DN05015/D

30 V, 2 A High Efficiency CVCC LED Driver

ON Semiconductor®

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DESIGN NOTE

Circuit Description

This Design Note (DN) is an extension to ON Semiconductor's Evaluation Board User's Manual EVBUM2039/D and features a 30 V max, 2 A version of the off-line, NCL30051 based constant voltage, constant current (CVCC) high efficiency LED driver. The original document features a 55 V max, constant current, 1.5 A (current settable) LED driver with multiple dimming capabilities and active power factor correction in a two-stage off-line converter utilizing a resonant half-bridge in the main conversion stage. This DN presents a similar version of that design which is suitable for driving LED strings up to 30 V at a max current of up to 3 A. This design is suitable for LED street lighting and wall pack lamp applications. The maximum output voltage and output current can be adjusted via resistors R28 and R26 respectively, shown in the secondary circuit schematic. The detailed circuit operational description can be found in the original mentioned NCL30051 evaluation board user's manual (EVBUM2039/D) and is essentially identical circuit-wise with the exception of the component changes that are indicated in the BOM. The resonant half-bridge transformer design for this DN was merely ratioed from the secondary winding on the original 55 V transformer design to meet the new voltage and current requirements. The primary winding, required inductances, and overall construction are essentially the same.

Key Features

- Input EMI Filter for Class A
- Constant Voltage, Constant Current Output Characteristic for LED Drive
- Dimming Features Including Pulse Width and Analog Dimming to 10%
- Over Current, Over Voltage and Over Temperature Capabilities
- Typical Efficiencies of 90%

Table 1. DEVICE DETAILS

Device	Application	Input Voltage	Output Power	Topology	I/O Isolation
NCL30051 NCS1002	LED Lighting (Wall Pack/Street Lights)	90−270 Vac	60 W Nominal	Boost PFC + Resonant HB	Yes − 3 kV

Table 2. OTHER SPECIFICATIONS

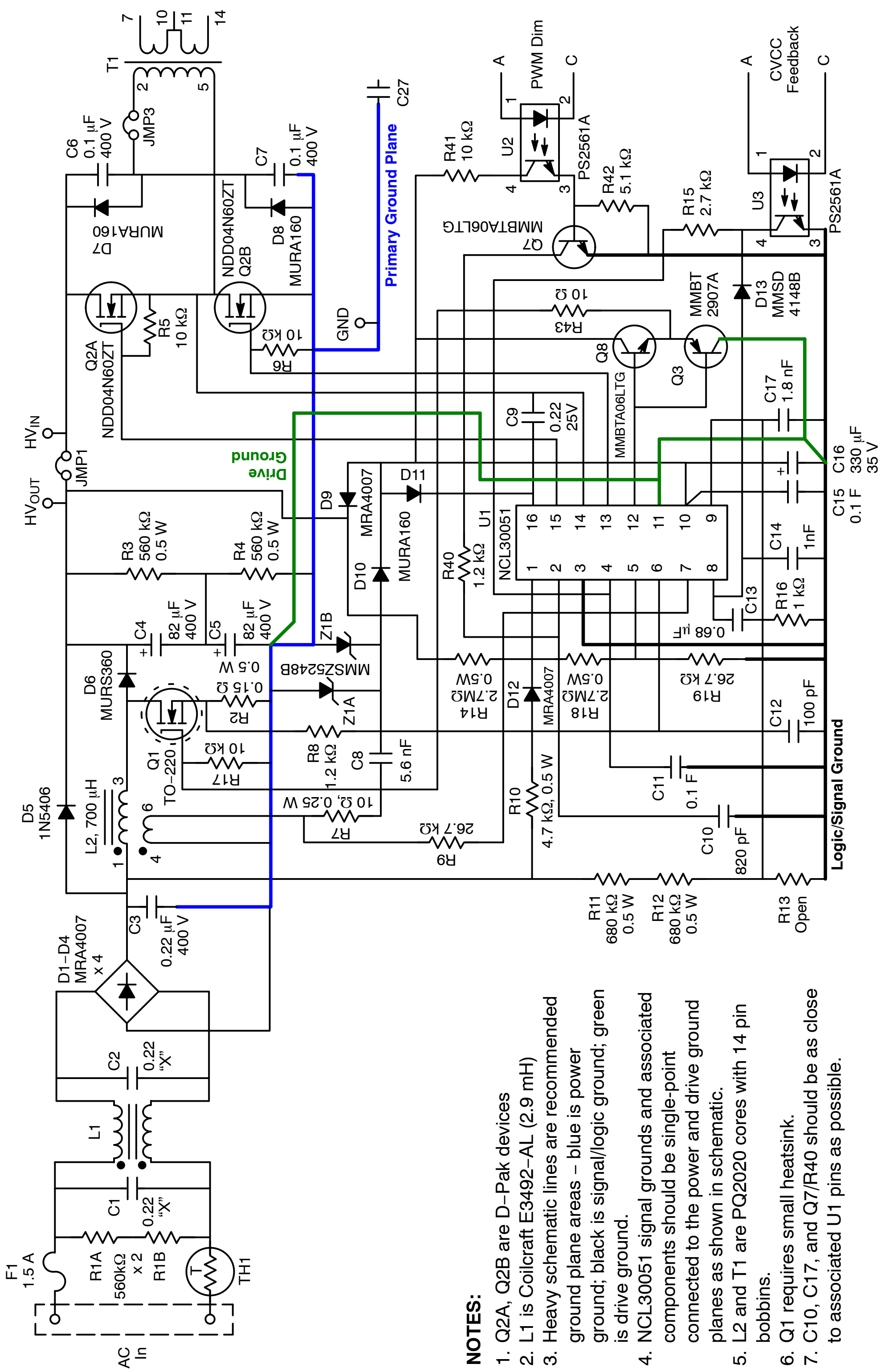
	Output	Unit
Output Voltage	30	V max
Ripple	250	mA max
Nominal Current	2	A
Max Current	(3)	A
Min Current	0	A

PFC (Yes/No)	Yes
Minimum Efficiency	88%
Inrush Limiting/Fuse	NTC Inrush Thermistor + 1.5 A Fuse
Operating Temperature Range	0 to +50°C
Cooling Method/Supply Orientation	Convection/NA
Signal Level Control	Yes (Dimming Controls)

Others	PWM, Bi-level and Analog LED Dimming Input Options

January, 2013 − Rev. 2

SCHEMATIC − PRIMARY SECTION



NOTES:

1. Q2A, Q2B are D−Pak devices
2. L1 is Coilcraft E3492−AL (2.9 mH)
3. Heavy schematic lines are recommended ground plane areas − blue is power ground; black is signal/logic ground; green is drive ground.
4. NCL30051 signal grounds and associated components should be single-point connected to the power and drive ground planes as shown in schematic.
5. L2 and T1 are PQ2020 cores with 14 pin bobbins.
6. Q1 requires small heatsink.
7. C10, C17, and Q7/R40 should be as close to associated U1 pins as possible.

Figure 1. NCL30051 60 W LED Driver

SCHEMATIC – SECONDARY SECTION

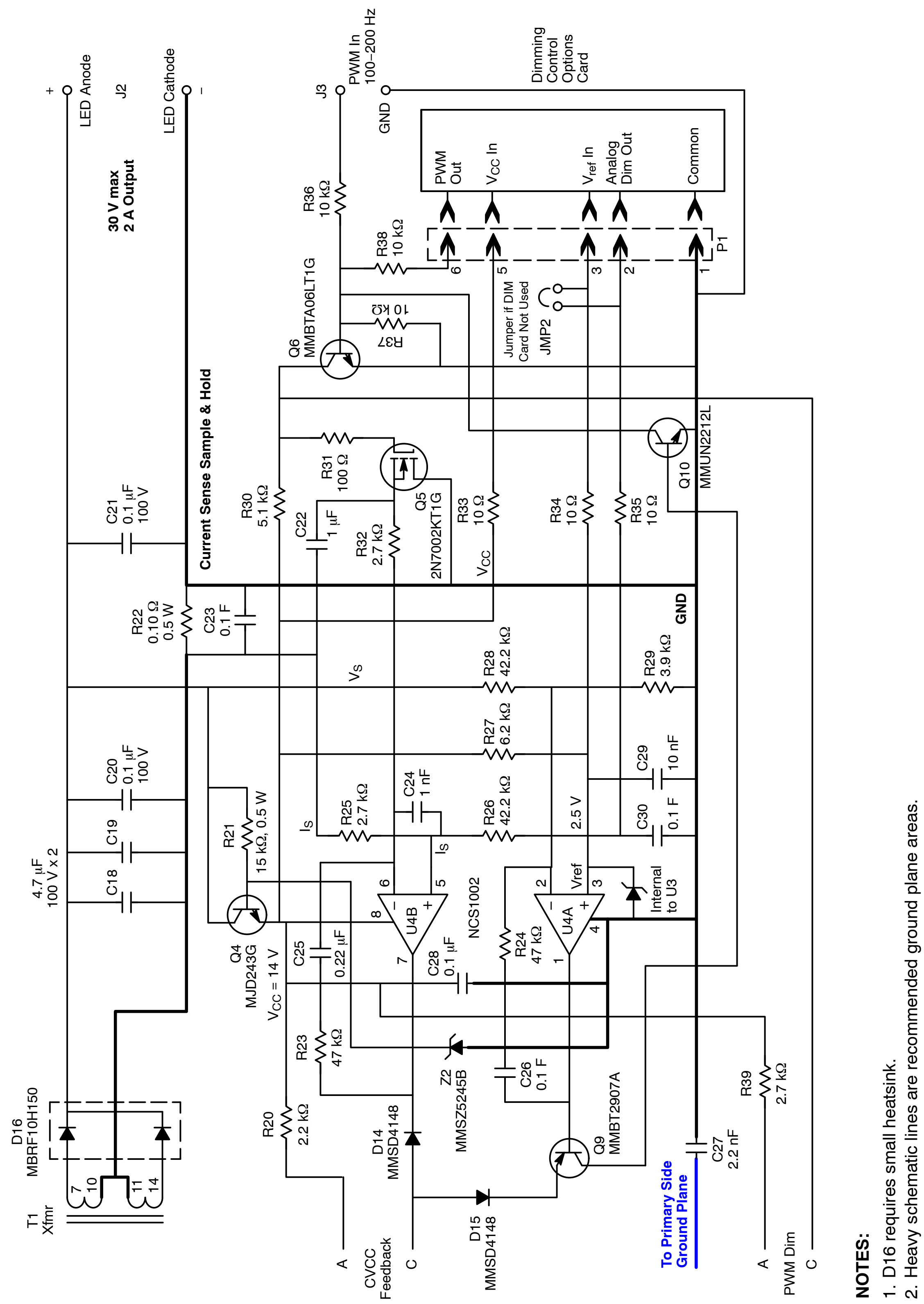


Figure 2. NCL30051 LED Driver CVCC Secondary Sensing and PWM Dimming Input Option

TEST DATA

Performance Parameters: Load is two Luminous Devices LED modules in series

Table 3. TEST DATA

V_{IN}	P_{IN}	PF	%THD	I_{OUT}	V_{OUT}	P_{OUT}	Efficiency
90	64	0.994	9.1	2.025	27.35	55.38	86.54%
100	63.2	0.995	9.5	2.025	27.34	55.36	87.60%
115	62.9	0.993	10.3	2.026	27.34	55.39	88.06%
180	62.4	0.975	15.9	2.025	27.33	55.34	88.69%
230	62.5	0.95	21.5	2.025	27.33	55.34	88.55%
265	62.6	0.926	26	2.025	27.32	55.32	88.38%

MAGNETICS DESIGN DATA SHEET

Project/Customer: ON Semiconductor − NCL30051 30 V/2 A CVCC LED driver
Part Description: Resonant Half-bridge Transformer − 60 W, 35 kHz, 30 V/2 A output
Schematic ID: T1
Core Type: PQ20/20, Ferroxcube 3C95 or equivalent material
Primary Inductance: 6 mH minimum
Leakage Inductance: 90−110 μH nominal (resonant half-bridge, leakage inductance is Lr)
Bobbin Type: PQ20/20 14 pin PC mount bobbin

Windings (in order):

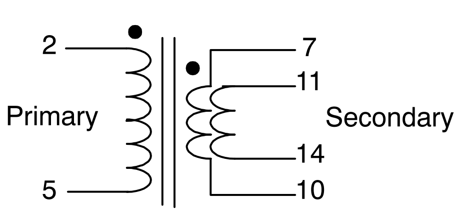
Winding #/Type	Turns/Material/Gauge/Insulation Data
Primary Winding (2−5)	96 turns of #28 HN magnet wire over 3 layers, 32 turns per layer approx. Self-leads to pins. Insulate with Mylar tape sufficient for 3 kV Hipot to next winding.
Secondary Winding (7, 11−10,14)	11 turns of 2 X #24 magnet wire bifilar wound over 2 or 3 layers. Self-leads to pins per schematic below. Final insulate with Mylar tape.

NOTE: The critical parameter is to achieve a leakage inductance of 90−110 μH with a min primary inductance of 6 mH. The overall turns can be increased or decreased to achieve this as long as the turns ratio remains 8.7:1.

Vacuum varnish assembly.

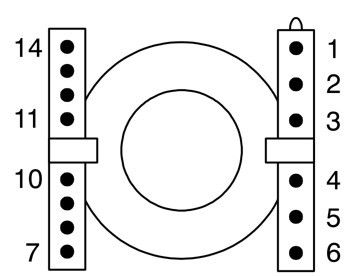
Hipot: 3,000 V from Primary to Secondary (1 minute)

Schematic



Lead Breakout/Pinout

Bottom View



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