



# Dual Output, 4W DC-DC Converter

ON Semiconductor

Device	Application	Input Voltage	Output Power	Topology	I/O Isolation
NCP1031	Vacuum Fluorescent Display power supply	26 Vdc	4 W	Flyback	Yes

	Output 1	Output 2
Output Voltage	5 V	14 V
Nominal Current	200 mA	200 mA

PFC (Yes/No)	No
Inrush Limiting / Fuse	NA
Operating Temp. Range	0 to +50°C
Cooling Method / Supply Orientation	Convection
Signal Level Control	No

Others	
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## Circuit Description

This Design Note illustrates a dual output, 4 watt, isolated dc-to-dc converter originally intended for fluorescent lighting applications. The converter is designed around ON Semiconductor's NCP1031 monolithic dc-to-dc switcher IC. The chip contains all of the control functions for a low power converter including an integrated 200 volt internal Mosfet. This particular design, with the appropriate circuit and component modifications can also be made to operate with nominal dc input voltages anywhere from 12 volts to 70 Vdc and with other output voltages depending on the particular application.

The dc input includes an EMI/ripple filter comprised of L1 and C1 followed by a flyback dc-to-dc converter composed of transformer T1, and U1, the NCP1031 controller/Mosfet. Once started via the input voltage on pin 8, the controller operates from an auxiliary Vcc voltage generated by the lower primary side bias winding of T1. This voltage is rectified by D2 and filtered by Vcc capacitor C5.

The NCP1031 includes input over-voltage and under-voltage shutdown sensing via pins 5 and 6 respectively. To minimized voltage spikes created by T1's leakage inductance, the snubber network of D1, C3 and R1 is included. Output overload protection is also provided within the NCP1031 by sensing the peak Mosfet current.

Output regulation is accomplished by sensing the 5 volt output, dividing the sense voltage to 2.5 volts with R9 and R10, and utilizing a TL431 programmable zener as an error amplifier to drive a feedback signal to U1 via optocoupler U2. Loop phase compensation is provided by R11 and C13. A ripple filter is provided by L2 and C10 to reduce the 5 volt output ripple and noise to a very low level.

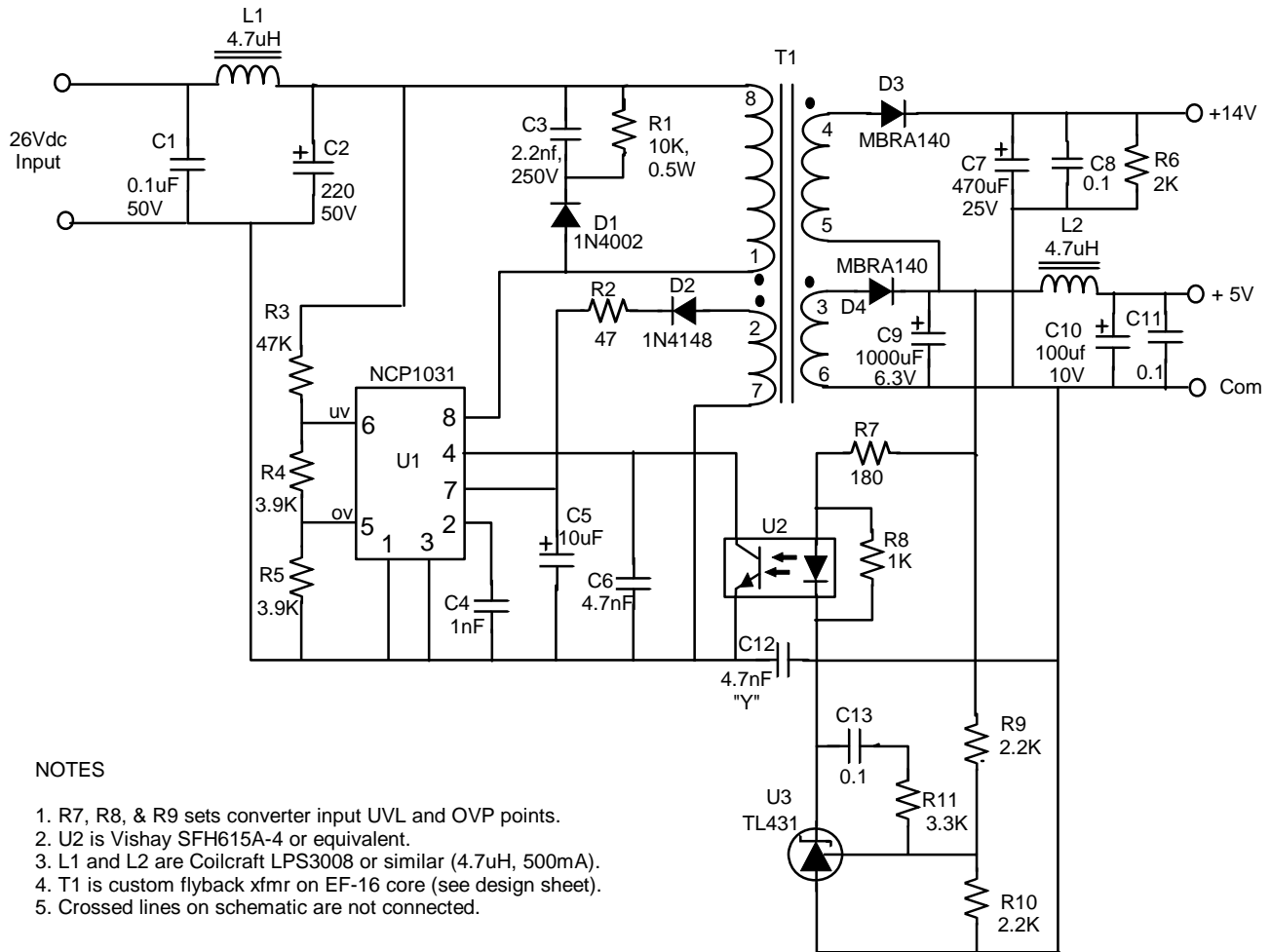
The 14 volt output is developed by "stacking" an additional number of transformer secondary turns on top of the 5 volt output. This stacked winding technique provides enhanced regulation of the "quasi-regulated" 14 volt output due to the fact that the initial 5 volts of this output is the fully regulated 5 volt output. A small pre-load (R6) is provided to avoid upward voltage creep if the 14 volt output is unloaded.

## Key Features

- Input EMI/ripple filter
- Simple, inexpensive flyback topology using monolithic dc-dc switching IC
- Dual regulated outputs
- Input UV and OV protection in addition to output short circuit protection
- Can be easily tailored for other input – output voltage configurations by changing transformer turns ratio and appropriate component ratings

# DN06046/D

## Schematic



### NOTES

1. R7, R8, & R9 sets converter input UVL and OVP points.
2. U2 is Vishay SFH615A-4 or equivalent.
3. L1 and L2 are Coilcraft LPS3008 or similar (4.7uH, 500mA).
4. T1 is custom flyback xfmr on EF-16 core (see design sheet).
5. Crossed lines on schematic are not connected.

### Dual Output, 4 Watt DC-DC Converter using ON Semi NCP1031

### Additional collateral from ON Semiconductor

- [NCP1031](#): Current Mode Controller Fixed Frequency Operation
- [MMSD4148](#) (1N4148): 100 V Switching Diode
- [TL431A](#): Programmable Precision Reference
- [MBR20100](#): 1A, 40 V Schottky Rectifier
- Application Note [AND8247](#): 5.0 W to 6.5 W Power Over Ethernet (PoE) DC-DC Converter
- Application Note [AND8119](#): Design of an Isolated 2 W Bias Supply for Telecom Systems Using the NCP1030
- Design Note [DN06007/D](#): Wide Input Range (20 Vdc to 140 Vdc) DC to DC Converter

## Magnetics Design

### NCP1031 Flyback Xfmr Design

Part Description: 5 watt, 200 kHz DCM flyback transformer, 5/14 volts out, 26 Vin

Schematic ID: T1

Core Type: Ferroxcube EF16 (E16/8/5); 3C95 material or similar

Core Gap: Gap for 60 - 70 uH

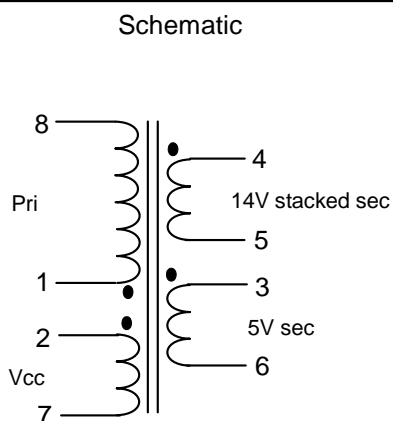
Inductance: 65 uH nominal

Bobbin Type: 8 pin horizontal mount for EF16

Windings (in order):

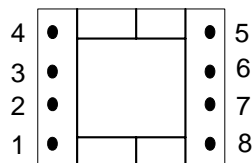
Winding # / type	Turns / Material / Gauge / Insulation Data
Vcc/Boost (2 - 7)	9 turns of #28HN spiral wound over 1 layer. Insulate with 1 layer of tape (250V insulation to next winding)
Primary (1 - 8)	24 turns of #28HN over 1 layer. Insulate for 500V minimum to the next winding.
5V Secondary (3 - 6)	5 turns of 2 strands of #28HN flat and spiral wound bifilar evenly over 1 layer; self leads to pins. Insulate with tape.
14V Secondary (4 - 5)	9 turns of 1 strand of #28HN spiral wound over 1 layer. Self leads to pins. Insulate with tape.

Hipot: 500V from Vcc boost/primary to secondaries



Lead Breakout / Pinout

(Bottom View - facing pins)



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Design note created by Frank Cathell, e-mail: [f.cathell@onsemi.com](mailto:f.cathell@onsemi.com)