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A 12 Volt, 30 Watt, Off-line Mini-Forward Converter

ON Semiconductor

Device	Application	Input Voltage	Output Power	Topology	I/O Isolation
NCP1251B NCP431 NDD04N60	White Goods, Small Instruments, E-Meters, Industrial Equipment	90 – 267 Vac	30 Watts	RCD Reset Forward Converter	3 kV

Other Specification

	Output 1	Output 2	Output 3	Output 4
Output Voltage	12 Vdc	N/A	N/A	N/A
Ripple	< 1%	N/A	N/A	N/A
Nominal Current	2.5 Amps	N/A	N/A	N/A
Max Current	3 Amp surge	N/A	N/A	N/A
Min Current	zero	N/A	N/A	N/A

PFC (Yes/No)	No
Efficiency	84% at full load
Inrush Limiting / Fuse	Yes
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 simple, low cost, high performance, off-line forward converter power supply using ON Semiconductor's NCP1251B flyback controller (TSOP6 package), NDD04N60 D-Pak Mosfet, and the NCP431 programmable zener (SOT23 package). This design is an extension of the "mini-forward" converter design described in ON Semiconductor's Application Note AND8489 in which the NCP1028 monolithic switcher was used as the main controller.

The use of an RCD snubber reset type of forward converter allows the extension of the useful duty cycle to over 50% without excessive voltage excursions across the MOSFET. The topology provides lower output ripple and noise, lower EMI generation, and slightly higher efficiency than an equivalent 12V/2.5A flyback

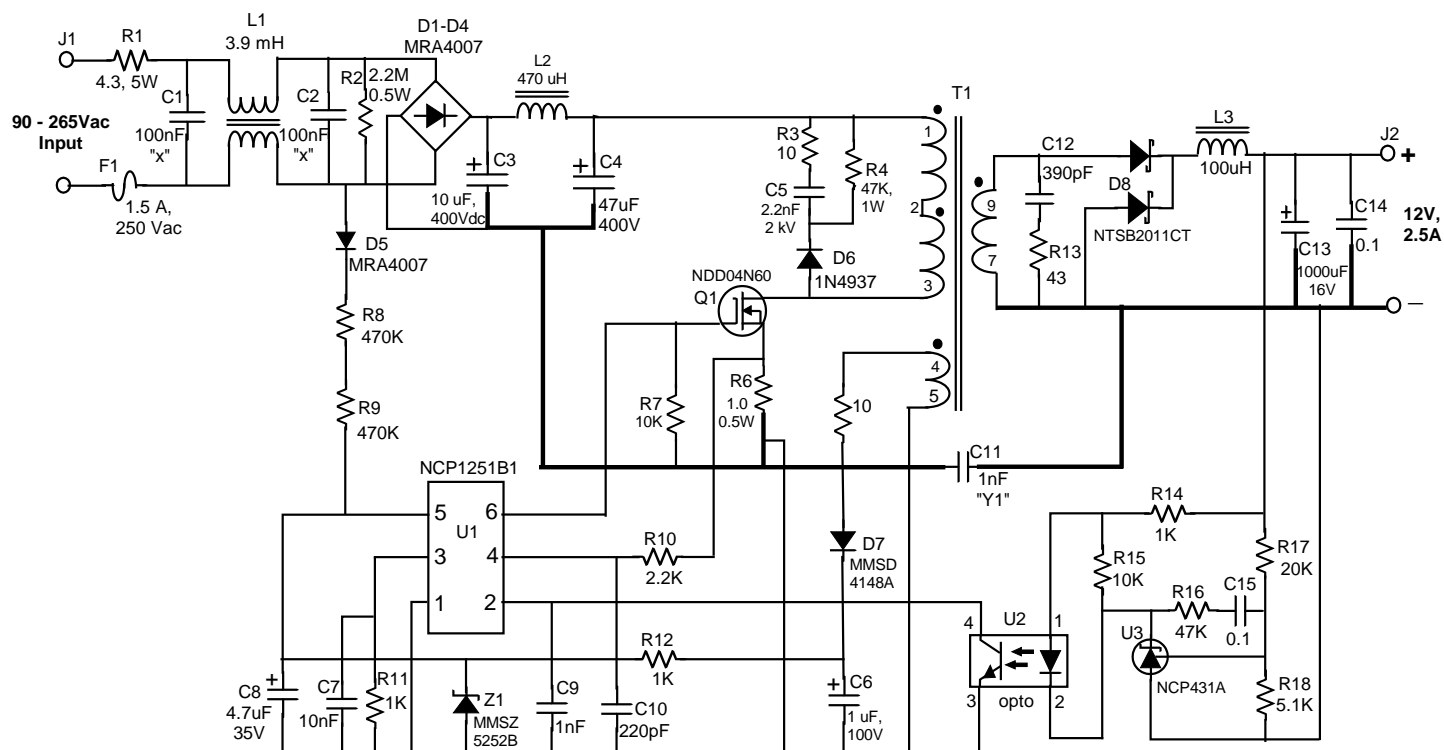
topology. This design is particularly useful in E-meter and white goods applications where a higher output power is required but low ripple/noise and high efficiency are imperative. In addition, all of the various features of the NCP1251 current mode controller can be utilized as needed.

The output inductor is an off-the-shelf part (Coilcraft) and the transformer is the same as that used in AND8489 and is available from Wurth Electronics (see drawing below).

Key Features

- Input EMI filter for conducted EMI compliance
- Low V_f Schottky rectifier for high efficiency
- Low standby (no load) power
- Current mode control with adjustable output voltage and current limit setpoints
- 5V/6A version also designed and tested.

Forward Converter Schematic



NOTES:

1. L1 is Coilcraft E3491-AL common mode EMI inductor (3.9mH)
2. L2 is Wurth 744772471 (470 uH) or similar
3. L3 is Coilcraft PCH-45X-104LT (100uH, 2.8A) inductor
4. R10 sets slope compensation.
5. R12 value dependent on Vout and Vcc winding turns.
6. R17 sets Vout (R17/18 node is set to 2.5V)
7. R6 sets current limit level.
8. R1 is optional inrush limiter.
9. U1 optocoupler is Vishay SFH6156A-4 or similar.
10. Crossed schematic lines are not connected.
11. Heavy schematic lines are recommended ground plane areas.

**30 Watt, 12 Volt Output NCP1251
Single Switch Forward Converter**

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Design note created by Frank Cathell, e-mail: f.cathell@onsemi.com

DN05029/D

MAGNETICS DESIGN DATA SHEET

Project / Customer: ON Semiconductor - 30 watt, 12 vout NCP1251 Fwd Conv

Part Description: 30 watt resonant reset forward conv. xfmr (Rev 1)

Schematic ID: T1

Core Type: EF25 (E25/13/7); 3C90 material or similar

Core Gap: No gap

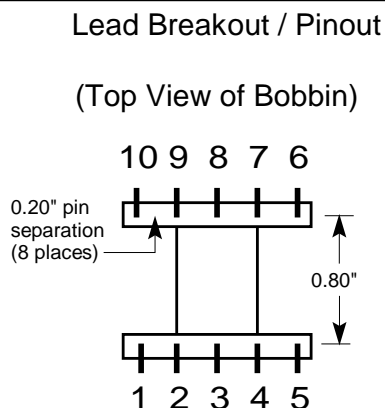
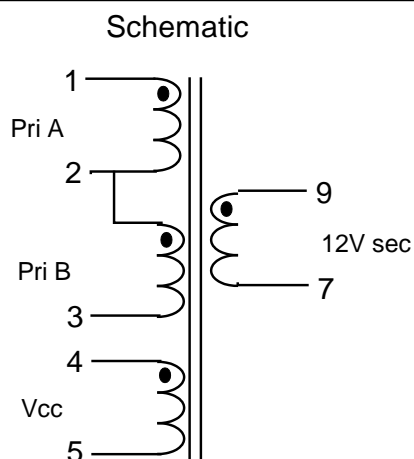
Inductance: (Primary) 12 mH minimum

Bobbin Type: 10 pin horizontal mount for EF25

Windings (in order):

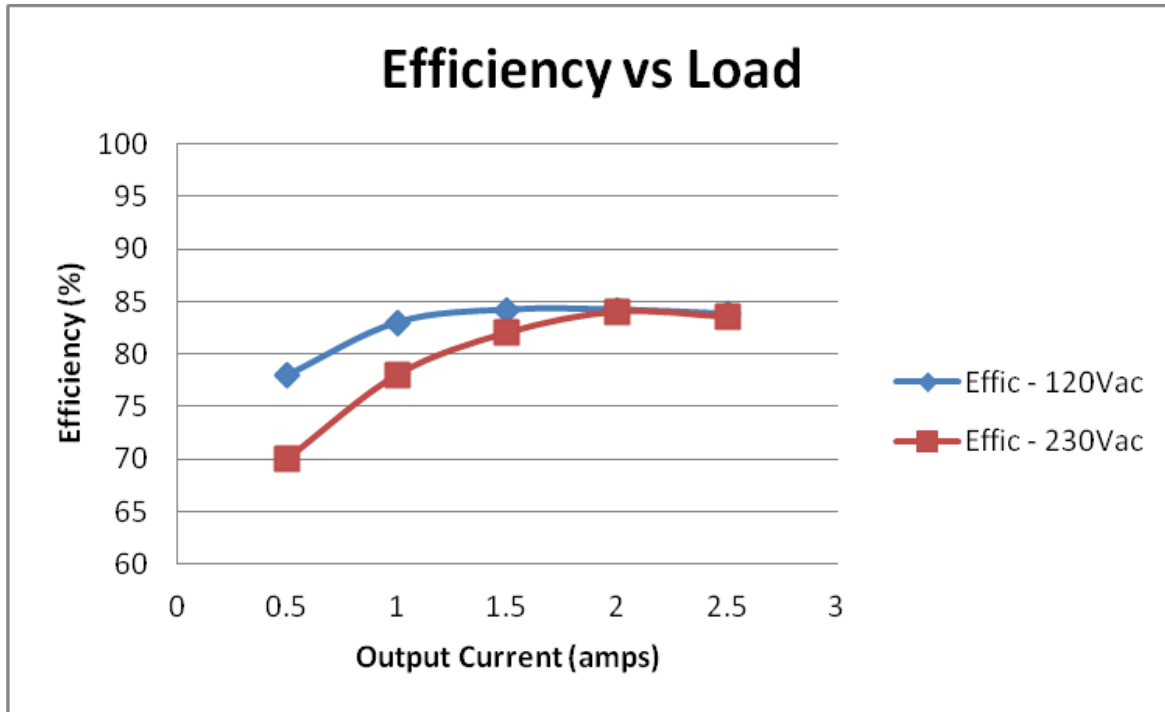
Winding # / type	Turns / Material / Gauge / Insulation Data
Primary A (1 - 2)	50T of #28HN over 2 layers (25 TPL). Insulate for 1 kV to next winding. Self leads to pins.
Vcc (4 - 5)	14 turns of #28 HN over 1 layer, close wound and centered in window. Self leads to pins. Insulate to 3 kV to next winding
12V Secondary (9 - 7)	20 turns of #24 triple insulated wire over one layer. Self leads to pins.
Primary B (2 - 3)	Same as Primary A. Insulate with tape and self-leads to pins.

Hipot: 3 kV from primaries & Vcc to secondary for 1 minute.



Transformer is available from Wurth Electronics as part number 750312228 Rev 0.

Efficiency Plots



References:

ON Semiconductor Data Sheet for NCP1251 controller.
ON Semiconductor Application Note AND8489/D
ON Semiconductor Design Notes DN05012 and DN05028