

"An Amplifier Circuit Arrangement"

15
5 The invention relates to a circuit arrangement comprising at least two amplifiers with different electrical properties, one of which is in operation at a time, the amplifier being multi-stage amplifiers having feed-back paths or branches which serve to stabilize the DC voltage. The feed-back branches are separated with respect to DC current by isolation
10 capacitor means and are connected via further capacitor means to a reference potential.

15 In radio receivers, for example, different amplifiers are required for processing a signal depending on whether there is AM or FM operation. Very different amplifier circuits are required in intermediate frequency amplifiers because of the different types of modulation - amplitude modulation or frequency modulation.

20 In the case of integrated circuits a common amplifier is frequently used for both types of operation; however, parts of the amplifier circuit are replaced by other parts depending on the type of operation and it
25 is possible that the operating point is switched. This circuit construction has the disadvantage that it is not possible to provide optimum dimensioning because of the dual function of the amplifier. The TDA 1083 circuit produced by AEG- TELEFUNKEN for example
30 contains a common switchable intermediate frequency amplifier for optional AM or FM operation.

35 It is possible to provide optimum dimensioning of the amplifier circuit if a separate intermediate frequency amplifier is provided for AM and FM operation. This

circuit construction has the disadvantage that more connections (pins) are required and the number of components in this circuit as well as the number of components connected externally is greater.

5

The present invention seeks to provide a simplified amplifier circuit which can be dimensioned optimally and in which symmetry is ensured and the number of input connections can be reduced considerably as well as the number of externally connected capacitors.

10

According to the present invention there is provided a circuit arrangement comprising at least two multi-stage amplifiers, only one of which is in operation at any time, said amplifiers having different electrical properties and having feed-back paths for stabilizing DC voltage, said feed-back paths being separated from each other with respect to DC current by means of isolation capacitor means, wherein a first feed back path of a first of the amplifiers is connected to a first feed-back path of the other amplifier, and said first feed-back paths are connected to a reference potential by a common capacitor, means being provided which permits current flow only through that one of said first feed-back paths which belongs to the amplifier which is in operation.

15

20

25

In particular the means are preferably electronic switches, with only the switch of the amplifier in operation being closed in each case.

30

In a preferred embodiment all corresponding feed-back branches of the amplifier are connected together, the sets of corresponding feed-back branches being isolated by a capacitor which is common to all of the amplifiers and being connected

35

to reference potential by a further capacitor which is also common to all of the amplifiers. All of the feed-back branches of the amplifiers include electronic switches which are only closed in the amplifier which is in operation. The electronic switches preferably comprise switching transistors, their emitter collector paths being connected in the feed-back branches. When the operating voltage is applied to the amplifier provided for operation the switching transistors contained in the amplifier are fed with a base potential driving these transistors.

A preferred embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, of which:

Fig.1 shows a prior art circuit arrangement; and

Fig.2 shows a circuit arrangement in accordance with the present invention.

In Figure 1 there is shown a circuit arrangement having two amplifiers for different frequencies with a total of 6 input connections and 4 capacitors. The upper amplifier arrangement as shown in the diagram may serve to amplify the intermediate frequency of the amplitude modulated signal, for example, whereas the lower amplifier serves to amplify the frequency modulated signal. Both amplifiers comprise a number of amplifier stages V_1 to V_x which are constructed like a differential amplifier for example. Each stage includes two transistors T_1 and T_2 which are connected together at the emitter electrodes and are supplied with a constant current via a current source Q_1 . The input signal is supplied to the base electrodes of the

two transistors T_1 and T_2 via the input connections 1 and 2. At the collectors of the two transistors the output signal of the first amplifier V_1 is supplied to the subsequent amplifier stages V_x . The final stage E_1 comprises two final stage transistors T_3 and T_4 , the base electrodes of which are supplied with the output signal of the last amplifier stage V_x . The amplified amplitude of modulated output signal $U_{OUT AM}$ is tapped at the emitter resistors R_5 and R_6 of the final stage transistor T_3 and T_4 .

Feed-back branches are provided for stabilising the DC voltage and connect the emitter of transistor T_3 via the resistor R_1 to the base electrode of the transistor T_1 of the first amplifier stage and the emitter electrode of the transistor T_4 via the resistor R_2 to the base electrode of the transistor T_2 of this first amplifier stage V_1 . The first feed-back branch with the resistor R_1 linked to the base electrode of transistor T_1 via the internal resistance R_i is of the generator in the input circuit. The two feed-back branches having the resistors R_1 and R_2 are isolated with respect to DC current by a capacitor C_1 . Furthermore, both feed-back branches are connected to earth potential via the capacitor C_2 . Since the capacitors C_1 and C_2 are connected externally to the integrated semi-conductor circuit, the said circuit has the input connections 1, 2 and 3, the pins 2 and 3 forming connections with the feed-back branches having the resistors R_1 and R_2 .

The intermediate frequency amplifier circuit for FM operation is basically identical in construction to the amplifier circuit for AM operation. Of course the components are of different dimensions or values and

the operating points are adjusted appropriately to FM operation. The FM amplifier circuit also includes two feed-back branches having resistors R_3 and R_4 which lead to the connection pins 5 and 6. The connection pins 5 and 6 are connected via the isolation capacitor C_3 whereas the connection pin 5 is also connected to earth potential via the capacitor C_4 .

During operation of the circuit either the AM amplifier or the FM amplifier is applied to the operating potential U_S via the switch S . The entire circuit therefore includes 4 capacitors C_1 , C_2 , C_3 and C_4 and requires 6 input connections 1-6.

The circuit shown in Figure 1 could for example be simplified by linking points 2 and 5 and by connecting them to reference potential via a capacitor which is then common to both points. However, this would result in an undesirable lack of symmetry of the circuit, since in operation the amplifier would in each case be subject to the feed-back resistance in the disconnected amplifier.

Referring now to Figure 2 there is shown a circuit arrangement in accordance with the invention comprising an AM amplifier and an FM amplifier. Apart from the arrangement of the feed-back branches and the input connections the circuit corresponds to the circuit of Figure 1. Both amplifiers comprise a number of amplifier stages V_1 to V_x or V_1 to V_x and final stages E_1 or E_1 . In the amplifier for the amplitude

modulated signal U_{AM} a first feed-back branch leads from the emitter electrode of the final stage transistor T_3 to the connection point 2 and a second

feed-back branch reads from the emitter electrode of the output transistor T_4 to the output connection 3. Two suitably constructed feed-back branches also form part of the amplifier for the frequency modulated signal U FM. These feed-back branches lead to the connection points 5 and 6 but coincide with the connection points 2 and 3 so that only the connection points 1, 2, 3 and 4 have to be guided out through the IC. Each feed-back branch includes a feed-back resistor R_1 , R_2 , R_3 or R_4 and the collector emitter path of a switching transistor T_5 , T_6 , T_5' or T_6' , which is connected in the series therewith. As shown in Figure 2 an isolation resistor R_7 , R_9 , R_7' or R_9' , respectively can be located in the emitter branch of the switching transistors and is connected to a respective connection point at the corresponding final stage transistor. The base electrodes of the switching transistors T_5 and T_6 which are arranged in the feed-back branches of the AM amplifier are connected via isolation resistors R_8 and R_{10} and are supplied to a potential connection c. Correspondingly, in the case of the FM amplifier the base electrodes of the switching resistors T_5' and T_6' are linked via isolation resistors R_8 , R_{10}' and connected to a potential connection d.

The input connections 3 and 6 in corresponding feed-back branches of the two amplifier circuits are interconnected in accordance with Fig.2 and are separated with respect to DC current from the connection points 2 and 5, which are also interconnected, by an isolation capacitor C_1 . The common connectionpoint 2 and 5 is connected to reference potential by a further capacitor C_2 . Capacitors C_1 and C_2 ensure that negative feed-back caused by alternating current is

prevented. In the circuit of Fig.2, internal resistances of the generator of the input circuits for the intermediate frequency amplifiers are designated R_i or R_i , respectively. If the AM amplifier circuit is set in operation by applying the supply voltage U_S via the connection point a then a base potential driving the switching transistors is supplied at the same time to the base electrodes of the switching transistors T_5 and T_6 in the feed-back branches of this AM amplifier circuit via the connection point c. Since, in the embodiment shown, the transistors T_5 and T_6 are PNP Bipolar transistors, the potential at the point c has to be negative with respect to the potential at the emitter electrodes of the final stage transistors T_3 and T_4 . In order that the transistors T_5 and T_6 in the FM amplifier are safely switched off, a base potential which is positive as compared to the potential prevailing at the final stage transistors T_3 and T_4 is supplied at the same time to the base electrodes of these transistors T_5 and T_6 via the connection point d.

During operation of the FM amplifier the potential ratios just described are exchanged. Adjustment of the said potentials is symbolised in Fig 2 by the switches S_1, S_2 and S_3 . However, it should also be pointed out that the switching voltages for the transistors are preferably obtained internally in the feed-back branches from the supply voltage, for example via a band-gap reference circuit.

An integrated semi-conductor circuit containing both the AM amplifier and the FM amplifier has only four input connections 1-4, the two externally connected capacitors C_1 and C_2 being connected thereto. The capacitors C_1 and C_2 have a value of approximately 100

nF in a preferred example while the feed-back resistors R_1 to R_4 have a value of $20k\Omega$ for example. Thus the number of input connections is reduced from six to four by the circuit arrangement in accordance with the invention compared to amplifiers such as those shown in Figure 1. The number of externally connected capacitors is halved from four to two.



CLAIMS

1. A circuit arrangement comprising at least two multi-stage amplifiers, only one of which is in operation at any time, said amplifiers having different electrical properties and having feed-back paths for stabilizing DC voltage, said feed-back paths being separated from each other with respect to DC current by means of isolation capacitor means, wherein a first feed-back path of a first of the amplifiers is connected to a first feed-back path of the other amplifier, and said first feed-back paths are connected to a reference potential by a common capacitor, means being provided which permits current flow only through that one of said first feed-back paths which belongs to the amplifier which is in operation.
2. An arrangement according to claim 1 wherein said amplifiers have similar circuit constructions, apart from the values of their components, and said feed-back paths constitute corresponding parts of the respective amplifiers.
3. A circuit arrangement according to claim 2 wherein said current flow permitting means comprises an electronic switch arranged in each of said feed-back paths, only the switches which are in the amplifier which is in operation being closed.



4. A circuit arrangement according to Claim 2 or 3, wherein all of the corresponding feed-back paths of the amplifiers are connected to one another and the sets of corresponding feed-back paths are isolated in relation to each other by a capacitor means which is common to all of the amplifiers and connected to a reference potential via a further capacitor which is also common to all of the amplifiers, and all of the feed-back paths of the amplifiers have electronic switches which are only closed in the amplifier which is in operation.

5. A circuit arrangement according to claim 3 or 4 wherein each electronic switch comprises switching transistors, the emitter-collector paths of which are connected in the feed-back paths, and when an operating voltage is applied to an amplifier a base potential is applied to operate the switching transistors in said amplifier.

6. A circuit arrangement according to any preceding claim wherein the amplifiers each comprise a plurality of differential amplifier stages and a final stage with two final stage transistors, a feed-back path leads from each final stage transistor to an associated base electrode of a transistor in a first of the differential amplifier stages.



7. A circuit arrangement according to claim 5 or 6 wherein isolation resistors are connected to the base electrodes of the switching transistors.
- 5 8. A circuit arrangement according to any preceding claim wherein said amplifiers comprise two switchable intermediate frequency amplifiers for the AM and FM operation of a radio receiver.
- 10 9. A circuit arrangement according to any preceding claims comprising an integrated semi-conductor circuit to which the capacitors are connected externally.
- 15 10. An amplifier circuit arrangement substantially as herein described with reference to Fig.2 of the accompanying drawings.
-