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A 24 Vin, 40 Watt, Low Cost, DC-to-DC Converter

ON Semiconductor

Device	Application	Input Voltage	Output Power	Topology	I/O Isolation
NCP1251B NCP431	Instruments, Telecom and Industrial Equipment	20 - 32 Vdc	40 Watts	DCM Flyback	Yes

Other Specification

	Output 1	Output 2	Output 3	Output 4
Output Voltage	12 Vdc	N/A	N/A	N/A
Ripple	< 2%	N/A	N/A	N/A
Nominal Current	3 Amps	N/A	N/A	N/A
Max Current	3.3 Amps	N/A	N/A	N/A
Min Current	zero	N/A	N/A	N/A

PFC (Yes/No)	No
Minimum Efficiency	>75%
Inrush Limiting / Fuse	Fuse
Operating Temp. Range	0 to 50C
Cooling Method / Supply Orientation	Convection NA
Signal Level Control	No

Others	Input EMI filter
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Circuit Description

This Design Note describes a very simple, low cost, yet high performance dc-to-dc converter using ON Semiconductor's NCP1251B current mode controller (TSOP6 package) and the NCP431 programmable zener (SOT23 package).

The 65 kHz flyback converter design operates in discontinuous conduction mode (DCM) and uses the conventional optocoupler (U2) feedback scheme for the voltage loop. Vcc for the NCP1251 current mode controller is derived directly from the dc input voltage via D2 and R1. The Design Note provides the complete circuit and transformer design details for a 12 volt, 3 amp output version. Other output voltages from 3.3 up to 28 Vdc are easy to implement by modifying the values (or ratings) of R8, R11, R12, C9, D5 and T1's secondary turns.

Over-current limiting is provided by sensing the peak current in the MOSFET Q1 via R6. Once the 800 mV threshold level on U1's pin 4 is exceeded the circuit will go a "hiccup" mode until the over-current condition is removed. A Vcc OVP circuit is implemented via Z1, while D1 (and fuse F1) provide reverse voltage polarity for the dc input.

Depending on the application, it may be necessary to add a small pi-network ripple filter to the output as shown in the lower section of the schematic below.

Key Features

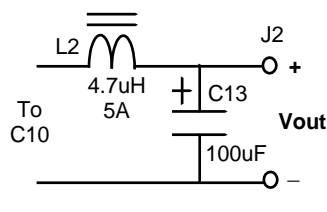
- Input EMI filter (L1, C1) for input EMI compliance
- Schottky output rectifier for high efficiency
- Current mode control
- Small pc board footprint
- Low cost component

Schematic



- # 40 Watt NCP1251B-65 DC/DC Converter (28Vin/65kHz) Rev. 2

Optional Ripple Filter



Disclaimer: ON Semiconductor is providing this design note "AS IS" and does not assume any liability arising from its use; nor does ON Semiconductor convey any license to its or any third party's intellectual property rights. This document is provided only to assist customers in evaluation of the referenced circuit implementation and the recipient assumes all liability and risk associated with its use, including, but not limited to, compliance with all regulatory standards. ON Semiconductor may change any of its products at any time, without notice.

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MAGNETICS DESIGN DATA SHEET

Project / Customer: ON Semiconductor - 40 watt, 12V/3A NCP1251 DC-DC Flyback

Part Description: 45 watt flyback transformer, 12V/3 amp out, 24 Vdc nominal input

Schematic ID: T1

Core Type: EE25/13/7 ferrite core; 3C90 material or similar

Core Gap: Gap for 22 uH +/- 10% across primary (pins 1 - 10)

Inductance: 22 uH nominal (+/- 10%) on primary

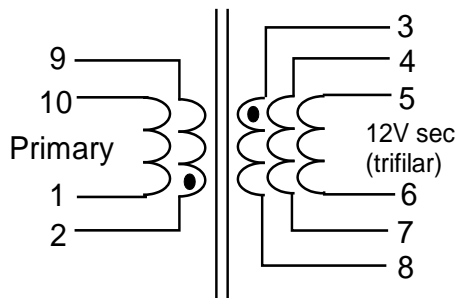
Bobbin Type: 10 pin horizontal mount for EE25/13/7 core

Windings (in order):

Winding # / type	Turns / Material / Gauge / Insulation Data
Primary (1,2 - 10,9)	12T of 2 strands of #24 mag wire bifilar over 1 layer. Insulate to 1 kV to next winding. Self leads to separate pins as shown in schematic below..
12V Secondary (3,4,5 - 8,7,6)	7 turns of 3 strands of #24 wound trifilar over one layer. Self leads to single pins for each wire as shown in drawing below. Insulate with tape for 1 kV breakdown.

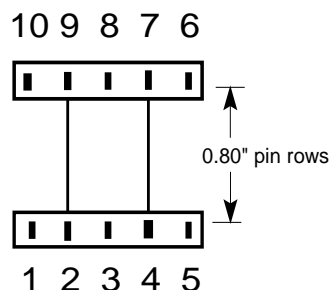
Hipot: 1 kV from primary to secondary for 1 minute.

Schematic



Lead Breakout / Pinout

(Bottom View of Bobbin)



References:

NCP1251 Data Sheet: http://www.onsemi.com/pub_link/Collateral/NCP1251-D.PDF

NCP1250/1251 Application Notes: AND8453/D, AND8468/D, AND8469/D, AND8488/D

NCP1251 Design Notes: DN05012, DN05017, DN05028, DN05029

NCP1031 DC-DC Converter Data Sheet: http://www.onsemi.com/pub_link/Collateral/NCP1030-D.PDF

NCP1030/1031 Application Notes: AND8119/D, AND8247/D

NCP1030/1031 Design Notes: DN06007, DN06046