Figure 6: PFC efficiency comparison (Pout = 350 W)

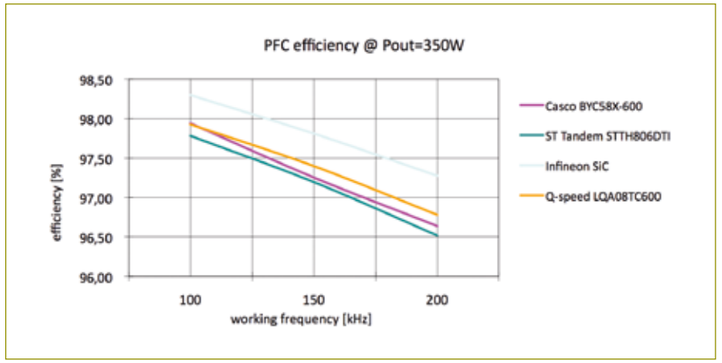
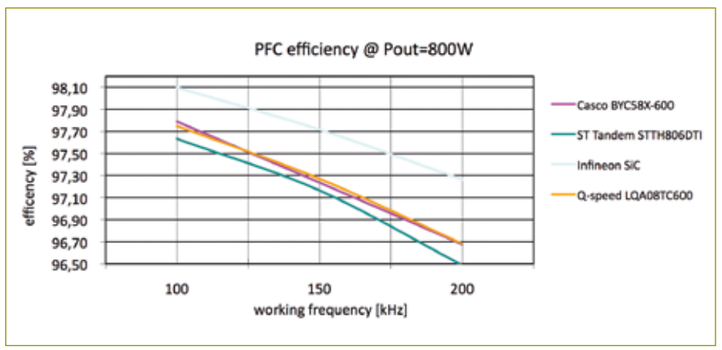
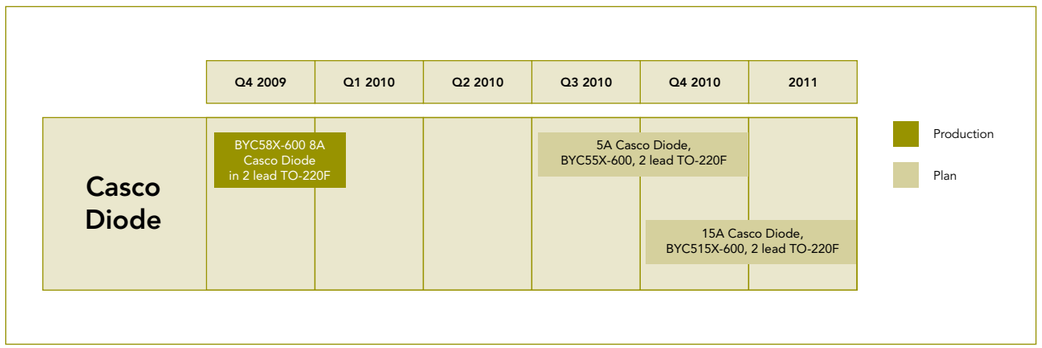


Figure 7: PFC efficiency comparison (Pout = 800 W)



The test results, given in Figures 6 and 7, show that the Casco diode, with its shorter t_{rr} and lower V_F, consistently achieves similar effiency to the Q-speed diode and better than ST Tandem diode.

NXP Casco diode family roadmap



NXP Casco diode
BYC58X-600
12.5 ns t_{rr}

Casco diode - the key to high PFC efficiency

BYC58X-600, the first in NXP's new Casco series, enhances efficiency in high-power SMPS applications and high-frequency power-switching circuits. Its hyperfast recovery speed significantly reduces switching losses.

Key features

- Hyperfast recovery speed: 12.5 ns at 25 °C (typ)
- Average forward current: 8 A
- Non-repetitive forward current: 110 A at t = 10 ms (sinusoidal waveform)
- Isolation voltage: 2500 V
- Package: 2-lead TO-220F (SOD113)

Key benefits

- Improved power efficiency for SMPS applications
- Improved reliability from cooler-running devices
- Improved sourcing choice for better delivery sustainability
- Better cost/performance ratio compared to SiC Schottky rectifier

Applications

- High output-power SMPS
- Servers, telecom equipment, and basestations
- Flat-panel TVs, LED lighting
- Industrial applications such as Uninterruptible Power Supplies (UPS)

The BYC58X-600 is the first in NXP's new Casco diode series of power diodes. Capable of hyperfast recovery speeds and offering low forward voltage drop, Casco diodes minimize system losses in Continuous Current Mode (CCM) Power Factor Correction (PFC) circuits.

Like all the diodes in the Casco family, the BYC58X-600 is constructed using two 300 V dice in series. This structure minimizes the stored charge in the diode, yielding a significant improvement in switching performance.

Advanced die-in-series technology allows the BYC58X-600 to achieve a typical reverse recovery time (t_{rr}) of 12.5 ns at 25 °C, and a maximum forward voltage drop of 2.4 V at 150 °C. This significantly reduces power losses for the diode and, even more importantly, for the switching MOSFET. As a result, Casco diodes help engineers meet the aggressive targets set by eco-design standards such as Energy Star.

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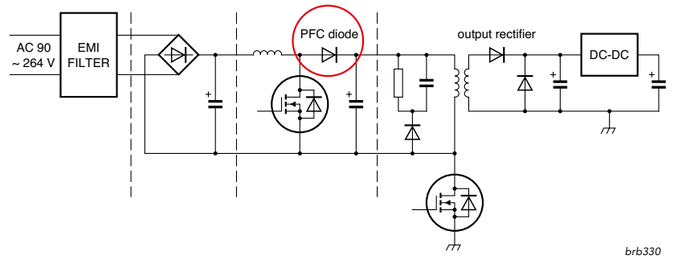
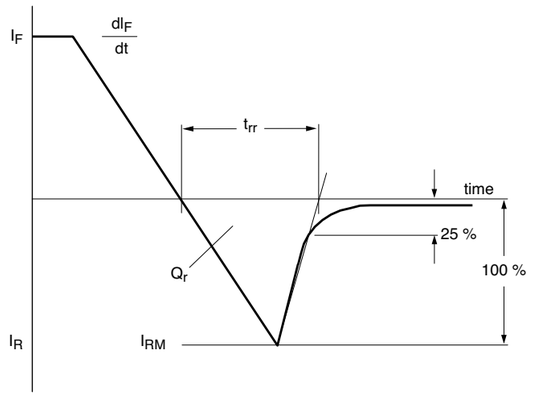
Figure 1: Typical SMPS application with active PFC input



In key benchmarks against major competitors, the Casco diode delivers better ratings for reverse recovery time and forward voltage drop, which gives higher PFC efficiency.

Figure 1 illustrates a typical SMPS AC-DC converter with PFC function. The PFC diode is the BYC58X-600 Casco diode.

Figure 2: The definition of reverse recovery time (t_{rr})



In medium- and high-power SMPS applications, the boost converter usually operates in CCM mode, with the MOSFET and diode alternating in conduction and the current staying above zero. During CCM operation, t_{rr} switching losses dominate overall power losses. Figure 2 illustrates the definition of t_{rr}, Q_r and I_{RM}. In general, the t_{rr} value increases as the temperature rises.

Figure 3: Competitive benchmark: t_{rr} versus dI_F/dt

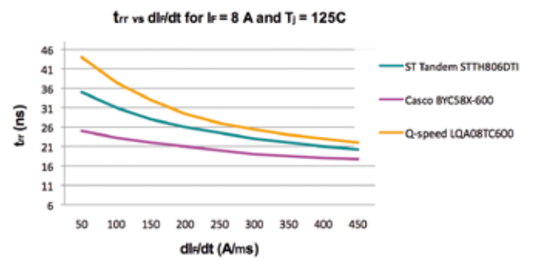
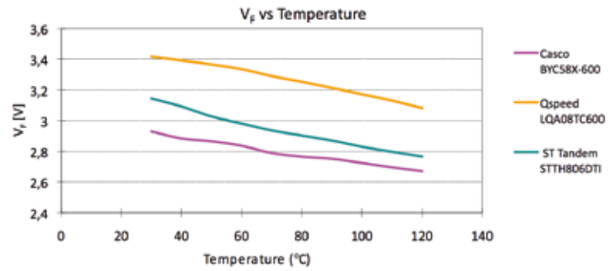


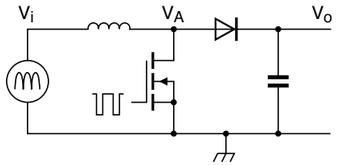
Figure 3 compares the t_{rr} of the Casco diode for various dI_F/dt at 125 °C with that of similar diodes. The longer the t_{rr}, the more heat is generated in the MOSFET. As shown in Figure 3, the Casco diode has a shorter t_{rr}, and thus provides better thermal performance at high ambient temperatures in real applications.

Figure 4: Competitive benchmark: V_F versus temperature



Forward voltage drop V_F plays a key role while the diode is conducting. The lower the V_F, the lower the power loss in the diode. As shown in Figure 4, the Casco diode has the lowest V_F, and as a result dissipates the least power.

Figure 5: PFC boost converter test circuit



The combination of fast t_{rr} and low V_F minimizes losses in both the diode **and** the MOSFET and yields the best overall system efficiency.
To evaluate efficiency, the Casco diode and comparable products were tested in the PFC boost converter circuit as shown in Figure 5.

In each of the experiments, the input voltage and current, along with the output voltage and current, were recorded after 20 minutes of thermal stabilization. Separate heatsinks were used for the diode and MOSFET.

NXP

BYC58X-600