

能源法规与市场趋势與最新恩智浦产品组合介绍, 包含: 恩智浦全数字设定LLC

AC/DC电源解决方案

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SECURE CONNECTIONS
FOR A SMARTER WORLD

EXTERNAL

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議程：

- 能源法规与市场趋势
- 最新恩智浦产品组合介绍, 包含: 恩智浦全数字設定LLC AC/DC电源解决方案：TEA2016、全新LLC 同步整流控制 IC：TEA2095以及主动桥堆整流控制器：TEA2208

能源法规与市场趋势



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节能法规 - 可能出台的新法规

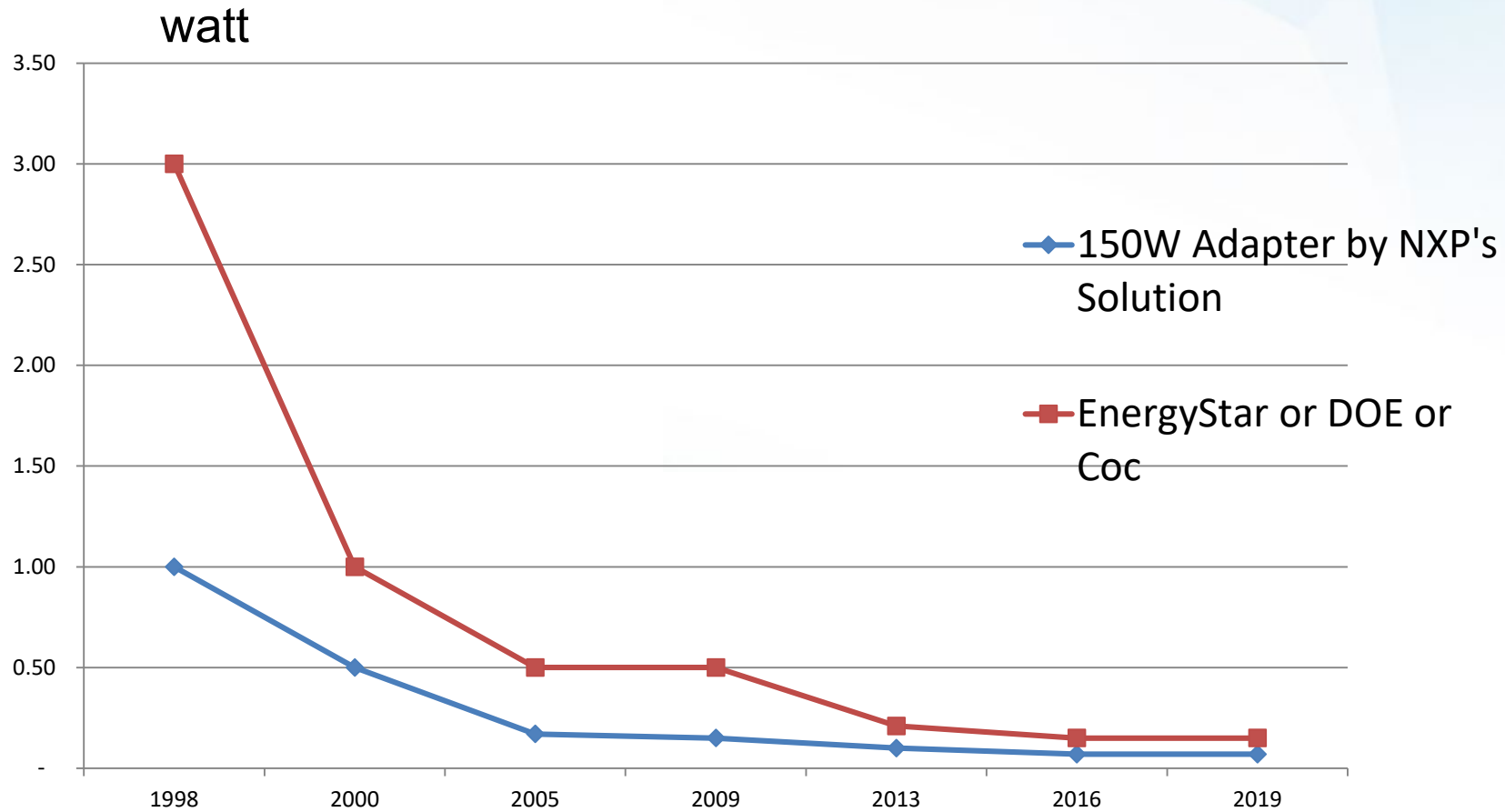
- 加州新能源法规: >80% 从~3W到以上 (何时 ?)
- 电视电源: <0.3W@待机模式(e.g. 12V/10mA) (某些品牌目前标准)
- EPA能源之星 7.0
 - ✓希望將最低计算 IPS 效率从 80Plus Bronze 提高到 80Plus Silver 效率等級 (自19年11月生效)
 - ✓**完整网络连接能力**- 已经修改完整网络连接能力的定义，以适应业界正在开发的全新极低功率模式。这些新模式可让网络持续处于连线状态，但功耗低于2瓦。
- EUP/ERP Lot 7: <0.2W@待机模式/无负载 (何时 ?)
- UL62368 (2019上半年)
- ...

节能法规 – 现有法规

- 任何电子机器/设备：EUP Lot6: <0.5W @无负载或待机模式
- 外部电源供电器含适配器:
 - DOE:
 - ✓ 5W~49W: 63%~88% 在电线端 & <0.1W@ 无负载
 - ✓ >=50W: >88%在电线端 & <0.21W@无负载
 - COC Tier 1:
 - ✓ 5W~49W: 64%~89%在电线端 & <0.15W
 - ✓ >=50W : >89%在电线端 & <0.25W
 - COC Tier 2:
 - ✓ **5W~49W: 64%~89%在电线端 & <0.075W**
 - ✓ **>=50W : >89%在电线端 & <0.15W**
- 能源之星:
- 80+...



无负载待机功率历史和趋势（150W适配器）



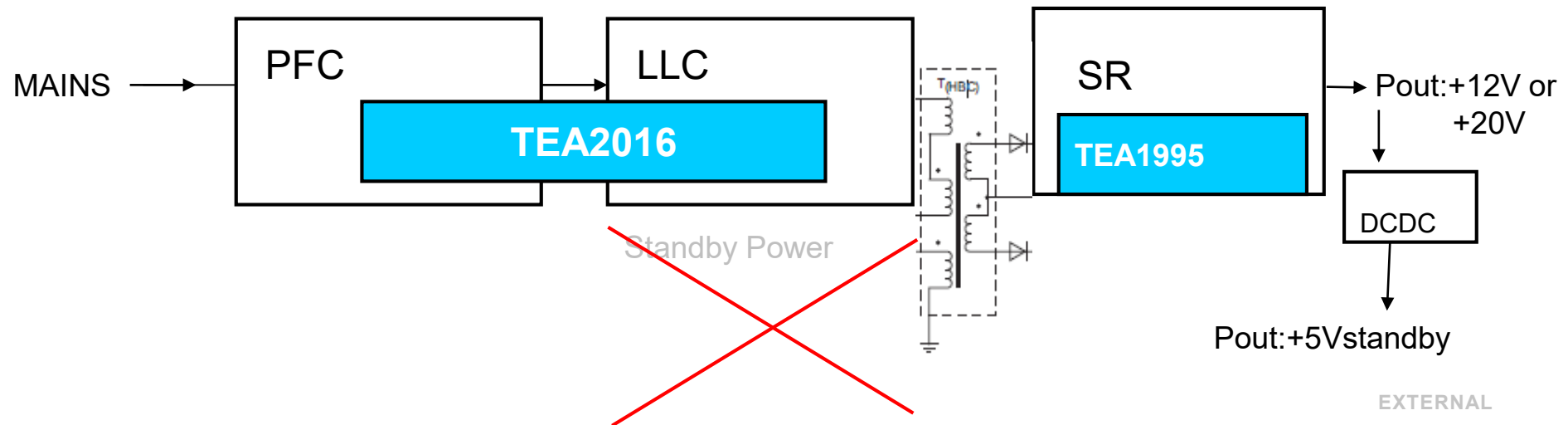
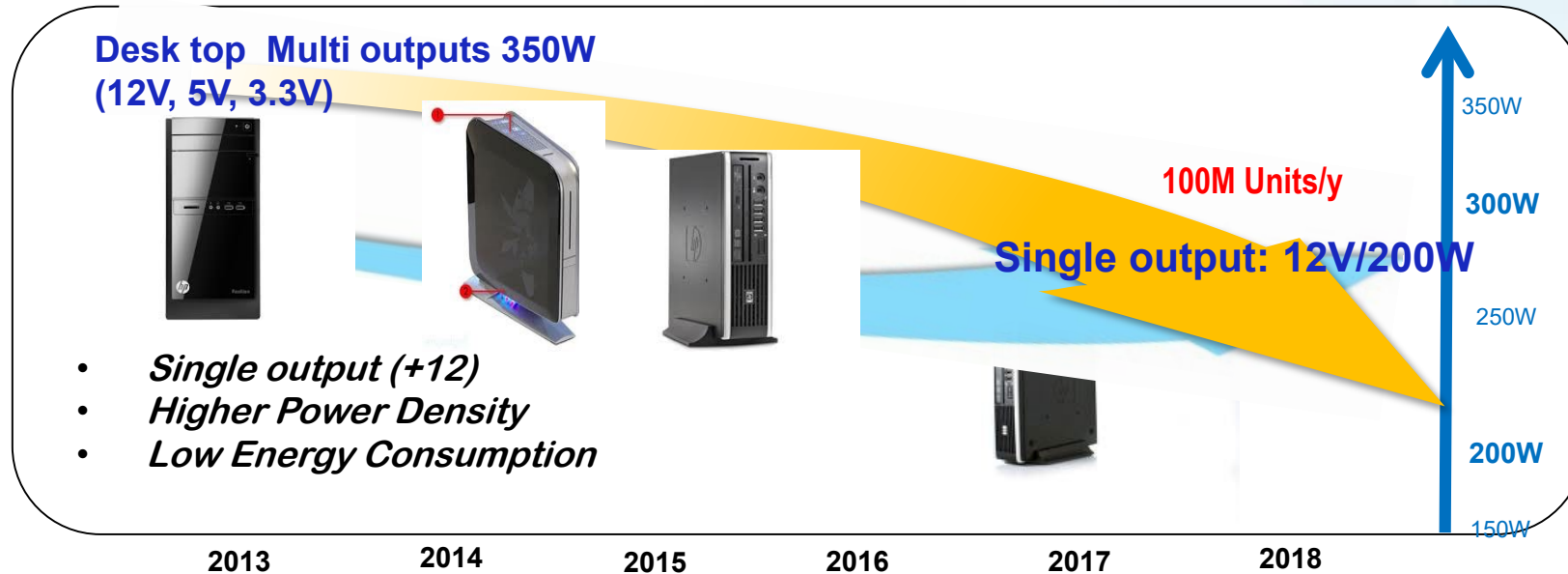
TEA1753

TEA1755

TEA1916

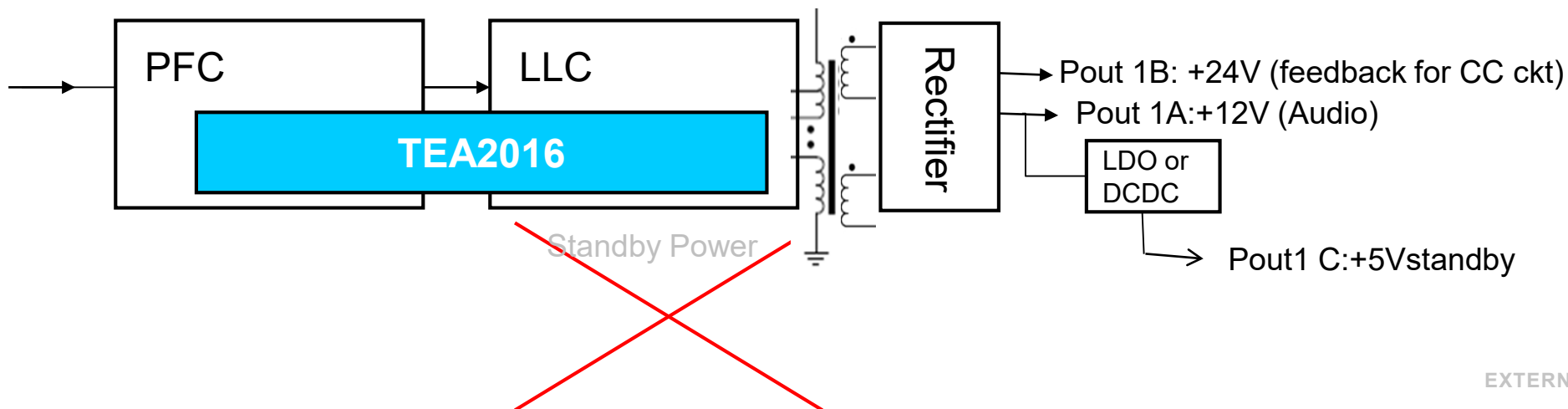
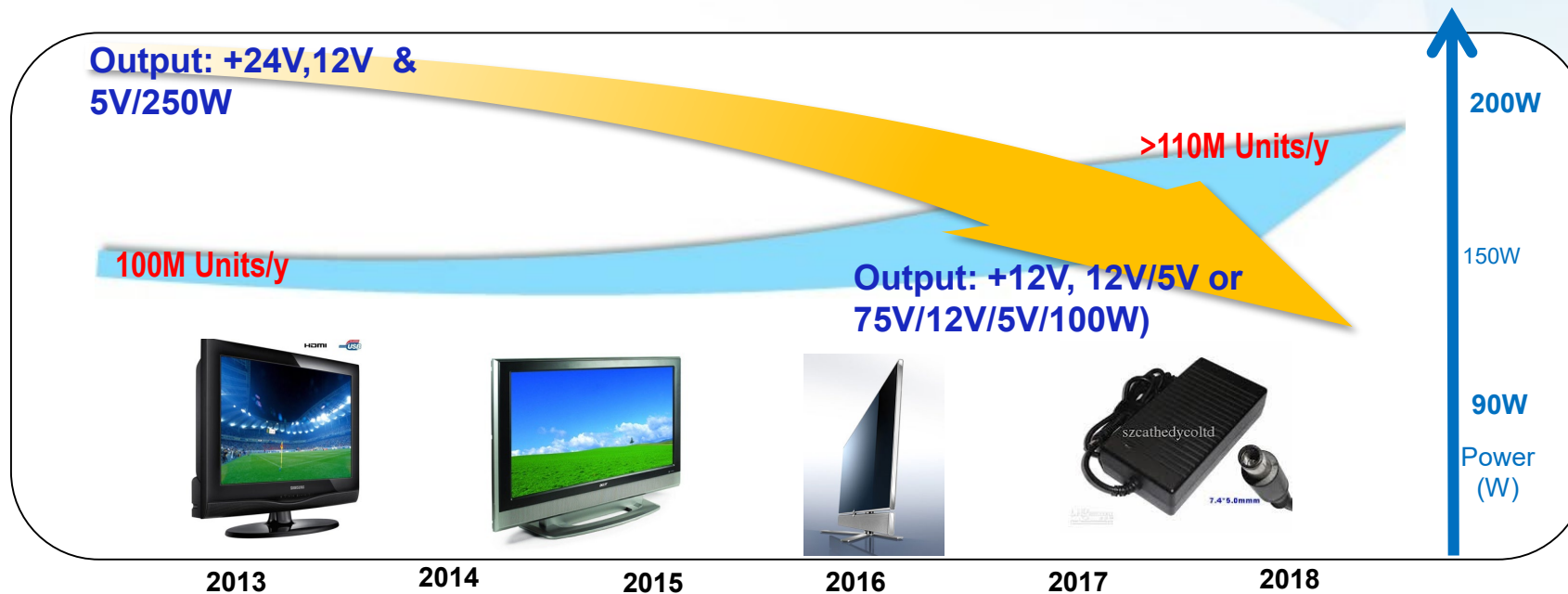
TEA2016

PC电源的主要市场趋势 (桌面+ AIO) 多输出→单输出





多输出电视趋势 → 2个输出，例如 LED电视电源



最新恩智浦产品组合



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反激拓扑的推力产品ACDC电源控制器

Application	Description	Range	USP
Adapters <75W	Flyback CCM controller	TEA1833(L)TS (TSOP6)	TEA1833: > 90%; <55mW@no load+ peak load (>=2 times) + Brown in/out
Adapters <75W	Flyback QR Controller	TEA1836(x)(L)T (SO14 or SO8)	TEA1836 + 1892TS: >91% & <25mW@ no load
Adapters 75W~180W	Flyback QR Combo Controller (PFC + PWM)	GreenChip 3.5, TEA1755T TEA1753 TEA1752 TEA1751	TEA1755+1792TS or 1761: >91%; <100mW@no load TEA1755 +1703TS <30~50mW@ no load Compact Size TEA1753: lower ripple noise
X-cap discharge	Active X-cap discharge IC	TEA1708T (SO8)	Reduce 10~20mW for 90W adapter Capable for 4KV surge
SR IC for Flyback & LLC	Synchronous Rectifier IC	TEA1892T(A)S (TSOP6)	Lower cost for one Low RdsON MOSFET (3~5mΩ) for higher efficiency
Type C PD/QC & Fast Charger/Adapters <75W	Flyback QR controller + SR IC+	TEA1936x (SO10)+TEA1993/8/9(TSOP6)	• >90%(meet COC tier 2); • <30mW@no load; • 2 Vcc to save regulators ; • <1% ripple noise

LLC拓扑的推力产品ACDC电源控制器



Application	Description	Part Number	USP	Status & Remarks
>75W Adapters, Lighting, PC power , TV Power & etc. (<=300W)	Resonant Combo SR for Resonant	TEA1713: Combo LLC TEA1716 Combo LLC SR: TEA1792ATS(TSOP6) for one MOS; TEA1795T (SO8) for 2 MOS	>90%~92% without SR; Combo IC; Less components; Compact Size 1713: <0.3W@no load 1716:<100mW@no load (90w adapter) and EUP lot 6 compliance	Adapters 120W~300W
>75W Adapters, Lighting, PC power , TV Power & etc. (<=300W)	LLC digital controller+ DCM PFC Controller	TEA19161 (SO16)+ TEA19162 (SO8)	- Parameters can be set by 4 registers <70mW@no load for 240W/12V 2~15% higher at load <10%; <+/-5% voltage regulation for 0% to 100% load - Meets Platinum standard	TEA19161+TEA19162: MP Q1'16
SR IC for LLC power supply (<1000W)	LLC Synchronous Rectifier IC	TEA1995T (SO8) or TEA2095 (SO8/HSO8)	2~7% High efficiency at middle load via adaptive driving capability by loading - TEA2095 for higher power (over 300W) & lower Vds MOSFET	TEA1995: MP Q3'15 TEA2095: Released Nov'19
>75W Adapters, Lighting, PC power , TV Power & etc. (<=300W)	LLC digital controller+ DCM PFC Controller	TEA2016 (SO16) + (TEA1995 or TEA2095)	>80 Parameters can be set by GUI 30~50 components reduced vs TEA1916 generation <70mW@no load for 240W/12V 2~15% higher at load <10%; <+/-5% voltage regulation for 0% to 100% load - Meets Platinum standard	TEA2016 released June'19 TEA2017 which will be released Q4'20 can support up to 1000W
200~ few KWs for any power which needs higher efficiency on Bridge stage	Active Bridge Rectifier Controller can work under any topology(e.g. LLC, & Forward, Fullbridge & etc.)	TEA2208 (SO14)	- Forward conduction losses of the diode rectifier bridge are eliminated - Very low IC power consumption (2 mW) with X-capacitor discharge - Very low external part count	TEA2208: released Nov'19

带来更低空载待机功耗、更高效率、更紧凑的尺寸！

恩智浦全数字LLC AC/DC 电源解决方案 TEA2016



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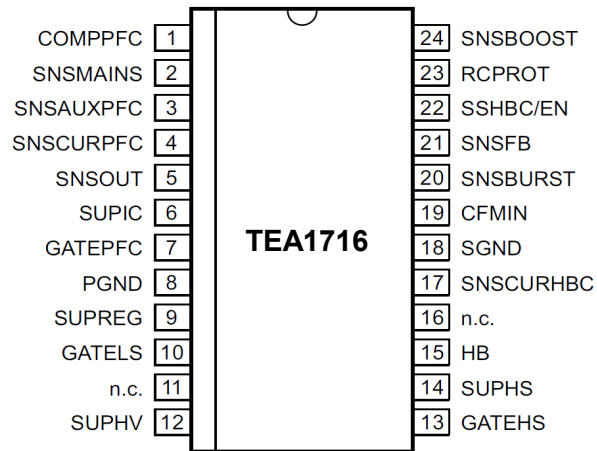


TEA2016T : 数字可编程PFC + LLC解决方案亮点

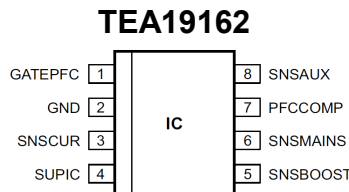
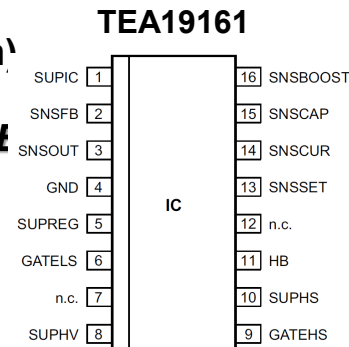
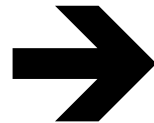
Same benefits as the TEA1916T solution, with following improvements / flexibility / programmability:

- Single SO16 package for PFC & LLC (SO16 with two pins not connected for High Voltage Spacing)
- High configurability (> 80 parameters for configuring) and internal MTP instead of external resistors
- Reduced eBOM
- Active X-cap discharge function (via HV pin)
- Digital stable state-machine. **NO FIRMWARE**

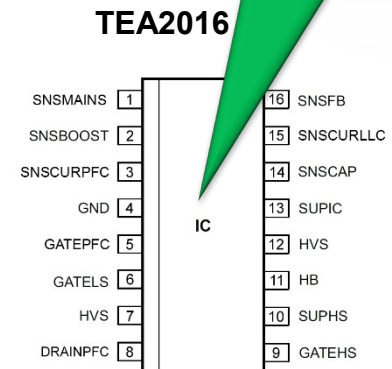
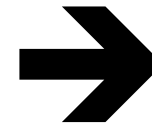
*LLC & PFC in single
SO16 package
MTP settings internal*



*Year 2012
First to meet
EUP Lot 6*

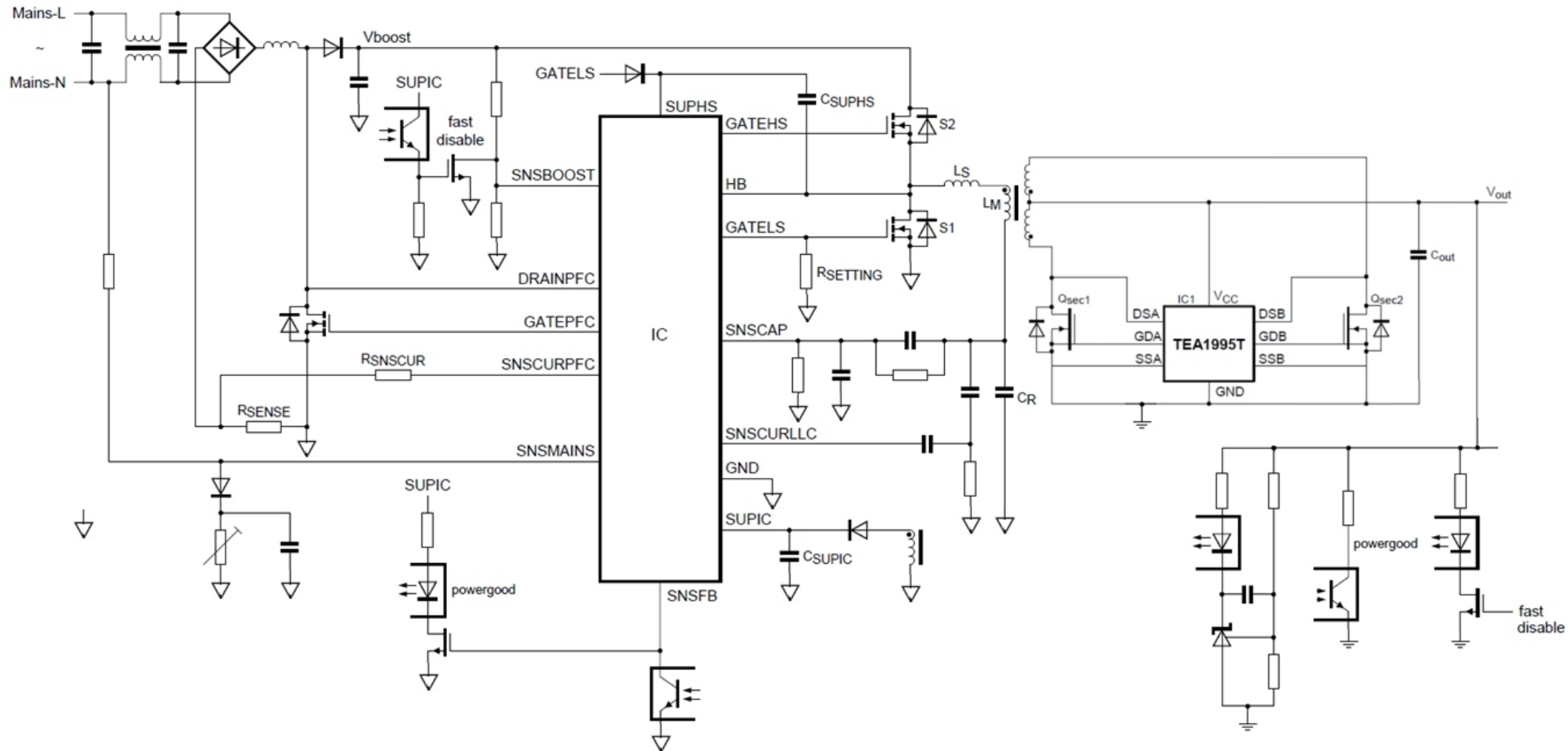


*Year 2016
Digital Cycle-by-cycle
concept*



*Year 2019
Programmability / Flexibility
single package*

TEA2016 应用 – 包括低EBOM和许多功能



→ Low eBOM count

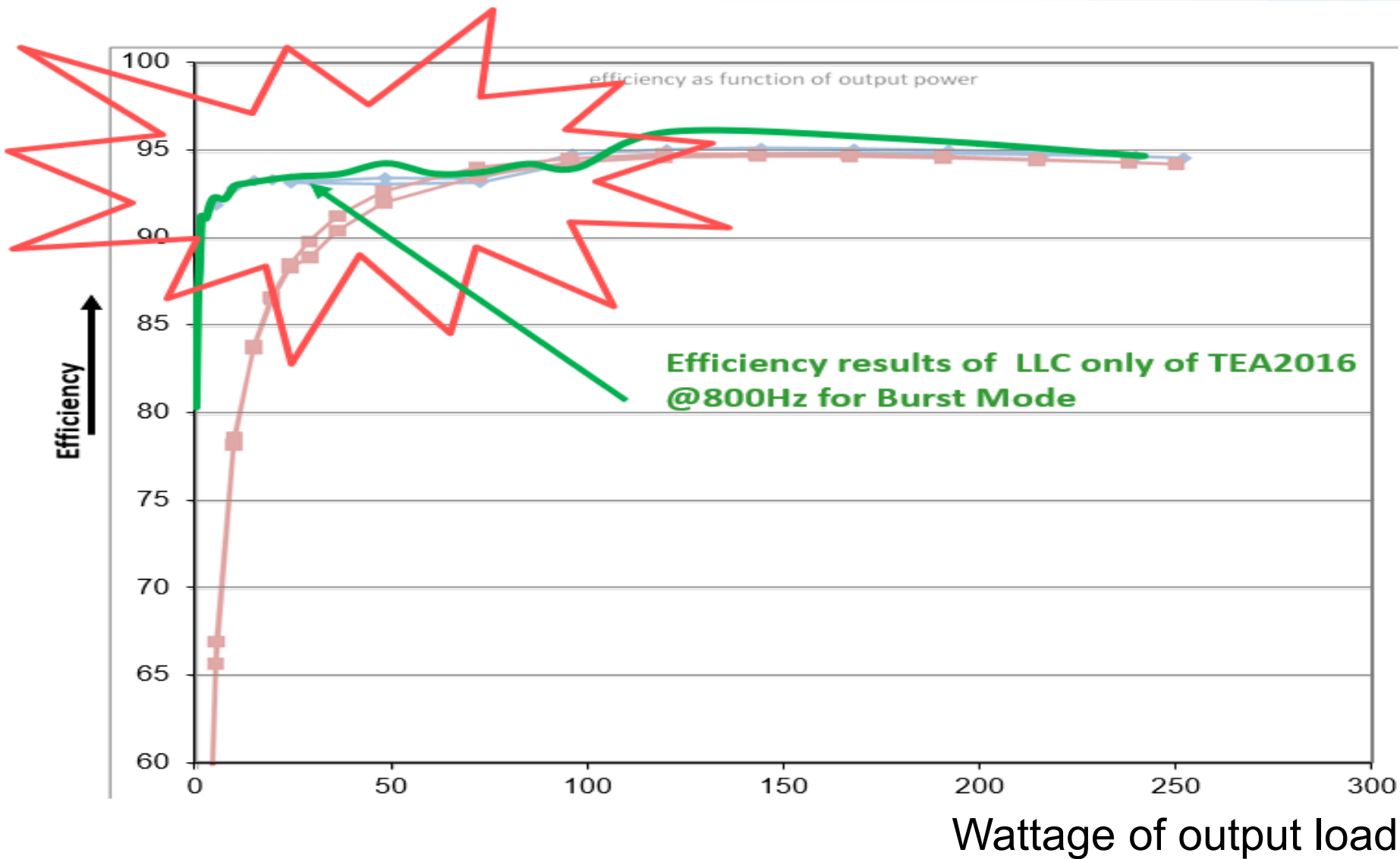
→ X-cap discharge integrated

→ Power-Good signal to secondary side

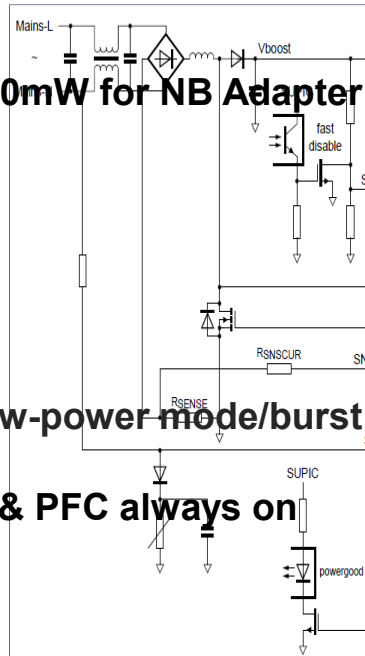
→ Internal reference voltage (Vref)

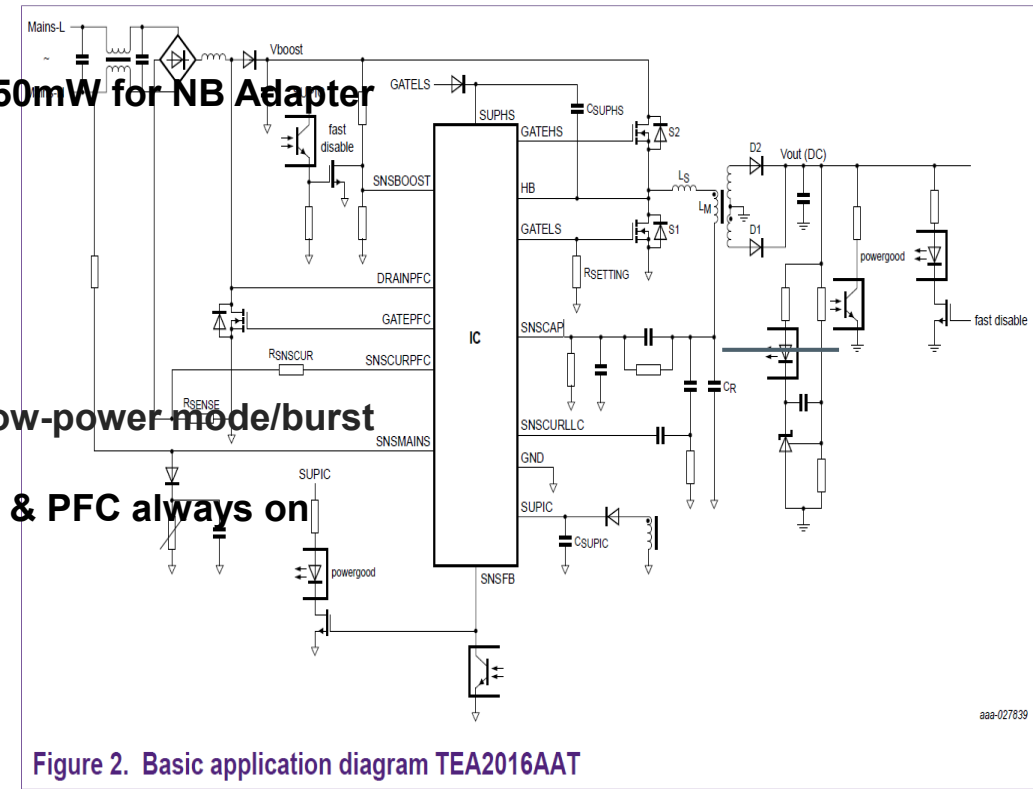
→ Overtemperature PROTECTION (NTC for OTP)

SUPER HIGH EFFICIENCY AT LIGHT LOAD



KEY FEATURES/ADVANTAGES OF TEA2016

- Different conversion modes to enable highest efficiency over the complete load range (High Power, Low Power & Burst Mode)
 - Full digital setting for over 80 parameters to reduce external components, protect own design & chance to use lower end components
 - Very low component count
 - Low no-load power (<75mW)
 - Meets EuP lot 6 easily (<360mW@250mW load (Regulation: <500mA@250mW for NB Adapter
 - PFC OVP protection to reduce ~10 components
 - Much lower audible noise
 - ✓ Operating frequencies to be outside the audible area at all operating modes
 - ✓ Soft start and soft stop in burst mode, reducing the audible noise
 - Accurate transition levels between operation modes (high-power mode/low-power mode/burst mode)
 - Fast load-step response to pass Vout stay at +/- 5% due to cycle by cycle & PFC always on
 - Active X-cap discharge integrated & UL certified
 - Adaptive non-overlap switching LLC & Capacitive mode prevention
 - Extensive Protections (OVP, OCP, OPP, SWP, UVP, OTP)
- 
- The diagram illustrates the internal circuitry of a power adapter. It starts with a 'Mains-L' input, followed by a transformer and a bridge rectifier. A 'Vboost' section is shown with a 'fast disable' feature. The output stage includes a 'SUPIC' (Switching Under Voltage Protection) and a 'powergood' signal. Various sense resistors like 'RSNSCUR' and 'RSNS' are indicated. The diagram is a detailed schematic showing the flow of power and the placement of various electronic components.

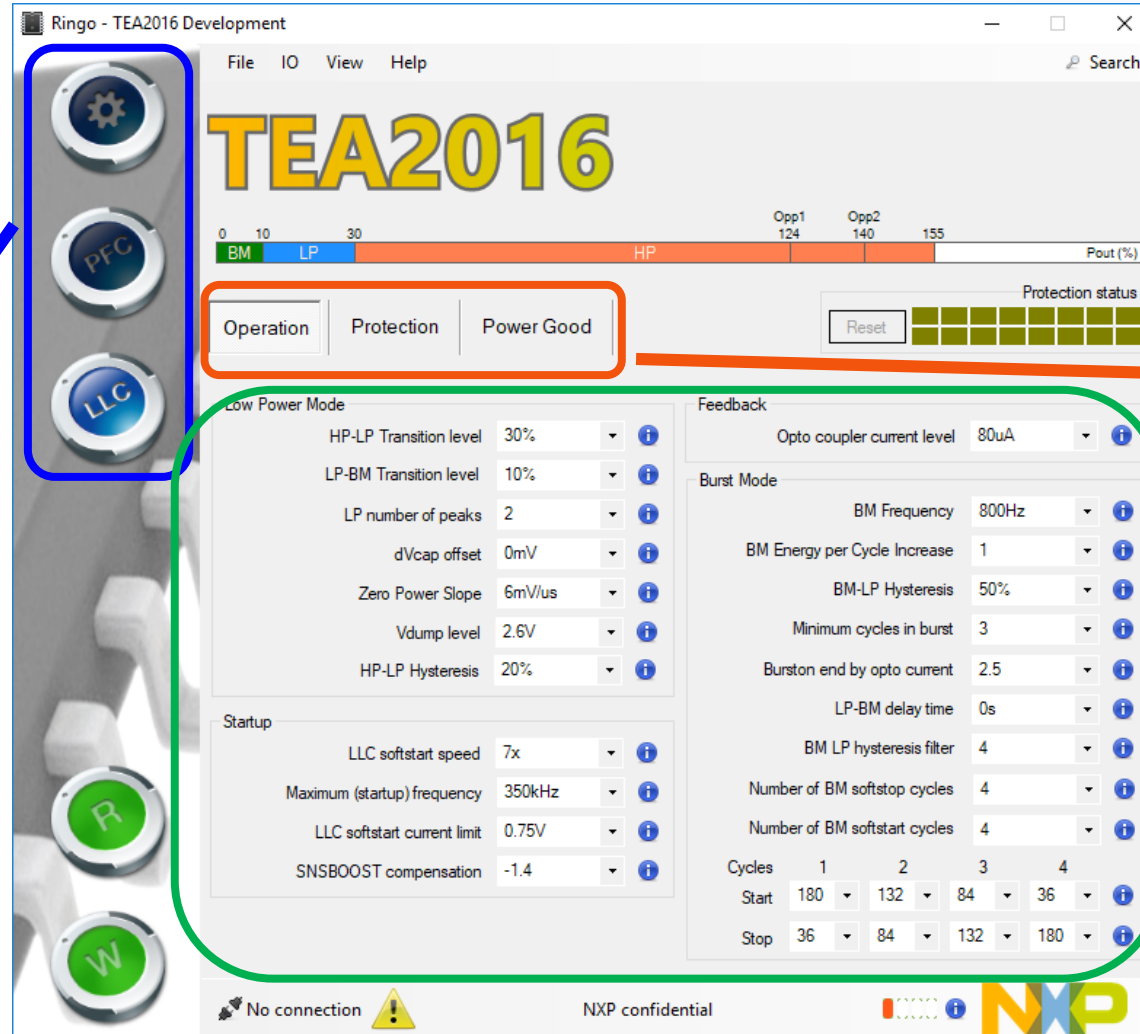


TEA2016 GUI-RINGO概览



Chapters

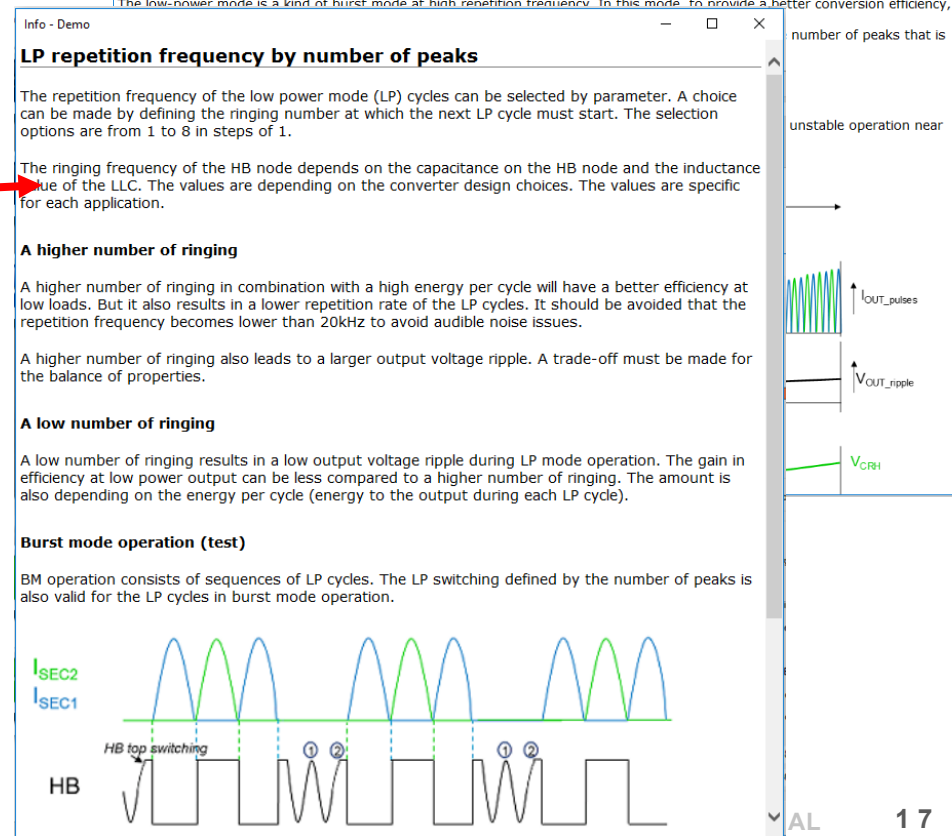
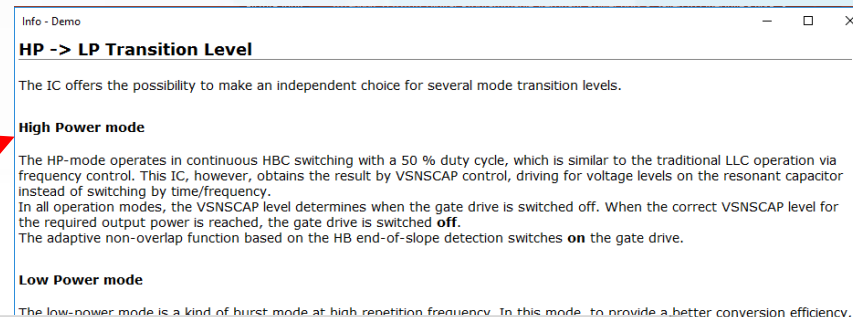
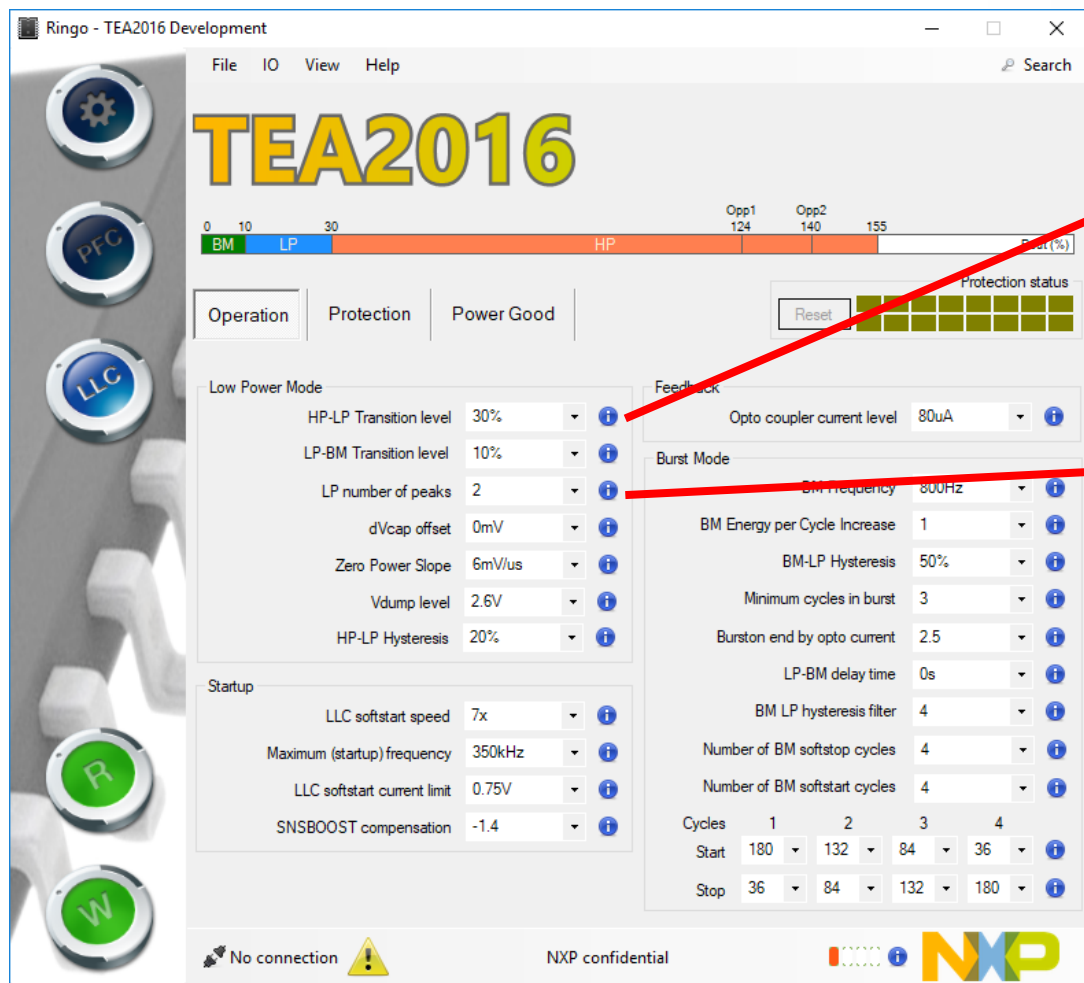
- General
- PFC
- LLC



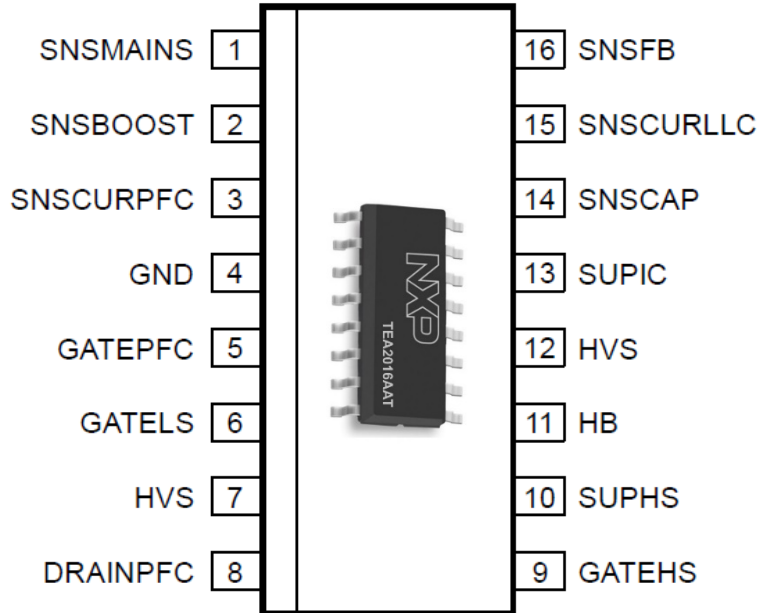
Tabs

Parameters
and
Setting

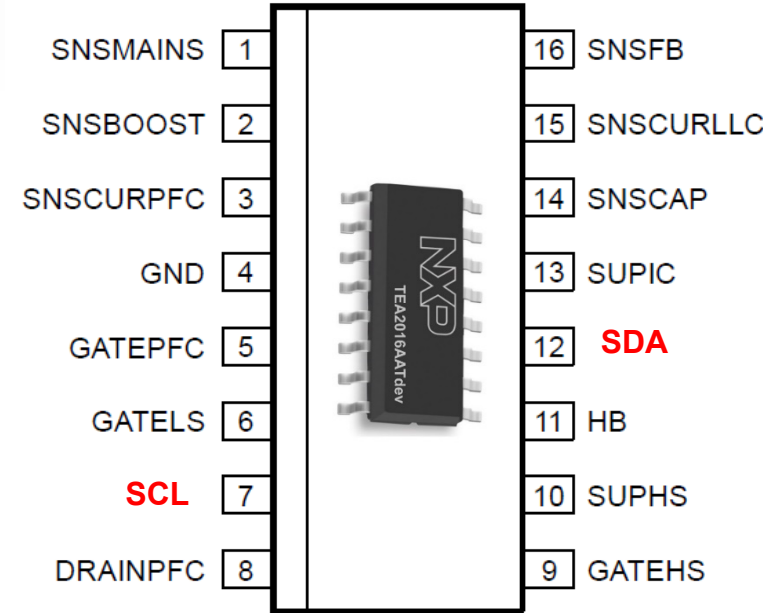
TEA2016 GUI-RINGO参数信息



TEA2016固定：引脚分配信息



TEA2016AAT



TEA2016AATdev

TEA2016AAT pin configuration (SOT109-1)

Difference: High Voltage Spacer pins are used in the TEA2016AATdev version for an additional I²C channel to enable changing settings during converter operation.

恩智浦全新LLC SR IC TEA2095



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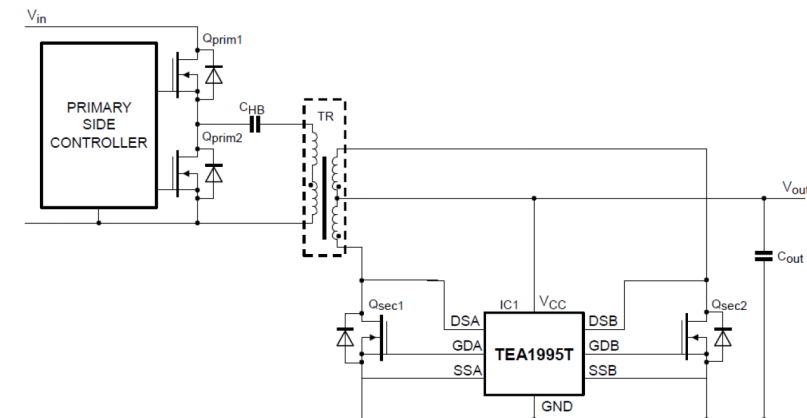
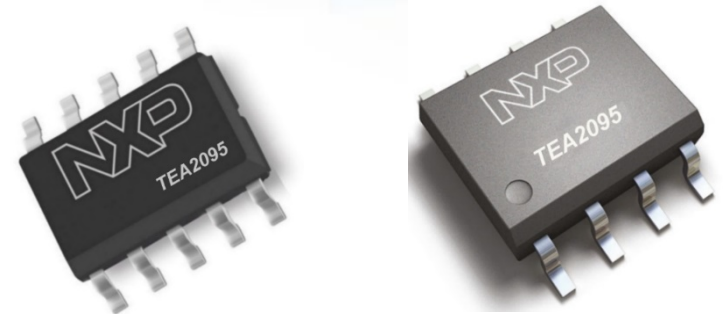
TEA2095 性能特征

Based on TEA1995:

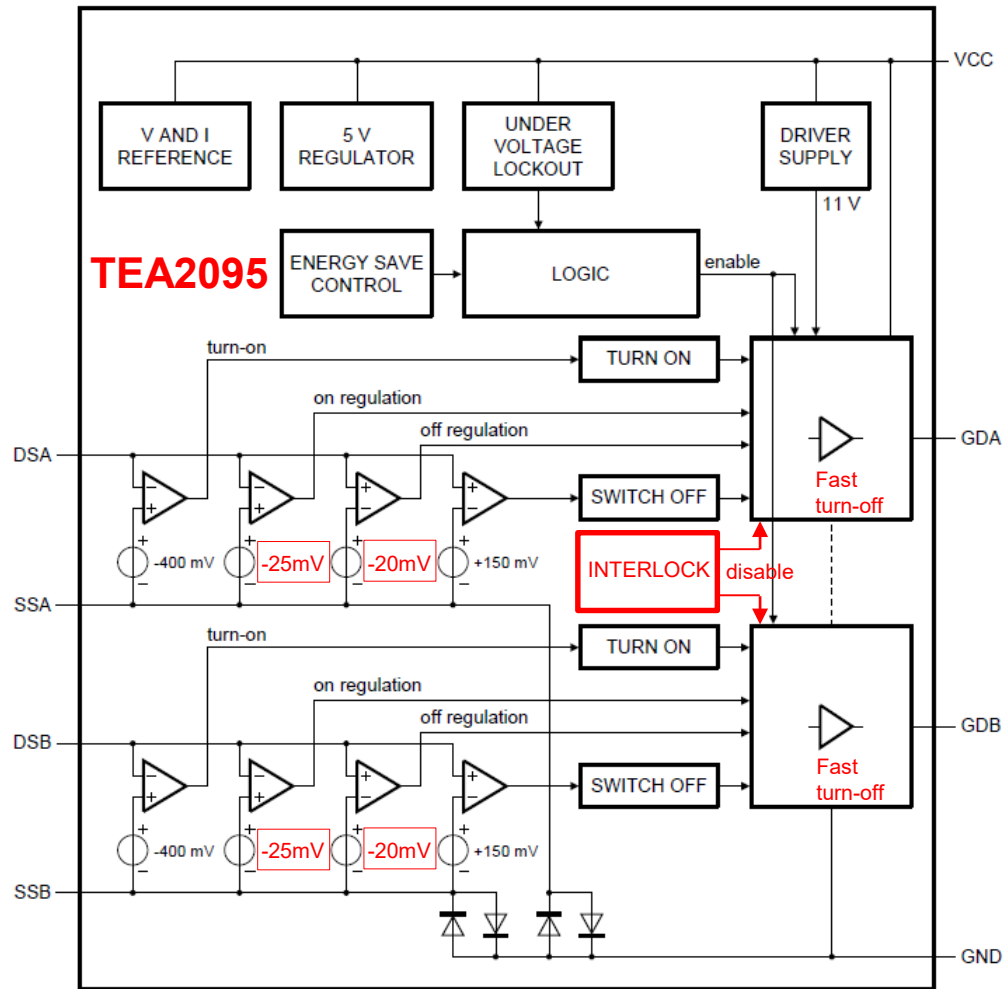
- Adaptive gate drive for maximum efficiency at high load and low load (optimized switching losses)
- Supply current in no-load reduced to $\sim 100\mu\text{A}$
- Very wide supply voltage range from 4.5V to 38V
- 2 channel SR for LLC resonant in a SO8 package
- SR control without minimum on-time and without reverse current. (For optimized efficiency and enabling high frequency)
- Adaptive gate drive for fast turn-off at end of conduction

New functions:

- Less high voltage spikes (lower V_{ds} Mosfets)
- Lower / selectable driver regulation level to support lower $R_{ds(on)}$ mosfets (higher power levels)
- Add a protection to prevent both mosfets to erroneously be driven at the same time
- Support 1MHz switching frequency

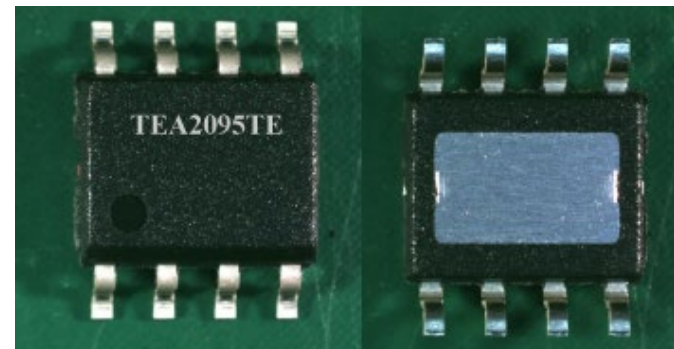


TEA2095 较于TEA1995的区别



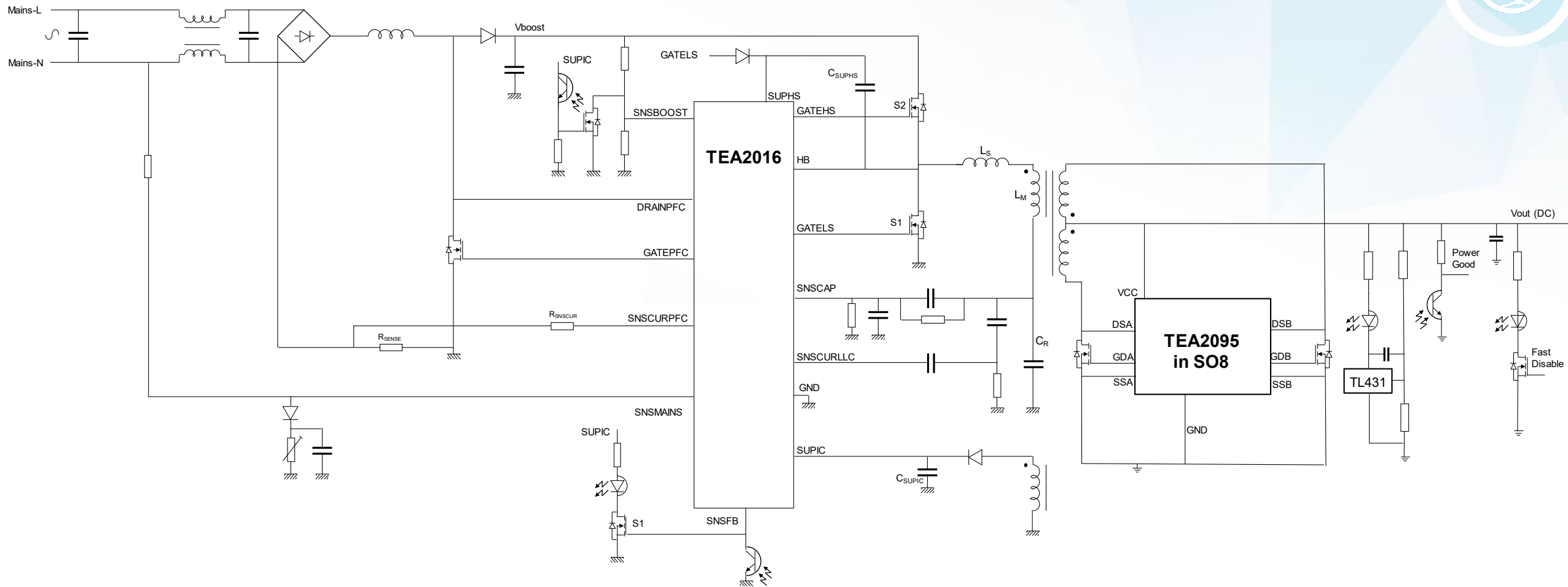
Changes in red

- Larger sink current
- Lower gate pull-down resistance
- Lower regulation level to 25mV
- Interlock function: no simultaneous conduction of both the mosfets (shoot through protection)
- Supply current in no-load ~100μA
- Available in standard SO8 package and in thermally enhanced HSO8 package with exposed die pad



HSO8 package

基于TEA2095的应用



恩智浦主动桥堆整流控制器 TEA2208



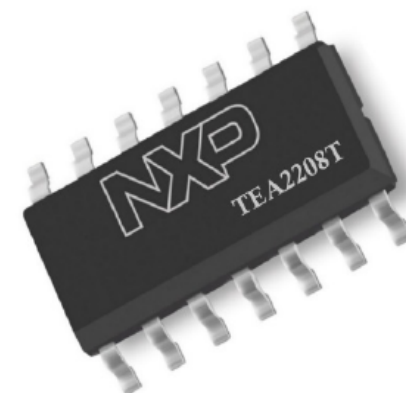
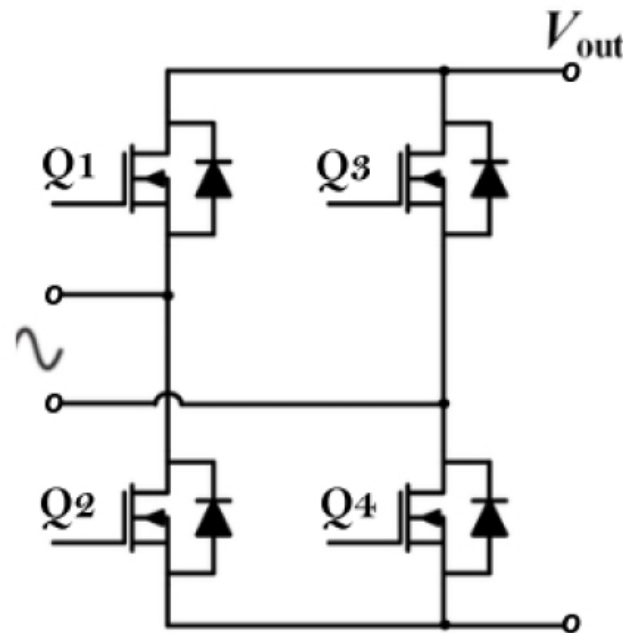
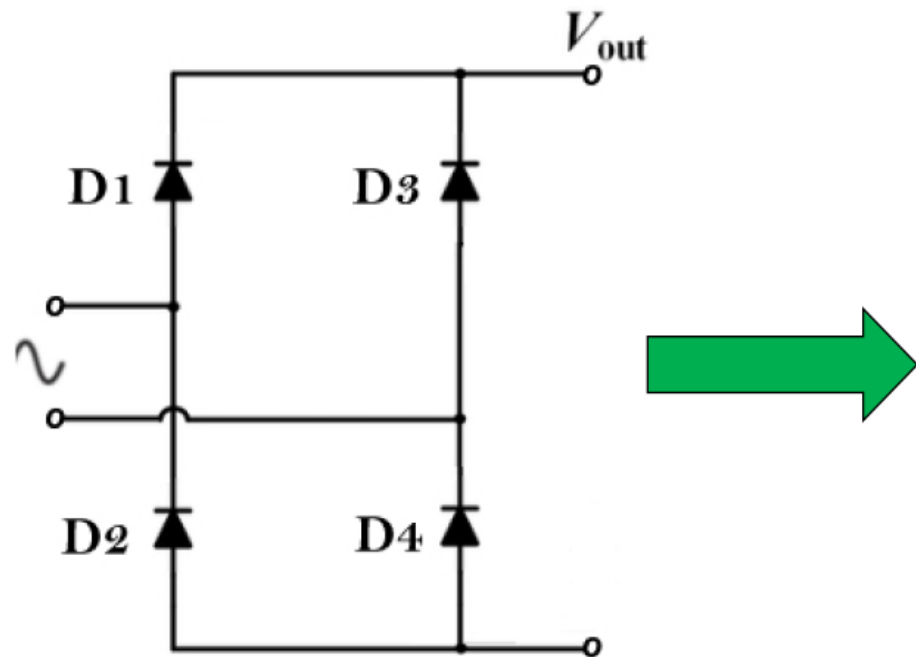
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TEA2208T-通过主动桥堆控制提升效率



Efficiency features

- Forward conduction losses of the diode rectifier bridge are eliminated
- Very low IC power consumption (2mW).

TEA2208T-通过主动桥堆控制提升效率



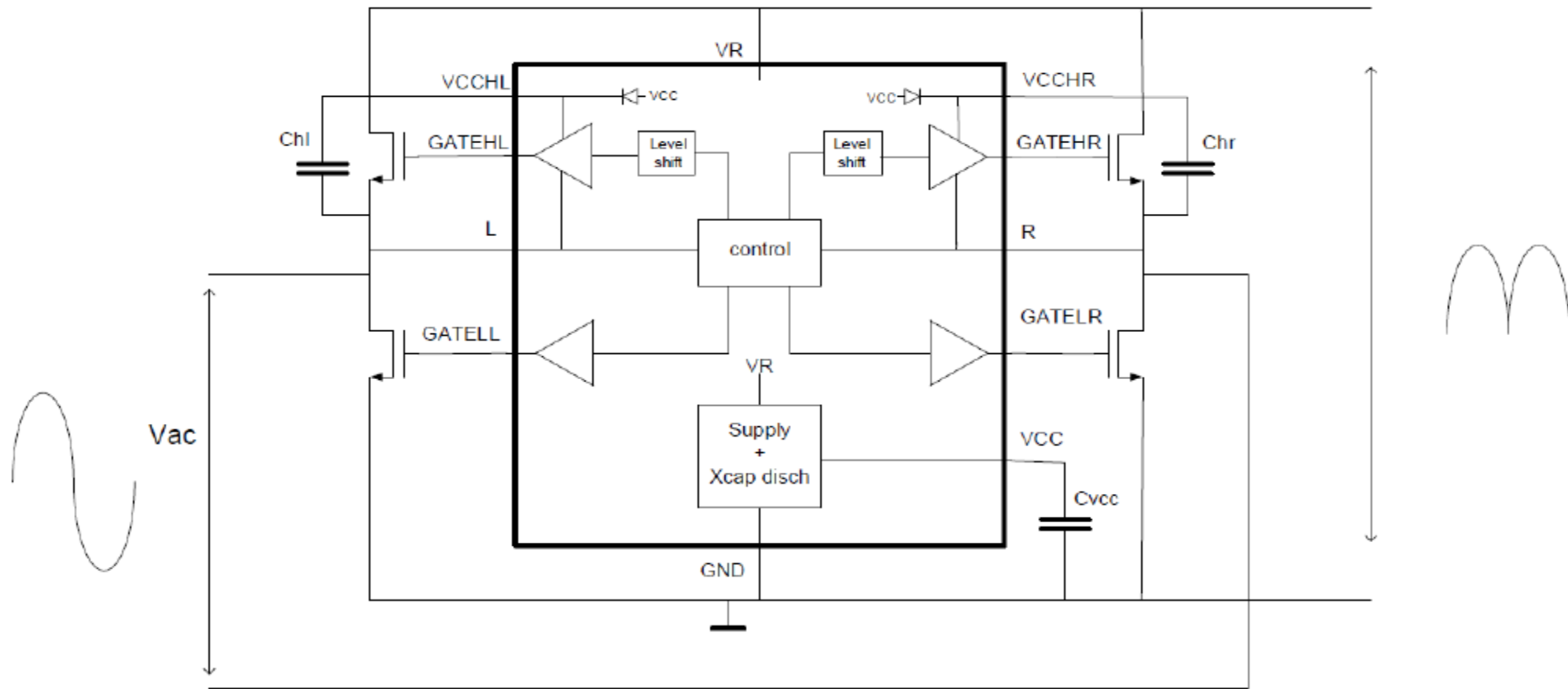
Application features

- Integrated high voltage level shifters
- Directly drives all four rectifier MOSFETs
- Very low external part count
- Integrated X-cap discharge (2mA)
- Self-supplying
- Full wave drive improving THD
- S014 package

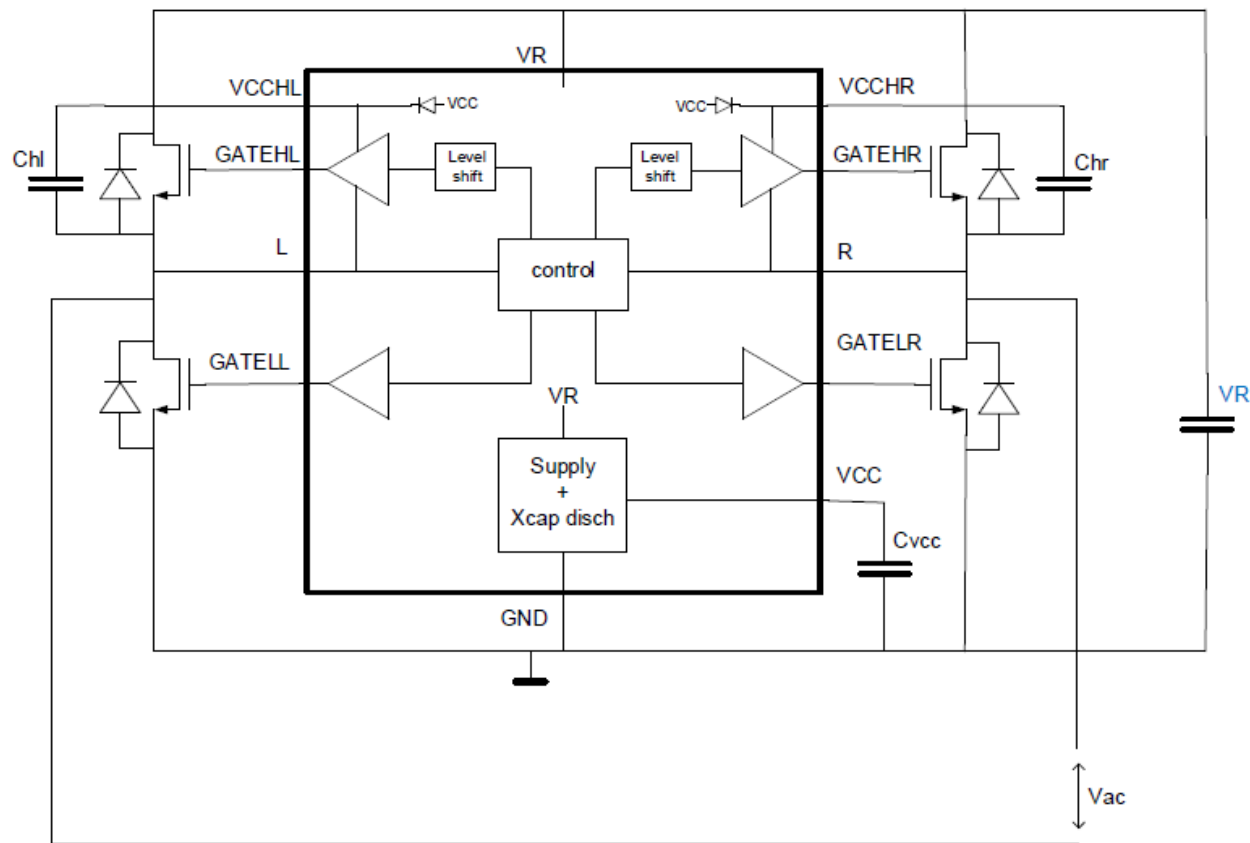
Control features

- Under voltage lock-out for high side and low-side drivers
- Drain-source overvoltage protection for all external power fets
- Gate pull-down currents at startup for all external power fets

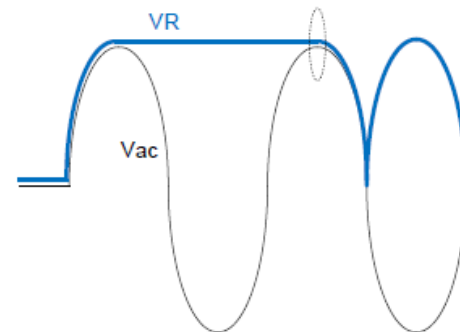
TEA2208T主动桥堆控制（包括X-CAP放电）



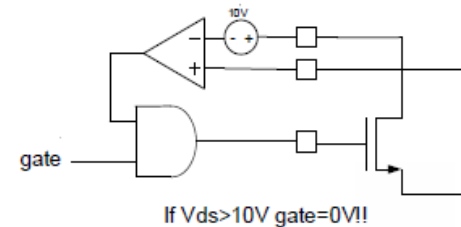
适用于所有功率器件的漏源过压保护



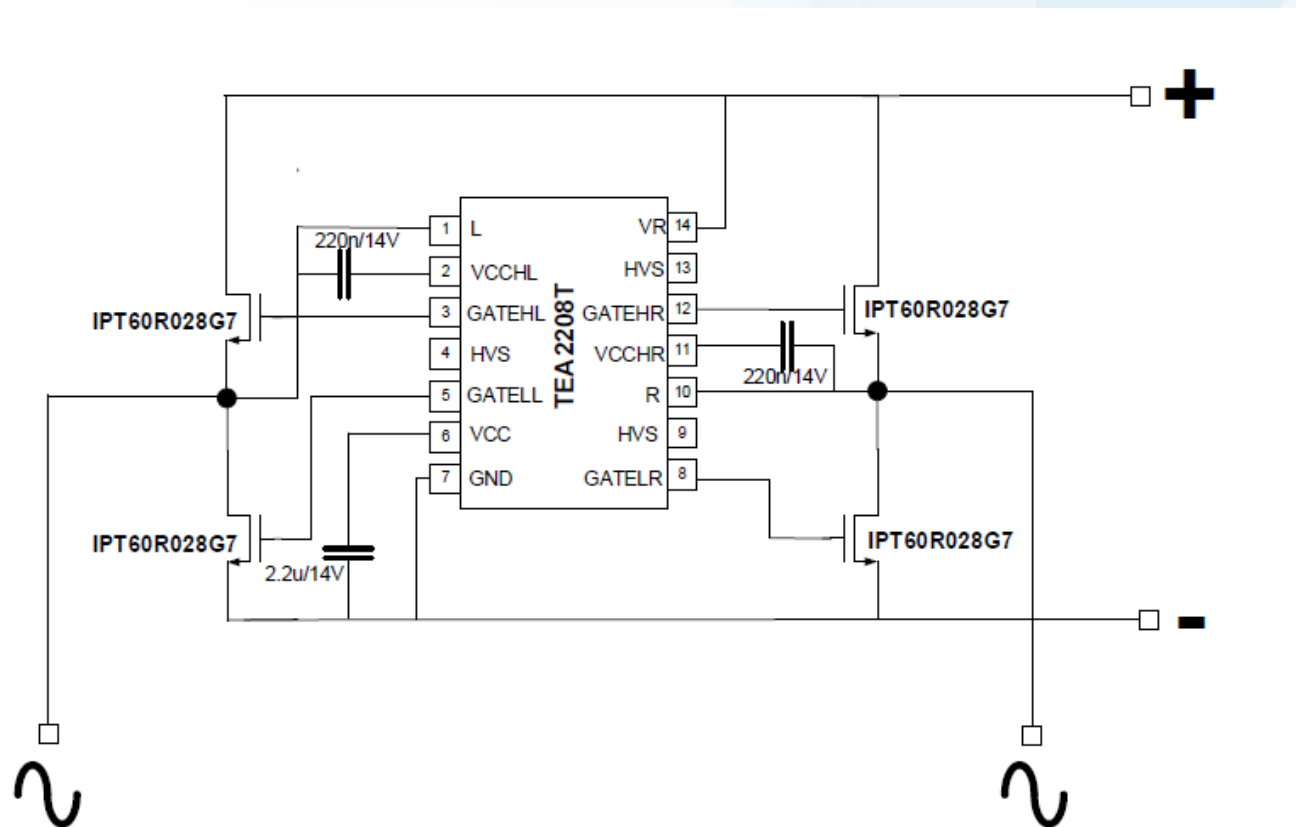
At startup do not turn on Mosfets at zero crossing but wait until $VR=V_{ac}$. Turning on the mosfets at the zero crossing will short the 0V mains to a large charged capacitor at VR. This would give large currents and dissipation peaks in the mosfets which will impact reliability.



Solution: every gatedriver has a V_{ds} protection, (can easily be realized in SOI, not in bulk)



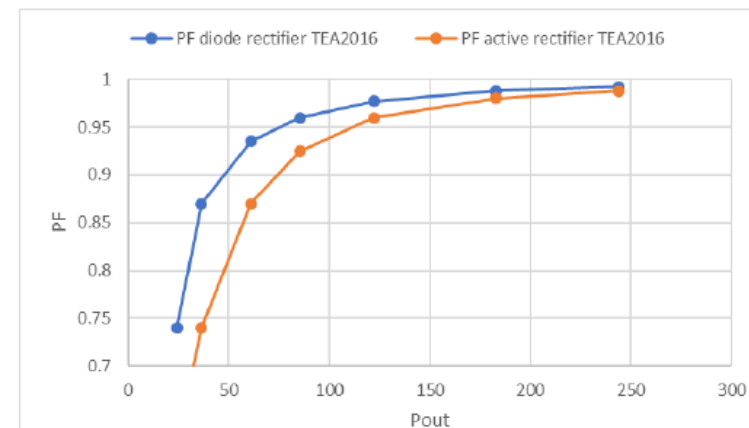
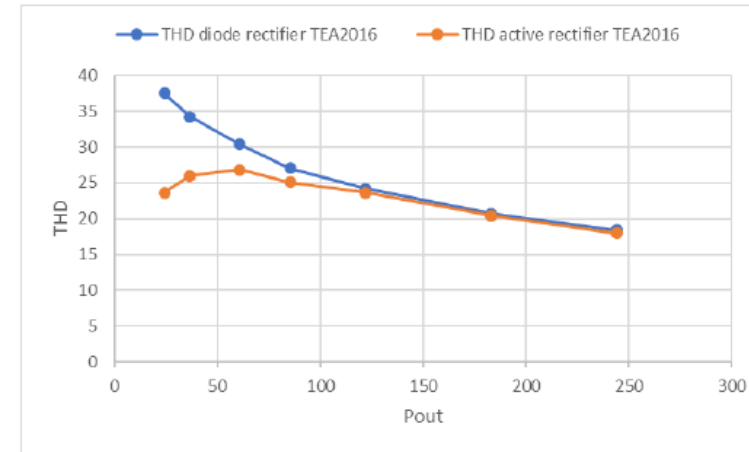
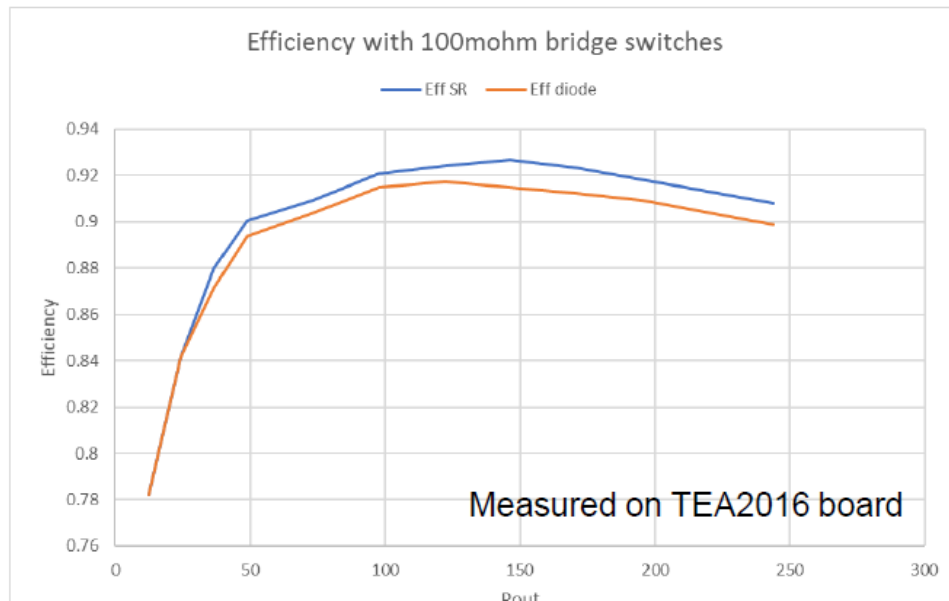
TEA2208T演示板



TEA2208T效率评估

Efficiency compared to diode bridge at 90Vac, Pout=240W

- RdsOn=95mohm Eff=90.4%
 - RdsOn=46mohm Eff=91.0%
 - Diode rectifier Eff=89.7%
(Tbridge=60degC at P=4W, confirms the efficiency gain)
- ➔ Efficiency gain is 1.3% / 4W
- ➔ At lower RdsOn switches, some more gain can be expected





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