CLAIMS

What is claimed is:

1. A coupler for wireless power transfer, the coupler comprising:

a coil configured for wireless power transfer based on magnetic induction, the coil comprising a plurality of coil portions, the plurality of coil portions comprising a first coil portion and a second coil portion wound in opposite directions, wherein

the first coil portion is nested within the second coil portion and defines a first area,

the second coil portion comprises a plurality of second loops and defines a second area, each of the plurality of second loops being a complete loop, and

the first coil portion and the second coil portion are configured such that a magnetic flux generated based on the first coil portion flows through the first area and into the second area,

wherein the first coil portion and the second coil portion together form a first anti-directional coil section, and the coil further comprises one or more additional anti-directional coil sections, each additional anti-directional coil section comprising a third coil portion and a fourth coil portion wound in opposite directions, wherein the third coil portion is nested within the fourth coil portion.

2. The coupler according to claim 1, wherein the first coil portion comprises one or more first loops and the plurality of second loops are wound in an opposite direction to the one or more first loops.

3. The coupler according to claim 1 or 2, wherein the first coil portion is wound in a clockwise direction and the second coil portion is wound in an anti-clockwise direction, or the second coil portion is wound in a clockwise direction and the first coil portion is wound in an anti-clockwise direction.

4. The coupler according to any one of claims 1 to 3, wherein the coil is configured to have a planar spiral configuration.

5. The coupler according to any one of claims 1 to 4, wherein the first coil portion and the second coil portion are each configured to have a unipolar coil configuration, and the coil has a multi-polar coil configuration.

~~6. The coupler according to any one of claims 1 to 5, wherein the first coil portion and the second coil portion together form a first anti-directional coil section, and the coil further comprises one or more additional anti-directional coil sections, each additional anti-directional coil section comprising a third coil portion and a fourth coil portion wound in opposite directions, wherein the third coil portion is nested within the fourth coil portion~~.

~~7~~6. The coupler according to claim ~~6~~1, wherein the first anti-directional coil section is nested within the one or more additional anti-directional coil section.

~~8~~7. The coupler according to any one of claims 1 to ~~7~~6, wherein the coil is configured as one continuous winding.

~~9~~8. The coupler according to any one of claims 1 to ~~8~~7, wherein the coil forms a first coil cell, and wherein the coupler further comprises one or more additional coil cells connected to the first coil cell, each additional coil cell comprising a second coil configured for wireless power transfer based on magnetic induction, the second coil comprising a plurality of coil portions comprising a fifth coil portion and a sixth coil portion wound in opposite directions, wherein the fifth coil portion is nested within the sixth coil portion.

~~10~~9. The coupler according to any one of claims 1 to ~~9~~8, further comprising a resonance capacitor connected to the coil in series or in parallel to form a resonance circuit configured for resonant inductive power transfer.

~~11~~10. The coupler according to any one of claims 1 to ~~10~~9, wherein the coupler is a transmitter coupler configured to receive a time-varying current from a power source connected thereto for generating a magnetic field to perform wireless power transfer with a receiver coupler over an air gap based on magnetic induction.

~~12~~11. The coupler according to any one of claims 1 to ~~10~~9, wherein the coupler is a receiver coupler configured to couple with a magnetic field generated from a transmitter coupler to induce a current in the receiver coupler for supplying power to an electrical load connected to the receiver couple to perform wireless power transfer with the transmitter coupler over an air gap based on magnetic induction.

~~13~~12. A wireless power transmitter comprising:

a power source configured to generate a time-varying current; and

a coupler according to any one of claims 1 to ~~10~~ 9 functioning as a transmitter coupler and connected to the power source, wherein the transmitter coupler is configured to receive the time-varying current from the power source for generating a magnetic field to perform wireless power transfer with a receiver coupler over an air gap based on magnetic induction.

~~14~~13. A wireless power receiver comprising:

an electrical load; and

a coupler according to any one of claims 1 to ~~10~~ 9 connected to the electrical load and functioning as a receiver coupler, wherein the receiver coupler is configured to couple with a magnetic field generated from a transmitter coupler to induce a current in the receiver coupler for supplying power to the electrical load connected to the receiver coupler to perform wireless power transfer with the transmitter coupler over an air gap based on magnetic induction.

~~15~~14. A system for wireless power transfer comprising:

a wireless power transmitter comprising:

a power source configured to generate a time-varying current; and

a transmitter coupler connected to the power source, wherein the transmitter coupler is configured to receive the time-varying current from the power source for generating a magnetic field to perform wireless power transfer with a receiver coupler over an air gap based on magnetic induction; and

a wireless power receiver comprising:

an electrical load; and

the receiver coupler connected to the electrical load, wherein the receiver coupler is configured to couple with the magnetic field generated from the transmitter coupler to induce a current in the receiver coupler for supplying power to the electrical load connected to the receiver coupler to perform wireless power transfer with the transmitter coupler over the air gap based on magnetic induction,

wherein at least one of the receiver coupler and the transmitter coupler is a coupler according to any one of claims 1 to ~~10~~9, and the wireless power transmitter and the wireless power receiver are separated by the air gap.

~~16~~15. The system according to claim ~~15~~14, wherein the receiver coupler and the transmitter coupler are each a coupler according to any one of claims 1 to ~~10~~9.

~~17~~16. The system according to claim ~~15~~14, wherein one of the receiver coupler and the transmitter coupler is a coupler according to any one of claims 1 to 10, and the other of the receiver coupler and the transmitter coupler is a coupler configured to have a unipolar configuration.

17~~8~~. A method of manufacturing a coupler for wireless power transfer, the method comprising:

configuring a coil for wireless power transfer based on magnetic induction, the coil comprising a plurality of coil portions, the plurality of coil portions

comprising a first coil portion and a second coil portion wound in opposite directions, wherein

the first coil portion is nested within the second coil portion and defines a first area,

the second coil portion comprises a plurality of second loops and defines a second area, each of the plurality of second loops being a complete loop, and

the first coil portion and the second coil portion are configured such that a magnetic flux generated based on the first coil portion flows through the first area and into the second area,

wherein the first coil portion and the second coil portion together form a first anti-directional coil section, and said configuring the coil comprises configuring the coil to further comprise one or more additional anti-directional coil section, each additional anti-directional coil section comprising a third coil portion and a fourth coil portion wound in opposite directions, wherein the third coil portion is nested within the fourth coil portion.

~~19~~18. The method according to claim ~~18~~17, wherein the first coil portion comprises one or more first loops and the plurality of second loops are wound in an opposite direction to the one or more first loops.

~~20~~19. The method according to claim ~~18 -~~17 or ~~19~~18, wherein said configuring a coil comprises winding the first coil portion in a clockwise direction and the second coil portion in an anti-clockwise direction, or winding the second coil portion in a clockwise direction and the first coil portion in an anti-clockwise direction.

2~~0~~1. The method according to any one of claims ~~18 -~~17 to ~~20~~19, wherein the coil is configured to have a planar spiral configuration.

~~22~~21. The method according to any one of claims ~~18 -~~17 to ~~21~~20, wherein the first coil portion and the second coil portion are each configured to have a unipolar coil configuration, and the coil has a multi-polar coil configuration.

~~23. The method according to any one of claims 18 to 22, wherein the first coil portion and the second coil portion together form a first anti-directional coil section, and said configuring the coil comprises configuring the coil to further comprise one or more additional anti-directional coil section, each additional anti-directional coil section comprising a third coil portion and a fourth coil portion wound in opposite directions, wherein the third coil portion is nested within the fourth coil portion.~~

~~24~~22. The method according to claim ~~23~~17, wherein the first set of anti-directional coil portions is nested within the one or more additional sets of anti-directional coil portions.

2~~5~~3. The method according to any one of claims ~~18~~ 17 to ~~24~~22, wherein the coil is configured as one continuous winding.

~~26~~24. The method according to any one of claims ~~18~~ 17 to ~~25~~23, wherein the coil forms a first coil cell, and the method further comprises configuring one or more additional coil cells connected to the first coil cell, each additional coil cell comprising a second coil configured for wireless power transfer based on magnetic induction, the second coil comprising a plurality of coil portions comprising a fifth coil portion and a sixth coil portion wound in opposite directions, wherein the fifth coil portion is nested within the sixth coil portion.

~~27~~25. The method according to any one of claims ~~18~~ 17 to ~~26~~24, further comprising providing a resonance capacitor connected to the coil in series or in parallel to form a resonance circuit configured for resonant inductive power transfer.

~~28~~26. The method according to any one of claims ~~18~~ 17 to ~~27~~25, wherein the coupler is a transmitter coupler configured to receive a time-varying current from a power source connected thereto for generating a magnetic field to perform wireless power transfer with a receiver coupler over an air gap based on magnetic induction.

~~29~~27. The method according to any one of claims ~~18~~ 17 to ~~27~~25, wherein the coupler is a receiver coupler configured to couple with a magnetic field generated from a transmitter coupler to induce a current in the receiver coupler for supplying power to an electrical load connected to the receiver couple to perform wireless power transfer with the transmitter coupler over an air gap based on magnetic induction.

~~30~~28. A method of wireless power transfer comprising:

generating, by a power source at a wireless power transmitter, a time-varying current; and

receiving, by a transmitter coupler at the wireless power transmitter connected to the power source, the time-varying current from the power source for generating a magnetic field to perform wireless power transfer with a receiver coupler over an air gap based on magnetic induction;

coupling, by the receiver coupler at a wireless power receiver connected to an electrical load, with a magnetic field generated from the transmitter coupler to induce a current in the receiver coupler to perform wireless power transfer with the transmitter coupler over the air gap based on magnetic induction; and

supplying, by the receiver coupler at the wireless power receiver, power to the electrical load connected thereto based on the current induced therein,

wherein at least one of the receiver coupler and the transmitter coupler is a coupler according to any one of claims 1 to ~~10~~9, and the wireless power transmitter and the wireless power receiver are separated by the air gap.