CLAIMS

What is claimed is:

1. A transformer coupled capacitive tuning match network comprising:

a coarse adjustment circuit configured to receive a first radio frequency (RF) signal and comprising

a first tune variable capacitance circuit configured to adjust a frequency of the first RF signal to generate a second RF signal, and

a first load variable capacitance circuit connected to a ground reference terminal and configured to adjust an impedance of the transformer coupled capacitive tuning match network; and

a fine adjustment circuit comprising

a second tune variable capacitance circuit configured to fine tune a frequency of the second RF signal, wherein a capacitance range of the second tune variable capacitance circuit is smaller than a capacitance range of the first tune variable capacitance circuit, and

a second load variable capacitance circuit connected to the ground reference terminal and configured to fine tune the impedance of the transformer coupled capacitive tuning match network, wherein a capacitance range of the second load variable capacitance circuit is smaller than a capacitance range of the first load variable capacitance circuit.

2. The transformer coupled capacitive tuning match network of claim 1, wherein:

the second tune variable capacitance circuit is connected in parallel with the first tune variable capacitance circuit; and

the second load variable capacitance circuit is connected in parallel with the first load variable capacitance circuit.

3. The transformer coupled capacitive tuning match network of claim 1, wherein:

the first tune variable capacitance circuit comprises a first variable capacitor;

the second tune variable capacitance circuit comprises a second variable capacitor connected in parallel with the first variable capacitor;

the first load variable capacitance circuit comprises a third variable capacitor; and

the second load variable capacitance circuit comprises a fourth variable capacitor connected in parallel with the third variable capacitor.

4. The transformer coupled capacitive tuning match network of claim 1, wherein:

the first tune variable capacitance circuit comprises a first variable capacitor;

the second tune variable capacitance circuit comprises a first plurality of capacitors connected in parallel with the first variable capacitor;

the first load variable capacitance circuit comprises a second variable capacitor; and

the second load variable capacitance circuit comprises a second plurality of capacitors connected in parallel with the second variable capacitor.

5. The transformer coupled capacitive tuning match network of claim 4, wherein:

the second tune variable capacitance circuit comprises a third variable capacitor connected in series with a first fixed capacitor; and

the second load variable capacitance circuit comprises a fourth variable capacitor connected in series with a second fixed capacitor.

6. The transformer coupled capacitive tuning match network of claim 1, further comprising:

a first motor configured to change a capacitance of the first tune variable capacitance circuit;

a second motor configured to change a capacitance of the first load variable capacitance circuit;

a first relay configured to change a capacitance of the second tune variable capacitance circuit; and

a second relay configured to change a capacitance of the second load variable capacitance circuit.

7. A system for substrate processing, comprising:

the transformer coupled capacitive tuning match network of claim 1; and

one or more controllers configured to

perform a rapid alternating process including iteratively switching between an etch process and a deposition process, and

setting the fine adjustment circuit to be in a first state during the etch process and in a second state during the deposition process.

8. The system of claim 7, wherein the one or more controllers are configured to change a state of at least one of the second tune variable capacitance circuit or the second load variable capacitance circuit while transitioning between the etch process and the deposition process.

9. The system of claim 7, further comprising a sensor configured to measure a phase and magnitude of the first RF signal,

wherein the one or more controllers are configured to, based on the phase and magnitude of the first RF signal, adjust at least one of a capacitance of the first tune variable capacitance circuit or a capacitance of the first load variable capacitance circuit.

10. The transformer coupled capacitive tuning match network of claim 1, wherein:

the second tune variable capacitance circuit comprises a first relay;

the first relay is configured to switch between a first capacitance and a second capacitance;

the second load variable capacitance circuit comprises a second relay; and

the second relay is configured to switch between a third capacitance and a fourth capacitance.

11. A system for substrate processing, comprising:

the transformer coupled capacitive tuning match network of claim 10; and

one or more controllers configured to

perform a rapid alternating process including iteratively switching between an etch process and a deposition process, and

set states of the first relay and the second relay to be in a first configuration during the etch process and in a second configuration during the deposition process.

12. The system of claim 11, wherein the one or more controllers are configured to:

transition the first relay between the first capacitance and the second capacitance when transitioning between the etch process and the deposition process; and

refrain from transitioning the second relay between the third capacitance and the fourth capacitance when transitioning between the etch process and the deposition process.

13. The system of claim 11, wherein the one or more controllers are configured to:

transition the first relay between the first capacitance and the second capacitance when transitioning between the etch process and the deposition process; and

transition the second relay between the third capacitance and the fourth capacitance when transitioning between the etch process and the deposition process.

14. A rapid alternating processing method comprising:

setting capacitance of a first tune variable capacitance circuit of a transformer coupled capacitive tuning match network, wherein the first tune variable capacitance circuit is configured to adjust a frequency of a first radio frequency (RF) signal to generate a second RF signal;

setting capacitance of a first load variable capacitance circuit, which is connected to a ground reference terminal and configured to adjust an impedance of the transformer coupled capacitive tuning match network;

setting capacitance of a second tune variable capacitance circuit and a second load variable capacitance circuit for an etch process, wherein

the second tune variable capacitance circuit is configured to fine tune a frequency of the second RF signal,

a capacitance range of the second tune variable capacitance circuit is smaller than a capacitance range of the first tune variable capacitance circuit,

the second load variable capacitance circuit is connected to the ground reference terminal and configured to fine tune the impedance of the transformer coupled capacitive tuning match network, and

a capacitance range of the second load variable capacitance circuit is smaller than a capacitance range of the first load variable capacitance circuit;

performing the etch process;

adjusting capacitance of at least one of the second tune variable capacitance circuit or the second load variable capacitance circuit for a deposition process; and

performing the deposition process.

15. The rapid alternating processing method of claim 14, further comprising:

iteratively switching between the etch process and the deposition process; and

setting the second tune variable capacitance circuit to be in a first state during the etch process and in a second state during the deposition process.

16. The rapid alternating processing method of claim 14, further comprising:

iteratively switching between the etch process and the deposition process; and

setting the second load variable capacitance circuit to be in a first state during the etch process and in a second state during the deposition process.

17. The rapid alternating processing method of claim 14, further comprising:

iteratively switching between the etch process and the deposition process; and

changing a state of the second tune variable capacitance circuit and a state of the second load variable capacitance circuit while transitioning between the etch process and the deposition process.

18. The rapid alternating processing method of claim 14, further comprising:

measuring a phase and magnitude of the first RF signal; and

based on the phase and magnitude of the first RF signal, adjusting at least one of a capacitance of the first tune variable capacitance circuit or a capacitance of the first load variable capacitance circuit.

19. The rapid alternating processing method of claim 14, further comprising:

iteratively switching between the etch process and the deposition process; and

controlling states of a first relay and a second relay to be in a first state during the etch process and in a second state during the deposition process,

wherein

the second tune variable capacitance circuit comprises the first relay,

the first relay is configured to switch between a first capacitance and a second capacitance,

the second load variable capacitance circuit comprises the second relay, and

the second relay is configured to switch between a third capacitance and a fourth capacitance.

20. The rapid alternating processing method of claim 19, further comprising:

transitioning the first relay between the first capacitance and the second capacitance when transitioning between the etch process and the deposition process; and

refraining from transitioning the second relay between the third capacitance and the fourth capacitance when transitioning between the etch process and the deposition process.

21. The rapid alternating processing method of claim 19, further comprising:

transitioning the first relay between the first capacitance and the second capacitance when transitioning between the etch process and the deposition process; and

transitioning the second relay between the third capacitance and the fourth capacitance when transitioning between the etch process and the deposition process.