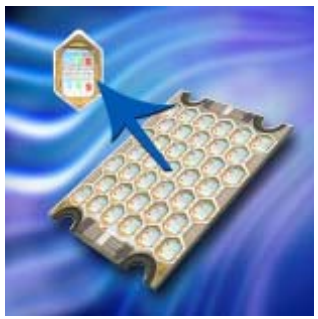
安森美半导体
ON Semiconductor®

LED照明解决方案





议程

- LED照明的分类及外形
- 交流-直流(AC-DC) LED的驱动方案
- 直流-直流(DC-DC) LED的驱动方案
- LED手电筒的驱动方案
- 总结

LED照明的分类

1. 交流-直流(AC-DC) LED的方案

   E14,E27的PAR灯,嵌灯,台灯和路灯

2. 直流-直流(DC-DC) LED的方案

   MR11,MR16,路灯的DC-DC部分

3. LED手电筒的方案

   低压小功率的升压/降压驱动

LED照明的外形

3 W PAR16

3x2 W PAR20

10 W PAR30

15 W PAR30

15 W PAR38

22 W PAR38

1 W G13

3 W GU10

1 W MR11

3 W MR16

3 W嵌灯

9 W嵌灯

15 W嵌灯

1 W LED阅读灯

100 W LED路灯

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AC-DC照明方案

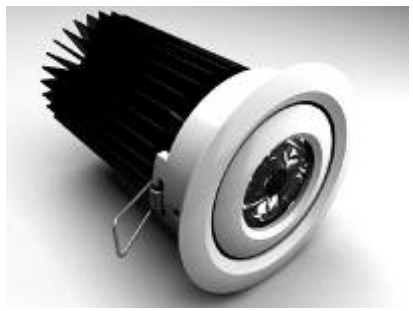
AC-DC

G13/GU10/PAR16/PAR20(1 W-8 W)

PAR30/PAR38/嵌灯(8 W-25 W)

区域照明(50 W-150 W)

区域照明(100 W-300 W)

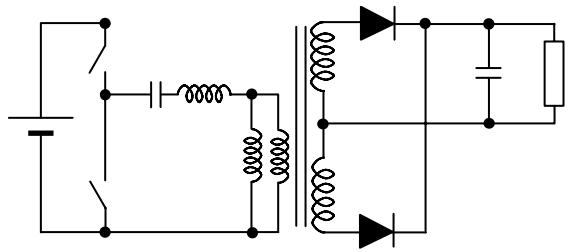


安森美半导体能提供何种AC-DC方案?

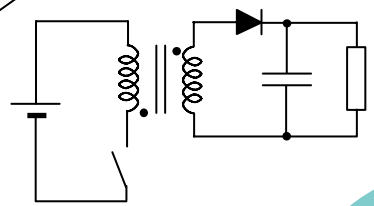
- 安森美半导体能提供各种LED照明的电源驱动器及功率因数校正(PFC)控制器
- 配合隔离及非隔离设计要求,提供不同LED应用方案
- 提供单级和双级PFC控制方案,符合有谐波及功率因数要求的应用
- 2009年产品开发重点:
  各种AC-DC和DC-DC 高效率的整体方案
  配合双向可控硅(TRIAC)调光器的整体方案

不同功率范围的隔离拓扑结构

增加功率及功率密度



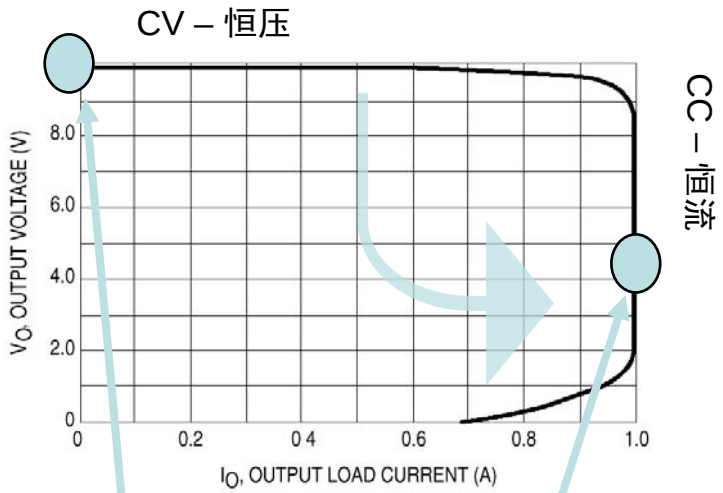
LLC半桥谐振拓扑结构



反激

反激拓扑结构是小于100 W的中低功率应用的标准选择，而半桥谐振(LLC)拓扑结构是高能效的首选

小功率LED驱动器特性

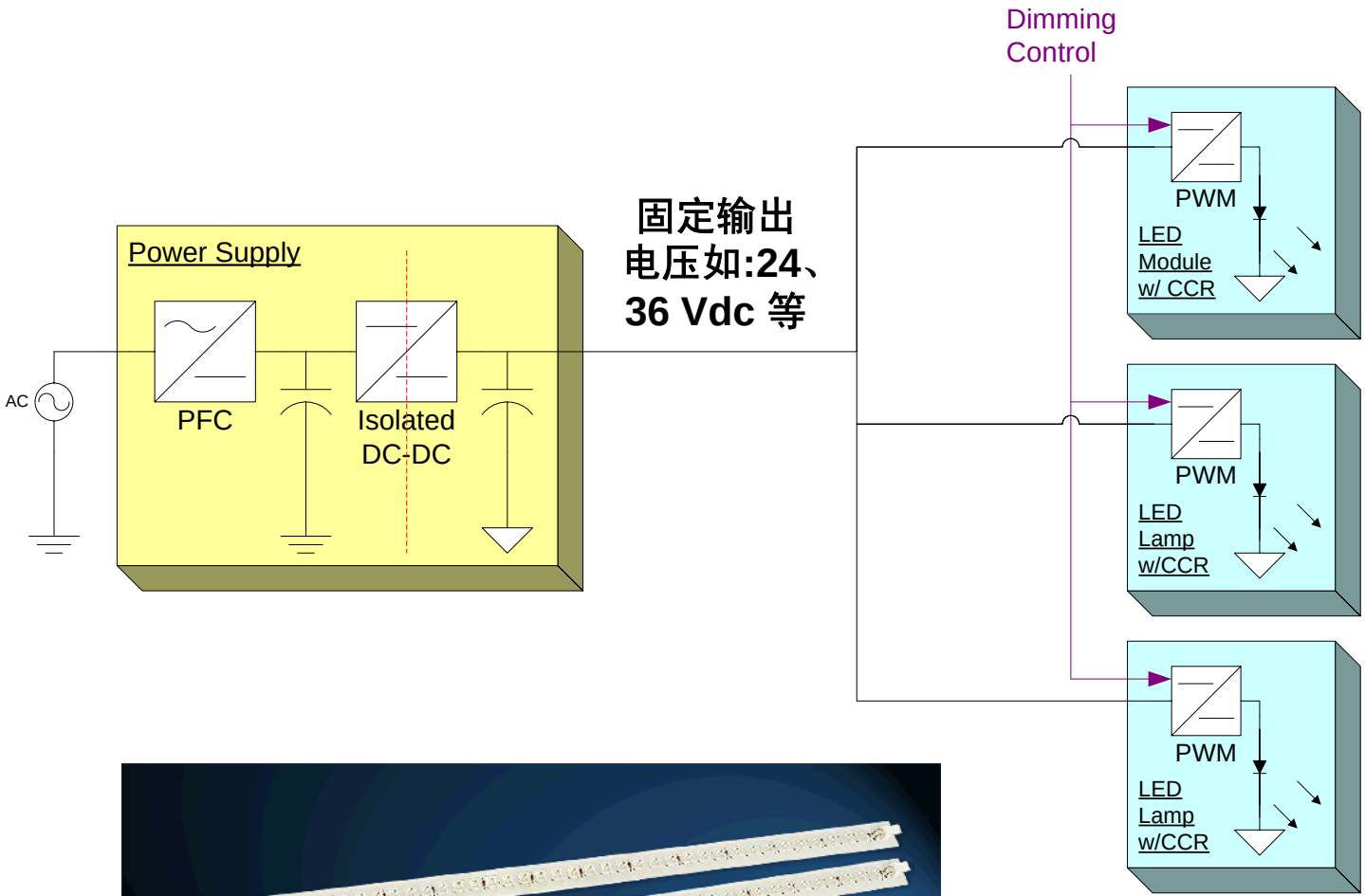


输出钳位的电压

•输出的限定电流
•输出电压取决于LED正向电压

- 小功率的LED电源通常以恒流(CC)驱动
- 恒压(CV)功能是在输出开路的情况下作为保护功能

大功率分布式LED配置示例



1 W-8 W应用要求

规格：

- 输入电压：90 V~264 Vac 或 LL/HL
- 功率范围：1 W-8 W
- 能效：80%
- 保护特性：短路和过功率保护
- 输出电流(恒流)：350 mA; 700 mA

应用：

- G13/GU10/PAR16/PAR20/嵌灯(Downlight)

设计参考文档：

- DN06027/D; DN06051/D; AND8328-D

产品：NCP1015

NCP1015 – 自供电单片开关调整器

NCP101X series offers everything needed to build a rugged and low-cost power supply. It integrates a fixed-frequency (65-100-130 kHz) current-mode controller and a **700 V MOSFET**

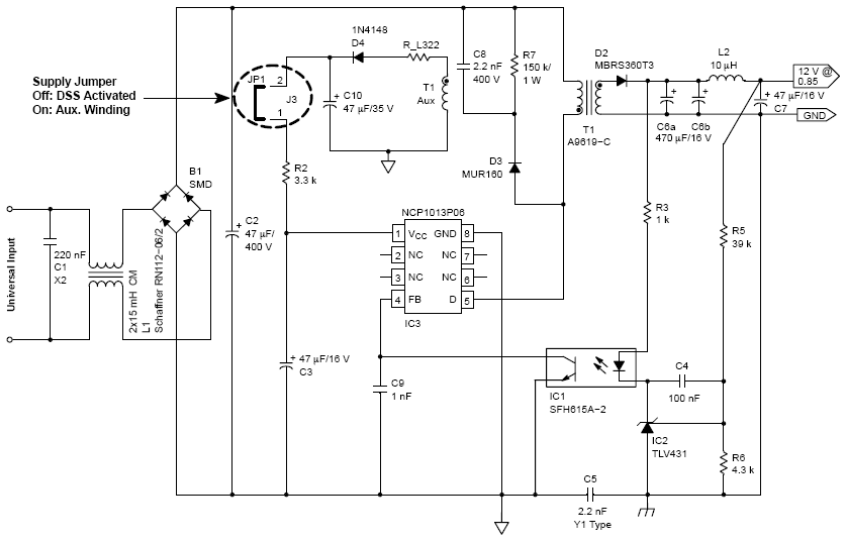
- 22Ω & 11Ω Rdson
- I peak from 100 to 450 mA
- Skip mode
- **Internal HV start-up featuring Dynamic Self Supply (DSS)**
- Broad type of applications
- Improved efficiency in light load
- Clean & loss less start-up sequence, less components

其它特性

- Short circuit protection Independent of the aux. winding when the DSS is used
- Soft start: 1 ms
- **Internal switching frequency: 65, 100 and 130 kHz**
- **Frequency jittering when the DSS is used**

市场及应用

- **Low power AC-DC LED driver**
- Low power AC adapters
- Auxiliary / standby PSU for desktop and flat TVs
- Low Power Open frame (DVD, STB)
- White goods / E meters

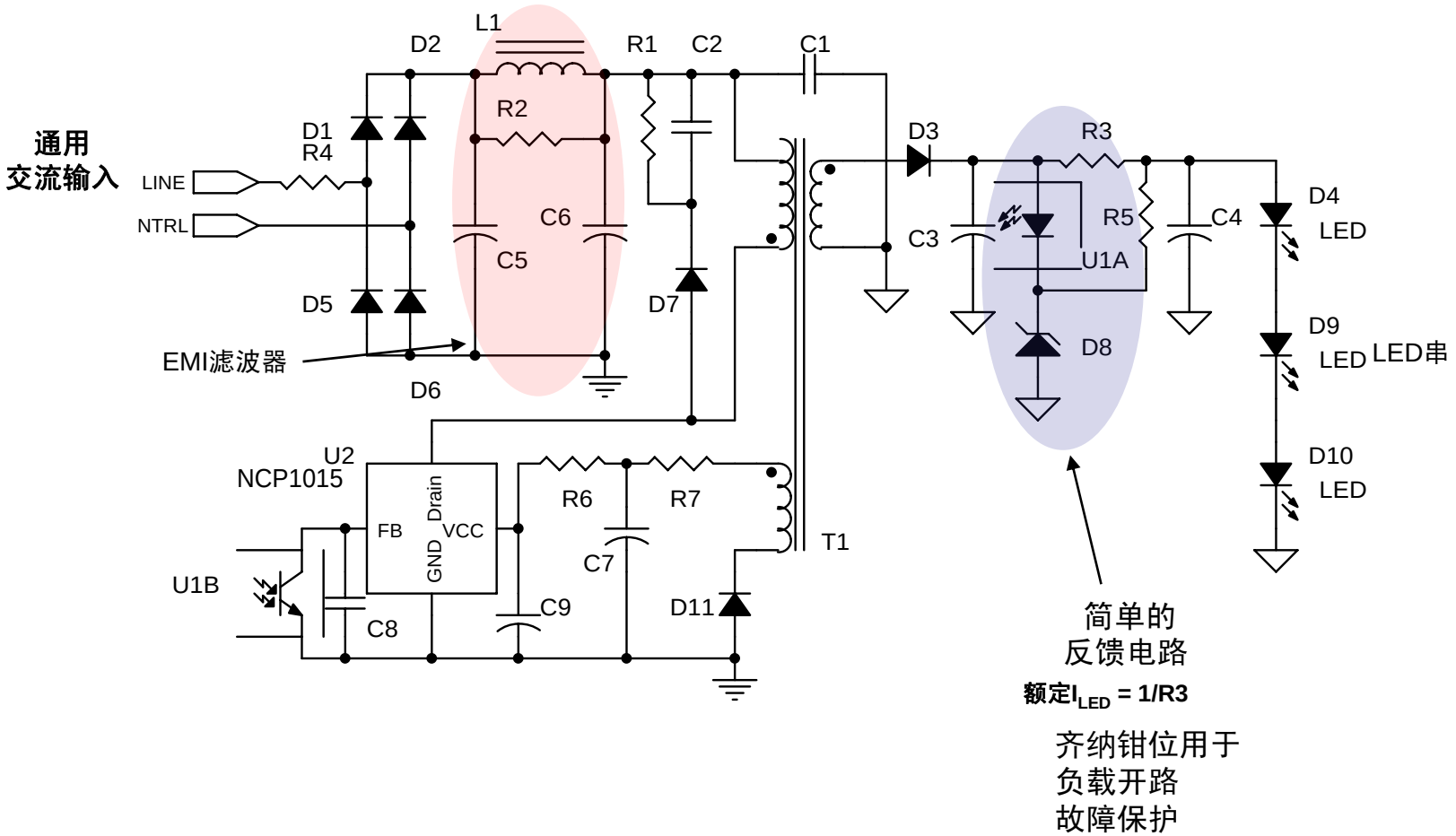


8 W/15 W通用电源

订购及封装信息

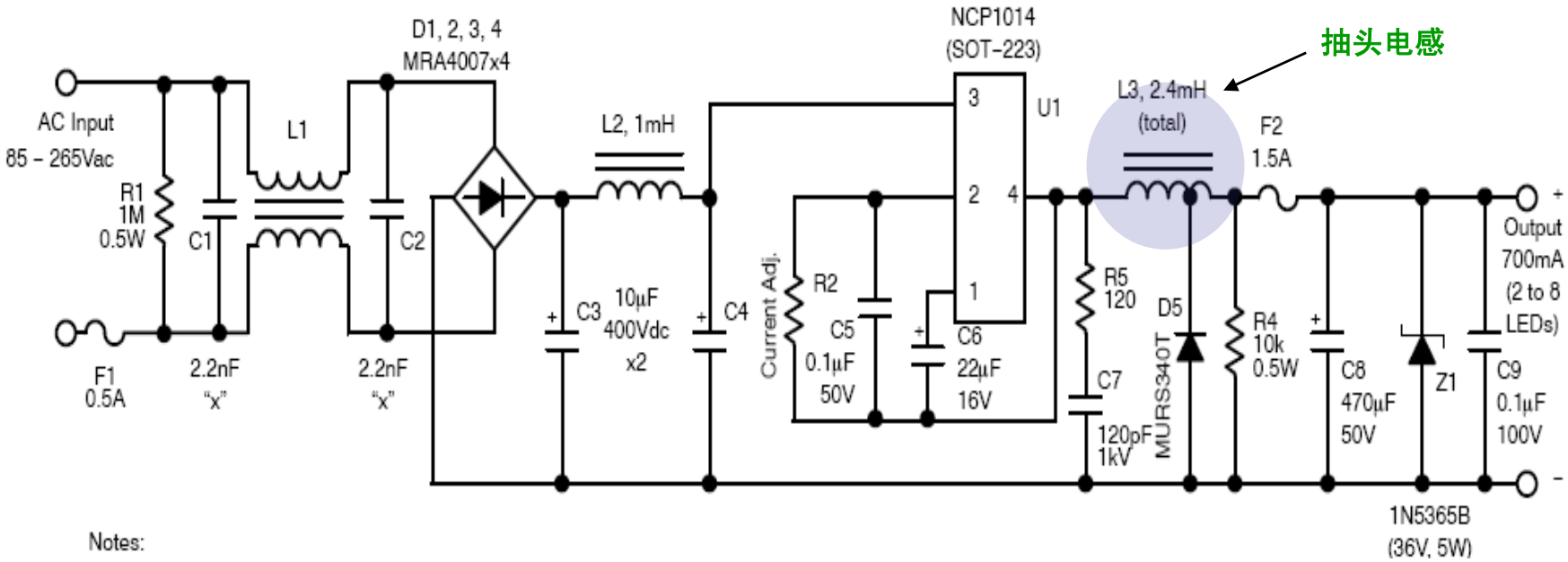
- SOT223, PDIP7 and SMD PDIP7

NCP1015(隔离)的1 W-8 W方案



NCP1015 8 W @ 85-264 Vac

NCP1015(非隔离)的1 W-8 W方案



NCP1015 1-8 W @ 85-265 Vac

8 W-25 W应用要求（不需要PFC)

规格：

- 输入电压：　90~132 Vac或180~264Vac(或通用输入)
- 功率范围：　8 W-25 W
- 能效：　85%
- 无功率因数要求
- 保护特性：　短路保护及开路保护
- 输出电流(恒流)：　350 mA; 700 mA; 1 A

应用：

- PAR30/PAR38/嵌灯(Downlight)

设计参考文档：

- DN06006/D; DN06040/D; DN06050/D

产品：NCP1028/NCP1351

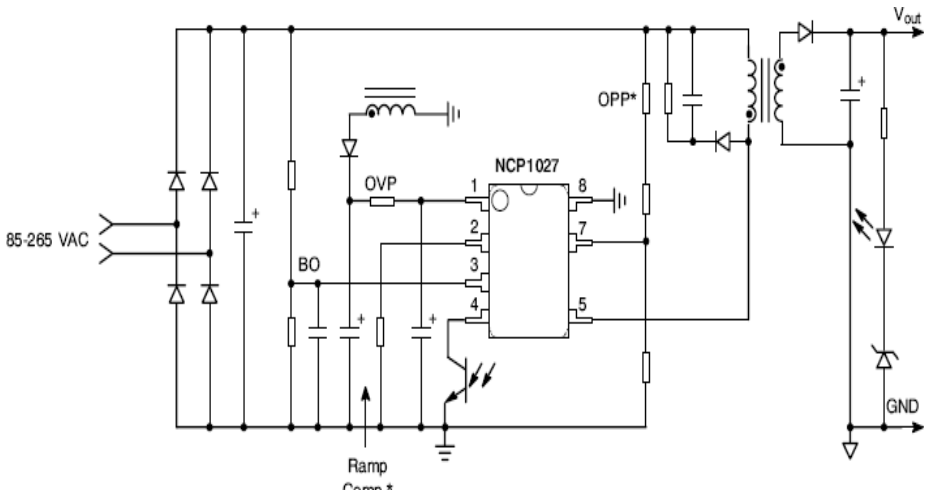
NCP1028 – 增强型单片开关调整器

The NCP1028 offers a new solution targeting output power levels from a few watts up to **15 W** in a universal mains flyback application.

- 5.8 Ω Rdson
  I peak: 800 mA
- Skip mode
- **Short circuit protection**
- Broad type of applications
- Improved efficiency in light load
- Independent of the aux winding

其它特性

- **Internal HV start-up**
- Soft start: 1 ms
- Internal switching frequency: 65 & 100 kHz
- **Over Power Compensation**
- **Internal ramp compensation**
- Latch input PIN
- **Brownout protection against low mains**



15 W/25 W通用电源

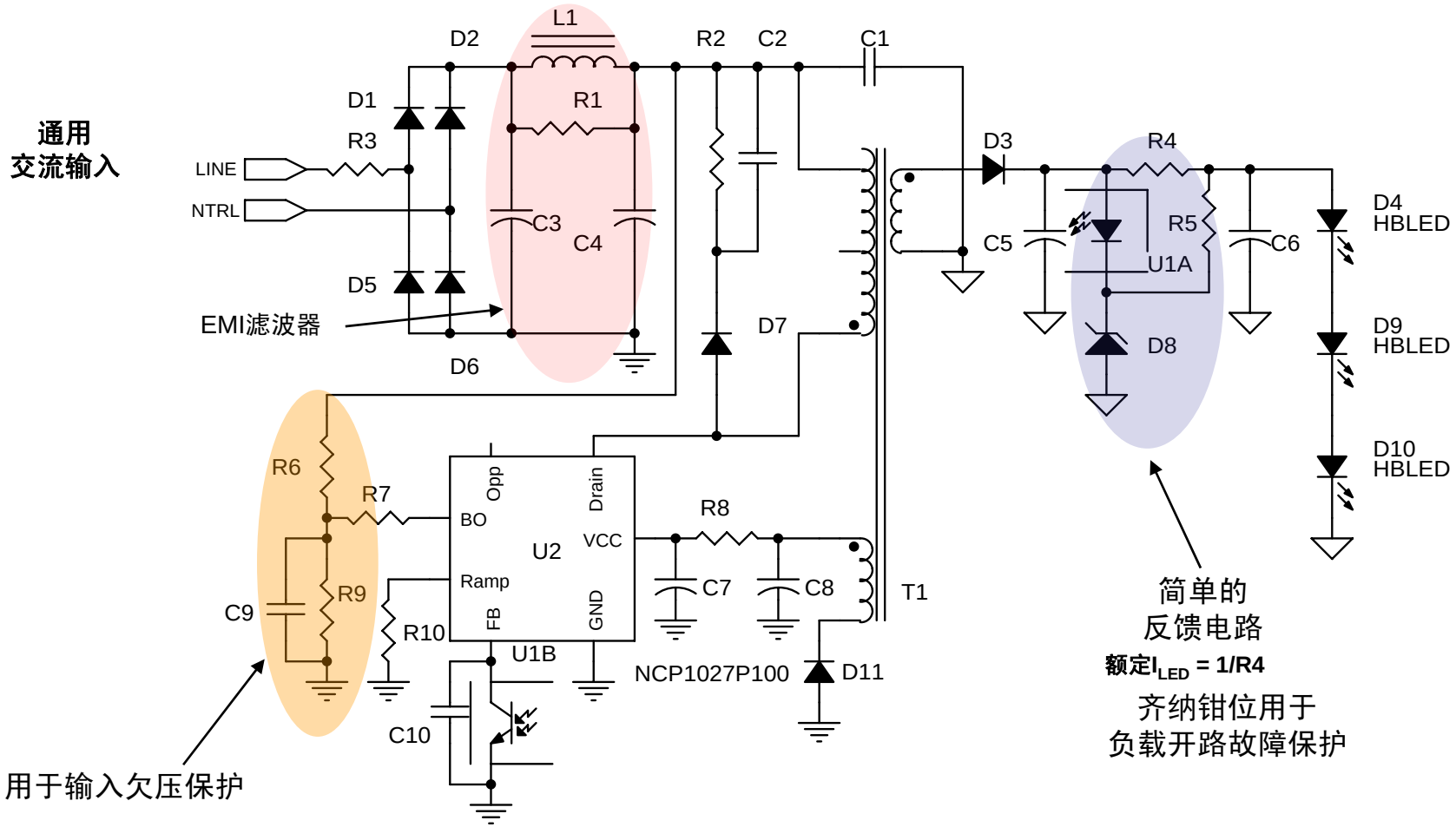
市场及应用

- **Medium power AC-DC LED driver**
- Medium power AC adapters
- Auxiliary / standby PSU for desktop and flat TVs
- Low Power Open frame (DVD, STB)

订购及封装信息

- NCP1028P065G & NCP1028P100G PDIP7

采用NCP1028的8 W-15 W方案

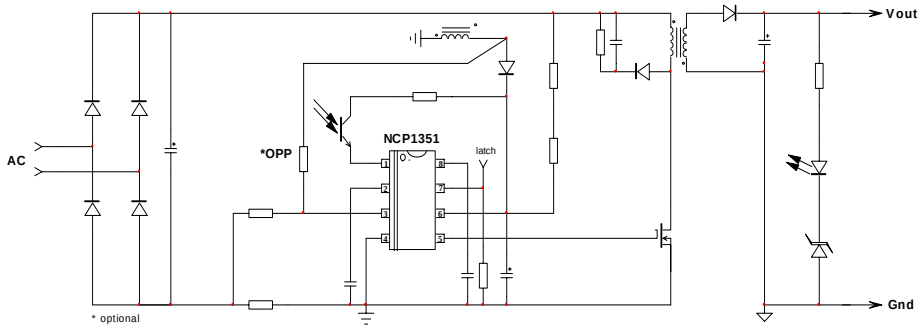


NCP1028 15 W @ 90-264 Vac

NCP1351 – 固定导通时间控制器

The NCP1351 is a current-mode controller targeting low power off-line flyback Switched Mode Power Supplies (SMPS) where total cost is of utmost importance

- **Quasi fixed Ton, variable Toff**
- **Frequency foldback** with Peak Current Compression
- Short circuit protection (latched A & C or auto-recovery B & D)
- Natural frequency foldback
- Noise free & improved efficiency in light load
- Independent of the aux. winding



其它特性

- C and D options accommodate large output power transients (printers)
- Primary or secondary side regulation
- **Latch input**
- Low start-up current
- **Natural frequency jittering**
- **Negative current sensing with programmable current sense resistor**
- **Extended Vcc range: 28 V**

简单及紧凑的设计

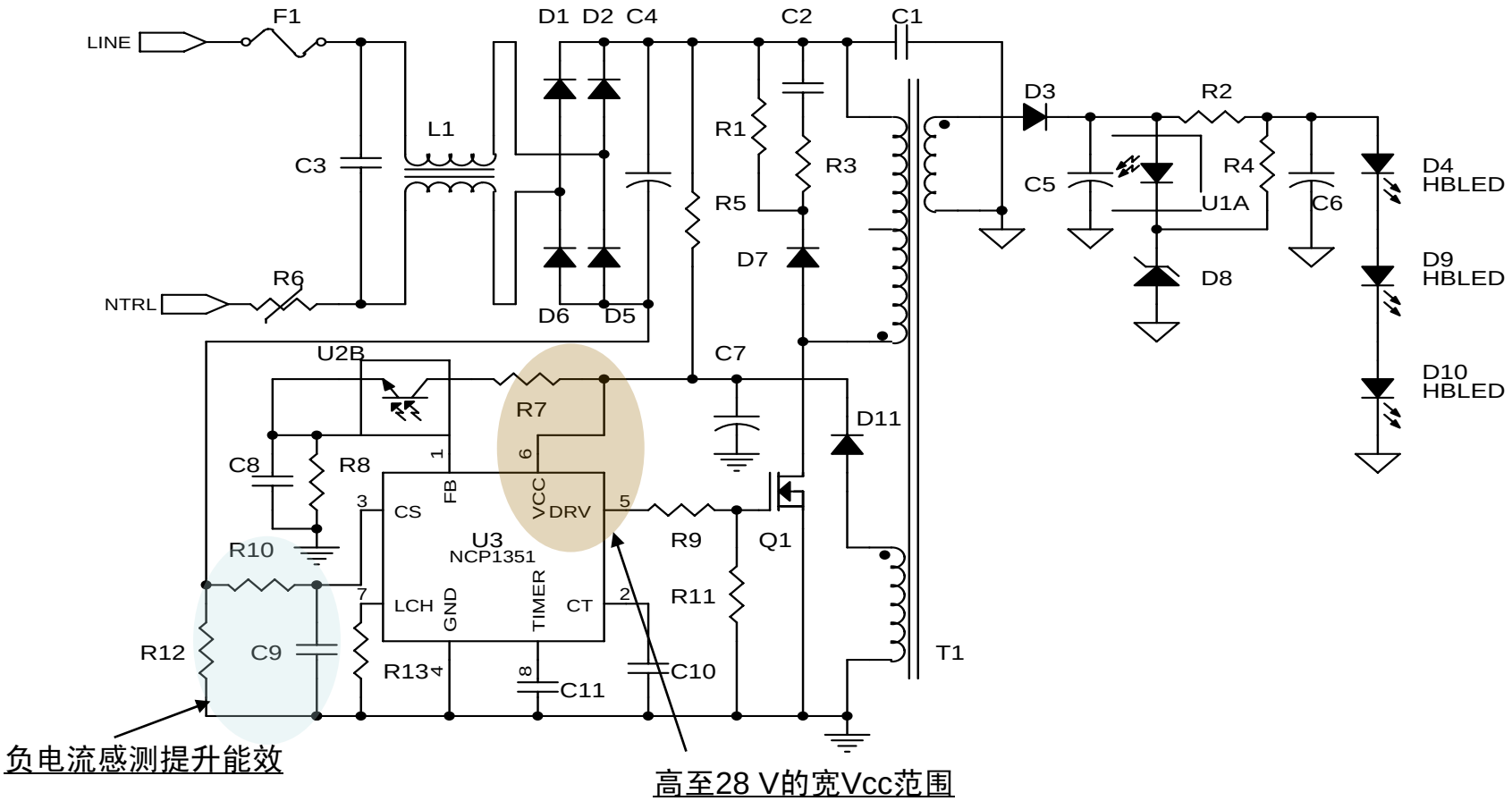
市场及应用

- **LED Power Supplies**
- Offline Adapters

应用及订购信息

- NCP1351XDR2G: SOIC8
- NCP1351XDR2G: PDIP8
- X = A, B, C ,D

NCP1351的 8 W-25 W 方案



NCP1351 25 W @ 90-264 Vac

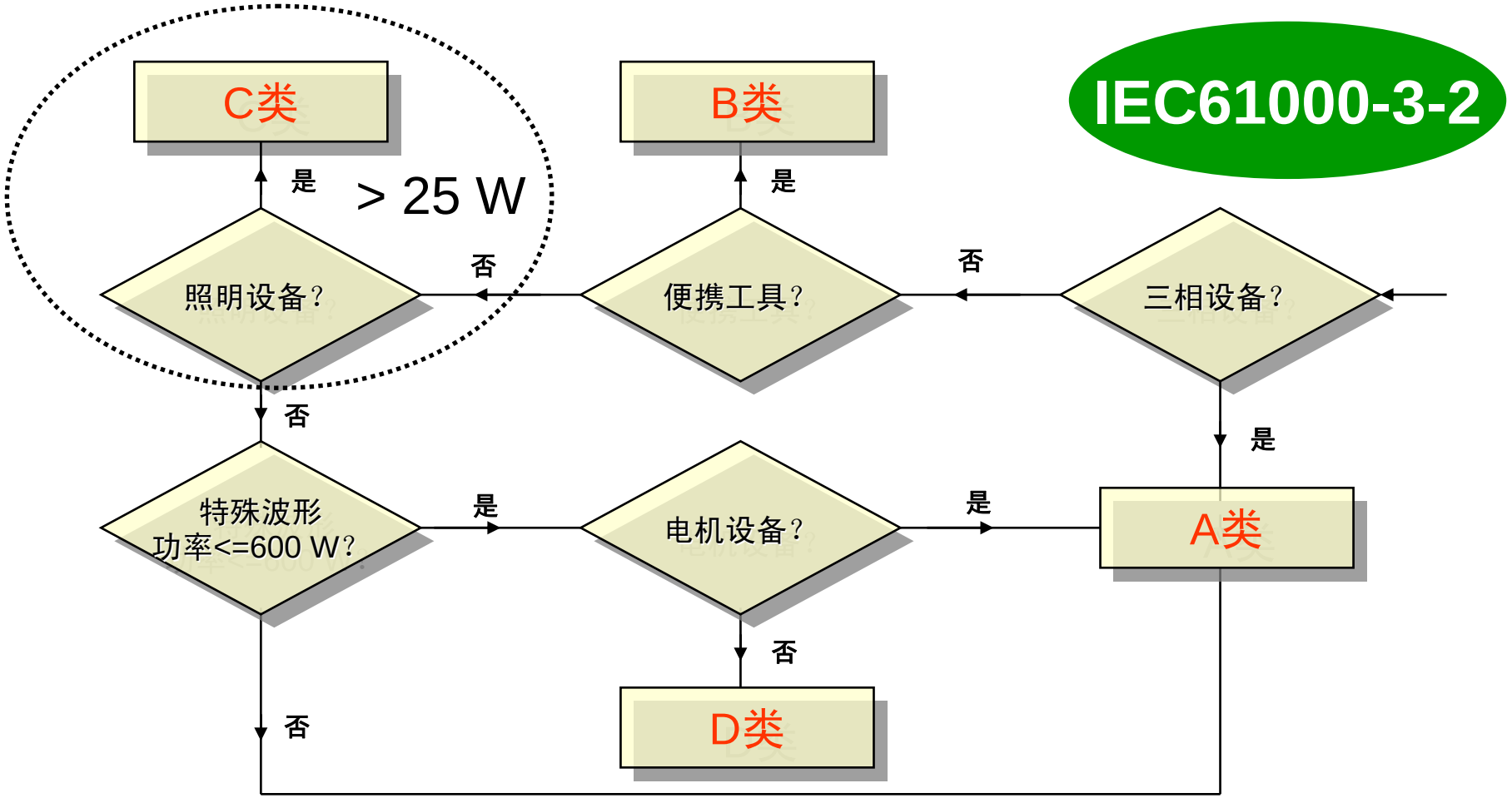
LED照明需要良好的功率因数(PF)吗？

- IEC(欧盟)在功率大于25 W照明的应用是有总谐波失真(THD)和功率因数的要求，许多不同地区也采用相应的标准。

- 美国“能源之星”(ENERGYSTAR™)对所有功率等级的固态照明(SSL) 都有PF的要求。这是一项自愿性的标准。
  - PF>0.7住宅应用
  - PF>0.9商业应用

- 虽然不是所有国家都有强制性要求，但在某些应用中是有PF要求:
  - 商用设施应用中, 对PF提出恰当的要求以获得最佳的效益
  - 在路灯的应用中，对PF会有较高的要求(通常>0.95).

谐波含量标准(功率因数)


IEC61000-3-2
C类
B类
是
> 25 W
照明设备?
否
便携工具?
否
三相设备?
否
是
特殊波形
功率<=600 W?
是
电机设备?
是
A类
否
否
D类

8 W-25 W应用要求 (需要PFC)

规格：

- 输入电压： 90 V~264 Vac 或 LL/HL
- 功率范围： 8 W-25 W
- 功率因数： >0.9
- 能效： 80%
- 保护特性： 短路及过功率保护
- 输出电流(恒流)： 350 mA; 700 mA; 1 A

应用：

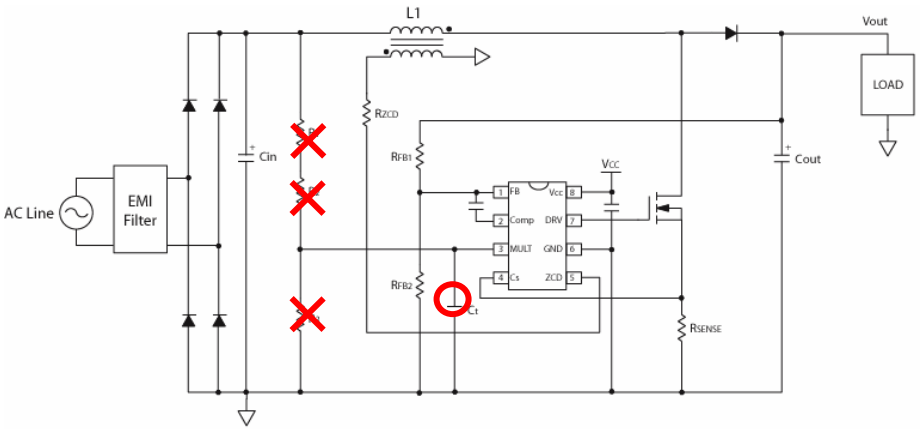
- PAR30/PAR38/嵌灯(Downlight)

产品：NCP1607/8

NCP1607 – 高性价比PFC控制器

The NCP1607 is a **Critical conduction Mode** (CRM) power factor controller specifically designed for use as a pre-converter in electronic ballast, ac adapters and other low to mid power off-line converters (typically up to 250 W)

- Pin to pin compatible with industry standards
- **Adjustable Over Voltage Protection with low current level options (OVP)**
- **Open loop protection**
- Reduce design efforts
- Design flexibility & rugged design, NCP1607B further reduces losses
- Rugged design



其它特性

- High Precision Voltage Reference (±1.5% over the VCC and Temp. ranges)
- **Built-in OCP with 2 voltage thresholds options**
- Inhibition capability
- Less than 50 µA start up current
- Drive capability 500/ 800 mA (source/sink)

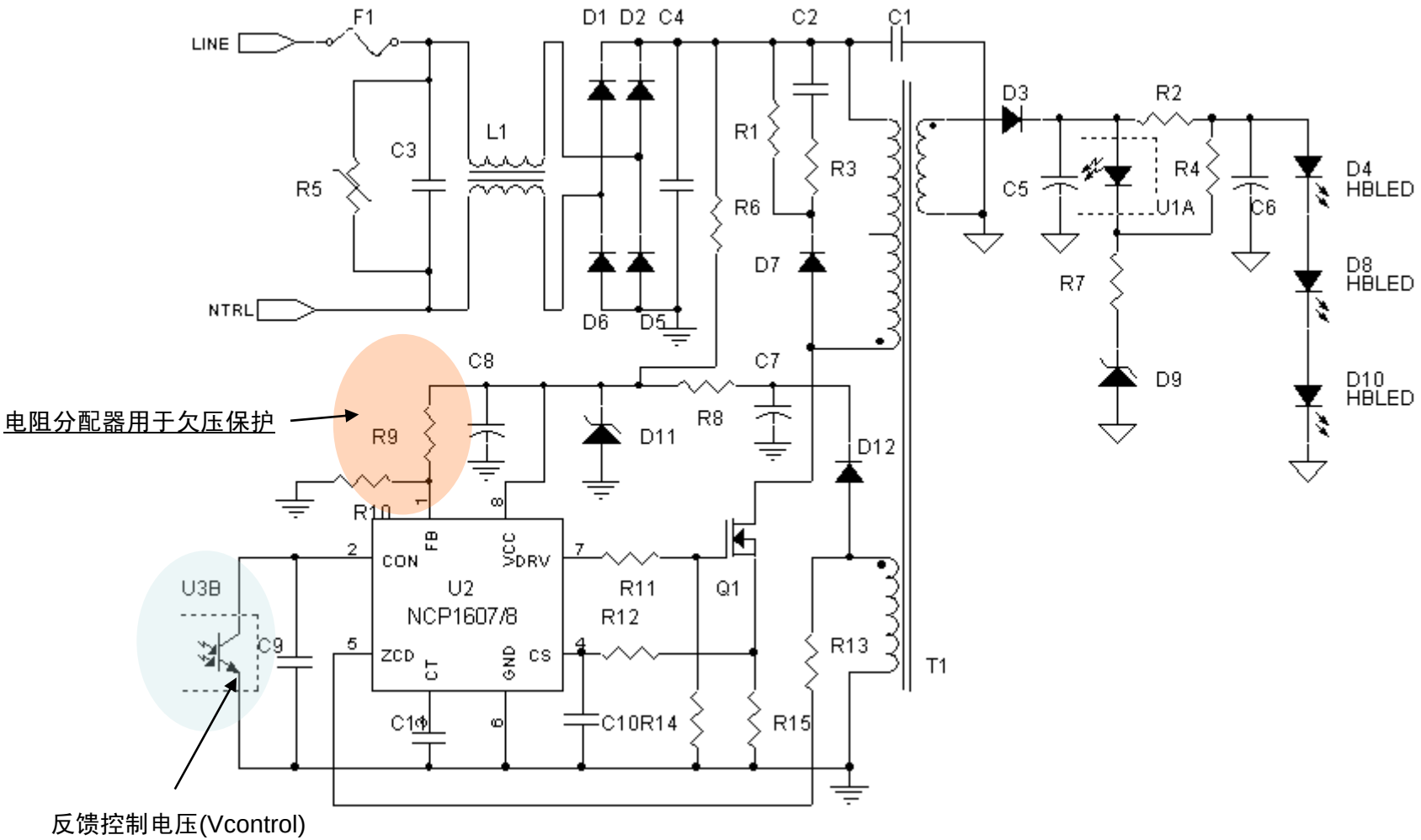
市场及应用

- Electronic Light Ballast
- AC adapters
- **LED Power Supplies/Drivers**

订购及封装信息

- NCP1607BDR2G: SOIC-8

NCP1607/8的8 W-25 W方案



NCP1607/8 25 W @ 85-135 Vac或185-264 Vac

50 W-200 W应用要求

规格：

- 输入电压： 90 V~264 Vac 或 LL/HL
- 功率范围： 50 W-150 W
- 功率因数： >0.95
- 能效： 85%
- 保护： 短路保护及过压保护

- 输出电流(恒流)： 350 mA; 700 mA; 1 A

应用：

- 街道照明
- 大功率区域照明

产品: **NCP1652**
NCP1607/8 + NCP1377
NCP1607/8 + NCP1396
NCP1901

NCP1652 – 改进型单段式PFC

NCP1652 has drive signals for active clamp or synchronous rectification to achieve optimum efficiency. Protective features (brownout, OCP, OVP), HV start-up and external ramp compensation enable easy implementation.

- Drive signals with prog. dead time
- Allows driving active clamp / synch rectifier
- Voltage Feed Forward
- Improved loop response
- **Over-current,**
- **Over-power limit**
- Rugged design

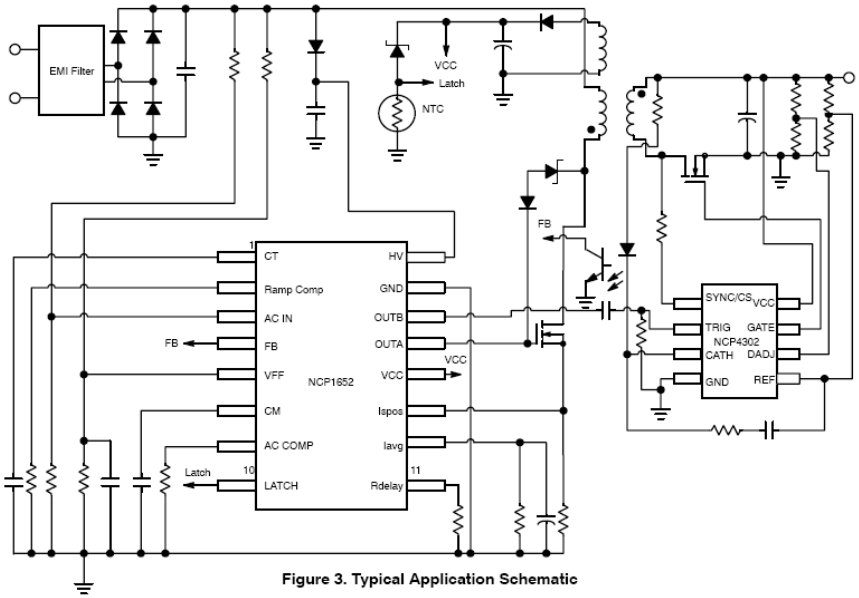


Figure 3. Typical Application Schematic

其它特性

- **Frequency Jittering for reduced EMI signature**
- **Brown-out Protection**
- **Soft-skip** below 30% Iout reduces noise
- **CCM/DCM operation**
- **Adj Frequency from 20 kHz to 250 kHz**

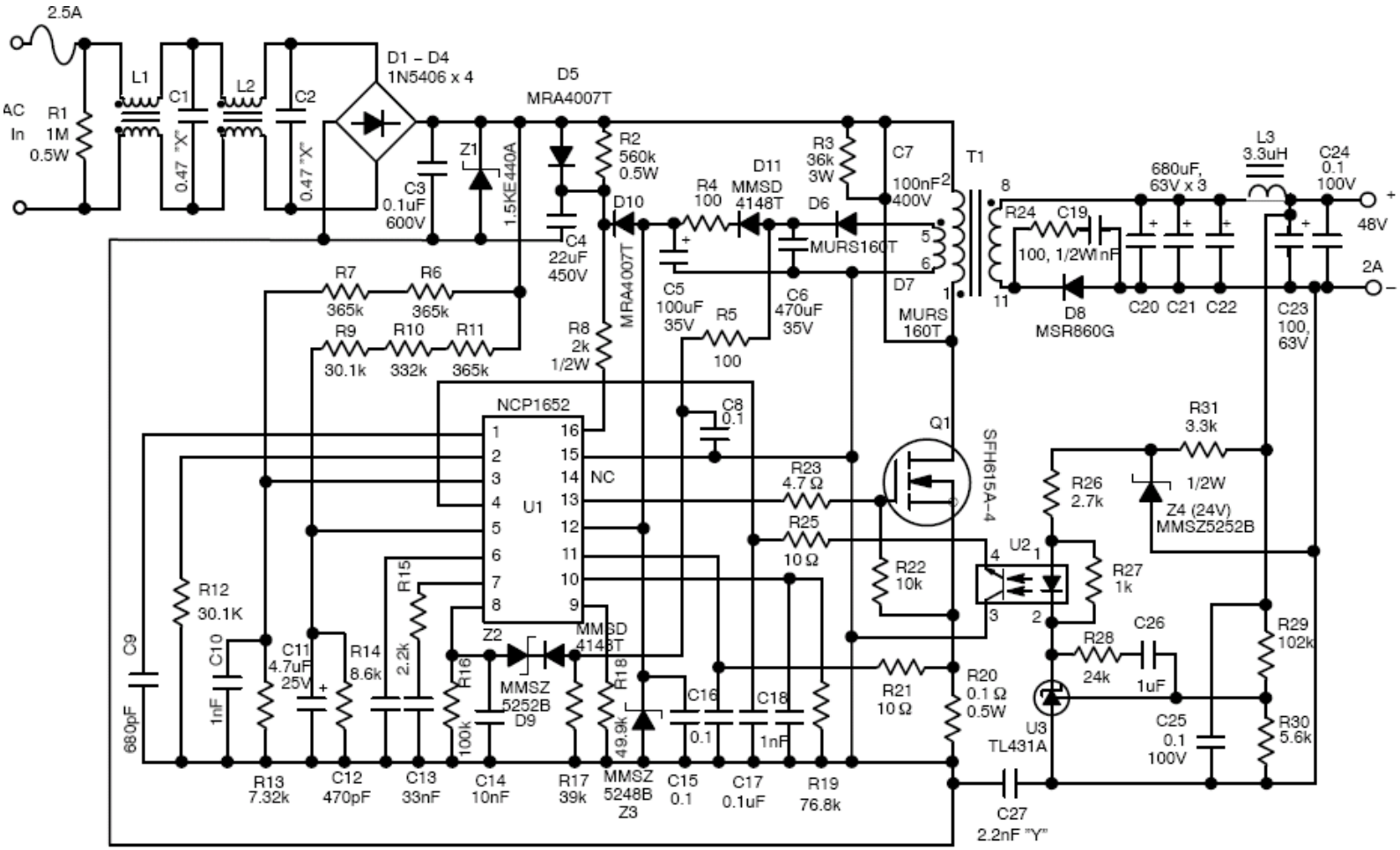
市场及应用

- High-power Adapters
- **LED Power Supplies and LED Drivers**
- High Powered Battery Chargers

订购及封装信息

- NCP1652DWR2G: SO-20 WB
- NCP1652DR2G: SO-16

NCP1652的50 W-150 W方案

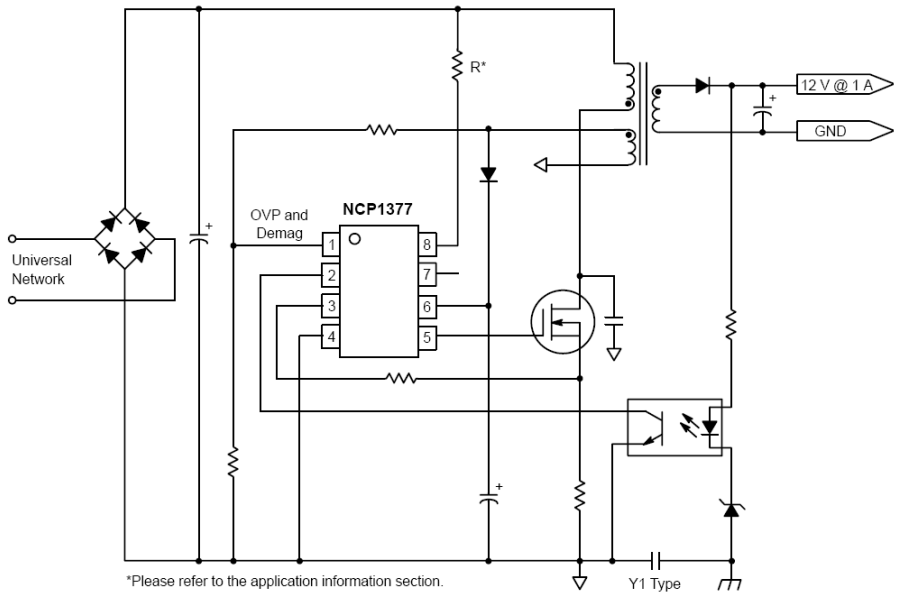


NCP1652 150 W @ 85-135 Vac或185-264 Vac

NCP1377 – 准谐振(QR)工作电流模式控制器

The NCP1377 combine a true current mode modulator and a demagnetization detector to ensure full Critical Conduction Mode in any load/line conditions and minimum drain voltage switching (Quasi-Resonant operation).

- **Quasi Resonant operation**
- Adjustable skip mode
- **Internal HV start-up**
- Minimize EMI radiation and capacitive losses
- Improved efficiency in light load
- Clean & loss less start-up sequence, less components



其它特性

- Under Voltage Lock-out
  - NCP1377: 7.6 V to 12.8 V typ
- Soft start : 1 ms
- **Latch input**
- Minimum off-time
  - NCP1377 = 8 µs

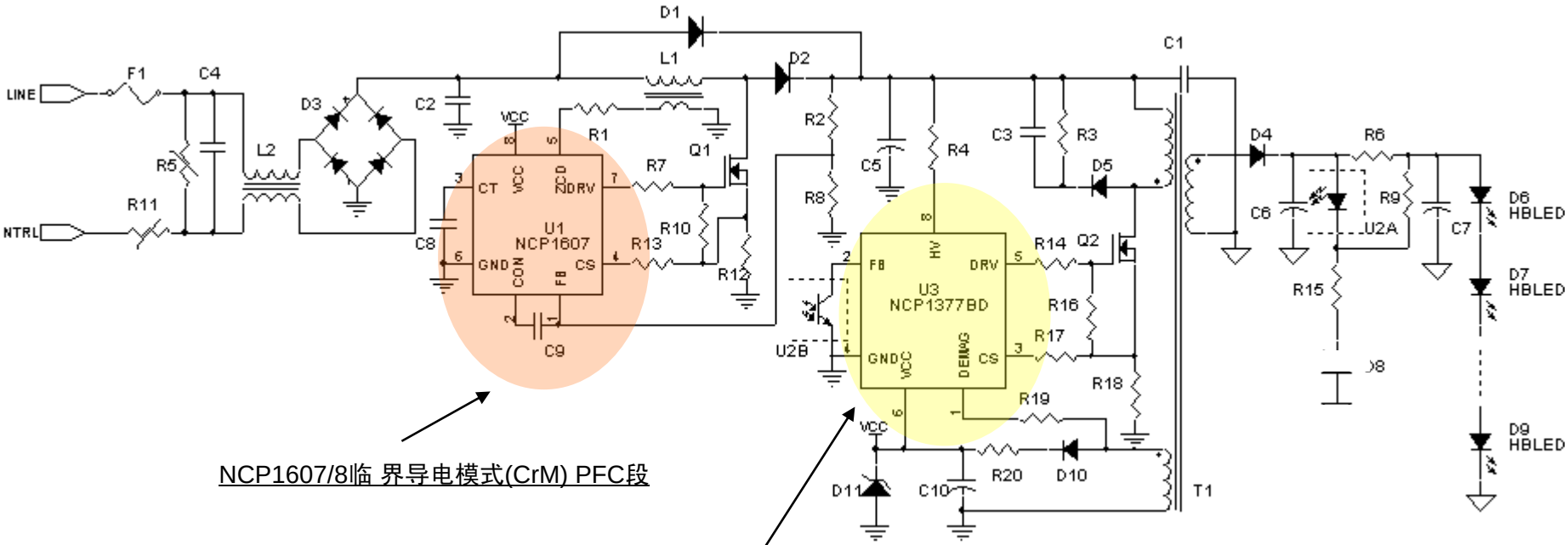
市场及应用

- **LED Power Supplies and LED Drivers**
- AC adapters
- Open frame PSU (DVD, STB)
- Auxiliary power supplies

订购及封装信息

- NCP1377DR2G : SOIC8
- NCP1377PG : PDIP8

NCP1607/8及NCP1377的50 W-150 W方案



NCP1607/8临 界导电模式(CrM) PFC段

NCP1377准谐振(QR)模式DC-DC段

NCP1607/8及 NCP1377 150 W @ 90-264 Vac

更高效率的LED电源

- 高效率的LED照明拓扑结构
  - 要求在较低的功率等级(如<50 W)时能提高效率>90%
  - 需要有新的拓扑结构来提供解决方案
  - 从反激式拓扑结构转向谐振半桥拓扑结构，以充分发挥零电压开关拓扑结构(ZVS)的优势

- 这些效率目标高于美国“能源之星”2.0等对外部电源的标准49 W功率时能效>87%，功率达75 W才要求PFC

- 安森美半导体已经开发出适用于LED电源的高效率谐振模式半桥方案

NCP1396 – 高性能谐振模式(LLC)控制器

On top of integrating the key features of a good resonant controller, the NCP1396 integrates the High voltage Half Bridge drivers.

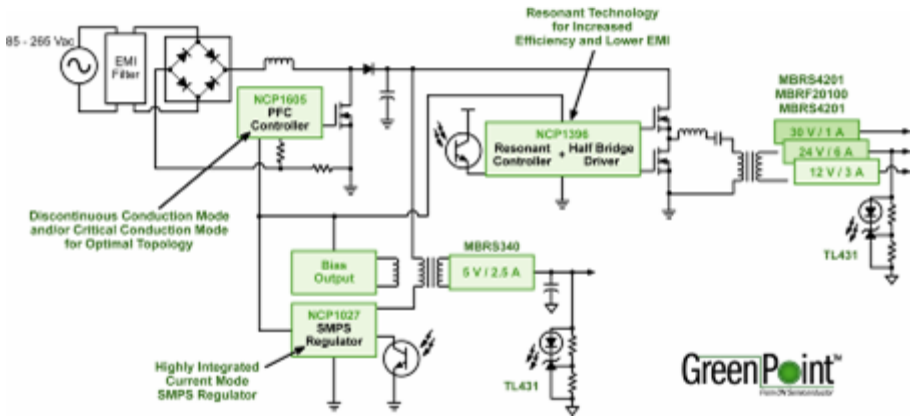
- **Built-in drivers**
- Adjustable & accurate minimum frequency
- Fast and slow fault detection, Broken FB loop detection
- Compact design
- Keeps the converter in the right region & ease the design
- Robust and rugged power supply & help to be compliant with safety standards

其它特性

- **Latch PIN, brownout**
- Adjustable dead-time
- Adjustable soft start
- Enable capability
- -40 to 125 ℃ junction temperature operation range

市场及应用

- Flat TVs
- **High Power LED Power Supplies**
- High power AC adapters



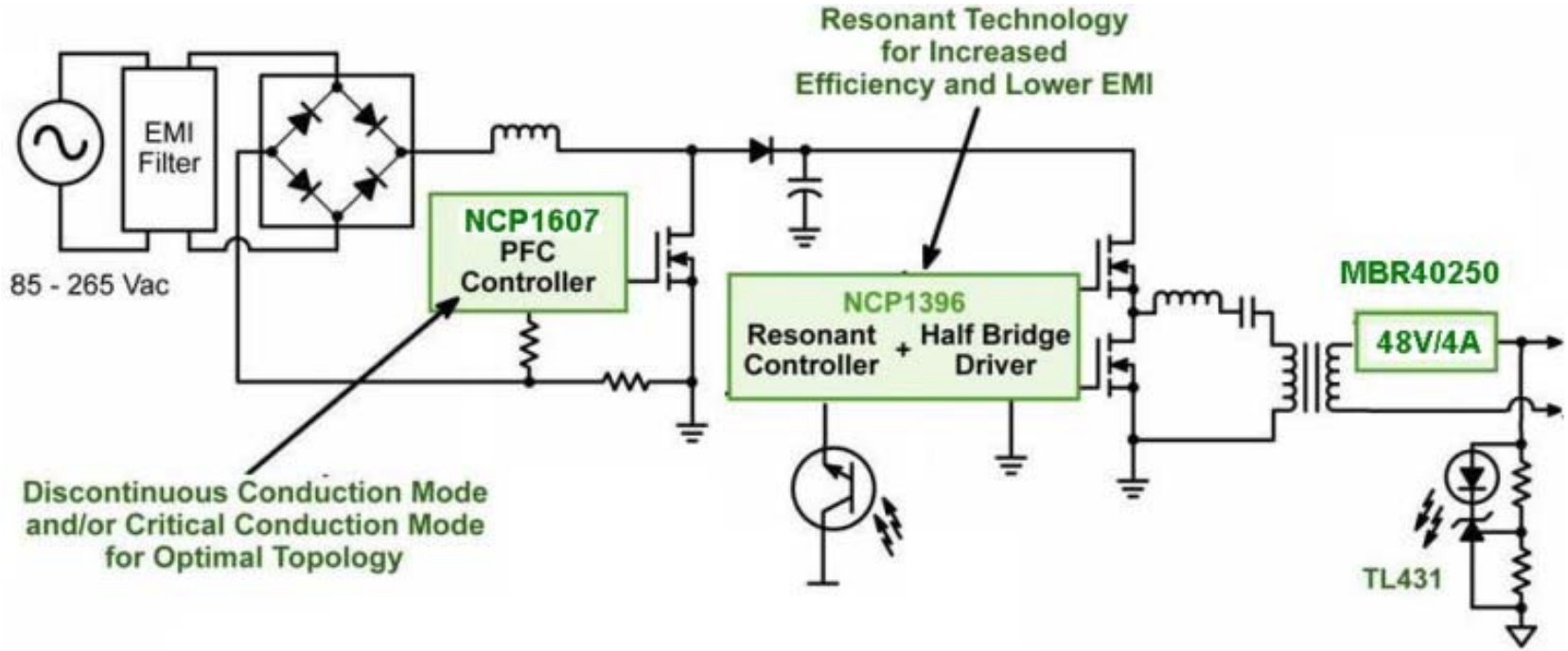
220 W参考设计

NCP1396A (12 V启动)，NCP1396B (10 V启动)

订购及封装信息

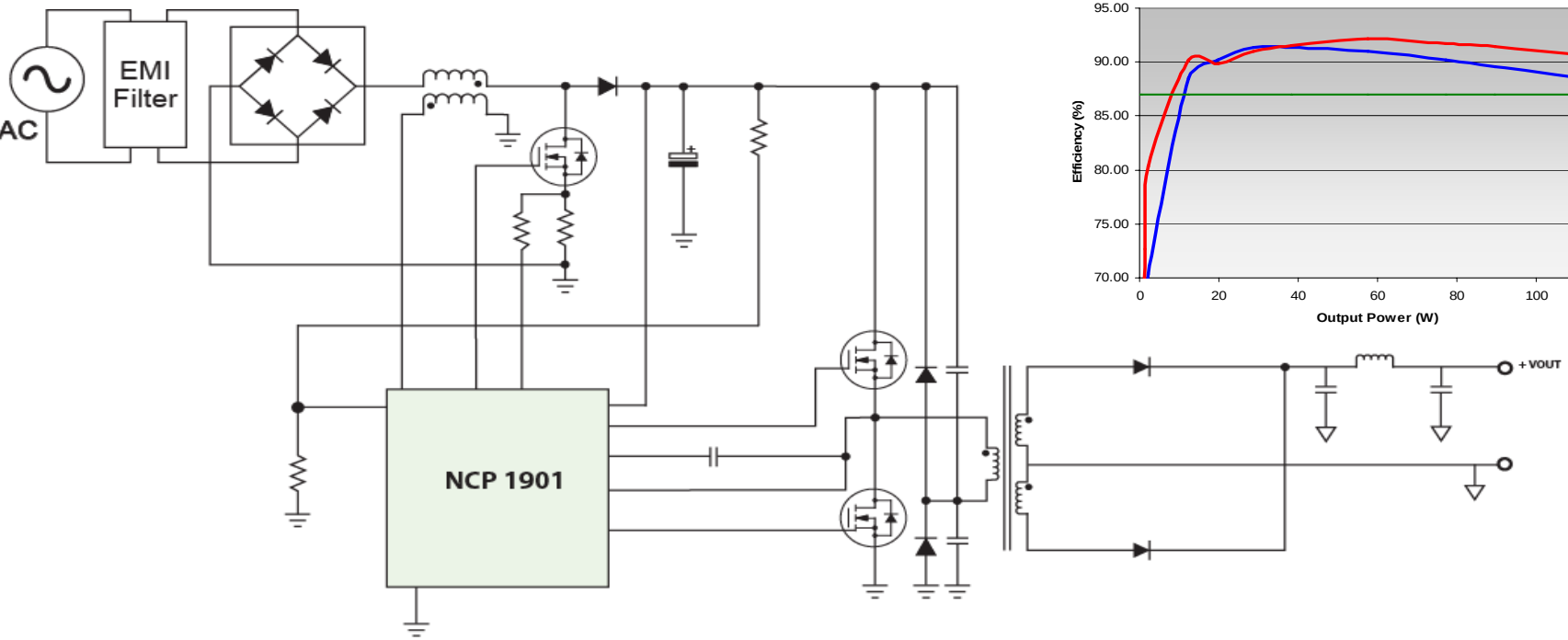
- NCP1396APG, NCP1396BPG: PDIP-16
- NCP1396ADR2G, NCP1396BDR2G: SOIC-16

NCP1607及NCP1396的100 W-200 W方案



NCP1607及 NCP1396 @ 90-264 Vac

NCP1901最新型的半桥谐振+PFC 100 W-200 W方案

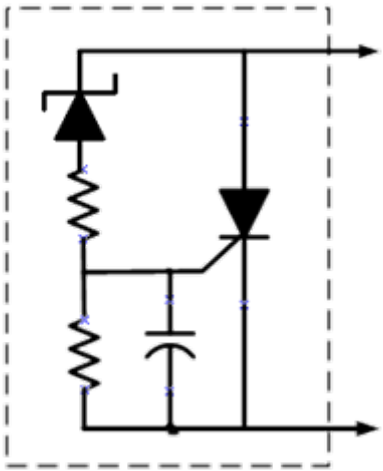


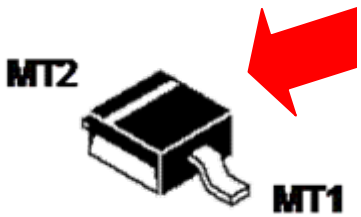
- 半桥段工作在固定频率及固定占空比以降低开关损耗。
- 初级端稳压，无需反馈环路！
- 调整半桥电源段的输入电压使输出稳压。
- 初级端检测过流情况。
- 极低 EMI及开关损耗。

NCP1901 @ 90-264 Vac

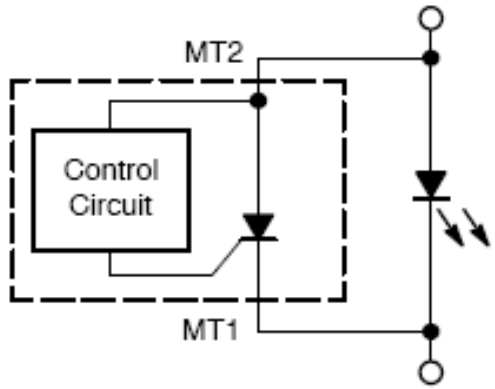
LED照明保护器件

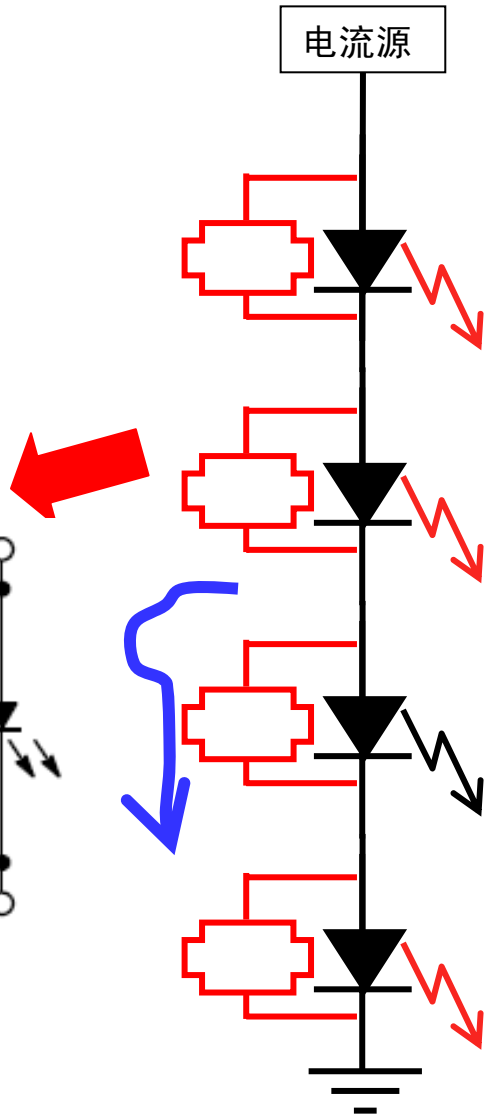
- 发生LED开路故障的事件时保护器件工作
- 恰当地散热可支持>1 A电流
- 有效提高LED照明的可靠性





NUD4700采用
PowerMite封装





AC-DC LED驱动方案总结

- NCP1015的1 W-8 W方案
- NCP1015的1 W-8 W方案(非隔离)
- NCP1028的8 W-15 W方案
- NCP1351的8 W-25 W方案
- NCP1607/8的8 W-25 W方案
- NCP1652的50 W-150 W方案
- NCP1607/8及NCP1377的50 W-150 W方案
- NCP1607/8及NCP1396的100 W-200 W方案
- NCP1901的100 W-200 W方案

议程

- LED照明的分类及外形
- 交流-直流(AC-DC) LED的驱动方案
- 直流-直流(DC-DC) LED的驱动方案
- LED手电筒的驱动方案
- 总结

DC-DC照明方案

DC-DC

1 W-3 W MR11/MR16 降压LED灯泡

1 W-20 W 升压LED驱动器

20 W-60 W大功率DC-DC LED驱动器

手电筒LED驱动方案

DC-DC 1 W-3 W要求

规格：

- 输入电压： 5 V~28 Vdc
- 能效： ≥ 90%
- 恒流： 350 mA; 700 mA;
- 频率： 达500 kHz~2 MHz;
- 温度： -40~125 ℃

应用：

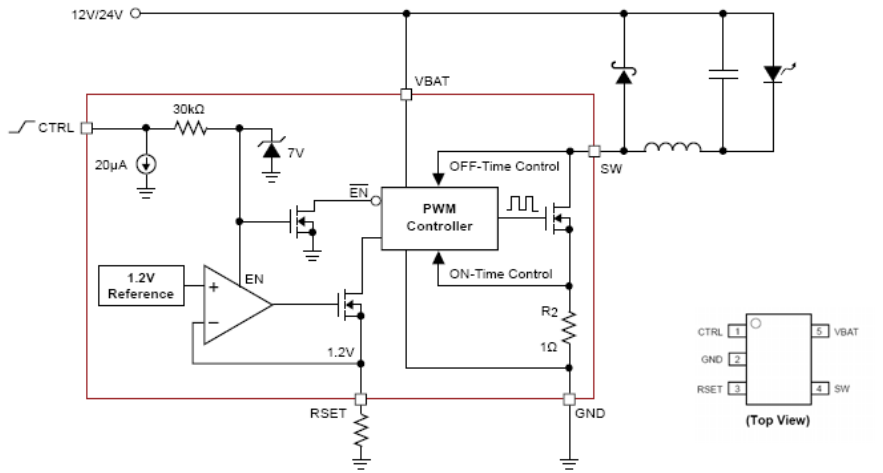
- MR11/MR16

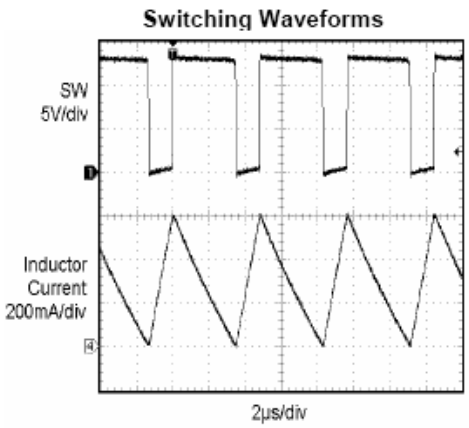
产品：CAT4201

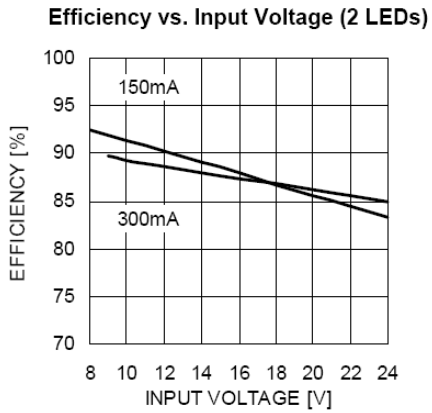
CAT4201降压LED驱动器

- 功能
  - **LED drive current up to 350 mA**
  - 12 V and 24 V system compatible
  - Handles transients up to 40 V
  - Enable Pin
  - **Power efficiency up to 94 percent**
  - **Drives up to 7 LEDs in series (24 V systems)**
- 全面的保护
  - Current limit and thermal protection
  - Open LED Protection
- 拥有专利的开关控制架构
  - **Reduces system complexity**
  - **Critical Conduction Operation**
  - **Improves efficiency**
- 封装
  - 5-lead thin SOT-23-5 (1mm height)

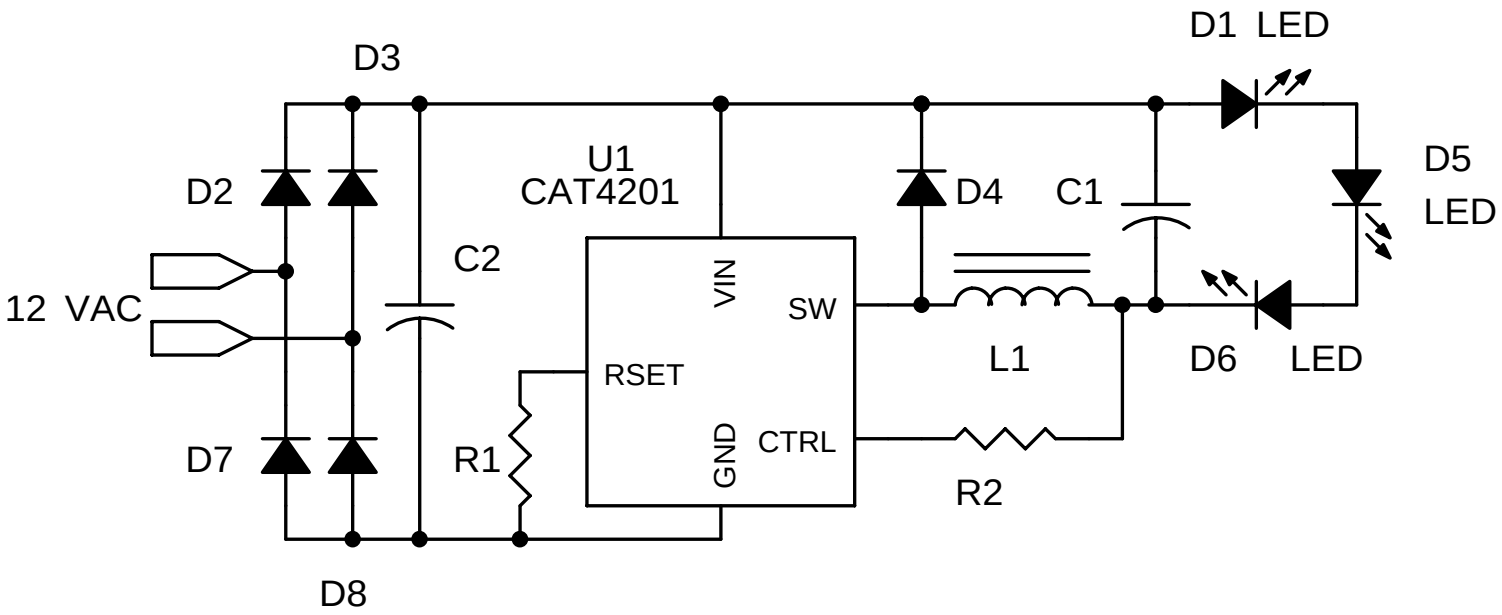
功能框图







CAT4201的1 W-3 W DC-DC方案



CAT4201 3 W @ 12 Vac

CAT4201：评估板

Figure 1. CAT4201EVAL2 with LED Module

可分层式
LED面板(1 W)
“菊花链”

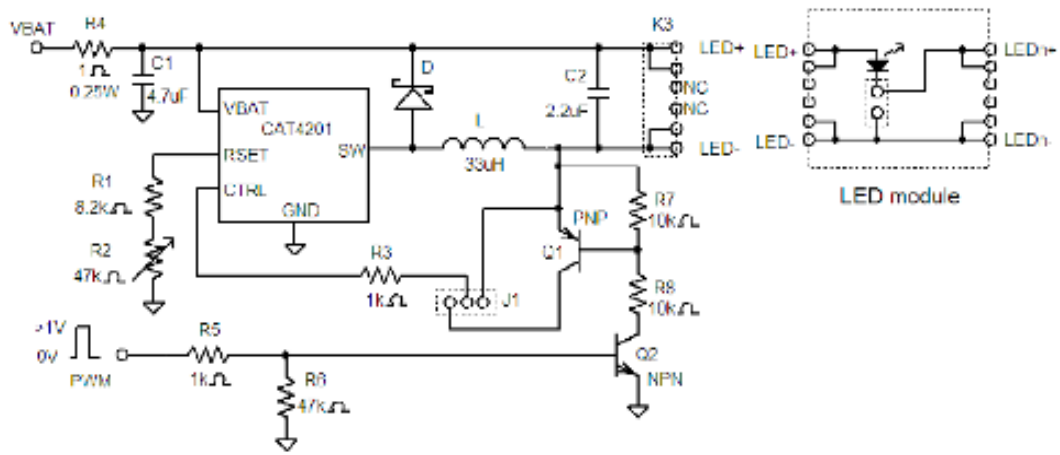


Figure 2. CAT4201EVAL2 Schematic

1 W-20 W的DC-DC升压应用要求

规格：

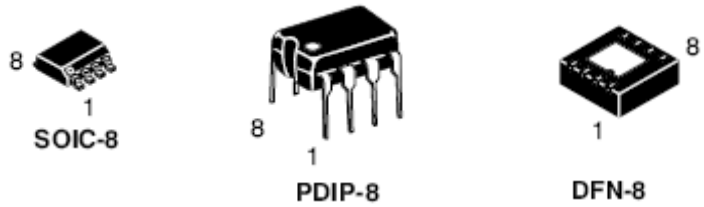
- 输入电压： 5 V~40 Vdc
- 能效： ≥ 85%
- 输出电流(恒流)： 350 mA; 700 mA;
- 频率： 达250kHz;

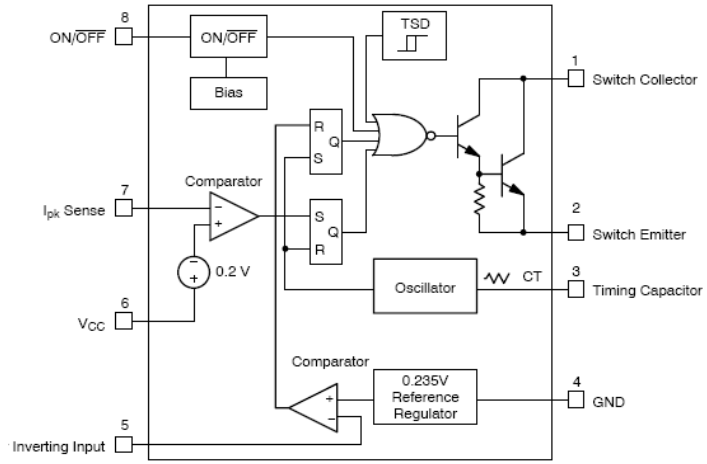
应用:

- DC-DC LED驱动器

产品：NCP3065/6

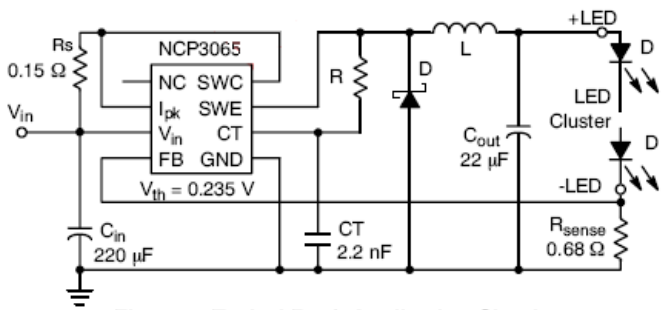
NCP/NCV3065/6 – 多模LED驱动器
降压/升压/SEPIC/逆变器



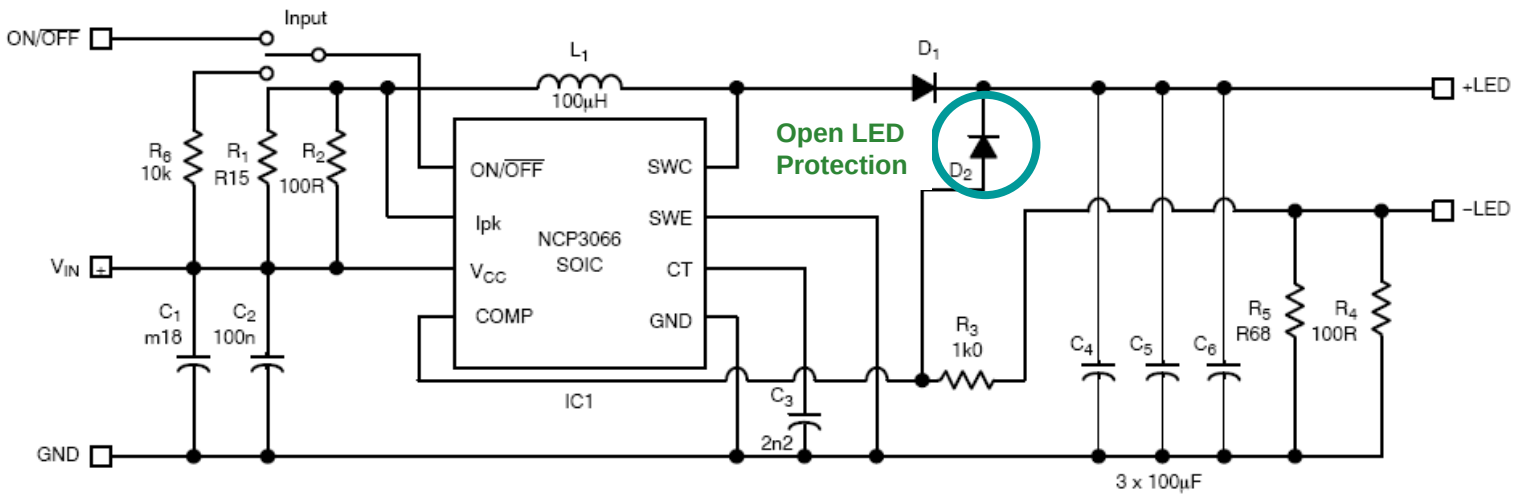


NCP3066

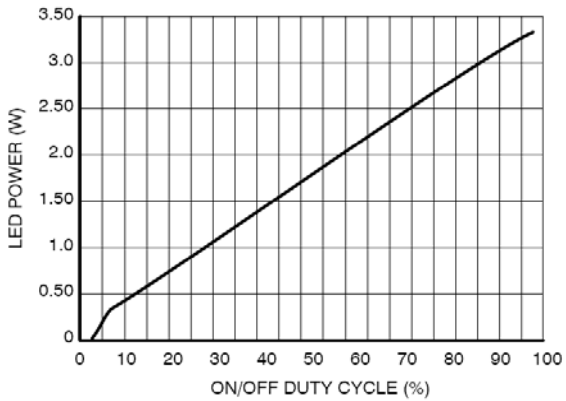
- 集成1.5 A开关
- 输入电压范围为3.0至40 V
- 235 mV的低反馈电压
- 逐周期电流限制
- 无需控制环路补偿
- 工作频率可调节，高至250 kHz
- 适合与所有类型陶瓷输出电容或无输出电容一起工作
- 模拟及数字PWM调光能力
- 内部磁滞热关机
- 提供NCV汽车应用版本
- NCP/NCV3066含“启用”(Enable)引脚



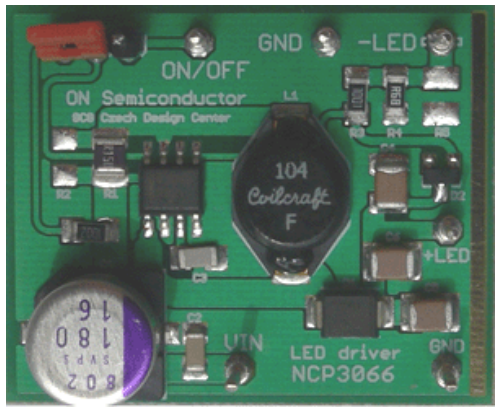
NCP3066升压LED配置



AND8289探讨升压
LED驱动器电路



调光性能



NCP3066SCBSTGEVB演示电路板

20 W-60 W的DC-DC LED驱动器要求

规格：

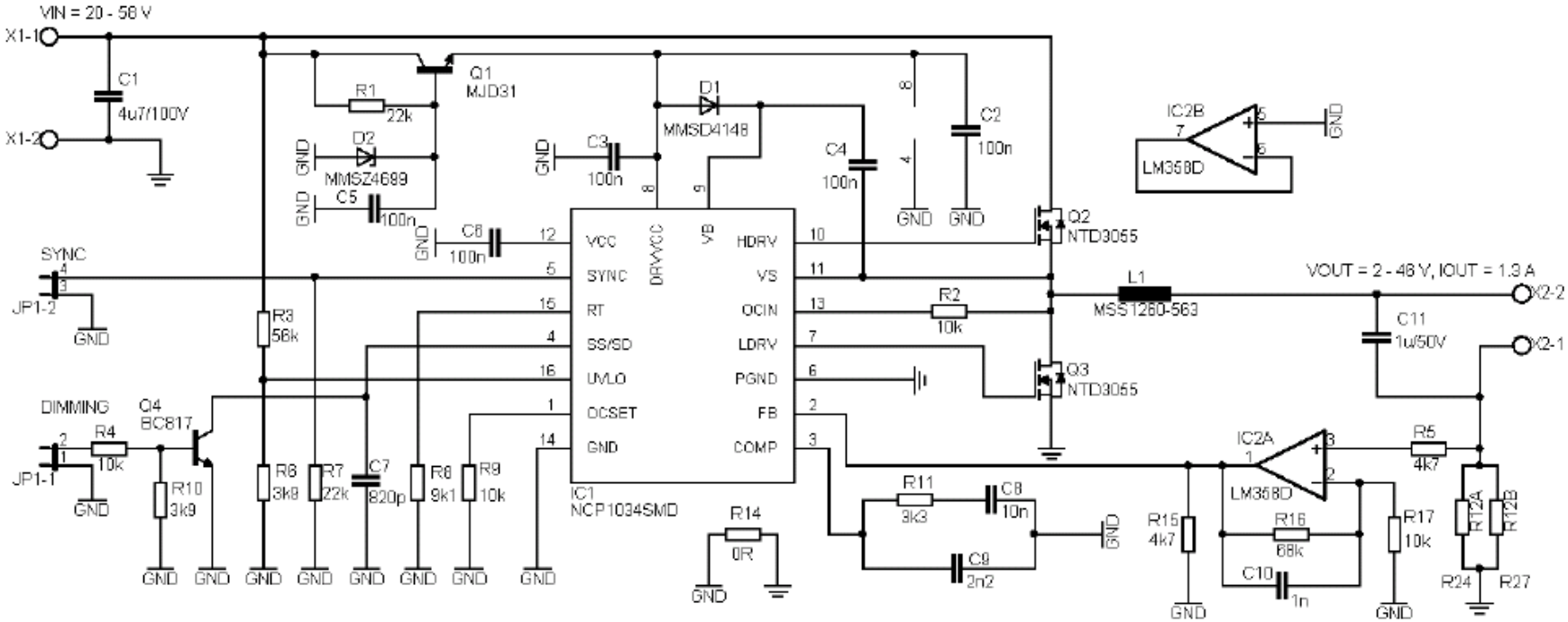
- 输入电压： 20 V~58 Vdc
- 输出电压： 2 V~46 Vdc
- 能效： ≥ 90%
- 输出电流(恒流)： 350 mA; 700 mA;1 A
- 频率： 400 kHz;

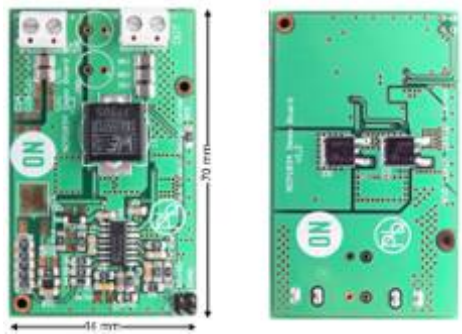
应用：

- 街道照明次级端DC-DC LED驱动器

产品：NCP1034

NCP1034的20 W-60 W DC-DC驱动器方案





NCP1034 20-60 W @ 20 V-58 Vdc

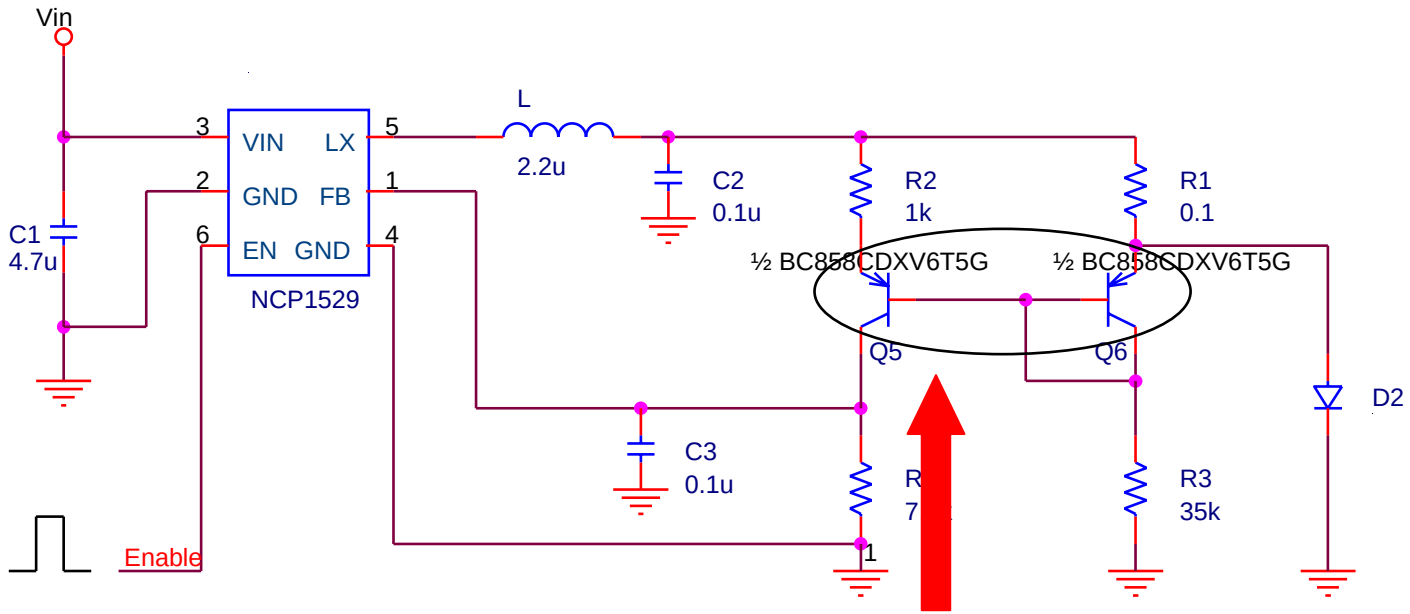
Demo Board

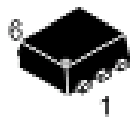
低能耗电流检测方法

NCP1529 with small-signal transistor to reduce feedback voltage

LED current = VFB x R2 / (R1 x R4). With the chosen value, we get: 1A

R3 is a biasing resistor, it does not directly impact the current. The value has been chosen to have roughtly the same current in the bipolar transistors.





BC858CDXV6T1G是用于电流感测器的双极结晶体管(BJT)

DC-DC LED 驱动方案总结

- CAT4201的1 W-3 W直流-直流(DC-DC)降压方案
- NCP3066的1 W~20 W直流-直流(DC-DC)升压方案
- NCP1034的20 W-60 W直流-直流(DC-DC)驱动器方案

议程

- LED照明的分类及外形
- 交流-直流(AC-DC) LED的驱动方案
- 直流-直流(DC-DC) LED的驱动方案
- LED手电筒的驱动方案
- 总结

手电筒DC-DC照明方案

手电筒DC-DC

升压手电筒DC-DC驱动器
降压手电筒DC-DC驱动器

1 W~3 W手电筒升压 LED驱动器要求

规格：

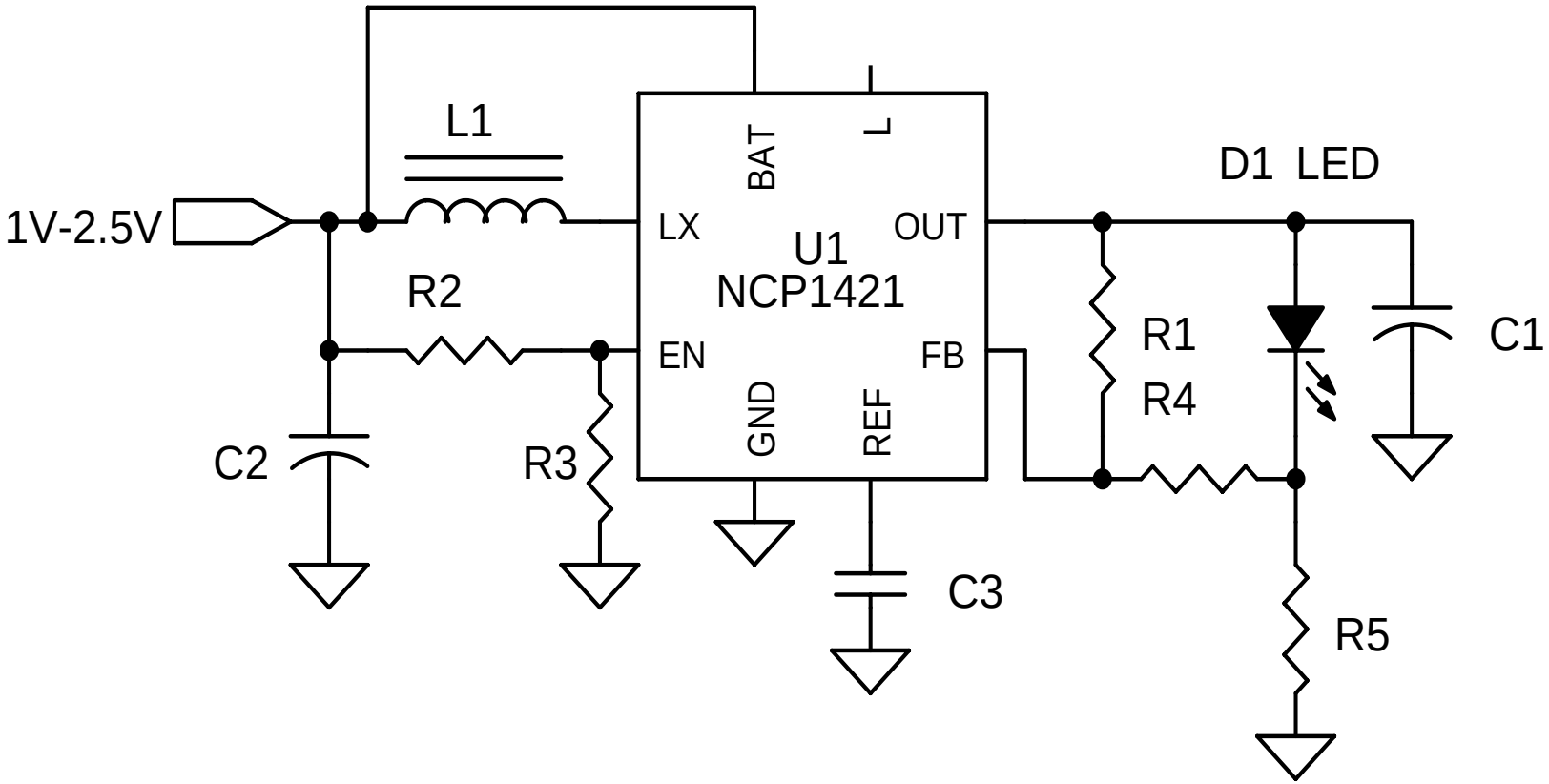
- 输入电压: 1 V~2.5 Vdc
- 能效: ≥ 90%
- 恒流: 350 mA; 600 mA;
- 频率: 达 1.2 MHz;

应用：

- 手电筒 DC-DC LED驱动器

产品：NCP1421

NCP1421的1 W~3 W手电筒升压方案



NCP1421 3 W @ 1 V-2.5 Vdc

1 W~3 W手电筒降压LED驱动器要求

规格：

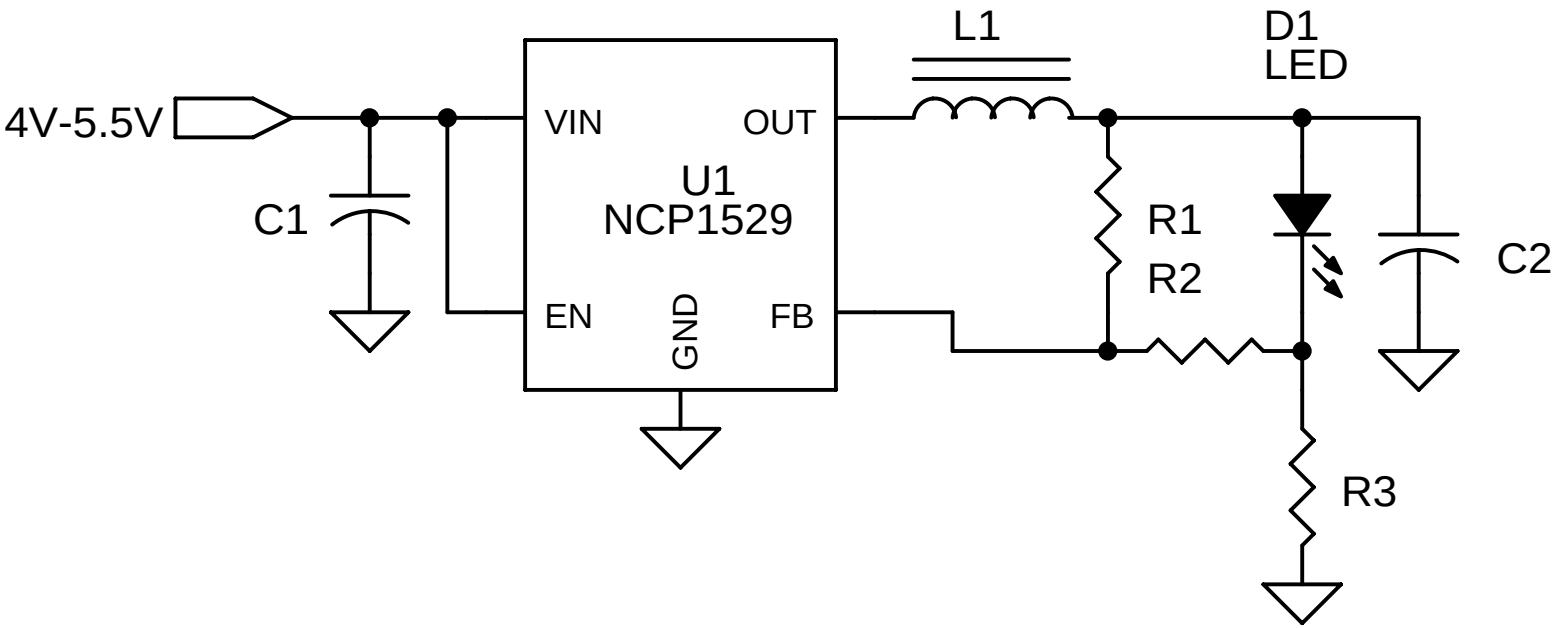
- 输入电压：　　4 V~5.5 Vdc
- 能效：　　≥ 90%
- 恒流：　　350 mA; 700 mA;
- 频率：　　达1.7 MHz;

应用：

- 手电筒 DC-DC LED驱动器

产品：NCP1529

NCP1529的1 W~3 W手电筒降压方案



NCP1529 3 W @ 4 V-5.5 Vdc

手电筒LED方案总结

- NCP1421的1 W~3 W手电筒升压方案
- NCP1529的1 W~3 W手电筒降压方案

议程

- LED照明的分类及外形
- 交流-直流(AC-DC) LED的驱动方案
- 直流-直流(DC-DC) LED的驱动方案
- LED手电筒的驱动方案
- 总结

总结

- 固态LED照明随着高性价比,超高亮度功率LED的出现而快速发展
- 高效的恒流是LED的关键驱动方式
- 根据输入电压，灯具大小和LED配置，来设计各种不同电源解决方案
- 要实现可靠的产品，必需要采用系统性设计的方法，考虑电气、散热和光学等多种因素
- 目前安森美半导体的产品已经可已全面覆盖AC-DC, DC-DC的LED驱动解决方案
- 安森美半导体将会继续致力于新技术的开发,为客户提供更优质高效的LED照明方案

谢谢！
如有问题，敬请提出！

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