CLAIMS

What is claimed is:

1. A radio frequency (RF) control system comprising:

a RF generator including a power amplifier that outputs a RF signal, the RF generator also including a controller, the controller varying a frequency of the RF signal; and

a matching network receiving the RF signal, the matching network including at least one impedance tuning element, the impedance tuning element being adjustable in accordance with commands communicated from the controller,

wherein in a first mode of operation, the controller enables adjustment of the frequency of the RF signal and the tuning element and in a second mode of operation, the controller inhibits adjustment of the frequency of the RF signal and enables adjustment of the impedance tuning element.

2. The RF control system of claim 1 wherein in the first mode of operation, the controller enables the adjustment of the frequency and the tuning element to provide an impedance match between the RF generator and a load and in the second mode of operation, the controller enables adjustment of the impedance tuning element to provide an impedance match between the RF generator and the load and inhibits adjustment of the frequency of the RF signal to provide an impedance match while adjusting the frequency of the RF signal to a target frequency.

3. The RF control system of claim 1 wherein the tuning element includes a load element and a tune element, and in the first and second modes of operation, the controller adjusts at least one of the load element and the tune element.

4. The RF control system of claim 3 wherein in the first mode of operation, the controller adjusts the frequency and at least one of the load element and the tune element to provide an impedance match between the RF generator and a load and in the second mode of operation, the controller adjusts at least one of the load element and the tune element to provide an impedance match between the RF generator and the load and adjusts the frequency to a target frequency.

5. The RF control system of claim 1, wherein in the first mode of operation, the frequency is adjusted within a predetermined range about a target frequency.

6. The RF control system of claim 5, wherein in the first mode of operation, the RF controller adjusts the frequency to vary an impedance match condition.

7. The RF control system of claim 5, wherein in the second mode of operation, the RF controller adjusts the frequency to a target frequency.

8. The RF control system of claim 7, wherein in the second mode of operation, the RF controller adjusts the frequency without reference to an impedance match condition.

9. The RF control system of claim 7, wherein in the first mode of operation, the RF controller adjusts the frequency to vary an impedance match condition.

10. The RF control system of claim 1, wherein in the second mode of operation, the RF controller adjusts the frequency to a target frequency.

11. The RF control system of claim 10, wherein in the second mode of operation, the RF controller adjusts the frequency without reference to an impedance match condition.

12. The RF control system of claim 10, wherein in the first mode of operation, the frequency is adjusted within a predetermined range about a target frequency.

13. The RF control system of claim 12, wherein in the first mode of operation, the RF controller adjusts the frequency to vary an impedance match condition.

14. The RF control system of claim 12, wherein in the second mode of operation, the RF controller adjusts the frequency without reference to an impedance match condition.

15. The RF control system of claim 1 wherein the matching network communicates a characteristic signal to the RF generator indicative of a characteristic of a respective RF output signal.

16. The RF control system of claim 1 wherein the RF generator operates in a continuous wave mode or a pulse mode.

17. A radio frequency (RF) control system comprising:

a RF generator including a power amplifier that outputs a RF signal, the RF generator generating a RF output signal to a matching network, the matching network receiving the RF signal, the matching network including an impedance tuning element; and

a controller varying a frequency of the RF signal and communicating commands to the matching network to adjust the impedance tuning element,

wherein in a first mode of operation, the controller adjusts the frequency of the RF signal and the tuning element to vary an impedance between the RF generator and a load and in a second mode of operation, the controller adjusts the frequency of the RF signal to a target frequency while adjusting the tuning element to vary the impedance .

18. The RF control system of claim 17, wherein in the first mode of operation, the frequency is adjusted within a predetermined range about a target frequency.

19. The RF control system of claim 18, wherein in the first mode of operation, the RF controller adjusts the frequency to vary the impedance.

20. The RF control system of claim 18, wherein in the second mode of operation, the RF controller adjusts the frequency to a target frequency.

21. The RF control system of claim 20, wherein in the second mode of operation, the RF controller adjusts the frequency without reference to the impedance.

22. The RF control system of claim 20, wherein in the first mode of operation, the RF controller adjusts the frequency to vary the impedance.

23. The RF control system of claim 17, wherein in the second mode of operation, the RF controller adjusts the frequency to a target frequency.

24. The RF control system of claim 23, wherein in the second mode of operation, the RF controller adjusts the frequency without reference to the impedance.

25. The RF control system of claim 23, wherein in the first mode of operation, the frequency is adjusted within a predetermined range about a target frequency.

26. The RF control system of claim 25, wherein in the first mode of operation, the RF controller adjusts the frequency to vary the impedance.

27. The RF control system of claim 25, wherein in the second mode of operation, the RF controller adjusts the frequency without reference to the impedance.

28. The RF control system of claim 17 wherein the RF generator operates in a continuous wave mode or a pulse mode.

29. A controller for a radio frequency (RF) control system, the RF control system including a RF generator having a power amplifier that outputs a RF signal to a matching network, the matching network receiving the RF signal, the matching network including at least one impedance tuning element, the controller varying a frequency of the RF signal and communicating commands to the matching network to adjust the impedance tuning element, wherein in a first mode of operation, the controller adjusts the frequency of the RF signal and the tuning element to provide an impedance match between the RF generator and a load and in a second mode of operation, the controller adjusts the impedance tuning element to provide an impedance match between the RF generator and the load and inhibits adjusting the frequency of the RF signal to adjust the impedance match, while adjusting the frequency of the RF signal.

30. The controller of claim 29 wherein in the first mode of operation, the controller adjusts the frequency and the tuning element to vary the impedance match between the RF generator and the load and in the second mode of operation, the controller adjusts only the impedance tuning element to vary the impedance match between the RF generator and the load.

31. The controller of claim 29 wherein the tuning element includes a load element and a tune element, and in the first and second modes of operation, the controller adjusts the load element and the tune element.

32. The controller of claim 31 wherein in the first mode of operation, the controller adjusts the frequency, the load element, and the tune element to maintain the impedance match between the RF generator and the load and in the second mode of operation, the controller adjusts the frequency to a target frequency.

33. The controller of claim 29, wherein in the first mode of operation, the frequency is adjusted within a predetermined range about a target frequency.

34. The controller of claim 33, wherein in the first mode of operation, the RF controller adjusts the frequency to vary the impedance match.

35. The controller of claim 33, wherein in the second mode of operation, the RF controller adjusts the frequency to a target frequency.

36. The controller of claim 35, wherein in the second mode of operation, the RF controller adjusts the frequency without reference to the impedance match.

37. The controller of claim 35, wherein in the first mode of operation, the RF controller adjusts the frequency to vary the impedance match.

38. The controller of claim 29, wherein in the second mode of operation, the RF controller adjusts the frequency to a target frequency.

39. The controller of claim 38, wherein in the second mode of operation, the RF controller adjusts the frequency without reference to the impedance match.

40. The controller of claim 38, wherein in the first mode of operation, the frequency is adjusted within a predetermined range about a target frequency.

41. The controller of claim 40, wherein in the first mode of operation, the RF controller adjusts the frequency to vary the impedance match.

42. The controller of claim 40, wherein in the second mode of operation, the RF controller adjusts the frequency without reference to the impedance match.

43. The controller of claim 29 wherein the RF generator operates in a continuous wave mode or a pulse mode.

44. A method for controlling a radio frequency (RF) system having a RF generator comprising:

generating a RF signal and varying a frequency of the RF signal; and

in a first mode of operation, adjusting the frequency of the RF signal and a tuning element of a matching network in response to an impedance match condition and in a second mode of operation adjusting only the tuning element while adjusting the frequency of the RF signal to a target frequency independently of an impedance match condition.

45. The method of controlling the RF system of claim 44 further comprising in the first mode of operation, adjusting the frequency and the tuning elements of a matching network to vary an impedance between the RF generator and a load and in the second mode of operation, adjusting only the tuning element to vary the impedance between the RF generator and the load.

46. The method of controlling the RF system of claim 44 wherein in the first mode of operation, adjusting a frequency of the RF signal, and at least one of a load element of the matching network or a tune element of a matching network and in the second mode of operation, adjusting only at least one of the load element of the matching network or the tune element of the matching network.

47. The method of controlling the RF system of claim 46 wherein in the first mode of operation, adjusting the frequency, and at least one of the load element or the tune element to vary an impedance between the RF generator and a load and in the second mode of operation, adjusting only at least one of the load element or the tune element to vary the impedance between the RF generator and the load.

48. The method of controlling the RF system of claim 44, wherein in the first mode of operation, adjusting the frequency within a predetermined range about a target frequency.

49. The method of controlling the RF system of claim 48, wherein in the first mode of operation, adjusting the frequency to vary the match condition.

50. The method of controlling the RF system of claim 48, wherein in the second mode of operation, adjusting the frequency to a target frequency.

51. The method of controlling the RF system of claim 50, wherein in the second mode of operation, adjusting the frequency without reference to the match condition.

52. The method of controlling the RF system of claim 50, wherein in the first mode of operation, adjusting the frequency to vary the match condition.

53. The method of controlling the RF system of claim 44, wherein in the second mode of operation, adjusting the frequency to a target frequency.

54. The method of controlling the RF system of claim 53, wherein in the second mode of operation, adjusting the frequency without reference to the match condition.

55. The method of controlling the RF system of claim 53, wherein in the first mode of operation, adjusting the frequency within a predetermined range about a target frequency.

56. The method of controlling the RF system of claim 55, wherein in the first mode of operation, adjusting the frequency to vary the match condition.

57. The method of controlling the RF system of claim 55, wherein in the second mode of operation, adjusting the frequency without reference to the match condition.

58. The method of controlling the RF system of claim 44 further comprising operating the RF generator in a continuous wave mode or a pulse mode.

59. A controller for a radio frequency (RF) control system operable in one of two modes comprising a first mode of operation, in which the controller adjusts a frequency of a RF signal and an impedance tuning element to vary an impedance match between a RF generator and a load and a second mode of operation in which the controller adjusts the impedance tuning element to vary an impedance match between the RF generator and the load and inhibits adjusting the frequency of the RF signal to vary the match, while adjusting the frequency of the RF signal.

60. The controller of claim 59 wherein in the first mode of operation, the controller adjusts the frequency and the tuning element to maintain the match between the RF generator and the load and in the second mode of operation, the controller adjusts only the tuning element to vary the match.

61. The controller of claim 59 wherein the tuning element includes a load element and a tune element, and in the first and second modes of operation, the controller adjusts the load element and the tune element.

62. The controller of claim 61 wherein in the first mode of operation, the controller adjusts the frequency and at least one of the load element or the tune element to maintain the match between the RF generator and a load and in the second mode of operation, the controller adjusts the frequency to a target frequency.

63. The controller of claim 59, wherein in the first mode of operation, the frequency is adjusted within a predetermined range about a target frequency.

64. The controller of claim 63, wherein in the first mode of operation, the RF controller adjusts the frequency to vary the match.

65. The controller of claim 63, wherein in the second mode of operation, the RF controller adjusts the frequency to a target frequency.

66. The controller of claim 65, wherein in the second mode of operation, the RF controller adjusts the frequency without reference to the match.

67. The controller of claim 65, wherein in the first mode of operation, the RF controller adjusts the frequency to vary the match.

68. The controller of claim 59, wherein in the second mode of operation, the RF controller adjusts the frequency to a target frequency.

69. The controller of claim 68, wherein in the second mode of operation, the RF controller adjusts the frequency without reference to the match.

70. The controller of claim 68, wherein in the first mode of operation, the frequency is adjusted within a predetermined range about a target frequency.

71. The controller of claim 70, wherein in the first mode of operation, the RF controller adjusts the frequency to vary the match.

72. The controller of claim 70, wherein in the second mode of operation, the RF controller adjusts the frequency without reference to the match.

CLAIMS

1. A radio frequency (RF) control system comprising:

a RF generator including a power amplifier that outputs a RF signal having an adjustable target frequency, the RF generator also including a controller, the controller varying the frequency of the RF signal; and

a matching network receiving the RF signal, the matching network including at least one impedance tuning element, the impedance tuning element being adjustable in accordance with commands communicated from the controller,

wherein in a first mode of operation when the RF signal is at a first target frequency, the controller enables adjustment of both the frequency of the RF signal about the target frequency and the tuning element to vary an impedance match and in a second mode of operation, when the RF signal is adjusting to a second target frequency, the controller inhibits adjustment of the frequency of the RF signal about the target frequency to vary an impedance match and enables adjustment of the impedance tuning element to vary an impedance match.

2. The RF control system of claim 1, wherein in the first mode of operation, the frequency is adjusted within a predetermined range about a target frequency.

3. The RF control system of claim 2, wherein in the second mode of operation, the controller otherwise adjusts the frequency.

4. The RF control system of claim 3, wherein in the second mode of operation, the controller adjusts the frequency without reference to an impedance match condition.

5. The RF control system of claim 3, wherein in the first mode of operation, the controller adjusts the frequency to vary an impedance match condition.

6. The RF control system of claim 2, wherein in the first mode of operation, the controller adjusts the frequency to vary an impedance match condition.

7. The RF control system of claim 1, wherein in the second mode of operation, the controller otherwise adjusts the frequency.

8. The RF control system of claim 7, wherein in the first mode of operation, the frequency is adjusted within a predetermined range about a target frequency.

9. The RF control system of claim 8, wherein in the first mode of operation, the controller adjusts the frequency to vary an impedance match condition.

10. The RF control system of claim 8, wherein in the second mode of operation, the controller adjusts the frequency without reference to an impedance match condition.

11. The RF control system of claim 7, wherein in the second mode of operation, the controller adjusts the frequency without reference to an impedance match condition.

12. The RF control system of claim 1 wherein the tuning element includes a load element and a tune element, and in the first and second modes of operation, the controller adjusts at least one of the load element and the tune element.

13. The RF control system of claim 12 wherein in the first mode of operation, the controller adjusts the frequency and at least one of the load element and the tune element to provide an impedance match between the RF generator and a load and in the second mode of operation, the controller adjusts at least one of the load element and the tune element to provide an impedance match between the RF generator and the load and otherwise adjusts the frequency.

14. The RF control system of claim 1 wherein in the first mode of operation, the controller enables the adjustment of the frequency and the tuning element to provide an impedance match between the RF generator and a load and in the second mode of operation, the controller enables adjustment of the impedance tuning element to provide an impedance match between the RF generator and the load and inhibits adjustment of the frequency of the RF signal to provide an impedance match while otherwise adjusting the frequency of the RF signal.

15. The RF control system of claim 1 wherein the matching network communicates a characteristic signal to the RF generator indicative of a characteristic of a respective RF output signal.

16. The RF control system of claim 1 wherein the RF generator operates in a continuous wave mode or a pulse mode.