[0020] Spatially relative terms, such as “inner,” “outer,” "beneath," "below," "lower," "above," "upper," and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. Spatially relative terms may be intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as "below" or "beneath" other elements or features would then be oriented "above" the other elements or features. Thus, the example term "below" can encompass both an orientation of above and below. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

[0021] In FIG. 1, a power generator system 10 is shown. The power generator system 10 includes an amplifier input module 12, a driver module 14, a power amplifier (PA) module (or simply PA) 16, and a load 18. The amplifier input module 12 receives and conditions a radio frequency (RF) signal 20 to generate a conditioned signal 22. The amplifier input module 12 may include, for example, a pre-amplifier. The conditioned signal 22 is provided to the driver module 14. Output of the driver module 14 is received by the PA module 16, which may be a high-power RF PA module. By way of a non-limiting example, the PA module 16 may provide a power output of greater than or equal to 2.5 kilowatts (kW). Output of the PA module 16 drives the load 18.

[0022] The load 18 may include ~~be~~ any of a number of elements or devices driven by a RF signal, including, by way of a non-limiting example, a plasma chamber. The load 18 may include broadband mismatched loads (i.e. cables with mismatched resistor terminations), narrowband mismatched loads (i.e. a 2-element matching network) and resonator loads.

[0023] Referring now also to FIG. 2, an example of the PA module 16 (identified as 16’) is shown. The power amplifier module 16’ may include a front end module 50, a combiner module 52, and an output module 54. The front end module 50 may include an input PA module 56, impedance transformation modules 58, 60, and switch modules 62, 64. The input PA module 56 receives

capacitances C2 and C3. The resistances R1 and R3 are used to provide an input impedance that can be easily matched at the outputs 112, 128 of the inductors L2, L3 and/or at the input (e.g., input 66) of the front end module 50'.

[0033] In one example implementation, each of the resistances R1, R3 is less than approximately 50Ω. In another nominal example implementation, each of the resistances is approximately equal to 12Ω±1Ω when operating at a 40MHz frequency. If higher impedance matching values are desired then higher resistance values may be used. As yet another nominal example implementation, each of the resistances R1, R3 is approximately 47Ω±1Ω when operating at a 60MHz frequency. Resistance values of resistances R1 and R3 may be varied, for example, based on the frequency of operation. The resistance values of the resistances R1 and R3 may be based on trade offs between two or more of PA input return loss (S11), PA gain (S21) and PA stability. S21 is a scattering parameter and is a forward transmission coefficient of a 50Ω terminated output.

[0034] The resistances R1 and R3 reduce the impedance at the inputs 114, 130 of the capacitances C2 and C3. The resistances R1 and R3 also dissipate reflected power received from the switch modules 62', 64'. This prevents the reflected power from being received by a driver module (e.g., the driver module 14). The reflected power can negatively affect performance of the driver module and/or performance of other PAs operating in parallel with the PA module of the front end module (e.g., the PA module 16). At certain operating frequencies (e.g. greater than 60MHz where transistor gain is low), the resistances R1 and R3 may not be included (i) when stability requirements are satisfied and (ii) to simplify the structure of the PA module.

[0035] The first switch module 62' includes the switch Q1. The second switch module 64' includes the switch Q2. The switches Q1 and Q2 include respective drains, gates and sources. The drains provide output signals of the switch elements Q1 and Q2. The gates are connected to the outputs 118, 132 of the capacitances C2 and C3. The sources are connected to the ground 116.

[0036] The resistances R2 and R4 may have resistance values greater than, for example, 100Ω. In one example implementation, the resistances R2

CLAIMS

What is claimed is:

1. A power amplifier comprising:

a first input module comprising a transformer and configured to receive a first radio frequency signal and generate output signals;

impedance transformation modules each of which having an output impedance and configured to receive a respective one of the output signals from the transformer; and

switch modules each of which comprising a transistor and connected to an output of one of the impedance transformation modules, wherein the transistor has an input impedance and outputs an amplified signal, and

wherein each of the output impedances is mismatched relative to a respective one of the input impedances.

2. The power amplifier of claim 1, wherein the input power amplifier comprises:

an inductance having an input and an output, wherein the input of the inductance is configured to receive the first radio frequency signal; and

a capacitance having a first terminal connected to the output of the inductance and to an input of the transformer.

3. The power amplifier of claim 1, wherein the impedance transformation modules are each configured to dissipate reflected power received from the switch modules.

4. The power amplifier of claim 1, wherein:

each of the impedance transformation modules comprises a capacitance,

the capacitance is in series with a respective output of the transformer and is connected to a control input of a respective one of the transistors.

each of the impedance transformation modules further comprises a biasing circuit; and

the biasing circuit is connected to an output of one of the capacitances and is configured to generate a bias voltage.

13. The power amplifier of claim 1, further comprising:

a combiner module configured to combine outputs of the transistors to generate a combined output signal; and

an output module configured to filter the combined output signal to generate a power amplifier output signal.

14. ~~A power generator system~~The power amplifier of claim 13 comprising:

a second input module configured to receive a second radio frequency signal and generate a conditioned signal;

a driver module configured to receive the conditioned signal and generate the first radio frequency signal; and

~~the power amplifier of claim 13; and~~

a load configured to receive the power amplifier output signal.

15. A power amplifier comprising:

an input module comprising a transformer and configured to receive a first radio frequency signal, wherein the transformer comprises

a first end configured to output a first output signal based on the first radio frequency signal, and

a second end configured to output a second output signal based on the first radio frequency signal;

a first capacitance in series with the first end and having a first output impedance;

a second capacitance in series with the second end and having a second output impedance;

a first transistor comprising a control terminal connected to the first capacitance, having a first input impedance, and outputting a first amplified

signal, wherein the first input impedance does not match the first output impedance; and

a second transistor comprising a control terminal connected to the second capacitance, having a second input impedance, and outputting a second amplified signal, wherein the second input impedance does not match the second output impedance.

16. The power amplifier of claim 15, wherein the input power amplifier comprises:

an inductance having an input and an output, wherein the input of the inductance is configured to receive the first radio frequency signal; and

a capacitance having a first terminal connected to the output of the inductance and to an input of the transformer.

17. The power amplifier of claim 15, further comprising:

a first inductance in series between the first end and the first capacitance;

a first resistance having a first terminal and a second terminal, wherein the first terminal of the first resistance is connected to the first inductance and to an input of the first capacitance, and wherein the second terminal of the first resistance receives a reference voltage;

a second inductance in series between the second end and the second capacitance; and

a second resistance having a first terminal and a second terminal, wherein the first terminal of the second resistance is connected to the second inductance and to an input of the second capacitance, and wherein the second terminal of the second resistance receives the reference voltage.

18. The power amplifier of claim 17, wherein:

the first resistance

reduces an impedance at an input of the first capacitance and dissipates a first reflected power signal received by the first transistor, and