CLAIMS

What is claimed is:

1. A voltage reduction apparatus, comprising:

a switched capacitor voltage reduction circuit electrically coupled to a power source for receiving an input direct current (DC) power signal having an input voltage level from the power source and discharging an output DC power signal having an output voltage level that is less than the input voltage level, the switched capacitor voltage reduction circuit including a plurality of switched capacitor devices, each of the switched capacitor devices including:

an input switching device;

at least one capacitor; and

a pair of output switching devices, the switched capacitor voltage reduction circuit being operable between a charging state and a discharging state, the input switching devices configured to couple the capacitors in series in the charging state to transmit the input DC power signal to charge the capacitors, the output switching devices configured to couple the capacitors in parallel in the discharging state to discharge the output DC power signal from the capacitors.

~~An apparatus, comprising:~~

~~a switching device coupled to a source of electrical power, the switching device being adapted to receive a direct current (DC) input power signal having an input voltage level, to receive a control signal and to produce an alternating current (AC) power signal as a function of the DC input power signal and the control signal, the AC power signal having the input voltage level and a frequency, the frequency of the AC power signal being responsive to the control signal, and,~~

~~a frequency dependent reactive device electrically coupled to the switching device for receiving the AC power signal and producing a DC output power signal having an output voltage level that is different than the input voltage level, the frequency dependent reactive device being chosen to achieve a desired voltage of the DC output power signal relative to the frequency of the AC power signal, the switching device adapted to adjust the frequency~~

~~of the AC power signal based on the output voltage level to produce the desired voltage level of the DC output power signal.~~

2. An apparatus in accordance with claim 1, further comprising a processor programmed to sense the input voltage level and transmit control signals to the switched capacitor devices for regulating each of the switched capacitor devices as a function of the sensed input voltage level.

~~An apparatus comprising:~~

~~a switching device being coupled to a source of electrical power and including a first pair of transistors, the switching device being adapted to receive a direct current (DC) input power signal having an input voltage level, to receive a control signal, and to produce an alternating current (AC) power signal as a function of the DC input power signal and the control signal, the AC power signal having the input voltage level and a frequency, the frequency of the AC power signal being responsive to the control signal;~~

~~a frequency dependent reactive device electrically coupled to the first pair of transistors for receiving the AC power signal and producing a DC output power signal having an output voltage level that is different than the input voltage level, the frequency dependent reactive device being chosen to achieve a desired voltage of the DC output power signal relative to the frequency of the AC power signal; and~~

~~a control element coupled to the switching device and the frequency dependent reactive device, the control element for sensing an actual voltage of the DC output power signal and responsively modifying the control signal delivered to fine tune the switching device to adjust the frequency of the AC power signal to achieve the desired voltage of the DC output power signal.~~

3. An apparatus in accordance with claim 2, the processor programmed to regulate the switched capacitor voltage reduction circuit to discharge the output DC power signal having a current level within a predefined range of current levels.

~~A power circuit for providing electrical power at a desired voltage level from an alternating current (AC) power source, comprising:~~

~~a rectifying circuit electrically coupled to the (AC) power source for receiving an AC input power signal from the AC power source and for producing a direct current (DC) input power signal having an input voltage level;~~

~~a switching device being coupled to the rectifying circuit and including first and second pairs of transistors, the first and second pairs of transistors for driving a high-side output and a low-side output, respectively, to receive the DC input power signal from the rectifying circuit and to produce an AC power signal having the input voltage level and a frequency, the frequency of the AC power signal being responsive to a control signal;~~

~~a control element coupled to the switching device for delivering the control signal to the switching device; and,~~

~~a frequency dependent reactive device electrically coupled to the first and second pairs of transistors for receiving the AC power signal and producing a DC output power signal having an output voltage level that is different than the input voltage level, the frequency dependent reactive device including first and second reactive elements and a rectifier, the first and second reactive elements being electrically coupled to the high-side and low-side outputs, respectively, and to the rectifier, and being chosen to achieve the desired voltage of the DC output power signal relative to the frequency of the alternating current AC power signal, the control element configured to modify the control signal delivered to the switching element to fine tune the switching device to adjust the frequency of the AC power signal to achieve the desired voltage of the DC output power signal.~~

4. An apparatus in accordance with claim 2, further comprising a vampire load elimination subsystem including a current sensor for sensing a current level of the output DC power signal, the processor programmed to shut-off input power to the switched capacitor voltage reduction circuit if the sensed current level is different from a predefined current level.~~An apparatus, as set forth in claims 1, 2, and 3, wherein the frequency dependent reactive device includes at least one reactive element.~~

5. An apparatus in accordance with claim 2, further comprising a communications controller coupled to the processor for transmitting control signals to the

processor to enable remote operation of the switched capacitor voltage reduction circuit.~~An apparatus, as set forth in claim 4, wherein the at least one rectifying reactive element is a capacitor.~~

6. An apparatus in accordance with claim 2, the charging state including a corresponding input switching device in an on-position and a corresponding pair of output switching devices in an off-position, the discharging state including the corresponding input switching device in the off-position and the corresponding pair of output switching devices in the on-position.~~An apparatus, as set forth in claims 1, 2, and 3, wherein the output power signal includes an AC signal component and the voltage level is peak voltage.~~

7. An apparatus in accordance with claim 6, the processor programmed to regulate each of the switched capacitor devices from the charging state to a hold state, and from the hold state to the discharging state, the hold state including the corresponding input switching device and the corresponding pair of output switching devices in the off-position to isolate the corresponding at least one capacitor from the power source.

~~An apparatus, as set forth in claims 1, 2, and 3, further comprising a control element coupled to the switching device and the frequency dependent reactive device, the control element for sensing an actual voltage of the DC output power signal and responsively modifying the control signal delivered to fine tune the switching device to adjust the frequency of the AC power signal to achieve the desired voltage of the DC output power signal.~~

8. An apparatus in accordance with claim 2, each of the input switching devices and the output switching devices including a field-effect transistor (FET) including a gate, each gate of each input FET being connected together for receiving a control signal from the processor, and each gate of each output FET being connected together for receiving another control signal from the processor.

~~An apparatus, as set forth in claim 7, wherein the control signal has an associated frequency, the control element modifying to the frequency of the control signal in response to the actual voltage of the DC output power signal to achieve the desired voltage.~~

9. An apparatus in accordance with claim 1, the plurality of switched capacitor devices including a first switched capacitor device and a second switched capacitor device, the first switched capacitor device including a first capacitor and a first input switching device coupled between the first capacitor and the power source, the second switched capacitor device including a second capacitor and a second input switching device coupled between the first capacitor and the second capacitor.

~~An apparatus, as set forth in claim 7, wherein the control signal is a frequency modulated signal having a period, the control element modifying the period in response to the actual voltage of the DC output power signal to achieve the desired voltage.~~

10. An apparatus in accordance with claim 1, further comprising a semiconductor chip, the switched capacitor voltage reduction circuit being formed on the semiconductor chip, the semiconductor chip including a substrate material including at least one of low Ohmic silicon, polysilicon, gallium nitride, gallium arsenide, silicon germanium, silicon carbide and indium phosphide.

~~An apparatus, as set forth in claim 7, wherein the control element monitors the current being delivered and shuts off when there is no load or a battery of a load is fully or nearly fully charged.~~

11. An apparatus in accordance with claim 1, further comprising a buck converter electrically coupled to the power source for receiving the input DC power signal and discharging a second output DC power signal having an output voltage level that is less than the input voltage level.

~~An apparatus, as set forth in claims 1, 2, and 3, the switching device including at least one pair of transistors in a totem pole configuration.~~

12. An apparatus in accordance with claim 1, further comprising a transformer coupled to the switched capacitor voltage reduction circuit for receiving the output DC power signal from the switched capacitor voltage reduction circuit and transmitting a modified output DC power signal having a voltage level that is less than the voltage level of the output DC power signal.

~~An apparatus, as set forth in claim 11, wherein the output of the switching device comprises the output current power signal.~~

13. An apparatus in accordance with claim 1, further comprising a rectifier circuit coupled between the power source and the switched capacitor voltage reduction circuit for receiving an alternative current (AC) power signal from the power source and transmitting the input DC power signal to the switched capacitor voltage reduction circuit.

~~An apparatus, as set forth in claim 11, wherein the transistors within the at least one pair of transistors operate 180 degrees out of phase.~~

14. A voltage reduction apparatus, comprising:

a switched capacitor voltage reduction circuit electrically coupled to a power source for receiving an input DC power signal having an input voltage level from the power source and discharging an output DC power signal having an output voltage level that is less than the input voltage level, the switched capacitor voltage reduction circuit including a plurality of switched capacitor devices, each of the switched capacitor devices including:

an input switching device;

at least one capacitor; and

a pair of output switching devices, the switched capacitor voltage reduction circuit being operable between a charging state and a discharging state, the input switching devices configured to couple the capacitors in series in the charging state to transmit the input DC power signal to charge the capacitors, the output switching devices configured to couple the capacitors in parallel in the discharging state to discharge the output DC power signal from the capacitors; and

a processor programmed to sense the input voltage level and transmit control signals to the switched capacitor devices for regulating each of the switched capacitor devices as a function of the sensed input voltage level.

~~An apparatus, as set forth in claims 1, 2, and 3, the switching device including first and second pairs of transistors, each pair of transistors being in a totem pole configuration.~~

15. An apparatus in accordance with claim 14, the charging state including a corresponding input switching device in an on-position and a corresponding pair of output switching devices in an off-position, the discharging state including the corresponding input switching device in the off-position and the corresponding pair of output switching devices in the on-position, the processor programmed to regulate each of the switched capacitor devices from the charging state to a hold state, and from the hold state to the discharging state, the hold state including the corresponding input switching device and the corresponding pair of output switching devices in the off-position to isolate the corresponding at least one capacitor from the power source.

~~An apparatus, as set forth in claim 14, wherein the output of the first and second pairs of transistors comprise the output current power signal.~~

16. An apparatus in accordance with claim 14, each of the input switching devices and the output switching devices including a FET including a gate, each gate of each input FET being connected together for receiving a control signal from the processor, and each gate of each output FET being connected together for receiving another control signal from the processor.

~~An apparatus, as set forth in claim 14, wherein the transistors within the first and second pairs of transistors operate 180 degrees out of phase.~~

17. An apparatus in accordance with claim 14, the plurality of switched capacitor devices including a first switched capacitor device and a second switched capacitor device, the first switched capacitor device including a first capacitor and a first input switching device coupled between the first capacitor and the power source, the second switched capacitor device including a second capacitor and a second input switching device coupled between the first capacitor and the second capacitor.

~~An apparatus, as set forth in claim 14, wherein the output of the first and second pairs of transistors are 180 degrees out of phase.~~

18. An apparatus in accordance with claim 14, further comprising a semiconductor chip, the switched capacitor voltage reduction circuit being formed on the

semiconductor chip, the semiconductor chip including a substrate material including at least one of low Ohmic silicon, polysilicon, gallium nitride, gallium arsenide, silicon germanium, silicon carbide and indium phosphide.

~~An apparatus, as set forth in claims 1, 2, and 3, the frequency dependent reactive device including at least one reactive element coupled to the switching device, the at least one reactive element having an impedance, the frequency dependent reactive device being chosen as a function of the impedance.~~

19. An apparatus in accordance with claim 14, further comprising a buck converter electrically coupled to the power source for receiving the input DC power signal and discharging a second output DC power signal having an output voltage level that is less than the input voltage level.

~~An apparatus, as set forth in claim 18, where the at least one reactive element is a capacitor.~~

20. An apparatus in accordance with claim 14, further comprising a transformer coupled to the switched capacitor voltage reduction circuit for receiving the output DC power signal from the switched capacitor voltage reduction circuit and transmitting a modified output DC power signal having a voltage level that is less than the voltage level of the output DC power signal.

~~An apparatus, as set forth in claims 1, 2, and 3, further comprising a universal serial bus port electrically coupled to the frequency dependent reactive device.~~

21. An apparatus in accordance with claim 14, further comprising a rectifier circuit coupled between the power source and the switched capacitor voltage reduction circuit for receiving an AC power signal from the power source and transmitting the input DC power signal to the switched capacitor voltage reduction circuit.

~~An apparatus, as set forth in claim claims 1, 2, and 3, further comprising a lighting device coupled control element, the control element for turning on the lighting device when power is being supplied.~~

22. A method of assembling a voltage reduction apparatus, including the steps of:

providing a semiconductor chip;

forming a switched capacitor voltage reduction circuit on the semiconductor chip, the switched capacitor voltage reduction circuit configured to receive an input DC power signal having an input voltage level from a power source and discharge an output DC power signal having an output voltage level that is less than the input voltage level, the switched capacitor voltage reduction circuit including a plurality of switched capacitor devices, each of the switched capacitor devices including an input switching device, at least one capacitor, and a pair of output switching devices, the switched capacitor voltage reduction circuit being operable between a charging state and a discharging state, the input switching devices configured to couple the capacitors in series in the charging state to transmit the input DC power signal to charge the capacitors, the output switching devices configured to couple the capacitors in parallel in the discharge state to discharge the output DC power signal from the capacitors.

~~An apparatus, as set forth in claims 1, 2, and 3, further comprising:~~

~~a second switching device coupled to the source of electrical power, the second switching device being adapted to receive a second control signal and to produce a second AC power signal, the frequency of the second AC power signal being responsive to the second control signal, and,~~

~~a second frequency dependent reactive device electrically coupled to the second switching device for receiving the second AC power signal and producing a second DC output power signal having a second voltage level, the second frequency dependent reactive device being chosen to achieve the desired second voltage of the second DC output power signal relative to the frequency of the second AC power signal, wherein the first and second output voltage levels are different.~~

23. A method in accordance with claim 22, including the step of:

forming a rectifier circuit on the semiconductor chip, the rectifier circuit electrically coupled between the power source and the switched capacitor voltage reduction circuit for

receiving an AC power signal from the power source and transmitting the input DC power signal to the switched capacitor voltage reduction circuit.

~~An apparatus, as set forth in claim 37, wherein the first output voltage level is one of 5 volts, 9 volts, 12 volts or 19.6 volts, and the second output voltage level is another one of 5 volts, 9 volts, 12 volts or 19.6 volts.~~