CLAIMS

What is claimed is:

1. A multi-channel radio frequency (RF) generator module comprising:

N power amplifiers that generate N RF outputs, respectively;

M drivers that drive the N power amplifiers based on M driver control signals, respectively;

a power supply module that receives alternating current (AC) input power and that applies L rail voltages to the N power amplifiers based on L rail voltage setpoints, respectively;

a control module that sets the L rail voltage setpoints and the M driver control signals,

wherein the N RF outputs are provided to N respective plasma electrodes of a plasma chamber, and

wherein N is an integer greater than one, L and M are integers greater than zero, and M and L are less than or equal to N;

a parameter determination module that determines N actual forward powers for the N RF outputs, respectively; and

a feedback module that determines a total forward power of the multi-channel RF generator module based on the N actual forward powers,

wherein the control module sets the L rail voltage setpoints based on the total forward power.

2. The multi-channel RF generator module of claim 1 wherein L, M, and N are equal to two.

3. The multi-channel RF generator module of claim 1 wherein one of L and M is equal to two and the other of L and M is equal to one.

4. The multi-channel RF generator module of claim 1 ~~further comprising a~~ the

parameter determination module ~~that~~ determines N reflection coefficients for the N RF outputs, respectively,

wherein the control module determines the M driver control signals based on the N reflection coefficients, respectively, and

wherein M is equal to N.

5. The multi-channel RF radio generator module of claim 1 further comprising:

N power amplifiers that generate N RF outputs, respectively;

M drivers that drive the N power amplifiers based on M driver control signals, respectively;

a power supply module that receives alternating current (AC) input power and that applies L rail voltages to the N power amplifiers based on L rail voltage setpoints, respectively;

a control module that sets the L rail voltage setpoints and the M driver control signals;

a parameter determination module that determines N reflection coefficients for the N RF outputs, respectively; and

a splitter module,

wherein the control module determines one driver control signal based on a greatest one of the N reflection coefficients,

wherein M is equal to one and the one driver generates one driver signal based on the one driver control signal, and

wherein the splitter module splits the one driver signal into N driver signals and drives the N power amplifiers based on the N driver signals, respectively,

wherein N is an integer greater than one, L is an integer greater than zero, and L is less than or equal to N.

6. The multi-channel RF generator module of claim 1 further comprising:

~~a~~ the parameter determination module that determines N actual forward powers and N reflection coefficients for the N RF outputs, respectively,

wherein the control module sets the L rail voltage setpoints based on the N

actual forward powers, respectively, and

wherein L is equal to N.

~~7. The multi-channel RF generator module of claim 1 further comprising:~~

~~a parameter determination module that determines N actual forward powers for the N RF outputs, respectively; and~~

~~a feedback a feedback module that determines a total forward power of the multi-channel RF generator module based on the N actual forward powers,~~

~~wherein the control module sets the L rail voltage setpoints based on the total forward power.~~

~~8.~~7. The multi-channel RF generator module of claim ~~7~~1 wherein the parameter determination module further determines N reflection coefficients for the N RF outputs, respectively, and

wherein the feedback module determines the total forward power based on a function of the N actual forward powers and the N reflection coefficients.

~~9.~~8. The multi-channel RF generator module of claim ~~7~~1 wherein the feedback module sets the total forward power equal to an average of the N actual forward powers.

~~10.~~9. The multi-channel RF generator module of claim ~~7~~1 wherein the parameter determination module further determines N reflection coefficients for the N RF outputs, respectively, and

wherein the feedback module sets the total forward power equal to one of the N actual forward powers associated with one of the N RF outputs when a first magnitude of the reflection coefficient of the one of the N RF outputs is greater than a second magnitude of a reflection coefficient of another one of the N RF outputs.

~~11.~~10. The multi-channel RF generator module of claim ~~7~~1 wherein the parameter determination module further determines N reflection coefficients for the N RF outputs, respectively, and

wherein the feedback module sets the total forward power equal to:

$$= \frac{(1+|\Gamma_1|^2)}{2} * PFwd_1 + \frac{(1-|\Gamma_2|^2)}{2} * PFwd_2,$$

where N is equal to one of the N reflection coefficients, N and wherein $PFwd_N$ is an N-th one of the N actual forward powers.

12.11. The multi-channel RF generator module of claim ~~7~~1 wherein the parameter determination module further determines N reflection coefficients for the N RF outputs, respectively, and

wherein the feedback module sets the total forward power equal to:

$$= \frac{(PFwd_1 + PFwd_2) * e^{-5*(|\Gamma_1| + |\Gamma_2|)^2}}{1 + e^{-5*(|\Gamma_1| + |\Gamma_2|)^2}},$$

where N is equal to one of the N reflection coefficients, N and wherein $PFwd_N$ is an N-th one of the N actual forward powers.

13.12. A multi-channel radio frequency (RF) generator module comprising:

N power amplifiers that generate N RF outputs, respectively;

M drivers that drive the N power amplifiers based on M driver control signals, respectively;

a power supply module that receives alternating current (AC) input power and that applies L rail voltages to the N power amplifiers based on L rail voltage setpoints, respectively;

a parameter determination module that determines N actual forward powers for the N RF outputs, respectively, and that determines N reflection coefficients for the N RF outputs, respectively;

a feedback module that determines a total forward power of the multi-channel RF generator module based on the N actual forward powers and the N reflection coefficients; and

a control module that controls the L rail voltage setpoints based on the total forward power,

wherein N is an integer greater than one, L and M are integers greater than zero, and M and L are less than or equal to N.

~~14.~~13. The multi-channel RF generator module of claim ~~13~~12 wherein the feedback module sets the total forward power equal to an average of the N actual forward powers.

~~15.~~14. The multi-channel RF generator module of claim ~~13~~12 wherein the feedback module sets the total forward power equal to one of the N actual forward powers associated with one of the N RF outputs when a first magnitude of the reflection coefficient of the one of the N RF outputs is greater than a second magnitude of a reflection coefficient of another one of the N RF outputs.

~~16.~~15. The multi-channel RF generator module of claim ~~13~~12 wherein the feedback module sets the total forward power equal to:

$$= \frac{\left(1+\left|\Gamma_1\right|-\left|\Gamma_2\right|\right)}{2} * PFwd_1 + \frac{\left(1-\left|\Gamma_1\right|+\left|\Gamma_2\right|\right)}{2} * PFwd_2,$$

where N is equal to one of the N reflection coefficients, and wherein $PFwd_N$ is an N-th one of the N actual forward powers.

~~17.~~16. The multi-channel RF generator module of claim ~~13~~12 wherein the feedback module sets the total forward power equal to:

$$= \frac{\left(PFwd_1 + PFwd_2\right) * e^{-5*\left(\left|\Gamma_1\right|+\left|\Gamma_2\right|\right)}}{1+e^{-5*\left(\left|\Gamma_1\right|+\left|\Gamma_2\right|\right)}},$$

where N is equal to one of the N reflection coefficients, and wherein $PFwd_N$ is an N-th one of the N actual forward powers.

~~18.~~17. The multi-channel RF generator module of claim ~~13~~12 wherein L and M are equal to two.

~~19.~~18. The multi-channel RF generator module of claim ~~13~~12 wherein one of L and

M is equal to two and the other of L and M is equal to one.

~~20.~~19. The multi-channel RF generator module of claim ~~13~~12 further comprising a splitter module,

wherein the control module generates one driver control signal based on a greatest one of the N reflection coefficients,

wherein M is equal to one and the one driver generates one driver signal based on the one driver control signal, and

wherein the splitter module splits the one driver signal into N driver signals and drives the N power amplifiers based on the N driver signals, respectively.

~~21.~~20. A multi-channel radio frequency (RF) generator module comprising:

at least two power amplifiers that each generate an RF output;

at least one driver that drives the power amplifiers based on at least one driver control signal;

a power supply module that receives alternating current (AC) input power and that applies at least one rail voltage to the power amplifiers based on at least one rail voltage setpoint; and

a control module that sets the at least one rail voltage setpoint and that sets the at least one driver control signal,

wherein each of the RF outputs are provided to at least two respective plasma electrodes of a plasma chamber;

a parameter determination module that determines at least two reflection coefficients for the RF outputs of the at least two power amplifiers, respectively; and

a splitter module,

wherein the control module determines only one driver control signal based on a greatest one of the reflection coefficients,

wherein the at least one driver includes only one driver, and the driver generates one driver signal based on the one driver control signal, and

wherein the splitter module splits the one driver signal into at least two driver signals and drives the at least two power amplifiers based on the at least two driver

signals, respectively.

~~22.~~21. The multi-channel RF generator module of claim ~~21~~20 wherein the at least two power amplifiers includes two power amplifiers, the at least one driver includes two drivers, and the at least one rail voltage includes two rail voltages.

~~23.~~22. The multi-channel RF generator module of claim ~~21~~20 ~~further comprising a~~ wherein the parameter determination module ~~that~~ determines at least two reflection coefficients for the RF outputs of the at least two power amplifiers, respectively, and

wherein the control module sets the at least one driver control signal based on the reflection coefficients.

~~24. The multi-channel RF generator module of claim 21 further comprising:~~

~~a parameter determination module that determines at least two reflection coefficients for the RF outputs of the at least two power amplifiers, respectively, and~~

~~a splitter module,~~

~~wherein the control module determines only one driver control signal based on a greatest one of the reflection coefficients,~~

~~wherein the at least one driver includes only one driver, and the driver generates one driver signal based on the one driver control signal, and~~

~~wherein the splitter module splits the one driver signal into at least two driver signals and drives the at least two power amplifiers based on the at least two driver signals, respectively.~~

~~25.~~23. The multi-channel RF generator module of claim ~~21~~20 ~~further comprising~~ wherein:

~~a~~ the parameter determination module ~~that~~ determines at least two actual forward powers and at least two reflection coefficients for the RF outputs of the at least two power amplifiers, respectively,

wherein the control module sets the at least one rail voltage setpoints based on the actual forward powers.

~~26. The multi-channel RF generator module of claim 21 further comprising:~~

~~a parameter determination module that determines at least two actual forward powers for the RF outputs of the at least two power amplifiers, respectively; and~~

~~a feedback module that determines a total forward power of the multi-channel RF generator module based on the at least two actual forward powers,~~

~~wherein the control module sets the at least one rail voltage setpoint based on the total forward power.~~

~~27.~~24. A multi-channel radio frequency (RF) generator module comprising:

at least two power amplifiers ~~means~~, that each ~~for generating~~ generate an RF output;

at least one driver ~~means for driving~~ that drives the power amplifiers ~~means~~ based on at least one driver control signal;

a power supply module ~~means for receiving~~ that receives alternating current (AC) input power and ~~for applying~~ that applies at least one rail voltage to the power amplifiers ~~means~~ based on at least one rail voltage setpoint; and

a control module ~~means~~ that sets ~~for setting~~ the at least one rail voltage setpoint and ~~for setting~~ that sets the at least one driver control signal;

a parameter determination module that determines at least two actual forward powers for the RF outputs of the at least two power amplifiers, respectively; and

a feedback module that determines a total forward power of the multi-channel RF generator module based on the at least two actual forward powers,

wherein each of the RF outputs are provided to at least two respective plasma electrodes of a plasma chamber;

wherein the control module sets the at least one rail voltage setpoint based on the total forward power.

~~28. The multi-channel RF generator of claim 27 wherein the at least two power amplifier means includes two power amplifier means, the at least one driver means includes two driver means, and the at least one rail voltage includes two rail voltages.~~

~~29. The multi-channel RF generator of claim 27 further comprising a determination means for determining at least two reflection coefficients for the RF outputs of the at least two power amplifiers, respectively,~~

~~wherein the control means is for setting the at least one driver control signal based on the reflection coefficients, respectively.~~

~~30. The multi-channel RF generator of claim 27 further comprising:~~

~~A determination means for determining at least two reflection coefficients for the RF outputs of the at least two power amplifiers, respectively;~~
~~and~~

~~a splitter means,~~

~~wherein the control module determines only one driver control signal based on a greatest one of the reflection coefficients,~~

~~wherein the at least one driver includes only one driver means for generating only one driver signal based on the one driver control signal, and~~

~~wherein the splitter means is for splitting the one driver signal into at least two driver signals and for driving the at least two power amplifiers based on the at least two driver signals, respectively.~~

25. A multi-channel radio frequency (RF) generator comprising:

at least two power amplifier means, each for generating an RF output;

at least one driver means for driving the power amplifier means based on at least one driver signal;

a power supply means for receiving alternating current (AC) input power and for applying at least one rail voltage to the power amplifier means based on at least one rail voltage setpoint; and

a control means for setting the at least one rail voltage setpoint and for setting the at least one driver signal;

wherein each of the RF outputs are provided to at least two respective plasma electrodes of a plasma chamber;

a determination means for determining at least two reflection coefficients for the RF outputs of the at least two power amplifiers, respectively; and

a splitter means,

wherein the control means is for determining only one driver control signal based on a greatest one of the reflection coefficients,

wherein the at least one driver means includes only one driver means for generating only one driver signal based on the one driver control signal, and

wherein the splitter means is for splitting the one driver signal into at least two driver signals and for driving the at least two power amplifiers based on the at least two driver signals, respectively.

26. The multi-channel RF generator of claim 25 wherein the at least two power amplifier means includes two power amplifier means, the at least one driver means includes two driver means, and the at least one rail voltage includes two rail voltages.

~~31.~~ 27.The multi-channel RF generator of claim ~~27~~ 25 ~~further comprising:~~

~~a~~ wherein the determination means ~~for determining~~ determines ~~at least two actual forward powers and~~ at least two reflection coefficients for the RF outputs of the at least two power amplifiers, respectively, and

wherein the control means is for setting the at least one ~~rail voltage setpoints~~ driver control signal based on the ~~actual forward powers~~ reflection coefficients, respectively.

~~32.~~ 28.~~The~~ A multi-channel radio frequency RF generator ~~further~~ comprising:

at least two power amplifier means, each for generating an RF output;

at least one driver means for driving the power amplifier means based on at least one driver signal;

a power supply means for receiving alternating current (AC) input power and for applying at least one rail voltage to the power amplifier means based on at least one rail voltage setpoint; and

a control means for setting the at least one rail voltage setpoint and for

setting the at least one driver signal;

a determination means for determining at least two actual forward powers for the RF outputs of the at least two power amplifiers, respectively; and

a feedback means for determining a total forward power of the multi-channel RF generator based on the at least two actual forward powers,

wherein each of the RF outputs are provided to at least two respective plasma electrodes of a plasma chamber, and

wherein the control module is for setting the at least one rail voltage setpoint based on the total forward power.