



30 V, 2 A High Efficiency CVCC LED Driver

ON Semiconductor®

<http://onsemi.com>

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
--------	--

SCHEMATIC – SECONDARY SECTION

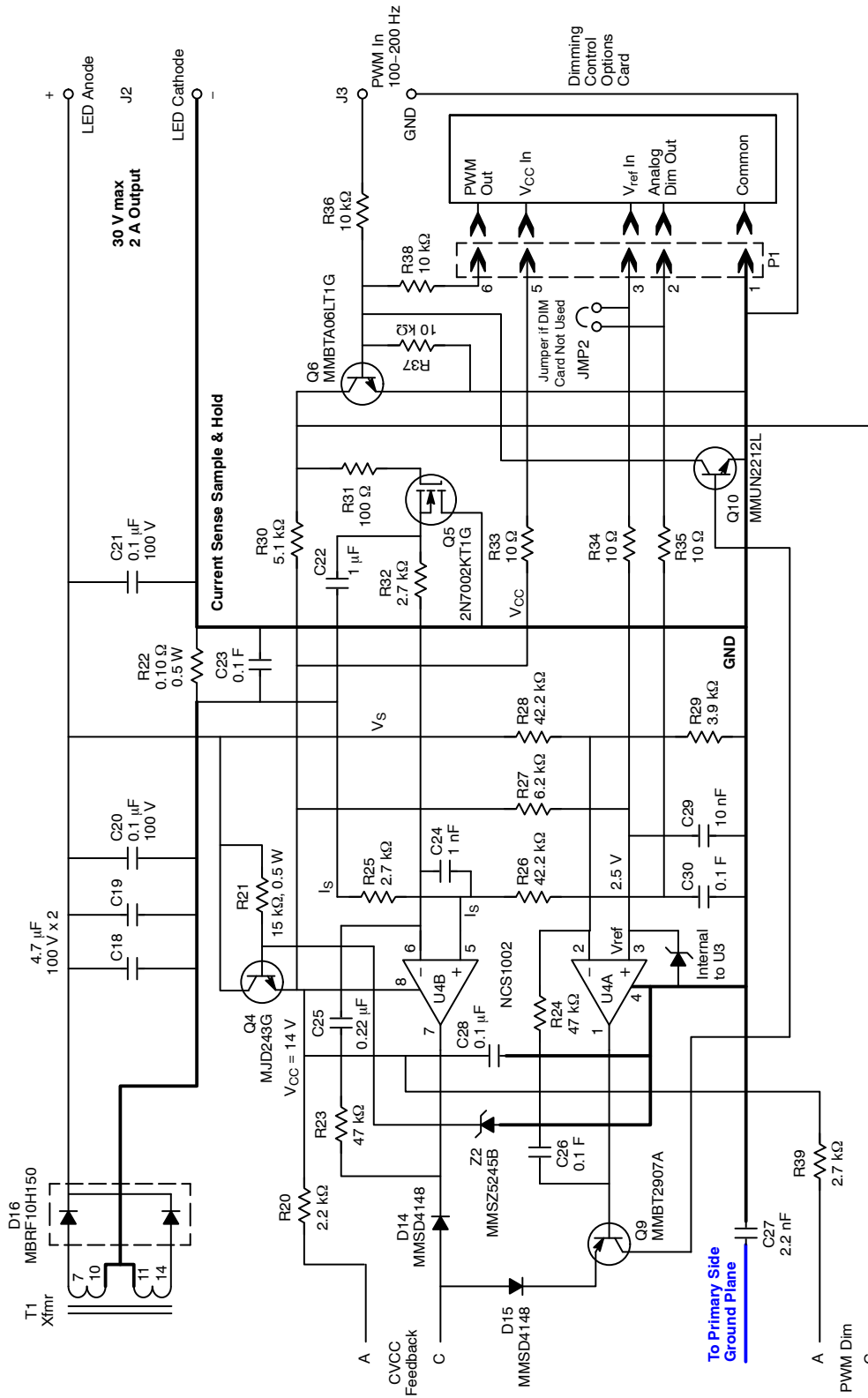


Figure 2. NCL30051 LED Driver CVCC Secondary Sensing and PWM Dimming Input Option

NOTES:

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

DN05015/D

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 μ H nominal (resonant half-bridge, leakage inductance is Lr)
Bobbin Type: PQ20/20 14 pin PC mount bobbin

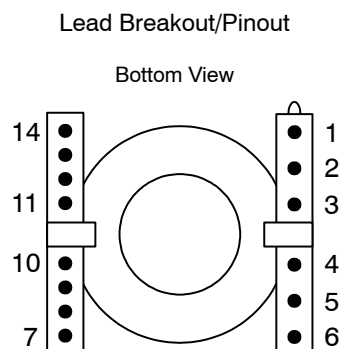
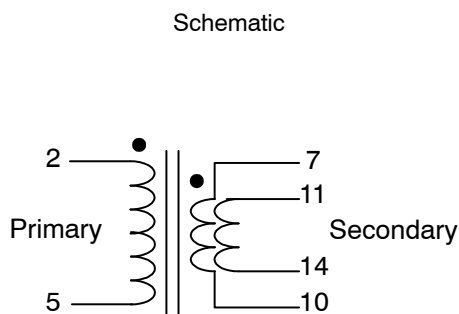
Windings (in order):


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 μ H 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)



ON Semiconductor and  are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of SCILLC's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com
Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative