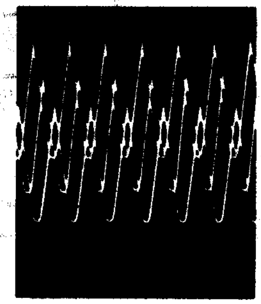

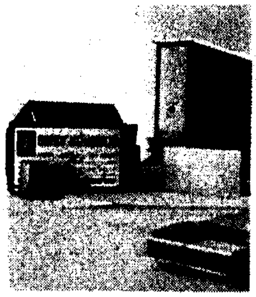

DRIVING LONG LINES

When long cables are connected to the output of an amplifier, the cable capacitance must be considered as a part of the amplifier load. As the frequency increases, the capacitive reactance of this load decreases:

$$\text{Capacitive Reactance } X_C = \frac{1}{2\pi fC}$$

If the actual load impedance in ohms is less than the minimum rated value for the amplifier, the amplifier may be unable to put out its maximum rated voltage without distortion. In other words, the maximum current rating may be exceeded.

In long cable situations, the following will apply:

- L = cable length in <u>feet</u>
- p = capacitance per unit length of cable in <u>pF/foot</u>
- f = maximum frequency in <u>thousands of Hz</u>
- R_L = resistive termination at the end of the cable in <u>kΩ</u>
- Z = minimum rated load impedance for the amplifier in <u>kΩ</u>

$$L = \frac{159000\sqrt{1 - \left(\frac{Z}{R_L}\right)^2}}{fpZ}$$

or

$$f = \frac{159000\sqrt{1 - \left(\frac{Z}{R_L}\right)^2}}{LpZ}$$

ENDEVCO

RANCHO VIEJO ROAD · SAN JUAN CAPISTRANO, CA 92675 · TELEPHONE (714) 493-8181

ANAHEIM, CA • ANNAPOLIS, MD • CHICAGO, IL • DAYTON, OH • HOUSTON, TX • LAMBERTVILLE, NJ • ORLANDO, FL • PALO ALTO, CA • W. MYSTIC, CT
ARGENTINA • AUSTRALIA • BRAZIL • CANADA • CHILE • FINLAND • FRANCE • INDIA • IRELAND • ITALY • JAPAN • KOREA • MALAYSIA • MEXICO
NETHERLANDS • NORWAY • SINGAPORE • SPAIN • SWEDEN • SWITZERLAND • TAIWAN • UNITED KINGDOM • URUGUAY • VENEZUELA • W. GERMANY

PRINTED IN USA

If R_L is large compared with Z, the relationships become:

$$L \approx \frac{159000}{fpZ}$$

$$f \approx \frac{159000}{LpZ}$$

Example:

$p = 40$ pF/foot

$f = 4000$ Hz

$R_L = 100$ kΩ

$Z = 10$ kΩ

R_L is large compared with Z, and L is approximately:

$$L \approx \frac{159000}{(4)(40)(10)} = \frac{159000}{1600} = 99.6 \text{ feet}$$

With longer lengths of cable, the amplifier will still operate satisfactorily if its maximum current rating is not exceeded. Therefore, longer lengths of cable could be used if the maximum amplifier voltage rating were reduced. In the above example, if the maximum output voltage were kept at less than one-fifth the normal rated maximum, the allowable cable length could be extended five times.

If the maximum current rating for the amplifier is known, the maximum voltage output without excessive current will be as follows:

$$E_{out} = \frac{I_{max}}{\sqrt{\frac{1}{R_L^2} + \frac{(2\pi fpL)^2}{10^{12}}}}$$

Where:

E_{out} = maximum output in volts without exceeding current rating

I_{max} = maximum output current in milliamperes

R_L = resistive termination at the end of the cable in kΩ

f = frequency in thousands of Hz

p = capacitance per unit length of cable in pF/foot

L = length of cable in feet

In long line situations, it may be advisable to use coaxial cable for the signal lead rather than combining the signal lead with other conductors in a multi-conductor cable. This may materially reduce the noise pickup. To prevent excessive ground loop noise pickup, it may also be advisable to make certain that the amplifier is electrically isolated from the mounting point and grounded to the signal ground return.