



Miniature, 15V/1.5A, No-Opto Isolated Flyback AC-DC Converter with Peak Efficiency of 87%, Using the MAX17690

MAXREFDES1309

Introduction

The MAXREFDES1309 is a miniature, no-opto flyback AC-DC converter that accepts input voltage from $24V \pm 15\%VAC/60VDC$ and outputs 15V at 1.5A, suitable for industrial isolation equipments and works from AC/DC input.

Due to its simplicity and low cost, the flyback converter is the preferred choice for low-to-medium isolated DC-DC power-conversion applications. However, the use of an optocoupler or an auxiliary winding on the flyback transformer for voltage feedback across the isolation barrier increases the number of components and design complexity. The MAX17690 eliminates the need for an optocoupler, or auxiliary transformer winding and achieves $\pm 5\%$ output voltage regulation over line, load, and temperature variations.

The MAX17690 implements an innovative algorithm to accurately determine the output voltage by sensing the reflected voltage across the primary winding during the flyback time interval. By sampling and regulating this reflected voltage when the secondary current is close to zero, the effects of secondary-side DC losses in the transformer winding, the PCB tracks, and the rectifying diode on output voltage regulation can be minimized. The MAX17690 also compensates for the negative temperature coefficient of the rectifying diode.

Other features include the following:

- 4.5V to 60V input voltage range
- Programmable switching frequency from 50kHz to 250kHz

- Programmable input enable/undervoltage lockout (UVLO) feature.
- Programmable input overvoltage protection
- Adjustable soft-start
- 2A/4A peak source/sink gate drive capability
- Hiccup mode short-circuit protection
- Fast cycle-by-cycle peak current limit
- Thermal shutdown protection
- Space-saving, 16-Pin, 3mm x 3mm TQFN package
- $-40^{\circ}C$ to $+125^{\circ}C$ operating temperature range

Hardware Specification

An isolated no-opto flyback AC-DC converter using the MAX17690 is demonstrated for a 15V DC output application. The power supply delivers up to 1.5A at 15V. Table 1 shows an overview of the design specification.

Table 1. Design Specification

PARAMETER	SYMBOL	MIN	MAX
Input Voltage	V_{INAC}	20VAC	28VAC
	V_{INDC}	48VDC	60VDC
Frequency	f_{SW}	147kHz	
Peak Efficiency at Full Load	η_{MAX}	87%	
Output Voltage	V_O	15V	
Output Voltage Ripple	$\Delta V_{O(SS)}$	900mV	
Output Current	I_O	15mA	1500mA
Maximum Output Power	P_O	22.5W	

Designed–Built–Tested

This document describes the hardware shown in the [Figure 1](#). The power supply has been built and tested. For more information, refer to the design verification testing document.

The Isolated No-Opto Flyback Converter

One of the drawbacks encountered in most isolated DC-DC converter topologies is that information relating to the output voltage on the isolated secondary side of the transformer must be communicated back to the primary side to maintain output voltage regulation. In a regular isolated flyback converter, this is normally achieved using an optocoupler feedback circuit or an additional auxiliary winding on the flyback transformer. The optocoupler feedback circuits reduce overall power-supply efficiency, and the extra components increase the cost and physical size of the power supply. In addition, an optocoupler feedback circuits are difficult to design reliably due to their limited bandwidth, nonlinearity, high CTR variation, and aging effects. The feedback circuits which employ auxiliary transformer windings also exhibit deficiencies. Using an extra winding adds to the flyback transformer's complexity, physical size, and cost, while load regulation and dynamic response are often poor.

The MAX17690 is a peak current-mode controller designed specifically to eliminate the need for an optocoupler or auxiliary transformer winding feedback in the traditional isolated flyback topology, therefore reducing size, cost, and design complexity.

For more information on the theory of operation of the isolated no-opto flyback converter, refer to the [MAX17690](#) data sheet.

Temperature Compensation

The rectifying diode on the secondary side of the flyback converter has a significant negative temperature coefficient ($-1\text{mV}/^\circ\text{C}$ to $-2\text{mV}/^\circ\text{C}$), which produces approximately 100mV to 200mV of variation in the output voltage over a rectifying diode operating junction temperature range of -25°C to $+125^\circ\text{C}$. The MAX17690 compensates for temperature variations and for a detailed description of how this temperature compensation is achieved, refer to the [MAX17690](#) data sheet.

Designing the No-Opto Flyback Converter Using the MAX17690

The MAX17690 data sheet details a general procedure for designing a non-synchronous no-opto flyback converter. The components in this reference design are calculated broadly in line with the design procedures outlined in the data sheet general design procedure.

Input Source

The MAXREFDES1309 works with AC input $24\pm 15\%$ VAC and $50\text{Hz}\pm 15\%$ frequency range. The AC input section consists of a safety capacitor (X-cap), a varistor to protect the board during high voltage surge, an electromagnetic interference (EMI) filter, rectification using individual Schottky diodes. The board can work with 48V nominal DC voltage and maximum 60VDC.

Note: Do not exceed the maximum DC input voltage beyond 60V.

Design Resources

Download the complete set of [Design Resources](#) including schematics, bill of materials, PCB layout, and test files..

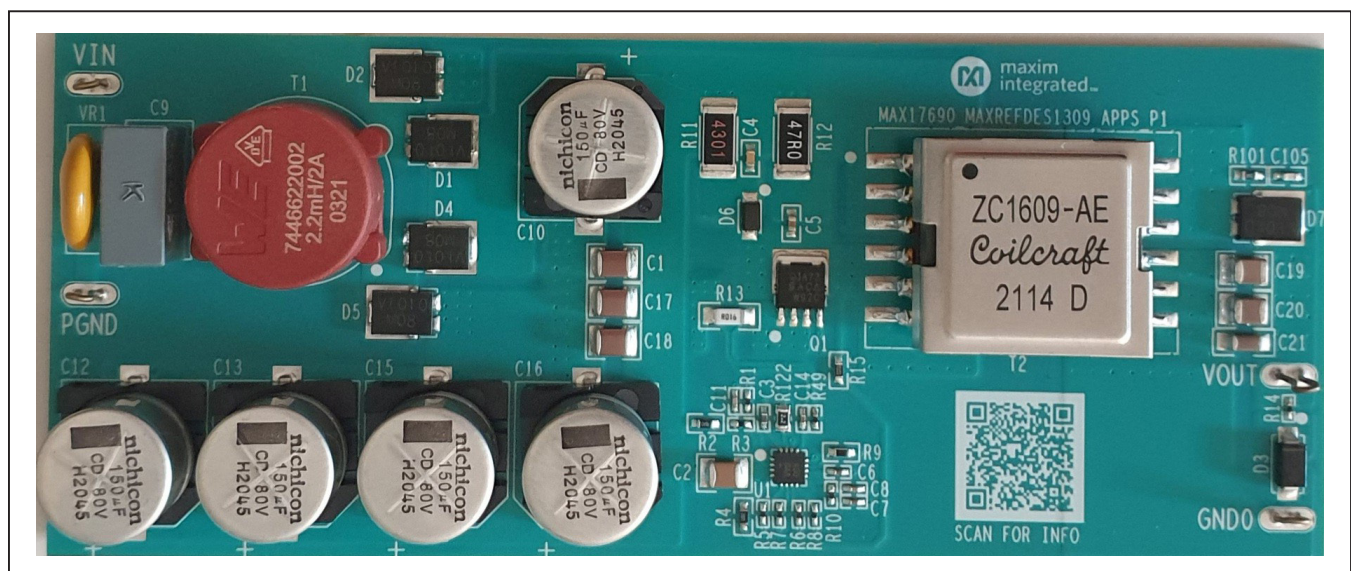


Figure 1. MAXREFDES1309 hardware.

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	11/21	Initial release	—



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