CLAIMS

1. A bus interconnect for interfacing a host system to a radio frequency (RF) generator that is coupled to a plasma chamber, comprising:

a plurality of host ports, wherein a first and a second port of the host system are used to provide a power component setting and a frequency component setting to the RF generator, and third, fourth, fifth, and sixth ports of the host system are used to receive four distinct variables that change over time, and a seventh port of the host system is used to provide a clock signal to the RF generator;

a plurality of generator ports used to send a power read back value and a frequency read back value to the host system;

a sampler circuit integrated with the host system, the sampler circuit configured to sample signals at the third, fourth, fifth, and sixth ports of the host system at selected clock edges defined by the clock signal to capture operating state data of the RF generator and the plasma chamber; and

a plurality of communication channels connecting the plurality of host ports with the plurality of generator ports, the plurality of communication channels including,

a first channel connecting the first port of the host system to a first port of the RF generator for facilitating a transfer of the power component setting from the first port of the host system to the first port of the RF generator;

a second channel connecting the second port of the host system to a second port of the RF generator for facilitating a transfer of the frequency component setting from the second port of the host system to the second port of the RF generator;

a third channel connecting the third port of the host system to a third port of the RF generator for facilitating a transfer of the power read back value from the third port of the RF generator to the third port of the host system;

a fourth channel connecting the fourth port of the host system to a fourth port of the RF generator for facilitating a transfer of the frequency read back value from the fourth port of the RF generator to the fourth port of the host system;

a fifth channel connecting the fifth port of the host system to a fifth port of the RF generator for facilitating a transfer of a first portion of the operating state data from the fifth port of the RF generator to the fifth port of the host system;

a sixth channel connecting the sixth port of the host system to a sixth port of the RF generator for facilitating a transfer of a second portion of the operating state data from the sixth port of the generator to the sixth port of the host system;

a seventh channel for facilitating a transfer of the clock signal from the seventh port of the host system to a seventh port of the RF generator to synchronize operation of the RF generator with the host system,

wherein the transfer of the power component setting, the frequency component setting, and the clock signal facilitates generation of an RF electrical signal by the RF generator that is coupled to the plasma chamber.

2. The bus interconnect of claim 1, wherein the signals sampled at the third, fourth, fifth, and sixth ports of the host system are resampled a set number of times to capture a full parallel data set.

3. The bus interconnect of claim 1, wherein the signals sampled at a clock edge are less than a full parallel data set.

4. The bus interconnect of claim 1, wherein an eighth port of the host system is used to provide a slave select signal to select the RF generator for providing data to or reading data from the RF generator wherein a ninth port of the host system is used to communicate a ground signal with the RF generator.

5. The bus interconnect of claim 1, wherein the first port of the host system is a power set point serial data out port, wherein the second port of the host system is a frequency set point serial data out port, wherein the third port of the host system is a power read back serial data in port, wherein the fourth port of the host system is a frequency read back serial data in port, wherein the fifth port of the host system is a real

portion of load impedance serial data in port, and wherein the sixth port of the host system is an imaginary portion of load impedance serial data in port.

6. The bus interconnect of claim 1, wherein the power component setting includes a power magnitude and the frequency component setting includes a frequency value.

7. The bus interconnect of claim 1, wherein the variables include:

frequency, power, real portion of load impedance, and imaginary portion of load impedance; or

frequency, voltage magnitude, current magnitude, and phase between the voltage and current; or

frequency, delivered power magnitude, and complex gamma; or

frequency, delivered power magnitude, and complex load impedance; or

frequency and complex forward power; or

frequency and complex reflected power; or

frequency and complex voltage and current.

8. The bus interconnect of claim 1, wherein the power read back value includes a power magnitude and the frequency read back value includes a frequency magnitude.

9. The bus interconnect of claim 1, wherein the sampler circuit is located within the host system.

10. The bus interconnect of claim 1, wherein the selected clock edges include rising clock edges or falling clock edges.

11. The bus interconnect of claim 1, wherein a bit of a signal of one of the variables is set during a falling clock edge and is latched during a rising clock edge.

12. The bus interconnect of claim 1, wherein the operating state data includes data indicating whether there is plasma unconfinement within the plasma chamber, data indicating whether there is arcing within the plasma chamber, or a combination thereof.

13. The bus interconnect of claim 1, wherein the operating state data is detected by a sensor of the RF generator.

14. A bus interconnect for interfacing a host system to a radio frequency (RF) generator that is coupled to a plasma chamber, comprising:

a plurality of host ports, wherein a first and a second port of the host system are used to provide a power component setting and a frequency component setting to the RF generator, and third, fourth, fifth, and sixth ports of the host system are used to receive four distinct variables that change over time;

a plurality of generator ports, wherein a first and a second port of the RF generator are used to send a power read back value and a frequency read back value to the host system; and

a sampler circuit integrated with the host system, the sampler circuit configured to sample signals at the third, fourth, fifth, and sixth ports of the host system at selected clock edges to capture operating state data of the RF generator and the plasma chamber; and

a plurality of communication channels connecting the RF generator and two additional RF generators with the host system, each RF generator coupled to the host system via nine communication channels.

15. A bus interconnect for interfacing a host system to a radio frequency (RF) generator that is coupled to a plasma chamber, comprising:

a first set of host ports, the first set of host ports used to provide a power component setting and a frequency component setting to the RF generator, and the first set of host ports used to receive distinct variables that change over time;

a second set of generator ports used to send a power read back value and a frequency read back value to the host system;

a sampler circuit integrated with the host system, the sampler circuit configured to sample signals at the ports of the first set at selected clock edges to capture operating state data of the RF generator and the plasma chamber; and

a plurality of communication channels connecting the first set of host ports with the second set of generator ports, the plurality of communication channels including,

a first channel connecting a first port of the first set of host ports to a first port of the second set of generator ports for facilitating a transfer of the power component setting from the first port of the first set of host ports to the first port of the second set of generator ports;

a second channel connecting a second port of the first set of host ports to a second port of the second set of generator ports for facilitating a transfer of the frequency component setting from the second port of the first set of host ports to the second port of the second set of generator ports;

a third channel connecting a third port of the first set of host ports to a third port of the second set of generator ports for facilitating a transfer of the power read back value from the third port of the second set of generator ports to the third port of the first set of host ports;

a fourth channel connecting a fourth port of the first set of host ports to a fourth port of the second set of generator ports for facilitating a transfer of the frequency read back value from the fourth port of the second set of generator ports to the fourth port of the first set of host ports;

wherein the transfer of the power component setting via the first channel and the frequency component setting via the second channel facilitates generation of an RF electrical signal by the RF generator that is coupled to the plasma chamber.

16. The bus interconnect of claim 15, wherein the signals sampled at the ports of the first set are resampled a set number of times to capture a full parallel data set.

17. The bus interconnect of claim 15, wherein the signals sampled at a clock edge are less than a full parallel data set.

18. The bus interconnect of claim 15, wherein the variables include:

frequency, power, real portion of load impedance, and imaginary portion of load impedance; or

frequency, voltage magnitude, current magnitude, and phase between the voltage and current; or

frequency, delivered power magnitude, and complex gamma; or

frequency, delivered power magnitude, and complex load impedance; or

frequency and complex forward power; or

frequency and complex reflected power; or

frequency and complex voltage and current; or

frequency, complex forward power, and complex reflected power; or

frequency, complex voltage, and complex current.

19. A plasma system comprising:

a host system for providing data signals;

a radio frequency (RF) generator coupled to the host system, the RF generator for generating an RF signal based on the data signals;

an impedance matching circuit for matching an impedance of the RF generator with an impedance of a plasma chamber;

an RF transmission line coupling the impedance matching circuit to the plasma chamber;

a bus interface connecting the host system to the RF generator, the bus interface including:

a first set of host ports, the first set of host ports used to provide a power component setting and a frequency component setting to the RF generator, and the first set of host ports used to receive distinct variables that change over time;

a second set of generator ports used to send a power read back value and a frequency read back value to the host system;

a sampler circuit integrated with the host system, the sampler circuit configured to sample signals at the ports of the first set at selected clock edges to capture operating state data of the plasma chamber and the RF generator; and

a plurality of communication channels connecting the first set of host ports with second set of generator ports, the plurality of communication channels including,

a first channel connecting a first port of the first set of host ports to a first port of the second set of generator ports for facilitating a transfer of the power component setting from the first port of the first set of host ports to the first port of the second set of generator ports;

a second channel connecting a second port of the first set of host ports to a second port of the second set of generator ports for facilitating a transfer of the frequency component setting from the second port of the first set of host ports to the second port of the second set of generator ports;

a third channel connecting a third port of the first set of host ports to a third port of the second set of generator ports for facilitating a transfer of the power read back value from the third port of the second set of generator ports to the third port of the first set of host ports;

a fourth channel connecting a fourth port of the first set of host ports to a fourth port of the second set of generator ports for facilitating a transfer of the frequency read back value from the fourth port of the second set of generator ports to the fourth port of the first set of host ports;

wherein the transfer of the power component setting via the first channel and the frequency component setting via the second channel facilitates generation of an RF electrical signal by the RF generator that is coupled to the plasma chamber.

20. The plasma system of claim 19, wherein the signals sampled at the ports of the first set are resampled a set number of times to capture a full parallel data set.

21. The plasma system of claim 19, wherein the signals sampled at a clock edge are less than a full parallel data set.

22. The plasma system of claim 19, wherein the variables include:

frequency, power, real portion of load impedance, and imaginary portion of load impedance; or

frequency, voltage magnitude, current magnitude, and phase between the voltage and current; or

frequency, delivered power magnitude, and complex gamma; or

frequency, delivered power magnitude, and complex load impedance; or

frequency and complex forward power; or

frequency and complex reflected power; or

frequency and complex voltage and current; or

frequency, complex forward power, and complex reflected power; or

frequency, complex voltage, and complex current.

23. The plasma system of claim 19, wherein the host system includes a statistical data decimation module, the statistical data decimation module for calculating statistical data based on the variables, the statistical data decimation module for deleting variable data other than the statistical data.

CLAIMS

1. A bus interconnect for interfacing a host system to a radio frequency (RF) generator that is coupled to a plasma chamber, comprising:

a plurality of host ports, wherein a first and a second port of the host system are used to provide a power component setting and a frequency component setting to the RF generator, and third, fourth, fifth, and sixth ports of the host system are used to receive four distinct variables that change over time;

a plurality of generator ports, wherein a first and a second port of the RF generator are used to send a power read back value and a frequency read back value to the host system; and

a sampler circuit integrated with the host system, the sampler circuit configured to sample signals at the third, fourth, fifth, and sixth ports of the host system at selected clock edges to capture operating state data of the RF generator and the plasma chamber.

2. The bus interconnect of claim 1, wherein the signals sampled at the third, fourth, fifth, and sixth ports of the host system are resampled a set number of times to capture a full parallel data set.

3. The bus interconnect of claim 1, wherein the signals sampled at a clock edge are less than a full parallel data set.

4. The bus interconnect of claim 1, wherein a seventh port of the host system is used to provide a slave select signal to select the RF generator for providing data to or reading data from the RF generator, wherein an eighth port of the host system is used to

provide a clock signal to the RF generator, wherein a ninth port of the host system is used to communicate a ground signal with the RF generator.

5. The bus interconnect of claim 1, wherein the first port of the host system is a power set point serial data out port, wherein the second port of the host system is a frequency set point serial data out port, wherein the third port of the host system is a power read back serial data in port, wherein the fourth port of the host system is a frequency read back serial data in port, wherein the fifth port of the host system is a real portion of load impedance serial data in port, and wherein the sixth port of the host system is an imaginary portion of load impedance serial data in port.

6. The bus interconnect of claim 1, wherein the power component setting includes a power magnitude and the frequency component setting includes a frequency value.

7. The bus interconnect of claim 1, wherein the variables include:

frequency, power, real portion of load impedance, and imaginary portion of load impedance; or

frequency, voltage magnitude, current magnitude, and phase between the voltage and current; or

frequency, delivered power magnitude, and complex gamma; or

frequency, delivered power magnitude, and complex load impedance; or

frequency and complex forward power; or

frequency and complex reflected power; or

frequency and complex voltage and current.

8. The bus interconnect of claim 1, wherein the power read back value includes a power magnitude and the frequency read back value includes a frequency magnitude.

9. The bus interconnect of claim 1, wherein the sampler circuit is located within the host system.

10. The bus interconnect of claim 1, wherein the selected clock edges include rising clock edges or falling clock edges.

11. The bus interconnect of claim 1, wherein a bit of a signal of one of the variables is set during a falling clock edge and is latched during a rising clock edge.

12. The bus interconnect of claim 1, wherein the operating state data includes data indicating whether there is plasma unconfinement within the plasma chamber, data indicating whether there is arcing within the plasma chamber, or a combination thereof.

13. The bus interconnect of claim 1, wherein the operating state data is detected by a sensor of the RF generator.

14. The bus interconnect of claim 1, further including a plurality of communication channels connecting the RF generator and two additional RF generators with the host system, each RF generator coupled to the host system via nine communication channels.

15. A bus interconnect for interfacing a host system to a radio frequency (RF) generator that is coupled to a plasma chamber, comprising:

a first set of host ports, the first set of host ports used to provide a power component setting and a frequency component setting to the RF generator, and the first set of host ports used to receive distinct variables that change over time;

a second set of generator ports used to send a power read back value and a frequency read back value to the host system; and

a sampler circuit integrated with the host system, the sampler circuit configured to sample signals at the ports of the first set at selected clock edges to capture operating state data of the RF generator and the plasma chamber.

16. The bus interconnect of claim 15, wherein the signals sampled at the ports of the first set are resampled a set number of times to capture a full parallel data set.

17. The bus interconnect of claim 15, wherein the signals sampled at a clock edge are less than a full parallel data set.

18. The bus interconnect of claim 15, wherein the variables include:

frequency, power, real portion of load impedance, and imaginary portion of load impedance; or

frequency, voltage magnitude, current magnitude, and phase between the voltage and current; or

frequency, delivered power magnitude, and complex gamma; or

frequency, delivered power magnitude, and complex load impedance; or

frequency and complex forward power; or

frequency and complex reflected power; or

frequency and complex voltage and current; or

frequency, complex forward power, and complex reflected power; or

frequency, complex voltage, and complex current.

19. A plasma system comprising:

a host system for providing data signals;

a radio frequency (RF) generator coupled to the host system, the RF generator for generating an RF signal based on the data signals;

an impedance matching circuit for matching an impedance of the RF generator with an impedance of a plasma chamber;

an RF transmission line coupling the impedance matching circuit to the plasma chamber;

a bus interface connecting the host system to the RF generator, the bus interface including:

a first set of host ports, the first set of host ports used to provide a power component setting and a frequency component setting to the RF generator, and the first set of host ports used to receive distinct variables that change over time;

a second set of generator ports used to send a power read back value and a frequency read back value to the host system; and

a sampler circuit integrated with the host system, the sampler circuit configured to sample signals at the ports of the first set at selected clock edges to capture operating state data of the plasma chamber and the RF generator.

20. The plasma system of claim 19, wherein the signals sampled at the ports of the first set are resampled a set number of times to capture a full parallel data set.

21. The plasma system of claim 19, wherein the signals sampled at a clock edge are less than a full parallel data set.

22. The plasma system of claim 19, wherein the variables include:

frequency, power, real portion of load impedance, and imaginary portion of load impedance; or

frequency, voltage magnitude, current magnitude, and phase between the voltage and current; or

frequency, delivered power magnitude, and complex gamma; or

frequency, delivered power magnitude, and complex load impedance; or

frequency and complex forward power; or

frequency and complex reflected power; or

frequency and complex voltage and current; or

frequency, complex forward power, and complex reflected power; or

frequency, complex voltage, and complex current.

23. The plasma system of claim 19, wherein the host system includes a statistical data decimation module, the statistical data decimation module for calculating statistical data based on the variables, the statistical data decimation module for deleting variable data other than the statistical data.