PHILIPS

# Bipolar-
# Diodes and Transistors for TV

2005-09-23

# Plasma/Plane TV

## Power

| AC/DC adaptor |
| --- |
| Power factor correction<br>**BYV29x-500/600;**<br>**BYC5/8/10x-600** |
| Standby MOSFET protection<br>**BY229-600; BY229X-600/800;** |
| Secondary rectification<br>**BYQ28E-200,BYQ28ED-200,**<br>**BYQ30E-200,BYQ40EW-200,**<br>**BYV32E-200,BYV32EB-200,BYV42E-200,**<br>**BYV42EB-200,BYV72EW-200,BYV79E-200**<br>**BYW29ED-200** |

# LCD TV/Monitor

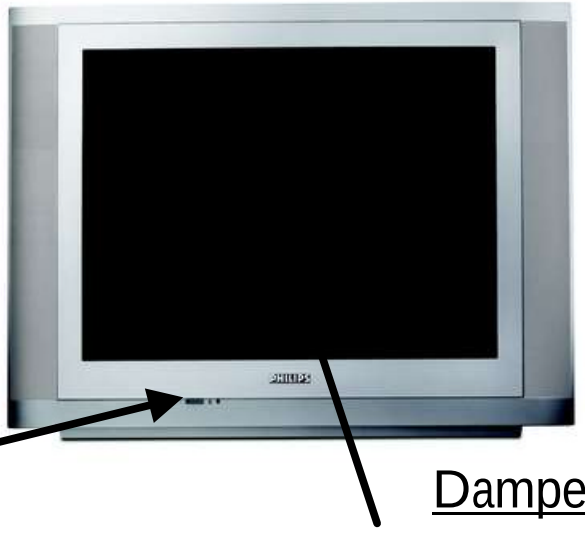
## Power

| AC/DC adaptor |
| --- |
| Power factor correction<br>**BYV29x-500/600;**<br>**BYC5/8/10x-600** |
| Standby MOSFET protection<br>**BY229-600; BY229X-600/800;** |
| Secondary rectification<br>**BYQ28E-200,BYQ28ED-200,**<br>**BYQ30E-200,BYQ40EW-200,**<br>**BYV32E-200,BYV32EB-200,BYV42E-200,**<br>**BYV42EB-200,BYV72EW-200,BYV79E-200**<br>**BYW29ED-200** |

# CRT TV/Monitor

## Power

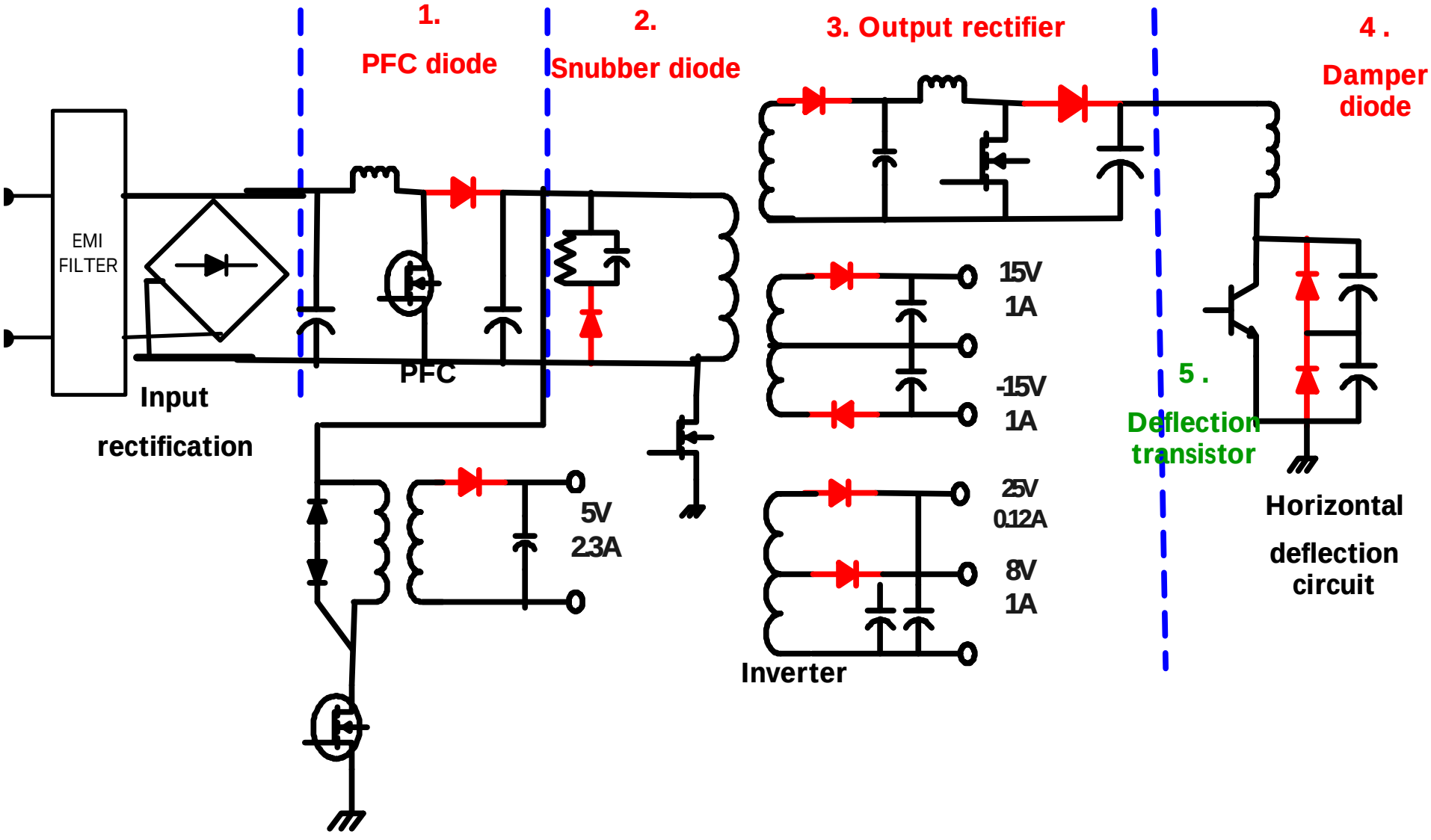
| AC/DC adaptor |
| --- |
| Power factor correction<br>**BYV29x-500/600;**<br>**BYC5/8/10x-600** |
| Standby MOSFET protection<br>**BY229-600; BY229X-600/800;** |
| Secondary rectification<br>**BYQ28E-200,BYQ28ED-200,**<br>**BYQ30E-200,BYQ40EW-200,**<br>**BYV32E-200,BYV32EB-200,BYV42E-200,**<br>**BYV42EB-200,BYV72EW-200,BYV79E-200**<br>**BYW29ED-200** |



Damper

| Monitor deflection | TV deflection |
| --- | --- |
| Damper and modulation<br>**BY329X-1500S,BY329X-1500**<br>**BY329X-1500S,BY329X-1500**<br>**BYM359X** | Damper and modulation<br>**BY329X-1500S,BY329X-1500**<br>**BY329X-1500S,BY329X-1500**<br>**BYM359X** |

# Bipolar in TV Power topology



# 1. PFC & Hyperfast recovery diodes:

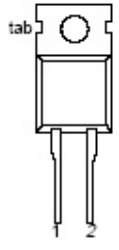
## (For Continuous Current Mode)

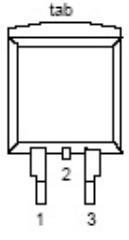
## BYC5/8/10-600; BYC5/8/10B-600;BYC10-600CT;BYC8/10X-600*

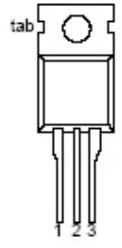
| Vrrm (V) | trr (ns) | Io(AV) (A) | Vf (V) | TO220AC (SOD59) | D2PAK (SOT404) | TO220AB (SOT78) | SOD113 (2-pin SOT186A) |
|---|---|---|---|---|---|---|---|
| 600 | 19 | 5 | 1.4 | BYC5-600 | BYC5B-600 | | |
| 600 | 19 | 8 | 1.4 | BYC8-600 | BYC8B-600 | | BYC8X-600* |
| 600 | 19 | 10 | 1.4 | BYC10-600 | BYC10B-600 | | BYC10X-600* |
| 600 | 19 | 2 x 5 | 1.4 | | | BYC10-600CT | |

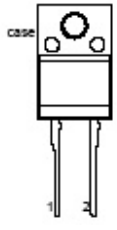
**Remark:**

**1.SOD113(TO-220F) is insulated package**



# 1. PFC & Ultrafast recovery diodes:

## (For Discontinuous Current Mode):

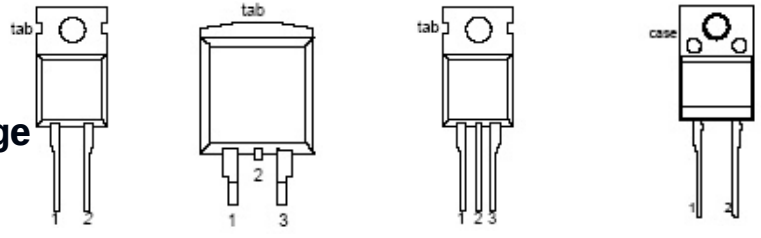
## BYV29x-500/600; BYT79/28-500;BYV34/44-500;BYV29-600*;

## BYT79/X-600*,BYV34/X-600*

| Vrrm (V) | trr (ns) | Io(AV) (A) | Vf (V) | TO220AC (SOD59) | D2PAK (SOT404) | TO220AB (SOT78) | SOD113 (2-pin SOT186A) | SOT186A (Insolated TO220) |
|---|---|---|---|---|---|---|---|---|
| 600 | 55 | 9 | 1 | BYV29-600* | BYV29B-600 | | BYV29X-600 | |
| 600 | 60 | 15 | 1.05 | BYT79-600* | | | BYT79X-600* | |
| 600 | 60 | 20 | 1.12 | | | BYV34-600* | | BYV34X-600* |
| 500 | 60 | 9 | 1.03 | BYV29-500 | | | BYV29X-500 | |
| 500 | 60 | 10 | 1.05 | | | BYT28-500 | | |
| 500 | 60 | 14 | 1.05 | BYT79-500 | | | | |
| 500 | 60 | 20 | 1.12 | | | BYV34-500 | | |
| 500 | 60 | 30 | 1.12 | | | BYV44-500 | | |

**Remark:**

**1.SOD113(TO-220F) is insolated package**



# 2. Fast Soft-Recovery Diodes(for snubber diodes):

- BY229X-200,BY229-600, BY229X-600/800;
- BY329-1000/1200,BY329X-1200

| Vrrm (V) | Io(AV) / If(AV) (A) | trr (ns) | SOD59 | SOD113 |
|---|---|---|---|---|
| 200 | 8 | 135 | | BY229X-200 |
| 600 | 8 | 135 | BY229-600 | BY229X-600 |
| 800 | 8 | 135 | | BY229X-800 |
| 1000 | 8 | 135 | BY329-1000 | |
| 1200 | 8 | 135 | BY329-1200 | BY329X-1200 |

# 3. Ultrafast Recovery Diodes (for snubber diodes and secondary rectifiers):

- BYW29xx-150/200;
- BYV32X-100/150/200, BYV42x-150/200, BYV72EW-200,
- BYQ28/30/40xx-200,
- BYT28-300

| Vrrm (V) | If(av) (A) | Vf (V) | If (A) | trr (ns) | DPAK (SOT428) | D2PAK (SOT404) | SOD113 (2-pin SOT186A) | SOD59 (TO220AC) | SOT186A (isolated TO220AB) | TO220AB (SOT78) | TO247 (SOT429) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 20 | 0.95 | 8 | 25 | | | | | | BYV32E-100 | |
| 150 | 8 | 0.895 | 8 | 25 | | | | BYW29E-150 | | | |
| 150 | 20 | 0.85 | 8 | 25 | | | | | | BYV32E-150 | |
| 150 | 30 | 0.85 | 15 | 28 | | | | | | BYV42E-150 | |
| 200 | 8 | 0.895 | 8 | 25 | BYW29ED-200 | | | BYW29E-200 | BYW29EX-200 | | |
| 200 | 10 | 0.895 | 5 | 25 | BYQ28ED-200 | | BYQ28X-200 | | | BYQ28E-200 | |
| 200 | 14 | 0.9 | 14 | 30 | | | | BYV79E-200 | | | |
| 200 | 16 | 0.95 | 8 | 25 | | | | | | BYQ30E-200 | |
| 200 | 20 | 0.85 | 8 | 25 | | BYV32EB-200 | | | | BYV32E-200 | |
| 200 | 30 | 0.82 | 15 | 28 | | | | | | | BYV72EW-200 |
| 200 | 30 | 0.85 | 15 | 28 | | | | | | BYV42E-200 | |
| 200 | 40 | 0.85 | 20 | 30 | | | | | | | BYQ40EW-200 |
| 300 | 10 | 1.05 | 5 | 60 | | | | | | BYT28-300 | |

# 3. Ultrafast Recovery Diodes (for snubber diodes and secondary rectifiers):

- BYV29x-400/500/600,BYV34-400/500,BYV44-500,
- BYT28-500, BYT79-500
- BYR29x-600/800;

| Vrrm (V) | If(av) (A) | Vf (V) | If (A) | trr (ns) | D2PAK (SOT404) | SOD113 (2-pin SOT186A) | SOD59 (TO220AC) | TO220AB (SOT78) |
|---|---|---|---|---|---|---|---|---|
| 400 | 9 | 1.03 | 8 | 60 | | | | BYV29-400 |
| 400 | 20 | 1.05 | 10 | 60 | | | | |
| 400 | 30 | 1.12 | 15 | 60 | | | | |
| 500 | 9 | 1.03 | 8 | 60 | | BYV29X-500 | BYV29-500 | |
| 500 | 10 | 1.05 | 5 | 60 | | | | BYT28-500 |
| 500 | 14 | 1.05 | 15 | 60 | | | BYT79-500 | |
| 500 | 20 | 1.05 | 10 | 60 | | | | BYV34-500 |
| 500 | 30 | 1.12 | 15 | 60 | | | | BYV44-500 |
| 600 | 8 | 1.5 | 8 | 75 | | BYR29X-600 | BYR29-600 | |
| 600 | 9 | 1 | 5 | 55 | BYV29B-600 | BYV29X-600 | | |
| 800 | 8 | 1.5 | 8 | 75 | | | BYR29-800 | |

# 4. Damper diodes:

## BY329/359/459x-1500, BYM357/358/359xx

| VRRM (V) | IF(av) (A) | VF (max) (V) | Vfr(typ) (A) | tfr(typ) (ns) | trr (max) (ns) | SOD113 (2-pin SOT186A) | SOD59 (TO220AC) | SOT186A 2-pin | SOT399 (TOP3D) |
|---|---|---|---|---|---|---|---|---|---|
| 1500 | 7 | 1.45 | 17 | 210 | 230 | BY329X-1500 | | | |
| 1500 | 7 | 1.6 | 23 | 220 | 160 | BY329X-1500S | BY329-1500S | | |
| 1500 | 10 | 1.5 | 11 | 280 | 600 | BY359X-1500 | BY359-1500 | | |
| 1500 | 10 | 2 | 17 | 280 | 350 | BY359X-1500S | | | |
| 1500 | 20 | 1.3 | 8 | 170 | 350 | BY459X-1500 | BY459-1500 | | |
| 1500 | 20 | 1.35 | 11 | 200 | 220 | BY459X-1500S | | | |
| 1500/600 | 60/70 | | | | | | | BYM357X | BYM357DX |
| 1500/600 | 60/70 | | | | | | | BYM358X | |
| 1500/800 | 60/70 | | | | | | | BYM359X | |
| 1500/800 | 60/70 | | | | | | | | BYM359DX |

# 5. Deflection transistors:

## BUT11APX--1000/1200, BU4506/07/08/15/22/25/30xx, BU2506/07/08/20/22/25/27/30/32xx, BU2720/25DX

| Vcesm (V) | Ic [SAT] (A) | tf [max] (us) | SOT186A (isolated TO220AB) | SOT199 | SOT399 (TOP3D) | TO247 (SOT429) |
|---|---|---|---|---|---|---|
| 1000 | 3 | 0.3 | BUT11APX | | | |
| 1200 | 2 | 0.3 | BUT11APX-1200 | | | |
| 1500 | 3 | 0.4 | BU4506DZ | | | |
| 1500 | 3 | 0.45 | | BU4506AF | BU4506AX | |
| 1500 | 3 | 0.5 | BU1506DX | BU2506DF | BU2506DX | |
| 1500 | 4 | 0.4 | | | BU4507DX | |
| 1500 | 4 | 0.45 | | | BU4507AX | |
| 1500 | 4 | 0.5 | BU1507AX | | BU2507AX | |
| 1500 | 4 | 0.5 | | | BU2507DX | |
| 1500 | 4.5 | 0.6 | BU1508AX | BU2508AF | BU2508AX | |
| 1500 | 4.5 | 0.6 | BU1508DX | BU2508DF | BU2508DX | |
| 1500 | 4.5 | 1 | | BU508AF | | BU508AW |
| 1500 | 4.5 | 1 | | BU508DF | | BU508DW |
| 1500 | 5 | 0.4 | BU4508DZ | BU4508DF | BU4508DX | |
| 1500 | 5 | 0.48 | | | BU4508AX | |

# 5. Deflection transistors:

## BUT11APX--1000/1200, BU4506/07/08/15/22/25/30xx, BU2506/07/08/20/22/25/27/30/32xx, BU2720/25DX

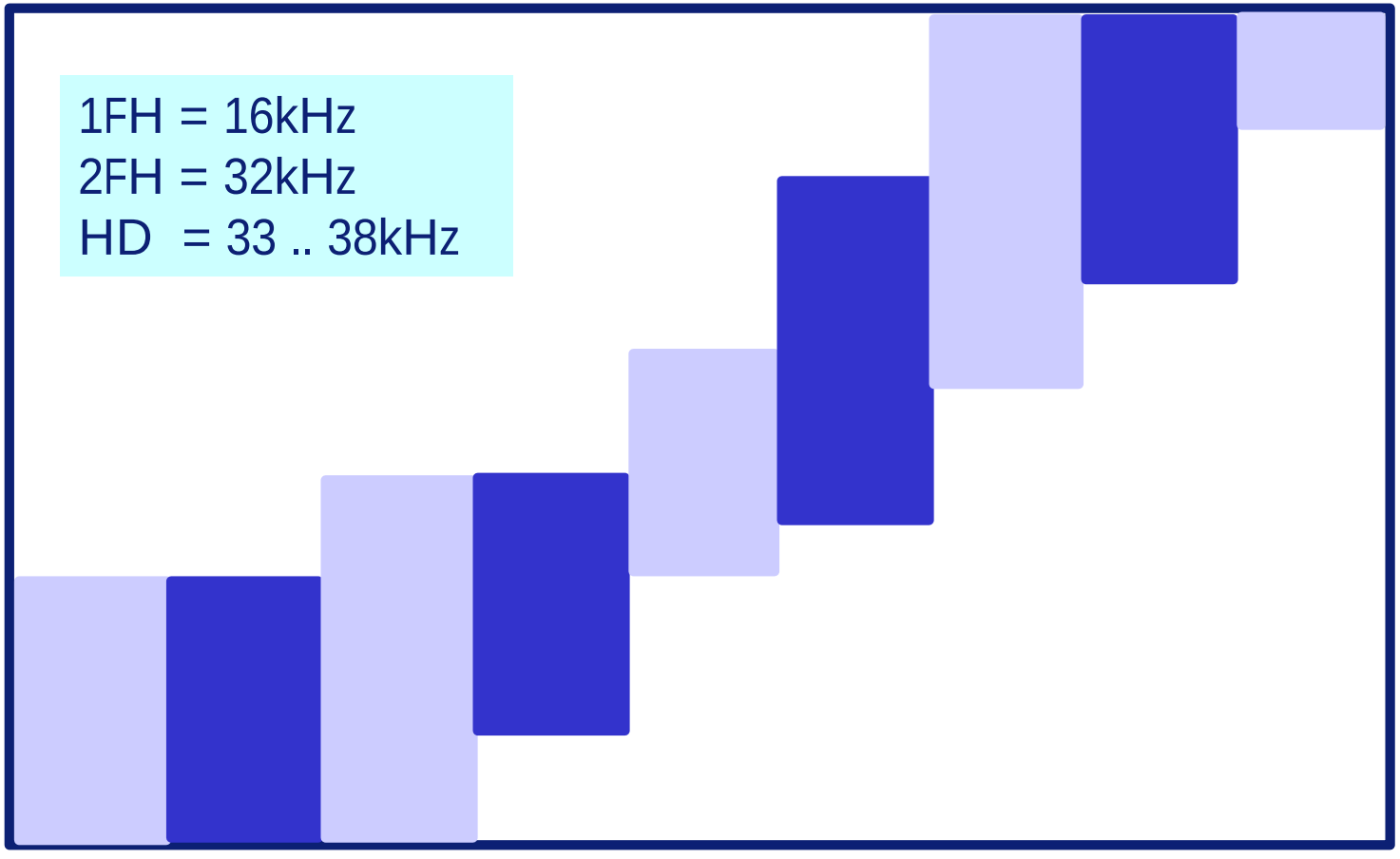
| Vcesm (V) | Ic [SAT] (A) | tf [max] (us) | SOT186A (isolated TO220AB) | SOT199 | SOT399 (TOP3D) | TO247 (SOT429) |
|---|---|---|---|---|---|---|
| 1500 | 6 | 0.5 | | BU4515AF | BU4515AX | |
| 1500 | 6 | 0.25 | | BU2522AF | BU2522AX | |
| 1500 | 6 | 0.5 | | BU2520AF | BU2520AX | |
| 1500 | 6 | 0.5 | | BU2520DF | BU2520DX | |
| 1500 | 7 | 0.4 | | BU4522AF | BU4522AX | |
| 1500 | 8 | 0.35 | | BU2525AF | BU2525AX | BU2525AW |
| 1500 | 8 | 0.35 | | | BU2525DX | |
| 1500 | 6 | 0.2 | | BU2527AF | BU2527AX | |
| 1500 | 6 | 0.2 | | | BU2527DX | |
| 1500 | 9 | 0.55 | | | BU4525AX | |
| 1500 | 7 | 0.1 | | | | BU2532AW |
| 1500 | 9 | 0.25 | | | | BU2530AW |
| 1500 | 10 | 0.4 | | | | BU4530AW |
| 1700 | 5.5 | 0.9 | | | BU2720DX | |
| 1700 | 7 | 0.8 | | | BU2725DX | |

# 5.Deflection transistors selection guide for CRT TV

36 "/ 110° / HD
28 "/ 110° / HD

36 "/ 110° / 2FH
32 "/ 110° / 2FH
29 "/ 110° / 2FH
28 "/ 110° / 2FH
25 "/ 110° / 2FH

28 "/ 110° / 1FH
25 "/ 110° / 1FH
21 "/ 90° / 1FH
20 "/ 90° / 1FH
17 "/ 90° / 1FH
15 "/ 90° / 1FH
14 "/ 90° / 1FH




BUT11APX-1200
BU2506
BU4506
BU1507
BU2507
BU4507
BU1508
BU2508
BU4508
BU508
BU4515
BU2520
BU4522
BU2525
BU4525
BU2530
BU4530
BU2532
BU4522

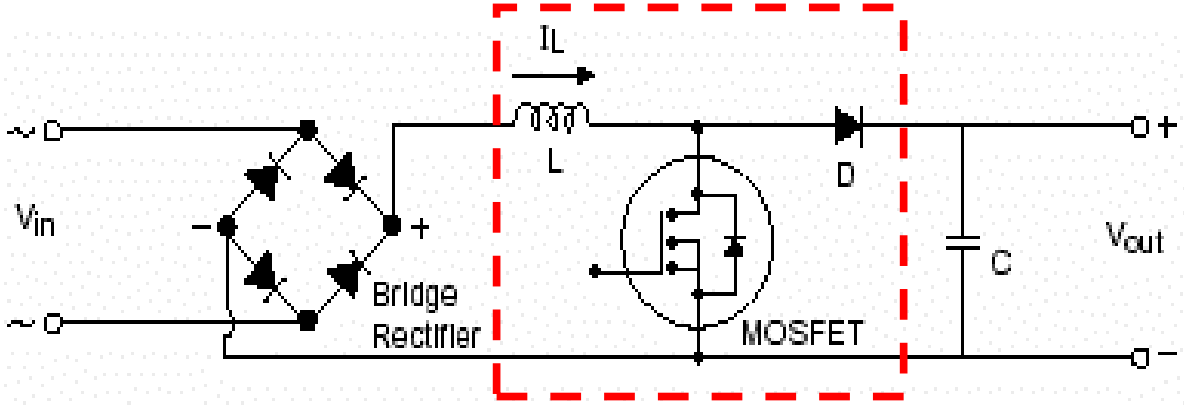
- **Appendix :**

  **PFC (Power Factor Correction)**

# What is PFC

■Power Factor Correction (PFC) can be defined as the reduction of the harmonic content, and/or the aligning of the phase angle of incoming current

■ PFC is necessary to reduce disturbance on AC distribution net and to maximize the real power drawn by the power supply from the AC line.




Boost APFC circuit

# PFC diodes in various applications

## Computer

desktop

file server

Notebook adaptor

## Consumer

adaptor

display

Plasma TV

LCD TV

CRT TV

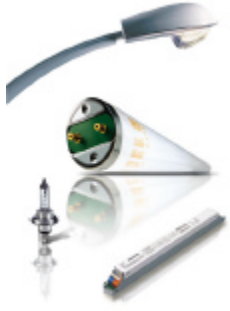
## Telecom (switching and terrestrial equipment)

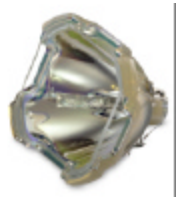
AC/DC converter

UPS

## Lighting

Ballast

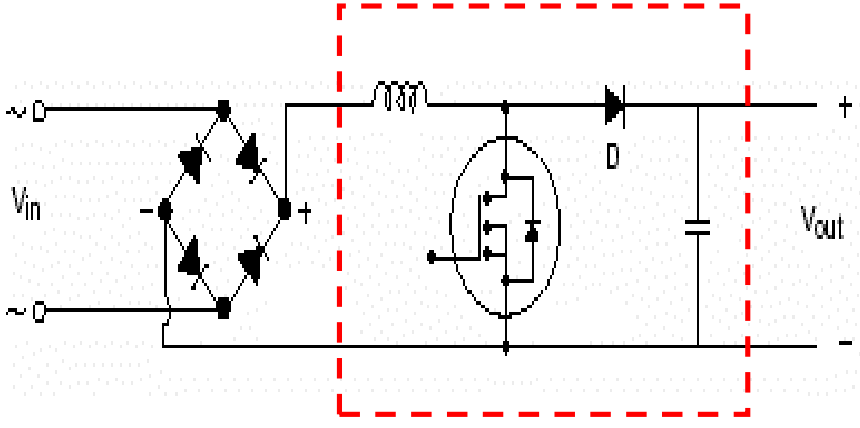




# Two PFC categories

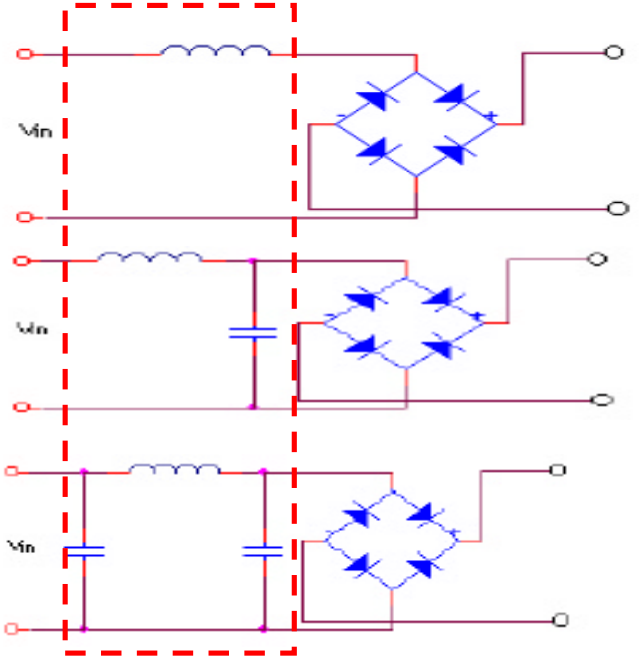
## Active PFC

- Composed of inductor, diode, capacitor and MOSFET
- PF>0.98
- Better reliability




## Passive PFC

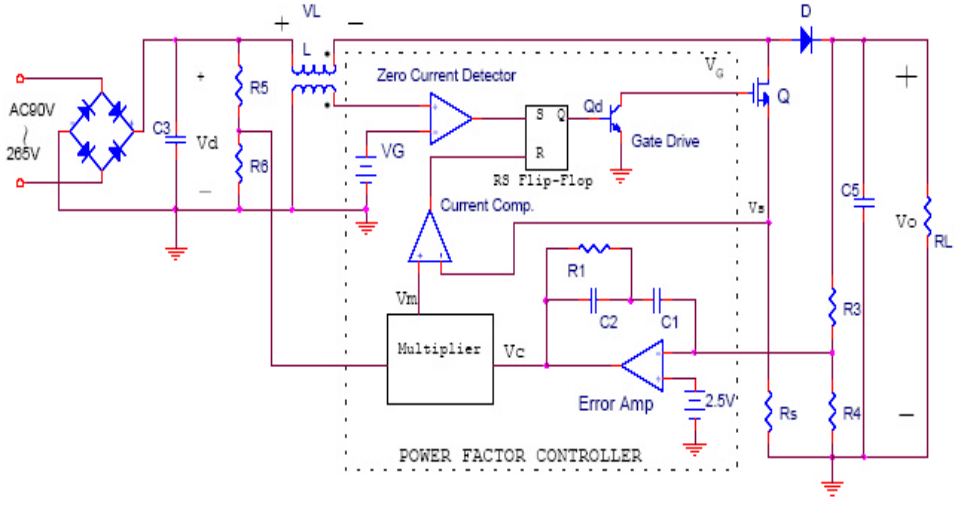
- Only composed of capacitor, inductor
- PF=0.7~0.8
- Worse reliability



# Two APFC categories

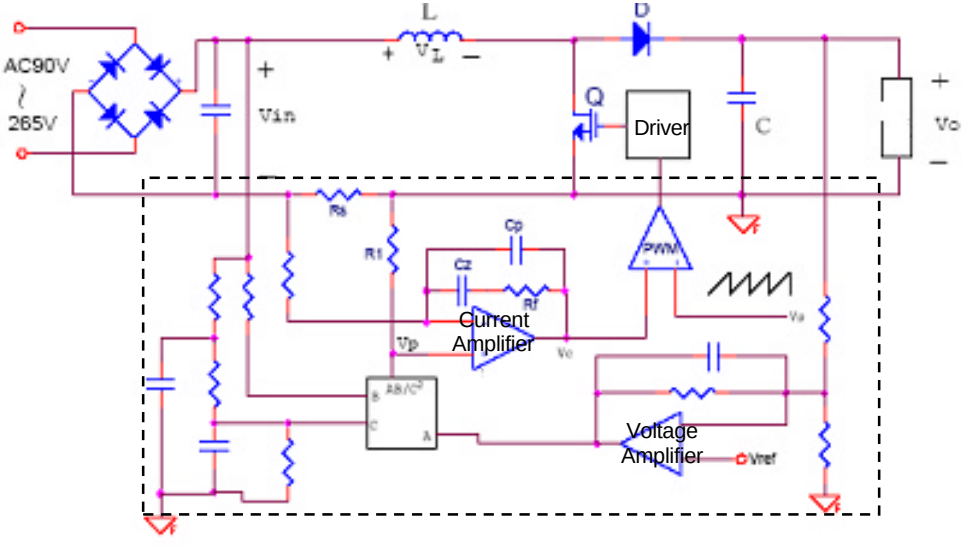
## Discontinuous Current Mode (DCM)

- 70W to around 200W
- PFC MOSFET is turned on only when the inductor current has reached zero.
- Lower Vf is preferred




## Continuous Current Mode (CCM)

- upwards from 200W~1000W
- PFC MOSFET is turned on when inductor current is still above zero and all reverse recovery energy is dissipated in the MOSFET.
- Smaller trr is preferred
- Better performance



# PFC basic concept

.

■Preal (real power available) = Vrms * Irms*(maximum power)* PF

PF (power factor)= $Cos\varphi \ / \sqrt{1+THD^2}$

where THD is the total harmonic distortion

and $\varphi$ is the phase shift between the voltage and the current.

■Two causes of power factor degradation

-Phase shift: caused by reactive inductive load (motor) or highly capacitive load( electroluminescent lighting)

-Distortion : caused by rectification into a capacitive filter , leading current spikes not to follow the input voltage waveform.

# AC line without PFC

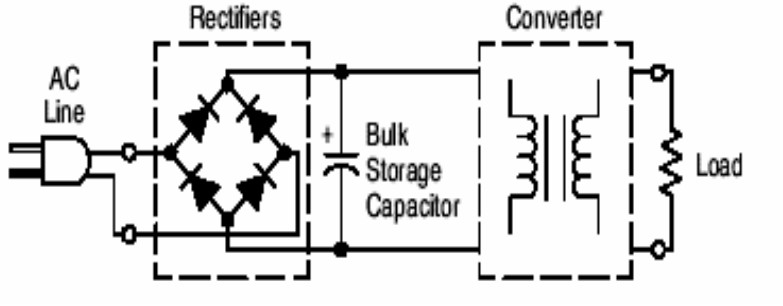
Most off-line appliances use a bridge rectifier associated to a huge bulk capacitor to derive raw dc voltage from the utility ac line.

**PF<1 and Preal<<Pmax**

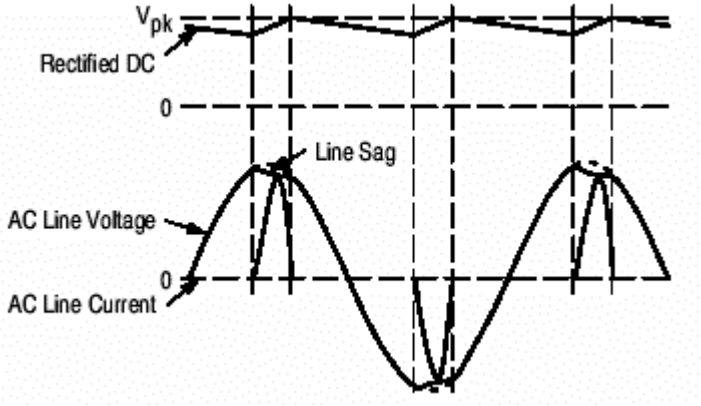
▪Disadvantages:
-results in a high harmonic content and in poor power factor ratios.

-results in a high charge current spike, excessive voltage drops in the wiring and imbalance problems in the three-phase power delivery utilized.

-a poor power factor (in the range of 0.5 - 0.6) means that only 50% to 60% of the maximum power is available.



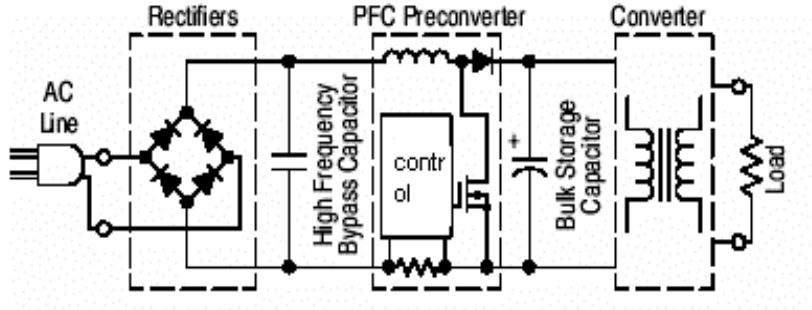

Typical circuit without PFC




Line waveform without PFC

# AC line with PFC

A boost converter placed after the bridge rectifier transforms a crest into a resistive load with a power factor equal 1 and a very low harmonic distortion.




AC line with PFC

**PF ≅1 and Preal ≅ Pmax**

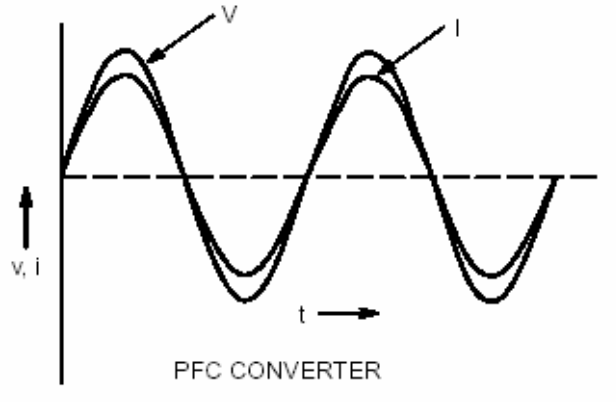
■Advantages:

-reduction of mains harmonic content

-reduction of peak current at mains frequency

-reduced Volt/Amp requested to the mains

-improvement of the output regulation of the downstream dc-dc converter




Line waveform with PFC

# Other benefits of PFC

1.Comply with regulation

Regulation such as IEC1000-3-2/EN61000-3-2 in Europe; JICC61000-3-2 and CCC in China and "80plus policy "in America impose restrictions on power factor and total harmonic distortion(THD) of high-power application like off-line power supplies

2. Optimize and compact circuit

–reduction of the electrolytic bulk capacitor used at PFC stage output

–reduced mains transformer size and weight

# Other benefits of PFC

3. Meet the trend of energy saving and green energy and also save electricity bill

For example

■ If the total user with PF below 80% is about 1.3billion and each person consumes one killowatt-hour electricity per day, when PF improve from 80% to 95%, electricity loss can be reduced by 0.25billion kWh per day

■ If PF is improve from 70% to 90%, the electricity bill will be reduced by 20% per month

# Why Philips PFC diodes ?

PFC diodes benefits

- World's fastest reverse recovery enable a high PFC frequency (up to 200 kHz)
- Ultrafast switching to minimise turn-off switch losses
- Low forward recovery voltage to minimise turn-on switch losses
- Minimised Vf to keep conduction losses as low as possible
- Excellent soft recovery characteristics minimise power-consuming oscillations
- High maximum junction temperature makes product suitable for operating at high temperature


PHILIPS