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***APEC** Conference and Expo 2011*

A Novel Predictive Energy Balancing Method for Improved Transient Response in Switched Mode Power Converters

Presenter: Bill Morong, PE

APEC

Improving Switched Mode Power Converter Dynamics

Predictive Energy Balance is a powerful technique for better control of switched mode power converters. A patented new control technology shown here allows a flyback converter to exhibit nearly ideal dynamics.

Prediction enables single-cycle response without causing a tendency to exhibit sub-harmonic behavior.

The key is for the control circuitry to follow the underlying kinetic energy equations.

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Energy Balance Equations

Energy Debt of Output Filter Capacitor

$$KEC=(C * (Eref-Eout)^2) / 2$$

Energy Supply of Switched Inductor

$$KEL= (L * I^2) / 2$$

Balance: $K * IL^2 = Vref - Vout$

Where K is a scaling factor

Imbalance: Energy debt yields slow response

Imbalance: Energy excess yields sub-harmonics

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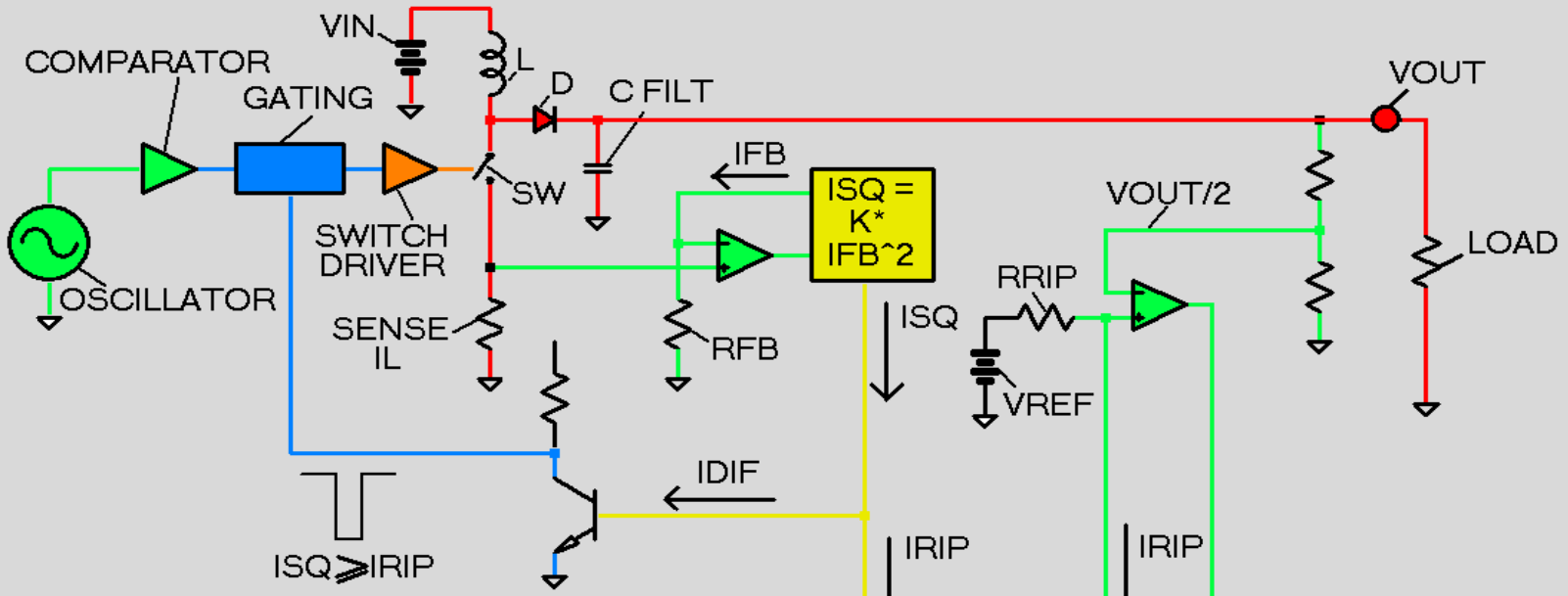
CogniPower Flyback Converter



Simple converter with sub-harmonic purity directly implements energy equations

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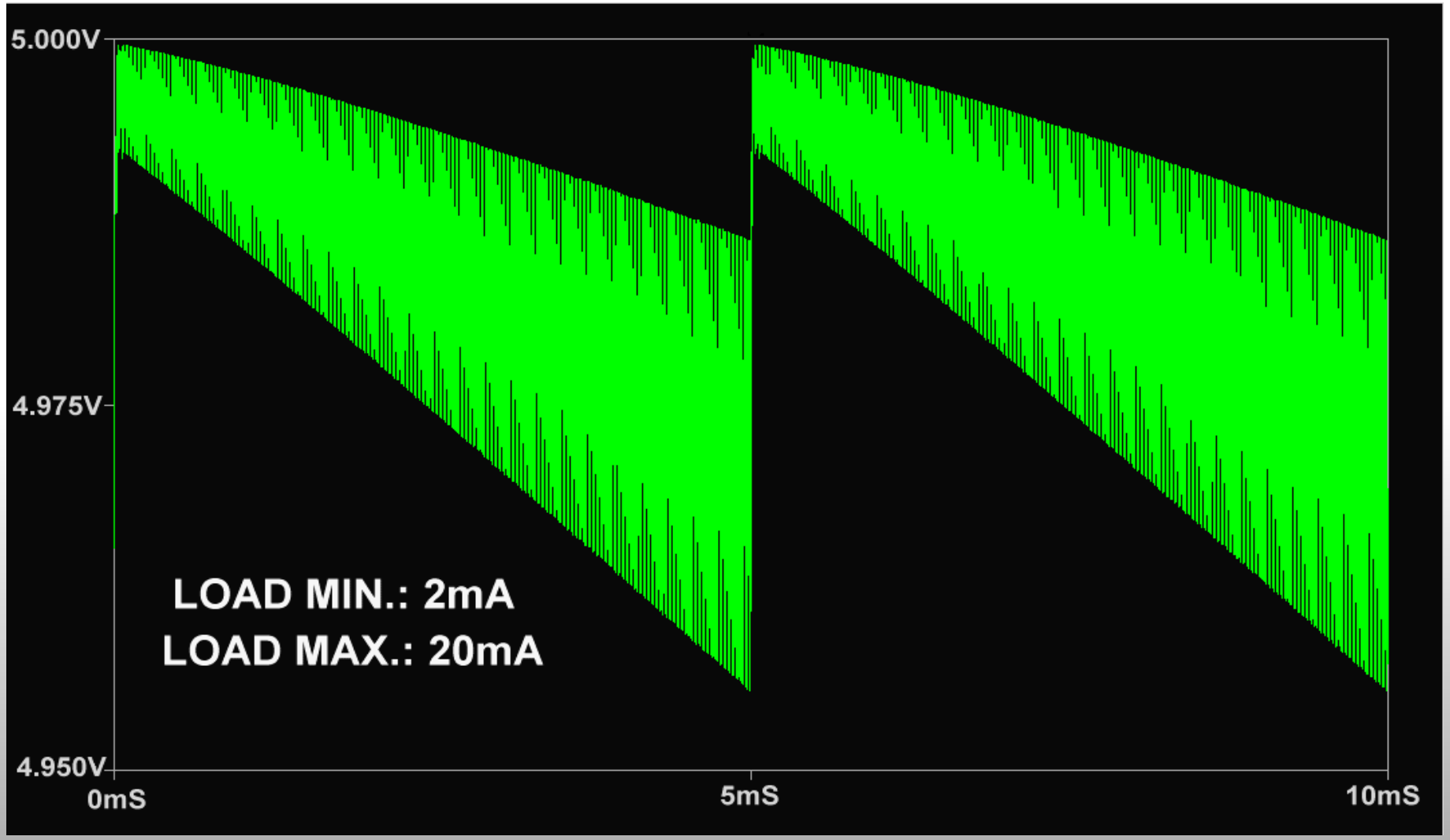
Even the Simplified Form Shows Pure Response

Except for the squaring function in the block diagram, the circuit shown is identical to ordinary flyback converters.

This form is algorithmically simple; it employs no load term or DC feedback.

The following simulations show the output under varying load conditions

Predictive Energy-Balanced Operation



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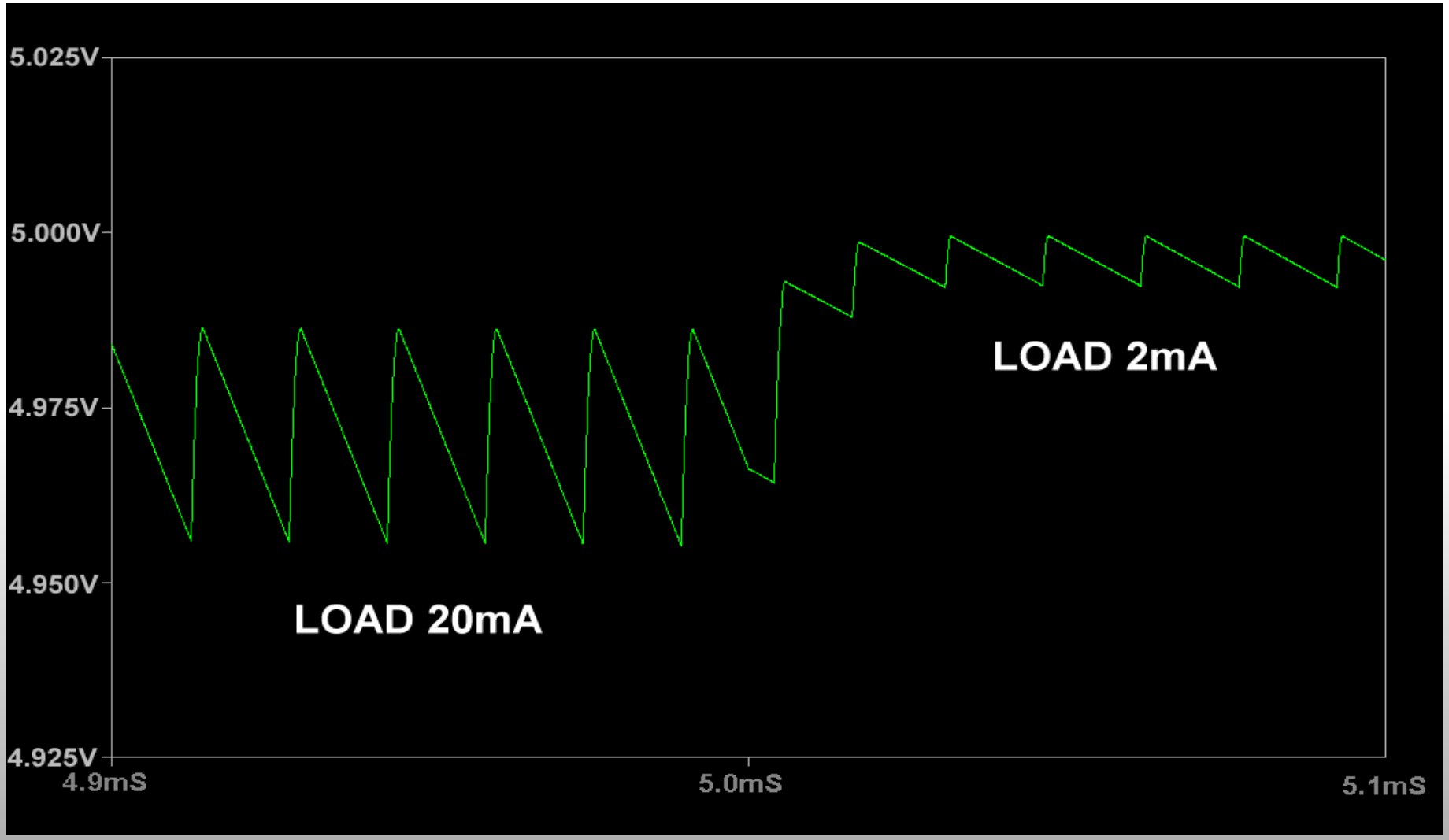
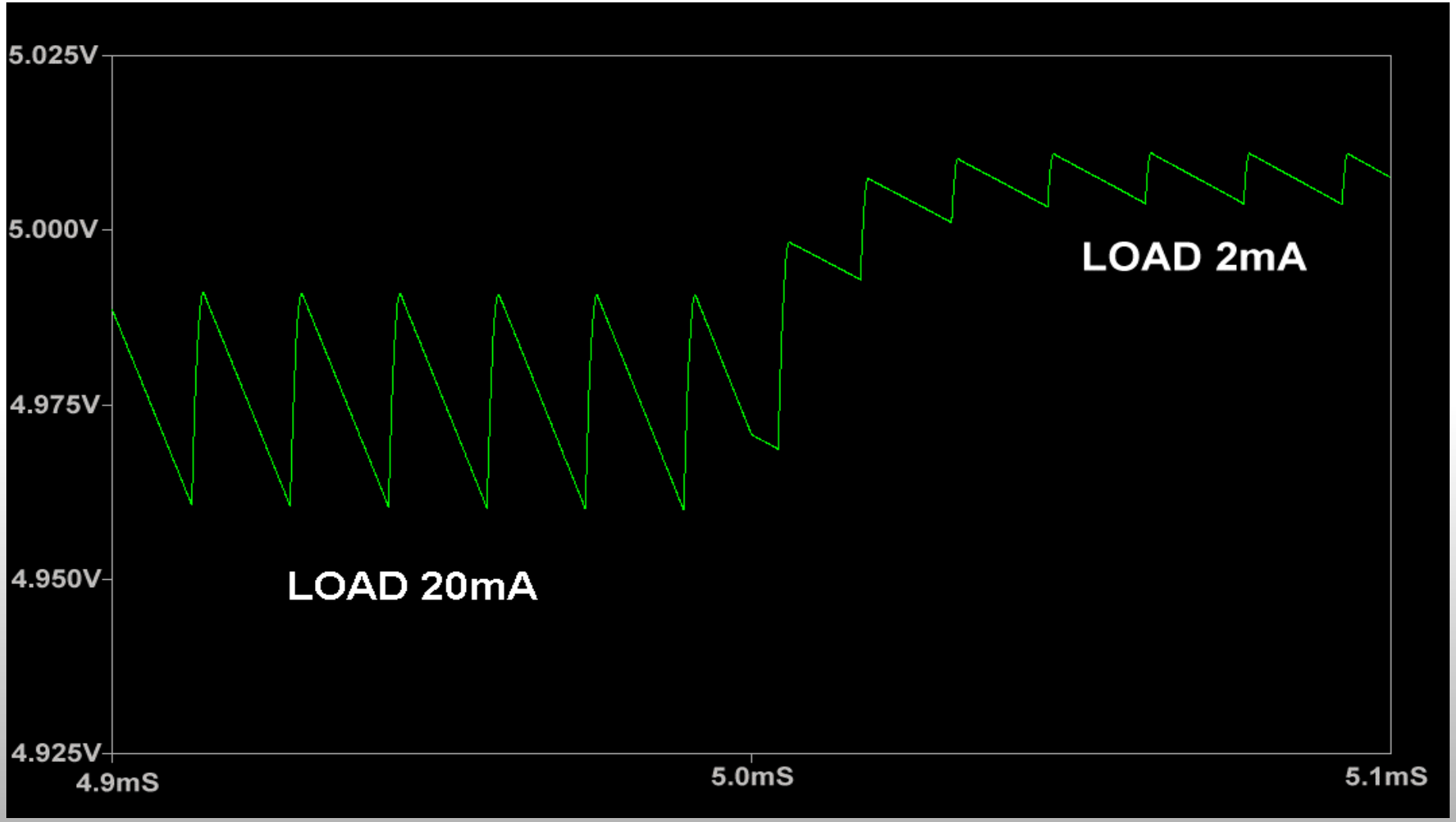
Energy-Balanced Transient Response



Unbalanced: 20% Energy Debt



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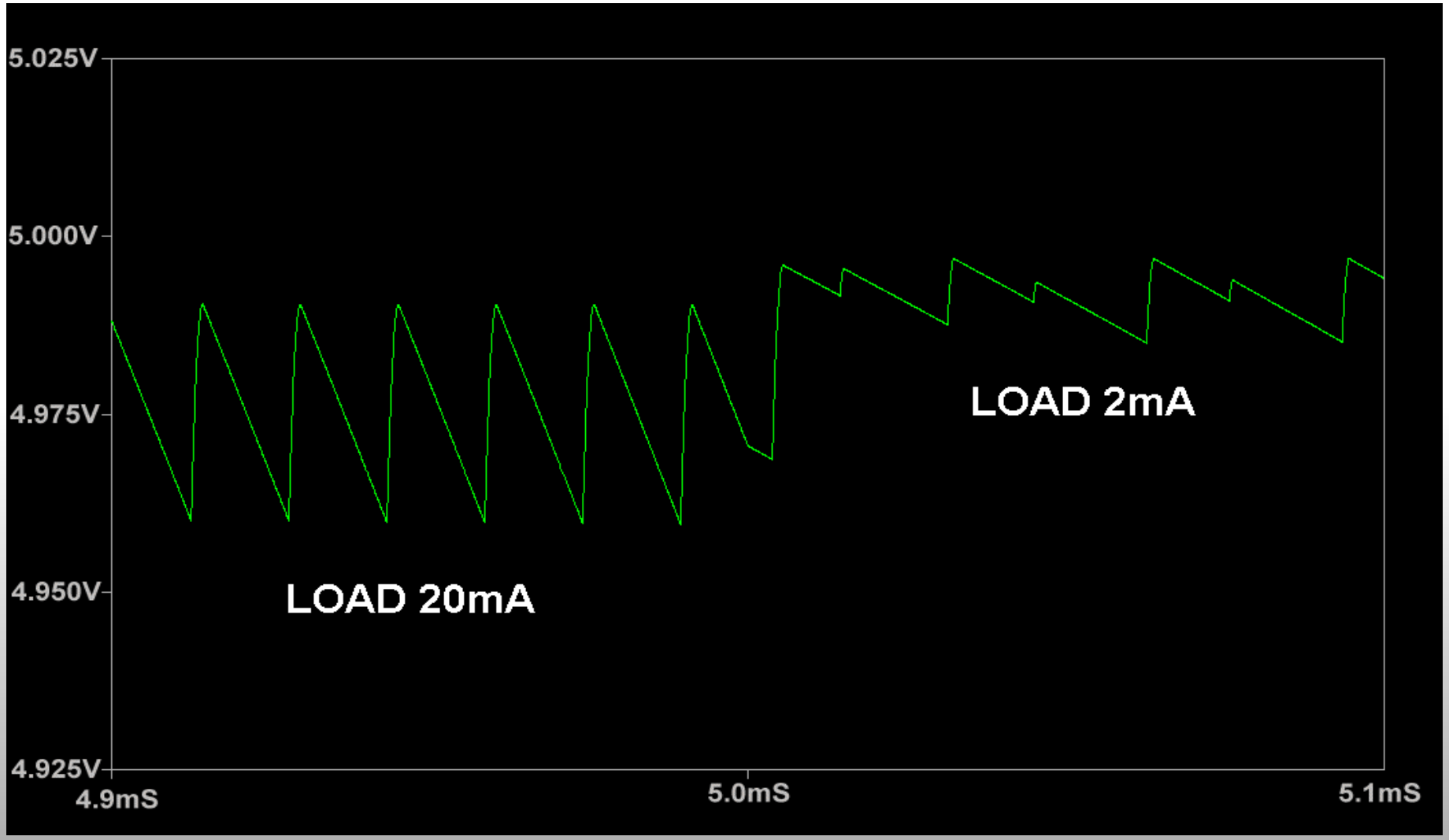
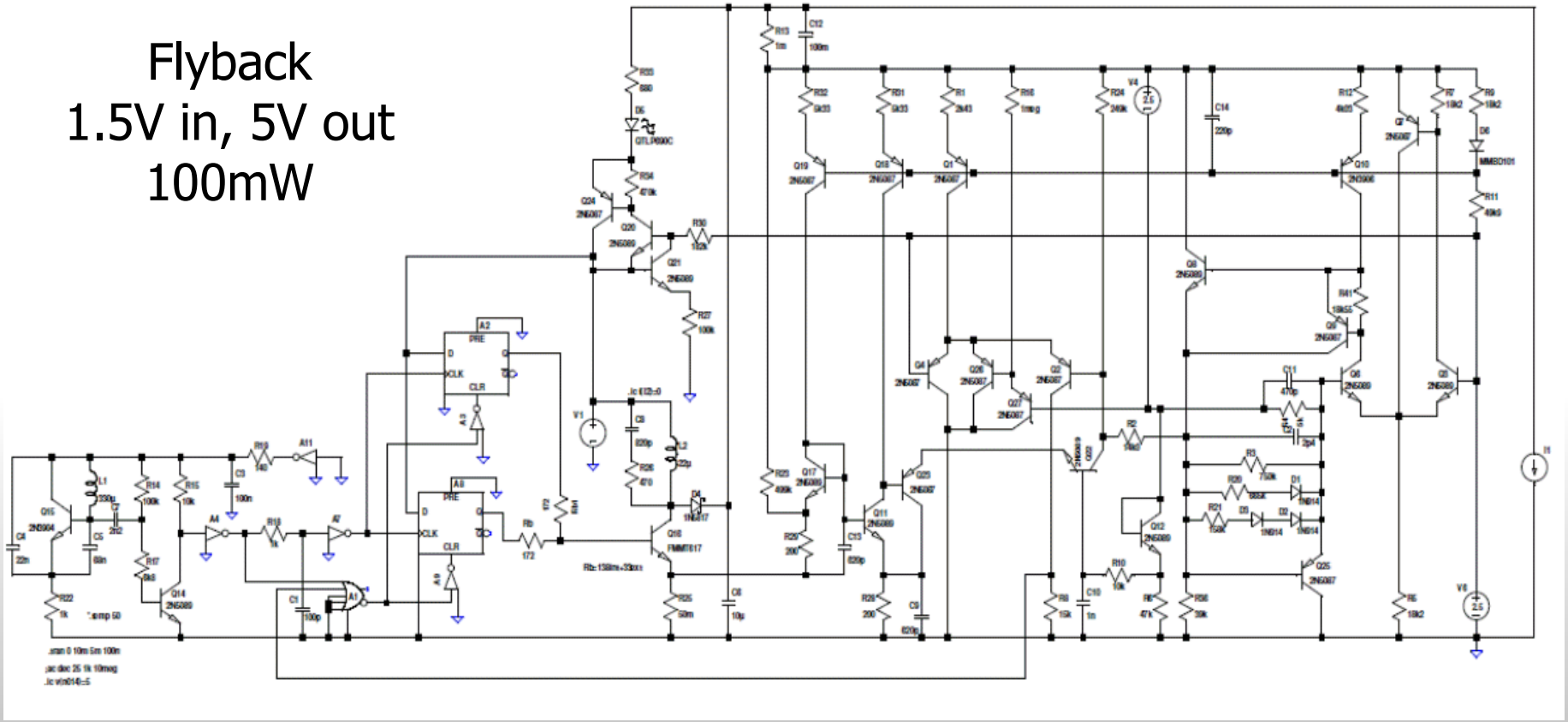
Unbalanced: 10% Energy Excess

Unbalanced: 20% Energy Excess



The Original Energy Balancing Converter

Flyback
1.5V in, 5V out
100mW



Here is the original circuit, built to validate the design for Patent #7,642,758. It works well, but employs more parts than needed.

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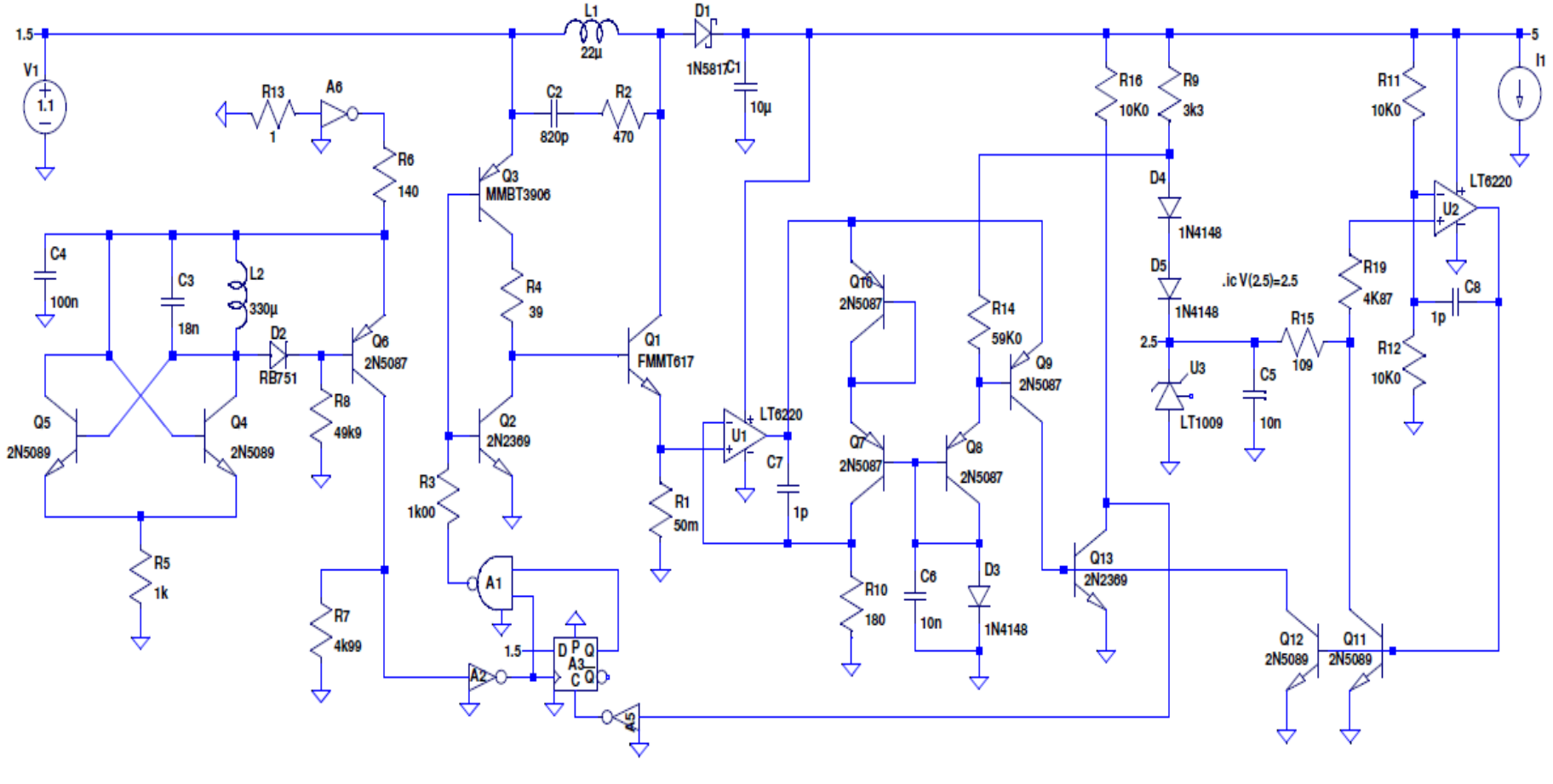
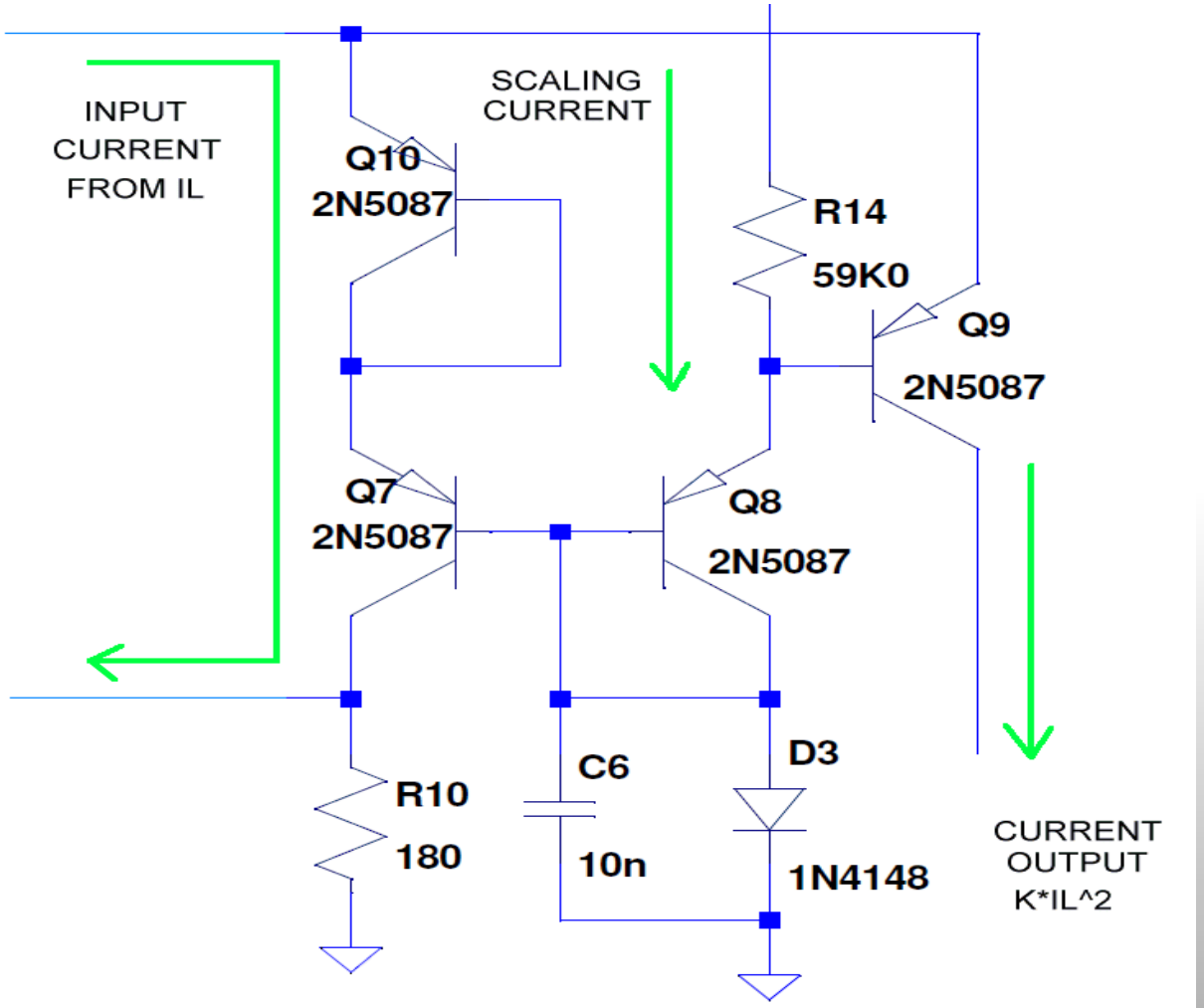
Improved Version, Fewer Parts



Predictive flyback with nearly ideal dynamic performance

The CogniPower Difference



The only addition to a conventional power converter needed to take advantage of energy balancing technology is this simple functional block.

Summary

- Directly implementing kinetic energy calculations greatly improves dynamic response of switched mode converters

- These techniques shown here for flyback converters can also be applied to other converter topologies

- The dynamic response follows the energy laws and does not need to be tuned for variations in operating conditions

- A slower, outside feedback loop can be added to correct for changes in filter capacitance, inductance, temperature, etc.

- The flexibility and agility enabled by predictive energy balance opens the way to new, more capable topologies

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Questions?

Come see us at Booth # 615

Thank you