Claims

What is claimed is:

1. An apparatus comprising:

a voltage regulator couplable to a tubing encapsulated cable extending downhole from a surface through a wellbore; and

a shunt current regulator to maintain a stable cable current communicatively coupled to the voltage regulator, the shunt current regulator including a sensing element to monitor a current drawn from the tubing encapsulated cable extending downhole,

wherein the shunt current regulator is couplable to a current load.

2. The apparatus of claim 1, wherein the current load comprises a high-current load connected to the voltage regulator.

3. The apparatus of claim 1, wherein the current load comprises a high-current load and a low-current load coupled in parallel.

4. The apparatus of claim 1, further comprising a computing device to receive a communication from the current load via the tubing encapsulated cable extending downhole.

5. The apparatus of claim 1, wherein the sensing element comprises a current sensing resistive element to produce a voltage monitored by the shunt current regulator.

6. The apparatus of claim 1, further comprising a transistor communicatively coupled to the sensing element, wherein a sense signal from the sensing element is configurable to provide a compensation signal that is applied to the transistor to control the transistor to regulate the current drawn from the tubing encapsulated cable extending downhole.

7. The apparatus of claim 6, further comprising:

a first amplifier connected to the sensing element to amplify the sense signal, wherein the sense signal comprises a voltage across the sensing element; and

a second amplifier connected to the transistor to amplify a correction signal to produce the compensation signal.

8. A method of current regulation, the method comprising:

monitoring, by a sensing element, a current drawn from a tubing encapsulated cable extending downhole from a surface through a wellbore;

generating a sense signal from the sensing element;

generating a compensation signal from the sense signal; and

controlling a transistor to regulate the current drawn from the tubing encapsulated cable extending downhole, wherein the controlling comprises:

dissipating power in the transistor to stabilize the current drawn; and

providing compensation current to increase the current drawn.

9. The method of current regulation of claim 8, wherein the sensing element comprises a current sensing resistive element connected between the tubing encapsulated cable and a shunt current regulator.

10. The method of current regulation of claim 8, further comprising setting a substantially constant current level, the setting comprising at least one of:

a first mode that increases the substantially constant current level to meet a current draw demand;

a second mode that allows an excessive current to be drawn from the tubing encapsulated cable preserving the substantially constant current level; or

a third mode that limits the current to the substantially constant current level.

11. The method of current regulation of claim 10, further comprising transitioning between modes automatically based on a temperature of the transistor or other physical properties of the transistor.

12. A system comprising:

a processing device couplable to a tubing encapsulated cable extending downhole from a surface through a wellbore, wherein the processing device is operable to:

decode communication from a downhole node; and

send communication to the downhole node;

the downhole node comprising:

a switch mode voltage regulator couplable to the tubing encapsulated cable;

a shunt current regulator to maintain a stable cable current couplable to the switch mode voltage regulator, the shunt current regulator including a sensing element to monitor a current drawn from the tubing encapsulated cable extending downhole; and

a current load.

13. The system of claim 12, wherein the current load comprises a high-current load and a low-current load connected in parallel.

14. The system of claim 12, wherein the downhole node further comprises a current sensing active circuit connected between the tubing encapsulated cable and the shunt current regulator.

15. The system of claim 12, wherein the sensing element comprises a current sensing active circuit, wherein the current sensing active circuit produces a voltage monitored by the shunt current regulator.

16. The system of claim 12, comprising a transistor communicatively coupled to the sensing element, wherein a sense signal from the sensing element provides a compensation signal that is applied to the transistor to control the transistor to regulate the current drawn from the tubing encapsulated cable.

17. The system of claim 16, further comprising:

a first amplifier connected to the sensing element to amplify the sense signal, wherein the sense signal comprises a voltage across the sensing element; and a second amplifier connected to the transistor to amplify a correction signal to produce the compensation signal.

18. The system of claim 12, further comprising an inductive coupler connected to the downhole node.

19. The system of claim 12, wherein at least one of the communication from the downhole node or the communication to the downhole node comprises power line communication over the tubing encapsulated cable.

20. The system of claim 12, wherein the shunt current regulator sets the current drawn from the tubing encapsulated cable in accordance with at least one of:

a first mode that increases a substantially constant current level to meet a current draw demand;

a second mode that allows an excessive current to be drawn from the tubing encapsulated cable preserving the substantially constant current level; or

a third mode that limits the current to the substantially constant current level.