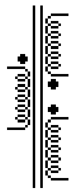
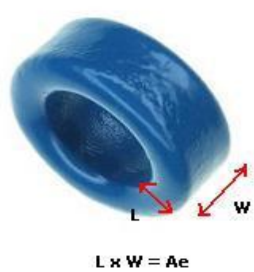
GDTS FOR DUMMIES



Gate Drive Transformer

GDT's or "gate drive transformers" are used in numerous circuits as a simple level-shifter/galvanic isolator/signal inverter for half/fullbridge drivers. You may have noticed one in my Multipurpose inverter, PLL SSTC or PLL Induction heater. They have a number of advantages, such as providing isolation between the drive and power circuitry, introducing very little extra delay and being simple to construct. I've built many GDT's and to begin with they seldom worked correctly. Things such as leakage inductance, minimum number of primary turns, core material were beyond me. I would simply wind an arbitrary number of turns on a tiny EE-core and hope for the best. As I've gained experience in the matter I've learned that the little details such as core material, and how one winds the turns are very important for creating a functional GDT.



First off, you need a proper core. The core must be ferrite, and have as small an air gap as possible. Perfectly suited for this are toroidal cores. Toroids can often be found as filters on various signal or ground cables in monitors or other equipment. Unfortuanetly, these toroids are sometimes powdered iron, which is unsuitable, making it a bit of a lottery. Powdered iron cores are generally color coded, and most often with two different colors. Ferrites on the other hand tend to be a single color, or unpainted. The core to left is a suitable ferrite for example. When shopping for a core look for one with a high high permeability or "AL" value, as this means more inductance per turn and less magnetizing current. Once you have a core you need to know how many primary turns are required. This depends on the drive voltage, frequency, the core's cross sectional area and the maximun flux density the core can handle at a given frequency. Fortunately these are related by a simple formula:

$$N = (V \times t) / (B \times Ae)$$

Where N is the minimun number of primary turns, V is the voltage applied to the core, t is the time the votlage is applied, B is the peak flux density and Ae is the cross sectional area of the core.

The core's cross sectional area, Ae, is the core area within single turn on the toroid. It can be found by measuring the length and width of the core where you wish to wind, or in the core's datasheet. The maximun flux density you want in your core can range from 0.1 – 0.3 Tesla for depending on the drive frequency. As frequency increases the core will heat more unless the flux density is decreased. For 100 - 200kHz, 0,25T works fine in most cases. The core datasheet will specify the flux density at various frequencies if you don't feel like experimenting. I've made a spreadsheet for quick GDT design, which can be downloaded >HERE<.

How you wind the turns are an equally important part of GDT creation as the other stages. With the wrong winding technique the leakage inductance (which is like an inductor in series with the load) will be large enough to resonate with the gate. This would cause a messy drive signal, which could be bad enough to put the mosfet into the linear range or even switch it at a higher frequency than intended. James Pawson from "thedatastream" collected some experimental data on different winding techniques to see how they alter the amount of leakage inductance.

From the data it was determined that using screened wire (coaxial cable such as in headphone cable) or the poor-mans alternative trifilar-wound wire (Trifilar-wound wire is 3 strands of wire twisted together first, then wound as a single winding) resulted in the least leakage inductance. The wire should also be wound over as much of the core window as possible.

Source: http://uzzors2k.4hv.org/index.php?page=gdthowto