CLAIMS

What is claimed is:

1. An energy harvesting apparatus, comprising:

an energy harvester for generating electric power from an ambient source;

a power conditioning circuit coupled to the output of the energy harvester; comprising:

~~a boost converter module;~~

a reconfigurable boost/buck-boost converter module configured to switch between a boost converter mode and a buck-boost converter mode; and

a power modification control module;

wherein the power modification control module is configured to initialize the energy harvesting apparatus from inactivity to a normal energy harvesting state by operating the reconfigurable boost/buck-boost converter module in the boost converter ~~module~~mode, and operating the reconfigurable boost/buck-boost converter module in the buck-boost converter mode when an output voltage of the power conditioning circuit rises to a predetermined value.

2. The energy harvesting apparatus of claim 1, wherein the power modification control module comprises a voltage driver module further comprising a voltage divider coupled to a semiconductor switch.

3. The energy harvesting apparatus according to claim 2, wherein the voltage divider comprises a pair of resistors arranged to activate the semiconductor switch when the output voltage rises to the predetermined value.

4. The energy harvesting apparatus according to claim 2, further comprising a converter control module configured to receive a driving signal from the voltage driver module and manipulate semiconductor switches for operating the reconfigurable

boost/buck-boost converter module in any one of the boost converter ~~module~~ mode and the buck-boost converter ~~module~~mode.

5. The energy harvesting apparatus according to claim 2, further comprising an oscillator module configured to provide a waveform variation for operating the reconfigurable boost/buck-boost converter module in any one of the boost converter ~~module~~ mode and the buck-boost converter ~~module~~mode.

~~6. The energy harvesting apparatus according to claim 1, wherein the power conditioning module comprises a combined boost / buck-boost converter arrangement configured to operate as any one of the boost converter module and the buck boost converter module at any time~~.

~~7.~~6. The energy harvesting apparatus according to claim 1, further comprising:

a rectifier coupled to the energy harvester, the rectifier comprising a plurality of semiconductor switches; and

a body bias control module configured to lower a threshold voltage of at least one of the plurality of semiconductor switches.

~~8.~~7. The energy harvesting apparatus according to claim ~~7~~6, wherein the plurality of semiconductor switches comprises any one of P-type semiconductor switches and N-type semiconductor switches, and the body bias control module is configured to connect a body of the P-type semiconductor switches to electrical ground, and to connect a body of the N-type semiconductor switches to a reference voltage.

~~9.~~8. The energy harvesting apparatus according to claim ~~8~~7, wherein the body bias control module comprises a comparator configured to compare the output voltage of the power conditioning circuit to a bandgap voltage.

~~10.~~9. The energy harvesting apparatus according to claim ~~9~~8, wherein the body bias control module connects the body of the P-type semiconductor switches to the reference

voltage, and connects the body of the N-type semiconductor switches to electrical ground, when the output voltage of the power conditioning circuit is larger than the bandgap voltage.

~~11.~~10. A method for operating an energy harvesting apparatus, the energy generating apparatus comprising an energy harvester for generating electric power from an ambient source, the energy harvester coupled to a power conditioning circuit comprising a reconfigurable boost/buck-boost converter configured to switch between a boost converter function and a buck-boost converter function, comprising:

initializing the energy harvesting apparatus from inactivity to a normal generation state, comprising:

carrying out ~~a~~ the boost converter function with the reconfigurable boost/buck-boost converter of the power conditioning ~~module~~circuit; and

monitoring an output voltage of the power conditioning circuit; and

switching from the boost converter function to ~~a~~ the buck-boost converter function with the reconfigurable boost/buck-boost converter of the power conditioning ~~module~~ circuit when the output voltage rises to a predetermined value.

~~12.~~11. The method according to claim ~~11~~10, comprising monitoring the output voltage and switching from the boost converter function to ~~a~~ the buck-boost converter function with a voltage driver module comprising a voltage divider coupled to a semiconductor switch.

~~13.~~12. The method according to claim ~~12~~11, comprising activating the semiconductor switch when a voltage drop across a resistor in the voltage divider rises to the predetermined value.

~~14.~~13. The method according to claim ~~12~~11, further comprising receiving a driving signal from the voltage driver module and manipulating semiconductor switches for operating any one of the boost converter function and the buck-boost converter function.

~~15.~~14. The method according to claim ~~12~~11, further comprising providing a waveform variation for operating any one of the boost converter function and the buck-boost converter function with an oscillator module.

~~16. The method according to claim 11, comprising manipulating a combined boost / buck-boost converter arrangement to operate any one of the boost converter function and the buck-boost converter function with an oscillator module.~~

~~17.~~15. The method according to claim ~~11~~10, wherein the energy harvesting apparatus comprises a rectifier coupled to the energy harvester, the rectifier comprising a plurality of semiconductor switches, the method comprising:

lowering a threshold voltage of at least one of the plurality of semiconductor switches with a body bias control module.

~~18.~~16. The method according to claim ~~17~~15, wherein the plurality of semiconductor switches comprises any one of P-type semiconductor switches and N-type semiconductor switches, the method comprising:

connecting a body of the P-type semiconductor switches to electrical ground; and

connecting a body of the N-type semiconductor switches to a reference voltage.

~~19.~~17. The method according to claim ~~18~~16, further comprising comparing the output voltage of the power conditioning circuit to a bandgap voltage.

~~20.~~18. The method according to claim ~~19~~17, further comprising:

determining when the output voltage of the power conditioning circuit is larger than the bandgap voltage;

connecting the body of the P-type semiconductor switches to the reference voltage; and

connecting the body of the N-type semiconductor switches to electrical ground.