ON Semiconductor

Design Note – DN05016/D

100V, 450mA Off-Line LED Driver with High PF

Device	Application	Input Voltage	Output Power	Topology	I/O Isolation
NCL30001 NCS1002	High PF CVCC LED Driver with Dimming	85 – 266 Vac	35 to 60 Watts	Single Stage PFC/Flyback	Yes – 3 kV

	Output 1
Output Voltage	100 Vdc max
Ripple	100 mA max
Nominal Current	450 mA (adjustable)
Max Current	600 mA
Min Current	350 mA

PFC (Yes/No)	Yes
Typical Efficiency	86%
Inrush Limiting / Fuse	Yes
Operating Temp. Range	0 to +40 °C
Cooling Method / Supply Orientation	Convection NA
Signal Level Control	Yes – Dimming functions

Others	PWM dimming to 3% with external digital input signal

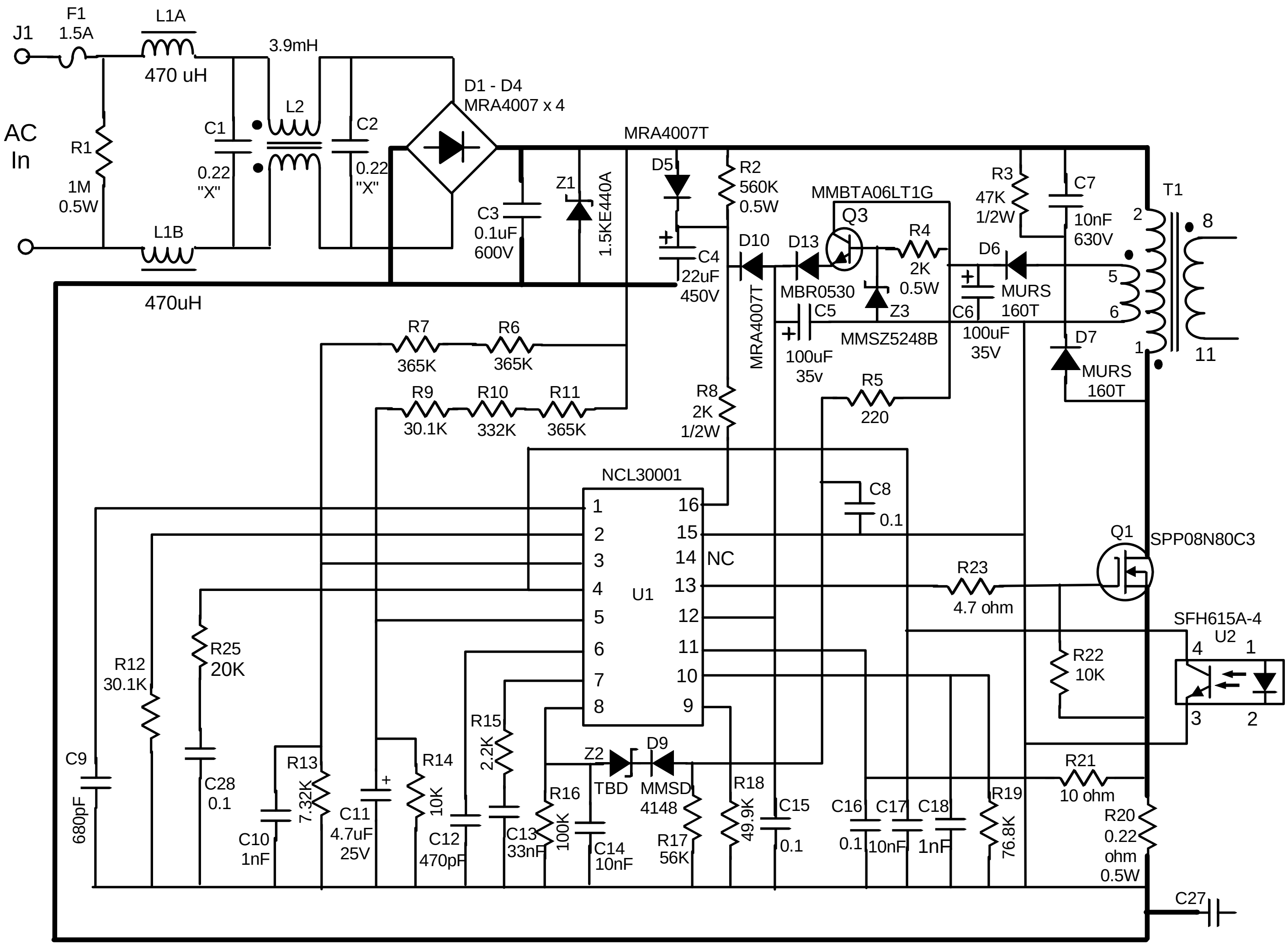
Circuit Description

This Design Note (DN) is an extension to ON Semiconductor's Application Note AND8470/D and features a 100 volt max, 0.45 amp version of the off-line, NCL30001 based constant voltage, constant current (CVCC) LED driver with inherent PFC described in that app note. The original app note features a 50 volt max, constant current, 1 to 2 amp (current settable) LED driver with multiple dimming capabilities and active power factor correction in a single continuous conduction mode (CCM) flyback converter stage. This DN presents a similar version that is suitable for driving series LED strings up to 100 volts at a max current of up to about 600 millamps. This design is suitable for LED strip lighting and fluorescent lamp replacements. The maximum voltage and output current can be adjusted via resistors R34 and R32 respectively. The detailed circuit operational description can be found in the original mentioned app note (AND8470/D) and is essentially identical circuit-wise with the exception of the component changes that are indicated in the BOM. The flyback transformer design for this DN was merely ratioed from the secondary winding on the original design to meet the new maximum voltage and current requirements. The primary winding, required inductance, and overall construction are essentially the same.

Key Features

- Single stage, isolated PFC converter for strip lighting and fluorescent tube replacements.
- Constant voltage, constant current output characteristic for LED drive
- Dimming features including pulse width dimming to 3%
- Over current, over voltage and over temperature capabilities
- Typical efficiencies above 86%

DN05016/D
Primary Side Schematic



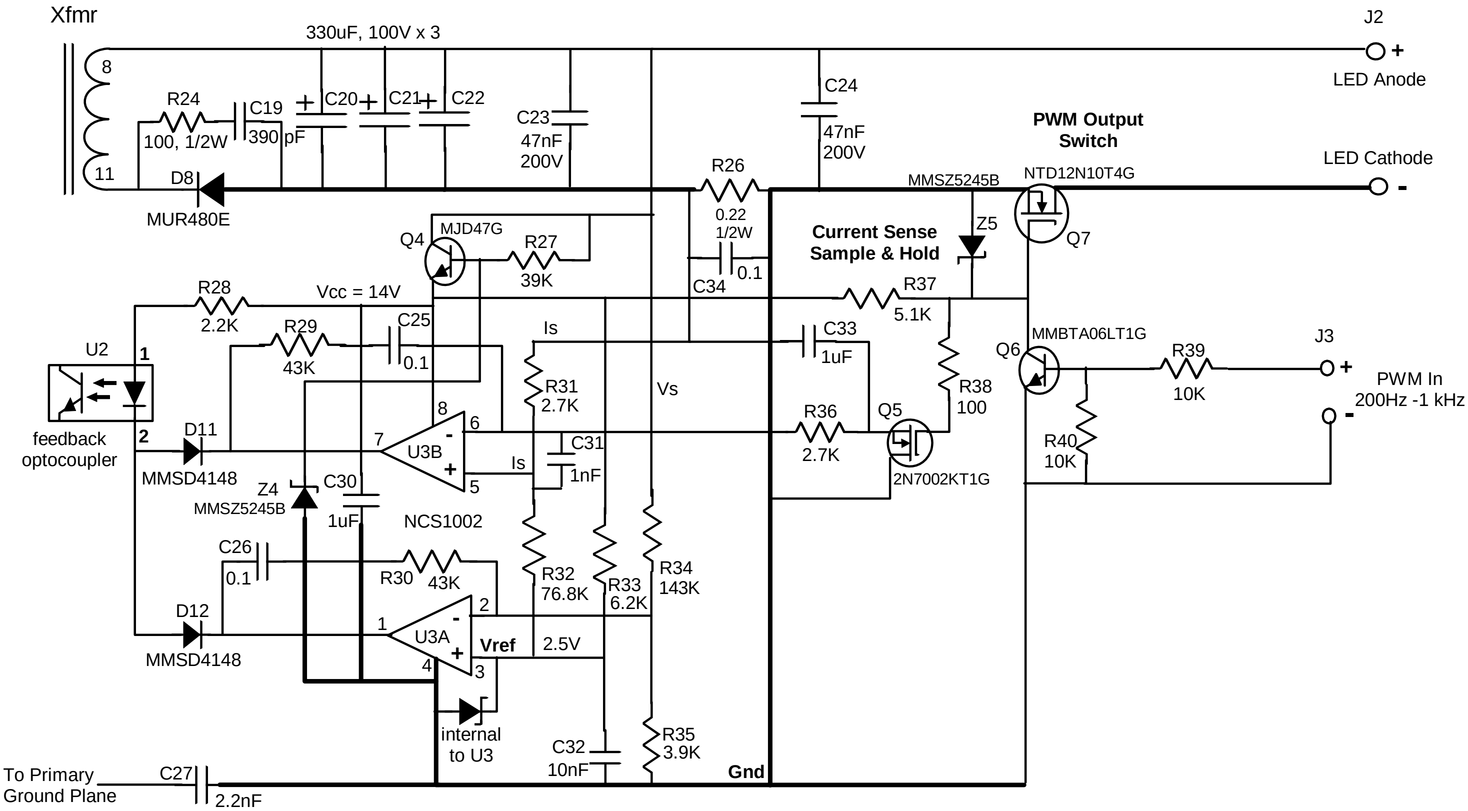
Notes:

1. Crossed schematic lines are not connected.
2. Heavy lines indicate power traces/planes.
3. Z2/D9 is for optional OVP (not used).
4. L1A/B are Coilcraft RFB1010-471AL or equivalent (470 uH).
5. L2 is Coilcraft E3491AL or equivalent (3.9 mH).
6. Q1 will require a small heatsink.
7. Q3 is omitted.

NCL30001 CVCC, 100V, 50 Watt Power Supply
Primary Control Side Schematic (Rev 3)

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

Secondary Side Schematic



100V/0.45A LED Driver CVCC Secondary Sensing
with PWM Dimming Input (Rev 3)

Maximum output voltage adjust resistor: R34
Output current adjust resistor: R32

See ON Semiconductor AND8470/D for original NCL30001 CVCC driver app note details.

MAGNETICS DESIGN DATA SHEET

Project: NCL30001, 40 W, 100 Vout, isolated, single stage CVCC PFC LED driver

Part Description: CCM Flyback transformer, 50-70 kHz, 100 Vout, 450 mA

Schematic ID: T1

Core Type: PQ3230, 3C94 (Ferroxcube) or P material (Mag Inc.)

Core Gap: Gap core for 900 to 1,100 uH across pins 1 to 2.

Inductance: 1000 uH nominal measured across primary (pins 1 to 2)

Bobbin Type: 12 pin pc mount (Mag Inc PC-B3230-12 or equivalent)

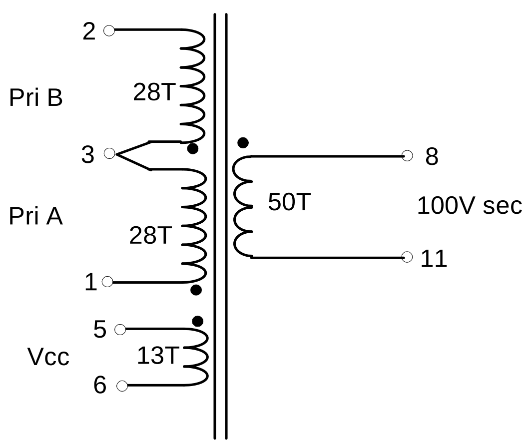
Windings (in order):

Winding # / type	Turns / Material / Gauge / Insulation Data
Primary A: (1 - 3)	28 turns of #24HN over one layer (no margins). Self-leads to pins. Insulate for 3 kV to next winding.
100V Secondary (8 - 11)	50 turns of #30HN close wound over one layer and centered with 1.5 mm end margins. Insulate with tape for 3 kV to next winding.
Primary B: (3 - 2)	Same as primary A. Insulate for 1.5 kV to Vcc/Aux.
Vcc/Aux (5 - 6)	13 turns of #24HN spiral wound and centered with 8 mm end margins. Insulate with tape and terminate self-leads to pins.

Safety margins not necessary as long as specified Hipot below can be met.

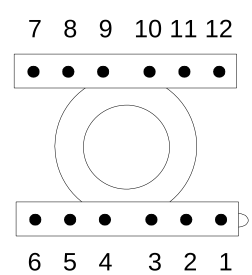
Hipot: 3 kV from primary/Vcc to 100V secondary winding.

Schematic



Lead Breakout / Pinout

(bottom view)



Wurth Electronics - Part # 750312294