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# DN05015/D

# 30 V, 2 A High Efficiency CVCC LED Driver

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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<br>NCS1002 | LED Lighting<br>(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 |

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January, 2013 − Rev. 2
Publication Order Number:
DN05015/D

## SCHEMATIC – PRIMARY SECTION

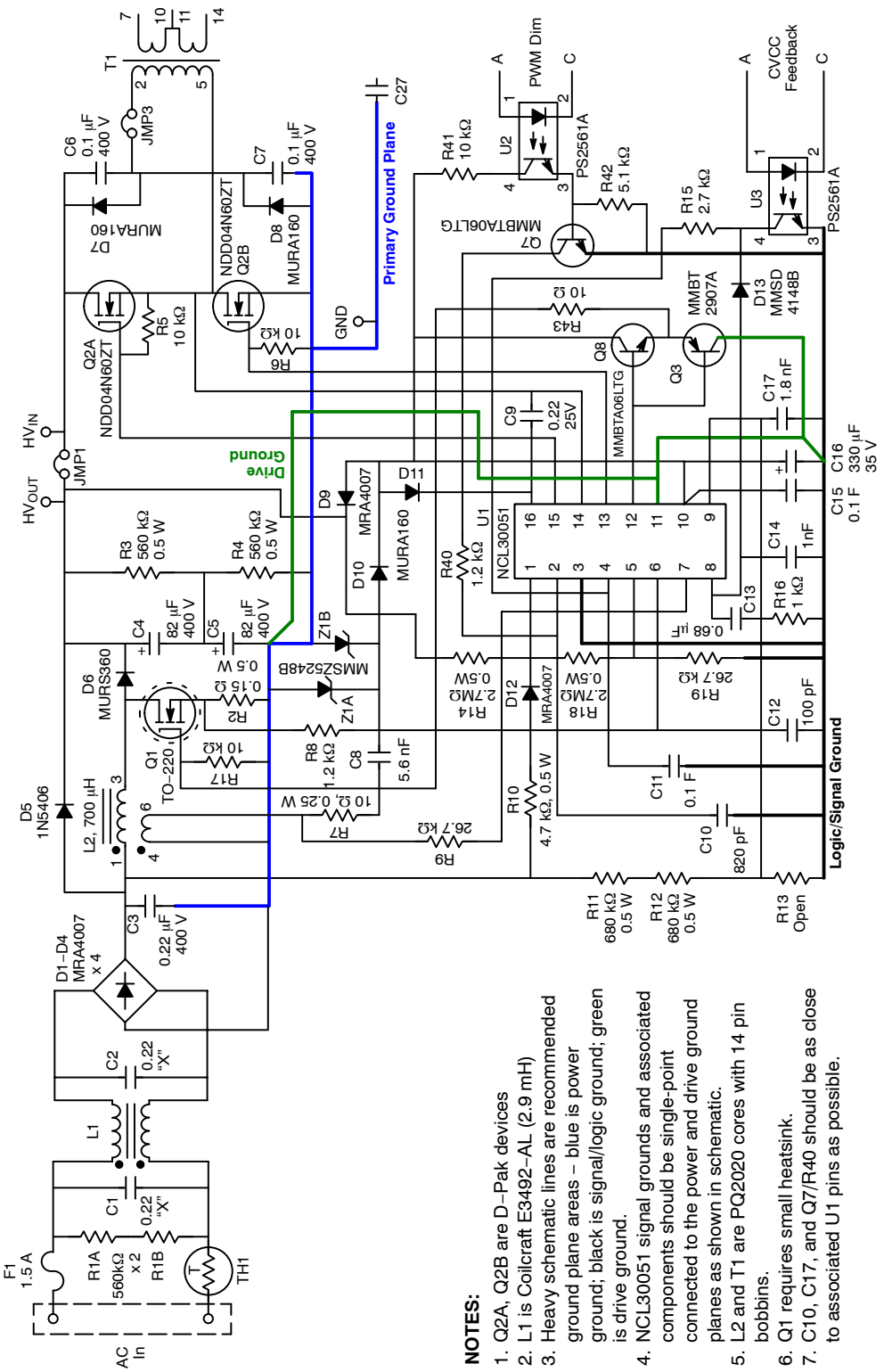
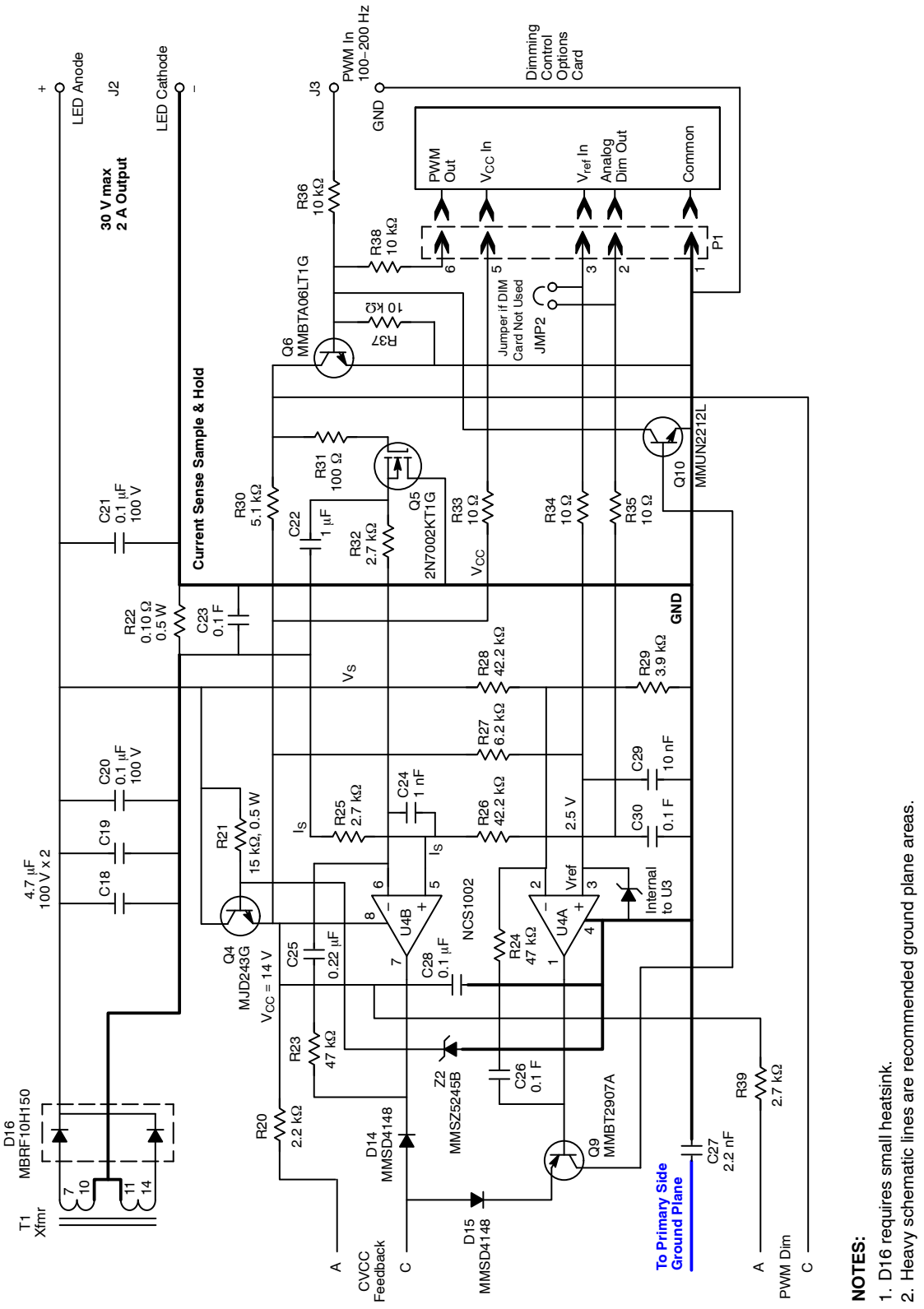



**Figure 1. NCL30051 60 W LED Driver**

## SCHEMATIC – SECONDARY SECTION




**NOTES:**

1. D16 requires small heatsink.
2. Heavy schematic lines are recommended ground plane areas.

**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):

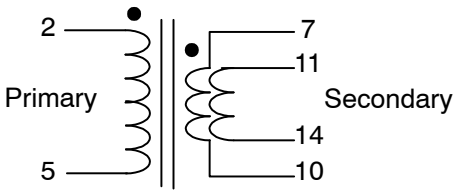
| Winding #/Type | Turns/Material/Gauge/Insulation Data |
|---|---|
| Primary Winding (2–5) | 96 turns of #28 HN magnet wire over 3 layers, 32 turns per layer approx. Self-leads to pins. Insulate with Mylar tape sufficient for 3 kV Hipot to next winding. |
| Secondary Winding (7, 11–10,14) | 11 turns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

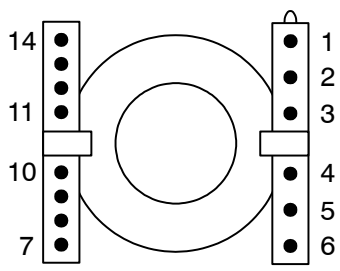
Hipot: 3,000 V from Primary to Secondary (1 minute)

Schematic




Lead Breakout/Pinout

Bottom View



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