CLAIMS

1. A cryogenic radio-frequency resonator system comprising:

an inductive device disposed at least partially within a rigid thermally conductive substrate;

a cryogenic capacitive device coupled to the inductive device and mounted on a circuit board that is disposed partially within the rigid thermally conductive substrate to form a rigid cryogenic resonant circuit with an associated circuit impedance value;

a radio-frequency (RF) input port to route an input RF signal to the rigid cryogenic resonant circuit, the rigid cryogenic resonant circuit generating an impedance-matched RF signal; and

an RF output port to provide the impedance-matched RF signal to an external cryogenic device.

2. The system of claim 1, wherein:

the rigid cryogenic resonant circuit includes an amplifier circuit;

the amplifier circuit generates an impedance-matched amplified RF signal; and

the RF output port provides the impedance-matched amplified RF signal to the external cryogenic device.

3. The system of claim 1, further including a thermally conductive enclosure.

4. The system of claim 3, wherein the thermally conductive enclosure includes a thermally conductive high-purity copper.

5. The system of claim 3, wherein the rigid thermally conductive substrate is thermally coupled to the thermally conductive enclosure.

6. The system of claim 3, wherein the thermally conductive enclosure includes at least one thermally conductive surface configured to mate with a thermally conductive mounting substrate.

7. The system of claim 1, wherein the cryogenic capacitive device includes a cryogenic capacitive material.

8. The system of claim 2, wherein the cryogenic capacitive device is configured to provide an adjustable capacitance, the adjustable capacitance modifying the amplifier impedance.

9. The system of claim 8, wherein the cryogenic capacitive device includes a plurality of capacitors, each of the plurality of capacitors configured to be removable to provide the adjustable capacitance.

10. The system of claim 8, wherein the cryogenic capacitive device includes a user-selectable capacitance to provide the adjustable capacitance.

11. A cryogenic radio-frequency resonator method comprising:

receiving an input radio-frequency (RF) signal via an RF input port at a rigid cryogenic resonant circuit, the rigid cryogenic resonant circuit including an inductive device disposed at least partially within a rigid thermally conductive substrate and a cryogenic capacitive device coupled to the inductive device and mounted on a circuit board that is disposed partially within the rigid thermally conductive substrate to form the rigid cryogenic resonant circuit;

generating an impedance-matched RF signal at the rigid cryogenic resonant circuit based on the input RF signal; and

providing the impedance-matched RF signal via an RF output port to an external cryogenic device.

12. The method of claim 11, wherein:

the rigid cryogenic resonant circuit includes an amplifier circuit;

the generation of the impedance-matched RF signal at the rigid cryogenic resonant circuit includes generating an impedance-matched amplified RF signal; and

the provision of the impedance-matched RF signal includes providing the impedance-matched amplified RF signal to the external cryogenic device.

13. The method of claim 11, wherein the rigid cryogenic resonant circuit is disposed within a thermally conductive enclosure.

14. The method of claim 13, wherein the thermally conductive enclosure includes a thermally conductive high-purity copper.

15. The method of claim 13, wherein the rigid substrate includes a thermally conductive substrate and is thermally coupled to the thermally conductive enclosure.

16. The method of claim 13, wherein the thermally conductive enclosure includes at least one thermally conductive surface configured to mate with a thermally conductive mounting substrate.

17. The method of claim 11, wherein the cryogenic capacitive device includes a cryogenic capacitive material.

18. The method of claim 11, wherein the cryogenic capacitive device is configured to provide an adjustable capacitance, the adjustable capacitance modifying a circuit impedance value associated with the rigid cryogenic resonant circuit.

19. The method of claim 18, wherein the cryogenic capacitive device includes a plurality of capacitors, each of the plurality of capacitors configured to be removable to provide the adjustable capacitance.

20. The method of claim 18, further including receiving a user-selectable capacitance input to provide the adjustable capacitance.