CLAIMS

What is claimed is:

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

a power converter circuit electrically coupled to an electrical power source for receiving alternating current (AC) input power from the electrical source and delivering direct current (DC) output power to an electronic device, the power converter circuit including a transformer and a switching device coupled to a primary side of the transformer for delivering power from the electrical power source to a primary side of the transformer;

a voltage sensor coupled to the primary side of the transformer for sensing a voltage level of power being generated by the transformer; and

a controller coupled to the voltage sensor and the switching device, the controller configured to receive the sensed voltage level from the voltage sensor and transmit a control signal to the switching device to adjust the voltage level of power being delivered to the electronic device.

2. An electrical circuit in accordance with claim 1, the controller configured to adjust a duty cycle of the control signal being transmitted to the switching device to adjust a voltage level of power being delivered to the electronic device.

3. An electrical circuit in accordance with claim 1, further comprising a quasi-resonant circuit coupled to the power converter circuit, the quasi-resonant circuit including a switching device coupled to the controller, the controller configured to determine a zero crossing of the transformer as a function of the sensed transformer voltage and operate the switching device to deliver input power to the transformer near the transformer zero crossing.

4. An electrical circuit in accordance with claim 1, further comprising a vampire load subsystem that is configured to determine if the sensed voltage is different than a threshold voltage level and operate the power converter circuit to disconnect power to the electronic device.

5. An electrical circuit in accordance with claim 1, further comprising a startup circuit that is connected to the controller for providing start-up power to the controller.

6. An electrical circuit in accordance with claim 1, further comprising:

a synchronous rectifier circuit coupled the transformer, the synchronous rectifier circuit comprising:

a synchronous switching device coupled to a secondary side of the transformer; and

a synchronous control device coupled to the synchronous switching device for transmitting a switch control signal to the synchronous switching device, the synchronous control device coupled to the controller for receiving a synchronization control signal from the controller and generating the switch control signal as a function of the received synchronization control signal.

7. An electrical circuit in accordance with claim 6, the synchronous rectifier circuit further comprising an electrical isolation device coupled between the synchronous control device and the controller.

8. An electrical circuit in accordance with claim 1, further comprising a second voltage sensor coupled to a secondary side of the transformer for sensing a voltage level of output power being delivered to the electronic device and transmitting the sensed output power voltage level to the controller, the controller configured to adjust a duty cycle of the control signal being transmitted to the switching device as a function of the sensed output power.

9. An electrical circuit in accordance with claim 1, further comprising a synchronous rectifier circuit connected to the transformer, the synchronous rectifier circuit comprising a synchronous switching device coupled to the primary side of the transformer.

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

a power converter circuit electrically coupled to an electrical power source for receiving alternating current (AC) input power from the electrical source and delivering direct current (DC) output power to an electronic device, the power converter circuit including a transformer and a first switching device coupled to a primary side of the transformer for delivering power from the electrical power source to the transformer;

a Hall Effect sensor coupled to the transformer for sensing a magnetic field being generated by the transformer; and

a controller coupled to the Hall Effect sensor and the switching device, the controller configured to receive the sensed magnetic field from the Hall Effect sensor and transmit a control signal to the switching device to adjust the voltage level of power being delivered to the electronic device, the control signal being determined as a function of the sensed magnetic field.

11. An electrical circuit in accordance with claim 10, the controller configured to adjust a duty cycle of the control signal being transmitted to the switching device to adjust a voltage level of power being delivered to the electronic device.

12. An electrical circuit in accordance with claim 10, further comprising a quasi-resonant circuit coupled to the power converter circuit, the quasi-resonant circuit including a second switching device coupled to the controller, the controller configured to determine a

zero crossing of the transformer as a function of the sensed magnetic field and operate the switching device to deliver input power to the transformer near the transformer zero crossing.

13. An electrical circuit in accordance with claim 10, further comprising a vampire load subsystem that is configured to determine if the sensed voltage is different than a threshold voltage level and operate the power converter circuit to disconnect power to the electronic device.

14. An electrical circuit in accordance with claim 13, further comprising:

a voltage sensor coupled to a secondary side of the transformer for sensing a voltage level of output power being delivered to the electronic device and transmitting the sensed output power voltage level to the controller, the controller configured to adjust a duty cycle of the control signal being transmitted to the first switching device as a function of the sensed output power.

15. An electrical circuit in accordance with claim 10, further comprising:

a synchronous rectifier circuit coupled to the transformer, the synchronous rectifier circuit comprising:

a synchronous switching device coupled to a secondary side of the transformer; and

a synchronous rectifier controller coupled to the synchronous switching device for transmitting a switch control signal to the synchronous switching device to modify the output power being delivered to the electronic device.

16. An electrical circuit in accordance with claim 15, the synchronous rectifier circuit further comprising:

a second hall effect sensor coupled to the secondary side for sensing a magnetic field of the transformer, the synchronous rectifier controller configured to generate the switch control signal as a function of the sensed magnetic field.

17. An electrical circuit in accordance with claim 10, further comprising a voltage sensor coupled to a secondary side of the transformer for sensing a voltage level of output power being delivered to the electronic device and transmitting the sensed output power voltage level to the controller, the controller configured to adjust a duty cycle of the control signal being transmitted to the switching device as a function of the sensed output power.

18. An electrical circuit in accordance with claim 10, further comprising a startup circuit that is connected to the controller for providing start-up power to the controller.

19. An electrical circuit in accordance with claim 10, further comprising a synchronous rectifier circuit connected to the transformer, the synchronous rectifier circuit comprising a synchronous switching device coupled to the primary side of the transformer.

20. An electrical circuit for providing electrical power for use in charging electronic devices, comprising:

a rectifier circuit coupled to an electrical source for receiving the AC input power from the electrical source and converting the AC input power to DC input power

a quasi-resonant circuit coupled to rectifier circuit, the quasi-resonant circuit including a first switching device, a diode, an inductor, and a capacitor;

a power converter circuit coupled to the quasi-resonant circuit for receiving the DC input power signal from the quasi-resonant circuit and delivering a DC output power having a reduced voltage level, the power converter circuit including a transformer and a second switching device coupled to a primary side of the transformer for delivering power from quasi-resonant circuit to the transformer primary side of the transformer;

a synchronous rectifier circuit coupled to the transformer, the synchronous rectifier circuit including a synchronous switching device coupled to a secondary side of the transformer and a synchronous rectifier controller coupled to the synchronous switching

device for transmitting a switch control signal to the synchronous switching device to modify the output power being delivered to the electronic device;

a voltage sensor coupled to the primary side of the transformer for sensing a voltage level of power being generated by the transformer; and

a controller coupled to the voltage sensor and the switching device, the controller configured to receive the sensed voltage level from the voltage sensor and transmit control signals to the first and the second switching devices to adjust the voltage level of power being delivered to the electronic device.

Claims

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

a rectifier circuit configured to receive an alternating current (AC) power input signal from an electrical power source and generate a rectified direct current (DC) power signal;

a quasi-resonant circuit electrically coupled to the rectifier circuit for receiving the rectified DC power signal from the rectifier circuit and delivering an intermediate DC power signal, the quasi-resonant circuit including a first switching device that is coupled to the rectifier circuit, a diode coupled in series between the first switching device and a first inductor, and a first capacitor that is coupled to the first inductor;

a power converter circuit electrically coupled to the quasi-resonant circuit for receiving the intermediate DC power signal and delivering DC output power to an electronic device, the power converter circuit including a transformer and a switching circuit coupled to a top side of a primary side of the transformer for delivering power to the primary side of the transformer, the switching circuit coupled between the quasi-resonant circuit and the transformer and including a second inductor coupled to the quasi-resonant circuit, a second switching device including a field effect transistor (FET) coupled to the second inductor, and a second capacitor coupled between the FET and the top side of the primary side of the transformer;

a voltage sensor coupled to the transformer for sensing a voltage level of power being generated by the transformer; and

a controller coupled to the voltage sensor and the first and the second switching devices, the controller configured to receive the sensed voltage level from the voltage sensor and transmit

a control signal to the first and the second switching devices to regulate the first and the second switching devices to adjust the voltage level of the DC output power being delivered to the electronic device.

2. An electrical circuit in accordance with claim 1, the controller configured to adjust a duty cycle of the control signal being transmitted to the second switching device as a function of a sensed current level of the output DC power to adjust a voltage level of power being delivered to the electronic device.

3. An electrical circuit in accordance with claim 1, wherein the controller is configured to determine a zero crossing of the transformer as a function of the sensed transformer voltage and operate the first switching device to deliver input power to the transformer near the transformer zero crossing.

4. An electrical circuit in accordance with claim 1, the controller comprising a vampire load subsystem coupled to the power converter circuit and configured to determine if the sensed voltage is different than a threshold voltage level and operate the power converter circuit to disconnect power to the electronic device.

5. An electrical circuit in accordance with claim 1, further comprising a startup circuit including a low power regulator circuit that is connected to the controller for providing start-up power to the controller.

6. An electrical circuit in accordance with claim 1, further comprising:

a synchronous rectifier circuit coupled to the transformer, the synchronous rectifier circuit comprising:

a synchronous switching device coupled to a secondary side of the transformer; and

a synchronous control device coupled to the synchronous switching device for transmitting a switch control signal to the synchronous switching device, the synchronous control device coupled to the controller for receiving a synchronization control signal from the controller and generating the switch control signal as a function of the received synchronization control signal.

7. An electrical circuit in accordance with claim 6, the synchronous rectifier circuit further comprising an electrical isolation device coupled between the synchronous control device and the controller.

8. An electrical circuit in accordance with claim 1, wherein the voltage sensor is coupled to a secondary side of the transformer for sensing a voltage level of output power being delivered to the electronic device and transmitting the sensed output power voltage level to the controller, the controller configured to adjust a duty cycle of the control signal being transmitted to the second switching device as a function of the sensed output power.

9. An electrical circuit in accordance with claim 1, wherein the rectifier circuit includes a synchronous rectifier circuit comprising a synchronous switching device.

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

a rectifier circuit configured to receive an AC power input signal from an electrical power source and generate a rectified DC power signal;

a quasi-resonant circuit electrically coupled to the rectifier circuit for receiving the rectified DC power signal from the rectifier circuit and delivering an intermediate DC power signal, the quasi-resonant circuit including a first switching device that is coupled to the rectifier

circuit, a diode coupled in series between the first switching device and a first inductor, and a first capacitor that is coupled to the first inductor;

a power converter circuit electrically coupled to the quasi-resonant circuit for receiving the intermediate DC power signal and delivering DC output power to an electronic device, the power converter circuit including a transformer and a switching circuit coupled to a top side of a primary side of the transformer for delivering power to the transformer, the switching circuit coupled between the quasi-resonant circuit and the transformer and including a second inductor coupled to the quasi-resonant circuit, a second switching device including a field effect transistor (FET) coupled to the second inductor, and a second capacitor coupled between the FET and the top side of the primary side of the transformer;

a Hall Effect sensor coupled to the transformer for sensing a magnetic field being generated by the transformer; and

a controller coupled to the Hall Effect sensor and the first and the second switching devices, the controller configured to receive the sensed magnetic field from the Hall Effect sensor and transmit a control signal to the first and the second switching devices to regulate the first and the second switching devices to adjust the voltage level of the DC output power being delivered to the electronic device, the control signal being determined as a function of the sensed magnetic field.

11. An electrical circuit in accordance with claim 10, the controller configured to adjust a duty cycle of the control signal being transmitted to the second switching device as a function of a sensed current level of the output DC power to adjust a voltage level of power being delivered to the electronic device.

12. An electrical circuit in accordance with claim 10, wherein the controller is configured to determine a zero crossing of the transformer as a function of the sensed magnetic field and operate the first switching device to deliver input power to the transformer near the transformer zero crossing.

13. An electrical circuit in accordance with claim 10, further comprising a vampire load subsystem that is configured to determine if the sensed voltage is different than a threshold voltage level and operate the power converter circuit to disconnect power to the electronic device.

14. An electrical circuit in accordance with claim 13, further comprising:

a voltage sensor coupled to a secondary side of the transformer for sensing a voltage level of output power being delivered to the electronic device and transmitting the sensed output power voltage level to the controller, the controller configured to adjust a duty cycle of the control signal being transmitted to the first switching device as a function of the sensed output power.

15. An electrical circuit in accordance with claim 10, further comprising:

a synchronous rectifier circuit coupled to the transformer, the synchronous rectifier circuit comprising:

a synchronous switching device coupled to a secondary side of the transformer; and

a synchronous rectifier controller coupled to the synchronous switching device for transmitting a switch control signal to the synchronous switching device to modify the output power being delivered to the electronic device.

16. An electrical circuit in accordance with claim 15, the synchronous rectifier circuit further comprising:

a second hall effect sensor coupled to the secondary side for sensing a magnetic field of the transformer, the synchronous rectifier controller configured to generate the switch control signal as a function of the sensed magnetic field.

17. An electrical circuit in accordance with claim 10, further comprising a voltage sensor coupled to a secondary side of the transformer for sensing a voltage level of output power being delivered to the electronic device and transmitting the sensed output power voltage level to the controller, the controller configured to adjust a duty cycle of the control signal being transmitted to the second switching device as a function of the sensed output power.

18. An electrical circuit in accordance with claim 10, further comprising a startup circuit including a low power regulator circuit that is connected to the controller for providing start-up power to the controller.

19. An electrical circuit in accordance with claim 10, wherein the rectifier circuit includes a synchronous rectifier circuit comprising a synchronous switching device.

20. An electrical circuit for providing electrical power for use in charging electronic devices, comprising:

a rectifier circuit coupled to an electrical source for receiving the AC input power from the electrical source and converting the AC input power to a rectified DC input power

a quasi-resonant circuit coupled to the rectifier circuit for receiving the rectified DC input power signal from the rectifier circuit and delivering an intermediate DC input power signal, the quasi-resonant circuit including a first switching device that is coupled to the rectifier circuit, a diode coupled in series between the first switching device and a first inductor, and a first capacitor coupled to the first inductor;

a power converter circuit coupled to the quasi-resonant circuit for receiving the intermediate DC input power signal from the quasi-resonant circuit and delivering a DC output power having a reduced voltage level, the power converter circuit including a transformer and a switching circuit coupled to a top side of a primary side of the transformer for delivering power from the quasi-resonant circuit to the primary side of the transformer, the switching circuit including a second inductor coupled to the quasi-resonant circuit, a second switching device including a field effect transistor (FET) coupled to the second inductor, and a second capacitor coupled between the FET and the top side of the primary side of the transformer;

a synchronous rectifier circuit coupled to the transformer, the synchronous rectifier circuit including a synchronous switching device coupled to a secondary side of the transformer and a synchronous rectifier controller coupled to the synchronous switching device for transmitting a switch control signal to the synchronous switching device to modify the output power being delivered to the electronic device;

a voltage sensor coupled to the transformer for sensing a voltage level of power being generated by the transformer; and

a controller coupled to the voltage sensor and the first and the second switching devices, the controller configured to receive the sensed voltage level from the voltage sensor and transmit control signals to the first and the second switching devices to adjust the voltage level of power being delivered to the electronic device.

21. An electrical circuit in accordance with claim 20, further comprising a startup circuit including a low power regulator circuit that is connected to the rectifier circuit for providing start-up power to the controller.

22. An electrical circuit in accordance with claim 1, the controller including firmware formed on a chip.