ON Semiconductor®

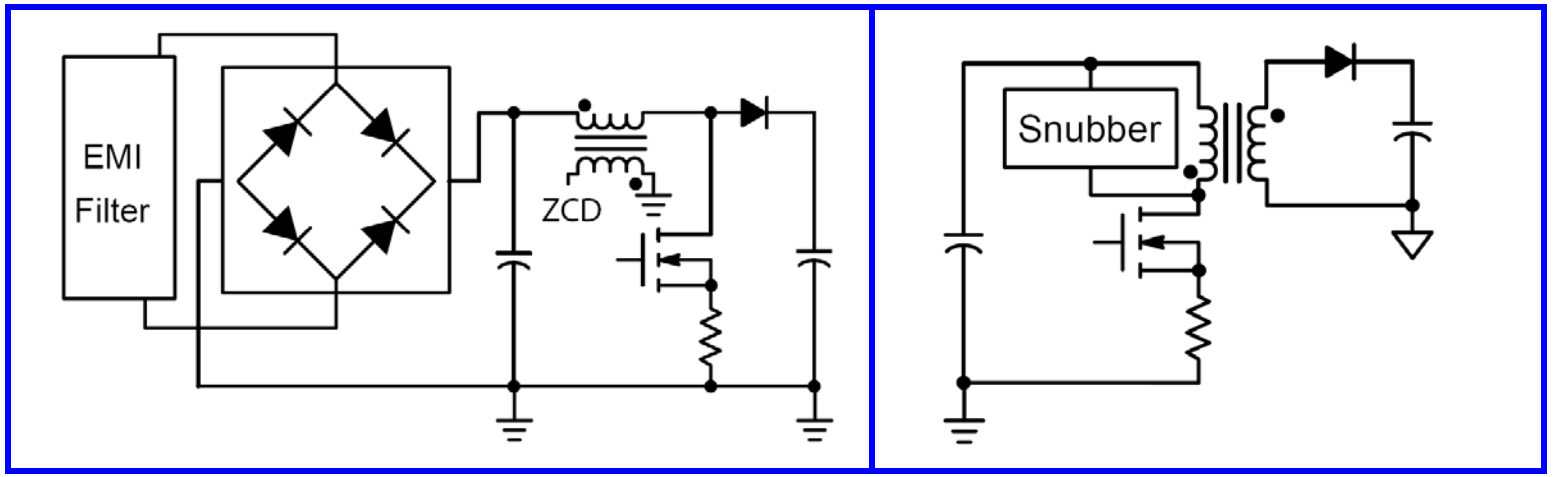
Adapters > 75W

Notebook Adapter Requirements and Trends

- Power rating of 75 W, 90 W and 120 W. Highest volume seen in 90 W platform.
- Power factor correction needed for input power greater than 75 W.
- Minimum efficiency requirement is increasing. Example is ENERGY STAR® 2.0 for EPS (External Power Supplies). It requires a minimum average efficiency of 87 % measured at the end of the cable. It becomes effective in November, 2008.
- Higher efficiency requirements enable a reduction in adapter dimensions.

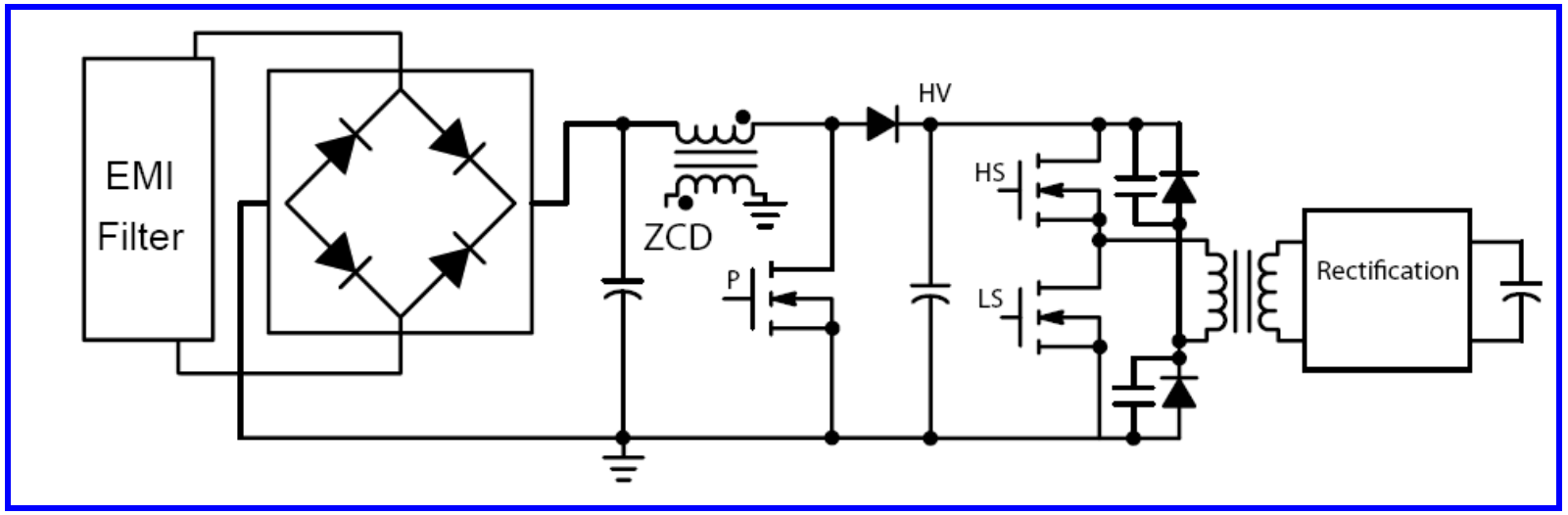
Traditional Architecture

- Traditionally, a discontinuous (DCM) or critical conduction mode (CrM) PFC stage is followed by a quasi-resonant flyback stage.
- Final solution typically uses one controller per stage with redundant support functions (i.e. supply voltage, brown out)



ON's Combination (Combo) Controller

- Flyback is replaced by resonant half-bridge stage.
- NCP1901 combines critical conduction and resonant half bridge power stages in one IC.



NCP1901 – Primary side Resonant controller with integrated PFC

Value Proposition

NCP1901 is a combination of a PFC and half bridge resonant controller which has all functionality to implement a notebook adapter with high efficiency and low form factor

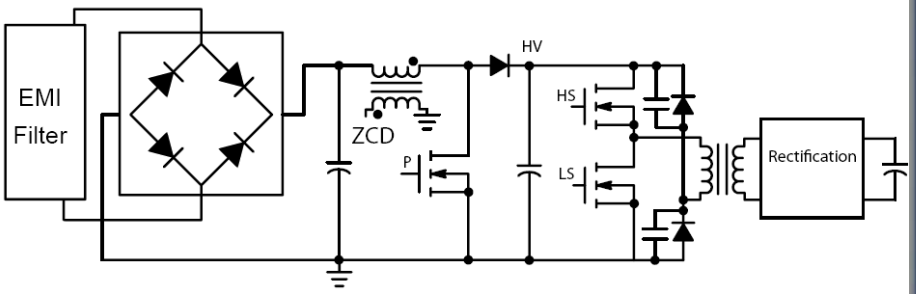
Unique Features

- Half bridge driver with 600V high side gate drive
- Resonant controller with fixed frequency and soft-skip
- PFC with constant on-time controller & error amp

Benefits

- No need for external level shifter or transformer
- Increases efficiency at light load. Reduces EMI
- Excellent PF at mains with low ripple

Application Data



Others Features

- Disable Input
- 50 ns max rise and fall time on the high and low side gate drive
- 500 ns min fixed crossover dead time between drives

Market & Applications

- High efficiency , small form factor Notebook Adapters

Ordering & Package Information

- NCP1901DR2G: SOIC-16
- NCP1901DWR2G: SOIC-20
- Available Q1-09

Pb

NCP1901 Features I

- Half-bridge stage operates at a fixed frequency and duty ratio to reduce switching losses.
- Regulation is achieved by modulating the input voltage of the HB power stage.
- Primary side regulation eliminates the feedback loop.
  - Can compensate for cable losses
- Extremely low EMI and switching losses.

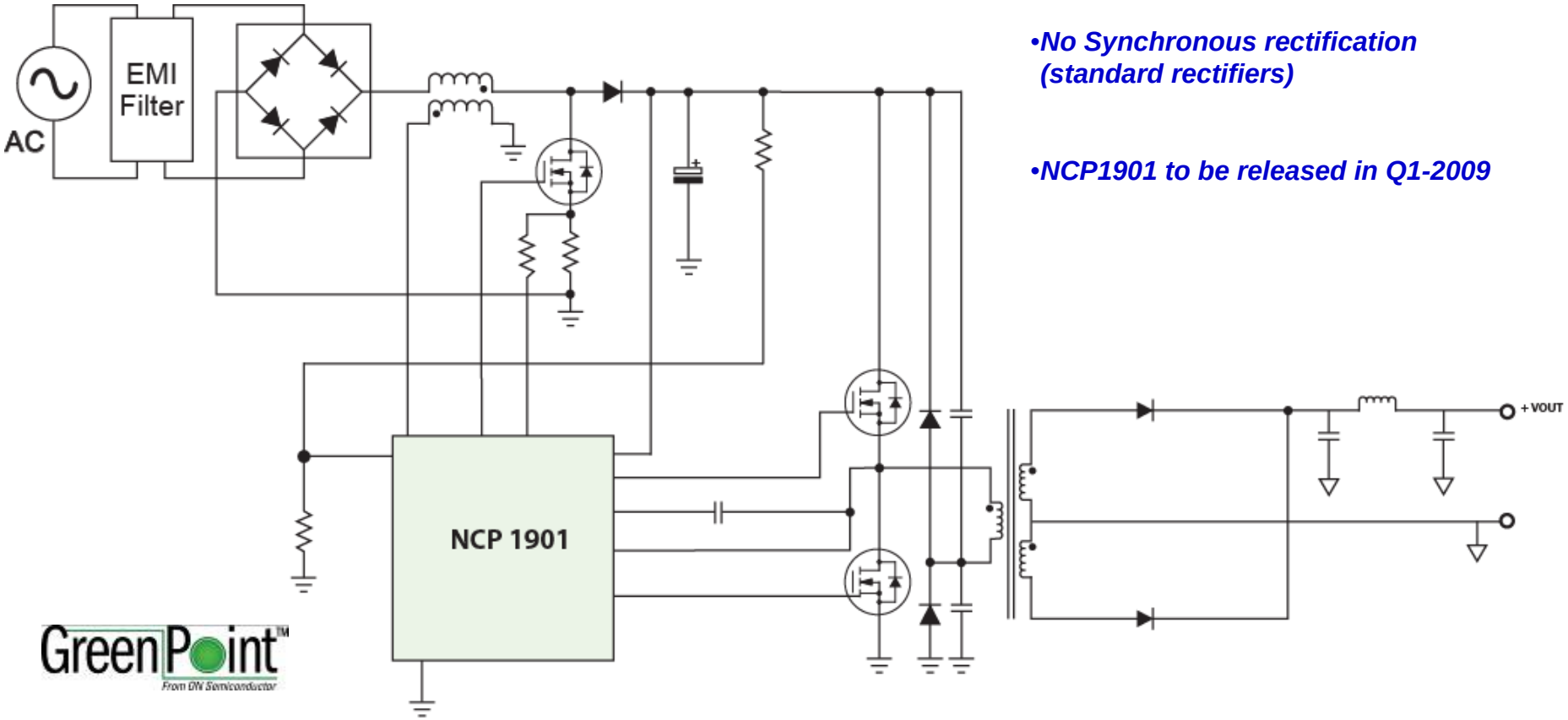
NCP1901 Features II

- Overvoltage information derived from auxiliary winding
  - No leakage inductance induced error as in forced commutating topologies
- Overcurrent condition is detected on the primary side.

90 W Adapter Example Using the NCP1901

- Design Requirements
  - Output voltage between 18.5 V and 20.5 V
  - Output power is 90 W
  - Universal input voltage range
  - Efficiency > 87%
  - Input power less than 0.5 W under no load condition

90 W, Notebook Adapter Reference Design



•No Synchronous rectification (standard rectifiers)

•NCP1901 to be released in Q1-2009

Performance

- Active mode efficiency: 89.4% @ 115 Vac; 90.9% @ 230 Vac, at the end of a 6-foot (1m80) long cable
- Standby mode consumption (@output power = 0): 420 mW @ 115 Vac
- Meets IEC61000-3-2 requirements and ENERGY STAR® 2.0 for PFC
- Exceeds ENERGY STAR® 2.0 efficiency requirements for external power supplies

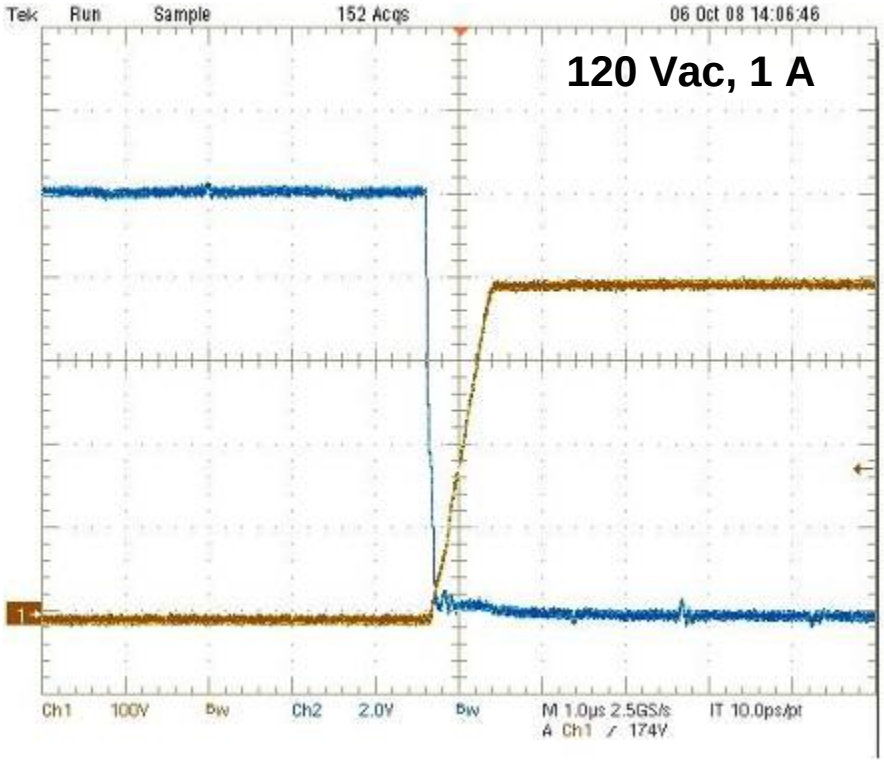
90 W Adapter Example Using the NCP1901

- Measurements at full load

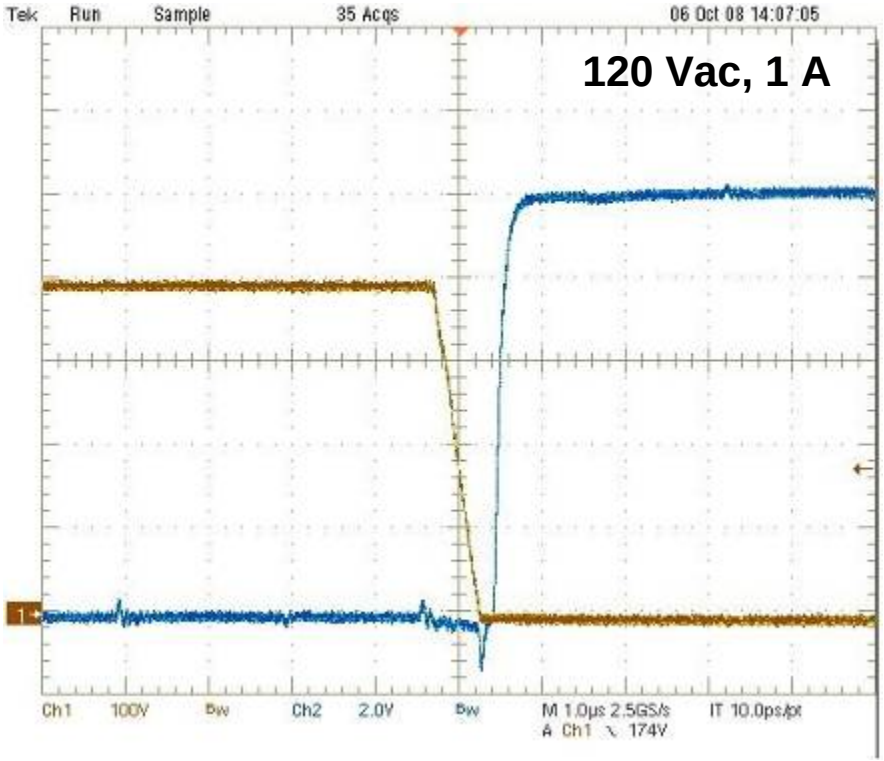
Input Voltage (Vac)	Output Power (W)	Input Power (W)	Efficiency (%)
90	88.60	100.4	88.24
110	89.24	100.5	88.79
115	89.93	100.6	89.39
230	91.68	100.9	90.86
264	91.77	101	90.86

90 W Adapter Example using the NCP1901

- Very low switching losses!!
  - Turn on and turn-off waveforms of HB low side MOSFET.



CH1: Drain of low side HB MOSFET
CH2: Gate of low side HB MOSFET



CH1: Drain of low side HB MOSFET
CH2: Gate of low side HB MOSFET

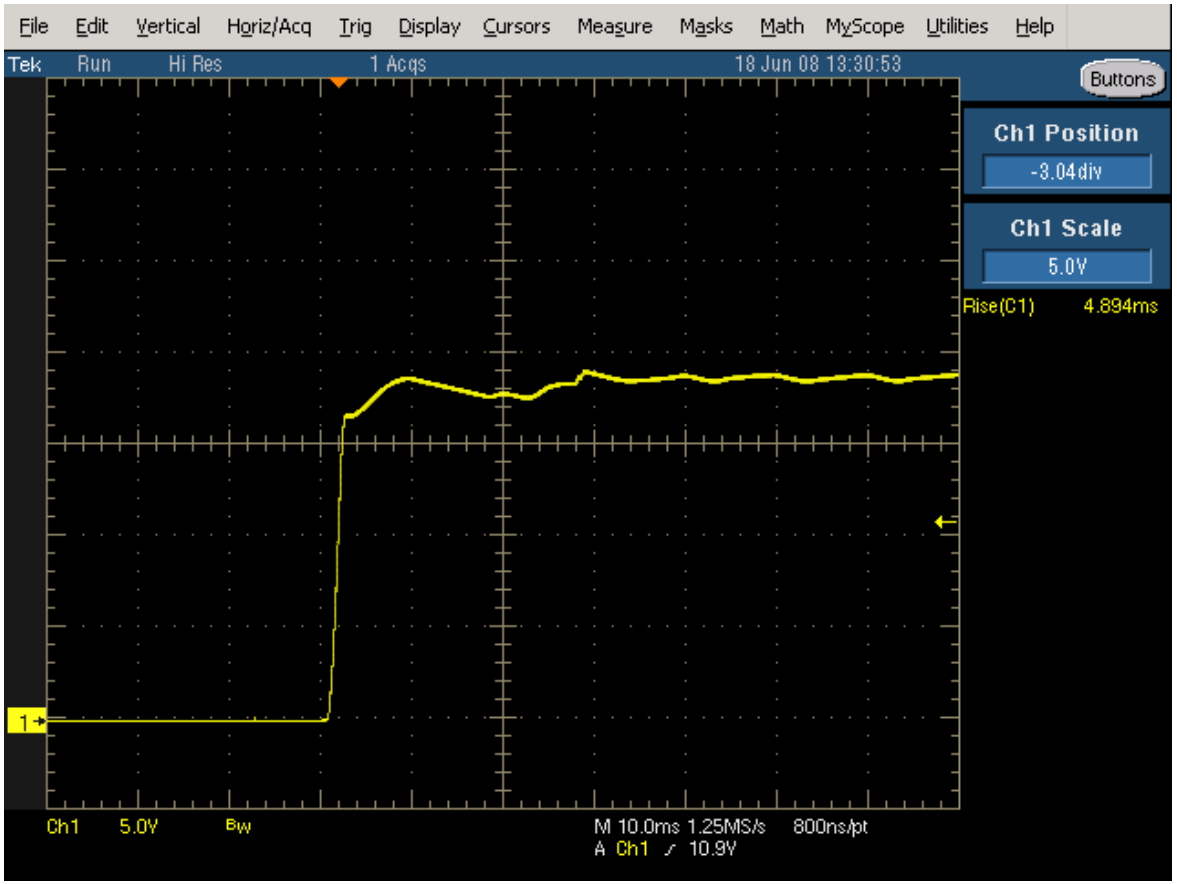
90 W Adapter Example using the NCP1901

- Meets ENERGY STAR® 2.0 for EPS (External Power Supplies) for standby efficiency requirements.

Input Voltage (Vac)	Output Power (W)	Input Power (W)	Requirements
115	0	0.420	Pin < 0.5 W
230	0	0.405	Pin < 0.5 W

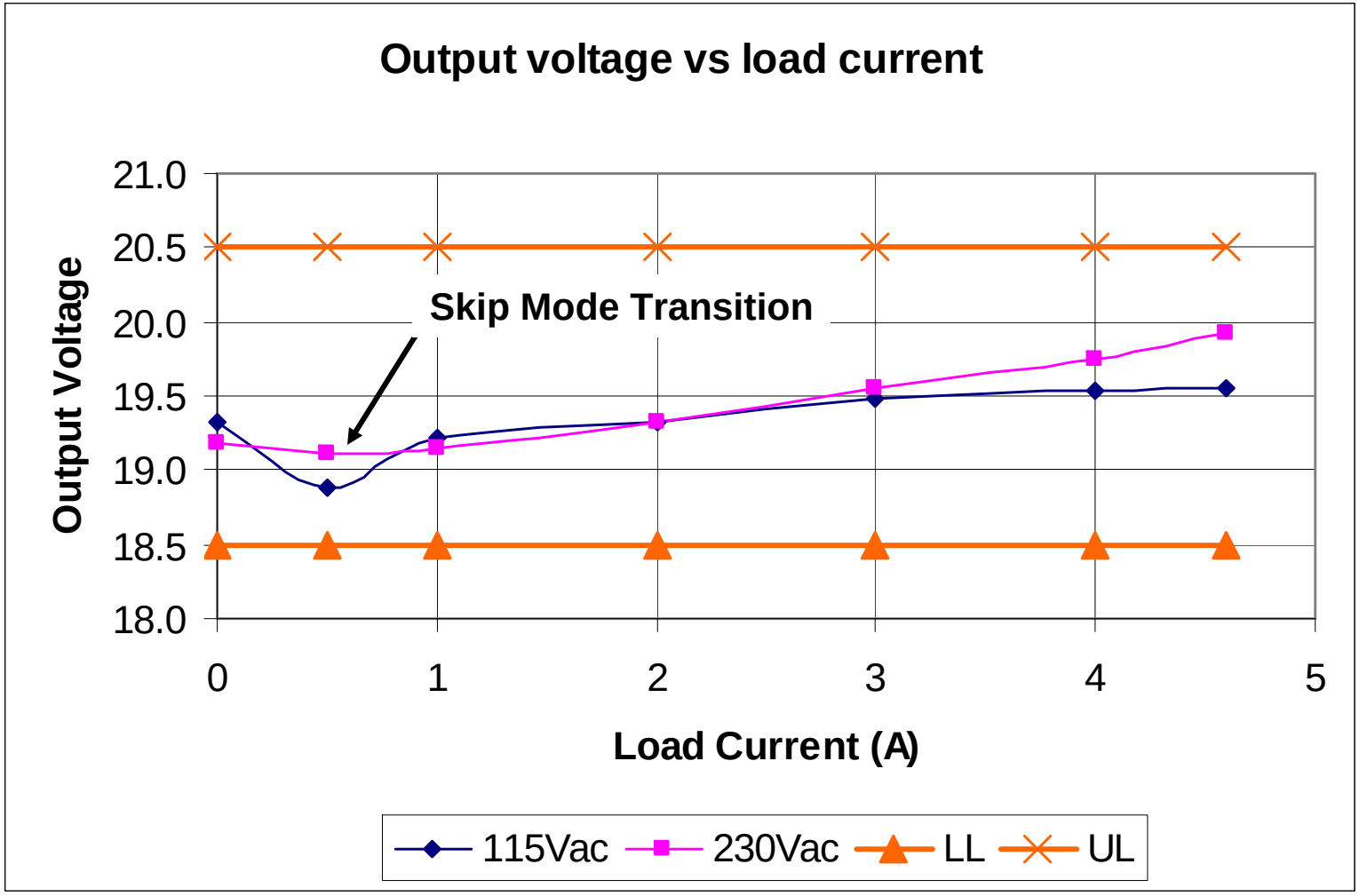
90 W Adapter Example using the NCP1901

- Soft-start controls startup time and peak current.



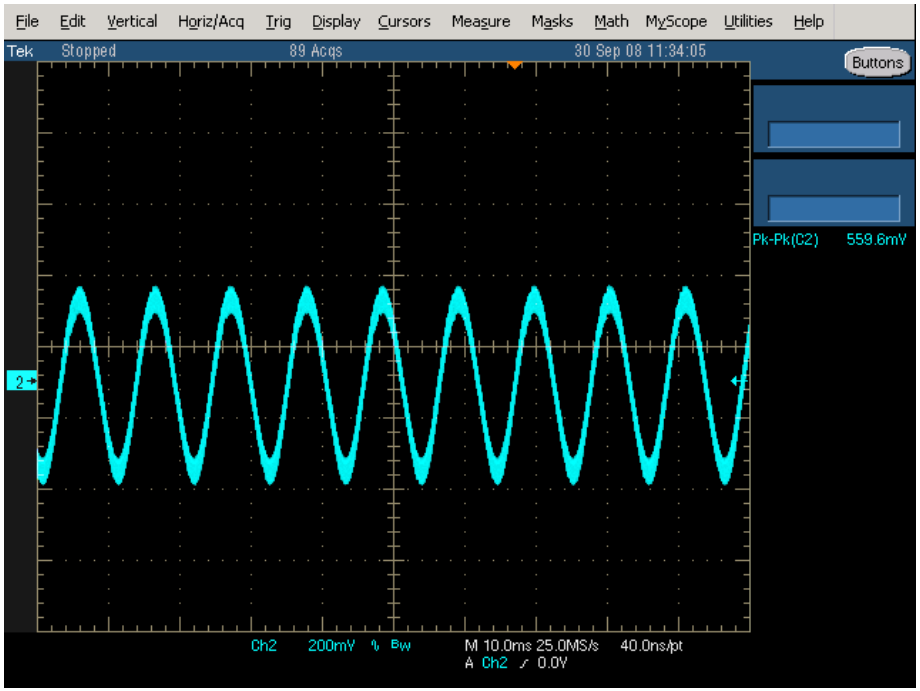
Vin: 264Vac
Iout: 4.6A

90 W Adapter Example using the NCP1901

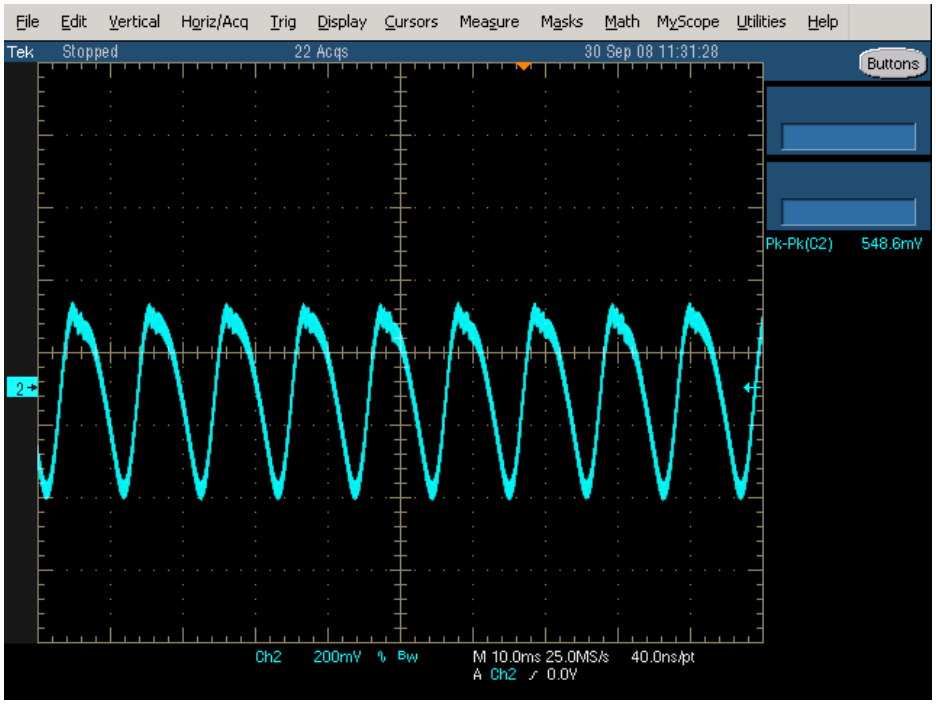


90 W Adapter Example using the NCP1901

- Output Voltage Ripple



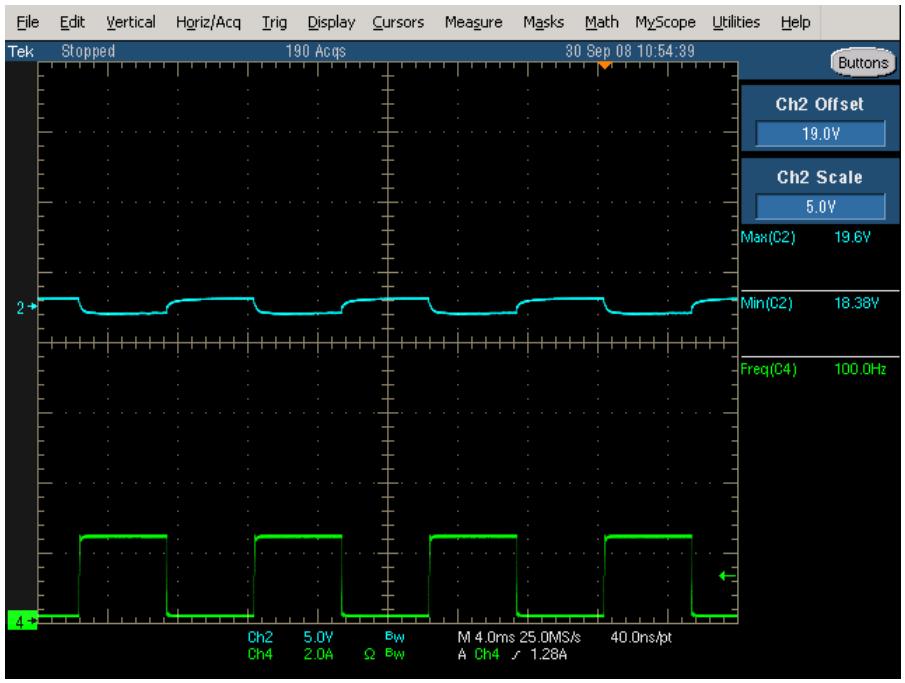
Vin: 90 Vac, 60 Hz
Iout: 4.6A



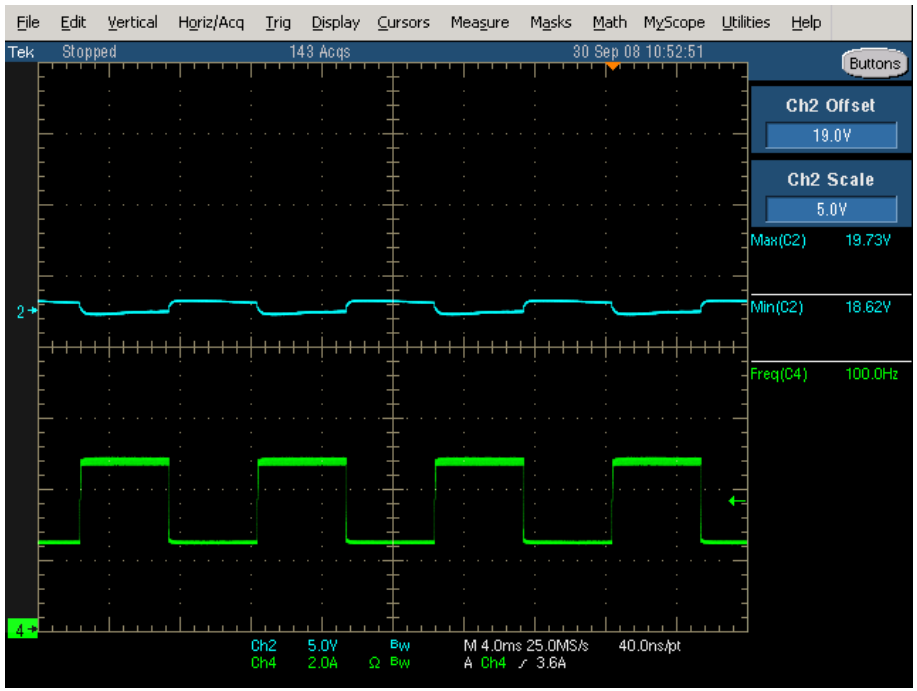
Vin: 264 Vac, 50 Hz
Iout: 4.6 A

90 W Adapter Example using the NCP1901

- Load Transient



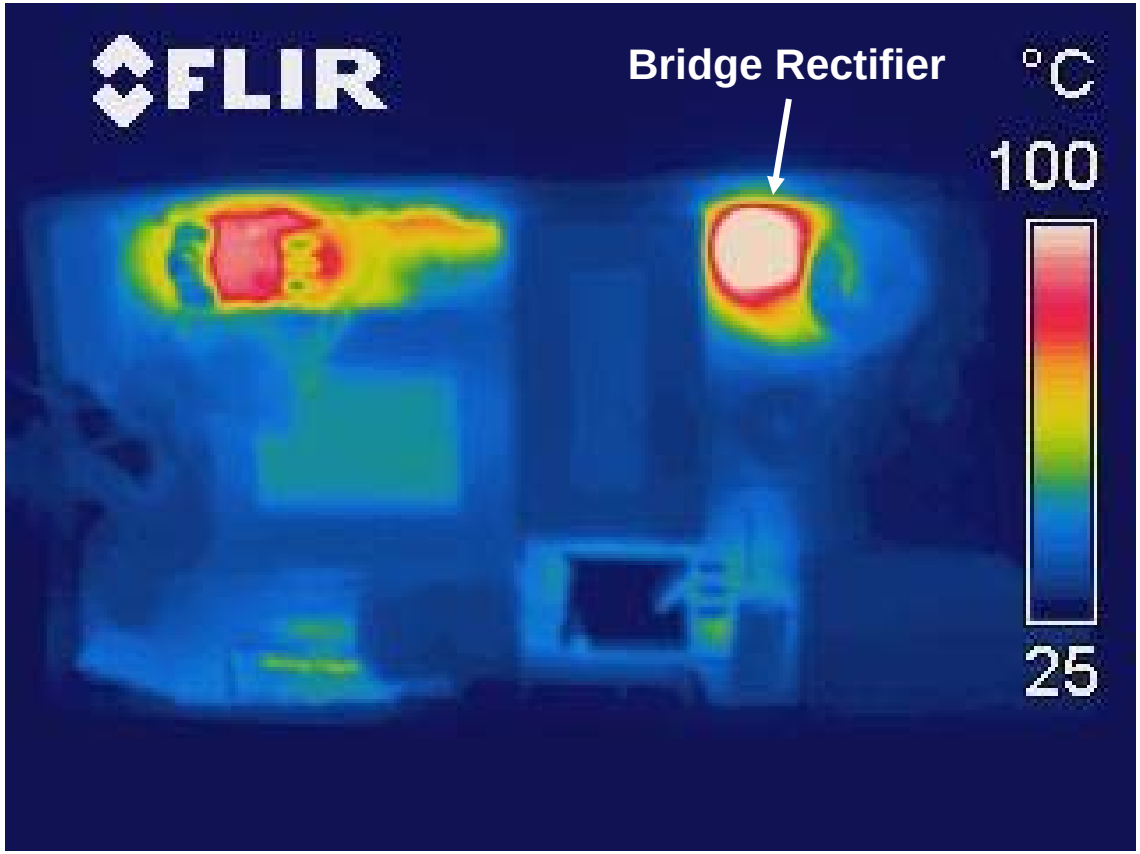
Vin: 90 Vac, 60 Hz
Load Step: 1% 50%



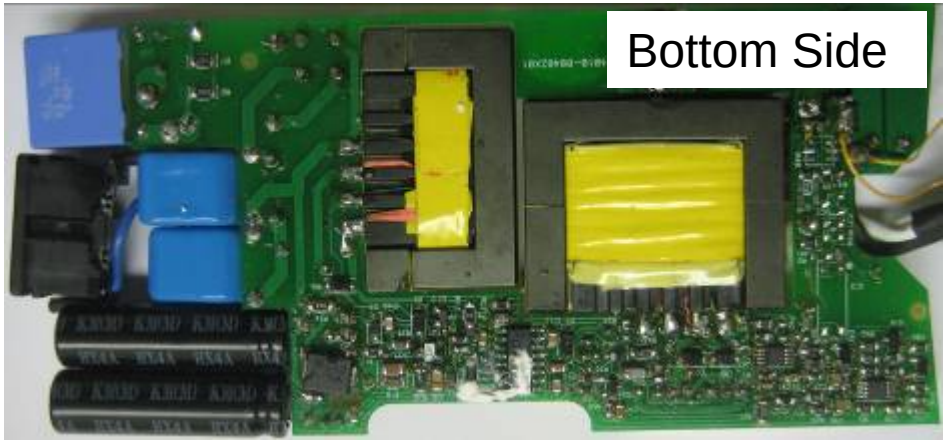
Vin: 264 Vac, 50 Hz
Load Step: 50% 100%

90 W Adapter Example using the NCP1901

- Thermal Image
  - Top Side, 120 Vac / 4.6 A



90 W Adapter Example using the NCP1901



- Very small heatsinks!
- Low profile.

Conclusion

- The NCP1901 simplifies system design by incorporating all the features needed to implement a PFC and resonant half-bridge stages in a single IC.

- A 90 W notebook adapter is implemented using the NCP1901. The adapter meets regulatory and environmental initiatives.

- High efficiency allows:
  - Primary side regulation
  - Reduction on the number of heatsinks
  - Reduction of the heatsink thickness (copper weight)

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