

Description

The invention relates to a level shifter as used for example in an input stage of a power supply regulator of a television apparatus, in particular to a circuit arrangement that combines an input signal with a reference signal to produce an output signal that is level shifted relative to that of the input signal.

In a power supply arrangement of, for example a television receiver, see for example DE-A-3028589, a voltage representative of a DC, regulated supply voltage B+ is coupled to, for example, an inverting input terminal of a B+ voltage regulator. A reference voltage is coupled to, for example, a noninverting input terminal of the regulator. The feed-back voltage that is representative, for example, of regulated supply voltage B+ is compared, in the input stage, with the reference voltage to generate an output voltage that is coupled to a controllable arrangement. The controllable arrangement regulates voltage B+ at a level that is determined by the reference voltage. Voltage B+ may be used, for example, to energize a deflection circuit output stage for a cathode ray tube (CRT).

In a similar prior art circuit, a voltage representative of, for example, a level of the beam current in the CRT is summed with the reference voltage, such that the sum of both, instead of the reference voltage alone, is applied to the noninverting input terminal of the input stage. A variation of the beam current representative voltage varies voltage B+ so as to maintain constant the raster width in the CRT when the beam current changes.

The summation of the constant reference voltage and the variable beam current representative voltage is done, in such prior art circuit, by coupling the beam current representative voltage via a zener diode to the noninverting input terminal. The zener diode develops between its anode and cathode electrodes the reference voltage. Thus, the reference voltage that level shifts the beam current representative voltage is series coupled with the beam current representative voltage.

A disadvantage of such zener diode level shifting is that a change in the zener voltage due to temperature, ageing or an inherent noise in the zener diode, causes the level to change.

It may be desirable to sum the beam current representative voltage with a reference voltage to generate a sum voltage that is applied to the noninverting input terminal of the input stage without using such zener diode as the level shifter.

In accordance with the invention, there is provided a power supply that includes a level shifter that level shifts an input voltage that varies an output voltage of said power supply in response to variation of the input voltage, comprising a source

of supply voltage; a controllable conductive element coupled to said supply voltage for generating therefrom said output voltage; means, including a comparator having one input coupled to receive a signal indicative of said output voltage and having an output signal coupled to a control terminal of said conductive element for varying, in accordance with the output signal of said comparator, the conduction of said conductive element to control said output voltage; characterized in that said level shifter has the form of a current mirror arrangement including a first transistor responsive to a current in a first circuit branch for generating a current in a second circuit branch which includes a first main current conducting electrode of said first transistor, that is the current mirror of said current in said first circuit branch, said first main current conducting electrode being coupled at a junction terminal to a source of predetermined current; a source of said input voltage coupled to an input terminal of said first transistor for varying said current in said first main current conducting electrode to produce a current that varies in accordance with said input voltage and with the difference between said current in said first main current conducting electrode and said current in said second circuit branch; a first resistance coupled to said junction terminal for conducting said differences related current to develop a voltage thereacross that varies in accordance with said input voltage, and a source of temperature compensated first voltage coupled via said first resistance to said junction terminal such that said voltage across said resistance is combined with said first voltage for developing a temperature compensated second voltage at said junction terminal that varies in accordance with said input voltage and that is level shifted in accordance with said temperature compensated first voltage, said temperature compensated, level shifted, second voltage being coupled to another input of said comparator for varying said output signal of said comparator in accordance therewith to control said output voltage.

In an embodiment of the invention, the reference voltage is produced by a voltage source of, for example, the well-known bandgap type. Thus, the beam current representative voltage is summed with and level shifted by the reference voltage that is produced by the bandgap type source. Advantageously, the bandgap type source is less susceptible than the zener diode to temperature changes, component ageing or noise.

In the drawings:

FIGURE 1 illustrates a simplified schematic diagram of a power supply regulator circuit that includes a level shifter, embodying an aspect of the invention;

FIGURE 2 illustrates a detailed schematic diagram of the level shifter of FIGURE 1; and FIGURES 3, 4, 5 and 6 illustrate level shifters embodying different aspects of the invention, respectively.

FIGURE 1 illustrates a simplified schematic diagram of a power supply of a television receiver, not shown in the FIGURES, that includes a regulator 100 that is an integrated circuit that regulates a supply voltage B+. Voltage B+ may be used, for example, to energize a horizontal deflection circuit or output stage 99 of the television receiver.

A voltage V+, representative of voltage B+, is obtained from output stage 99. Voltage V+ is coupled to a voltage divider 605 that includes series coupled resistors 601, 604 and 602. Resistor 604 includes a wiper k for developing at wiper k a voltage that is representative of, for example, voltage B+. The voltage at wiper k, that is adjustable by varying the position of wiper k, is coupled to an inverting input terminal 608 of an error amplifier 610 via a resistor 607.

A small voltage that is proportional to the beam current in the CRT of the receiver is coupled from a tertiary winding of transformer T to a terminal 611 to form a voltage V_{NINI} that is indicative of the beam current.

Voltage V_{NINI} that varies when a variation of the beam current occurs, is coupled via a level shifter 600, embodying an aspect of the invention, to a noninverting input terminal 609 of error amplifier 610 to produce an input voltage V_{NIN} . Level shifter 600 establishes a fixed offset voltage between terminals 611 and 609 that is determined by a voltage V_{BG} . Voltage V_{BG} is generated in a bandgap type voltage source 699. Bandgap type voltage source 699 advantageously maintains voltage V_{BG} constant such that voltage V_{BG} is affected significantly less by component aging or tolerance than would have occurred had a zener diode been used. As explained later on the feed back arrangement of regulator 100 causes voltage B+ to be such that voltage V_{IN} becomes equal to voltage V_{NIN} .

An integrating filter 612 is coupled between inverting input terminal 608 and an output terminal 618 of amplifier 610 to provide the loop filter of regulator 100. A filtered error voltage V_o , developed at terminal 618 is coupled to a first input terminal of an adder 613. A horizontal rate sawtooth generator 98 develops a horizontal rate signal, having an upramping portion, which is added to error voltage V_o in adder 613. The sum signal that is also upramping, is applied to an inverting input terminal (614) of a comparator 615 functioning as a pulse width modulator.

When, during its upramping portion, the output of adder 613 becomes more positive than a con-

stant DC voltage V_{REF} , that is coupled to a noninverting input terminal of comparator 615, a negative going transition at an output terminal 615a of comparator 615 is coupled via a buffer amplifier 616 to a control terminal 617a of a switch 617b of a switch mode power supply output stage 617 to turn on switch 617b of output stage 617.

An input terminal 617c of output stage 617 is coupled to unregulated voltage V_{UR} . Regulated voltage B+ is developed at an output terminal 617d of output stage 617.

The duration, during each horizontal period, H, in which switch 617b conducts is determined by the level of error voltage V_o of error amplifier 610. Thus, regulated voltage B+ is determined by voltage V_{NIN} . As indicated before, voltage V_{NIN} is produced by level shifter 600, embodying an aspect of the invention, that is described now in detail.

FIGURE 2 illustrates a schematic diagram of level shifter 600 of FIGURE 1 and of error amplifier 610. Similar numbers in FIGURES 1 and 2 represent similar items or functions. Level shifter 600 of FIGURE 2 is temperature compensated over a wide range of ambient operating temperatures, such as between 0°C and 70°C, to produce voltage V_{NIN} that is substantially unaffected by a change in the temperature within such range.

A temperature compensated current control arrangement 650 generates a control voltage V_{BR} on a rail signal line 900. Rail signal line 900 is coupled to the base electrode of each of transistors Q142, Q725, Q727, Q736 and Q737. The emitter electrodes of the above-mentioned transistors are coupled through corresponding resistors to a fixed DC voltage V_{CC} . Current control arrangement 650 controls voltage V_{BR} in such a way that the collector current in each of the above-mentioned transistor stays substantially constant when the temperature changes. An example of an arrangement that is similar to current control arrangement 650 is described in detail in U.S. Patent No. 3,886,435, in the name of S. A. Steckler, entitled VBE VOLTAGE SOURCE TEMPERATURE COMPENSATION NETWORK.

Level shifter 600 includes transistors Q736 and Q737. The emitter currents in transistors Q736 and Q737 are controlled by resistors R728 and R69, respectively, having the same value, so as to cause the respective collector currents of transistors Q736 and Q737, that are temperature compensated, to be equal. The collector of transistor Q737 is coupled to a current mirror arrangement that includes transistors Q733, Q734 and Q735. The collector of transistor Q737 is coupled to the collector of transistor Q734. The emitter of transistor Q735 is coupled to each of the bases of transistors Q733 and Q734. Transistor Q735 provides the base current drive to each of transistors Q733 and Q734. The

emitter of transistor Q734 is coupled to ground via a resistor R732. The P-N junction of transistor Q734 between the base and emitter electrodes of transistor Q734, provides temperature compensation that compensates for a temperature related variation of the base-emitter voltage of transistor Q733. The emitter of transistor Q733 is coupled through resistor R731 to terminal 611, where voltage V_{NINI} of FIGURE 1 is developed. The value of resistor R731 is equal to that of resistor R732. Voltage V_{NINI} is prevented from exceeding predetermined limits in either polarity by a diode network 675. The collector of transistor Q733 is coupled to the collector of transistor Q736 at a junction terminal 733A.

Assume that voltage V_{NINI} is zero. In this case, the current mirror arrangement of transistors Q733, Q734 and Q735, produces a collector current i_{Q733} in transistor Q733 that is equal to the collector current i_{Q734} in transistor Q734 because the base current of transistor Q735 is negligible. As explained before, when voltage V_{NINI} is zero, collector current i_{Q736} in transistor Q736 is equal to collector current i_{Q737} in transistor Q737 over a wide temperature range. Also, when voltage V_{NINI} is zero, each of collector current i_{Q734} and its mirror the collector current i_{Q733} is equal to current i_{Q737} over such wide temperature range. It follows that current i_{Q733} is also equal to current i_{Q736} .

Bandgap type voltage source 699 supplies temperature compensated reference voltage V_{BG} that is coupled via a resistor R729 to terminal 733A. Because, as described before, when voltage V_{NINI} is zero, current i_{Q733} is supplied entirely by current i_{Q736} , and because the impedance at terminal 733A, that is contributed by the collectors of transistors Q733 and Q736 is high, a current i_{R729} in resistor R729 is zero; therefore, voltage V_{NIN} at terminal 733A is equal to voltage V_{BG} . Thus, in accordance with an aspect of the invention, when voltage V_{NINI} is zero, voltage V_{NIN} is level shifted by an amount that is equal to voltage V_{BG} .

When voltage V_{NINI} at terminal 611 is different from zero, currents i_{Q736} and i_{Q737} will not be equal. The difference current between currents i_{Q733} and i_{Q736} will cause a voltage to develop across resistor R729 that, in turn, will cause a corresponding change in voltage V_{NIN} at terminal 733A. Because transistor Q733 is coupled, relative to voltage V_{NINI} , as a common base amplifier, and because resistors R731 and R729 are, illustratively, equal, the gain, or the ratio between voltage V_{NIN} and voltage V_{NINI} , is one, resulting in an amplifier having a unity gain.

In carrying out another aspect of the invention, voltage V_{NIN} , that is level shifted relative to voltage V_{NINI} by an amount that is equal to voltage V_{BG} , follows variations of voltage V_{NINI} that occur in a range between positive and negative values.

Voltage V_{BG} is temperature compensated and has a tolerance range that is narrow relative to, for example, a zener diode. Furthermore, component aging affects voltage V_{BG} substantially less than it affects, for example, the breakdown voltage of a zener diode. Moreover, the level shifting caused by level shifter 600 is, advantageously, less susceptible to temperature, aging and noise when compared with that produced by a corresponding level shifter in the prior art that utilizes a zener diode interposed between a beam current input terminal and a noninverting input terminal of a differential amplifier to perform such level shifting.

Should a temperature change cause a corresponding change in current i_{Q736} , for example, that, as indicated before, would be relatively small, transistors Q737, Q733, Q734 and Q735 will cause a proportional change in current i_{Q733} to occur that will prevent even such small change in temperature from affecting the difference current between currents i_{Q736} and i_{Q733} . Therefore, when voltage V_{NINI} is zero, voltage V_{NIN} is, advantageously, not affected by collector currents i_{Q736} and i_{Q737} , but is entirely determined by voltage V_{BG} that is temperature compensated.

It should be understood that temperature compensation may be adequate even when voltage V_{NINI} is significantly different from zero. If temperature compensation, in this case, is inadequate, a further improvement in temperature compensation may be obtained by coupling the terminal of, for example, resistor R732, that in FIGURE 2 is grounded, to a voltage that is different from zero and that is related to, for example, voltage V_{NINI} .

Advantageously, voltage V_{BG} , as explained before, is maintained at tight tolerances, is temperature compensated and is substantially unaffected by components aging. Therefore, advantageously, no factory temperature burn-in process is required prior to the installment of regulator 100 of FIGURE 1 in the television receiver. Furthermore, voltage divider 605 that includes resistors 601, 604 and 602 is required to compensate, advantageously, only for a narrower tolerance range than in prior art circuits in which a zener diode is used for performing the level shifting function of level shifter 600 of FIGURE 2.

Voltage V_{IN} is coupled to the base of a transistor Q721. The clamping operation of a pair of transistors Q145 and Q146 prevents voltage V_{IN} from being above voltage V_{BG} or from being below voltage V_{BG} by more than a predetermined magnitude. Voltage V_{IN} is coupled to inverting input terminal 608 and voltage V_{NIN} is coupled to noninverting input terminal 609 of error amplifier 610. Amplifier 610 includes a current source formed by a transistor Q142 that provides the combined emitter currents of a transistor Q148 and of a transistor

Q149, coupled as a differential amplifier. The bases of transistors Q148 and Q149 are coupled to the emitters of transistors Q721 and Q723 respectively. Transistors Q721 and Q723 operate as emitter followers to couple voltages V_{IN} and V_{NIN} to the bases of transistors Q148 and Q149, respectively.

A current mirror arrangement 610b that is coupled to the collectors of transistors Q148 and Q149 causes a current i_{610} , coupled to integrating filter 612 of FIGURE 1, to be equal to the difference between the collector currents in transistors Q148 and Q153. Consequently, current i_{610} that is coupled to filter 612 of FIGURE 1, is proportional to the difference between voltages V_{IN} and V_{NIN} . The proportionality factor is determined by the gain of error amplifier 610.

FIGURES 3, 4, 5 and 6 illustrate level shifters 600a, 600b, 600c and 600d, respectively, embodying other aspects of the invention, respectively. In FIGURES 2-6, numbers and symbols of similar items or functions are similar except that they include the letters a, b, c and d, in FIGURES 3, 4, 5 and 6, respectively.

In FIGURE 3, resistors R731 and R732, that are used in the circuit of FIGURE 2, were eliminated. Without resistors R731 and R732, the gain of amplifier 600a of FIGURE 3 is, advantageously, higher than unity.

In FIGURE 3, a diode D_{CMA} and a temperature compensated current source I_{1a} cause the collector currents in transistors Q737a and Q736a to be, for example, equal. Similarly, transistor Q734a causes the collector current in transistor Q733a to be, for example, equal to that in each of transistors Q737a and Q736a when voltage V_{NINI} is zero.

In FIGURE 4, voltage V_{NINIb} is applied differentially between the emitters of transistors Q733b and Q734b. Such arrangement provides, advantageously, an improved common mode rejection.

In FIGURE 5 the type, N-P-N or P-N-P, of the corresponding transistors is opposite than that in FIGURE 2 so that voltage V_{NINIc} may, if desired, be referenced to voltage V_{CC} , instead of to ground.

In FIGURE 6, the input impedance to voltage V_{NINId} is, advantageously, higher than to voltage V_{NINI} of FIGURE 2 because of the usage of a transistor Q750 that is coupled as an emitter follower.

Claims

1. A power supply that includes a level shifter (600) that level shifts an input voltage (V_{NINI}) that varies an output voltage ($B+$) of said power supply in response to variation of the input voltage, comprising :

a source (V_{UR}) of supply voltage;
a controllable conductive element (617b)

coupled to said supply voltage for generating therefrom said output voltage ($B+$);

means, including a comparator (610) having one input (-) coupled to receive a signal (V_{IN}) indicative of said output voltage ($B+$) and having an output signal (V_o) coupled to a control terminal (617a) of said conductive element (617b) for varying, in accordance with the output signal (V_o) of said comparator, the conduction of said conductive element (617b) to control said output voltage; characterized in that :

said level shifter has the form of a current mirror arrangement (Q733,734,735) including a first transistor (Q733) responsive to a current (i_{Q737}) in a first circuit branch for generating a current (i_{Q736}) in a second circuit branch which includes a first main current conducting electrode (at 733a) of said first transistor (Q733), that is the current mirror of said current (i_{Q737}) in said first circuit branch, said first main current conducting electrode (collector in Fig.2) being coupled at a junction terminal (733A) to a source (Q736) of predetermined current (100 μ A in Figure 2);

a source (611) of said input voltage (V_{NINI}) coupled to an input terminal (emitter in Fig.2) of said first transistor (Q733) for varying said current in said first main current conducting electrode (collector in Fig.2) to produce a current (i_{R729}) that varies in accordance with said input voltage (V_{NINI}) and with the difference between said current (i_{Q733}) in said first main current conducting electrode (collector) and said current (i_{Q736}) in said second circuit branch;

a first resistance (R729) coupled to said junction terminal (733A) for conducting said differences related current (i_{R729}) to develop a voltage thereacross that varies in accordance with said input voltage (V_{NINI}); and

a source (699) of temperature compensated first voltage (V_{BG}) coupled via said first resistance (R729) to said junction terminal (733A) such that said voltage across said resistance (R729) is combined with said first voltage (V_{BG}) for developing a temperature compensated second voltage (V_{NIN}) at said junction terminal (733A) that varies in accordance with said input voltage (V_{NINI}) and that is level shifted in accordance with said temperature compensated first voltage (V_{BG}), said temperature compensated, level shifted, second voltage (V_{NIN}) being coupled to another input (+) of said comparator (610) for varying said output signal (V_o) of said comparator (610) in accordance therewith to control said output voltage ($B+$).

Q149, coupled as a differential amplifier. The bases of transistors Q148 and Q149 are coupled to the emitters of transistors Q721 and Q723 respectively. Transistors Q721 and Q723 operate as emitter fol-
lowers to couple voltages V_{IN} and V_{NIN} to the bases of transistors Q148 and Q149, respectively.

A current mirror arrangement 610b that is coupled to the collectors of transistors Q148 and Q149 causes a current i_{610} , coupled to integrating filter 612 of FIGURE 1, to be equal to the difference between the collector currents in transistors Q148 and Q153. Consequently, current i_{610} that is coupled to filter 612 of FIGURE 1, is proportional to the difference between voltages V_{IN} and V_{NIN} . The proportionality factor is determined by the gain of error amplifier 610.

FIGURES 3, 4, 5 and 6 illustrate level shifters 600a, 600b, 600c and 600d, respectively, embodying other aspects of the invention, respectively. In FIGURES 2-6, numbers and symbols of similar items or functions are similar except that they include the letters a, b, c and d, in FIGURES 3, 4, 5 and 6, respectively.

In FIGURE 3, resistors R731 and R732, that are used in the circuit of FIGURE 2, were eliminated. Without resistors R731 and R732, the gain of amplifier 600a of FIGURE 3 is, advantageously, higher than unity.

In FIGURE 3, a diode D_{oma} and a temperature compensated current source I_{1a} cause the collector currents in transistors Q737a and Q736a to be, for example, equal. Similarly, transistor Q734a causes the collector current in transistor Q733a to be, for example, equal to that in each of transistors Q737a and Q736a when voltage V_{NINi} is zero.

In FIGURE 4, voltage V_{NINib} is applied differentially between the emitters of transistors Q733b and Q734b. Such arrangement provides, advantageously, an improved common mode rejection.

In FIGURE 5 the type, N-P-N or P-N-P, of the corresponding transistors is opposite than that in FIGURE 2 so that voltage V_{NINic} may, if desired, be referenced to voltage V_{oc} , instead of to ground.

In FIGURE 6, the input impedance to voltage V_{NINid} is, advantageously, higher than to voltage V_{NINI} of FIGURE 2 because of the usage of a transistor Q750 that is coupled as an emitter follower.

Claims

1. A power supply that includes a level shifter (600) that level shifts an input voltage (V_{NINI}) that varies an output voltage ($B+$) of said power supply in response to variation of the input voltage, comprising :

a source (V_{UR}) of supply voltage;
a controllable conductive element (617b)

coupled to said supply voltage for generating therefrom said output voltage ($B+$);

means, including a comparator (610) having one input (-) coupled to receive a signal (V_{IN}) indicative of said output voltage ($B+$) and having an output signal (V_o) coupled to a control terminal (617a) of said conductive element (617b) for varying, in accordance with the output signal (V_o) of said comparator, the conduction of said conductive element (617b) to control said output voltage; characterized in that :

said level shifter has the form of a current mirror arrangement (Q733,734,735) including a first transistor (Q733) responsive to a current (i_{Q737}) in a first circuit branch for generating a current (i_{Q736}) in a second circuit branch which includes a first main current conducting electrode (at 733a) of said first transistor (Q733), that is the current mirror of said current (i_{Q737}) in said first circuit branch, said first main current conducting electrode (collector in Fig.2) being coupled at a junction terminal (733A) to a source (Q736) of predetermined current (100 μ A in Figure 2);

a source (611) of said input voltage (V_{NINI}) coupled to an input terminal (emitter in Fig.2) of said first transistor (Q733) for varying said current in said first main current conducting electrode (collector in Fig.2) to produce a current (i_{R729}) that varies in accordance with said input voltage (V_{NINI}) and with the difference between said current (i_{Q733}) in said first main current conducting electrode (collector) and said current (i_{Q736}) in said second circuit branch;

a first resistance (R729) coupled to said junction terminal (733A) for conducting said differences related current (i_{R729}) to develop a voltage thereacross that varies in accordance with said input voltage (V_{NINI}); and

a source (699) of temperature compensated first voltage (V_{BG}) coupled via said first resistance (R729) to said junction terminal (733A) such that said voltage across said resistance (R729) is combined with said first voltage (V_{BG}) for developing a temperature compensated second voltage (V_{NIN}) at said junction terminal (733A) that varies in accordance with said input voltage (V_{NINI}) and that is level shifted in accordance with said temperature compensated first voltage (V_{BG}), said temperature compensated, level shifted, second voltage (V_{NIN}) being coupled to another input (+) of said comparator (610) for varying said output signal (V_o) of said comparator (610) in accordance therewith to control said output voltage ($B+$).



2. A power supply according to Claim 1 characterized in that said second circuit branch comprises a second transistor (Q736) having a main current electrode that is coupled to said junction terminal (733A) and wherein said first circuit branch comprises a third transistor (Q737) that generates, in a main current conducting electrode thereof, said current (I_{Q737}) that is coupled to said current mirror arrangement (Q733,734,735) such that said current mirror arrangement generates said current in said first main current conducting electrode of said first transistor (Q733) at a level that is in accordance with said current in said third transistor (Q737).
3. A power supply according to Claim 2 characterized by a temperature compensated means (650) coupled to corresponding control electrodes of each of said second (Q736) and third (Q737) transistors for generating said corresponding currents in said first and second circuit branches that remain substantially unchanged over said wide range of temperatures.
4. A power supply according to Claim 2 or 3 characterized in that said current mirror arrangement further includes a fourth transistor (Q735) that is coupled to a control electrode of said first transistor (Q733) and that is coupled in a path of said current in said third transistor (Q737) to develop a voltage at said control electrode of said first transistor (Q733) that causes said current in said first transistor (Q733) to be the current mirror of said current in said fourth transistor (Q735).
5. A power supply according to Claim 4 characterized in that said input voltage (V_{NINI}) is coupled between corresponding main current conducting electrodes of each of said first (Q733) and fourth (Q735) transistors for varying, in accordance with said input voltage, said currents in each of said first (Q733) and fourth (Q735) transistors.
6. A power supply according to any of Claim 2 - 5 characterized by a second resistance (R731), via which said input voltage (V_{NINI}) is coupled to an emitter electrode of said first transistor (Q733).
7. A power supply according to Claim 6 characterized in that said first transistor (Q733) forms an amplifier having a gain that is determined by a ratio between said second (R731) and first (R729) resistances.

8. A power supply according to Claim 6 characterized in that said second resistance (R731) has a value substantially less than said first resistance (R729) such that said gain is higher than unity.
9. A power supply according to Claim 6 characterized by a fourth transistor (Q750) responsive to said input voltage (V_{NINI}) and coupled as an emitter follower such that an emitter electrode of said fourth transistor (Q750) is coupled to said emitter electrode of said first transistor (W_{733d}).
10. A power supply according to any of claims 2 - 9 characterized in that an impedance that is formed at said junction terminal (733A) by said first (Q733) and second (Q736) transistors is substantially higher than said first resistance (R729).
11. A power supply according to any preceding Claim characterized in that said source of said first voltage (V_{BG}) comprises a bandgap type voltage source (699).
12. A power supply according to any preceding Claim characterized in that said current mirror arrangement (Q733,734,735) maintains a ratio between said current in said first main current conducting electrode and said current in said second circuit branch unchanged over a wide range of temperatures.
13. A power supply according to any preceding Claim characterized in that said first voltage (V_{BG}) is developed at a first terminal of said first resistance (R729) and said second voltage (V_{NIN}) is developed at a second terminal of said first resistance (R729) remote from said first terminal and wherein said second voltage (V_{NIN}) comprises an algebraic sum of said first voltage (V_{BG}) and said voltage across said first resistance (R729).

Patentansprüche

1. Netzteil, das einen Pegelumsetzer (600) aufweist, der eine Eingangsspannung (V_{NINI}) pegelumsetzt, die eine Ausgangsspannung (B+) des Netzteils als Antwort auf eine Änderung der Eingangsspannung variiert, mit
 - einer Quelle (V_{UR}) von Versorgungsspannung;
 - einem steuerbaren leitfähigen Element (617b), das an die Versorgungsspannung zum Erzeugen der Ausgangsspannung (B+) daraus gekoppelt ist;



- Mitteln, die einen Komparator (610) beinhalten, der einen Eingang (-) hat, der so gekoppelt ist, daß er ein Signal (V_{IN}) erhält, das die Ausgangsspannung (B+) anzeigt, und ein Ausgangssignal (V_O) hat, das an einen Steueranschluß (617a) des leitfähigen Elementes (617b) gekoppelt ist, zum Variieren der Leitfähigkeit des leitfähigen Elementes (617b) in Übereinstimmung mit dem Ausgangssignal (V_O) des Komparators, um die Ausgangsspannung zu steuern;
dadurch gekennzeichnet,
- daß der Pegelumsetzer die Form einer Stromspiegel-Anordnung (Q733, 734, 735) hat, die einen ersten Transistor (Q733) beinhaltet, der abhängig von einem Strom (I_{Q737}) in einem ersten Schaltungszweig ist, zum Erzeugen eines Stromes (I_{Q736}) in einem zweiten Schaltungszweig, welcher eine erste Haupt-Stromführungs-Elektrode (an 733A) des ersten Transistors (Q733) beinhaltet, der der Stromspiegel des Stromes (I_{Q737}) in dem ersten Schaltungszweig ist, wobei die erste Haupt-Stromführungs-Elektrode (Kollektor in Fig. 2) an den Verbindungsanschluß (733A) mit einer Quelle (Q736) von vorbestimmtem Strom (100 μ A in Fig. 2) gekoppelt ist;
- daß eine Quelle (611) der Eingangsspannung (V_{NIN}) an einen Eingangsanschluß (Emitter in Fig. 2) des ersten Transistors (Q733) gekoppelt ist zum Ändern des Stromes in der ersten Haupt-Stromführungs-Elektrode (Kollektor in Fig. 2), um einen Strom (I_{R729}) zu erzeugen, der in Übereinstimmung mit der Eingangsspannung (V_{NIN}) und mit der Differenz zwischen dem Strom (I_{Q733}) in der ersten Haupt-Stromführungs-Elektrode (Kollektor) und dem Strom (I_{Q736}) in dem zweiten Schaltungszweig variiert;
- daß ein erster Widerstand (R729) mit dem Verbindungsanschluß (733A) gekoppelt ist zum Führen des differenzenbezogenen Stromes (I_{R729}), um eine Spannung darüber zu bilden, die in Übereinstimmung mit der Eingangsspannung (V_{NIN}) variiert;
- daß eine Quelle (699) einer temperaturkompensierten ersten Spannung (V_{BG}) über einen ersten Widerstand (R729) an den Verbindungsanschluß (733A) gekoppelt ist, so daß die Spannung über dem Widerstand (R729) mit der ersten Spannung (V_{BG}) kombiniert wird zum Bilden einer temperaturkompensierten zweiten

Spannung (V_{NIN}) an dem Verbindungsanschluß (733A), die in Übereinstimmung mit der Eingangsspannung (V_{NIN}) variiert und die pegelverschoben/pegelumgesetzt in Übereinstimmung mit der temperaturkompensierten ersten Spannung (V_{BG}) ist, wobei die temperaturkompensierte pegelumgesetzte zweite Spannung (V_{NIN}) an einen anderen Eingang (+) des Komparators (610) zum Variieren des Ausgangssignales (V_O) des Komparators (610) in Übereinstimmung damit gekoppelt wird, um die Ausgangsspannung (B+) zu steuern.

2. Netzteil nach Anspruch 1,
dadurch gekennzeichnet,

- daß der zweite Schaltungszweig einen zweiten Transistor (Q736) aufweist, der eine - mit dem Verbindungsanschluß (733A) gekoppelte - Haupt-Stromelektrode hat;
- daß der erste Schaltungszweig einen dritten Transistor (Q737) aufweist, der in einer Haupt-Stromführungs-Elektrode von ihm den Strom (I_{Q737}) erzeugt, der an die Stromspiegel-Anordnung (Q733, 734, 735) gekoppelt ist/wird, so daß sie den Strom in der ersten Haupt-Stromführungs-Elektrode des ersten Transistors (Q733) auf einem Pegel erzeugt, der in Übereinstimmung mit dem Strom in dem dritten Transistor (Q737) ist.

3. Netzteil nach Anspruch 2,
gekennzeichnet durch

temperaturkompensierte Mittel (650), die mit korrespondierenden Steuerelektroden jedes des zweiten (Q736) und dritten (Q737) Transistors gekoppelt sind zum Erzeugen der korrespondierenden Ströme in den ersten und zweiten Schaltungszweigen, die im wesentlichen unverändert über den großen Temperaturbereich bleiben.

4. Netzteil nach Anspruch 2 oder 3,
dadurch gekennzeichnet,

daß die Stromspiegel-Anordnung einen vierten Transistor (Q735) aufweist, der an eine Steuerelektrode des ersten Transistors (Q733) gekoppelt ist und der in einen Pfad des Stromes in dem dritten Transistor (Q737) gekoppelt ist, um eine Spannung an der Steuerelektrode des ersten Transistors (Q733) zu bilden, die bewirkt, daß der Strom in dem ersten Transistor (Q733) der gespiegelte Strom (current mirror)



des Stromes in dem vierten Transistor (Q735) ist.

5. Netzteil nach Anspruch 4, **dadurch gekennzeichnet**, daß die Eingangsspannung (V_{NIN}) gekoppelt ist zwischen korrespondierende Haupt-Strompfad-Elektroden jedes des ersten (Q733) und vierten (Q735) Transistors zum Variieren der Ströme in jedem des ersten und vierten Transistors (Q733, Q735) in Übereinstimmung mit der Eingangsspannung.

6. Netzteil nach einem der Ansprüche 2 bis 5, **gekennzeichnet durch** einen zweiten Widerstand (R731), über welchen die Eingangsspannung (V_{NIN}) an eine Emittierelektrode des ersten Transistors (Q733) gekoppelt ist.

7. Netzteil nach Anspruch 6, **dadurch gekennzeichnet**, daß der erste Transistor (Q733) einen Verstärker bildet, der eine Verstärkung hat, die bestimmt wird durch ein Verhältnis zwischen dem zweiten (R731) und ersten (R729) Widerstand.

8. Netzteil nach Anspruch 6, **dadurch gekennzeichnet**, daß der zweite Widerstand (R731) einen Wert hat, der wesentlich geringer ist, als der des ersten Widerstandes (R729), so daß die Verstärkung höher als eins (unity) ist.

9. Netzteil nach Anspruch 6, **gekennzeichnet durch** einen vierten Transistor (Q750), der abhängig von der Eingangsspannung (V_{NINid}) ist und als Emittierfolger gekoppelt ist, so daß eine Emittierelektrode des vierten Transistors (Q750) an die Emittierelektrode des ersten Transistors (W_{733d}) gekoppelt ist.

10. Netzteil nach Anspruch 2 bis 9, **dadurch gekennzeichnet**, daß eine - an dem Verbindungsanschluß (733A) von dem ersten (Q733) und dem zweiten (Q736) Transistor gebildete - Impedanz wesentlich höher ist, als der erste Widerstand (R729).

11. Netzteil nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet**, daß die Quelle der ersten Spannung (V_{BG}) eine bandabstands-ähnliche Spannungsquelle (699) aufweist (bandgap-type voltage source).

12. Netzteil nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet**, daß die Stromspiegel-Anordnung (Q733, 734, 735) ein Verhältnis zwischen dem Strom in der ersten Haupt-Stromführungselektrode und dem Strom in dem zweiten Schaltungszweig unverändert über einen breiten (weiten) Temperaturbereich aufrechterhält.

13. Netzteil nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet**, daß die erste Spannung (V_{BG}) an einem ersten Anschluß des ersten Widerstandes (R729) und die zweite Spannung (V_{NIN}) an einem zweiten Anschluß des ersten Widerstandes (R729) gebildet wird, der fern von dem ersten Anschluß ist und wobei die zweite Spannung (V_{NIN}) die algebraische Summe der ersten Spannung (V_{BG}) und der Spannung über dem ersten Widerstand (R729) umfaßt.

Revendications

1. Alimentation qui inclut un décaleur de niveau de tension (600) qui décale en niveau une tension d'entrée (V_{NIN}) qui fait varier une tension de sortie (B+) de ladite alimentation en réponse à la tension d'entrée, comprenant :
une source (V_{UR}) de tension d'alimentation ;

un élément de conduction que l'on peut commander (617b) couplé à ladite tension d'alimentation pour générer à partir d'elle ladite tension de sortie (B+);

des moyens incluant un comparateur (610) comportant une entrée (-) couplé pour recevoir un signal (V_{IN}) indicateur de ladite tension de sortie (B+) et comportant un signal de sortie (V_o) couplé à la borne de commande (617a) dudit élément de conduction (617b) pour faire varier, selon le signal de sortie (V_o) dudit comparateur, la conduction dudit élément de conduction (617b) afin de commander ladite tension de sortie ; caractérisée en ce que :

ledit décaleur de niveau à la forme d'un dispositif à miroir de courant (Q733, 734, 735) incluant un premier transistor (Q733) sensible à un courant (i_{Q737}) dans une première branche de circuit pour générer un courant (i_{Q738}) dans une seconde branche de circuit qui inclut une première électrode conductrice de courant principal (au niveau 733a) dudit premier transistor (i_{Q733}) qui est le miroir de courant dudit courant (i_{Q737}), de la première branche de circuit, ladite première électrode conductrice du courant principal (collecteur en Figure 2) étant



couplée au niveau d'une borne de jonction (733A) à une source (Q736) de courant prédéterminé (100 μ A en Figure 2) ;

une source (611) de ladite tension d'entrée (V_{NINI}) couplée à une borne d'entrée (émetteur en Figure 2) dudit premier transistor (Q733) pour faire varier ledit courant dans ladite première électrode conductrice du courant principal (collecteur en Figure 2) afin de produire un courant (I_{R729}) qui varie selon ladite tension d'entrée (V_{NINI}) et la différence entre ledit courant (I_{Q733}) principal (collecteur) et ledit courant (I_{Q736}) dans ladite seconde branche de circuit ;

une première résistance (R729) couplée à ladite borne de jonction (733A) destinée à conduire ledit courant associé aux différences (I_{R729}) pour développer une tension à travers elle qui varie selon ladite tension d'entrée (V_{NINI}) ; et

une source (699) d'une première tension à compensation thermique (V_{BG}) couplée via ladite première résistance (R729) à ladite borne de jonction (733A) de telle sorte que ladite tension à travers ladite résistance (729) est combinée à ladite première tension (V_{BG}) afin de développer une seconde tension à compensation thermique (V_{NIN}) au niveau de la borne de jonction (733A) qui varie selon ladite tension d'entrée (V_{NINI}) et qui est décalée en niveau selon ladite première tension à compensation thermique (V_{BG}), ladite seconde tension, décalée en niveau à compensation thermique (V_{NIN}) étant couplée à une autre entrée (+) dudit comparateur (610) afin de faire varier ledit signal de sortie (V_o) dudit comparateur (610) selon elle pour commander ladite tension de sortie (B+).

2. Alimentation selon la revendication 1 caractérisée en ce que ladite seconde branche de circuit comprend un second transistor (Q736) comportant une électrode de courant principal qui est couplée à ladite borne de jonction (733A) et dans laquelle ladite première branche de circuit comprend un troisième transistor (Q737) qui génère, dans son électrode conductrice du courant principal, ledit courant (I_{Q737}) qui est couplé audit dispositif à miroir de courant (Q733, 734, 735) de telle sorte que ledit dispositif à miroir de courant génère ledit courant dans ladite première électrode conductrice du courant principal dudit premier transistor (Q733) à un niveau qui est en accord avec ledit courant dans ledit troisième transistor (Q737).

3. Alimentation selon la revendication 2 caractérisée par des moyens à compensation thermi-

que (650) couplés aux électrodes de commande correspondante de chacun desdits second (Q736) et troisième (Q737) transistors pour générer lesdits courants correspondants dans lesdites première et seconde branches de circuit qui restent sensiblement inchangés sur ladite large gamme de températures.

4. Alimentation selon la revendication 2 ou 3 caractérisée en ce que ledit dispositif à miroir de courant inclut de plus un quatrième transistor (Q735) qui est couplé à une électrode de commande dudit premier transistor (Q733) et qui est couplé dans le parcours dudit courant dudit troisième transistor (Q737) pour développer une tension au niveau de ladite électrode de commande dudit premier transistor (Q733) qui entraîne ledit courant dudit premier transistor (Q733) à être le miroir de courant dudit courant dans ledit quatrième transistor (Q735).
5. Alimentation selon la revendication 4 caractérisée en ce que ladite tension d'entrée (V_{NINI}) est couplée entre les électrodes correspondantes du courant principal de chacun desdits premier (Q733) et quatrième (Q735) transistors pour faire varier, selon ladite tension d'entrée, lesdits courants dans chacun desdits premier (Q733) et quatrième (Q735) transistors.
6. Alimentation selon l'une quelconque des revendications 2-5 caractérisée par une seconde résistance (R731), via laquelle ladite tension d'entrée (V_{NINI}) est couplée à l'électrode d'émetteur dudit premier transistor (Q733).
7. Alimentation selon la revendication 6 caractérisée en ce que ledit premier transistor (Q733) forme un amplificateur ayant un gain qui est déterminé par un rapport entre lesdites seconde (R731) et première (R729) résistances.
8. Alimentation selon la revendication 6 caractérisée en ce que ladite seconde résistance (R731) possède une valeur sensiblement inférieure à ladite première résistance (R729) de telle sorte que ledit gain est supérieur à l'unité.
9. Alimentation selon la revendication 6 caractérisée par un quatrième transistor (Q750) sensible à ladite tension d'entrée (V_{NINI}) et couplé comme un émetteur-suiveur de telle sorte que l'électrode d'émetteur dudit quatrième transistor (Q750) est couplée à ladite électrode d'émetteur dudit premier transistor (W_{733d}).



10. Alimentation selon l'une quelconque des revendications 2-9 caractérisée en ce qu'une impédance qui est formée au niveau de ladite borne de jonction (733A) par lesdits premier (Q733) et second (Q736) transistors est sensiblement supérieure à ladite première résistance (R729). 5
11. Alimentation selon l'une quelconque des revendications précédentes caractérisée en ce que ladite source de ladite première tension (V_{BG}) comprend une source de tension du type à largeur de bande interdite (699). 10
12. Alimentation selon l'une quelconque des revendications précédentes caractérisée en ce que ledit dispositif à miroir de courant (Q733, 734, 735) maintient inchangé le rapport entre ledit courant de ladite première électrode de conduction du courant principal et ledit courant de ladite seconde branche de circuit sur une large gamme de température. 15
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13. Alimentation selon l'une quelconque des revendications précédentes caractérisée en ce que ladite première tension (V_{BG}) est développée à une première borne de ladite première résistance (R729) et ladite seconde tension (V_{NIN}) est développée à une seconde borne de ladite première résistance (R729) éloignée de ladite première borne et dans laquelle ladite seconde tension (V_{NIN}) comprend la somme algébrique de ladite première tension (V_{BG}) et de ladite tension à travers ladite première résistance (R729). 25
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