Claims

1. An electrical circuit for providing electrical power for use in powering electronic devices, comprising:

a primary power circuit adapted to be electrically coupled to an electrical power source, the primary power circuit configured to receive an alternating current (AC) input power signal from the electrical power source and generate an intermediate direct current (DC) power signal, the intermediate DC power signal being generated at a first voltage level that is less than a voltage level of the AC input power signal, the primary power circuit including:

a rectifier circuit configured to receive the AC power input signal from the electrical power source and generate a rectified DC power signal, the rectified DC power signal having a voltage level that is approximately equal to the voltage level of the AC input power signal; and

a switch capacitor voltage breakdown circuit coupled to the rectifier circuit for receiving the rectified DC power signal from the rectifier circuit and generating the intermediate DC power signal, the switch capacitor voltage breakdown circuit including:

~~a pair of flyback capacitors electrically coupled in parallel;~~

a first flyback capacitor:

a second flyback capacitor;

a plurality of switch assemblies electrically coupled to each of the ~~pair of~~ first and the second flyback capacitors, the plurality of switch assemblies being operated between a charge phase and a discharge phase, the plurality of switch assemblies including a first switch assembly configured to couple the first flyback capacitor to ground and a second switch assembly configured to couple the second flyback capacitor to ground; and

a hold capacitor electrically coupled to each of the flyback capacitors, the plurality of switch assemblies being operated to selectively deliver the rectified DC power signal to each of the flyback capacitors during the charge phase and to selectively deliver the intermediate DC power signal to the hold capacitor during the discharge phase;

a buck regulator circuit electrically coupled in parallel with the switch capacitor voltage breakdown circuit; and

an integrated circuit controller including a processor programmed to regulate the switch capacitor voltage breakdown circuit at a different frequency than the buck regulator circuit; and

a secondary power circuit electrically coupled to the primary power circuit, the secondary power circuit configured to receive the intermediate DC power signal from the primary power circuit and deliver an output DC power signal to an electronic device, the output DC power signal being delivered at an output voltage level that is less than the first voltage level of the intermediate DC power signal.

2. An electrical circuit in accordance with claim 1, ~~further comprising an integrated circuit controller including a~~ including the processor programmed to sense the input voltage level and transmit control signals to the switch capacitor voltage breakdown circuit for regulating the switch assemblies as a function of the sensed input voltage level.

3. An electrical circuit in accordance with claim 1, including the processor programmed to regulate the switch capacitor voltage breakdown circuit to facilitate capacitive isolation.

4. An electrical circuit in accordance with claim 2, including 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 primary power circuit if the sensed current level is different from a predefined current level.

5. An electrical circuit in accordance with claim 2, including a communications controller coupled to the processor for transmitting control signals to the processor to enable remote operation of the electrical circuit.

6. An electrical circuit in accordance with claim 1, at least one of the switch assemblies including:

a MOSFET switch;

at least one level shifter coupled to the MOSFET switch for receiving an LDO signal and delivering a control signal to the MOSFET switch as a function of the LDO signal; and

a dickson charge pump coupled to the level shifter, the dickson charge pump configured to receive the rectified DC power signal and generate an output power signal having a voltage level that is greater than the voltage level of the rectified DC power signal, the output power signal being delivered to the level shifter for use in operating MOSFET switch.

7. An electrical circuit in accordance with claim 1, the switch capacitor voltage breakdown circuit including a switch capacitor control circuit coupled to each of the plurality of switch assemblies, the switch capacitor control circuit including:

a voltage sensing circuit for sensing a voltage level of the rectified DC power signal; and

a gain controller configured to select a gain setting of the switch capacitor voltage breakdown circuit as a function of the sensed voltage level and operating each of the plurality of switch assemblies as a function of the selected gain setting.

8. An electrical circuit in accordance with claim 1, the ~~primary power circuit including a~~ buck regulator circuit for receiving the rectified DC power signal from the rectifier circuit and generating a second intermediate DC power signal.

9. An electrical circuit in accordance with claim 8, the buck regulator circuit including a regulator switch assembly coupled to a voltage reduction circuit, the voltage reduction circuit including at least one diode, an inductor, and a capacitor, the regulator switch assembly being operated to selectively deliver the rectified DC power signal to the voltage reduction circuit.

10. An electrical circuit in accordance with claim 9, the buck regulator circuit including a buck regulator control circuit for providing a pulse-width modulated control signal to the regulator switch assembly to selectively deliver the rectified DC power signal to the voltage reduction circuit, the buck regulator control circuit including:

a voltage sensing circuit for sensing the first voltage level of the intermediate DC power signal; and

a regulator controller for generating the pulse-width modulated control signal as a function of the sensed first voltage level, the regulator controller configured to adjust a duty cycle of the control signal being delivered to maintain the voltage level of the intermediate DC power signal at a predefined voltage level.

11. An electrical circuit in accordance with claim 1, the secondary power circuit including a forward converter circuit including a primary voltage reduction circuit and a secondary voltage reduction circuit, the primary voltage reduction circuit configured to receive the intermediate DC power signal from the primary power circuit and deliver a secondary DC power signal to the secondary voltage reduction circuit, the secondary DC power signal having a voltage level that is less than the voltage level of the intermediate DC

power signal, the secondary voltage reduction circuit configured to receive the secondary DC power signal and generate the output DC power signal being delivered to the electronic device.

12. An electrical circuit in accordance with claim 11, the primary voltage reduction circuit including a transformer, a primary side of the transformer being coupled to the primary power circuit and a secondary side of the transformer being coupled to the secondary voltage reduction circuit.

13. An electrical circuit in accordance with claim 12, including a primary side current sense circuit that is connected to the primary side of the transformer to sense the load current and the load voltage to facilitate regulating the DC output signal.

14. A power module for providing electrical power for use in powering electronic devices, comprising:

at least one switch capacitor voltage breakdown circuit for receiving a power input signal from an electrical power source and generate an output power signal, the at least one switch capacitor voltage breakdown circuit including:

~~a pair of flyback capacitors electrically coupled in parallel; and~~

a first flyback capacitor:

a second flyback capacitor;

a hold capacitor; and

a plurality of switch assemblies electrically coupled to each of the ~~pair of~~ first and the second flyback capacitors and the hold capacitor, the plurality of switch assemblies including a first switch assembly configured to couple the first flyback capacitor to ground and a second switch assembly configured to couple the second flyback capacitor to ground, the plurality of switch assemblies being operated to selectively deliver the power input signal to

each of the flyback capacitors during a charge phase and to selectively deliver the output power signal to the hold capacitor during the discharge phase;

a buck regulator circuit electrically coupled in parallel with the at least one switch capacitor voltage breakdown circuit; and

an integrated circuit controller including a processor programmed to regulate the switch capacitor voltage breakdown circuit at a different frequency than the buck regulator circuit.

15. A power module in accordance with claim 14, including ~~a~~ the buck regulator ~~circuit electrically coupled in parallel with the switch capacitor voltage breakdown circuit~~ including a regulator switch assembly coupled to a voltage reduction circuit, the voltage reduction circuit including at least one diode, an inductor, and a capacitor, the regulator switch assembly being operated to selectively deliver the power input signal to the voltage reduction circuit.

16. A power module in accordance with claim 15, including ~~an integrated circuit controller programmed to regulate the switch capacitor voltage breakdown circuit and the buck regulator circuit~~ the buck regulator circuit including a buck regulator control circuit for providing a pulse-width modulated control signal to the regulator switch assembly to selectively deliver the power input signal to the voltage reduction circuit.

17. A power module in accordance with claim 14, including a forward converter circuit coupled to the switch capacitor voltage breakdown circuit, the forward converter circuit including a transformer coupled to the switch capacitor voltage breakdown circuit for receiving an intermediate power signal and delivering the output power signal to an electronic device.

18. A power module in accordance with claim 14, including a semiconductor chip, the flyback capacitors and the switch assemblies being formed on the semiconductor chip.

19. A power module in accordance with claim 14, at least one of the switch assemblies including:

a MOSFET switch; and

a dickson charge pump coupled to the MOSFET switch.

20. A power module in accordance with claim 19, wherein the MOSFET switch includes a high voltage MOSFET formed on a low voltage integrated circuit.

21. A power module in accordance with claim 16, the integrated circuit controller programmed to regulate the switch capacitor voltage breakdown circuit at a different frequency than the buck regulator circuit.

22. A power module in accordance with claim 16, including a communications controller coupled to the integrated circuit controller for transmitting control signals to the integrated circuit controller to enable remote operation of the power module.

23. A power module in accordance with claim 14, including a vampire load elimination subsystem including a current sensor for sensing a current level of the output power signal and to disconnect input power if the sensed current level is different from a predefined current level.

24. An electrical circuit in accordance with claim 1, the flyback capacitors and the switch assemblies being formed on a semiconductor chip

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

providing a semiconductor chip;

forming a switch capacitor voltage breakdown circuit on the semiconductor chip, the switch capacitor voltage breakdown 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 switch capacitor voltage breakdown circuit including a first flyback capacitor, a second flyback capacitor, a hold capacitor, and a plurality of switch assemblies electrically coupled to each of the flyback capacitors and the hold capacitor, the plurality of switch assemblies including a first switch assembly configured to couple the first flyback capacitor to ground and a second switch assembly configured to couple the second flyback capacitor to ground, the plurality of switch assemblies being operated to selectively deliver the power input signal to each of the flyback capacitors during a charge phase and to selectively deliver the output power signal to the hold capacitor during the discharge phase;

forming a buck regulator circuit on the semiconductor chip, the buck regulator circuit electrically coupled in parallel with the at least one switch capacitor voltage breakdown circuit; and

forming an integrated circuit controller on the semiconductor chip, the integrated circuit controller programmed to sense the voltage level of input DC power signal and adjust the gain of the switch capacitor voltage breakdown circuit as a function of the sensed voltage level to generate the output DC power signal, and to regulate the switch capacitor voltage breakdown circuit at a different frequency than the buck regulator circuit.