further includes a first secondary AFT coupled to the secondary driver and amplifier. The secondary generator includes a second secondary AFT coupled to the secondary driver and amplifier. The secondary generator also includes a processor, which is coupled to the first secondary AFT and the second secondary AFT. The secondary generator further includes a sensor coupled to the electrode. The sensor is used for sensing current and voltage transferred between the secondary generator and the electrode during the first and second states. The processor is configured to generate parameters based on the current and voltage and is configured to determine whether a first one of the parameters for the first state exceeds a first boundary and whether a second one of the parameters for the second state exceeds a second boundary. The first secondary AFT is configured to provide a first secondary frequency input to the secondary driver and amplifier upon receiving the determination that the first parameter exceeds the first boundary and the second secondary AFT configured to provide a second secondary frequency input to the secondary driver and amplifier upon receiving the determination that the second parameter exceeds the second boundary.

[0010] In an embodiment, a system including a digital pulsing source for generating a pulsed signal is described. The system includes a primary generator. The primary generator includes a primary driver and amplifier coupled to an electrode for supplying a primary radio frequency (RF) signal to the electrode. The primary generator also includes one or more primary processors coupled to the digital pulsing source for receiving the pulsed signal. The one or more primary processors are configured to identify a first one of two states of the pulsed signal and a second one of the two states, determine to provide a primary power value to the primary driver and amplifier when the pulsed signal is in the first state, and determine to provide a primary frequency value of the primary RF signal when the pulsed signal is in the first state.

[0011] In this embodiment, the system further includes a secondary generator, which includes a secondary driver and amplifier coupled to the electrode for supplying a secondary RF signal to the electrode. The secondary generator further includes one or more secondary processors coupled to the digital pulsing source for receiving the pulsed signal. The one or more secondary processors are configured to determine whether a parameter associated with plasma exceeds a first boundary when the pulsed signal is in the first state, determine whether the parameter exceeds a second boundary when the pulsed signal is in the second state, and determine to provide a first secondary power value to the secondary driver and amplifier in response to determining that the parameter exceeds the first boundary. The one or more secondary processors are further configured to determine to provide a second secondary power value to the secondary driver and amplifier in response to determining that the parameter exceeds the second boundary, determine to provide a first secondary frequency value to the secondary driver and amplifier in response to determining that the parameter exceeds the first boundary, and determine to provide a second secondary frequency value to the secondary driver and amplifier in response to determining that the parameter exceeds the second boundary.

[0012] In an embodiment, a method includes receiving a digital pulsing signal, which has two states. The method includes receiving current and voltage values, calculating parameters associated with plasma impedance from the current and voltage power values, and determining during the first state whether a first one of the parameters exceeds a first boundary. The method also includes providing a first frequency value and a first power value to a radio frequency (RF) driver and amplifier upon determining that the first parameter exceeds the first boundary, determining during the second state whether a second one of the parameters exceeds a second boundary, and providing a second frequency value and a second

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The embodiments may best be understood by reference to the following description taken in conjunction with the accompanying drawings.

[0017] Figure 1 is a block diagram of an embodiment of a system for changing a state based on plasma impedance, in accordance with an embodiment described in the present disclosure.

[0018] Figure 2 is an embodiment of a table showing a change in states based on whether a gamma value is greater than a first threshold or a second threshold, in accordance with an embodiment described in the present disclosure.

[0019] Figure 3 shows an embodiment of a graph, which is a plot of a forward power versus time of two RF signals during a training routine, in accordance with an embodiment described in the present disclosure.

[0020] Figure 4 is an embodiment of a flowchart of a training routine, in accordance with an embodiment described in the present disclosure.

[0021] Figure 5 is a diagram of an embodiment of a system for changing a state based on plasma impedance, where the power controllers and/or the frequency tuners ~~do not~~ provide non-zero values, in accordance with an embodiment described in the present disclosure.

[0022] Figure 6A shows graphs with two radio frequency (RF) signals in which one of the RF signals has a constant value or varying values, in accordance with an embodiment described in the present disclosure.

[0023] Figure 6B shows graphs with two RF signals in which both the RF signals have varying values, in accordance with an embodiment described in the present disclosure.

P11 and having the frequency value F11 via a transmission line 230 and the impedance matching circuit 182 to the plasma chamber 102.

[0050] When the TTL signal 112 transitions from the state ~~S1~~ S0 to the state S1 and when the 2 MHz DA system supplies forward power having the power value proportional to the power value P11 and having the frequency value F11 to the plasma chamber 102, impedance ~~with~~ within the plasma chamber 102 changes. When the impedance within the plasma chamber 102 changes as a result of transition of the TTL signal 112 from the state ~~S1~~ S0 to the state ~~S0~~ S1, a sensor 212 of a 60 MHz generator 276 measures forward power and reflected power, which is RF power reflected from the plasma of the plasma chamber 102, on a transmission line 232. The sensor 212 provides the measurement of the forward and reflected powers to an analog-to-digital (ADC) converter 222, which converts the measurements from an analog format to a digital format. The digital values of the forward and reflected powers are provided to a DSP 150. In an embodiment, a DSP includes an ADC. It should further be noted that in one embodiment, the DSP 150 lacks reception of the TTL signal 112. Rather, in this embodiment, the DSP 150 receives another digital pulsed signal that may not be synchronous with the TTL signal 112. In one embodiment, the other digital pulsed signal received by the DSP 150 is synchronous with the TTL signal 112.

[0051] During the state S1 of the TTL signal 112, e.g., immediately after the state transition from ~~S1~~ S0 to ~~S0~~ S1 of the TTL signal 112, the DSP 150 calculates a relationship, e.g., a square root of a ratio of the digital reflected power signal and the digital forward power signal, a voltage standing wave ratio (VSWR), etc., during the state S1 to generate a first gamma value. A gamma value of 1 indicates a high degree of mismatch between impedances of a source and a load and a gamma value of 0 indicates a low degree of mismatch between impedances of a source and a load. If a gamma value is zero, power delivery to the plasma chamber 102 is deemed highly efficient. If the gamma value is 1, the power delivery is

[0069] In one embodiment, the system 180 excludes the impedance matching circuits 182 and/or 186. In an embodiment, a single controller is used instead of the power controller 142 and the AFT 114, a single controller is used instead of the power controller 152 and the AFT 118, and a single controller is used instead of the power controller 154 and the AFT 120.

[0070] In the embodiment in which the 27 MHz DA system is used in addition to using the 2 and 60 MHz ~~power supplies~~DA systems, a 27 MHz generator is similar to the 60 MHz generator 276 except that the 27 MHz generator includes the 27 MHz DA system instead of the 60 MHz DA system. The 27 MHz generator is coupled to the lower electrode 104 of the plasma chamber 102 via an impedance matching circuit (not shown) and a transmission line (not shown). Moreover, the 27 MHz DA system is coupled to a digital pulsed signal source, other than the Tool UI ~~112~~190, and a digital pulsed signal generated by the digital pulsed signal source may not be synchronous with the TTL signal 112. An example of a digital pulsed signal source includes a clock oscillator or a computer that includes a TTL circuit that generates a TTL signal. In one embodiment, the digital pulsed signal generated by the digital pulsed signal source is synchronous with the TTL signal 112. The 27 MHz generator includes two power controllers, two AFTs, a DSP, an ADC, a sensor, and the 27 MHz DA system.

[0071] In an embodiment, the first threshold and the second threshold are generated during a training routine, e.g., a learning process. During the training routine, when the 2 MHz DA system changes its RF power signal from a low power value to a high power value, there is an impedance mismatch between one or more portions, e.g., plasma, etc., within the plasma chamber 102 and 60 MHz DA system. The high power value is higher than the low power value. The 2 MHz DA system changes a state of its RF power signal from the low power value to the high power value when a state of the TTL signal 112

sensed values voltage and current. For example, one or more sensors, e.g., voltage sensors, current sensors, etc. sense current and voltage on the transmission line 232, and provide the sensed current and voltage values as complex values to the DSP 150. The DSP 150 calculates forward and reflected powers from the sensed current and voltage values, and generates gamma values from the forward and reflected powers.

[0076] In one embodiment, instead of the sensor 212 sensing the forward and reflected powers, during the state S1 of the TTL signal ~~106~~112, a first comparator compares voltage or current, which is reflected on the transmission line 232, to determine whether the voltage or current is greater than a first pre-determined value. During the state S1 of the TTL signal ~~106~~112, when the voltage or current is greater than the first pre-determined value, the first comparator provides a first signal to the DSP 150 and when the voltage or current is not greater than the first pre-determined value, the comparator provides a second signal to the DSP 150. In response to receiving the first signal, the DSP 150 identifies that the voltage or current is greater than the first pre-determined value and in response to receiving the second signal, the DSP 150 identifies that the voltage or current does not exceed the first pre-determined value. When the DSP 150 identifies that the voltage or current exceeds the first pre-determined value, the DSP 150 determines the frequency value F21 corresponding to the first pre-determined value and provides the frequency value F21 to the AFT 118. Moreover, upon receiving the indication that the voltage or current exceeds the first pre-determined value, the DSP 150 determines the power value P21 corresponding to the first pre-determined value and provides the power value P21 to the power controller 152. The comparator is coupled to the DSP 150.

[0077] In this embodiment, during the state S0 of the TTL signal ~~106~~112, the comparator compares voltage or current, which is reflected on the transmission line 232, to determine whether the voltage or current is greater than a second pre-determined value.

When the voltage or current is greater than the second pre-determined value, the comparator provides the first signal to the DSP 150 and when the voltage or current is not greater than the second pre-determined value, the comparator provides the second signal to the DSP 150. In response to receiving the first signal during the state S0 of the TTL signal ~~106~~112, the DSP 150 identifies that the voltage or current is greater than the second pre-determined value and in response to receiving the second signal during the state S0 of the TTL signal ~~106~~112, the DSP 150 identifies that the voltage or current does not exceed the second pre-determined value. When the DSP 150 determines that the voltage or current exceeds the second pre-determined value, the DSP 150 determines the frequency value F20 corresponding to the second pre-determined value and provides the frequency value F20 to the AFT 120. Moreover, upon receiving the indication that the voltage or current exceeds the second pre-determined value, DSP 150 determines the power value P20 corresponding to the second pre-determined value and provides the power value P20 to the power controller 154. In an embodiment, a comparator includes analog circuitry, e.g., one or more operational amplifiers.

[0078] Figure 2 is an embodiment of a table 250 showing a change in states based on whether a gamma value is greater than the first threshold or the second threshold. As indicated in the table 250, the TTL signal 112 is used to provide a digital pulsed signal, e.g., a clock signal, to the DSP 140 (Figure 1).

[0079] When the TTL signal 112 is in the state S1, the 2 MHz signal has the high power level. During the state S1 of the TTL signal 112, it is determined whether a gamma value exceeds the first threshold. In response to determining that the gamma value exceeds the first threshold, power value of the 60 MHz signal is changed to the power value P20 from the power value P21 and the frequency value of the 60 MHz signal is changed from the frequency value F20 to the frequency value F21 to achieve a state S1.

[0080] Also, when the TTL signal 112 is in the state S0, the 2 MHz signal has the low power level. During the state S0 of the TTL signal 112, it is determined whether a gamma value exceeds the second threshold. In response to determining that the gamma value exceeds the second threshold, power value of the 60 MHz signal is changed to the power value P21 from the power value P20 and the frequency value of the 60 MHz signal is changed from the frequency value F21 to the frequency value F20 to achieve a state S0.

[0081] Figure 3 shows an embodiment of a graph 111, which is a plot of a forward power versus time of two RF signals, the 2 MHz signal and the 60 MHz signal during the training routine. In an embodiment, the training routine is performed once to determine tuned RF values, e.g., the power values P20 and P21, the frequency values F20 and F21, the threshold values, etc., or performed once during a time period to account for, for example, plasma impedance. In this example, the 2 MHz signal is an independently pulsing (IP) RF signal and the 60 MHz signal represents a dependent RF signal that tunes its RF frequency to optimize power delivery when the 2 MHz RF signal pulses. Although only one dependent RF generator (e.g., 60 MHz) is discussed in connection with Figure 3, it should be understood that there may be multiple dependent RF generators, each of which may undergo a similar training routine to ascertain its own optimal tuned RF frequencies and thresholds when the IP RF signal pulses.

[0082] Figure 3 may be better understood when studied in conjunction with an embodiment of a flowchart of a method 113, which is described with reference to Figure 4. The method 113 is an example of the training routine.

[0083] At a point 115, an IP RF signal 119 of the IP RF generator (e.g., ~~2 MHz~~ 2 MHz generator) is pulsed high to a high power set point. In the example of Fig. ~~1~~3, the high power set point for the 2 MHz IP RF generator is 6 kilowatts (kW). This is also shown in an operation 117 of Figure 4.

pulses high. The gamma value of 0.04 verifies that power delivery is efficient at this optimal tuned RF frequency for the dependent RF generator.

[0087] The dependent RF generator is then operated in the fixed frequency mode whereby its RF frequency is not allowed to tune. Instead, the dependent RF generator is forced to operate at the aforementioned 61.3 MHz optimal tuned RF frequency and the 2 MHz IP RF signal transitions from its high power set point to its low power set point (from 121 to 127). This can be seen in an operation 131 of Figure 4. Although the low power set point for the 2 MHz RF signal is zero in the example of Fig. 2, in an embodiment, the low power set point may be any power level setting that is lower than the high power set point of 6 kW.

[0088] After the IP RF signal pulses low (after point 127), the previous optimal tuned RF frequency of 61.3 MHz is no longer efficient RF frequency for power delivery by the dependent RF generator. This is because the plasma impedance has changed when the 2 MHz IP RF signal pulses low to deliver a lower amount of RF power to the plasma within the plasma chamber 102. The inefficiency is reflected in a gamma value of 0.8, which is detected by the sensor 212 of the dependent RF generator. This gamma value of 0.8 is recorded in an operation 133 of Figure 4 and may be set as an IDPC_Gamma1 threshold in an operation 135 of Figure 4. The IDPC_Gamma1 threshold is an example of the second threshold. The ~~IDPC_Gamma2~~ IDPC_Gamma1 threshold is stored within a memory device of the DSP150, a memory device of the AFT 120, and/or a memory device of the power controller 154 (Figure 1).

[0089] During production time, as the IP RF signal is pulsed high and the 60 MHz RF signal is at 61.3 MHz and the IDPC_Gamma1 threshold is subsequently encountered, the dependent RF generator determines that the 2 MHz IP RF signal has just transitioned from high to low.

[0090] In one or more embodiments, the IDPC_Gammal threshold can be adjusted for sensitivity by a Threshold 1 Adjust value. For example, it may be desirable to set in the operation 135 the IDPC_Gammal threshold at 0.7 instead of 0.8, e.g., slightly below a gamma value that exists due to the high-to-low transition of the 2 MHz IP RF signal, to increase the high-to-low detection sensitivity by the sensor 212. In this example, the ~~Threshold 1~~ Threshold 1 Adjust value is -0.1, and the IDPC_Gamma l threshold of 0.7 is the sum of the gamma value of 0.8 and the ~~Threshold I~~ Threshold 1 Adjust value of -0.1.

[0091] Once the IDPC_Gammal threshold is obtained, the 60 MHz dependent RF generator is set to the frequency self-tuning mode in an operation 139 to enable the 60 MHz dependent RF generator to determine an optimal tuned RF frequency for power delivery when the 2 MHz IP RF signal pulses low. Again, the low pulse of the 2 MHz IP RF signal is artificially extended between points 127 and 137 of Figure 3 to enable both an ascertainment of the IDPC_Gamma l threshold and to permit the 60 MHz dependent RF generator to self-tune to an optimal RF frequency for power delivery during the low pulse of the 2 MHz IP RF signal.

[0092] Once the dependent RF generator tunes to the optimal RF frequency, e.g., 60.5 MHz, for power delivery during the low pulse of the 2 MHz IP RF signal, the optimal tuned RF frequency of the dependent RF generator is recorded in an operation 141 and is set as ~~IDPC Freq 2~~ IDPC_Freq2 in an operation 143.

[0093] After the dependent RF generator has tuned to its optimal RF frequency value, e.g., 60.5 MHz, etc., for the low pulse of the 2 MHz IP RF signal, the dependent RF generator is set to operate in a fixed frequency mode in an operation 145 at an IDPC_Freq2 and the 2 MHz IP RF generator is allowed to pulse high, e.g., transition from the point 137 to a point 147. The IDPC_Freq2 is an example of the frequency value F20. Forward power

[0097] The two optimal tuned RF frequencies values, e.g., 61.3 MHz and 60.5 MHz, and the two gamma threshold values, e.g., IDPC_Gamma1 threshold and IDPC_Gamma2 threshold, are then employed during production time when the 2 MHz is allowed to pulse and the 60 MHz dependent RF generator flips back and forth between the two previously learned optimal tuned RF frequencies when the sensor 212 detects that a gamma value has exceeded the thresholds. The 60 MHz signal is illustrated as a signal 155 in Figure 3.

[0098] Figure 5 is a diagram of an embodiment of a system 262 for changing a state based on plasma impedance, where the power controllers and/or the frequency tuners ~~do not~~ provide non-zero values. The system 262 is similar to the system 180 of Figure 1 except that the system 262 includes a power controller 172 and an AFT 264, each of which provide non-zero values.

[0099] The DSP 140 provides the identified state S0 from a corresponding memory location to the AFT 264 and to the power controller 172. As an example, the DSP 140 indicates to the AFT 264 and the power controller 172 that the TTL signal 112 is in the state S0 between times t2 and t3 of a duty cycle. The AFT 264 determines a frequency value based on a state of the TTL signal 112 and the power controller 172 determines a power value based on the state of the TTL signal 112. For example, the AFT 264 determines that a frequency value F10 is to be provided to the 2 MHz DA system when the state of the TTL signal 112 is S0 and the power controller 172 determines that a power value P10 is to be provided to the 2 MHz DA system when the state of the TTL signal 112 is S0. In one embodiment, the values F10 and P10 are positive values.

[00100] The frequency value F10 is stored in the AFT 264 and the power value P10 is stored in the power controller 172. When the state of the TTL signal 112 is S0, the

[00116] Figure 8 is a block diagram of an embodiment of a system ~~310~~311 for selecting between AFTs 118 and 120 (Figures 1 and 3) based on whether a gamma value is greater than the first threshold or the second threshold. When the TTL signal 112 is in the state S1 and a gamma value measured during the state S1 exceeds the first threshold, a select logic 128, which is an example of a selector, of the system ~~310~~311 selects the AFT 118 and when the TTL signal 112 is in the state S0 and a gamma value measured during the state S0 exceeds the second threshold, the select logic 128 selects the AFT 120. Examples of the select logic 128 include a multiplexer. When the select logic 128 includes the multiplexer, a signal indicating that a gamma value measured during the state S1 of the TTL signal 112 is greater than the first threshold or a signal indicating that a gamma value measured during the state S0 of the TTL signal 112 is greater than the second threshold is received at a select input of the multiplexer. The DSP 150 generates a signal indicating a gamma value measured during the state S1 of the TTL signal 112 is greater than the first threshold and provides the signal to the multiplexer when the TTL signal 112 has the state S1. The DSP 150 generates a signal indicating that a gamma value measured during the state S0 of the TTL signal 112 is greater than the second threshold and provides the signal to the multiplexer when the TTL signal 112 has the state S0.

[00117] In one embodiment, the select logic 128 includes a processor. In an embodiment, the select logic 128 is implemented within the DSP 140.

[00118] When the AFT 118 is selected, the AFT 118 provides the frequency value F21 to the 60 MHz DA system. Similarly, when the AFT 120 is selected, the AFT 120 provides the frequency value F20 to the 60 MHz DA system.

[00119] The 60 MHz DA system generates the ~~2~~60 MHz signal synchronous with a clock signal that is received from a clock source ~~312~~313. In one embodiment, the clock signal of

the clock source ~~312~~ 313 is asynchronous with the TTL signal 112. In an embodiment, the clock signal of the clock source ~~3112~~ 313 is synchronous with the TTL signal 112.

[00120] In one embodiment, the select logic 128 selects between the power controllers 152 and 154 (Figure 5) instead of the AFTs 118 and 120. When the power controller 152 is selected during the state S1 of the TTL signal 112, the power controller 152 provides the power value P21 to the 60 MHz DA system and when the power controller 154 is selected ruing the state S0 of the TTL signal 112, the power controller 154 provides the power value P20 to the 60 MHz DA system.

[00121] In one embodiment, the select logic 128 is implemented within the 27 MHz generator in a similar manner in which the select logic 128 is implemented within the 60 MHz generator 276 (Figures 1 and 3).

[00122] A value of gamma is transferred by the select logic 128 to AFT 118 or 120 based on the state S1 or S0. For example, when the state is S1, the DSP 150 provides the first gamma value to the select logic 128. In this example, the select logic 128 that has selected the AFT 118 during the state S1 transfers the first gamma value received from the DSP 150 to the AFT 118. As another example, when the state is S0, the DSP 150 provides the second gamma value to the select logic 128. In this example, the select logic 128 that has selected the AFT 120 during the state S0 transfers the second gamma value received from the DSP 150 to the AFT 120.

[00123] Similarly, in the embodiments in which the power controllers 152 and 154 (Figure 5) are used, the select logic 128 transfers the first gamma value received from the DSP 150 to the power controller 152 during the state S1 and transfers the second gamma value received from the DSP 150 to the power controller 154.

learning purposes. It should further be noted that the 60 MHz signal is illustrated as a signal ~~460~~ 406 in Figure 10.

[00139] In one embodiment, during production time, such self-tuning is not used since the dependent RF generator operates essentially as a state machine and flips from one learned optimal RF frequency to another learned optimal RF frequency as it detects the high-to-low transition of the IP RF signal and the low-to-high transition of the IP RF signal. The high-to-low transition is detected by comparing a measured gamma value to the IDPC_Gamma1 threshold and by determining the previous state of the IP RF signal prior to the detection of the gamma excursion. Moreover, the low-to-high transition is detected by comparing the measured gamma value versus the IDPC_Gamma2 threshold and by determining the previous state of the IP RF signal prior to the detection of the gamma excursion.

[00140] It should be noted that although the above-described embodiments relate to providing the 2 MHz RF signal and/or 60 MHz signal and/or 27 MHz signal to the lower electrode 104 and grounding the upper electrode 110, in several embodiments, the 2 MHz, 60 MHz, and 27 MHz signals are provided to the upper electrode 110 while the lower electrode 104 is grounded.

[00141] It is also noted that in one embodiment, an input, e.g., frequency input, power input, etc., or a level, e.g., power level, frequency level, includes one or more values that are within a limit, e.g., standard deviation, etc., of another value. For example, a power level includes the power value P21 and other power values that are within the limit of the power value P21. In this example, the power level excludes any power values for another state, e.g., power value P20 for state S0. As another example, a frequency input includes the frequency value F11 and other frequency values that are within a limit of the frequency value

signal is in a first state, the primary AFT configured to provide a second primary frequency input to the primary driver and amplifier when the pulsed signal is in a second state; and

a secondary generator coupled to the electrode, the secondary generator including a secondary driver and amplifier for supplying a secondary RF signal to the electrode, the secondary generator further including a first secondary AFT coupled to the secondary driver and amplifier, the secondary generator including a second secondary AFT coupled to the secondary driver and amplifier, the secondary generator including a processor, the processor coupled to the first secondary AFT and the second secondary AFT, the secondary generator further including one or more sensors coupled to the electrode, the one or more sensors for sensing current and voltage transferred between the secondary generator and the electrode during the first and second states, the processor configured to generate parameters based on the current and voltage, the processor configured to determine whether a first one of the parameters for the first state exceeds a first boundary and whether a second one of the parameters for the second state exceeds a second boundary, the first secondary AFT configured to provide a first secondary frequency input to the secondary driver and amplifier upon receiving the determination that the first parameter exceeds the first boundary, the second secondary AFT configured to provide a second secondary frequency input to the secondary driver and amplifier upon receiving the determination that the second parameter exceeds the second boundary.

5. The system of claim 4, further comprising a selector coupled to the processor for selecting the first secondary AFT or the second secondary AFT, the selector for selecting the first secondary AFT in response to receiving a signal from the ~~secondary~~ processor indicating that the first parameter exceeds the first boundary, the selector for selecting the

second secondary AFT in response to receiving a signal from the ~~secondary~~ processor indicating that the second parameter exceeds the second boundary.

6. The system of claim 4, wherein the electrode includes a lower electrode of a plasma chamber.

7. The system of claim 4, wherein during the first state, the primary driver and amplifier is configured to generate the primary RF signal having a lower frequency than that of the secondary RF signal, wherein the primary RF signal has a higher amount of power than the secondary RF signal.

8. The system of claim 4, wherein the processor is configured to determine whether the pulsed signal is in the first or the second state based on a magnitude of the pulsed signal.

9. The system of claim 4, wherein each of the first and second parameter includes a gamma value or an impedance difference value.

10. A system comprising:

a digital pulsing source for generating a pulsed signal;

a primary generator including:

a primary driver and amplifier coupled to an electrode for supplying a primary radio frequency (RF) signal to the electrode;

one or more primary processors coupled to the digital pulsing source for receiving the pulsed signal,

the one or more primary processors configured to:

identify a first one of two states of the pulsed signal and a second one of the two states;

determine to provide a primary power value to the primary driver and amplifier when the pulsed signal is in the first state; and

determine to provide a primary frequency value of the primary RF signal when the pulsed signal is in the first state; and

a secondary generator including:

a secondary driver and amplifier coupled to the electrode for supplying a secondary RF signal to the electrode;

one or more secondary processors coupled to the digital pulsing source for receiving the pulsed signal,

the one or more secondary processors configured to:

determine whether a parameter associated with plasma exceeds a first boundary when the pulsed signal is in the first state;

determine whether the parameter exceeds a second boundary when the pulsed signal is in the second state;

determine to provide a first secondary power value to the secondary driver and amplifier in response to determining that the parameter exceeds the first boundary;

determine to provide a second secondary power value to the secondary driver and amplifier in response to determining that the parameter exceeds the second boundary;

determine to provide a first secondary frequency value to the secondary driver and amplifier in response to determining that the parameter exceeds the first boundary; and

determine to provide a second secondary frequency value to the secondary driver and amplifier in response to determining that the parameter exceeds the second boundary.

11. The system of claim 10, further comprising a selector coupled to the one or more secondary processors for selecting the first secondary frequency value or the second secondary frequency value, the selector for selecting the first secondary frequency value in response to receiving a signal from the one or more secondary processors indicating that the ~~first~~ parameter exceeds the first boundary, the selector for selecting the second secondary frequency value in response to receiving a signal from the one or more secondary processors indicating that the ~~second~~ parameter exceeds the second boundary.

12. The system of claim 10, wherein the parameter includes a gamma value or an impedance difference value.

13. The system of claim 10, wherein the electrode includes a lower electrode of a plasma chamber.

14. The system of claim 10, wherein during the first state, the primary driver and amplifier is configured to generate the primary RF signal having a lower frequency than that of the secondary RF signal, wherein the primary RF signal has a higher amount of power than the secondary RF signal.