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LDO-Assisted DC/DC Converters for Power Management Integrated Systems

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Two different alternatives have been widely used for decades to provide the necessary power supply energy to charge battery systems. These two alternatives are known largely: (1) The use of voltage series linear regulators (classic standard NPN –or nMOS– topologies and LDO), and (2) DC/DC switching converters, thanks to which high current and high efficiency power supply systems can be obtained.

However, a third alternative, linear-assisted DC/DC regulators (or linear-switching hybrid converters) is also possible. They are circuital structures that present an increasing interest for the implementation of power supply systems and battery chargers that require two demanding design specifications: (1) High slew-rate of the output current, and (2) high current consumption by the output load. This it is the case of the systems based on the modern microprocessors and DSPs, where both requirements converge. These linear-switching hybrid regulators are able to combine the well-known advantages of the two existing typical alternatives for the implementation of DC/DC voltage regulators or converters, diminishing as well their disadvantages. They are an attractive alternative susceptible to be used in photovoltaic solar facilities and power management systems as DC/DC converters and battery charge regulators.

This structure consists, mainly, of a voltage linear regulator in parallel with a step-down switching DC/DC converter. In this topology, on the one hand, the value of the output voltage, supposed constant, is fixed with good precision by the voltage linear regulator. The current through this linear regulator controls the switching element of the DC/DC converter. On the other hand, the power stage (that is, the switching converter) injects at the output the current required to force to a minimum value (not necessarily zero) the current through the linear regulator. As a consequence, it is obtained, altogether, a power supply system where the switching frequency comes fixed, among other parameters, by the value of the current through the linear regulator. As an additional advantage of the structure, it can be emphasized that the use of filters in the respective outputs of the linear and switching blocks is not, in this case, necessary.

The present article shows a review and the modeling of linear-assisted DC-DC regulators as candidate topology for photovoltaic solar facilities.

Keywords: Battery chargers, DC-DC switching converters, voltage linear regulators, linear-assisted DC-DC voltage regulators, hysteretic control.