High-current variable lipstick

If you remove all the metallic parts – and the red part – of a lipstick applicator and substitute a ferrite rod for the lipstick, the result is the core of a variable inductor capable of carrying an alternating current of several amps.

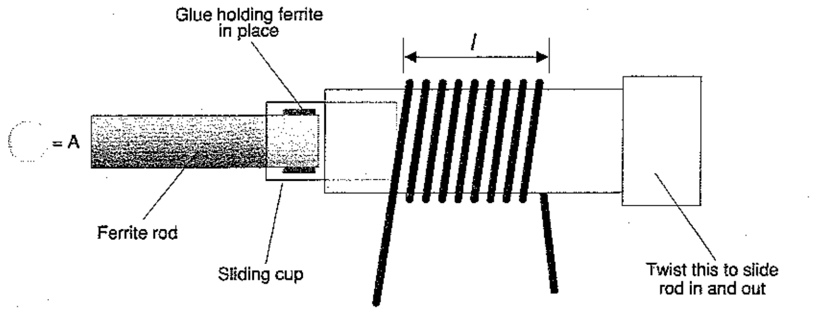
Maximum inductance is given by the standard formula:

$$L = \frac{n^2 A \mu_0 \mu_r}{l} \text{ henries}$$

and the minimum inductance approaches the value given when the relative permeability μ_r=1.

Using the layout shown in the diagram with about 20 turns, inductance ranged from 4-20μH with my prototype.

Name not supplied
Edinburgh



Mechanics of a lipstick make a low-value variable inductor.

Monitor RS-232 activity

Using only a moving-coil voltmeter, you can observe the average activity on an RS-232 link and easily detect oddities.

A centre-zero meter in voltmeter configuration with a suitable series resistor is simply connected between common and the line to be watched.

Since RS-232 transmission is in the form of two voltages with opposite polarity to indicate binary 0 or 1. If you assume one start and one stop bit, maximum usage will show on the meter, scaled for ±100%, as zero. Idling shows up as –90% to –100%, fairly busy as –50% to –20% and flat out as –20% to +20%. The region +20% to +50% means that something is not quite right. Anything over +50% indicates a probable fault.

Trim the series resistor to obtain a –100% reading for zero traffic.

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Transconductance square rooter

In the simple circuit of **Fig. 1**, output signal V_o is the square root of input voltage V_i. The circuit is based on the quadratic law connecting I_D and V_{GS} in an enhancement mode mosfet, $I_D=K(V_{GS}-V_T)^2$. This may also be written $V_{GS}=V_T+\sqrt{(I_D/K)}$, where V_T is the threshold voltage and K is a constant depending on the physical parameters of the mosfet.

Together with Tr_1, op-amp A_1 forms a voltage follower, so $V_{R2}=V_i$, $I_D=V_i/R_2$ and V_{GS}, which is buffered and referred to ground by a difference amplifier, is then $V_T+\sqrt{(V_i/KR_2)}$.

The second stage allows V_T to be subtracted, through RV_1, and it allows total gain to be adjusted through RV_2, in order to obtain $V_o=\sqrt{V_i}$.

To avoid thermal drift problems, the mosfet works close to the threshold voltage, with low values of I_D, where $I_D=f(V_{GS})$ is exponential rather than quadratic. However, a good adherence to the root law can be obtained by iteratively adjusting RV_1 and RV_2.

Figure 2 shows V_o versus V_i with an input range of 0 to 1V with a root function.

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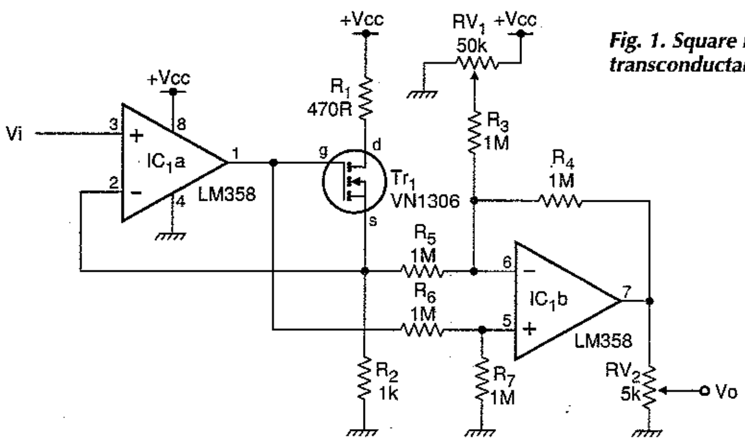

Fig. 1. Square rooting circuit based on transconductance.

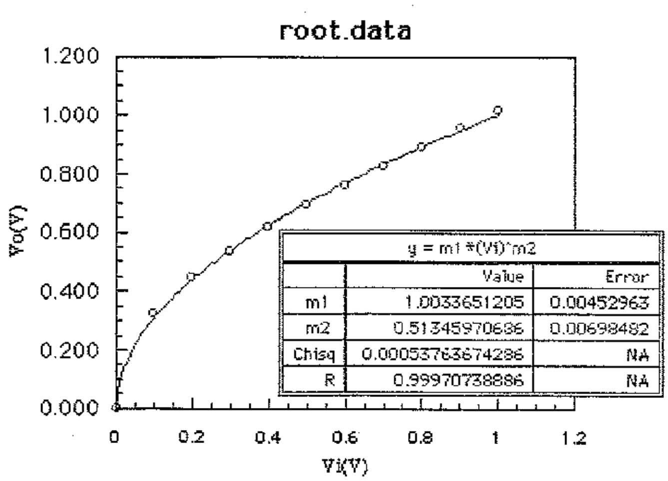

Fig. 2. Graph showing how voltage V_o closely approximates the square root of V_i.