The Combination of Linear and Adaptive Non-Linear Control for Fast Transient Response in Highly Efficient Voltage Regulators and DC-DC Converters

Power supplies with diverse specifications and capabilities have become a necessity to provide a constant voltage to today’s wide range of electronic devices. In order to operate correctly, electronic devices require this constant voltage for their various components, with some components requiring different amounts of power than the others. One of the main challenges for power supply designers is the creation of voltage regulators which are capable of fast transient response, high current slew rates and low output voltages. A fast transient response will decrease the amount of time it takes for a regulator to convert the input voltage to its desired constant output voltage level upon a sudden change in that input voltage (e.g. when turning on a power supply or during transient voltage spikes). Higher current slew rate capabilities will increase the range in which a power supply can withstand voltage changes. In the past both linear and non-linear approaches were utilized to provide such capabilities to power supply systems. Unfortunately, both methods have their own down falls including low efficiencies for large voltage drops, large amounts of unused energy being dissipating in the form of heat greatly increasing the temperature of the device and the need for bulky equipment. Thus, there is a need to unite these approaches in order to combine the best performances of the slow linear controls and the fast adaptive non-linear controls for enhanced transient response.

**Technical Details**

This invention achieves this combination in order to reduce the delay time of compensation networks for fast transient response. The adaptive non-linear control is only activated in transient periods, combined with linear control to reduce the control delay time. The combination also reduces the requirement of Error Amplifications (EA) compensation networks making the device independent of the linear control bandwidths. Furthermore, this type of control can be easily implemented in a cost effective way, and guarantees the stability of the converter under load current steps, derating and bad designs of the linear control.

**Benefits**

- Largely reduces delay time compared with conventional linear control, resulting in enhanced performance of the device

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• Reduces transient voltage spikes, reducing the risk of damaging the device
• Largely reduces the requirement of an Error Amplifier (EA), enabling the use of less components
• Provides enhanced converter stability, enhancing the capability of handling derating and bad designs of the linear control
• Simplifies the design of linear control, enabling easier implementation and reduced manufacturing cost

Applications

• Voltage regulators

• High current slew rate
• High power density
• High efficiency DC-DC converters (both isolated and non-isolated)

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