

RADIO

Handbook

SIXTEENTH EDITION

*This book is revised and brought up to date (at irregular intervals) as necessitated by technical progress.*

# THE RADIO HANDBOOK

**Sixteenth Edition**

**WILLIAM I. ORR, W6SAI**  
Editor, 16th Edition

*The Standard of the Field —*

*for advanced amateurs  
practical radiomen  
practical engineers  
practical technicians*



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than with other types, except direct coupling. The R-C amplifier may exhibit tendencies to "motorboat" or oscillate if it is used with a high impedance plate supply.

## 6-6 Video-Frequency Amplifiers

A video-frequency amplifier is one which has been designed to pass frequencies from the lower audio range (lower limit perhaps 50 cycles) to the middle r-f range (upper limit perhaps 4 to 6 megacycles). Such amplifiers, in addition to passing such an extremely wide frequency range, must be capable of amplifying this range with a minimum of amplitude, phase, and frequency distortion. Video amplifiers are commonly used in television, pulse communication, and radar work.

Tubes used in video amplifiers must have a high ratio of  $G_m$  to capacitance if a usable gain per stage is to be obtained. Commonly available tubes which have been designed for or are suitable for use in video amplifiers are: 6AU6, 6AG5, 6AK5, 6CB6, 6AC7, 6AG7, and 6K6-GT. Since, at the upper frequency limits of a video amplifier the input and output shunting capacitances of the amplifier tubes have rather low values of reactance, low values of coupling resistance along with peaking coils or other special interstage coupling impedances are usually used to flatten out the gain/frequency and hence the phase/frequency characteristic of the amplifier. Recommended operating conditions along with expressions for calculation of gain and circuit values are given in figure 9. Only a simple two-terminal interstage coupling network is shown in this figure.

The performance and gain-per-stage of a video amplifier can be improved by the use of increasingly complex two-terminal interstage coupling networks or through the use of four-terminal coupling networks or filters between successive stages. The reader is referred to Terman's "Radio Engineer's Handbook" for design data on such interstage coupling networks.

## 6-7 Other Interstage Coupling Methods

Figure 10 illustrates, in addition to resistance-capacitance interstage coupling, seven additional methods in which coupling between two successive stages of an audio-frequency amplifier may be accomplished. Although

resistance-capacitance coupling is most commonly used, there are certain circuit conditions wherein coupling methods other than resistance capacitance are more effective.

**Transformer Coupling** Transformer coupling, as illustrated in figure 10B, is seldom used at the present time between two successive single-ended stages of an audio amplifier. There are several reasons why resistance coupling is favored over transformer coupling between two successive single-ended stages. These are: (1) a transformer having frequency characteristics comparable with a properly designed R-C stage is very expensive; (2) transformers, unless they are very well shielded, will pick up inductive hum from nearby power and filament transformers; (3) the phase characteristics of step-up interstage transformers are poor, making very difficult the inclusion of a transformer of this type within a feedback loop; and (4) transformers are heavy.

However, there is one circuit application where a step-up interstage transformer is of considerable assistance to the designer; this is the case where it is desired to obtain a large amount of voltage to excite the grid of a cathode follower or of a high-power Class A amplifier from a tube operating at a moderate plate voltage. Under these conditions it is possible to obtain a peak voltage on the secondary of the transformer of a value somewhat greater than the d-c plate supply voltage of the tube supplying the primary of the transformer.

**Push-Pull Transformer Interstage Coupling** Push-pull transformer coupling between two stages is illustrated in figure 10C. This interstage coupling arrangement is fairly commonly used. The system is particularly effective when it is desired, as in the system just described, to obtain a fairly high voltage to excite the grids of a high-power audio stage. The arrangement is also very good when it is desired to apply feedback to the grids of the push-pull stage by applying the feedback voltage to the low-potential sides of the two push-pull secondaries.

**Impedance Coupling** Impedance coupling between two stages is shown in figure 10D. This circuit arrangement is seldom used, but it offers one strong advantage over R-C interstage coupling. This advantage is the fact that, since the operating voltage on the tube with the impedance in the plate circuit is the plate supply voltage, it is possible to obtain approximately twice the peak voltage output that it is possible to obtain with R-C coupling. This is because, as has been

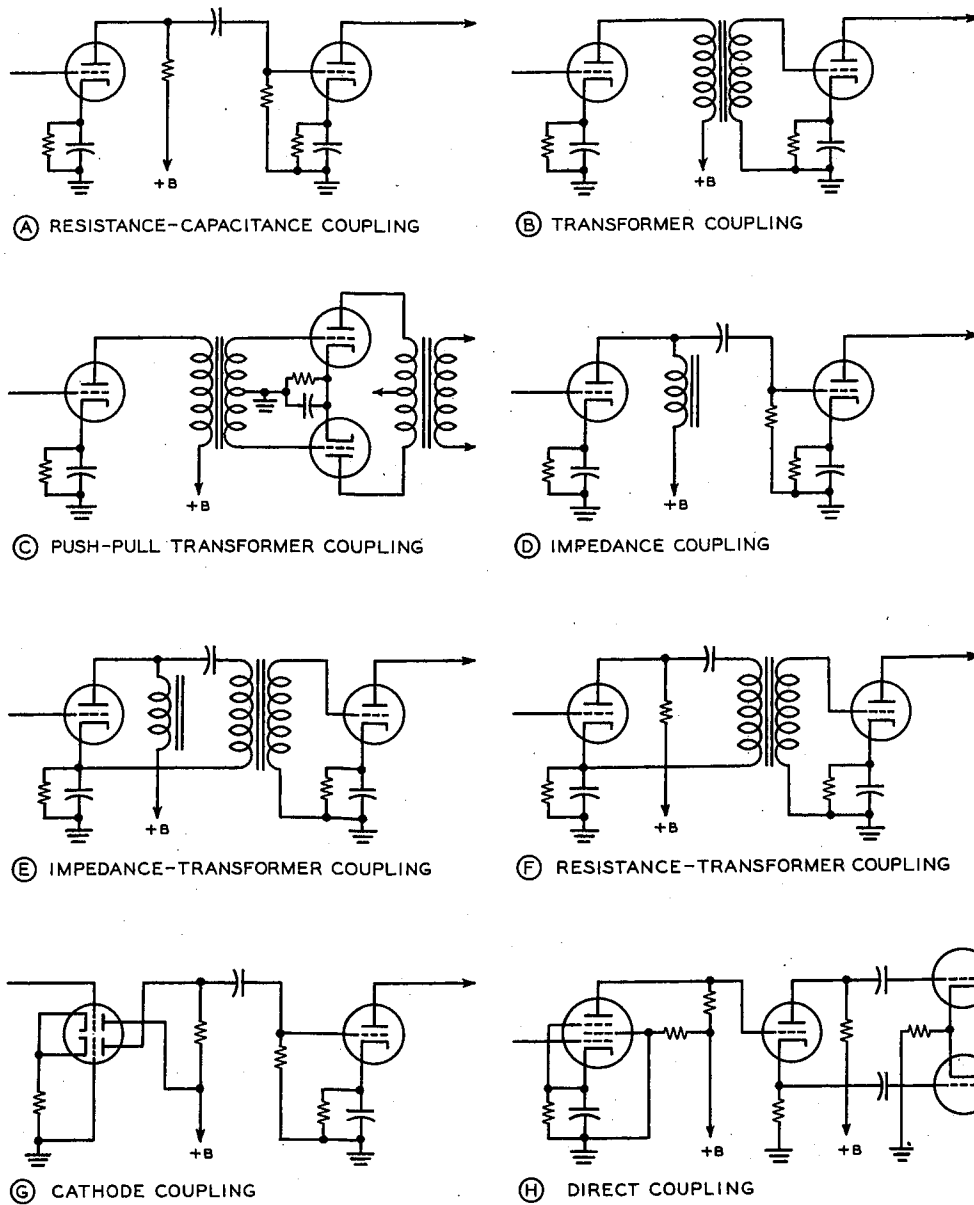


Figure 10  
 INTERSTAGE COUPLING METHODS FOR AUDIO FREQUENCY VOLTAGE AMPLIFIERS

mentioned before, the d-c plate voltage on an R-C stage is approximately one-half the plate supply voltage.

**Impedance-Transformer and Resistance-Transformer Coupling** These two circuit arrangements, illustrated in figures 10E and 10F, are employed when it is desired to use transformer coupling for the reasons cited above, but where it is desired that the d-c plate current of the amplifier

stage be isolated from the primary of the coupling transformer. With most types of high-permeability wide-response transformers it is necessary that there be no direct-current flow through the windings of the transformer. The impedance-transformer arrangement of figure 10E will give a higher voltage output from the stage but is not often used since the plate coupling impedance (choke) must have very high inductance and very low distributed capacitance in order not to restrict the range of

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