P O W E R

DESIGN FAQs

Frequently Asked Questions:

NON-ISOLATED DC-DC CONVERTERS

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What's the difference between isolated and non-isolated dc-dc converters?

Isolation describes the electrical separation between the input and output of a dc-dc converter. An isolated dc-dc converter uses a transformer to eliminate the dc path between its input and output. In contrast, a non-isolated dc-dc converter has a dc path between its input and output. Non-isolated dc-dc converter designs usually employ ICs specifically intended for that purpose.

Why is isolation necessary for system power sources?

For safety considerations, there must be isolation between an electronic system's ac input and dc output. Isolation requirements cover all systems operating from the ac power line, which can include an isolated front-end ac-dc power supply followed by an isolated "brick" dc-dc converter, followed by a non-isolated point-of-load converter. Typical isolation voltages for ac-dc and dc-dc power supplies run from 1500 to 4000 V, depending on the application.

What are typical applications for non-isolated dc-dc converter ICs?

Battery-based systems that don't use the ac power line represent a major application for non-isolated dc-dc converters. Point-of-load dc-dc converters that draw input power from an isolated dc-dc converter, such as a bus converter, represent another widely used non-isolated application.

What is the circuit for a typical non-isolated dc-dc converter IC?

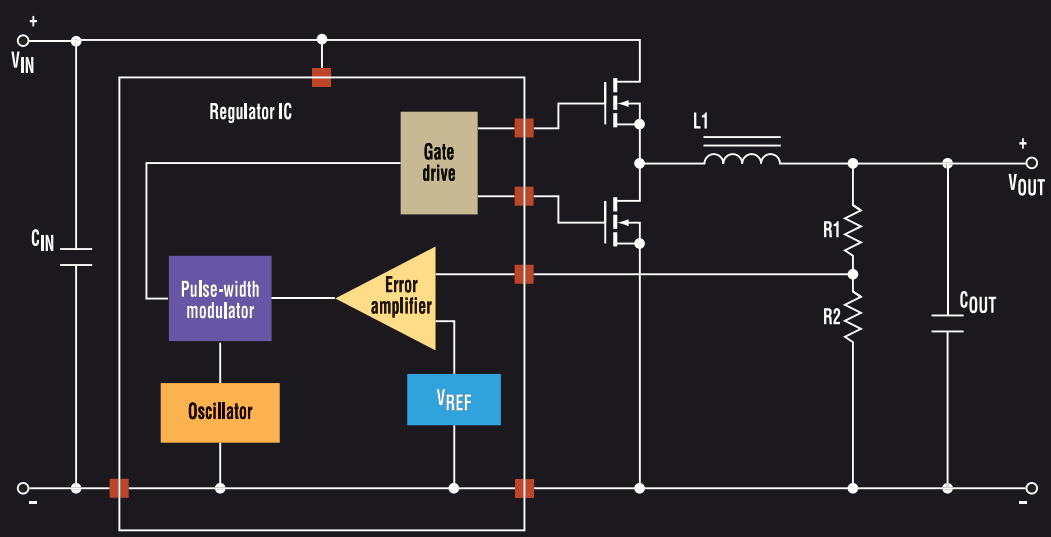
The figure shows a simplified schematic of non-isolated buck converter IC. Resistors R1 and R2 form a voltage divider that sets this buck converter's output voltage. This enables a non-isolated dc-dc converter to have different output voltages by using precision resistors to set the output to 1.8, 2.5, 3.3, or 5.0 V, and so on.

What typical component configurations fit isolated switch-mode dc-dc converter ICs?

Isolated dc-dc converters use a switching transformer whose secondary is either diode- or synchronous-rectified to produce a dc output voltage using an inductor-capacitor output filter. It usually employs an optocoupler that provides an isolated feedback voltage. Flyback or forward converters are typical topologies. This configuration has the advantage of producing multiple output voltages by adding secondary transformer windings.

What typical component configurations fit non-isolated switch-mode dc-dc converter ICs?

Most of these dc-dc converter ICs use either an internal or external synchronous rectifier. Their only magnetic component is usually an output



This non-isolated buck converter IC uses an external synchronous converter consisting of n-channel power MOSFETs. It feeds back a non-isolated dc voltage, whereas an isolated converter would require an optocoupler for feedback.

inductor. For the same power and voltage levels, it usually has lower cost and fewer components while requiring less pc-board area than an isolated dc-dc converter. This type of dc-dc converter also is less susceptible to generating electromagnetic interference because its only magnetic component is an inductor.

Why is the non-isolated dc-dc converter IC's input capacitor important?

The dominating factor that usually sets an input capacitor's size is its current-handling capability. The package size and capacitor's equivalent series resistance (ESR) usually determine this capability. If these two criteria are met, there's usually enough capacitance to prevent impedance interactions with the input voltage source. Generally, use a ceramic capacitor for the input filtering because it provides the combination of low impedance and small footprint. C_{IN} is the input capacitor in the figure.

Why is the non-isolated dc-dc converter IC's output filter important?

The output filter consists of an inductor (L1 in the figure) and capacitor (C_{OUT} in the figure). Because the output capacitor is part of the dc-dc converter's feedback loop, its size and ESR are important. The inductor's characteristics affect output ripple as well as circuit stability. The inductor's important parameters include its inductance, saturation current, and core material. The saturation current should be higher than the maximum output current so it can handle any ripple or momentary overcurrent events.

Is soft-start necessary in a non-isolated dc-dc converter IC?

Internal soft-start limits inrush current and enables a controlled startup of the dc-dc converter. Without soft-start, the dc-dc converter can produce startup transients that affect other circuits within the system. Most IC soft-start circuits employ an external capacitor that establishes the startup time. ED Online 11265