

30 V、2 Aの高効率CVCC LEDドライバ



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DESIGN NOTE

回路説明

このデザイン・ノート(DN)は、オン・セミコンダクターの評価ボードユーザーマニュアル EVBUM2039/Dの追加資料です。NCL30051を利用したオフラインCVCC(定電圧、定電流)高効率LEDドライバ(最大電圧30 V、電流2 A)について説明します。EVBUM2039/Dでは、最大電圧55 V、定電流1.5 A(電流値は設定可能)のLEDドライバについて説明しました。メイン変換ステージにハーフブリッジを用いた2ステージ構成のオフライン・コンバータ内にアクティブ力率補正機能と複数の調光機能とを備えたLEDドライバです。このデザインノートでは、最大電圧30 V、最大電流3 AでLEDストリングを駆動するのに適した設計を紹介します。全体的な構成は、EVBUM2039/Dに示したものと同じです。LEDによる街路照明や壁灯に適した設計です。最大出力電圧と最大出力電流は、2次側の回路図に示したR28、R26の各抵抗でそれぞれ調整できます。回路動作

の詳しい説明は、EVBUM2039/Dに示しましたが、回路に関しては、BOMに示した部品変更を除いて基本的に同じです。このデザインノートに示した共振型ハーフブリッジ・トランスの設計は、電圧と電流に関する今回の要件を満たす手段として、EVBUM2039/Dに示した55 V変圧器の2次巻線数を変更しただけです。1次巻線、必要なインダクタンス、全体の構造は、基本的に同じです。

主な特長

- クラスAの入力EMIフィルタ
- LEDの駆動に適した定電圧、定電流の出力特性
- 10%までの調光機能(パルス幅変調方式およびアナログ方式による調光)
- 過電流性能、過電圧性能、過熱性能
- 効率の標準値は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

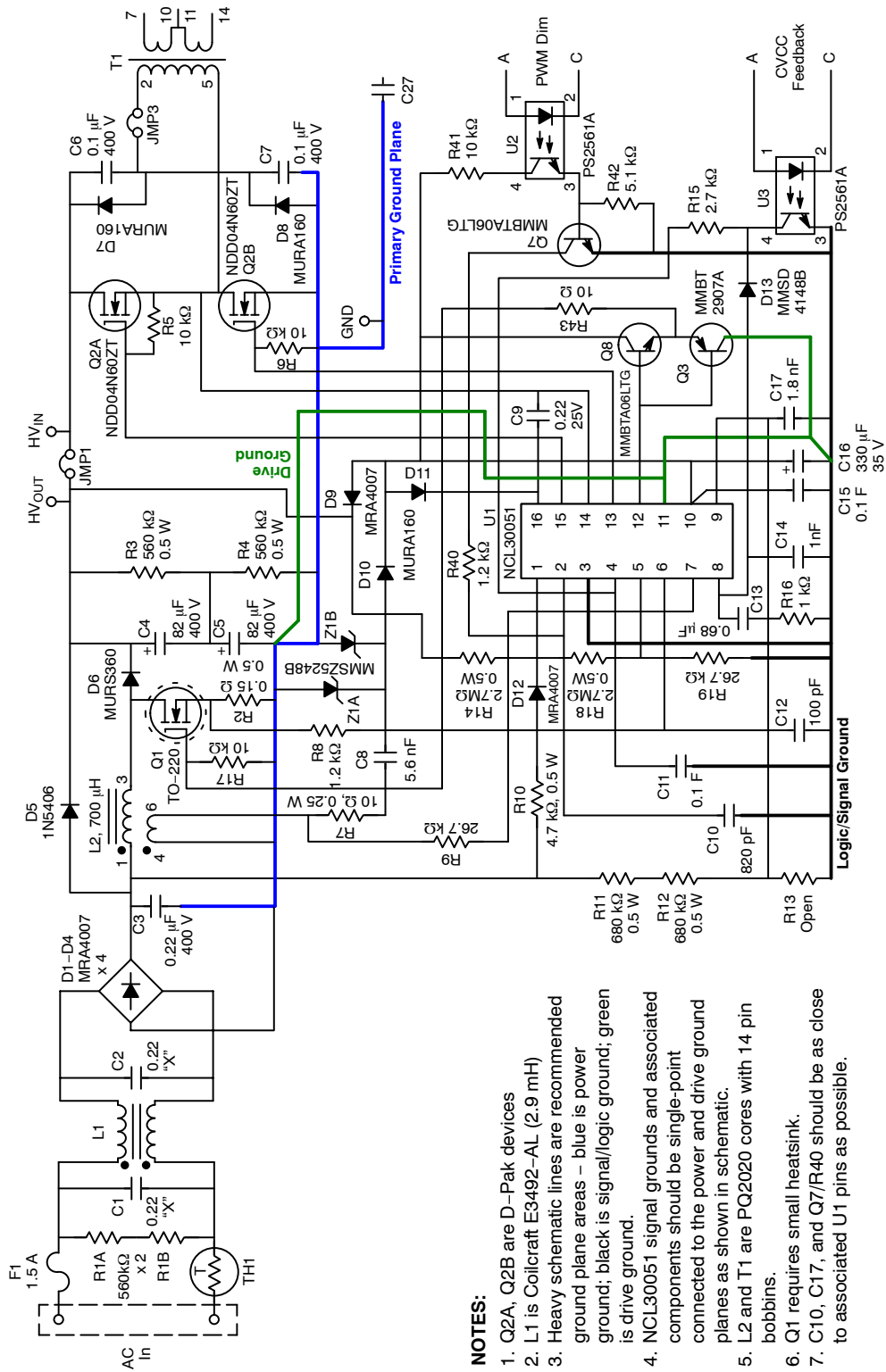
Table 2. OTHER SPECIFICATIONS

	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
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SCHEMATIC - PRIMARY SECTION

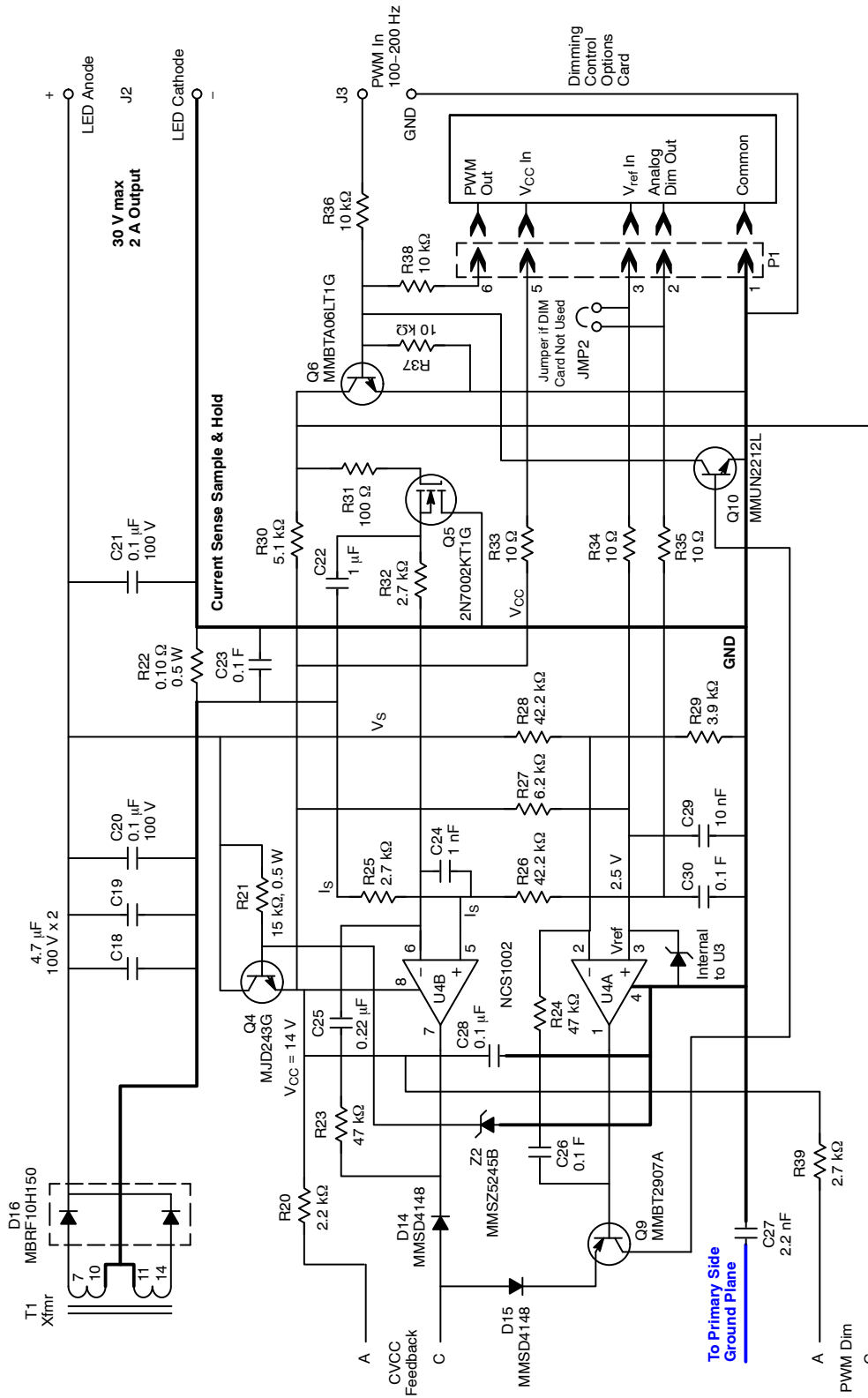


NOTES:

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



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

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

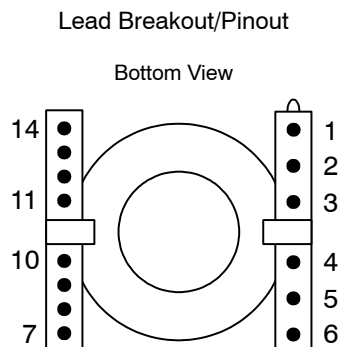
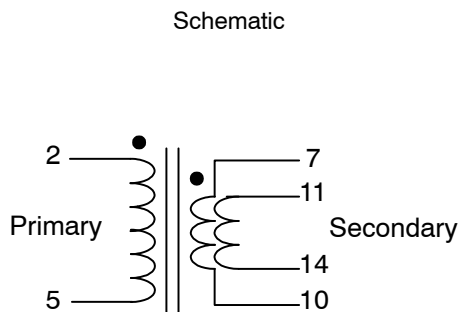
Windings (in order):


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)



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