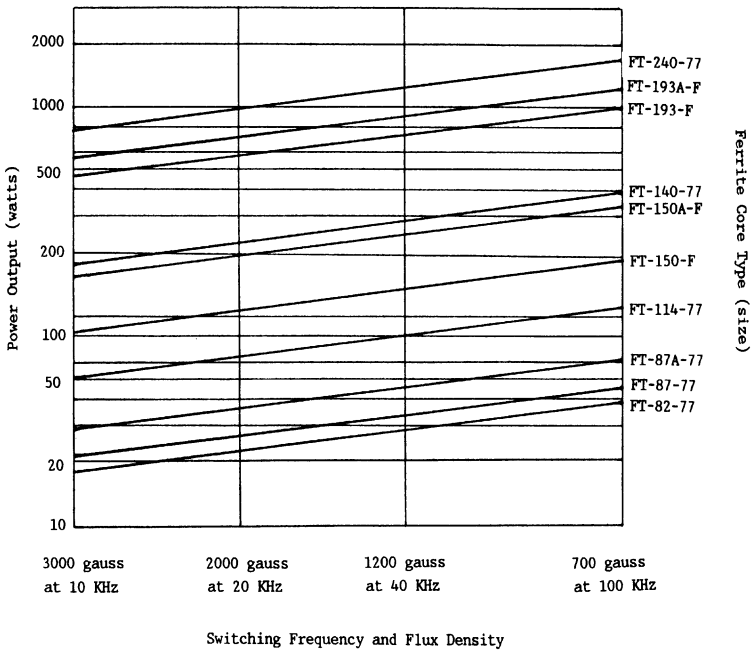
Guide to select the proper size ferrite core

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



FERRITE BEADS

A Ferrite bead is a dowel-like device which has a center hole and is composed of ferromagnetic material. Ferrite beads are available in many sizes and several different ferrite materials. When a ferrite bead is placed on to a current carrying conductor it will act as an RF choke. It offers a simple, 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, interstage connections, and ground leads. Adjacent 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 onto 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 the impedance offered by each additional bead will be additive as it is placed on to the conductor. Since the magnetic field is totally contained within the bead, it doesn't 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 200 MHz, although it is still very effective for the amateur band. The #64 material is most effective above 200 MHz. and #75 material is recommended for frequencies below 10 MHz. The #75 material can also be very effective even below the AM broadcast band.

Ferrite toroidal cores can also function as frequency attenuators and the same rules will apply. In some cases a toroidal core may be more desirable since it will offer larger than one half inch ID. Not all bead materials are found in the toroidal core line. Whenever possible use the recommended bead material. If not available, substitute with a toroidal core material having the closest permeability. The lower permeability materials will have the greatest effect on the higher frequencies as will the higher permeability materials have the greatest effect on the lower frequencies.

FERRITE BEADS (cont)

A Ferrite bead is usually thought of as quite a small device with a very small ID where only one pass of the wire is practical. However, there are now up to one-half inch ID beads available for coax and larger wire bundles. Also, several turns of smaller wire may be wound on to these larger beads, in which case the impedance will increase as to the number of turns squared. The larger size beads are also available in a 'split' version for easy installation. See the following page for dimensions and part numbers.

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.

Fairly high currents can be tolerated before saturation begins to occur. If saturation does occur, impedance will drop to a very low level causing the bead to become ineffective as an RF attenuator. Once the cause of saturation has been removed, the bead will return to normal with no ill effects.

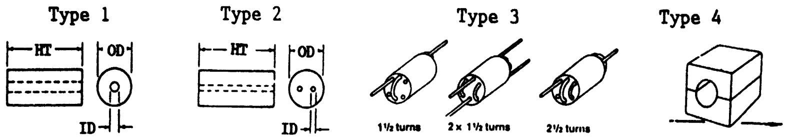
Temperature rise above the Curie point will also cause the bead to become non-magnetic, rendering it useless as a noise attenuating device. As soon as the cause of the temperature rise has been corrected, and the bead has been allowed to cool, normal operation will be regained and no damage will result. Depending on the material, Curie temperature can run anywhere from 120^{o}C to 500^{o}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

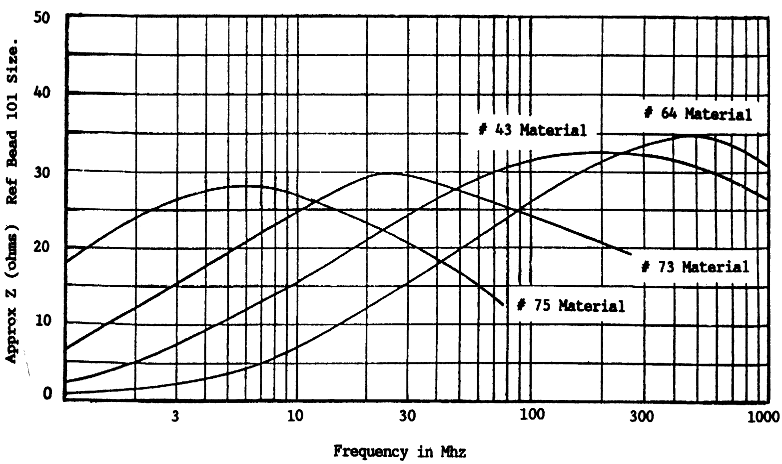
Part number	Bead type	Dimensions (inches) OD	ID	Hgt	A_L of Materials (mh/1000 turns) 43	64	73	75	77	Impedance factor*
FB-(--)-101	1	.138	.051	.128	510	150	1500	3000	----	1.00
FB-(--)-201	1	.076	.043	.150	360	110	1100	----	----	0.70
FB-(--)-301	1	.138	.051	.236	1020	300	3000	----	----	2.00
FB-(--)-801	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.



Material vs Frequency vs Impedance

* Impedance Factor: The following chart is based on the '101' size bead which will be used as a reference. Impedance in ohms for a given size bead can be approximated, if the impedance of the '101' bead (from the curves) is multiplied by the impedance factor for the given bead.



Ferrites for RFI

Ferrite toroidal cores, as well as beads, can be very useful in the suppression 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 up to 200 MHz and better. 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. Ferrite cores are not recommended for differential-mode noise. See section on AC line filters which use #26 Iron Powder material.

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, the impedance of each core 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. When using toroidal cores, materials 77, and 'F' are recommended for RFI caused by amateur transmitters. We suggest not more than 15 turns for this frequency range.

The #43 material can be used to attenuate frequencies from about 2 MHz to 200 MHz with increasing attenuation as the frequency increases. It can be effective for the amateur band as well, but optimum results are above 30 MHz. Use no more than 15 turns for the amateur band and as the frequency becomes greater the turns count should gradually be reduced. For anything above 200 MHz, use a small #61 material ferrite toroidal core, or a #64 material ferrite bead. Normal practice is to make only one pass of the conductor through the core or bead. Impedance can be increased by using two or more cores or beads.

The 'J' material is recommended for frequencies below 10 MHz. but can also be very effective even below the AM broadcast band. A maximum of 30 turns is suggested.

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 corrected 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-240-43 or an FT-240-77 toroidal core, not more than 15 times. The power cord plug will probably limit the number of turns and fewer will be OK. 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 which may be connected to the same power source.

Split ferrite beads, cores and bars are now available for ease of installation without removing the end connector of the cable. The split beads and sleeves are useful for wire bundles and coax cables. (2X-43-251 for quarter inch ID and the 2X-43-151 for half inch ID) Usually, only one pass of a conductor through a split core is practical or desirable.

Split bars are especially designed for computer flat ribbon cables. Use the 2X-43-051 for a 2.5" width cable, the 2X-43-951 for the 2" width, and the 2X-43-651 for the 1.3" width cable. Two or more cores can be placed on the same cable, in which case the impedance will be additive.

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 an amateur antenna feed line, usually due to a mismatch causing high SWR and RF radiation. This, of course, can be checked with an SWR meter, and can be corrected by installing an antenna balun, or by placing three or four ferrite beads over the coax at the antenna feed point.

Use the FB-77-1040 bead for the half inch OD coax,(see above for split version) or the FB-77-5621 bead for quarter inch OD (again see above for split version). This should prevent RF reflection back into the outside shield of the coax feed line, which could radiate RFI and TVI

RFI in telephones can be substantially reduced with the insertion of an RF choke in each side of the talk circuit (red and green wires). An FT-50A-75 core with about 20 turns of enamelled wire will make an excellent one millihenry choke for this purpose. These can be located inside the phone base out of sight. If mounting inside the phone base is not possible because of lack of space, these chokes may be placed in a tiny plastic box and mounted near the wall jack. If this sounds like to much work, similar results can be obtained by winding several turns of the telephone wall-cord through a ferrite FT-140-77 core. For frequencies below the amateur band use the F-140-J core.

FERRITE CORES FOR RFI SUPPRESSION

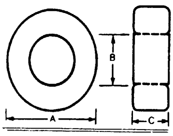
Following is a list of a few of the larger Ferrite Beads (FB), Ferrite Toroidal Cores (FT), and Split Ferrite Cores (2X), all of which are extensively used for RFI problems involving multiple wire bundles, coaxial cables, microphone cables, AC power cords, telephone cables, computer cables, etc.

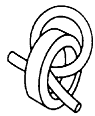
The 43 material is a good all around material for most RFI problems. However the lower frequencies from .5 to 10 MHz. can best be served with the 'J' or 75 material. The 77 material can provide excellent attenuation of RFI caused by amateur radio frequencies from 2 to 30 MHz. and the 43 material is best 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.

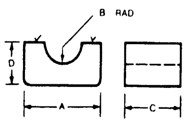
Split beads and bars (2X) are now available and can be installed without removing the end connector from the cable. Split bars are especially designed for computer ribbon cables. They are presently available for 1.3", 2.0" and 2.5" computer ribbon cables. For greater attenuation use additional cores.

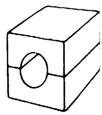
Below are a few of the most widely used cores for RFI, showing typical 'Z' in ohms for one turn at 25 MHz and 100 MHz. Most sizes are available in 43, and 77 materials. Those sizes availabale in the J material are marked with *



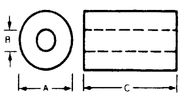


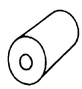
	Part number	A dim. (in)	B dim. (in)	C dim. (in)	25 MHz	100 MHz
*	FT-50A-75	.500	.312	.250	below 10 MHz	
	FT-50B-43	.500	.312	.500	56	90
	FT-50B-77	.500	.312	.500	74	60
*	FT-87A-75	.870	.540	.500	below 10 MHz	
*	FT-114-43	1.142	.750	.295	27	47
	FT-114-77	1.142	.750	.295	35	29
*	FT-140-43	1.400	.900	.500	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



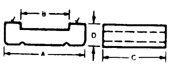


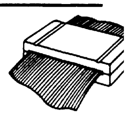
	Part number	A dim. (in)	B dim. (in)	C dim. (in)	25 MHz	100 MHz
	2X-43-251	.590	.250	1.125.	171	275
	2X-43-151	1.020	.500	1.125	159	245





	Part number	A dim. (in)	B dim. (in)	C dim. (in)	25 MHz	100 MHz
	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





	Part number	A dim. (in)	B dim. (in)	C dim. (in)	25 MHz	100 MHz
	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

Broadband Transformers

Broadband Transformers, as the name implies, are transformers which will operate over a broad frequency range. They can provide a step-up or a step-down impedance ratio, match an unbalanced source to a balanced load, or serve both purposes.

The two-hole, 'binocular type', ferrite core, known as the balun core, is very popular for low power applications. Balun cores will provide maximum impedance per length of turn which will better serve the broadband transformer. Two-hole balun cores are widely used as 75 and 300 ohm matching transformers for receivers and low power UHF and VHF applications.

The bandwidth of a broadband transformer has limitations. The functions which control the low frequency performance are parallel inductance and parallel resistance. This combination must remain sufficiently high in order to maintain an acceptable match. Unless a very low 'Q' core is used these will be the dominant factors. Normally, the inductive reactance at the lowest frequency should be four times greater than the source impedance. However, in order to achieve this ratio, we may find that excessive turns may be required which will adversely affect the high frequency performance. Using a core of high permeability will minimize the number of required turns.

The factors which limit the high frequency performance are distributed capacity and inductance leakage due to uncoupled flux. The more the distributed capacity and the flux leakage can be minimized, the better will be the high frequency performance of the transformer. The best compromise between distributed capacity and leakage inductance can be obtained by twisting the conductors together prior to winding. This greatly minimizes the leakage inductance in small transformers.

In applications which generate minimal flux, such as in low power applications and 1 to 1 ratio transformers, the goals can best be accomplished by using a high permeability core to minimize turns at the lowest frequency. Fewer turns will create less distributed capacity which will improve the high frequency response.

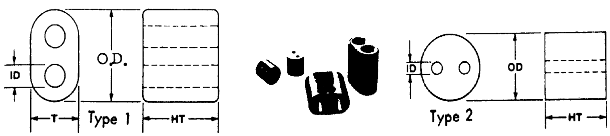
Generally, ferrite cores are preferred for broadband transformers because of their high permeability factors. However, in power applications the high permeability ferrite cores can be easily saturated, and care must be taken to keep the induced flux density well below the maximum flux density rating of the core in order to confine the signal energy to the linear portion of the flux density curve. Detailed information can be found in the 'Ferro- magnetic Design and Applications Handbook' by Doug DeMaw. We now stock this item.

The main concern in power applications is core loss generated by the net induced flux. In this case, iron powder cores are usually preferred because of their higher maximum flux density rating. Core loss increases at a squared rate with flux density at any given frequency.

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.

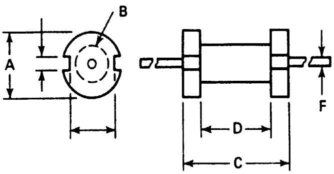


Dimensions in inches; A_L value in mh/1000 turns based on hole to hole winding

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

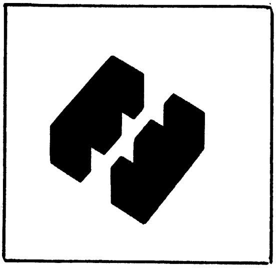
BOBBIN # B-72-1111 A_L= 17 NI= 60

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

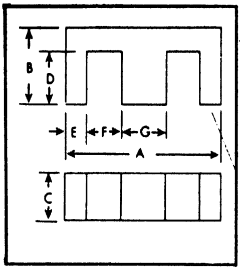
Inductance	wire turns	wire size	I (max)
25 uh	25	20	5.20
50 uh	36	22	3.60
100 uh	50	24	2.60
250 uh	80	26	1.60
500 uh	113	27	1.10
1.0 mh	160	28	.80
2.5 mh	253	30	.50
5.0 mh	358	32	.36
10.0 mh	506	34	.25
25.0 mh	800	36	.16

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

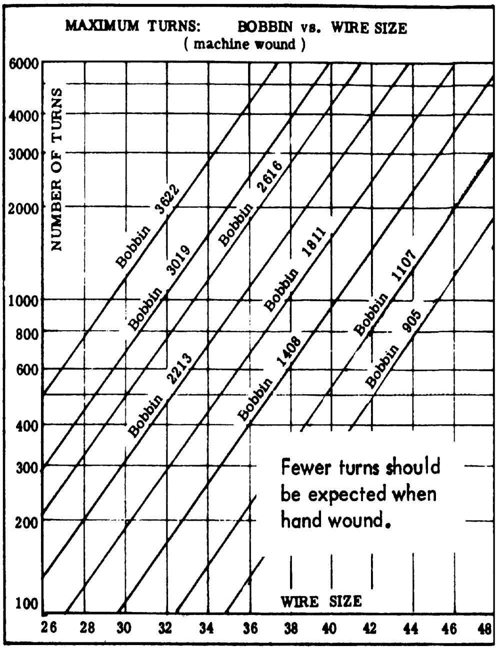
Part No. \/	A_e mm^2	I_e mm	Ve mm^3	A_s mm^2	A_w mm^2	$A_c \times A_w$ mm^4	A_L value mh/1000 turns
E-77-188	22.5	40.1	900	1050	55.7	1250	1350
E-77-250	40.4	48.0	1930	1700	80.6	3250	1660
E-77-375	90.3	68.8	6240	3630	151.0	13700	2760
E-77-500	160.0	76.7	12300	5410	163.0	26100	4470
E-77-625	184.0	98.0	18000	7550	287.0	52900	4150

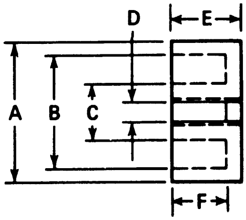
Wire size vs. Number of turns

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	2101				

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)

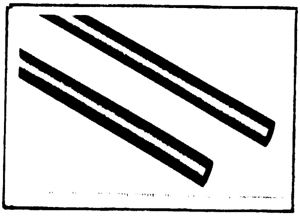
part mumber	A	B	C	D	E	F
PC-1107-77	11.10	9.20	4.60	2.10	3.21	2.27
PC-1408-77	14.05	11.80	5.90	3.10	4.18	2.90
PC-1811-77	18.00	15.25	7.45	3.10	5.27	3.70
PC-2213-77	21.60	18.70	9.25	4.55	6.70	4.70
PC-2616-77	25.50	21.60	11.30	5.55	8.05	5.60
PC-3019-77	30.00	25.40	13.30	5.55	9.40	6.60
PC-3622-77	35.60	30.40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

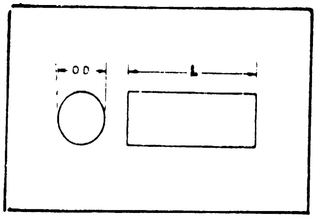
Magnetic Dimensions

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 conserative, based on 20 KHz. switching frequency.

Ferrite Rods





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.

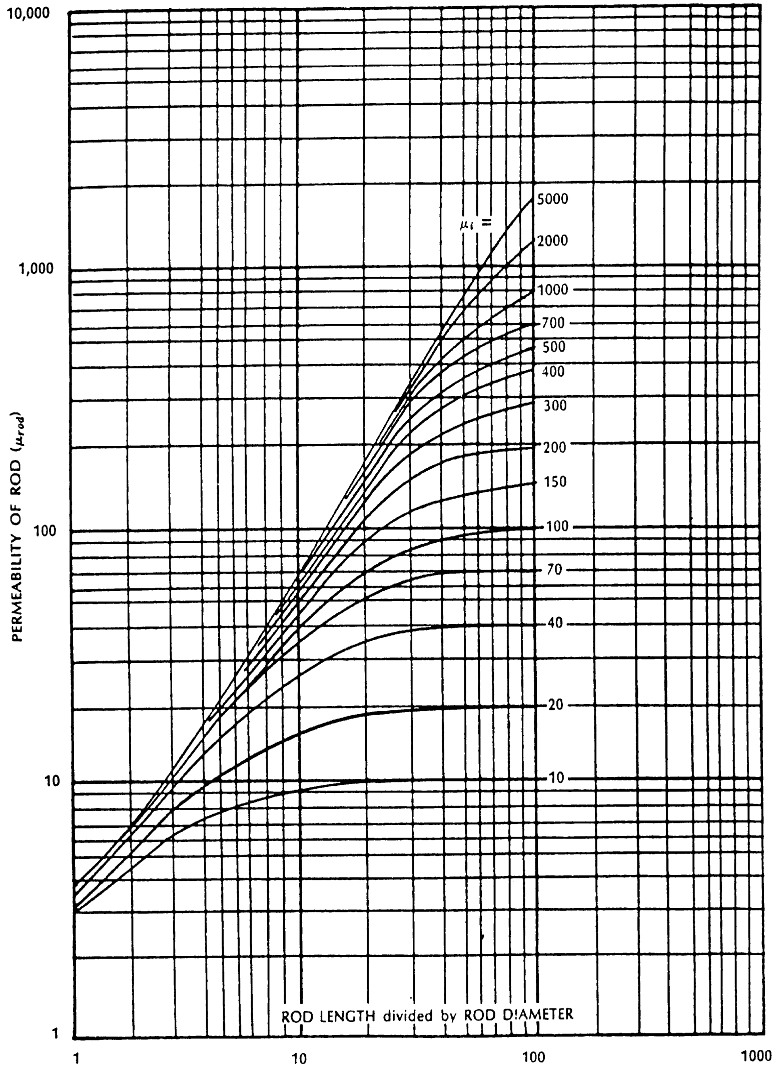
CHOKE APPLICATIONS; Both the #33 and the #61 material rods are extensively used in choke applications. The #33 material should be selected for the 40 and 80 meter bands and the #61 material is most suitable for 10 through 40 meters. The #33 material rods are also often used in speaker cross-over networks. 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.

Permeability of Ferrite Rods



PERMEABILITY OF ROD vs. ROD LENGTH DIVIDED BY ROD DIAMETER FOR VARIOUS MATERIAL PERMEABILITIES

This family of curves shows the value of the effective permeability of a ferrite rod as a function of its length to diameter ratio, as well as a function of the material permeability of the rod. It illustrates that generally, a great difference exists between the material permeability and the effective permeability of a rod. It also illustrates how, in some instances, the effective permeability of a rod can be influenced by changing its mechanical dimensions, more than by changing its material permeability, while in other cases, the reverse is true.

AMIDON Associates, INC.