NXP Hyperfast Enhanced Efficiency Diode in LCD TV SMPS

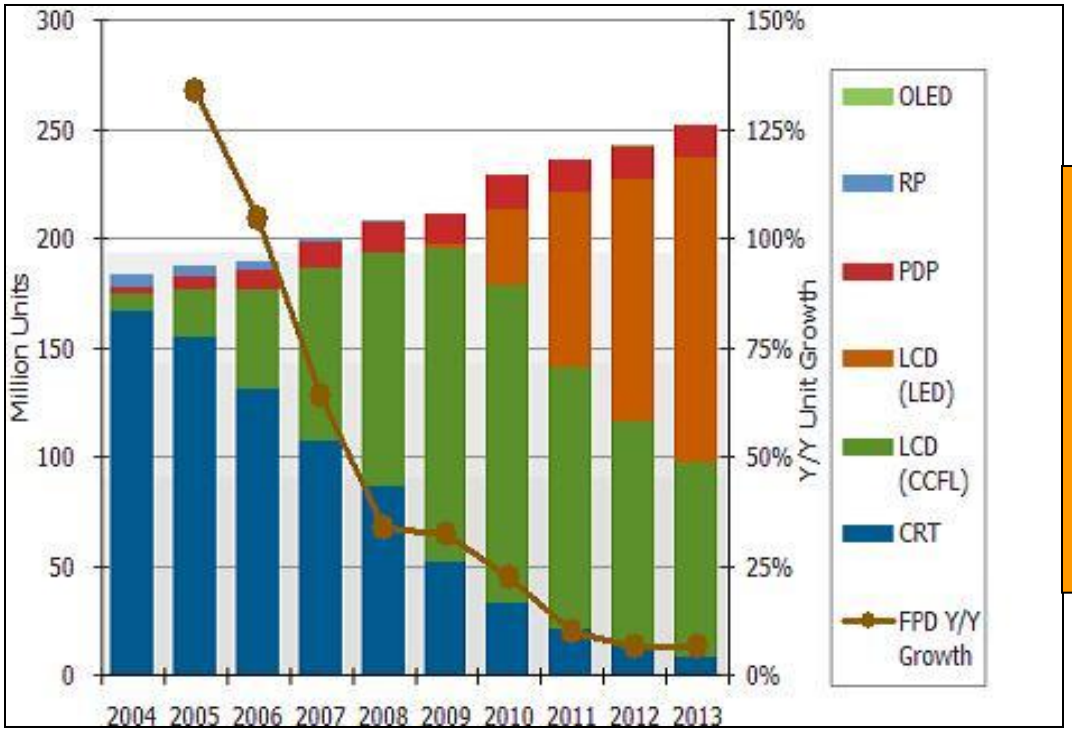
BYC8-600P & BYC8X-600P

LCD/LED TV Power Adapter

TV Power Market Demands

How power diodes affect efficiency in PFC circuits

Global TV Shipment and Forecast



LCD TV(CCFL Backlight) began replacing traditional CRT TVs from 2007. Since 2010, LCD TV (LED Backlight) shipments have grown very fast and by the end of 2012 .Its market share is expected to exceed LCD TV(CCFL Backlight) volume. Continued growth for LCD TV with LED backlight technologies is expected.

Source: Display Search

LCD TV Power Market Demands

Energy Star

Version 5: Effective on May 01 / 2012

Viewable Screen Area A: square inches	Power on_max (Watts) A: square inches	Power on_max (Watts) A: square centimeters
A < 275.0	Pmax = 0.130*A+5	Pmax = 0.020*A+5
275.0 ≤ A ≤ 1068.0	Pmax = 0.084*A+18	Pmax = 0.013*A+18
A > 1068.0	108	108

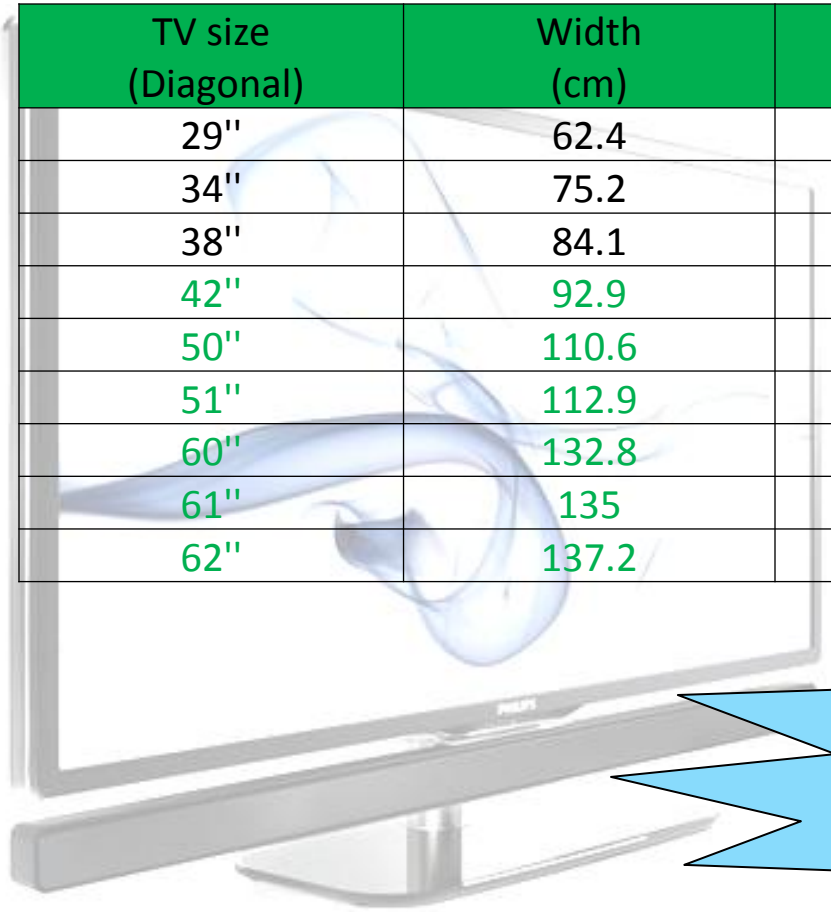
EU Energy Efficiency

EC642/2009: Effective on April 01 / 2012

Television type	Power on_max (Watts) A: expressed in dm^2
Television sets	16 + A * 34579
Television monitors	12 + A *34579

Energy Star V 5.0 for TV

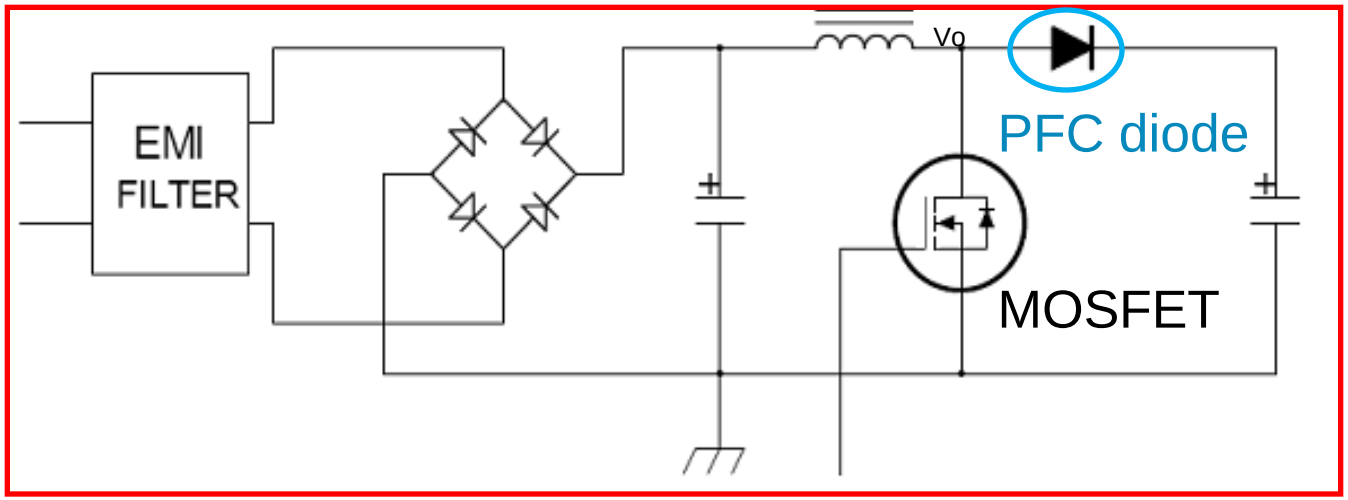
TV size (Diagonal)	Width (cm)	Height (cm)	Area Size (cm^2)	Power on_max (W)
29''	62.4	36.1	2300	47.9
34''	75.2	42.3	3200	59.6
38''	84.1	47.3	4000	70
42''	92.9	52.3	4900	81.7
50''	110.6	62.2	6900	107.7
51''	112.9	63.5	7200	108
60''	132.8	74.7	9900	108
61''	135	75.9	10300	108
62''	137.2	77.2	10600	108



Any TV size bigger than 40'' needs a PFC circuit

PFC circuits need optimized PFC diodes!

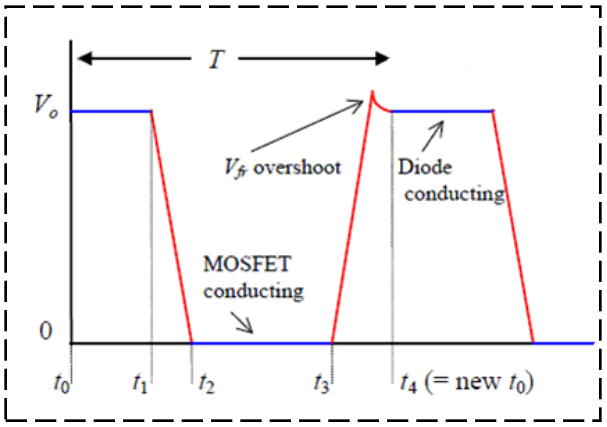
PFC Circuit in LCD TV SMPS



Conventional PFC topology.

PFC diode selection is concerned about diode parameters which affect power dissipation in both the PFC diode and the MOSFET.

Power Losses in a PFC circuit



How do power losses in PFC circuits relate to PFC diode parameters? (see following slides)

Contributors to Power losses in PFC circuits	Significance	Why	Parameter
MOSFET on-state losses	Minimized	due to MOSFET's "on resistance"	MOSFET, Rdson
MOSFET switching losses	Minimized	due to MOSFET's internal capacitances	MOSFET, Cgd, Cgs, Cds
MOSFET turn-on losses	Very high	induced by reverse recovery of PFC diode	Diode reverse recovery time, T_{rr} Diode reverse recovered charge, Q_R Diode peak reverse recovery current ,I_{RM}
Diode forward losses	Very small	forward conduction losses	Diode forward voltage, V_F
Diode switching losses	Very small	reverse recovery losses	Diode reverse recovery time, T_{rr} Diode forward recovery voltage, V_{FR}

NXP Hyperfast Enhanced Efficiency Diode

Quick Reference Data

Application Evaluation

BYC8-600P & BYC8X-600P

Overview

Description

Hyperfast **E**nhanced **E**fficiency **D**iode - Platinum (Pt) doped 600V Power diode
Continuous **C**urrent **M**ode (CCM) Rectifier Diode for High Efficiency SMPS applications

Key features

- **Hyperfast reverse recovery time - T_{rr} (typ) ≤ 12ns** @ I_F = 1A, V_R =200V, **dI_F/dt =** 200A/µs;
- **Low forward voltage - V_F (max) < 1.9V** @ I_F = 8A, T_j = 125° C;
- **Low reverse leakage current - I_R ≤ 200µA** @ V_R = 600V, T_j = 125° C;
- **Available in TO-220AC, TO-220F**(“full pack”) and **DPAK** packages;

Benefits

- Significantly reduces the power dissipation in MOSFET at SMPS primary side
- Reduces the size of required heatsink
- Low leakage for improved reliability
- Planar passivated for voltage ruggedness and reliability
- Industry standard packages

Key Parameters (1)

Forward Voltage (V_F) and Reverse Recovery Time (T_{rr})

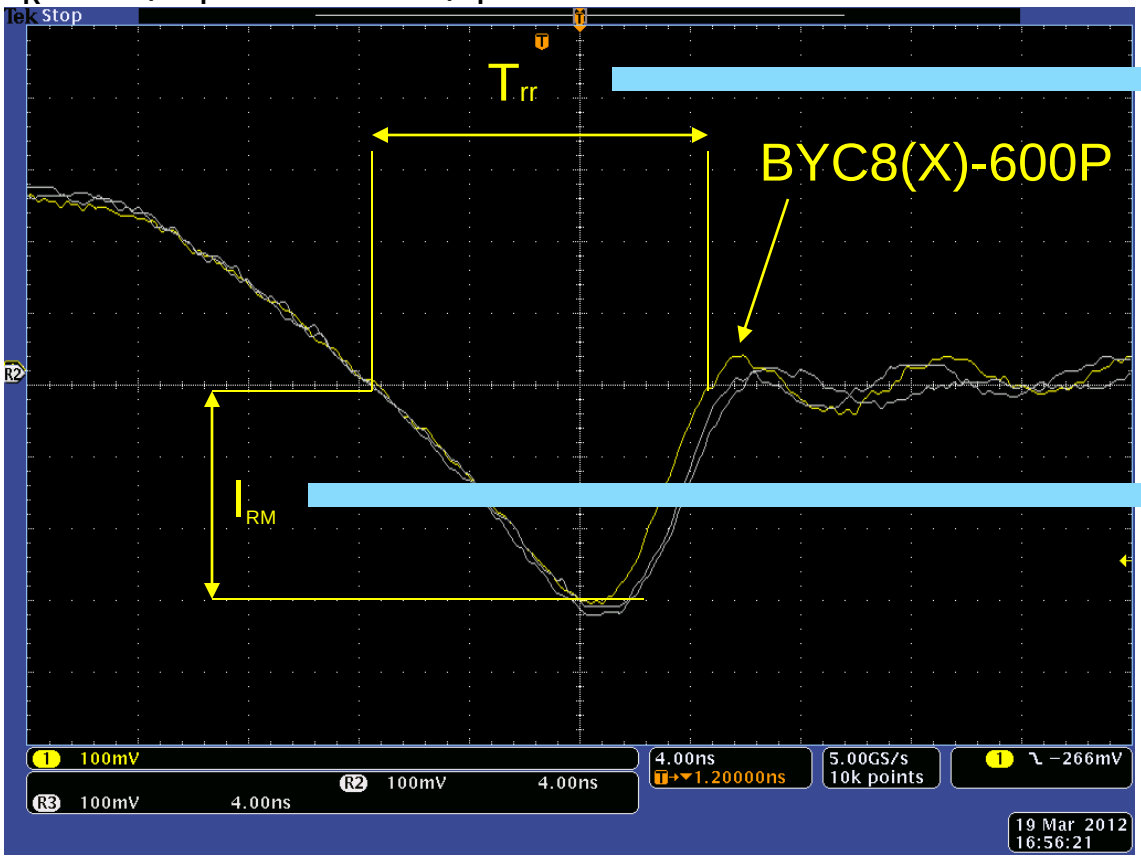
Vendor	V_F @ I_F = 8A; 125degC	T_{rr} @ I_F = 1A, V_R =200V, dI_F/dt = 200 A/µs	I_{RM} @ I_F = 1A,V_R = 200V, dI_F/dt = 200 A/µs
NXP	**≤1.9V**	**10ns**	**3.8A**
Competitor 1	≤1.9V	12ns	4.4A
Competitor 2	2.1V	13ns	3.8A

For PFC: BYC8-600P & BYC8X-600P have better specifications

Key Parameters (2)

Reverse Recovery Time (T_{rr}) waveform

V_R = 30V, dI_F/dt = 200A/us, I_F = 1A

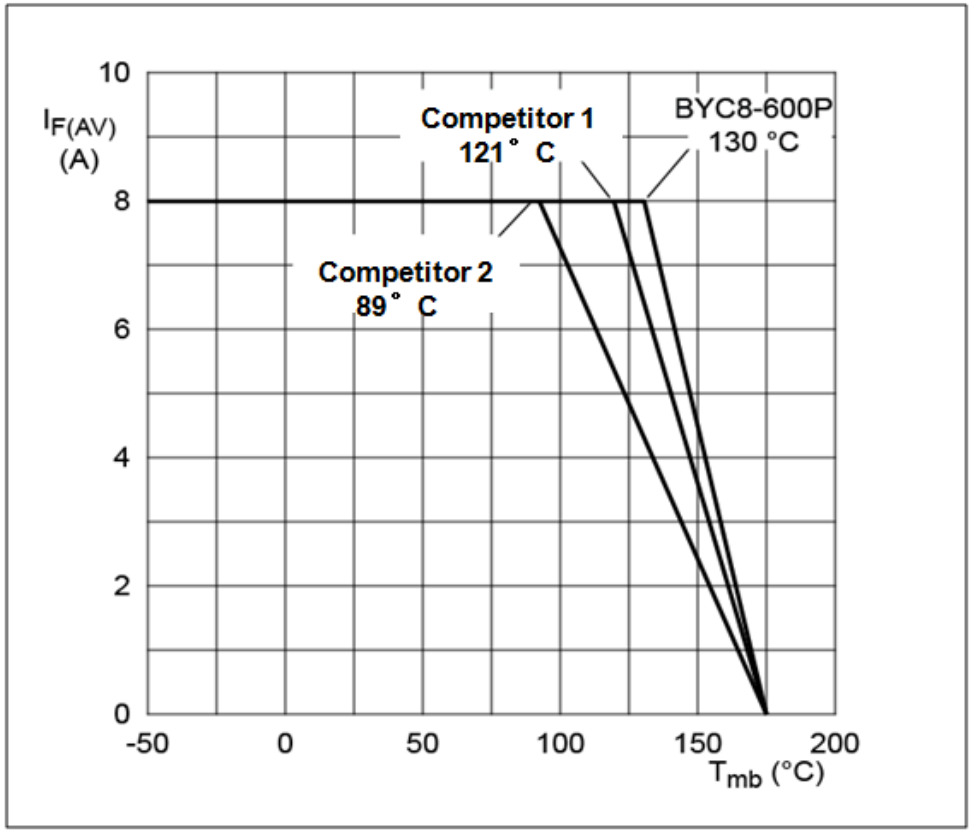


The faster the T_{rr} the lower the power dissipation in MOSFET

Competitive I_{RM}

Key Parameters (3)

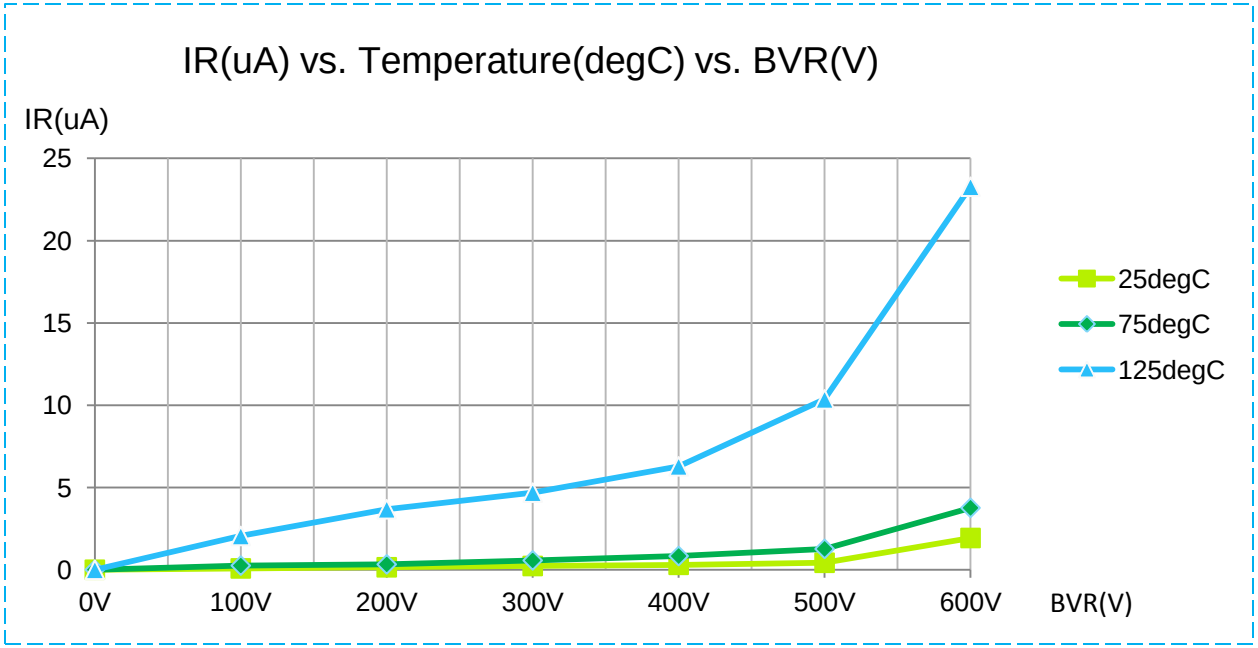
Forward Current Deration Curve vs. Temperature



According to the I_F deration curve, BYC8P-600 outperforms the other competitors.

Key Parameters (4)

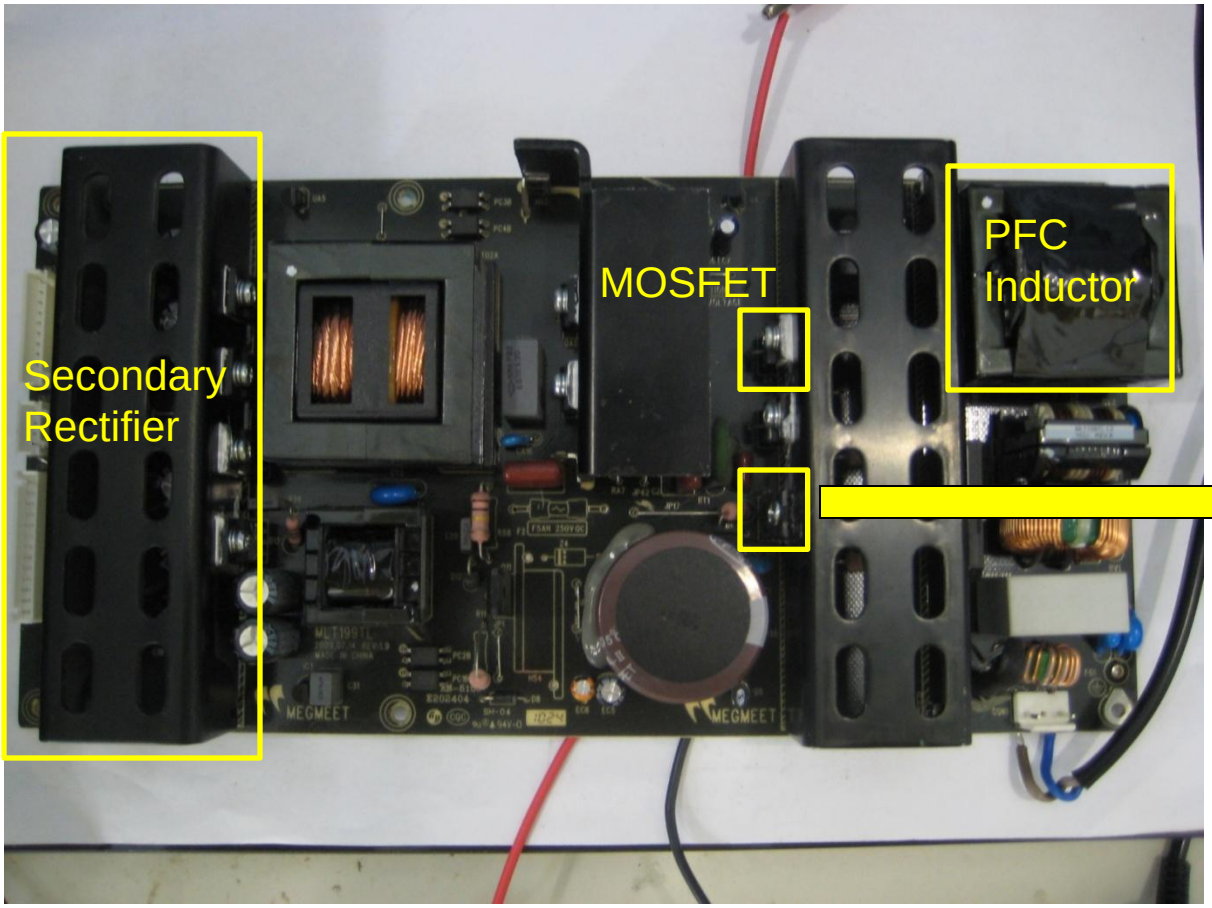
Leakage Current(uA) Curve vs. Temperature



Competitive leakage current

Benchmark Evaluation

MEGMEET LCD TV SMPS Practical layout

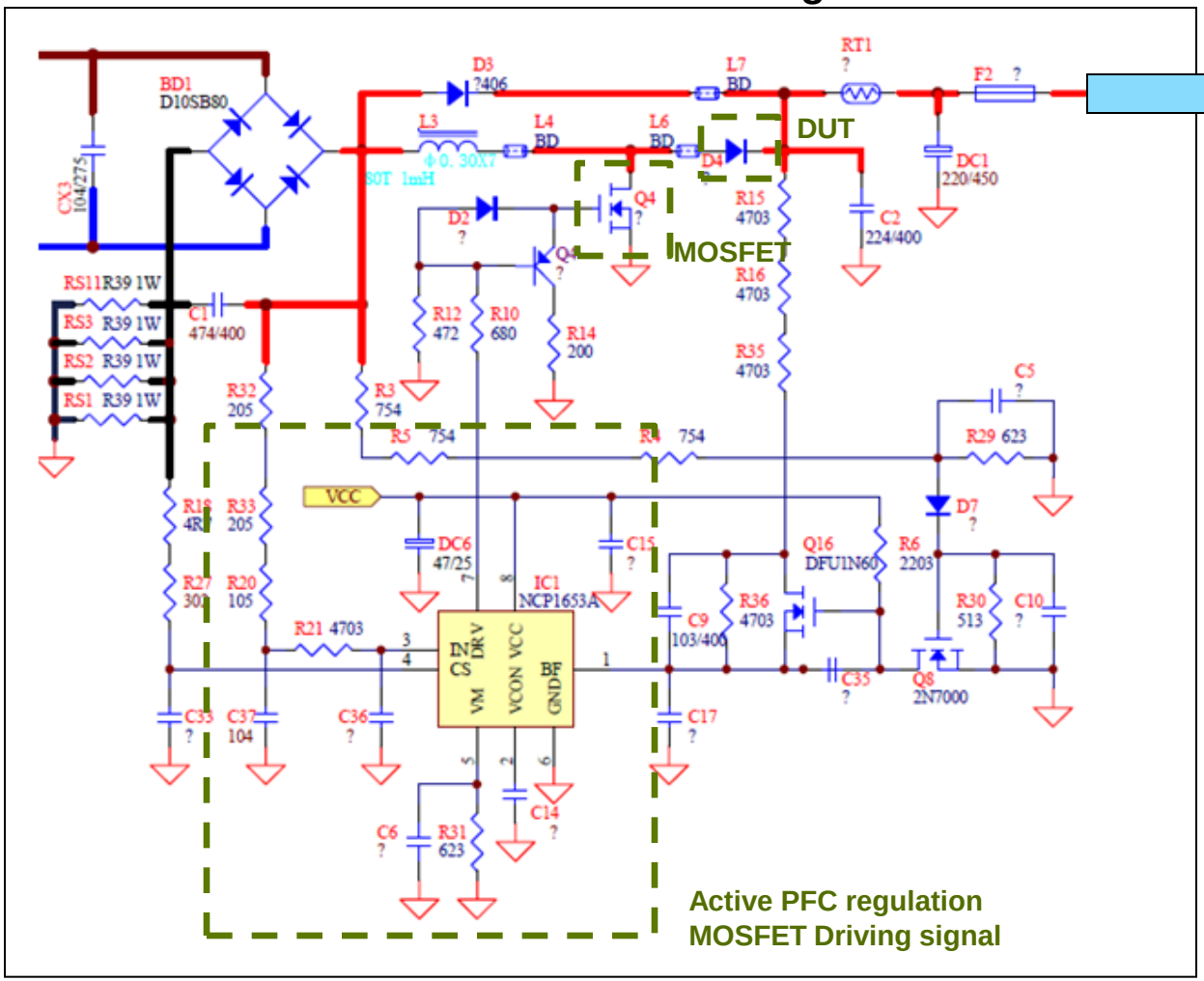


Device **U**nder **T**est

MEGMEET MLT198L
This product has the output power set at 200 Watts.

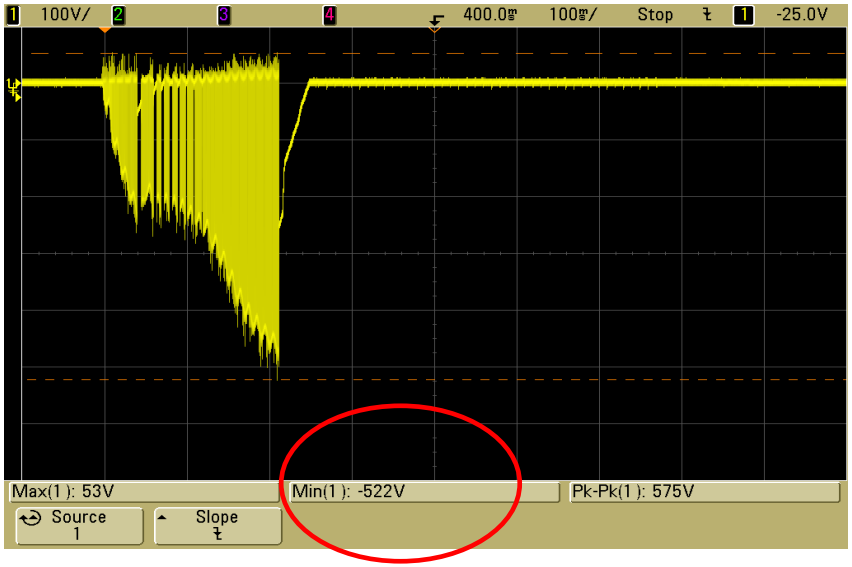
Benchmark Evaluation

MEGMEET LCD TV SMPS PFC Circuit Diagram

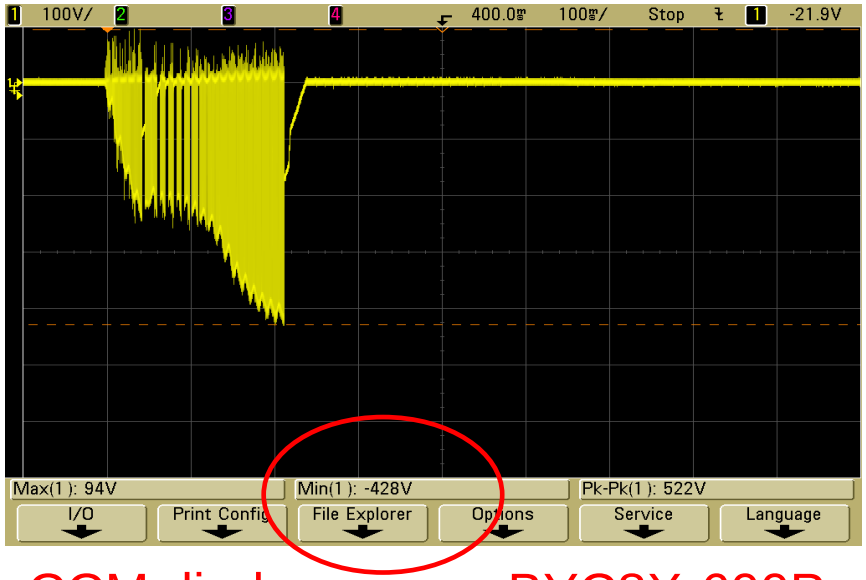


Connect to simulated electrical load

Reduced Peak Reverse Bias At Device Switch-On



DCM diode

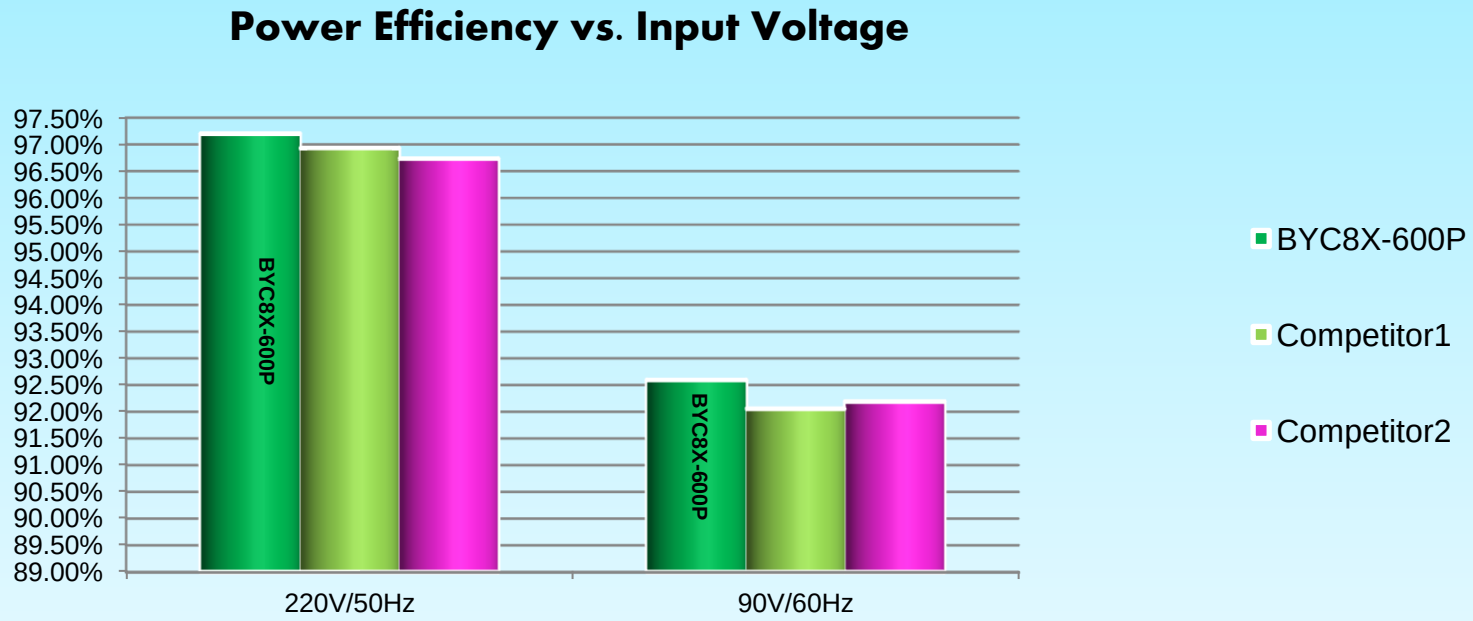


CCM diode

BYC8X-600P

A CCM diode has faster T_{rr} and achieves a lower peak reverse bias at switch-on than a DCM (slower T_{rr}) diode.

Superior Power Efficiency Performance

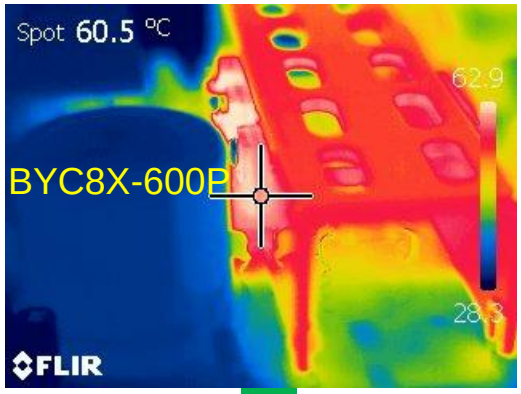


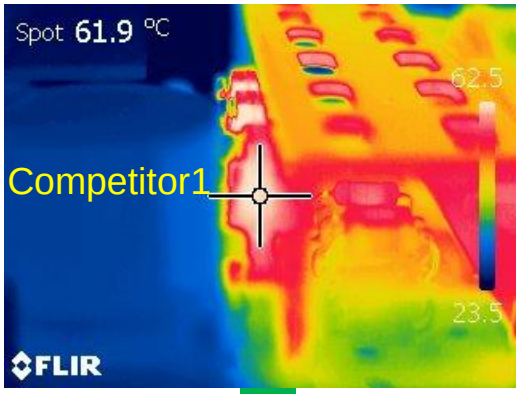
Max Output Load: 200W / 400V; Input voltages : 220V / 50Hz / 1A; 90V / 60Hz / 2.2A

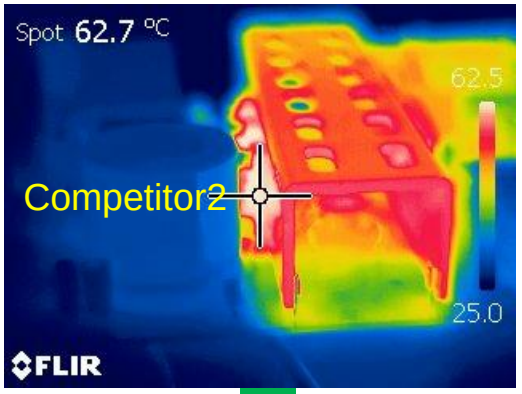
For PFC: BYC8-600P & BYC8X-600P always achieve better power efficiency performance

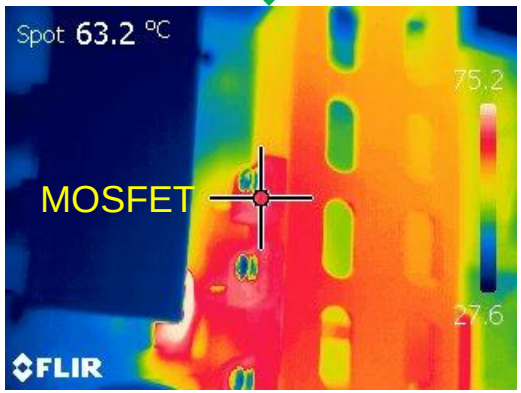
Competitive Thermal Performance

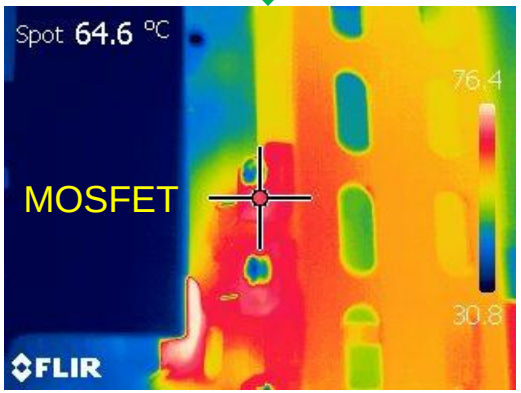
Test condition: Vin=90Vac, f=60Hz, Output power=200W.

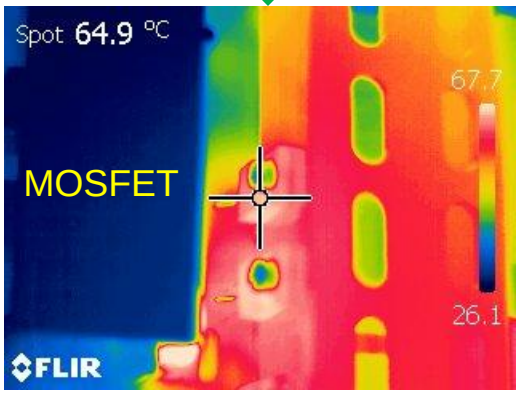












Thermal performance of BYC8(X)-600P is similar compared with competitors, even slightly better due to very competitive V_F-trr trade-off correlation and R_{th} parameter.

Datasheet

BYC8-600P
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BYC8X-600P
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THANK YOU