

CURRENT MIRROR CIRCUIT

This invention relates to current mirror circuits.

A current mirror circuit used widely has the structure indicated in Figure 2. A current flows as indicated by connecting a current source I to a diode-connected transistor T_6 . Thus, if the base current of the transistors T_6 , T_7 is I_B , then a current $(I - 2I_B)$ flows into the transistors T_6 , T_7 .

This current mirror circuit has a disadvantage that the current in the mirror side is reduced by $2I_B$. In addition, there is a disadvantage that the collector current of the transistor T_7 is varied due to current modulation by the Early effect depending on the collector potential of the mirror side.

The present invention seeks to provide a current mirror circuit that does not have these disadvantages.

According to the present invention there is provided a current mirror circuit comprising a first transistor, a second transistor diode-connected in series to said first transistor, a third transistor whose base is connected to the base of said first transistor, a fourth transistor connected in series to

the third transistor with the base connected to the base of said second transistor and a fifth transistor whose emitter is connected to the base of said first transistor, whose base is connected to the collector of said first transistor and whose collector is connected to the collector of said fourth transistor.

Preferably a current source is connected to the collector of the second transistor.

The invention is illustrated, merely by way of example, in the accompanying drawings, in which:-

Figure 1 is a circuit diagram of one embodiment of a current mirror circuit according to the present invention; and

Figure 2 is a circuit diagram of a current mirror circuit of the prior art.

In Figure 1, a diode-connected transistor T_4 is connected in series to a transistor T_1 and the bases of transistors T_2 , T_5 are respectively connected to the bases of the transistors T_1 , T_4 . Moreover, the emitter and base of a transistor T_3 are respectively connected to the base and collector of the transistor T_1 and the collector is connected to the collector of the transistor T_5 .

When a current source I is connected as shown, a collector current I_{CT4} of the transistor T_4 can be

expressed as follows:

$$I_{CT4} = I - 2I_{B2}$$

and the emitter current I_{ET4} is expressed as follows in relation to the base current I_{B2} :

$$I_{ET4} = I - I_{B2}$$

In this case, the collector current I_{CT1} of the transistor T_1 is reduced only by the base current $2I_{B1}/h_{FE}$ of the transistor T_3 and can be expressed as follows:

$$I_{CT1} = I - I_{B2} - 2I_{B1}/h_{FE}$$

Since the collector current I_{CT2} of the transistor T_2 is equal to that of the transistor T_1 :

$$I_{CT2} = I_{CT1}$$

The collector current I_{CT5} of the transistor T_5 is reduced by I_{B2} from the value of the current I_{CT2} and can be expressed as follows:

$$I_{CT5} = I - 2I_{B2} - 2I_{B1}/h_{FE}$$

Since the collector current $2I_{B1}$ of the transistor T_3 is added to the collector current of the transistor T_5 ,

$$\begin{aligned} I_{CT5} + I_{CT3} \\ = I - 2I_{B2} - 2I_{B1}/h_{FE} + 2I_{B1} \end{aligned}$$

Here, when $I_{B1} = I_{B2} = I_B$,

$$I_{CT5} + I_{CT3} = I - 2I_B/h_{FE}$$

and the influence of I_B on the mirror side becomes $1/h_{FE}$

in comparison with that of the current mirror circuit of the prior art.

Since the collector voltage of the transistor T_2 is set to the same voltage as that of a terminal P, namely $2V_{BE}$ when the base-emitter voltage of the transistors T_1 - T_3 is set to V_{BE} by cascade-connecting the transistor T_5 , influence of the Early effect can also be suppressed.

Thus with the current mirror circuit according to the present invention and described above the reduction of current in the current side can be set to $1/h_{FE}$ and the Early effect in the output side can also be suppressed, and thereby a current mirror circuit suited to integration can be obtained.

CLAIMS

1. A current mirror circuit comprising a first transistor, a second transistor diode-connected in series to said first transistor, a third transistor whose base is connected to the base of said first transistor, a
5 fourth transistor connected in series to the third transistor with the base connected to the base of said second transistor and a fifth transistor whose emitter is connected to the base of said first transistor, whose base is connected to the collector of said first
10 transistor and whose collector is connected to the collector of said fourth transistor.
 2. A current mirror circuit as claimed in claim 1 in which a current source is connected to the collector of the second transistor.
 - 15 3. A current mirror circuit substantially as herein described with reference to and as shown in Figure 1 of the accompanying drawings.
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