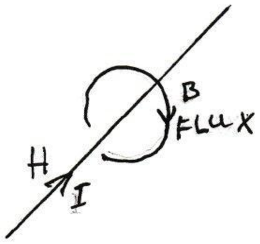
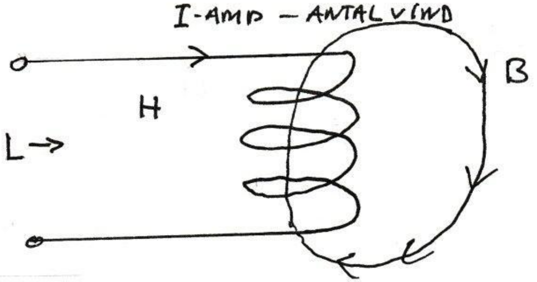
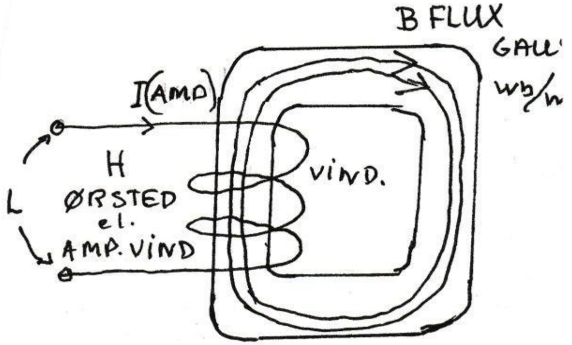
PULVERJERN OG FERRIT KERNER TIL SPOLER

VED OZ4BM





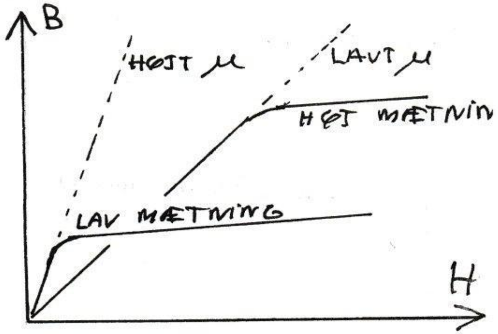
$\frac{B}{H} = \mu = 1$ FOR LUFT
OG ISS. MATR.



PULVERJERN OG FERR

$\frac{B}{H} = \mu = 10 - 500$

FLUX (B) KAN MÆTTES



EGENSKABER VED MAGNETISK LEDENDE MATERIALE

EGNET FOR LF OG HF OMRÅDER

<u>JERNPULVER:</u>

*PRESSET AF PULVER FRA EGNET JERN

* EGENSKABER ER FREKVENS AFHÆNGIGE

* SPOLERS L KAN KUN MÅLES RIGTIG VED DEN ANVENDTE FREKVENS

* MÆTTES IKKE LET, DERFOR EGNET TIL "POWER"

* LAVERE MAG. PERMABILITET

* TEMPERATURSTABILITET GOD

<u>FERRIT:</u>

* PRESSET AF JERNOXID OG MnZn eller NiZn

* EGENSKABER ER FREKVENS AFHÆNGIGE

* SPOLERS L KAN KUN MÅLES RIGTIG VED ANVENDT FREKV.

* MÆTTER RET LET, DERFOR KUN EGNET V. SMÅSIGNAL

DOG UNDTAGES SPECIELT FREMSTILLET FERRIT AF NiZn - MATERIALE MED LAV PERMABILITET

* HØJ MAG. LEDNINGSEVNE

* DÅRLIG TEMPERATURSTAB.

AF DISSE GRUNDE ER DET VIGTIGT AT VÆLGE DET BEDST EGNEDE MATERIALE

MAGNETICS & FERROMAGNETICS MATERIALS

Magnetic materials are used in applications such as power supply transformers, audio transformers, AC and RF filter inductors, broadband and narrow band transformers, damping network, EMI/RFI suppressors, etc. The basic characteristic of magnetic materials is the permeability (μ). It is a measure of how superior a specific material is than air as a path for magnetic line of force. Air has a μ of 1. Another characteristic of magnetic material is saturation. It is the maximum value of magnetic induction at a specified field strength. When a material saturates, it losses its linearity. Magnetic materials are available in many different types and sizes.

IRON POWDER CORES

These cores are composed of finely defined particles of iron which are insulated from each other but bound together with a binding compound. The iron powder and binding compound are mixed and compressed under heavy pressure, and baked at high temperature. The characteristics of the cores are determined by the size and density of the core, and the property of the iron powder. Powdered iron cores do not saturate easily, and has high core temperature stability and Q. However, it is only available in low permeability (below $\mu_i = 75$). The high temperature stability makes it suitable for applications such as narrow band filter inductors, tuned transformers, oscillators and tank circuits. See section I for more details on materials, shapes and sizes.

FERRITES

Ferrites are ceramics materials that can be magnetized to a high degree. The basic component is iron oxide combined with binder compounds such as nickel, manganese, zinc or magnesium. Two major categories of ferrites are manganese zinc (MnZn), and nickel zinc (NiZn). Ferrites are manufactured by homogeneously mixing the iron oxide with the binder, and calcinated (heating mixture to 1000 °C). This causes partial decomposition of the carbonates and oxides. The mixtures are dry pressed into a core configuration, and finally sintered. This is done by gradually raising the temperature up to 1500 °C in a kiln. Typically the cores will shrink by 10 to 20% of its original size after sintering. Ferrites can be manufactured to permeability of over 15,000 with little eddy current losses. However, the high permeability of the ferrite makes it unstable at high temperatures, and saturates easily. It is suitable for applications where saturation are needed such as DC to DC converters, magnetics amplifiers, etc. It must be noted that driving ferrites with excessive current may cause permanent damage to the core.

Ferrites are widely used as attenuators of unwanted high frequency signals. These ferrites are know as EMI/RFI suppressors. They are typically available as beads, split cores, flat ribbon core and toroidal cores. Ferrite tiles are also available for use in anechoic chambers.

Another application of ferrites are in transformers, inverters and inductors in the 5KHz to 100 KHz range. It is cheaper than tape wound cores and are used in applications where high flux density and high temperature stability are not critical.

Typical applications:

1) Inverter power supplies: 5KHz to 500KHz, and under 50 watts at 10KHz. For high power application, use tape wound core as saturating core and ferrite core as output transformers.
2) Fly back transformers
3) High frequency power supplies (1 Kw)

Ferrite cores can be gapped to avoid saturation under DC bias conditions.

LAMINATED OR TAPE WOUND CORES

These cores are manufactured by using different steel grades with different widths and thickness, wound in circular manner. Tape wound cores have very high permeability and are used primarily in power supply transformers, reactors in 60 Hz to 400 Hz, Dc to Dc converters, and current transformers. It provides very high flux densities and good temperature stabilities. It is also the most costly core to manufacture.

2

IRON POWDER MATERIAL

MATERIAL #0 (μ=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 AL value may not be as accurate as we would like. Inductance vs. number of turns will vary greatly depending upon the winding technique.

MATERIAL #1 (μ=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 (μ=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 (μ=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 (μ=8):
A carbonyl 'SF' material. Offers very good 'Q' and temperature stability for the 20 MHz to 50 MHz frequency range. Available in both toroidal form and shielded coil form.

MATERIAL #7 (μ=9):
A carbonyl 'TH' material. Very similar to the #2 and #6 materials but offers better temperature stability than either. Available in both toroidal form and shielded coil form. Frequency ranges from 5 MHz to 35 MHz.

MATERIAL #10 (μ=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

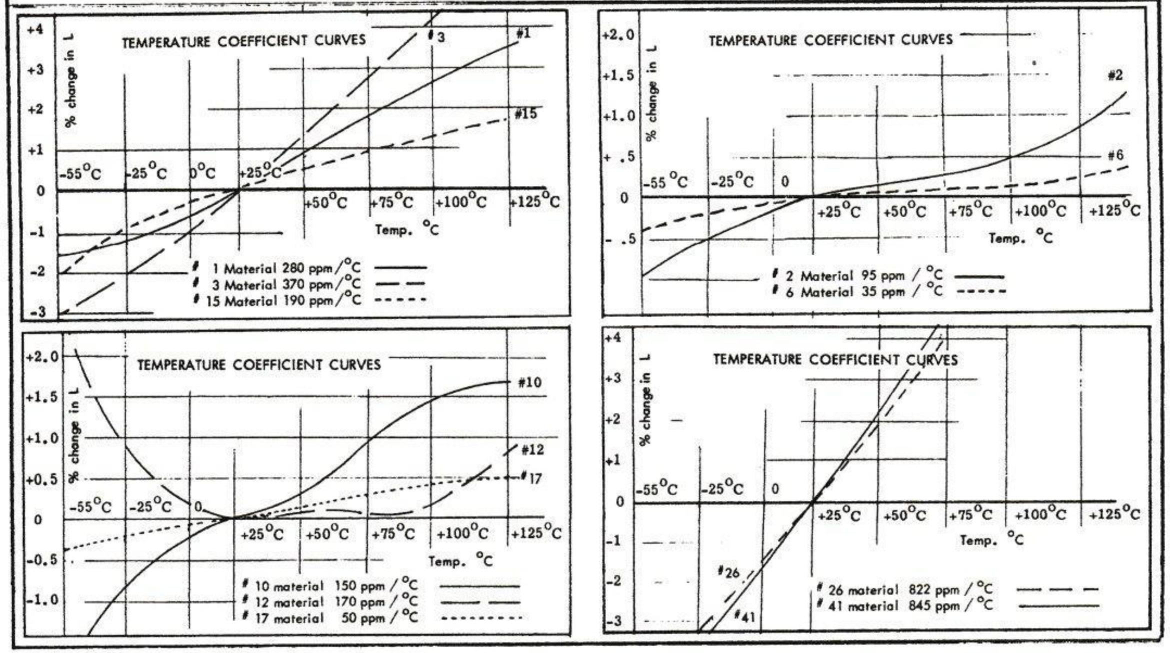
MATERIAL #12 (μ=4):
A synthetic oxide material which provides good 'Q' and moderate stability for frequencies from 50 MHz to 200 MHz. If high 'Q' is of prime importance this material is a good choice. If stability is of a prime importance, consider the #17 material. The #12 material is available in all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

MATERIAL #15 (μ=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 (μ=4):
This is a new carbonyl material which is very similar to the #12 material except that it has better temperature stability. However, as compared to the #12 material, there is a slight 'Q' loss of about 10 % from 50 MHz to 100 MHz. Above 100 MHz, the 'Q' will gradually deteriorate to approximately 20% lower. It is available in both toroidal form and the shielded coil form.

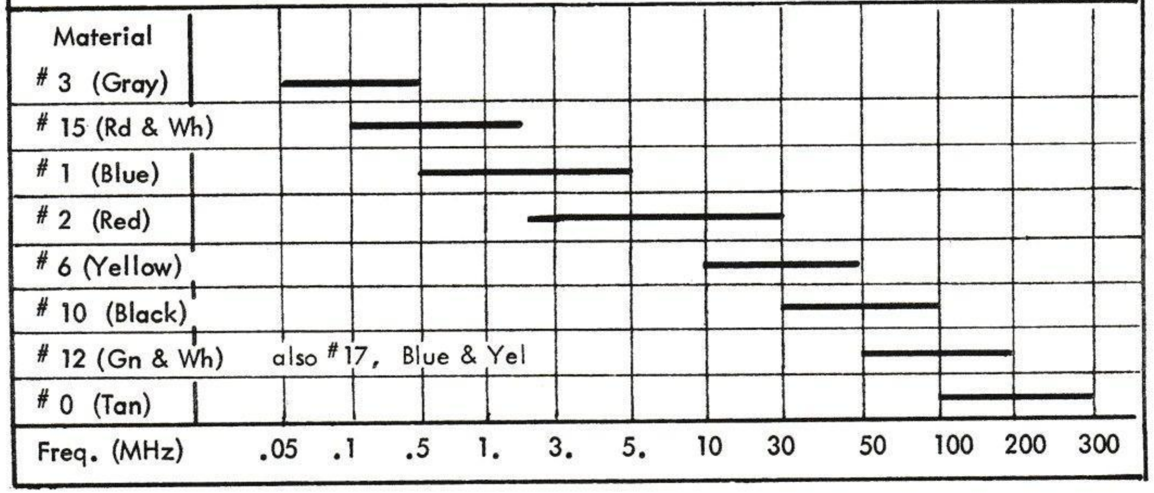
MATERIAL #26 (μ=75):
A Hydrogen Reduced material. Has highest permeability of all of the iron powder materials. Used for EMI filters and DC chokes. The #26 is very similar to the older #41 material but can provide an extended frequency range.

TEMPERATURE COEFFICIENT CHARTS

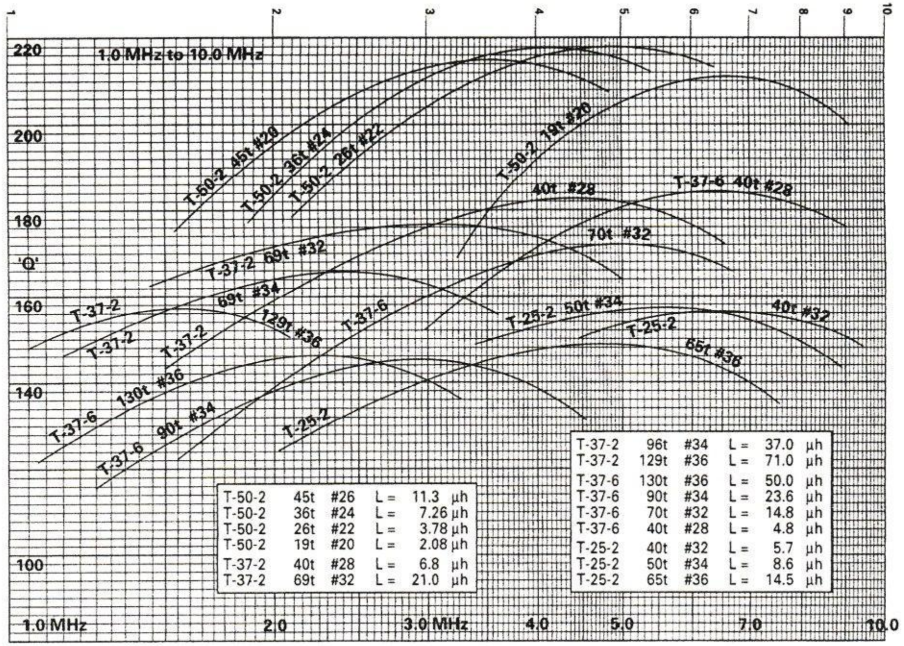


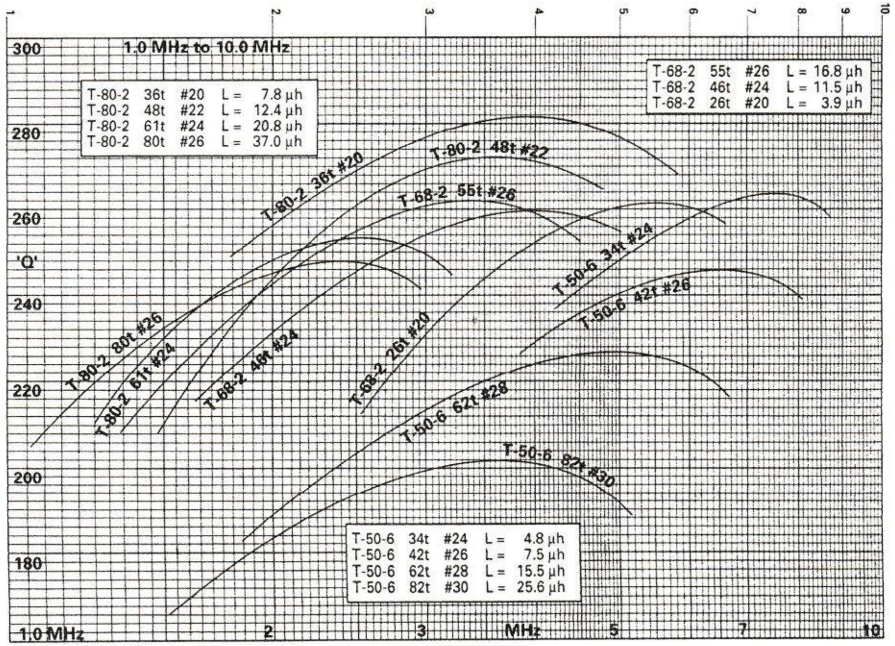
IRON - POWDER MATERIAL vs. FREQUENCY RANGE

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 Q-CURVES





IRON POWDER TOROIDAL CORES (For Resonant Circuits)

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

Core number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	l_e (cm)	A_e $(cm)^2$	V_e $(cm)^3$	A_L Value µh/100 turns
T-12-2	.125	.062	.050	.74	.010	.007	20
T-16-2	.160	.078	.060	.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 Permeabilty 35 Freq. Range 0.05 MHz - 0.5 MHz Color - Gray

Core number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	l_e (cm)	A_e $(cm)^2$	V_e $(cm)^3$	A_L Value µh/100 turns
T-12-3	.125	.062	.050	.74	.010	.007	60
T-16-3	.160	.078	.060	.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

X

(4)

SECTION I: 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 is 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 μ_i to 35 μ_i 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, they are very much in demand for broadband inductors, especially where high power is concerned.

The Hydrogen Reduced Iron cores have higher permeabilities ranging from 35 μ_i to 90 μ_i. 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. You will find 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 can be found in the charts on the next several pages. Use this A_L value and the formula below to calculate the number of turns for a specific inductance.

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

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

I NOGLE FERRIT MATERIALE TABELLER FOR KERNER ANVENDES A_L i mhy/1000 turns

Please see section IV on "Toroid Mounts & E-Core Bobbins" for information on mounting toroids to PC Boards. Amidon also provides complete wound and mounted cores.

- **For standard wound toroid, please see section V.**
- **For custom inductors based on your specifications, please call or fax today. You will be assured of prompt response with quotations in less than 72 hours.**
- **Amidon provides low cost manual and automated coil windings. Please call for more information.**

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 a 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 guidelines as suggested 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:

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

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

KERNEN MÅ GODT BLIVE SÅ VARM AT MAN KAN FØLE DEN MEGET VARM UDEN AT MAN "BRÆNDER" FINGRENE (SVARER TIL CA 60°) MEN SÅ HELLER IKKE MERE!

EGENSKABER VED MAGNETISK LEDENDE MATERIALE

EGNET FOR LF OG HF OMRÅDER

JERNPULVER:	FERRIT:
*PRESSET AF PULVER FRA EGNET JERN	* PRESSET AF JERNOXID OG MnZn eller NiZn
* EGENSKABER ER FREKVENS AFHÆNGIGE	* EGENSKABER ER FREKVENS AFHÆNGIGE
* SPOLERS L KAN KUN MÅLES RIGTIG VED DEN ANVENDTE FREKVENS	* SPOLERS L KAN KUN MÅLES RIGTIG VED ANVENDT FREKV.
* MÆTTES IKKE LET, DERFOR EGNET TIL "POWER"	* MÆTTER RET LET, DERFOR KUN EGNET V. SMÅSIGNAL DOG UNDTAGES SPECIELT FREMSTILLET FERRIT AF NiZn - MATERIALE MED LAV PERMABILITET
* LAVERE MAG. PERMABILITET	* HØJ MAG. LEDNINGSEVNE
* TEMPERATURSTABILITET GOD	* DÅRLIG TEMPERATURSTAB.

AF DISSE GRUNDE ER DET VIGTIGT AT VÆLGE DET BEDST EGNEDE MATERIALE

SECTION II: FERRITE CORES

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

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

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

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

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

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

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

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

To improve voltage breakdown, coatings of ferrite cores are available for the F, J, W and H materials. Typical coatings are parylene C, Gray Coating and Black Lacquer. Parylene C coating has a thickness of 0.5 mils to 2 mils with a voltage breakdown of 750V. Gray coating has a thickness of 4 mils to 8 mils with voltage breakdown of 500V. Black Lacquer coating has a thickness of 0.5 mils to 2 mils with no increase in voltage breakdown.

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

- **For standard stocking items of Inductors, Chokes, Transformers and other wound ferrites, please see section V.**
- **For custom design of Inductors, Chokes, Transformers or Special Coil Windings, please call or fax your specifications today.**
- **Amidon provides engineering designs, prototyping and manufacturing. Low to high volume production capability with the most competitive pricing.**

FERRITE MATERIALS

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

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

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

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

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

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

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

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

MATERIAL 77 ($\mu = 2000$) Has high saturation flux density at high temperature. Low core loss in the 1 KHz to 1 MHz range. For low level power conversion and 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' ($\mu = 3000$) High saturation flux density at high temperature. For power conversion transformers. Good frequency attenuation 0.5 MHz to 50 MHz. Toroids only.

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

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

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

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

FERRITE TOROIDAL CORES

MATERIAL 77 (upgrade of the 72 material) — **Permeability 2000**

Core number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	ℓ_e (cm)	A_e (cm)^2	V_e (cm)^3	A_L Value mh/1000 turns
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. (inches)	I.D. (inches)	Hgt. (inches)	ℓ_e (cm)	A_e (cm)^2	V_e (cm)^3	A_L Value mh/1000 turns
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. (inches)	I.D. (inches)	Hgt. (inches)	ℓ_e (cm)	A_e (cm)^2	V_e (cm)^3	A_L Value mh/1000 turns
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	.261	1.414	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-140A-J	1.400	.900	.590	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
FT-337 -J	3.375	2.187	.500	— Available on Request Only. —			

FERRITE CORES FOR RFI SUPPRESSION

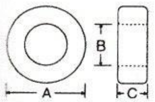
Following is a list of large size Ferrite Beads (FB), Ferrite Toroidal Cores (FT), and Split Ferrite Cores (2X), all of which are extensively used for RFI problems involving multiple wire bundles, coaxial cables, microphone cables, AC cords, and computer ribbon cables. These larger ferrite beads and toroidal cores can provide larger ID to accommodate the larger diameter coaxes and wire bundles.

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' 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 ferrite bead material having a permeability of 2500 and can provide RF attenuation very similar to the 77 core material.

When more impedance is needed (with any bead or core) use additional cores on the same conductor or a core with a large enough ID to accommodate multiple wire turns. When additional cores are added, the impedance will be additive, but when additional wire turns are added the impedance increases as to the number of turns squared.

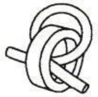
Split beads and 'bars' are also available so that they may be installed without removing the end connector from the cable. Split bars are especially designed for computer ribbon cables. They are presently available for 1.3", 2.0" and 2.5" computer ribbon cables. Two or more may be used on the same cable to increase the impedance.

Shown below are typical impedances in ohms at 25 and 100 MHz with only one pass through the core.

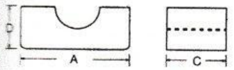


4BM SPOLER
FT82-77

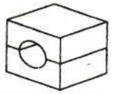
Part Number	A dim. (in)	B dim. (in)	C dim. (in)	25 MHz	100 MHz
FT-50B-43	.500	.312	.500	56	90
FT-50B-77	.500	.312	.500	74	60
FT-114-43	1.142	.750	.295	27	47
FT-114-77	1.142	.750	.295	35	29
FT-140-43	1.400	.900	.500	47	75
FT-140-77	1.400	.900	.500	62	50
FT-193- J	1.930	1.250	.625	below 10 MHz	
FT-240-43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



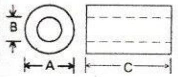
Note: All of the above size cores are available in the 'J' material which will be most effectivce if the troublesome frequency is below 10 MHz.



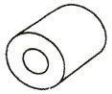
Part Number	A dim. (in)	B dim. (in)	C dim. (in)	25 MHz	100 MHz
2X-43-251	.590	.250	1.125	171	275
2X-43-151	1.020	.500	1.125	159	245

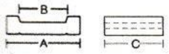


Also see page 60 on "Round Cable Suppression Cores" for more selection

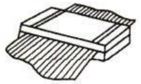


Part Number	A dim. (in)	B dim. (in)	C dim. (in)	25 MHz	100 MHz
FB-43-1020	1.000	.500	1.120	155	235
FB-77-1024	1.000	.500	.825	25	-
FB-43-5621	.562	.250	1.125	171	250
FB-77-5621	.562	.250	1.125	50	-
FB-43-6301	.375	.194	.410	55	48
FB-77-6301	.375	.194	.410	73	59





Part Number		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 calbe	90	250



NOGLE PRAKTISKE MÅLINGER:

MATERIALE m- VINDINGER	L MÅLT 0,5 MHZ	L MÅLT 3 MHZ	SPÆRRE-Z V. 3MHZ
PULV. JERN — T130 – 2 μ=10 20 VIND.	1,8 μH	5 μH	ca 100 Ω
PULV JERN — T80 – 2 μ=10 20 VIND.	0,9 μH	3 μH	ca 65 Ω
FERRIT FT82 – 77 μ = 2000 20 VIND.	156 μH	? STOR VANS. MÅLT	ca 3 kΩ
FERRIT UKENDT ? 100kHz–1MHz ? 20 VIND.	64 μH	70 μH	ca 1 kΩ

L er afhængig af:

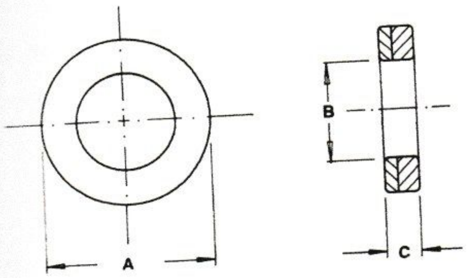
μ + kerneareal i spolen + N^2 (VIND.)

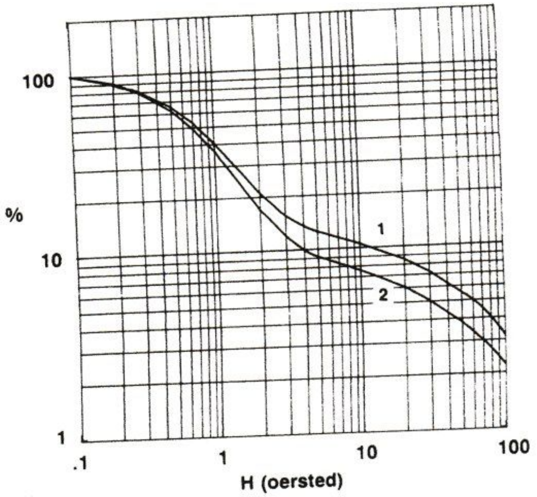
COMPOSITE TOROIDS

Composite toroidal cores combine a high permeability 77 ferrite toroid with a high saturation #52 iron powder toroid.

Composite cores are particularly useful for choke applications that have large swings in the direct current. It is also used in some EMI suppressor designs with bias currents.

All composite toroids have been burnished to remove sharp edges. Composite toroids are supplied with a uniform coating of green insulating enamel. Composite toroids can withstand a minimum breakdown voltage of 1000 V_{rms}, uniformly applied across the height of the core. The mechanical dimensions and tolerances include the enamel coating.





Percent of Original Inductance Factor vs. DC Field Strength.

1 CT-50A-57, CT-82A-57, CT-100A-57, CT-150A-57, CT-200A-57

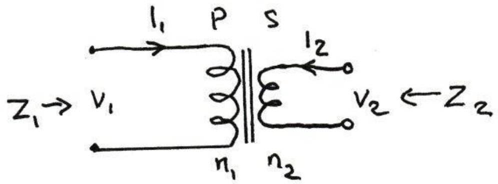
2 CT-50-57, CT-82-57, CT-100-57, CT-150-57, CT-200-57

Dimensions *(Bold numbers are in millimeters, bottom numbers are in inches)*

Part number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	Weight (g)	ℓ_e (cm)	A_e $(cm)^2$	V_e $(cm)^3$	A_L Value mh/1000 turns
CT-50-57	**12.95±0.4** .510	**7.35±0.25** .290	**7.1±0.4** .280	3.3	3.07	.168	.52	450
CT-50A-57	**12.95±0.4** .510	**7.35±0.25** .290	**9.3±0.5** .365	4.5	3.07	.221	.68	475
CT-82-57	**21.2±0.5** .835	**12.95±0.4** .510	**10.15±0.5** .525	12	5.2	.377	1.95	625
CT-82A-57	**21.2±0.5** .835	**12.95±0.4** .510	**13.3±0.6** .525	16.5	5.2	.50	2.58	650
CT-100-57	**26.0±0.75** 1.025	**15.25±0.5** .600	**12.1±0.6** .475	23	6.2	.59	3.69	800
CT-100A-57	**26.0±0.75** 1.025	**15.25±0.5** .600	**15.9±0.6** .625	32	6.2	.79	4.9	825
CT-150-57	**38.6±1.0** 1.520	**21.2±0.6** .835	**15.9±0.6** .625	74	8.9	1.28	11.4	1250
CT-150A-57	**38.6±1.0** 1.520	**21.2±0.6** .835	**20.95±0.65** .825	100	8.9	1.70	15.1	1300
CT-200-57	**51.05±1.25**	**31.5±1.0**	**19.7±0.6**	150	12.5	1.82	22.7	1275

KERNER ANVENDT SOM TRANSFORMATORER

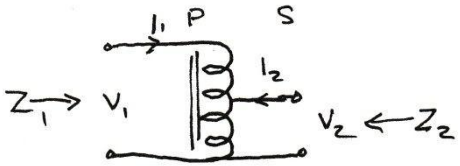
- DOBBELT VIKLEDE – PRIM/SEK



- DC ADSKILLELSE
- "HÅRD KOBLING" LIDT VANSKELIG OG DERMED VANSKELIG BÅNDBREDDE

$$\frac{V_1}{V_2} = \frac{n_1}{n_2} \; ; \; \frac{Z_1}{Z_2} = \left(\frac{n_1}{n_2}\right)^2$$

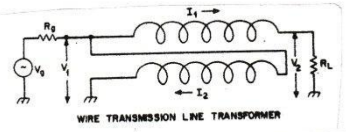
- SOM AUTOTRAFO

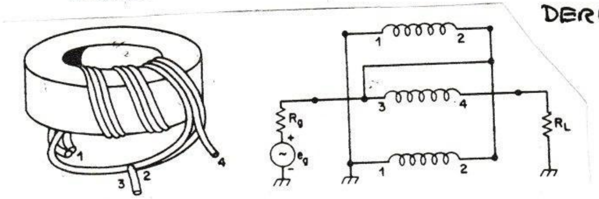


- IKKE DC ADSKILLELSE
- KOBLING LIDT BEDRE END DOBB. VIKLET

DISSE TYPER ANVEND SOM BALLUN/UNUN KALDES "SPÆNDINGSBALLUN"

- BIFILARVIKLEDE TRANSMISSIONS-TRANSFORMATORER (BENYTTES MEST SOM BALLUN-UNUN)





- IKKE DC ADSKILLELSE
- KAN GIVE MEGET "HÅRD KOBLING" OG DERME STOR BÅNDBREDDE

MANGE FORSKELLIGE PRAKTISKE UDFORMNINGER SOM ER BESKREVET I MEGEN LITTERATUR

VED POWER TRANSFORMERING

- "ALMINDELIGT" HØJ-μ FERRIT GÅR NEMT I MÆTNING VED FÅ WATT. MED VARME, FORVRÆNGNING OSV TIL FØLGE

- DER FREMSTILLES SPECIAL-FERRIT KERNER AF $Z_n N_i$ MED LAVT μ (50-80) SOM BRUGES TIL HØJ-EFFEKT BALUN FREMSTILLING (BREDBÅND) MEN DET SKAL FREMSKAFFES SPECIELT, ER IKKE DEL AF "STANDARD-PRODUKTPROGRAM"

- DER FINDES OGSÅ "KOMBINATIONS-KERNER" AF PULVERJERN OG FERRIT TIL "POWER-BRUG"

- PULVERJERN ER OK TIL POWER MEN HAR LAVT μ (10-30) – "BÅNDBREDDE-BØVL"

- FÆRDIG VIKLEDE BALUNS I MANGE UDGAVER FINDES F. EKS HOS AMIDON TIL RELATIVT OK PRISER

- ENKELTBÅNDS TRANSFORMATORER SOM ALM. P/S VIKLEDE ER OK TIL "HJEMMEVIKLING" F. EKS. FORAN ANT. TUNER IDET SPREDNINGSINDUKTION MM. INDGÅR I TUNERENS KOMPENCERING.

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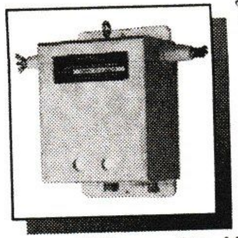

PRIS EKSEMPEL:
0,1–50 MHz 9:1 100 W
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BALUN

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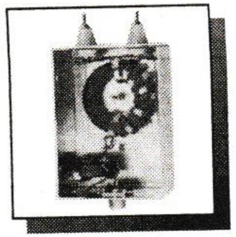
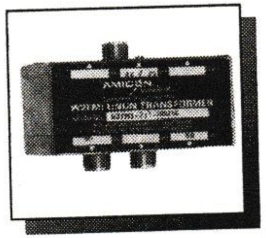
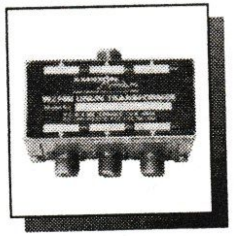


BALanced to **UN**balanced Transformer (Impedance Matching Device)



UNUN



UNbalanced to **UN**balanced Transformer (Impedance Matching Device)

SOME BACKGROUND ON BALUNS AND UNUNS

Baluns and ununs (unbalanced-to-unbalanced transformers) belong to a class of matching devices known as *transmission line transformers.* They transmit the energy from input to output by a transmission line mode instead of by flux linkages as in the case of conventional transformers. When properly designed, they can have extremely high efficiencies and very broad bandwidths. The theory of operation of these devices rests chiefly on that of chokes and transmission lines. A balun or unun is simply a choke that isolates the input from the output (thus only allowing transmission currents to flow) and a configuration of transmission lines.

A major difficulty (even today) is that this very important and popular class of matching devices is not included in the curriculums at universities. In fact, there are no standards for the specification and testing of these devices by any professional group! As a result, practically everyone still perceives these devices as conventional transformers and not transmission line transformers. To remedy this, it has been suggested that this class of transformers be called *broadband transmission line matching networks.*

For more detailed information, please read the following written by Dr. Jerry Sevick, and available from Amidon Associates Inc.

1) *Transmission Line Transformers,* 2nd. Ed. published by ARRL. Contains analysis, characterization, and designs of BALUNs and UNUNs. Good for students, engineers and designers.
2) Series on BALUNs and UNUNs in *Communications Quarterly* and *CQ. Magazine* Describes various type of BALUNs and UNUNs designs. Good for experimenters and "do-it-yourself"
3) *Transmission Line Design Handbook .* Contains 48 improved designs of BALUNs and UNUNs covering all impedance ratios. Good for "do-it-yourself", hobbyists, and Amateurs.
4) *Building and Using Baluns and Ununs: Practical Designs for the Experimenter.* Published by CQ Communications, Inc. Jerry Sevick. The all new definitive source for his latest practical information and designs. Unique opportunity to learn about the application of baluns and ununs for dipoles, yagis, log periodics, beverages, antenna tuners, and countless other examples.

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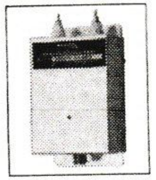
1.5:1 Baluns - 75 ohms balanced to 50 ohm unbalanced (coaxial)

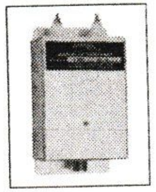


- For 1/2 Wave Dipoles at 0.22 wavelengths above ground

When a half-wave dipole is at a height of about 0.22 wavelengths above ground, its resonant input impedance is close to 75 ohms. A 1.5:1 balun then performs the perfect match to 50-ohm coaxial cable. Although a VSWR of 1.5:1 (without the balun) is not of great importance, some personal satisfaction can be realized by using this balun.

Model: W2FMI-1.5:1-HB75 *Dimensions: *5.5" x 3.8" x 2.3" (*6.8" Including Flange)*

2:1 Baluns - 100 ohms balanced to 50 ohms unbalanced (coaxial)

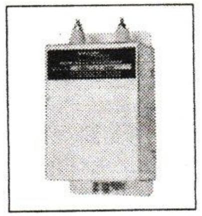


- For 1/2 Wave Dipoles at 0.22 and 0.33 wavelengths above ground
- For Quad Loop Antennas which have resonance input impedance Close to 100 ohms

Probably the most useful application of a 2:1 balun is in matching 50-ohm coaxial cable to the input of quad loop antennas. These broadband antennas generally have input impedances close to 100 ohms. When the half-wave dipole is at about 0.33 wavelengths above ground, its resonant input impedance is close to 100 ohms. This would create a VSWR of 2:1. Obviously, a 2:1 balun is needed here.

Model: W2FMI-2:1-HB100 *Dimensions: *5.5" x 3.8" x 2.3" (*6.8" Including Flange)*
(Quad Loop & 1/2 Wave Dipole, 0.33 wavelength)

4:1 Balun - 200 ohms balanced to 50 ohms unbalanced (coaxial).



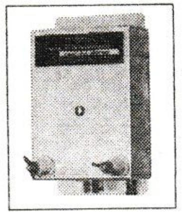
- For 2Kw Log Periodic Beams Antennas
- For Folded Dipole using 300-ohm ribbon at 0.17 wavelength above ground
- Multi-Band Antenna
- Off Center-Fed Antennas
- 1 MHz to 50 MHz
- 2 Kw to 10 Kw

Models:

W2FMI-4:1-HBM200 *Dimensions: *5.5" x 3.8" x 2.3" (*6.8" Including Flange)*
(General impedance match, Folded Dipole, etc.)
W2FMI-4:1-HB/U200 *Dimensions: *5.5" x 3.8" x 2.3" (*6.8" Including Flange)*
(Balun for Off Center-Fed Antenna, and Unun)

The 4:1 balun finds use in matching 50-ohm cable to log periodic beam antennas, multi-band antennas and folded dipoles using 300-ohm ribbon at a height of about 0.17 wavelength above ground. A dual ferrite core version is also available for high power and for G5RV. For antenna tuners, please use HBHT200. The 4:1 HB/U200 is both a current and a voltage balun. The 4:1HB/U200 is uniquely designed to function both as balanced to unbalanced matching and unbalanced to unbalanced matching. It is particularly suited for off-center fed antennas.

4:1 Antenna Tuner Balun



- For 10Kw Antenna Tuners
- For High Power (10Kw) Log Periodic Beam Antennas
- For High Power (10Kw) G5RV Multi-band Antennas
- 1 MHz to 50 MHz

Models: W2FMI-4:1-HBHT200 *Dimensions: *5.5" x 3.8" x 2.3" (*6.8" Including Flange)*
(10 Kw for Antenna Tuners, G5RV, etc)

The 4:1 baluns in antenna tuners can be subjected to very hostile conditions (mainly very high impedances and hence, high voltages) depending upon the length of the transmission lines. Therefore special attention is paid to the design of the balun and the best length for one-half of the dipole and the feedline. For antenna tuners, experience has shown that a balun with a rather large powdered-iron toroidal core, connected as a voltage (Ruthroff's design) balun, to be the preferred choice. These 10Kw balun can also be used for high power log periodic antenna and G5RV.

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