CLAIMS:

1. A wireless power transfer system comprising:

a first converting unit operable at a constant operating frequency and configured to convert a first DC voltage of an input power to a first AC voltage;

a contactless power transfer unit coupled to the first converting unit and configured to transmit the input power having the first AC voltage, wherein the contactless power transfer unit comprises at least a first power exchange coil and a second power exchange coil magnetically coupled to each other and operable at a resonant frequency;

a second converting unit coupled to the contactless power transfer unit and configured to receive a power having a second AC voltage corresponding to the first AC voltage from the contactless power transfer unit, convert the second AC voltage of the received power to a second DC voltage, and transmit the power having the second DC voltage to an electric load; and

an active voltage tuning unit coupled to the contactless power transfer unit and configured to control the second DC voltage based on a difference between the second DC voltage and a reference voltage and at least one among a difference between the resonant frequency and the constant operating frequency and a difference between a phase angle of the first AC voltage and a phase angle of an AC current.

2. The wireless power transfer system of claim 1, wherein the active voltage tuning unit comprises:

a switching sub-unit coupled in parallel to an impedance element which is coupled in series with one of the first power exchange coil and the second power exchange coil;

a controller coupled to the switching sub-unit and configured to:

vary a duty cycle of a switching signal based on the difference between the second DC voltage and the reference voltage, and at least one among the difference between the resonant

frequency and the constant operating frequency and the difference between the phase angle of the first AC voltage and the phase angle of the AC current; and

transmit the switching signal having the varied duty cycle to the switching sub-unit to control the second DC voltage across the electric load.

3. The wireless power transfer system of claim 2, wherein the controller is configured to increase the duty cycle of the switching signal if the second DC voltage is less than the reference voltage and if at least one of the resonant frequency is less than the constant operating frequency and the phase angle of the AC current is less than the phase angle of the first AC voltage.

4. The wireless power transfer system of claim 3, wherein the controller is configured to increase the duty cycle of the switching signal to increase the second DC voltage so that the second DC voltage matches with the reference voltage.

5. The wireless power transfer system of claim 2, wherein the controller is configured to decrease the duty cycle of the switching signal if the second DC voltage is greater than the reference voltage and if at least one of the resonant frequency is less than the constant operating frequency and the phase angle of the AC current is less than the phase angle of the first AC voltage.

6. The wireless power transfer system of claim 5, wherein the controller is configured to decrease the duty cycle of the switching signal to decrease the second DC voltage so that the second DC voltage matches with the reference voltage.

7. The wireless power transfer system of claim 2, wherein the controller is configured to decrease the duty cycle of the switching signal if the second DC voltage is less than the reference voltage and if at least one of the resonant frequency is greater than the constant

operating frequency and the phase angle of the AC current is greater than the phase angle of the first AC voltage.

8. The wireless power transfer system of claim 7, wherein the controller is configured to decrease the duty cycle of the switching signal to increase the second DC voltage so that the second DC voltage matches with the reference voltage.

9. The wireless power transfer system of claim 2, wherein the controller is configured to increase the duty cycle of the switching signal if the second DC voltage is greater than the reference voltage and if at least one of the resonant frequency is greater than the constant operating frequency and the phase angle of the AC current is greater than the phase angle of the first AC voltage.

10. The wireless power transfer system of claim 9, wherein the controller is configured to increase the duty cycle of the switching signal to decrease the second DC voltage so that the second DC voltage matches with the reference voltage.

11. The wireless power transfer system of claim 2, wherein the switching sub-unit comprises a first electronic switch and a second electronic switch coupled antiparallel to each other, wherein the controller is configured to activate and deactivate at least one of the first electronic switch and the second electronic switch based on the varied duty cycle of the switching signal.

12. The wireless power transfer system of claim 11, wherein at least one of the first electronic switch and the second electronic switch is activated and deactivated to change an impedance of the contactless power transfer unit so that the second DC voltage is correspondingly changed across the electric load.

13. The wireless power transfer system of claim 2, further comprising:

a voltage sensor electrically coupled to the electric load and configured to determine the second DC voltage across the electric load;

a first transceiver coupled to the voltage sensor and configured to receive a voltage signal representative of the second DC voltage and transmit the voltage signal representative of the second DC voltage; and

a second transceiver communicatively coupled to the first transceiver and configured to receive the voltage signal and transmit the voltage signal to the first converting unit.

14. The wireless power transfer system of claim 13, wherein if the active voltage tuning unit is coupled to the second power exchange coil (134), the controller is configured to:

receive the voltage signal representative of the second DC voltage from the voltage sensor;

receive a frequency signal representative of the difference between the resonant frequency and the constant operating frequency from the first converting unit via the first transceiver and the second transceiver; and

receive a phase signal representative of the difference between the phase angle of the first AC voltage and the phase angle of the AC current from the first converting unit via the first transceiver and the second transceiver.

15. The wireless power transfer system of claim 13, wherein if the active voltage tuning unit is coupled to the first power exchange coil, the controller is configured to:

receive the voltage signal representative of the second DC voltage from the first converting unit via the first transceiver and the second transceiver;

receive a frequency signal representative of the difference between the resonant frequency and the constant operating frequency from the first converting unit; and

receive a phase signal representative of the difference between the phase angle of the first AC voltage and the phase angle of the AC current from the first converting unit.

16. A method for operating a wireless power transfer system (100), the method comprising:

converting, by a first converting unit, a first DC voltage of an input power to a first AC voltage;

receiving, by a contactless power transfer unit, the input power having the first AC voltage from the first converting unit and transmitting a power having a second AC voltage corresponding to the first AC voltage;

converting, by a second converting unit, the second AC voltage to a second DC voltage;

transmitting the power having the second DC voltage from the second converting unit to an electric load; and

controlling, by an active voltage tuning unit, the second DC voltage based on a difference between the second DC voltage and a reference voltage and at least one among a difference between a resonant frequency of the contactless power transfer unit and a constant operating frequency of the first converting unit and a difference between a phase angle of the first AC voltage and a phase angle of an AC current.

17. The method of claim 16, wherein controlling the second DC voltage comprises:

varying, by a controller, a duty cycle of a switching signal based on the difference between the second DC voltage and the reference voltage, and at least one of the difference between the resonant frequency and the constant operating frequency, and the difference between the phase angle of the first AC voltage and the phase angle of the AC current; and

transmitting the switching signal having the varied duty cycle to a switching sub-unit to control the second DC voltage across the electric load.

18. The method of claim 17, wherein varying the duty cycle of the switching signal comprises:

increasing the duty cycle of the switching signal if the second DC voltage is less than the reference voltage and if at least one of the resonant frequency is less than the constant operating frequency and the phase angle of the AC current is less than the phase angle of the first AC voltage; and

decreasing the duty cycle of the switching signal if the second DC voltage is greater than the reference voltage and if at least one of the resonant frequency is less than the constant operating frequency and the phase angle of the AC current is less than the phase angle of the first AC voltage.

19. The method of claim 17, wherein varying the duty cycle of the switching signal comprises:

decreasing the duty cycle of the switching signal if the second DC voltage is less than the reference voltage and if at least one of the resonant frequency is greater than the constant operating frequency and the phase angle of the AC current is greater than the phase angle of the first AC voltage; and

increasing the duty cycle of the switching signal if the second DC voltage is greater than the reference voltage and if at least one of the resonant frequency is greater than the constant operating frequency and the phase angle of the AC current is greater than the phase angle of the first AC voltage.

20. The method of claim 17, wherein controlling the second DC voltage comprises:

receiving, by the active voltage tuning unit, a voltage signal representative of the second DC voltage from a voltage sensor;

receiving a frequency signal representative of the difference between the resonant frequency and the constant operating frequency from the first converting unit via a first transceiver and a second transceiver; and

receiving a phase signal representative of the difference between the phase angle of the first AC voltage and the phase angle of the AC current from the first converting unit via the first transceiver and the second transceiver.

21. The method of claim 17, wherein controlling the second DC voltage comprises:

receiving, by the active voltage tuning unit, a voltage signal representative of the second DC voltage from a voltage sensor via a first transceiver and a second transceiver;

receiving a frequency signal representative of the difference between the resonant frequency and the constant operating frequency from the first converting unit; and

receiving a phase signal representative of the difference between the phase angle of the first AC voltage and the phase angle of the first AC current from the first converting unit.