**1:3**

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**Method of** Coupling

*e*ri

dian Cine Age og

**A signal a**mplifier cannot provide sufficient gain for many applications. In those cases, two or more stages are cascaded in such a way that the output of the first stage becomes the input of the second stage. The output of the second stage becomes the input of the third stage and so on. The methods by which such individual stages are connected are called coupling.

**The various met**hods of coupling are: -

• Direct coupling,

R-C coupling, 11 2

• Transformer coupling and

• Impedance coupling. *51.3.1 Direct cou****pling*** .. . **in direct coupling, t**he output of one stage is electrically connected

**directly to the i**nput of the next stage. ).

**(Direct couplin**g is used in differential amplifiersi operational **-amplifiers and integrated** circuits.. Two practical circuits that employ direct

coupling are the CE-CC configuration, and the Darlington-pair amplifier, ki **shown in Figure** 1.*2*4(a*)* and *(b*) respective*ly,*

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**22 • Electronic Circuit**

O +12V

СЕ А

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**(b)**

***Fig. 1.24. (*a) *T*he C*E-*C*C configuration (b) The***

***Darlington-pair amplifier*** The merits and demerits of the direct coupling are as follows:

***Merits*** (i) The circuit is simple and its cost is low. *0* (ii) It has outstanding ability to amplify low frequency signals. (iii) It has a flat frequency response as shown in Figure 1.10(c) up to the

**upper cut-off frequency.**

**A*V*A**

**Am**

**Am**

mt-------

***Fig. 1.24. (c) Gain versus frequency plot Demerits*** (i) It has a poor temperature effect to the operating point since B and BE

vary with the variation of the temperature, i.e., the dc current flows *it*o

one stage to another and as a result the Q-point becomes unstable. (ii) It is not suitable for high frequency signals. ***Applications***

Direct coupling is mainly used when the load in a serie connected directly to the output terminal of the active devices, such **headphones, loudspeakers.** Similarly, direct coupling is used in p amplifiers, differential amplifiers, regulator circuits and in power supplies.

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*1.3.2 R-C Coupling*

**A two-sta**ge R-C coupled amplifier in a CE-configuration is shown in Figure 1.25.(The signal developed across the collector resistor Rc of the first stage is coạpled to the base of the second transistor through the coupling ca*p*aci*t*or C2.*)*

The coupling capacitor C couples the ac signal voltage to the base of transistor Q.) In the absence of C1, the signal resistance will be parallel to R, and the bias voltage of the base will be affected. With a low resistance of **Rs, the transistor Q, may turn** off due to the very low bias voltage at the base. *|* The function of C, is to allow the alternating current to flow from the source

to the input of the circuit. *)*

RES

a *Fig. 1.25****. Two stage R-C coupled amplifier***

( The emitter bypass capacitor Ce offers a low resistance path to the ac signal. In the absence of Ce, the signal drop across Re will reduce the effective voltage across the base-emitter terminal and thus reduce the gain. )

*(F*or a dc, CE acts as an open circuit and Re, the feedback resistor, provides a better stability.) Thus, the feedback resistor Re with the bypass capacitor Ce provides two advantages; better stability and high gain. *V*

(The coupling capacitor Cz allows the ac signal to pass to the next stage but blocks the passage of the dc voltage. Thus, the operating point becomes stable.) ***Frequency response*** (a) Low- frequency range (below 50 Hz): \* At low frequencies, the

capacitive reactance of coupling capacitors C, and C2 are high. Thus, the signal drops across them and as a result the voltage gain is reduced. Similarly, the signal drops across R and this will also reduce the

**voltage gaini.** (b) Medium-frequency range *(*50 H*z-2*0 KH2) At medium frequencies, the

capacitive reactances of cy; cl and ce a*re* very small rand ; they

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*"Advantages*

W The main advantages of R-C coupled amplifiers are:

*(*i) Excellent frequency response, i.e., constant gain over de

audio-frequency range. (ii) Cheaper in cost. (iii) Very compact circuit.

(iv) Operating point or Q-point becomes stable. • ***Disadvantages***

*T*he main disadvantages of R-C coupled capacitors are: *(*i) Poor impedance matching due to the 11

impedances of the R-C coupled capacitor oupe the speaker.

to

*the*

*diff*erence 11

*itor output and that of*

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(ii) \*

(iii)

Tendency of becoming noisy with age, particularly in moist climates. T

hey

r Low voltage and power gain due to the low resistance presented by the input of the each stage compared to that of the preceding stage.

*Applications*

R-C coupled transistor amplifiers are widely used as voltage amplifiers in the initial stages of the public address systems. But, due to the poor impedance matching, this type of coupling is rarely used in the final

stage. *W 1.3.****3 Transformer coupling*** radio

**A two-stage t**ransformer coupled amplifier is shown in Figure 1.2*7.*

o+*V*cc

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**CE** TyRRE SR2

IL111 *on Fig. 1.27.* ***A transformer coupled amplifier***

The poor impedance matching of the R-C coupled amplifier is minimized in a transformer-coupled amplifier. The low resistance of the load can be matched with the output resistance of the preceding stage by suitably selecting the turn ratio of the t**ransformer. The main advantages,** disadvantages and the applications of the transformer-coupled amplifier are: **Adv*antages*** (1) There is no dc power loss at the primary side of the transformer; so, the

efficiency of the transformer-coupled amplifier is higher than that of the

R-C coupled amplifier. (11) It provides the excellent impedance matching. (iii) It provides high gain.

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***Disadvantages*** *“)* ***The* frequency response of the transformer-coupled a**mplifier is veri.

p oor. There will be disproportionate amplification o**f frequencies in the** complete signal such as music, speech etc. It intro**duces the frequency** distortion.

he gain is co**nstant ov**er a small range of f**requencies.**

(ii) The gain is constant over (111**) It tends to introduce a h**um in the output. **(iv) At radio freque**ncies, the ir

reactance creates a lot of problems. ***Applications***

10 frequencies, the inductance and the inter-winding capacitive

Trar

mer-coupled amplifiers are widely used for impedance

generally not used in the intermediate stages in a

**matching. They are ge**nerally not used in the in **cascaded am**plifier but in the initial or the output stage. ***1.3.4 Impedance coupling***

**A two-stage impedance coupled amp**lifier is shown in F**igure 1:2**0..

*VC*C

*0000*0

100000

**CE**

***Fig. 1.28*. A t*wo-stage impedance-coupled amplifier***

Sinc**e there is no pow**er loss at the inductor, its efficiency is high.

Impedance coupling is very similar to R-C coupling. The difference is the use of an impedance device (a coil) to replace the load resistor (Rc). Figure 1.28 shows an impedance-coupling network between the two stages of an amplification.

Impedance matching enables maximum power to be delivered from the source of the load.

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