FERRITE BEADS

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

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

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

We recommend the #73 or the #77 ferrite bead material for the attenuation of RFI resulting from transmissions in the amateur band. The #43 material will provide best RFI attenuation from 30 to 400 MHz, and the #64 material is most effective above 400 MHz. The #J material is recommended for RFI from 0.5 to 10 MHz, but it can also be quite effective even below the AM broadcast band.

Ferrite beads are usually quite small and as a result only one pass, or a small number of turns are possible. On the other hand, a toroidal core usually has a much larger inner diameter and will accept a greater number of turns. The greater number of turns can be an advantage in some cases where a large amount of impedance is required. The increase in impedance is proportional to the square of the number of turns.

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 crisscrossed 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 are based on the current industry standard, which are two and one half turns threaded through the holes, crisscrossing from one side to the other side.

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

The #73 and #J 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.