

CLAIMS

What is claimed is:

1. A substrate processing system comprising:
a substrate support configured to support a substrate, wherein the substrate
5 support comprises one or more heating elements; and
a power supply circuit comprising
a direct current-to-alternating current converter configured to convert a
first direct current voltage to a first alternating current voltage, wherein the direct
current-to-alternating current converter comprises at least one switch, and
10 an isolation circuit comprising one of a coupled inductor or a transformer,
wherein the one of the coupled inductor or the transformer is configured to convert the
first alternating current voltage to a second alternating current voltage and isolate the
one or more heating elements from an earth ground,
wherein the power supply circuit is configured to provide an output voltage to the
15 one or more heating elements based on the second alternating current voltage.
2. The substrate processing system of claim 1, wherein the isolation circuit is
configured to supply the second alternating current voltage to the one or more heating
elements.
3. The substrate processing system of claim 1, further comprising a controller,
20 wherein:
the direct current-to-alternating current converter comprises a switch and a
primary winding of the one of the coupled inductor or the transformer; and
the controller is configured to transition the switch between ON and OFF states
at a predetermined frequency when providing power to the one or more heating
25 elements.
4. The substrate processing system of claim 3, wherein the predetermined
frequency is between 10 kilo-Hertz and 100 kilo-Hertz.

5. The substrate processing system of claim 1, further comprising an alternating current-to-direct current converter configured to convert the second alternating current voltage to a second direct current voltage and provide the second direct current voltage to the one or more heating elements.
- 5 6. The substrate processing system of claim 5, wherein:
the one of the coupled inductor or the transformer and the alternating current-to-direct current converter provide a buck converter; and
the transformer is a step-down transformer.
7. The substrate processing system of claim 5, wherein:
10 the one of the coupled inductor or the transformer and the alternating current-to-direct current converter provide a boost converter; and
the transformer is a step-up transformer.
8. The substrate processing system of claim 5, wherein:
the direct current-to-alternating current converter comprises a metal-oxide-
15 semiconductor field effect transistor connected in series with a primary coil of the one of the coupled inductor or the transformer; and
the alternating current-to-direct current converter comprises
a diode connected in series with a secondary winding of the one of the
coupled inductor or the transformer, and
20 a capacitor connected in parallel with the one or more heating elements
and across the secondary winding and the diode.
9. The substrate processing system of claim 1, wherein:
the one of the coupled inductor or the transformer comprises a primary winding
and a secondary winding;
25 the primary winding is connected to the earth ground; and
the secondary winding is not connected to the earth ground.
10. The substrate processing system of claim 1, further comprising a controller,
wherein:
the direct current-to-alternating current converter comprises an H-bridge;

the H-bridge includes a first switch, a second switch, a third switch, and a fourth switch; and

the controller is configured to transition the first switch, the second switch, the third switch, and the fourth switch between ON and OFF states when providing power
5 to the one or more heating elements.

11. The substrate processing system of claim 10, wherein the controller is configured to:

transition the first switch and the fourth switch to an ON state while transitioning the second switch and the third switch to an OFF state; and

10 transition the first switch and the fourth switch to an OFF state while transitioning the second switch and the third switch to an ON state.

12. The substrate processing system of claim 10, wherein:

the first switch and the second switch are connected in series; and

the third switch and the fourth switch are connected in series and together are
15 connected in parallel with the series combination of the first switch and the second switch.

13. The substrate processing system of claim 12, wherein:

the first switch and the second switch are connected to a first end of a primary winding of the one of the coupled inductor or the transformer; and

20 the third switch and the fourth switch are connected to a second end of a primary winding of the one of the coupled inductor or the transformer.

14. The substrate processing system of claim 13, further comprising an alternating current-to-direct current converter configured to convert the second alternating current voltage to a second direct current voltage and provide the second direct current voltage
25 to the one or more heating elements, wherein:

the primary winding receives the first alternating current voltage; and

a secondary winding of the one of the coupled inductor or the transformer supplies the second alternating current voltage to the first alternating current-to-direct current converter.

15. The substrate processing system of claim 13, further comprising an alternating current-to-direct current converter configured to convert the second alternating current voltage to a second direct current voltage and provide the second direct current voltage to the one or more heating elements, wherein the alternating current-to-direct current converter comprises:

a diode connected in series with a secondary winding of the one of the coupled inductor or the transformer; and

a capacitor connected in parallel with the one or more heating elements and across the secondary winding and the diode.

16. The substrate processing system of claim 1, further comprising a first alternating current-to-direct current converter configured to convert the second alternating current voltage to a second direct current voltage and provide the second direct current voltage to the one or more heating elements, wherein:

the one or more heating elements comprise a first heating element;

the one of the coupled inductor or the transformer comprises a primary winding and a first secondary winding; and

the first alternating current-to-direct current converter is connected to the first secondary winding and provides the second alternating current voltage to the first heating element.

17. The substrate processing system of claim 16, further comprising a second alternating current-to-direct current converter, wherein:

the one or more heating elements comprise a second heating element;

the one of the coupled inductor or the transformer comprises a second secondary winding; and

the second alternating current-to-direct current converter converts the first alternating current voltage to a third alternating current voltage and provides the third alternating current voltage to the second heating element.

18. A substrate processing system comprising:

a substrate support configured to support a substrate, wherein the substrate support comprises one or more heating elements;

a power supply circuit comprising

a switch configured to receive a first direct current voltage,

one of a coupled inductor or a transformer comprising a primary winding and a secondary winding, wherein the primary winding is connected to the switch and an earth ground, and wherein the secondary winding is not connected to the earth ground,

5 a diode connected in series with the secondary winding, and
 a capacitor connected to the diode and in parallel with the one or more heating elements, wherein the diode and the capacitor convert an alternating current output of the secondary winding to a second direct current voltage, and wherein the capacitor provides the second direct current voltage to the one or more heating
10 elements; and

 a controller configured to transition the switch between an ON state and an OFF state at a predetermined frequency when powering the one or more heating elements.

19. The substrate processing system of claim 18, further comprising a second capacitor, wherein:

15 the first direct current voltage is received across the second capacitor; and
 the switch is connected to an output end of the second capacitor.

20. A substrate processing system comprising:

 a substrate support configured to support a substrate, wherein the substrate support comprises one or more heating elements;

20 a power supply circuit comprising

 an H-bridge configured to receive a first direct current voltage, wherein the H-bridge comprises a first switch, a second switch, a third switch, and a fourth switch,

 one of a coupled inductor or a transformer comprising a primary winding
25 and a secondary winding, wherein the primary winding is connected to the H-bridge and an earth ground, and wherein the secondary winding is not connected to the earth ground,

 a diode connected in series with the secondary winding, and

a capacitor connected to the diode and in parallel with the one or more heating elements, wherein the diode and the capacitor convert an alternating current output of the secondary winding to a second direct current voltage, and wherein the capacitor provides the second direct current voltage to the one or more heating elements; and

a controller configured to transition the first switch, the second switch, the third switch, and the fourth switch between an ON state and an OFF state at a predetermined frequency when powering the one or more heating elements.

21. The substrate processing system of claim 20, wherein:
- the first switch and the second switch are connected in series;
- the third switch and the fourth switch are connected in series and together are connected in parallel with the series combination of the first switch and the second switch;
- the first switch and the second switch are connected to a first end of a primary winding of the one of the coupled inductor or the transformer; and
- the third switch and the fourth switch are connected to a second end of a primary winding of the one of the coupled inductor or the transformer.

22. The substrate processing system of claim 21, further comprising a second capacitor configured to receive the first direct current voltage,
- wherein the second capacitor is
- connected in parallel with the series combination of the first switch and the second switch, and
- connected in parallel with the series combination of the third switch and the fourth switch.