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HIGH IMPEDANCE POWER SUPPLY

This invention relates to electrical power supplies and in particular to a current source power supply suitable for use in a two-wire communication network.

BACKGROUND OF THE INVENTION

As an example only, the invention is discussed in the context of a control system for a building which uses a two-wire communications medium which is also used to conduct power to the remotely located controllers in the system. The control system comprises many low power consumption transceiver devices connected in parallel via the two-wire power and communications medium, although other mediums are suitable for the application of the invention described. Fig. 1 depicts a basic layout of such a network.

Each device in the control system is adapted and arranged to exchange signals via the two-wire medium while also adapted to receive power from a central power supply.

Pairs of wires used in this configuration are typically twisted together to balance electromagnetic interaction between themselves and other adjacent wires and are available either shielded or unshielded. However, other combined power and communications mediums may comprise other configurations of conductors suited or adapted to carry both power supply current from the power source to the remote transceiver devices as well as control signals.

The effective input impedance of all devices when "listening" for a communication message is preferably considerably higher than the effective output impedance of the transmitting portion of each device. However, since all the devices on the network are powered via the same pair of wires, the communication signal reception is adversely affected if the power supply input impedance of the device is low relative to the effective input impedance of the receiver portion of the device.

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Preferably therefore the network requires a device power supply with an extremely high input impedance at the frequencies utilised by the communication signal, while still being capable of providing the required power to supply each device. This provides for the highest possible quantity of devices that can be simultaneously connected to the power and signal communications medium.

As an example only, typical operating requirements of a network device power supply current source may be as follows:

Maximum voltage (under transient conditions): Vmax = 65V

Minimum voltage for operation: Vmin = 6V

Current regulation range; 5mA < I supply < 35mA

Impedance over communication frequency range: Z in > 50k Ohms

Communication frequency range: 3kHz < Fcom < 20kHz

One alternative is the use of an inductor in series with the power supply input to provide high impedance at the desired communication frequencies, while still allowing the device to derive power from the wires. However, in order to provide the required impedance, the inductor must exhibit approximately 5 Henry's of inductance. This value of inductance is typically only available by using an inductor having a large quantity of turns about a magnetic core, which is typically bulky and uneconomic if there are a large number of remote control devices in the network.

Power supplies required to provide a constant current source may include semiconductor current sources utilising either Junction Field Effect Transistors (JFET/s) operating above their pinch-off voltage, or bipolar transistors in a current "mirror" configuration, adapted to utilise the bipolar transistor's base voltage in such a way as to define the collector current, or any linear transistor operating with a

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negative feedback loop which attempts to regulate current.

However, it is also known, that current sources using JFET transistors operating above pinch-off are typically limited by device parameters. Typical JFET impedances, for devices intended for operation in this mode are < 25k Ohms at a current of 4.7mA.

Transistors (Bipolar or FET) which are used to regulate current in response to a feedback circuit are dependent on the response time of the controlling circuit for suitable performance. The use of such a circuit in high voltage applications such as those described in the embodiment of the invention are unnecessarily complicated by the use of a variety of operational amplifier based circuits additional to the constant current power supply circuit.

A further current source technique which uses linear bipolar integrated circuits is a current mirror. A typical current mirror circuit is depicted in Fig. 2. Input current, Iin is "reflected" in the output portion of the circuit, such that, if the impedance of the circuit is appropriate, an identical current will flow in the collectors of both transistors Q1 and Q2. The current mirror circuit depicted in Fig. 2, Iin causes a current to flow in the base of transistor Q1, thus allowing a collector current to flow in the same transistor. The resulting current flow through the emitter of Q1 creates a voltage drop from base to emitter, of V_{BE}, which is related (logarithmically) to the current flow Iin. As transistor Q2 has its base connected in parallel with the base of transistor Q1, it has the same base-emitter voltage, and hence, allows the same current to flow in its emitter from the supply connected to its collector.

In a discrete component circuit of the current mirror, it is necessary to introduce resistors in series with the emitters of the transistors, so that the effects of temperature and parameter mismatching are less pronounced. Emitter resistors

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also allow for a simple means of scaling the output current if required.

Integrated circuit versions of a current mirror utilise various known techniques to provide the necessary regulated constant current, but in the case of a network comprising a plurality of devices spaced along a two-wire power current carrying and signal carrying medium, the high voltage requirements which are required, make a current integrated circuit solution more difficult if not impractical.

Therefore, it is an aspect of the invention to provide a constant current source which uses a novel combination of a current mirror principle and a negative feedback loop in order to achieve the requisite regulation of current which still exhibits a high input impedance at the frequencies used to communicate the control signals. The invention overcomes the problems that those circuit techniques by themselves involve.

BRIEF DESCRIPTION OF THE INVENTION

In a broad aspect of the invention a current source power supply comprises

a current mirror circuit having high input impedance and also having current flowing in first and second paths therethrough as well as a current flow control portion,

a current reference means adapted to connect between the output portion of said first path of current in said current mirror circuit and an output of said current source power supply,

a current sensing means adapted to connect between the output portion of said second path of current in said current mirror circuit and said output of said current source power supply,

a feedback circuit connecting the current flow control portion of said current mirror circuit to both first and second paths of current wherein the feedback circuit regulates the current in the current sensing means so that

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the total voltage drop across the current sensing means and the feedback circuit is matched to the voltage drop across the current reference means.

In a further aspect of the invention of a current source power supply, the current mirror comprises two small signal transistors having their base terminals connected to each other and their collectors connected to a common voltage source.

In a further aspect of the invention of a current source power supply the reference current means comprises a zener diode voltage reference and a resistor to convert the measured current to a voltage for comparison with the reference voltage.

A current source power supply according to any preceding aspect wherein the predetermined input impedance of said current source power supply is greater than 50 ohms.

A specific embodiment of the invention will now be described in some further detail with reference to and as illustrated in the accompanying figures.

This embodiment is illustrative, but not restrictive, of the invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Fig. 1 depicts a plurality of control devices interconnected by a pair of wires which form a common network topology;

Fig. 2 is a circuit of a prior art current mirror; and

Fig. 3 depicts a current source circuit in accordance with an embodiment of the invention.

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DETAILED DESCRIPTION OF THE INVENTION

A large variety of information, control and management systems utilising two wire power and communication mediums have been developed for an equally large variety of systems used in the residential, commercial building and industrial areas. Pairs of conductors are easily laid and routed in new and existing buildings and simple tap-in like connections are connectable at any point along the pair of conductors. The basic topology of such a network is depicted pictorially in Fig. 1. Wires 10 and 12 provide a medium for the communication of signals either to or from the devices 14, 16, 18 and 20 which can be distributed as required along the full length of the wires 10 and 12. It is preferable for there to be a maximum useable length of wire along which a device can be located and this aspect of the invention will be described later in the specification.

A suitable current source power supply circuit which overcomes the problems of the prior art, comprises a circuit utilising both the current mirror principle and a negative feedback loop. The supply current can be regulated while adequate input impedance at the communication frequencies used is provided.

Fig. 3 depicts one embodiment of such a current source power supply circuit where R2 is a high-value resistor, which provides sufficient current to the base of Q4 to bring it into conduction, after which positive feedback through transistor Q1 will maintain proper operation.

A low-voltage (3.3V) zener diode Z3 is used to establish a reference voltage and current and is one example of a reference current means. A separate circuit which produces a low current reference could also provide this function of the circuit.

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Transistor Q4 is a summation element and part of the feedback circuit of the current power supply which provides base current to both transistors Q1 and Q2, causing current to flow in each of the two collectors thereof. Q1 and Q2 in this configuration with each other provide one example of a current mirror means. A voltage drop appears across resistor R6 in response to the current from transistor Q2 where a resistor is one example of a current sensing means.

Transistor Q4 regulates the current I_2 so that the voltage drop across resistor R6, plus the base emitter voltage V_{BE} of transistor Q4, matches the zener voltage drop of Z3.

Note it is preferable but not essential that the temperature coefficient of the base emitter V_{BE} of transistor Q4 is approximately the same for zener diode Z3, so that the regulated current is not adversely affected by temperature variation.

Capacitor C1 is used optionally in the circuit to provide stability at high frequencies of operation.

Current I_1 through zener diode Z3 is regulated, and in the order of 5mA for the range of currents required by the network. This ensures that the characteristics of the zener diode are stable and repeatable.

Transistor Q3 may be optionally included to provide additional current at a higher voltage than that of the output terminal of the current source. Resistors R2, R3 and R4 are preferably included to offset the errors caused by mismatching parameters and temperature characteristics of the discrete transistors used in this embodiment, Q1 and Q2. Resistor R5 provides a similar function should the additional transistor Q3 with its additional current carrying capacity be utilised.

Further, circuits as described above may be added to provide even more current to suit a particular application of the

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invention.

Resistor R6 is a current sense means used to predetermine the required regulation current and the current provided could be generated by a separate circuit.

The total impedance of the current source at communication frequencies typically in the frequency range 3kHz < Fcom < 20kHz is determined to a large extent by component parameters. Transistors Q1, Q2 and Q3 may preferably be BC856/BC556 components, which have been specifically selected for their *h* parameters, and therefore can provide consistent and predictable impedance performance. Transistor Q4 operates with a very low collector current and therefore does not significantly affect the output impedance of the current source.

The preceeding description discloses a discrete component version of a constant current source power supply. However, it is within the skill of the person skilled in the art to provide a circuit with the same functionality and in an integrated circuit or hybrid surface mounted form. The circuit principles are the same but the form of the electronics is varied to suit high volume production considerations.

It will be appreciated that the invention makes use of both a current mirror principle and a negative feedback loop in order to achieve the desired circuit response for a current source suitable for the application described. However, it will be appreciated by those skilled in the art that the invention is not restricted in its use to the application described and neither is the present invention restricted in its preferred embodiment with regards to the particular components and configuration described herein. It will be appreciated that various modifications can be made without departing from the principles of the invention, therefore, the invention should be understood to include all such modifications within its scope.

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HIGH IMPEDANCE POWER SUPPLY

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A current source power supply comprising:

a current mirror circuit having high input impedance and also having current flowing in first and second paths therethrough as well as a current flow control portion,

a current reference means adapted to connect between the output portion of said first path of current in said current mirror circuit and an output of said current source power supply,

a current sensing means adapted to connect between the output portion of said second path of current in said current mirror circuit and said output of said current source power supply,

a feedback circuit connecting the current flow control portion of said current mirror circuit to both first and second paths of current wherein the feedback circuit regulates the current in the current sensing means so that the total voltage drop across the current sensing means and the feedback circuit is matched to the voltage drop across the current reference means.

2. A current source power supply according to claim 1 wherein said current mirror comprises two small signal transistors having their base terminals connected to each other and their collectors connected to a common voltage source.

3. A current source power supply according to claim 1 wherein said reference current means comprises a zener diode voltage reference and a resistor to convert the measured current to a voltage for comparison with said reference voltage.

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4. A current source power supply according to claims 1,2 and 3 wherein said feedback circuit comprises a small signal transistor having a collector connected to the base terminals of said current mirror circuit, an emitter connected to the junction of the second path of current of said current mirror circuit and said current sensing means, and a base connected to the junction of said first path of current of said current mirror circuit and said current reference means.

5. A current source power supply according to claim 4 wherein said feedback circuit small signal transistor is operated with a small collector current while maintaining the input impedance characteristics of said current source power supply.

6. A current source power supply according to claim 5 wherein said feedback circuit small signal transistors is an npn type.

7. A current source power supply according to claim 2 wherein said small signal transistors are matched transistors.

8. A current source power supply according to claim 2 wherein said small signal transistors are npn type transistors.

9. A current source power supply according to claim 7 wherein said small signal transistors have their emitters connected via series resistors to said common voltage source so as to match the parameters and temperature characteristics of said small signal transistors.

10. A current source power supply according to claim 7 wherein said small signal transistors are selected based on their gain characteristics so as to provide a predetermined high input impedance characteristic.

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11. A current source power supply according to claim 1 having a capacitor means in parallel with said current reference means to frequency stabilise said current source power supply.

12. A current source power supply according to claim 1 having at least one additional current carrying path provided by a current amplifier means connected to said voltage source means and said constant current output, having a current flow control portion connected to said current flow control portion of said current mirror circuit such that the current provided by said additional current carrying path adds to the total current provided by said current source power supply.

13. A current source power supply according to any preceding claim wherein the predetermined input impedance of said current source power supply is greater than 50 ohms.

14. A two wire communication system having a current source power supply according to any preceding claim.

15. A current source power supply substantially as hereinbefore described with reference to and as illustrated in the accompanying Figure 3.

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HIGH IMPEDANCE POWER SUPPLY

ABSTRACT

An electrical power supply for a two-wire power and communications network is disclosed (Fig 1, 10, 12, 14-20).

A constant current source is desirable which also exhibits high input impedance at the frequency of operation of the two-wire communication network. The invention disclosed uses a novel combination of the current mirror principle and a negative feedback loop in order to achieve the requisite regulation of current and high input impedance.

Current mirror circuit (Q1, Q4) has a current flow control portion (Q4) and two current paths, where in the first current path there is a current reference (Z3) and in the second current path there is a current sensing means (R6). A feedback circuit is provided from the current flow control portion (Q4) of the current mirror circuit (Q1, Q4) to both the first and second current paths, where the feedback circuit regulates the current in the current sensing means (R6) so that the total voltage drop across the current sensing means (R6) and the feed back circuit is matched to the voltage drop across the current reference means (Z3).

Additional current carrying paths (R3, Q3, I_3) can be added to the constant current power supply to increase the total current provided by the power supply into the two-wire power and communications network.

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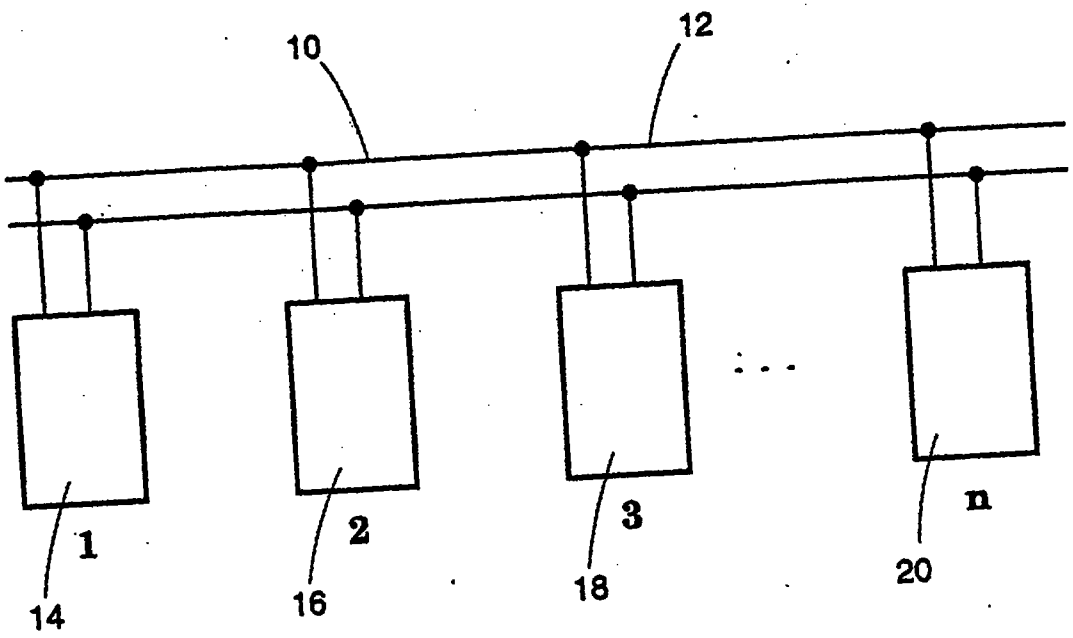
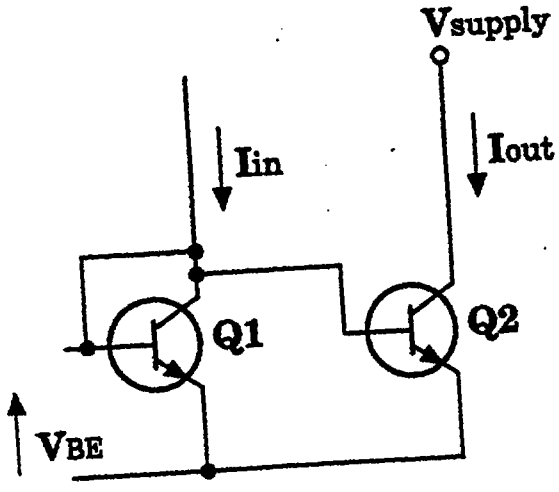


FIGURE 1



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FIGURE 2

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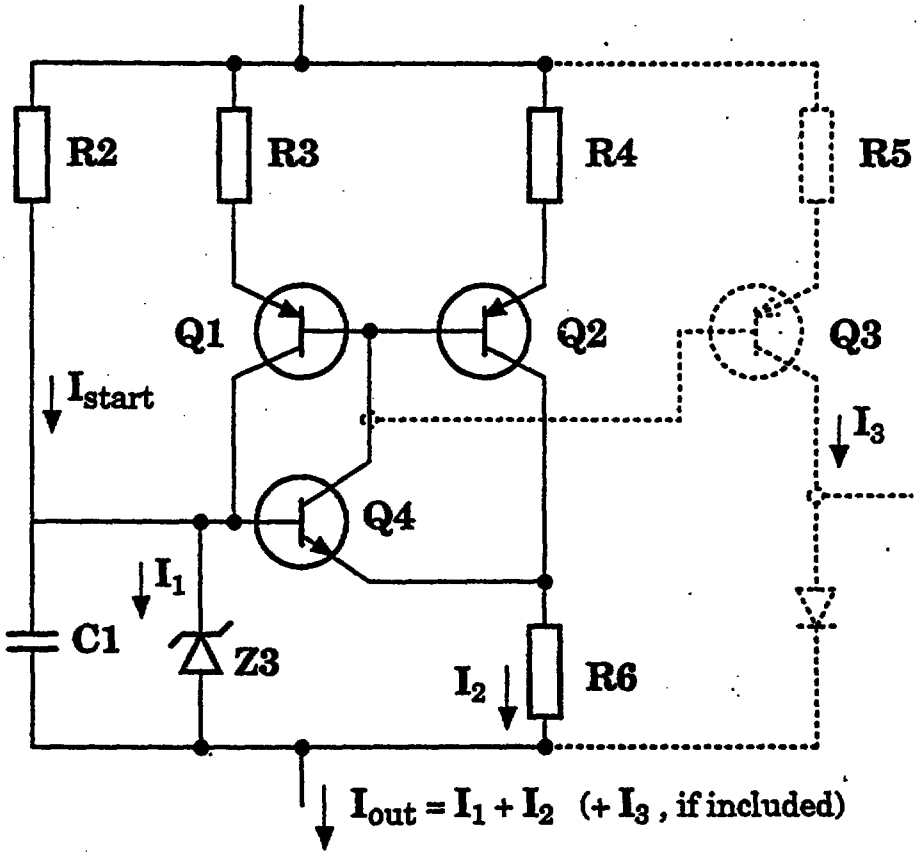


FIGURE 3

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REPLACEMENT SHEET
Date : 1 SEP 199F

HIGH IMPEDANCE POWER SUPPLY

This invention relates to electrical power supplies and in particular to a current source power supply suitable for use in a two-wire communication network.

BACKGROUND OF THE INVENTION

As an example only, the invention is discussed in the context of a control system for a building which uses a two-wire communications medium which is also used to conduct power to the remotely located controllers in the system. The control system comprises many low power consumption transceiver devices connected in parallel via the two-wire power and communications medium, although other mediums are suitable for the application of the invention described. Fig. 1 depicts a basic layout of such a network.

Each device in the control system is adapted and arranged to exchange signals via the two-wire medium while also adapted to receive power from a central power supply.

Pairs of wires used in this configuration are typically twisted together to balance electromagnetic interaction between themselves and other adjacent wires and are available either shielded or unshielded. However, other combined power and communications mediums may comprise other configurations of conductors suited or adapted to carry both power supply current from the power source to the remote transceiver devices as well as control signals.

The effective input impedance of all devices when "listening" for a communication message is preferably considerably higher than the effective output impedance of the transmitting portion of each device. However, since all the devices on the network are powered via the same pair of wires, the communication signal reception is adversely affected if the power supply input impedance of the device is low relative to the effective input impedance of the receiver portion of the device.

REPLACEMENT SHEET
Date : 1 SEP 1995

Preferably therefore the network requires a device power supply with an extremely high input impedance at the frequencies utilised by the communication signal, while still being capable of providing the required power to supply each device. This provides for the highest possible quantity of devices that can be simultaneously connected to the power and signal communications medium.

As an example only, typical operating requirements of a network device power supply current source may be as follows:

Maximum voltage (under transient conditions): Vmax = 65V

Minimum voltage for operation: Vmin = 6V

Current regulation range; 5mA < I supply < 35mA

Impedance over communication frequency range: Z in > 50k Ohms

Communication frequency range: 3kHz < Fcom < 20kHz

One alternative is the use of an inductor in series with the power supply input to provide high impedance at the desired communication frequencies, while still allowing the device to derive power from the wires. However, in order to provide the required impedance, the inductor must exhibit approximately 5 Henry's of inductance. This value of inductance is typically only available by using an inductor having a large quantity of turns about a magnetic core, which is typically bulky and uneconomic if there are a large number of remote control devices in the network.

Power supplies required to provide a constant current source may include semiconductor current sources utilising either Junction Field Effect Transistors (JFET/s) operating above their pinch-off voltage, or bipolar transistors in a current "mirror" configuration, adapted to utilise the bipolar transistor's base voltage in such a way as to define the collector current, or any linear transistor operating with a

REPLACEMENT SHEET
Date : 1 SEP 1995

negative feedback loop which attempts to regulate current.

However, it is also known, that current sources using JFET transistors operating above pinch-off are typically limited by device parameters. Typical JFET impedances, for devices intended for operation in this mode are < 25k Ohms at a current of 4.7mA.

Transistors (Bipolar or FET) which are used to regulate current in response to a feedback circuit are dependent on the response time of the controlling circuit for suitable performance. The use of such a circuit in high voltage applications such as those described in the embodiment of the invention are unnecessarily complicated by the use of a variety of operational amplifier based circuits additional to the constant current power supply circuit.

A further current source technique which uses linear bipolar integrated circuits is a current mirror. A typical current mirror circuit is depicted in Fig. 2. Input current, Iin is "reflected" in the output portion of the circuit, such that, if the impedance of the circuit is appropriate, an identical current will flow in the collectors of both transistors Q1 and Q2. The current mirror circuit depicted in Fig. 2, Iin causes a current to flow in the base of transistor Q1, thus allowing a collector current to flow in the same transistor. The resulting current flow through the emitter of Q1 creates a voltage drop from base to emitter, of V_{BE}, which is related (logarithmically) to the current flow Iin. As transistor Q2 has its base connected in parallel with the base of transistor Q1, it has the same base-emitter voltage, and hence, allows the same current to flow in its emitter from the supply connected to its collector.

In a discrete component circuit of the current mirror, it is necessary to introduce resistors in series with the emitters of the transistors, so that the effects of temperature and parameter mismatching are less pronounced. Emitter resistors

REPLACEMENT SHEET
Date : 1 SEP 1995

also allow for a simple means of scaling the output current if required.

Integrated circuit versions of a current mirror utilise various known techniques to provide the necessary regulated constant current, but in the case of a network comprising a plurality of devices spaced along a two-wire power current carrying and signal carrying medium, the high voltage requirements which are required, make a current integrated circuit solution more difficult if not impractical.

Therefore, it is an aspect of the invention to provide a constant current source which uses a novel combination of a current mirror principle and a negative feedback loop in order to achieve the requisite regulation of current which still exhibits a high input impedance at the frequencies used to communicate the control signals. The invention overcomes the problems that those circuit techniques by themselves involve.

BRIEF DESCRIPTION OF THE INVENTION

In a broad aspect of the invention a current source power supply comprises

a current mirror circuit having high input impedance and also having current flowing in first and second paths therethrough as well as a current flow control portion,

a current reference means adapted to connect between the output portion of said first path of current in said current mirror circuit and an output of said current source power supply,

a current sensing means adapted to connect between the output portion of said second path of current in said current mirror circuit and said output of said current source power supply,

a feedback circuit connecting the current flow control portion of said current mirror circuit to both first and second paths of current wherein the feedback circuit regulates the current in the current sensing means so that

REPLACEMENT SHEET
Date : 1 SEP 1995

the total voltage drop across the current sensing means and the feedback circuit is matched to the voltage drop across the current reference means.

In a further aspect of the invention of a current source power supply, the current mirror comprises two small signal transistors having their base terminals connected to each other and their collectors connected to a common voltage source.

In a further aspect of the invention of a current source power supply the reference current means comprises a zener diode voltage reference and a resistor to convert the measured current to a voltage for comparison with the reference voltage.

A current source power supply according to any preceding aspect wherein the predetermined input impedance of said current source power supply is greater than 50 ohms.

A specific embodiment of the invention will now be described in some further detail with reference to and as illustrated in the accompanying figures.

This embodiment is illustrative, but not restrictive, of the invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Fig. 1 depicts a plurality of control devices interconnected by a pair of wires which form a common network topology;

Fig. 2 is a circuit of a prior art current mirror; and

Fig. 3 depicts a current source circuit in accordance with an embodiment of the invention.

REPLACEMENT SHEET
Date : 1 SEP 1995

DETAILED DESCRIPTION OF THE INVENTION

A large variety of information, control and management systems utilising two wire power and communication mediums have been developed for an equally large variety of systems used in the residential, commercial building and industrial areas. Pairs of conductors are easily laid and routed in new and existing buildings and simple tap-in like connections are connectable at any point along the pair of conductors. The basic topology of such a network is depicted pictorially in Fig. 1. Wires 10 and 12 provide a medium for the communication of signals either to or from the devices 14, 16, 18 and 20 which can be distributed as required along the full length of the wires 10 and 12. It is preferable for there to be a maximum useable length of wire along which a device can be located and this aspect of the invention will be described later in the specification.

A suitable current source power supply circuit which overcomes the problems of the prior art, comprises a circuit utilising both the current mirror principle and a negative feedback loop. The supply current can be regulated while adequate input impedance at the communication frequencies used is provided.

Fig. 3 depicts one embodiment of such a current source power supply circuit where R2 is a high-value resistor, which provides sufficient current to the base of Q4 to bring it into conduction, after which positive feedback through transistor Q1 will maintain proper operation.

A low-voltage (3.3V) zener diode Z3 is used to establish a reference voltage and current and is one example of a reference current means. A separate circuit which produces a low current reference could also provide this function of the circuit.

REPLACEMENT SHEET
Date : 1 SEP 19

Transistor Q4 is a summation element and part of the feedback circuit of the current power supply which provides base current to both transistors Q1 and Q2, causing current to flow in each of the two collectors thereof. Q1 and Q2 in this configuration with each other provide one example of a current mirror means. A voltage drop appears across resistor R6 in response to the current from transistor Q2 where a resistor is one example of a current sensing means.

Transistor Q4 regulates the current I_2 so that the voltage drop across resistor R6, plus the base emitter voltage V_{BE} of transistor Q4, matches the zener voltage drop of Z3.

Note it is preferable but not essential that the temperature coefficient of the base emitter V_{BE} of transistor Q4 is approximately the same for zener diode Z3, so that the regulated current is not adversely affected by temperature variation.

Capacitor C1 is used optionally in the circuit to provide stability at high frequencies of operation.

Current I_1 through zener diode Z3 is regulated, and in the order of 5mA for the range of currents required by the network. This ensures that the characteristics of the zener diode are stable and repeatable.

Transistor Q3 may be optionally included to provide additional current at a higher voltage than that of the output terminal of the current source. Resistors R2, R3 and R4 are preferably included to offset the errors caused by mismatching parameters and temperature characteristics of the discrete transistors used in this embodiment, Q1 and Q2. Resistor R5 provides a similar function should the additional transistor Q3 with its additional current carrying capacity be utilised.

Further, circuits as described above may be added to provide even more current to suit a particular application of the

REPLACEMENT SHEET
Date : 1 SEP 1997

invention.

Resistor R6 is a current sense means used to predetermine the required regulation current and the current provided could be generated by a separate circuit.

The total impedance of the current source at communication frequencies typically in the frequency range 3kHz < Fcom < 20kHz is determined to a large extent by component parameters. Transistors Q1, Q2 and Q3 may preferably be BC856/BC556 components, which have been specifically selected for their *h* parameters, and therefore can provide consistent and predictable impedance performance. Transistor Q4 operates with a very low collector current and therefore does not significantly affect the output impedance of the current source.

The preceeding description discloses a discrete component version of a constant current source power supply. However, it is within the skill of the person skilled in the art to provide a circuit with the same functionality and in an integrated circuit or hybrid surface mounted form. The circuit principles are the same but the form of the electronics is varied to suit high volume production considerations.

It will be appreciated that the invention makes use of both a current mirror principle and a negative feedback loop in order to achieve the desired circuit response for a current source suitable for the application described. However, it will be appreciated by those skilled in the art that the invention is not restricted in its use to the application described and neither is the present invention restricted in its preferred embodiment with regards to the particular components and configuration described herein. It will be appreciated that various modifications can be made without departing from the principles of the invention, therefore, the invention should be understood to include all such modifications within its scope.

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REPLACEMENT SHEET
Date: 1 SEP 1995

HIGH IMPEDANCE POWER SUPPLY

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A current source power supply comprising:

a current mirror circuit having high input impedance and also having current flowing in first and second paths therethrough as well as a current flow control portion,

a current reference means adapted to connect between the output portion of said first path of current in said current mirror circuit and an output of said current source power supply,

a current sensing means adapted to connect between the output portion of said second path of current in said current mirror circuit and said output of said current source power supply,

a feedback circuit connecting the current flow control portion of said current mirror circuit to both first and second paths of current wherein the feedback circuit regulates the current in the current sensing means so that the total voltage drop across the current sensing means and the feedback circuit is matched to the voltage drop across the current reference means.

2. A current source power supply according to claim 1 wherein said current mirror comprises two small signal transistors having their base terminals connected to each other and their collectors connected to a common voltage source.

3. A current source power supply according to claim 1 wherein said reference current means comprises a zener diode voltage reference and a resistor to convert the measured current to a voltage for comparison with said reference voltage.

REPLACEMENT SHEET
Date : 1 SEP 1995

4. A current source power supply according to claims 1,2 and 3 wherein said feedback circuit comprises a small signal transistor having a collector connected to the base terminals of said current mirror circuit, an emitter connected to the junction of the second path of current of said current mirror circuit and said current sensing means, and a base connected to the junction of said first path of current of said current mirror circuit and said current reference means.

5. A current source power supply according to claim 4 wherein said feedback circuit small signal transistor is operated with a small collector current while maintaining the input impedance characteristics of said current source power supply.

6. A current source power supply according to claim 5 wherein said feedback circuit small signal transistors is an npn type.

7. A current source power supply according to claim 2 wherein said small signal transistors are matched transistors.

8. A current source power supply according to claim 2 wherein said small signal transistors are npn type transistors.

9. A current source power supply according to claim 7 wherein said small signal transistors have their emitters connected via series resistors to said common voltage source so as to match the parameters and temperature characteristics of said small signal transistors.

10. A current source power supply according to claim 7 wherein said small signal transistors are selected based on their gain characteristics so as to provide a predetermined high input impedance characteristic.

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REPLACEMENT SHEET
Date : 1 SEP 1995

11. A current source power supply according to claim 1 having a capacitor means in parallel with said current reference means to frequency stabilise said current source power supply.

12. A current source power supply according to claim 1 having at least one additional current carrying path provided by a current amplifier means connected to said voltage source means and said constant current output, having a current flow control portion connected to said current flow control portion of said current mirror circuit such that the current provided by said additional current carrying path adds to the total current provided by said current source power supply.

13. A current source power supply according to any preceding claim wherein the predetermined input impedance of said current source power supply is greater than 50 ohms.

14. A two wire communication system having a current source power supply according to any preceding claim.

15. A current source power supply substantially as hereinbefore described with reference to and as illustrated in the accompanying Figure 3.

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HIGH IMPEDANCE POWER SUPPLY

ABSTRACT

An electrical power supply for a two-wire power and communications network is disclosed (Fig 1, 10, 12, 14-20).

A constant current source is desirable which also exhibits high input impedance at the frequency of operation of the two-wire communication network. The invention disclosed uses a novel combination of the current mirror principle and a negative feedback loop in order to achieve the requisite regulation of current and high input impedance.

Current mirror circuit (Q1, Q4) has a current flow control portion (Q4) and two current paths, where in the first current path there is a current reference (Z3) and in the second current path there is a current sensing means (R6). A feedback circuit is provided from the current flow control portion (Q4) of the current mirror circuit (Q1, Q4) to both the first and second current paths, where the feedback circuit regulates the current in the current sensing means (R6) so that the total voltage drop acrpss the current sensing means (R6) and the feed back circuit is matched to the voltage drop across the current reference means (Z3).

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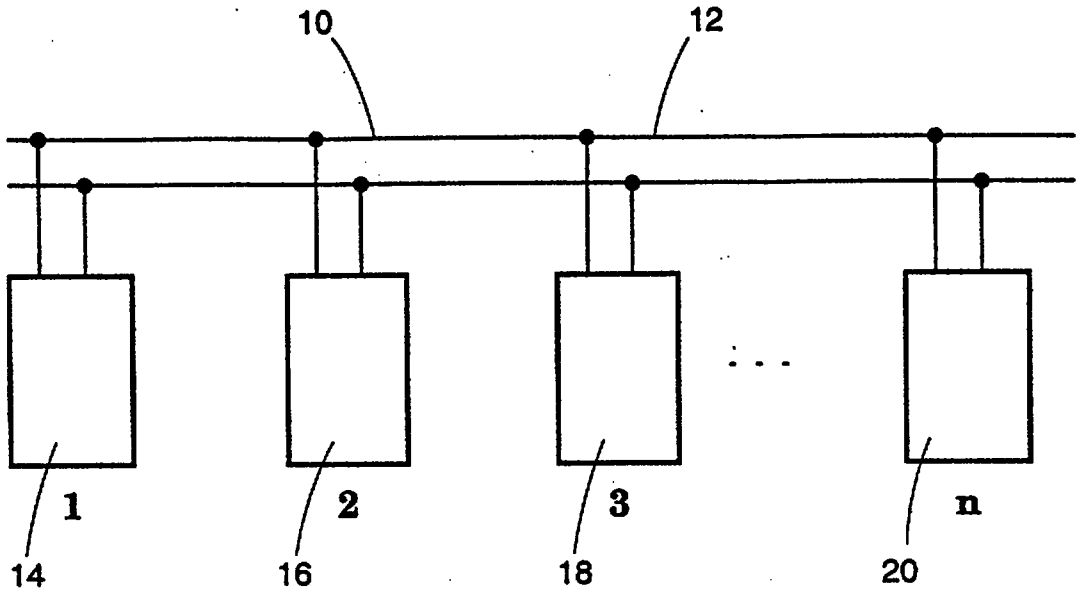


FIGURE 1

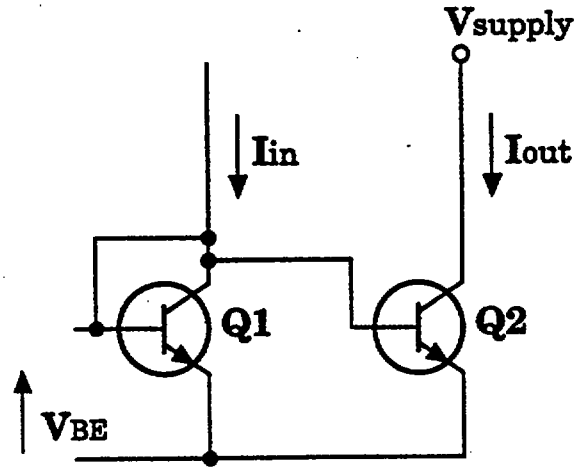


FIGURE 2

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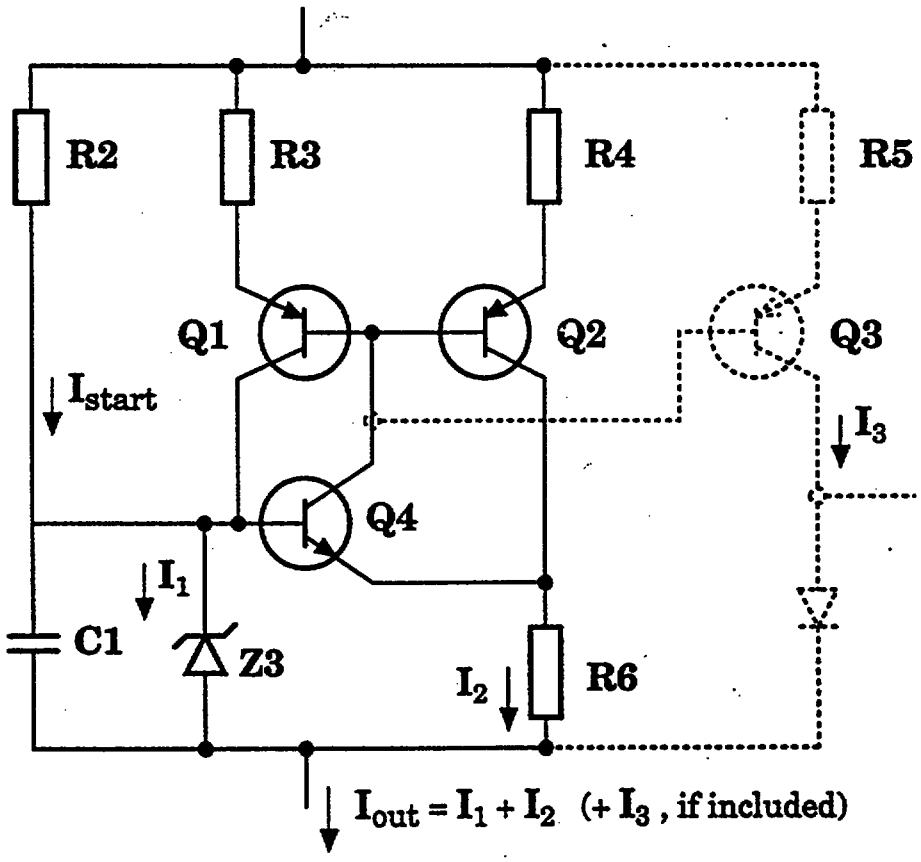


FIGURE 3