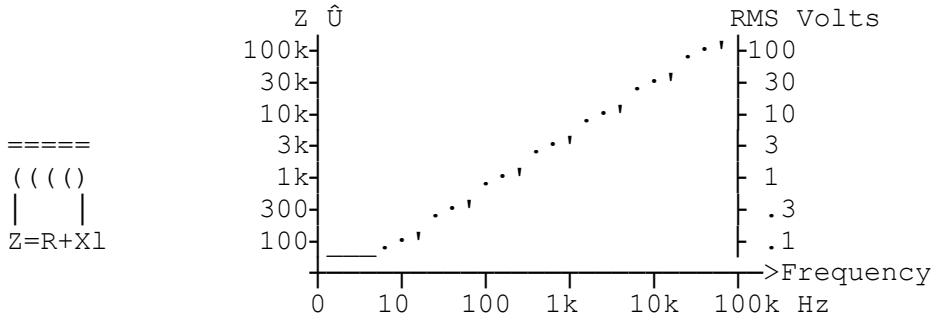
Driving Inductive Loads

By G8MNY (Updated Aug 13)
(8 Bit ASCII graphics use code page 437 or 850, Terminal Font)

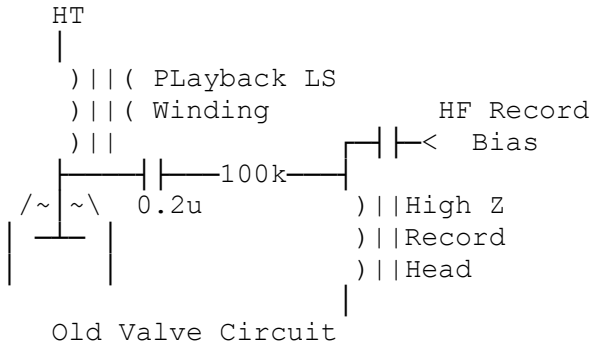
If you have ever tried to get a tape recorder head current flat, magnetic cutting pickup, LF scope scan coils, hearing aid loop etc, you will be aware it is not very efficient & impossible to match over a wide frequency range.

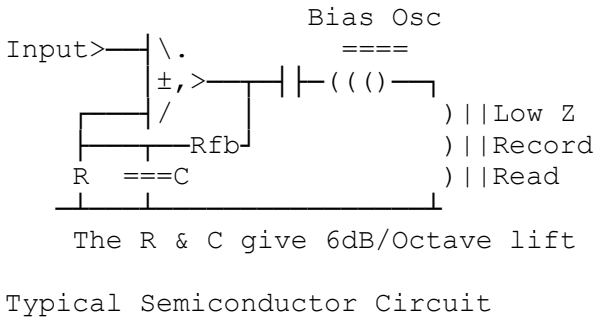
TYPICAL HEAD LOAD



Theory says the impedance Z starts at the DC resistance & then the coil inductance reactance Xl takes over as you increase frequency. As the impedance gets higher at higher frequency the self & lead capacitance will resonate coil making the total Z go very high.

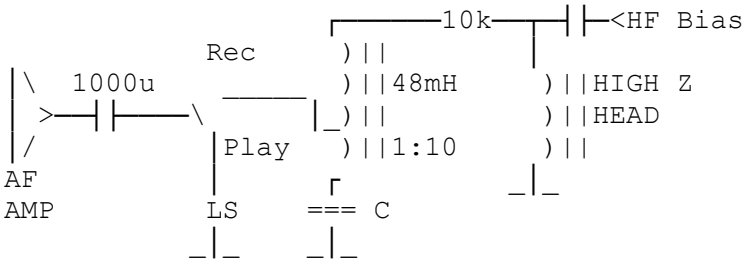
So trying to design a driving stage to give constant magnetic field (or force) is really impossible. What is normally done in the Valve era was to use a high series resistor from a high power stage, so the constant current was fed in as the head Z was always much lower than the series R.





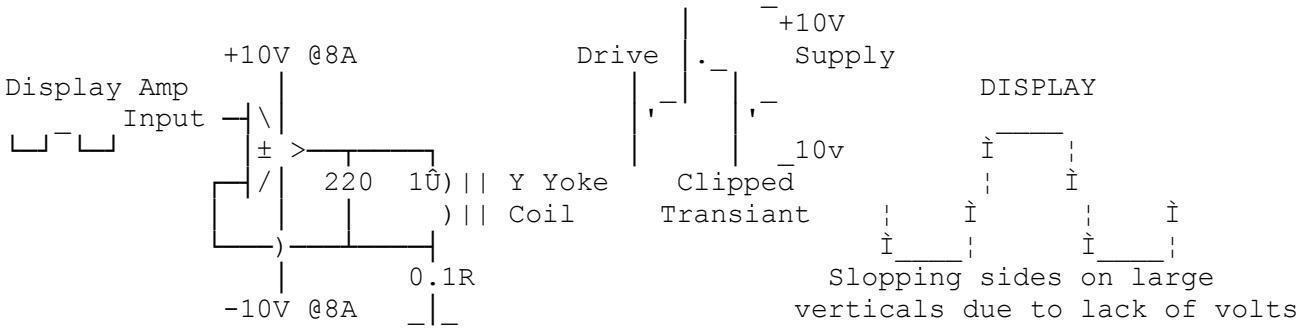
For tape record a large HF bias voltage is applied too. For transistorised equipment especially battery powered using such a wasteful approach is not used. Instead pre-emphisis is used to predict the head current & drive the head from a lower impedance. This gives a flat response OK, but it has the problem that higher drive voltage is not available as needed for LOUD treble, so most simple designs suffer from treble clipping (SHUSHY treble) in the driving amp & this is often mistaken for poor tape etc.

ONE SOLUTION
Many years ago I made a tape recorder from scratch using an old Valve type tape deck & I knew there would be this problem with a semiconductor design. I came up with this approach still using the AF amp as a drive source, but a step up transformer that gradually came in at HF to boost the voltage available at the treble end to give the full unclipped recording level.



At bass to mid the constant current came from the series 10k, from mid to treble the step up came in as the cap C & the tapping ratio were chosen to give the drive required step up to maintain the full head current for tape saturation.

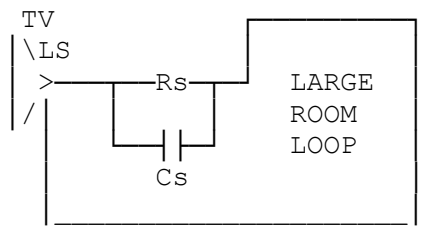
MAGNETICLY DEFLECTED X/Y SCOPE DISPLAY
I have a 12" one of these, I use it for displaying a spectrum analyser adaptor. It uses constant current power output drivers with current NFB. The whole thing runs terribly hot, as any display offset (e.g. trace at the bottom of screen) needs huge standing current from a low voltage supply, & at only a few 10s of kHz the supply is far to low to give much deflection current.



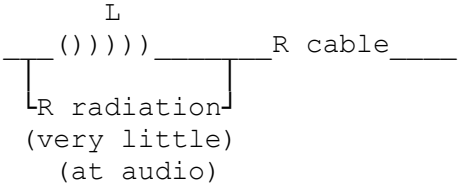
Putting the yoke coil in the NFB loop gives the required voltage to frequency uplift of 6dB/Octave, but due to the coil there is a time delay that causes instability, so the amp gain has to be reduced at HF to make this circuit work.

Unlike with audio, the signal phase is important on scopes. so no bodges really work well. :-(

DEAF AID INDICTIVE LOOP
Here is another inductance load! The main problem here is not to overload to a driving amp etc. & still give plenty of treble.



Equivalent Loop Circuit



Rs makes up the total DC resistance to not less than 8 ohms, & it has to handle most of the LS amp power (1-5W). Cs (e.g. 1-10uF) can then boost some of the treble if needed, as the loop Z goes up due to it's inductance. The lower the loop DC resistance the bigger Rs needs to be, & the more Cs may have an effect. If the loop is made more sensitive with several turns, it may be too inductive (<1mH for 8Û system) & treble will be reduced!

Why don't U send an interesting bul?

73 De John, G8MNY @ GB7CIP