安森美半导体
ON Semiconductor®

功率小于75 W的适配器

Adapters < 75 W

议程 Agenda

- 新的“能源之星”要求 New ENERGY STAR® requirements
- 满足新规范所需要的特性 Needed features to meet the new specification
- 新的控制器 New controllers
- 实际案例 Practical examples
- 结论 Conclusion

EPA 2.0 (外部电源 External Power Supplies)

EPA ENERGY STAR Version 2.0 EPS Voluntary Specification
(Effective November 1, 2008)

AC-AC和AC-DC外部电源标准型号产品在工作模式的能效标准

Energy-Efficiency Criteria for Ac-Ac and Ac-Dc External Power Supplies in Active Mode: Standard Models

Nameplate Output Power (P_{no})	Minimum Average Efficiency in Active Mode (expressed as a decimal)
0 to ≤ 1 watt	≥ 0.480 * P_{no} + 0.140
> 1 to ≤ 49 watts	≥ [0.0626 * Ln (P_{no})] + 0.622
> 49 watts	≥ 0.870

(此前的1.1版中的相应规范为>0.84)
(was > 0.84 in previous version 1.1)

空载能耗标准

Energy Consumption Criteria for No-Load

Nameplate Output Power (P_{no})	Maximum Power in No-Load	
	AC-AC EPS	AC-DC EPS
0 to < 50 watts	≤ 0.5 watts	≤ 0.3 watts
≥ 50 to ≤ 250 watts	≤ 0.5 watts	≤ 0.5 watts

(1.1版规范为<0.5 W)
(< 0.5 W in 1.1)

(1.1版规范为<0.75 W)
(< 0.75 W in 1.1)

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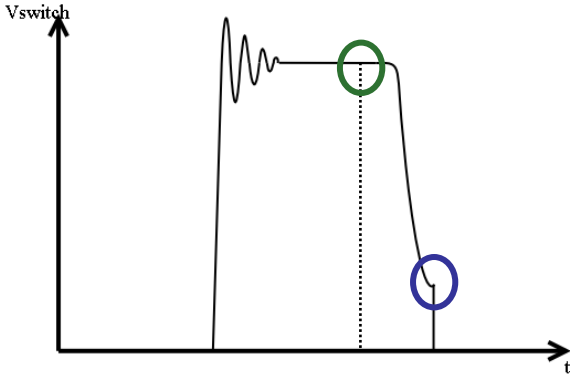
提升能效 Improving Efficiency

- 损耗来源 Sources of loss:
  - 开关损耗 Switching losses:

$$P_{loss(switching)} = \frac{1}{2} \cdot C_{DRAIN} \cdot V_{DRAIN(turn-off)}^{2} \cdot F_{SW}$$

  - 门极驱动损耗 Gate charge losses:

$$P_{loss(gate)} = V_{gate(high)} \cdot Q_{gate} \cdot F_{SW}$$

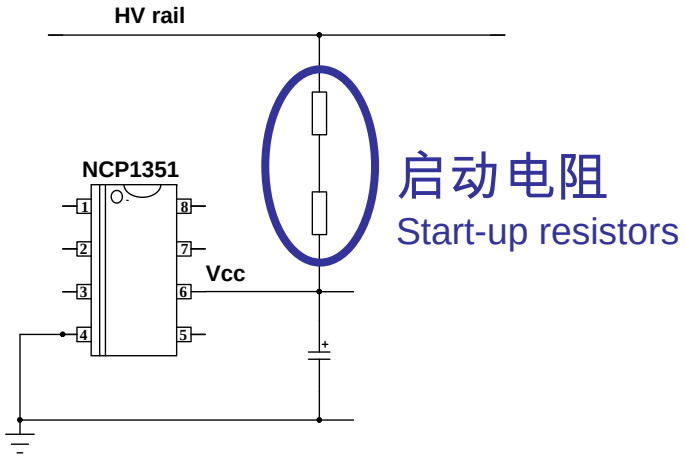


- 提升能效的途径 Ways to improve efficiency:
  - 降低开关频率(F_{SW}) ➔ 轻载时频率反走 frequency foldback at light loads
    Lower the switching frequency FSW
  - 降低关闭时的漏极电压 Lower the Drain voltage at turn-off ➔ 谷底开关 valley switching

降低空载输入功率 Reducing No-load Input Power

- 启动电路中的静态损耗 Static losses in the start-up circuit:
  - 启动电阻持续地从大电容消耗电流 Start-up resistor permanently drawing current from the bulk capacitor

- 降低启动电路损耗的途径 Ways to lower the start-up circuit losses
  - 采用外部启动电阻 With external start-up resistor ➔ 极低启动电流 Extremely low start-up current
  - 集成启动电流源 Integrated start-up current source ➔ 关断时极低泄漏电流 Extremely low leakage when off
  - 连接启动电路至半波整流交流输入 Connect the start-up circuit to the half-wave rectified ac input



议程 Agenda

- 新的“能源之星”要求New ENERGY STAR® requirements
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满足要求的恰当控制器 The Right Controllers

- 两种新系列的控制器实现提升能效和降低空载输入功率所需的特性 Two new families of controllers implement features to increase efficiency and lower no-load input power:
  - NCP1237/38/87/88:
    固定频率控制器，带集成启动电流源、频率反走和跳周期模式 fixed-frequency controllers with integrated start-up current source, frequency foldback and skip mode
    → 提升轻载能效，改善待机功耗 Increased efficiency at light load and standby
  - NCP1379/80
    谷底开关控制器，带极低启动电流和频率反走功能 valley switching controllers with extremely low start-up current and frequency foldback
    → 提升所有负载等级时的能效 Increased efficiency at all load levels

NCP1237/38/87/88

价值主张 Value Proposition

The NCP12X7/X8 series represents the next generation of fixed frequency PWM controllers. It targets applications where cost-effectiveness, reliability, design flexibility and low standby power are compulsory.

独特特性 Unique Features

- High-voltage current source with built-in Brown-out and mains OVP
- Freq. reduction in light load conditions and skip mode
- Adjustable Over Power Protection

优势 Benefits

- Fewer components and rugged design
- Extremely low no-load standby power
- Simple option to alter the max. peak current set point at high line

其它特性 Others Features

- Latch-off input for severe fault conditions, allowing direct connection of NTC
- Timer-based protection: auto-recovery or latched
- Dual OCP option available
- Built-in ramp compensation
- Frequency jittering for a softened EMI signature
- Vcc operation up to 30 V

市场和应用 Market & Applications

- AC-DC adapters for notebooks, LCD monitor, game console, printers
- CE applications (DVD, STB)

应用数据 Application Data



	DSS	Dual OCP	Latch	Auto Recovery
NCP1237A	Yes	Yes	Yes	
NCP1237B	Yes	Yes		Yes
NCP1238A	Yes	No	Yes	
NCP1238B	Yes	No		Yes
NCP1287A	HV only	Yes	Yes	
NCP1287B	HV only	Yes		Yes
NCP1288A	HV only	No	Yes	
NCP1288B	HV only	No		Yes

根据不同终端应用需求提供不同选择

Various options available depending upon end applications needs

订购和封装信息 Ordering & Package Information

- NCP1237/38xDR2G - NCP1287/88xDR2G
- SOIC-7 2500p per reel

Pb O, DW

节 电 王

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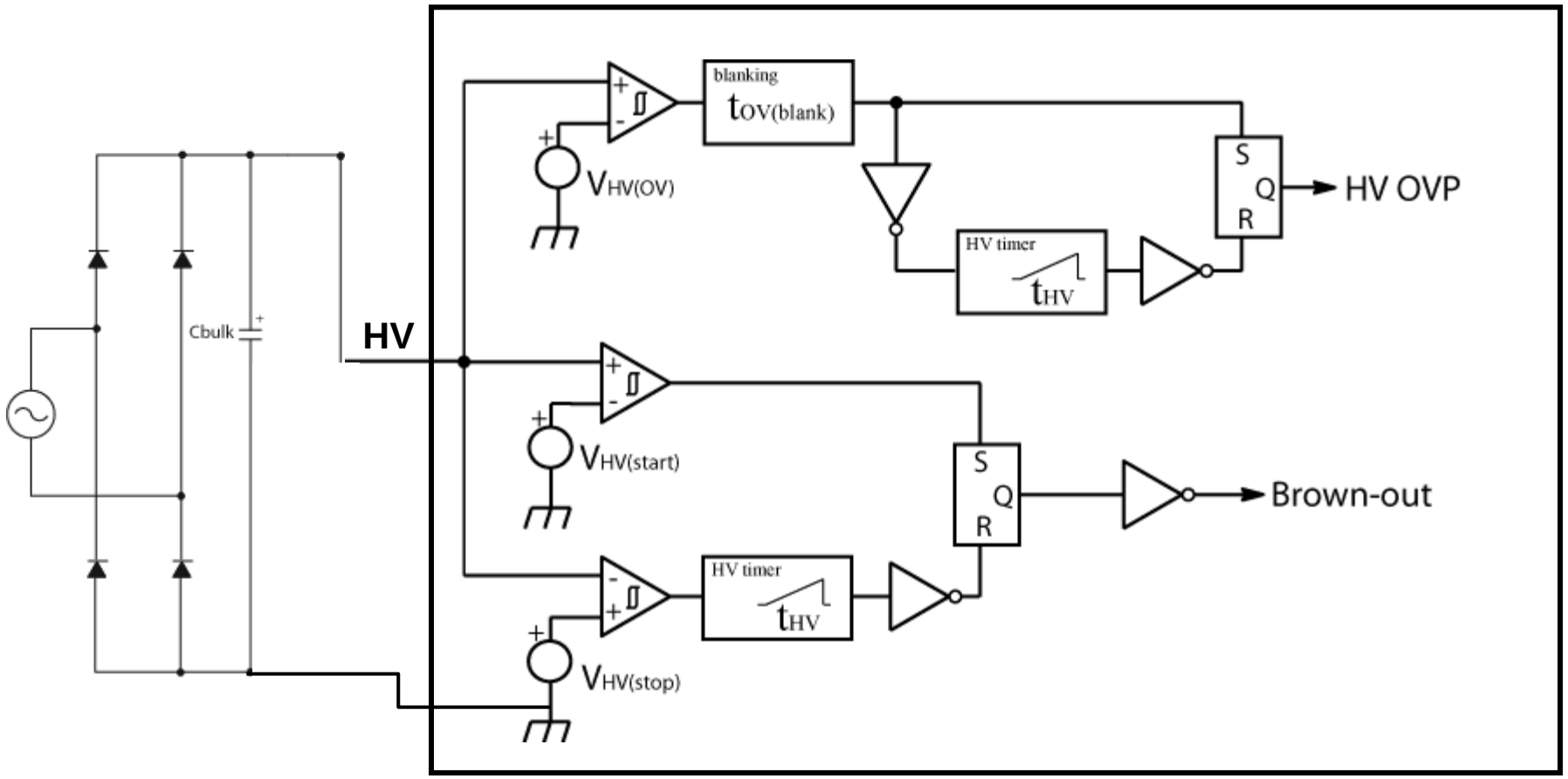
NCP1237/38/87/88 – 输入欠压和主电源过压保护

NCP1237/38/87/88 – Brown-out and Mains OVP



检测不受高压引脚纹波影响

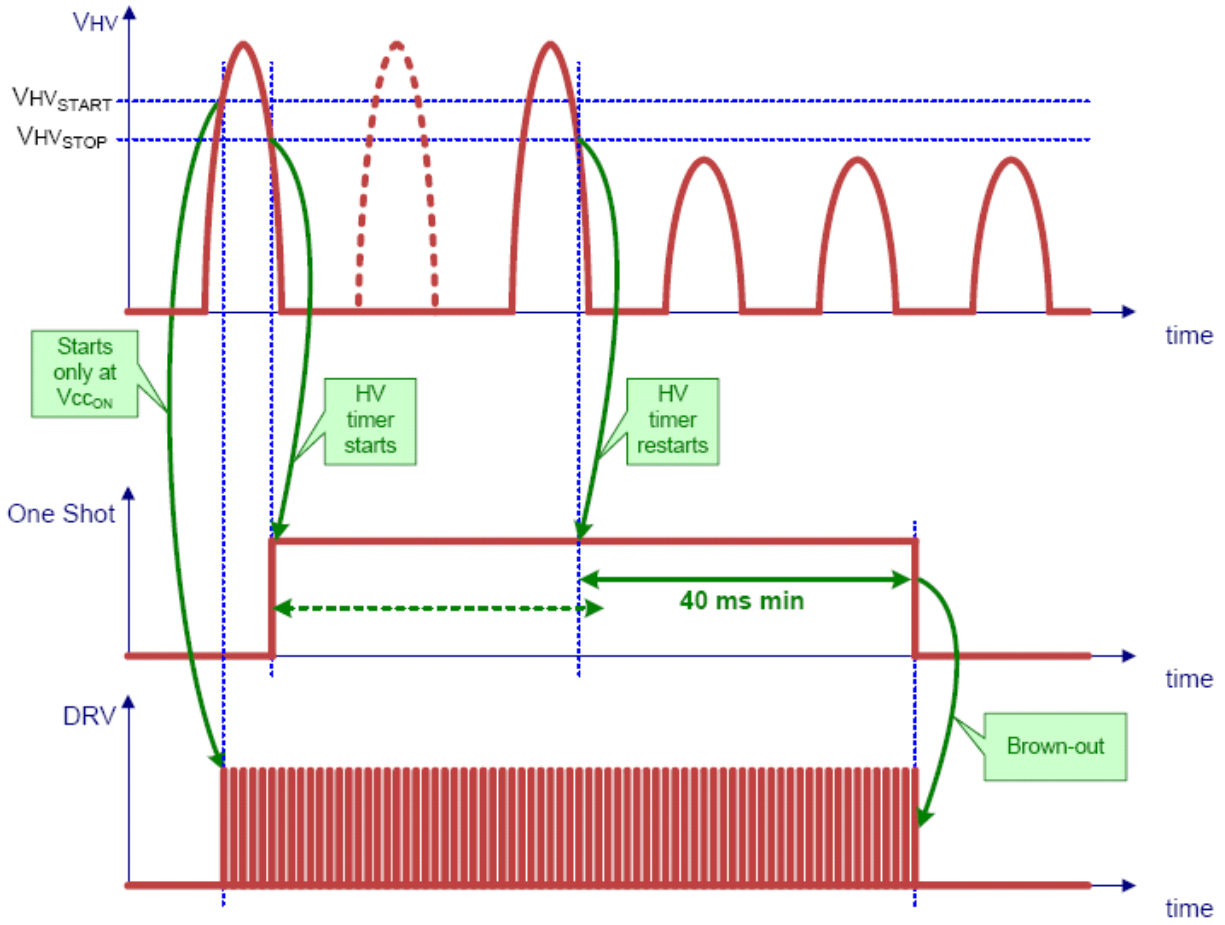
Detection independent of Ripple on HV pin

能连接至半波整流交流线路

Can be connected to the half-wave rectified ac line

NCP1237/38/87/88 – 输入欠压和主电压过压保护

NCP1237/38/87/88 – Brown-out and Mains OVP



基于定时器的检测

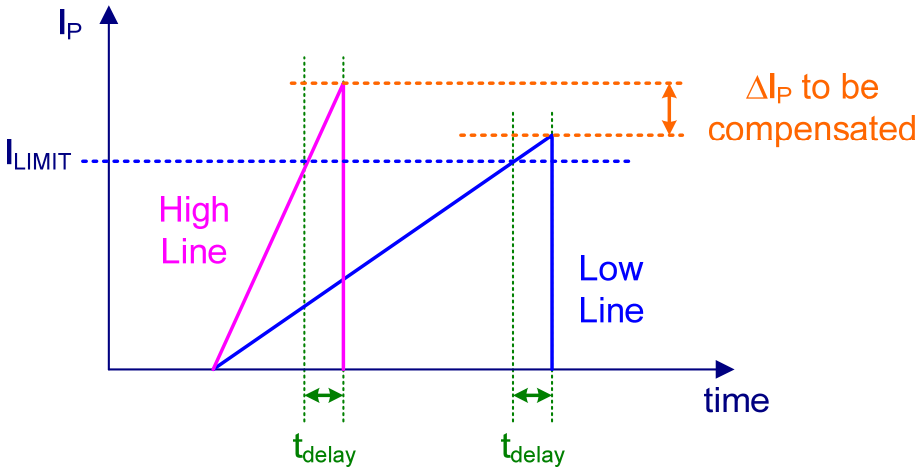
Timer-based detection

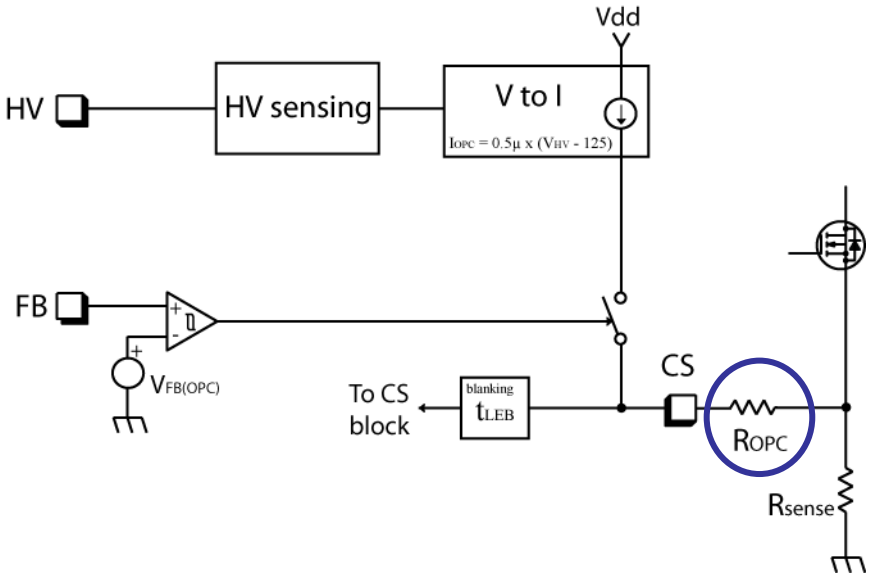
传递完整线路周期压降

Passes full line cycle drop-out

NCP1237/38/87/88 – 过功率保护

NCP1237/38/87/88 – Over Power Protection





需要针对传播延迟进行补偿

Need to compensate for the effect of the propagation delay

补偿电流产生电流感测信号偏移

The compensation current creates an offset on the Current Sense signal

过功率保护 Over Power Protection ⇒ 最大输出功率时钳位 Maximum output power clamped

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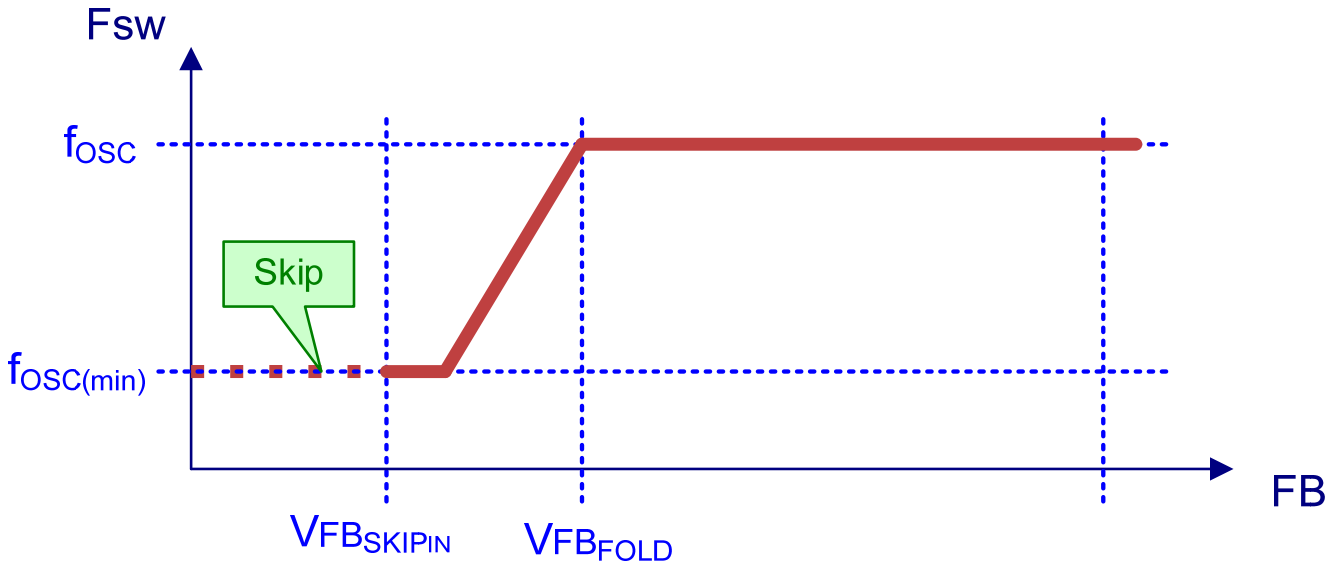
NCP1237/38/87/88 – 频率反走

NCP1237/38/87/88 – Frequency Foldback



轻载时开关频率降低
Switching frequency lowered at light load

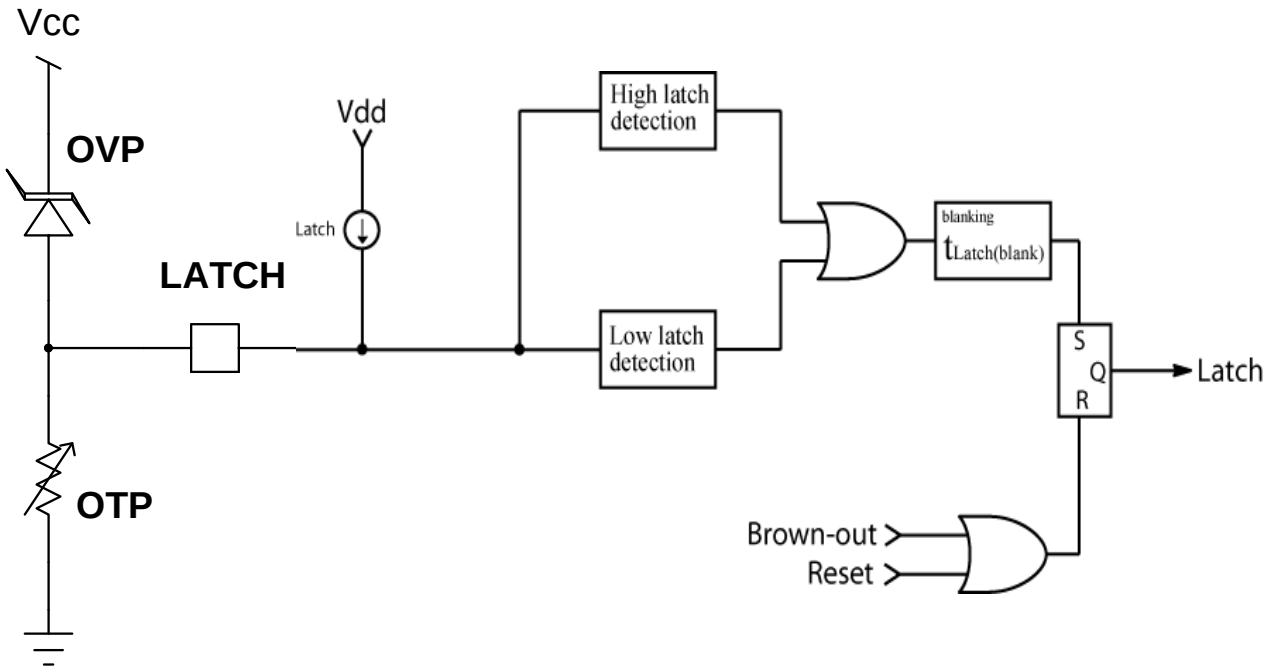
能效升高
Increased efficiency

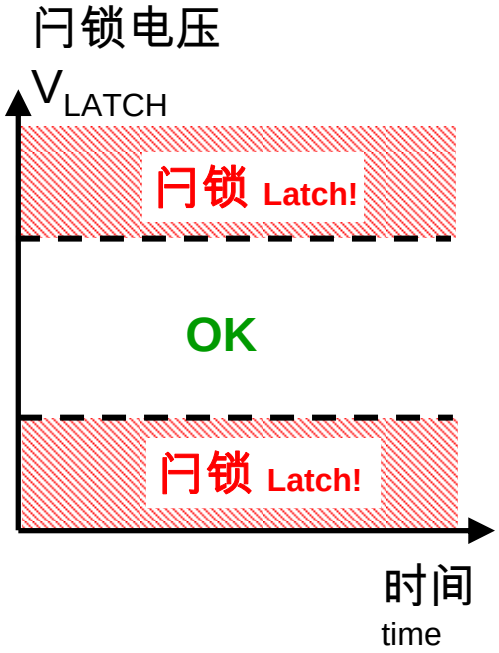
开关频率在25 kHz时钳位
Switching frequency clamped at 25 kHz

没有可听噪声
No audible noise

NCP1237/38/87/88 – 闩锁保护

NCP1237/38/87/88 – Latch-off Protection





NTC热敏电阻能够直接连接至IC

An NTC thermistor can be directly connected to the IC

所需外部元件更少 Less external components needed

NCP1379/80

价值主张 Value Proposition

The NCP1380 is a high-performance circuitry aimed to powering QR converters. Capitalizing on a novel valley-lockout system, the controller shifts gears and reduces the switching frequency as the power loading becomes lighter.

独特特性 Unique Features

- Valley switching operation with valley-lockout
- Freq. reduction in light load condition
- Adjustable Over Power Protection

优势 Benefits

- Excellent efficiency over a wide range and noise free operation
- Extremely low no-load standby power
- Simple option to alter the max. peak current set point at high line

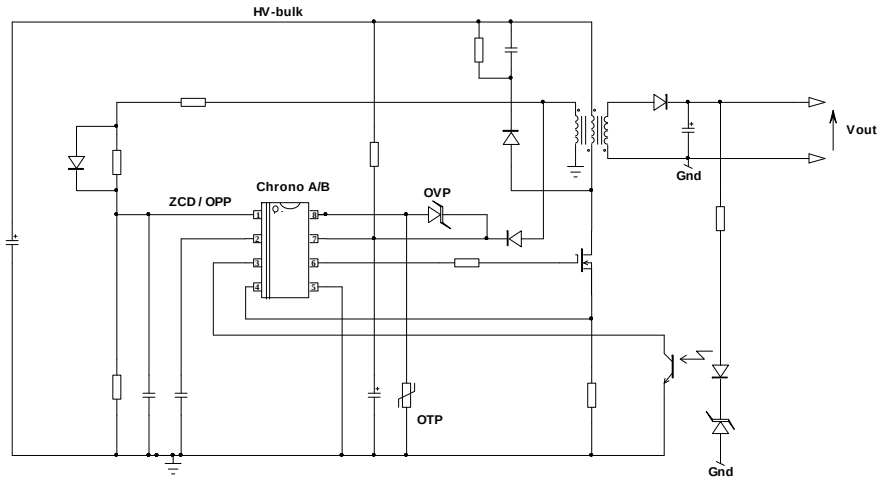
其它特性 Others Features

- Auto-recovery or latched internal output short-circuit protection
- Fixed 80 ms timer for short-circuit protection
- Combined Over-voltage and over-temperature protection (A and B versions)
- Combined OVP & brown-out (C and D versions)
- 3 µs blanking delay to ignore leakage ringing at turn-off

市场和应用 Market & Applications

- AC-DC adapters for notebooks, LCD monitor, game console
- Auxiliary power for Flat TVs
- CE applications (DVD, STB)

应用数据 Application Data



Design flexibility

订购和封装信息 Ordering & Package Information

- NCP1380xDR2G
- SOIC-8 2500p per reel

Pb

O, DW

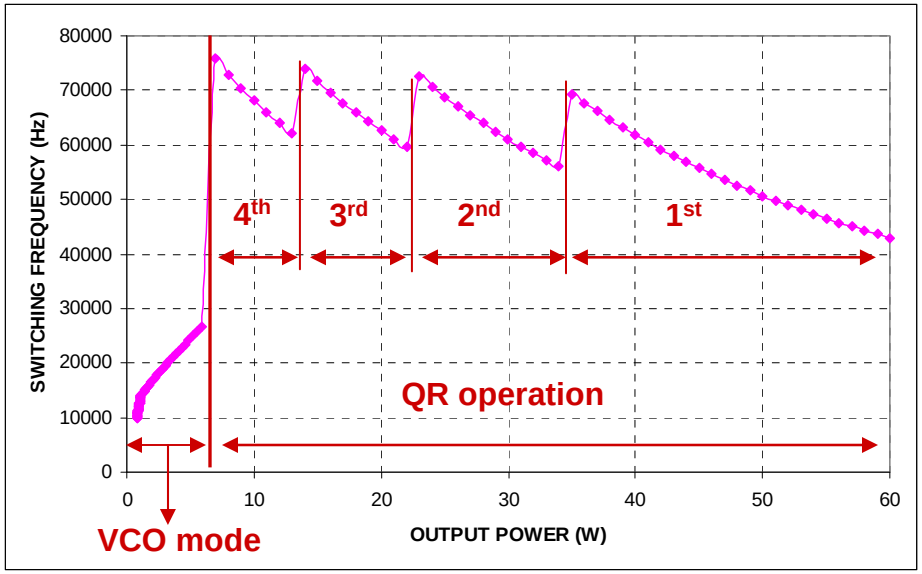
NCP1379/80 – 准谐振模式，带谷底锁定

NCP1379/80 – QR Mode with Valley Lockout

- 负载下降时，控制器改变谷底频率(从第1至第4个谷底) As the load decreases, the controller changes valley (1st to 4th valley)
- 在输出功率大幅变化之前，控制器将保持谷底锁定状态 The controller stays locked in a valley until the output power changes significantly.

➢ 没有谷底跳频噪声 No valley jumping noise

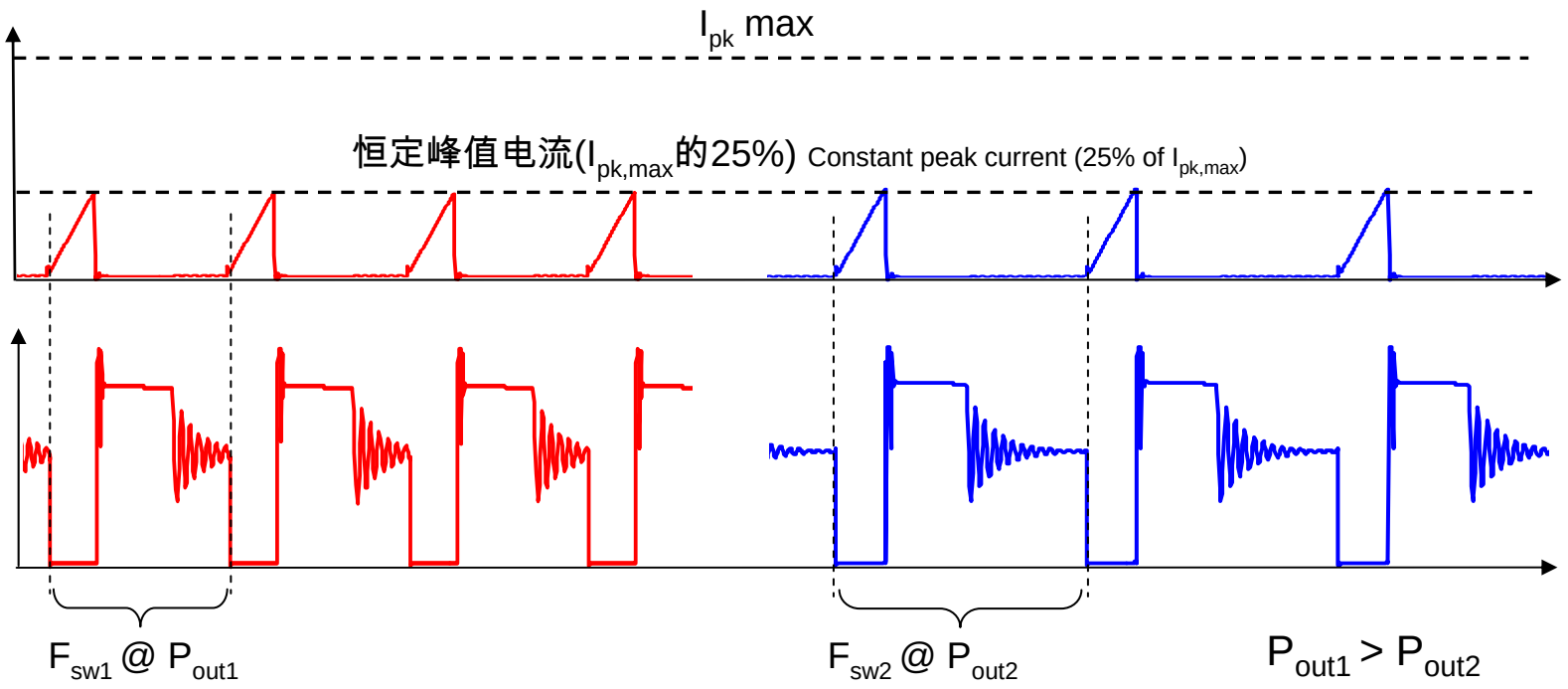
➢ 自然的开关频率限制 Natural switching frequency limitation



NCP1379/80 – 频率反走

NCP1379/80 – Frequency Foldback

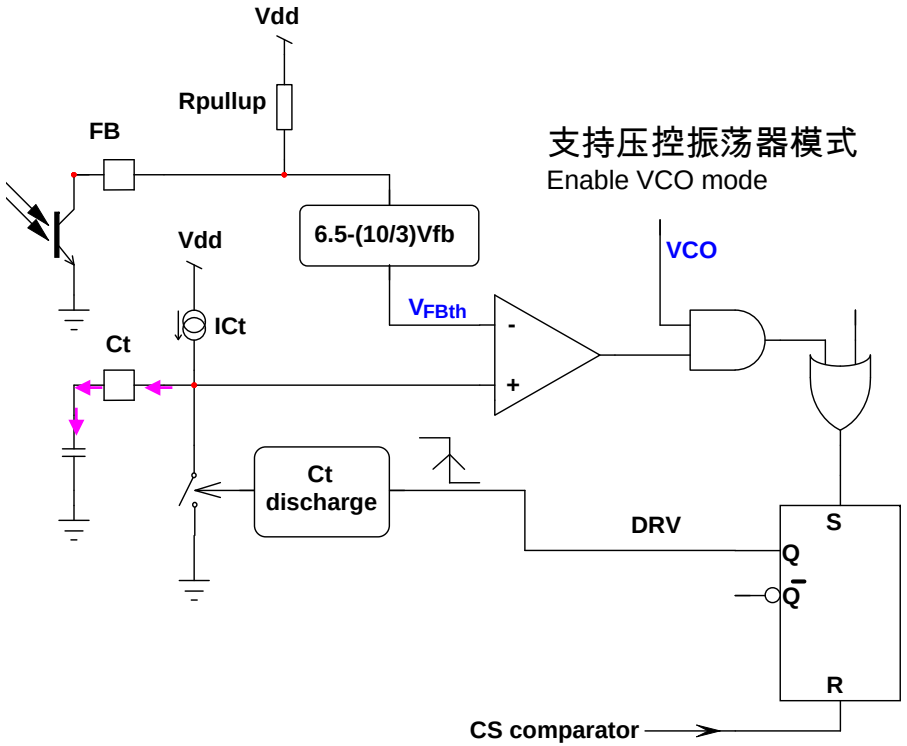
- 当反馈电压(V_{FB})低于0.8 V(输出功率P_{OUT}下降)或反馈电压低于1.6 V(输出功率上升)时发生频率反走 Occurs when V_{FB} < 0.8 V (P_{OUT} decreasing) or V_{FB} < 1.6 V (P_{OUT} increasing)
- 固定峰值电流(最大峰值电流$I_{pk,max}$的25%)、可变频率由反馈(FB)环路设定 Fixed peak current (25% of $I_{pk,max}$), variable frequency set by the FB loop.

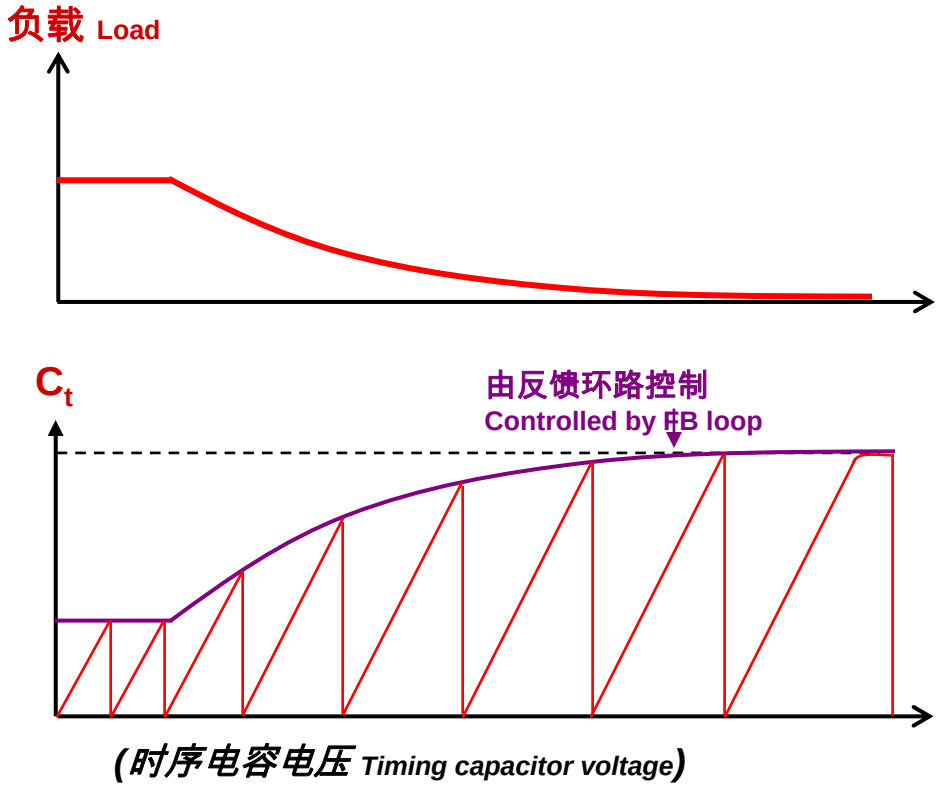


NCP1379/80 – 频率反走

NCP1379/80 – Frequency Foldback

- 开关频率在Ct电容充电结束前设定 The switching frequency is set by the end of charge of Ct capacitor
- Ct电容的充电结束由反馈(FB)环路来控制 The end of charge of Ct capacitor is controlled by the FB loop



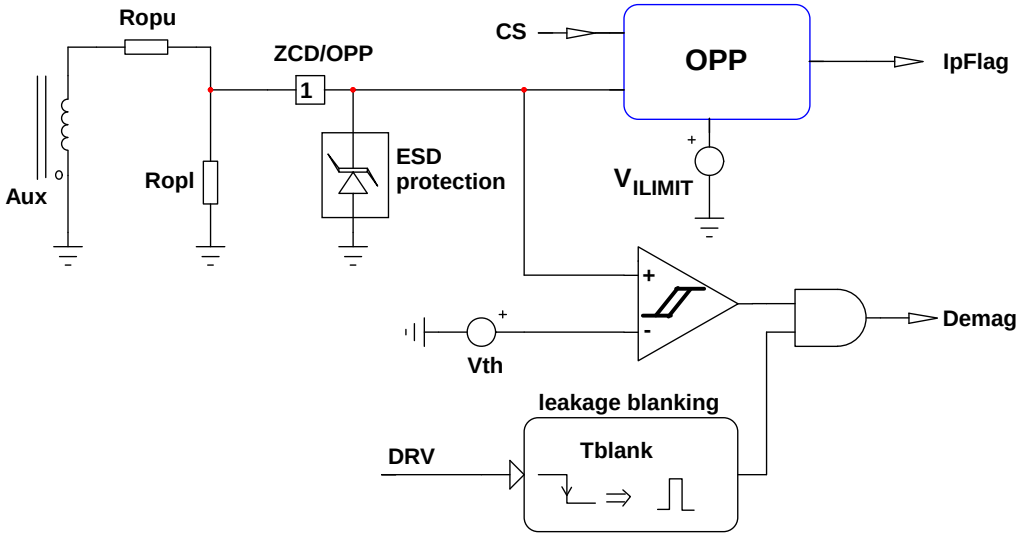


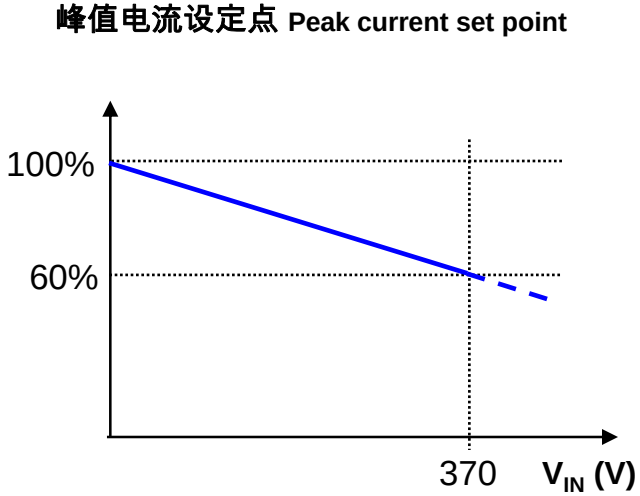
(时序电容电压 Timing capacitor voltage)

NCP1379/80 – 过功率保护

NCP1379/80 – Overpower Protection

- 导通时间期间带反激极性的谐振电感L_{aux}振荡至$-NV_{IN}$ L_{aux} with flyback polarity swings to $-NV_{IN}$ during the on time.
- 采用R_{opu} // R_{opl}调节过功率保护(OPP)电压值 Adjust amount of OPP voltage with R_{opu} // R_{opl}.
- $V_{CS,max} = 0.8\ V + V_{OPP}$





非耗散型过功率保护！

Non dissipative OPP !

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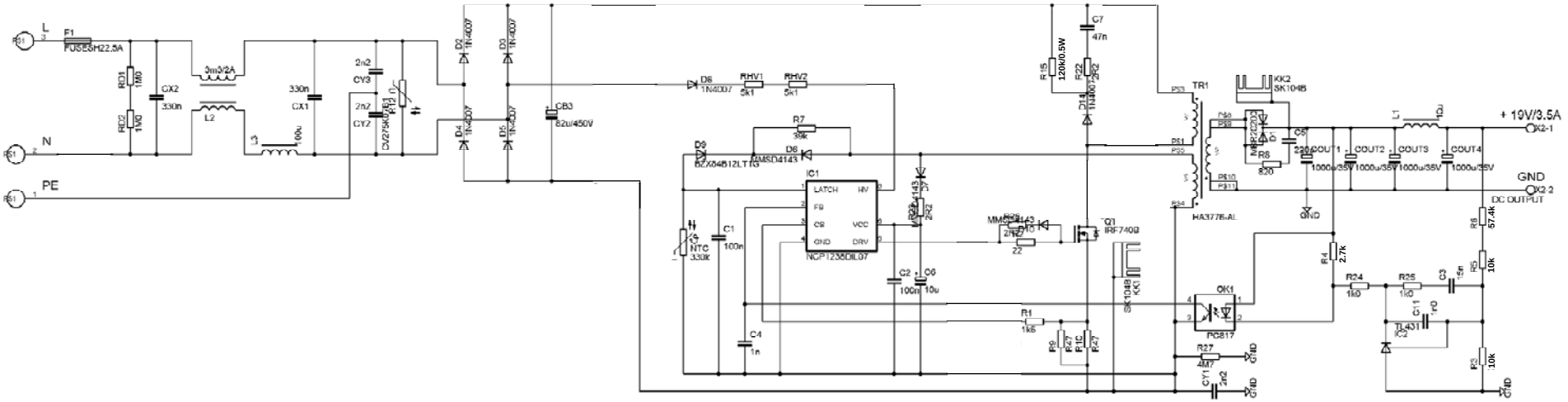
固定频率示例：示意图 Fixed-frequency Example: Schematic

典型的65 W笔记本适配器(19 V输出)

A typical 65 W notebook adapter (19 V output)



(未针对EPS 2.0版规范优化)

(not optimized for EPS 2.0)

固定频率示例：能效
Fixed-frequency Example: Efficiency

- “能源之星”外部电源(EPS) 2.0版规范能效(与前一代产品NCP1271比较)

  EPS 2.0 efficiency (compared to NCP1271, from a previous generation)

V_{IN} / % of P_{OUTnom}	115 Vac	*NCP1271*	230 Vac	*NCP1271*
100 % (65 W)	88.5 %	*88.7 %*	88.4 %	*88.2 %*
75 % (49 W)	89.2 %	*89.1 %*	88.2 %	*88.3 %*
50 % (32 W)	88.9 %	*88.9 %*	86.8 %	*87.0 %*
25 % (16 W)	88.2 %	*88.4 %*	87.3 %	*84.3 %*

频率反走产生的效果
Effect of the frequency foldback

230 Vac时平均能效：87.7%

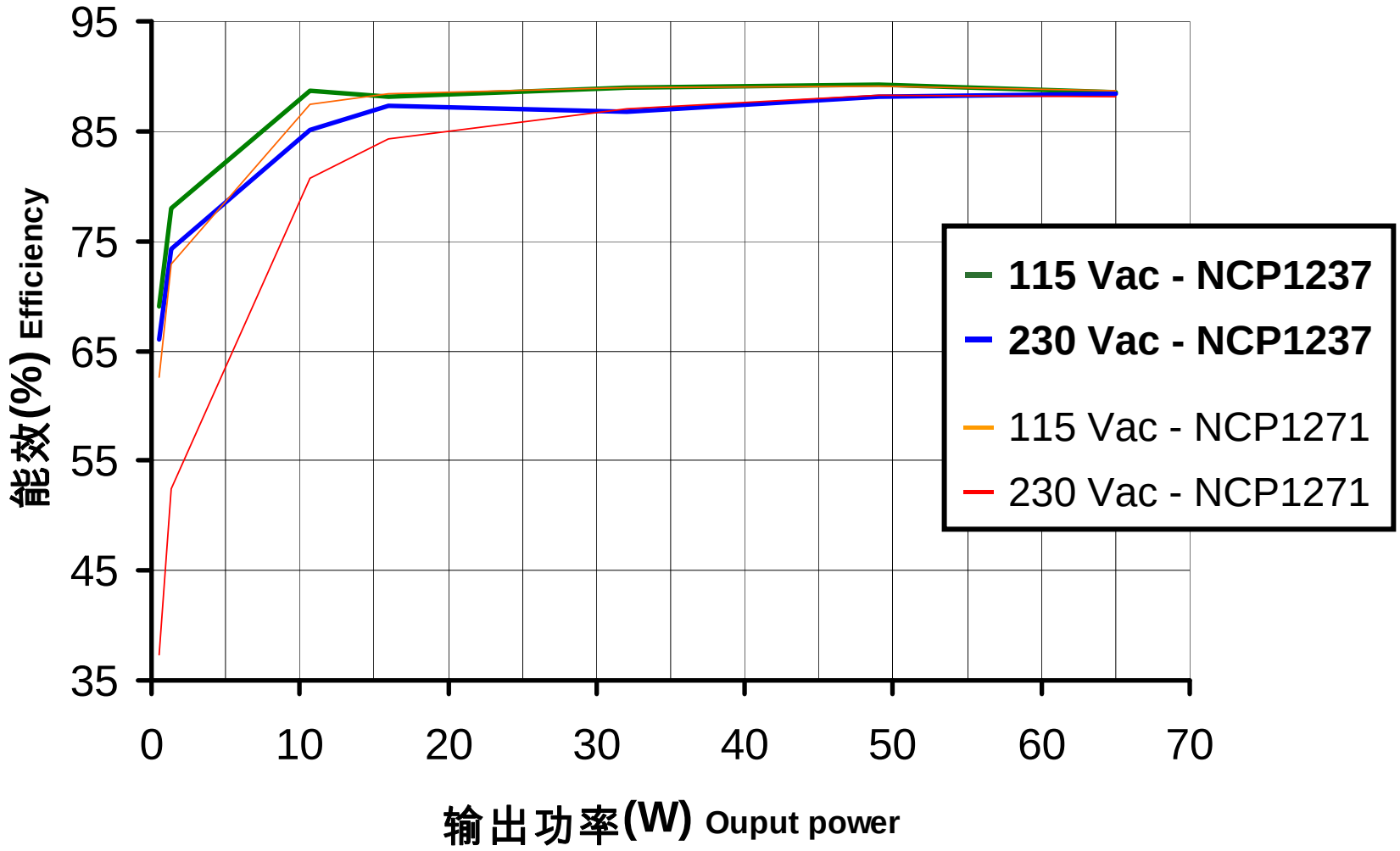
Average at 230 Vac: 87.7 %

固定频率示例：待机能耗
Fixed-frequency Example: Standby Power

- NCP1237的轻载和空载输入功率Light load and no load input power with the NCP1237
  (与前一代产品NCP1027比较 compared to NCP1271, from a previous generation)

P_{OUT} \ V_{IN}	115 Vac	*NCP1271*	230 Vac	*NCP1271*
10.7 W	12.0 W (88.7 %)	*12.2 W (87.5 %)*	12.5 W (85.1 %)	*13.2 W (80.76 %)*
1.3 W	1.67 W (78.0 %)	*1.77 W (72.9 %)*	1.75 W (74.2 %)	*2.46 W (52.4 %)*
0.5 W	0.74 W (69.0 %)	*0.81 W (62.6 %)*	0.76 W (66.0 %)	*1.34 W (37.3 %)*
No load	71 mW	*76 mW*	97 mW	*121 mW*

固定频率示例：总结
Fixed-frequency Example: Summary



谷底开关示例：能效
Valley Switching Example: Efficiency

•谷底开关控制器NCP1380的EPS 2.0能效 EPS 2.0 efficiency with the NCP1380, valley switching controller

V_{IN} % of P_{OUTnom}	115 Vac	230 Vac
100 %	88.7 %	91.1 %
75 %	88.8 %	90.9 %
50 %	89.2 %	89.1 %
25 %	88.2 %	87.9 %

115 Vac时平均能效：88.7%

Average at 115 Vac: 88.7 %

谷底开关示例：待机能耗
Valley Switching Example: Standby Power

- NCP1380的轻载和空载输入功率 Light load and no load input power with the NCP1380

V_{IN} / P_{OUT}	115 Vac	230 Vac
10.7 W	12.37 W (86.5 %)	12.44 W (86 %)
1.3 W	1.85 W (70.3 %)	1.82 W (71.4 %)
0.5 W	0.82 W (61 %)	0.78 W (64.1 %)
空载 No load	122 mW	210 mW

即使有启动电阻仍可满足“能源之星”空载待机能耗要求

No-load standby power meets ENERGY STAR® with a start-up resistor!

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功率小于75 W的适配器：结论

Adapters < 75 W: Conclusion

- 采用传统反激转换器满足“能源之星”或IEC的最新要求成为可能Meeting the most recent requirements from ENERGY STAR® or IEC is possible with the classical **Flyback** converter
- 具有相同的轻载时频率反走概念的两款新控制器使这成为可能 Two new controllers sharing the same concept of frequency foldback at light load make it possible:
  - 固定频率：NCP1238系列 Fixed-frequency: NCP1238 family
  - 谷底开关(准谐振，QR)：NCP1380系列 Valley-switching (Quasi-resonant, QR): NCP1380 family
- 平均能效高于**87%**具有可能性 Average efficiencies above **87%** are possible
- 即便有启动电阻，仍可能实现低于300 mW的空载输入功率 No-load input power below **300 mW** is possible, even with a **start-up resistor**
- 可以实现低于**100 mW**的空载输入功率，但单纯凭控制器本身并不能确保这一点。整个电源的设计必须做到减少功率浪费。 No-load input power below **100 mW** is achievable, although the controller alone cannot ensure this. The whole power supply must be designed to reduce power waste.

For More Information

- View the extensive portfolio of power management products from ON Semiconductor at www.onsemi.com
- View reference designs, design notes, and other material supporting the design of highly efficient power supplies at www.onsemi.com/powersupplies