Introduction
Automotive powertrain systems require numerous isolated DC/DC bias supplies to power a variety of electronics including gate drivers, controllers, and MCU’s. The flyback topology is the most popular solution due to its low-cost, wide-input voltage range, and ability to provide multiple outputs. Flyback controllers are typically operated either directly off the 12 V, 48 V or HV battery or off a regulated voltage rail. Below is an example block diagram from TI design, TIDA-01505, for a backup flyback power supply. The high-voltage to low-voltage backup supply powers the low-voltage side of the traction inverter system in case the 12 V battery was to fail.

When selecting a flyback controller, there are a number of things to consider such as the control scheme, operating input voltage range, and duty cycle. The UCC28C4X-Q1 family supports a fixed-frequency, peak current-mode flyback implementation with UVLO and maximum duty-cycle limit options. UCC28C4X-Q1 can be configured with either primary-side regulation using an auxiliary winding or secondary-side regulation with the use of an optocoupler. This family of devices features high frequency operation up to 1 MHz with low start up and operating currents, thus minimizing start up loss and operating power consumption for improved efficiency. The devices also feature a fast current sense to output delay time of 35 ns, and a ±1-A peak output current capability for driving large external MOSFETs directly.
Feature differentiation and system considerations

The table below provides a concise description of the feature differences between the UCC28C4X-Q1 family.

Maximum duty cycle limit

For the flyback converter, a nominal operating point around 50% maximum duty cycle maximizes the conduction interval for both primary and secondary and minimizes RMS currents. A 50% maximum duty cycle limit also provides a known max volt-second product which can be applied to the transformer, reducing the risk of saturation and may eliminate the need for slope compensation. Alternatively, a wide-input voltage flyback converter may require a PWM that can operate up to nearly 100% duty cycle. For applications that have a wide-input voltage range requirement, such as the backup supply in the traction inverter system, a controller with 100% max duty cycle limit should be selected.

UVLO turn-on

Three sets of UVLO thresholds are available with the following turn-on and turn-off thresholds: 14.5 V/9.0 V, 8.4 V/7.6 V, and 7.0 V/6.6 V.

The 14.5 V/9.0 V UVLO option is primarily intended for offline or medium to high volt battery or rail power applications, where the wider hysteresis allows for longer soft-starting time of the converter while the VCC cap discharges and the auxiliary winding comes up into regulation. The 8.4 V/7.6 V UVLO option is ideal for high frequency DC/DC converters and is optimized to run off a 12-VDC rail allowing up to 25% voltage tolerance. The 7.0 V/6.6 V UVLO option is designed to support operation from a 12V battery and supports ISO 16750-2: Level 1 operation. A TVS diode and RC filter or simple linear regulator is recommended for protection of VCC pin. For an even lower turn-on voltage, UCC2813-3-Q1 and UCC2813-5-Q1 feature a maximum turn on voltage of 4.5 V enabling operation during cold cranking from 12 V battery systems and support ISO 16750-2: Level 4 operation.

UCC28C4X-Q1 Feature Differentiation

<table>
<thead>
<tr>
<th></th>
<th>UCC28C40-Q1</th>
<th>UCC28C41-Q1</th>
<th>UCC28C42-Q1</th>
<th>UCC28C43-Q1</th>
<th>UCC28C44-Q1</th>
<th>UCC28C45-Q1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum duty cycle limit</td>
<td>100%</td>
<td>50%</td>
<td>100%</td>
<td>100%</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>UVLO ON/OFF</td>
<td>7 V/6.6 V</td>
<td>7 V/6.6 V</td>
<td>14.5 V/9 V</td>
<td>8.4 V/7.6 V</td>
<td>14.5 V/9 V</td>
<td>8.4 V/7.6 V</td>
</tr>
</tbody>
</table>

Important Notice: The products and services of Texas Instruments Incorporated and its subsidiaries described herein are sold subject to TI’s standard terms and conditions of sale. Customers are advised to obtain the most current and complete information about TI products and services before placing orders. TI assumes no liability for applications assistance, customer’s applications or product designs, software performance, or infringement of patents. The publication of information regarding any other company’s products or services does not constitute TI’s approval, warranty or endorsement thereof.
IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI’s Terms of Sale (www.ti.com/legal/termsofsale.html) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2019, Texas Instruments Incorporated