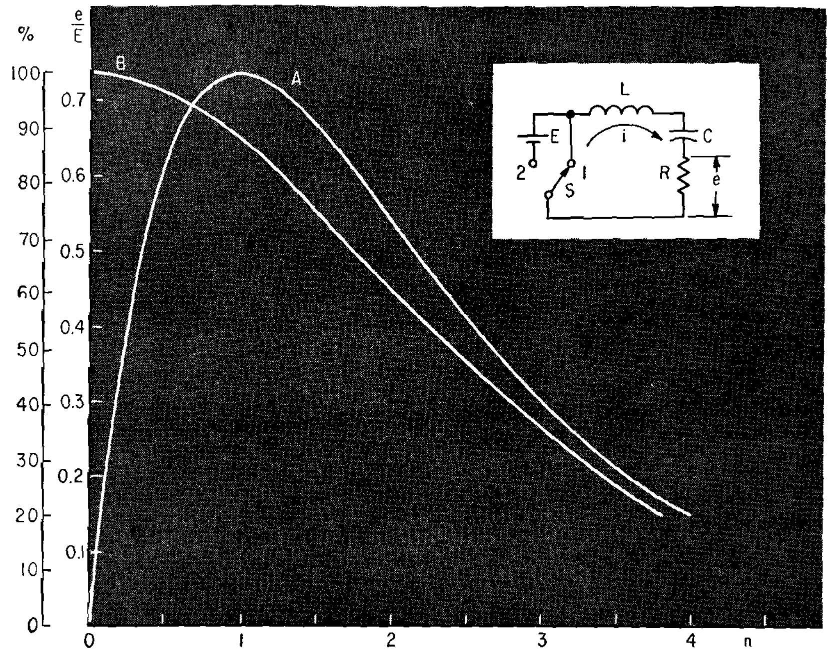

FOR *the critically damped circuit shown, curve A gives the ratio e/E versus n. Curve B shows the ratio e/E versus pulse width in terms of n. The percent scale refers to the percent of maximum pulse amplitude for either curve*

Chart Gives RLC Values for Critical Damping

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SELECTING component values for generating a critically damped transient in a simple RLC circuit is a cut-and-try process under conditions frequently encountered in practice. The selection of components for a circuit such as that shown is facilitated by the normalized graphs. When the switch transfers from contact 1 to contact 2, a transient is generated as described by E. A. Guillemin in "Communication Networks," volume 1, page 55. Variations of this circuit may be used to generate pulses for resetting counters in pulse-operated equipment either manually or by remote control.

If $R/4L = 1/RC$, the circuit will be critically damped. The voltage across resistance R will be a pulse described by Eq. 1

$$e = \frac{REt}{L} \epsilon^{-Rt/2L} \qquad (1)$$

The pulse will have a maximum of $e = 2E\epsilon^{-1}$ when $t = 2L/R$. This cannot be solved explicitly for t, consequently the pulse width can not be determined. If the substitution $t = 2L/R$. This cannot be solved expulse may be described by the normalized Eq. 2

$$\frac{e}{E} = 2n\epsilon^{-n} \qquad (2)$$

Curve A represents Eq. 2. Curve B, obtained graphically from curve A, shows the amplitude of the normalized pulse as a function of the normalized pulse width in n units. Consider the simplification of calculations resulting from the use of these curves in the following example.

Given: $R = 25$ ohms; desired pulse amplitude $= 8$ v maximum; desired pulse width at 6 v $=$ 1.5 μsec; Find E, L, and C.

The maximum pulse height is 0.736 E, therefore $E = 8/0.736$ or $E = 10.9$ volts. Six volts is 75 percent of the maximum pulse height. Referring to curve B, the pulse width in n units is 1.5.

$$L = \frac{tR}{2n} = \frac{(1.5)(25)(10^{-6})}{(1.5)(2)} = 12.5\mu h$$

$$C = \frac{4L}{R^2} = \frac{(4)(12.5)(10^{-6})}{625} = 0.08\mu f$$

To determine any other characteristics of the pulse from the normalized curve A, simply multiply the ordinate by E and the abscissa by $2L/R$.