



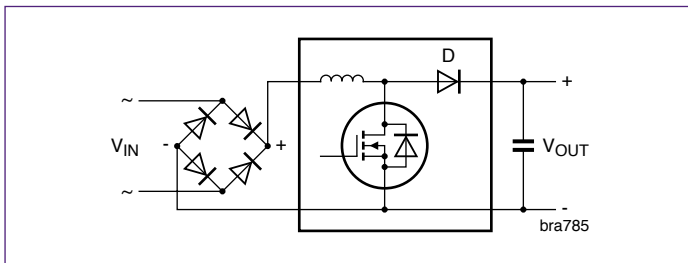
Bipolar power diodes and transistors for electronic ballast

Understanding PFC - Lighting applications

What is Power Factor Correction (PFC)

- ▶ It can be defined as the reduction of the harmonic content, and / or the aligning of the phase angle of incoming current
- ▶ PFC is required to reduce disturbance on the AC distribution net and maximize the real power drawn by the power supply from the AC line.

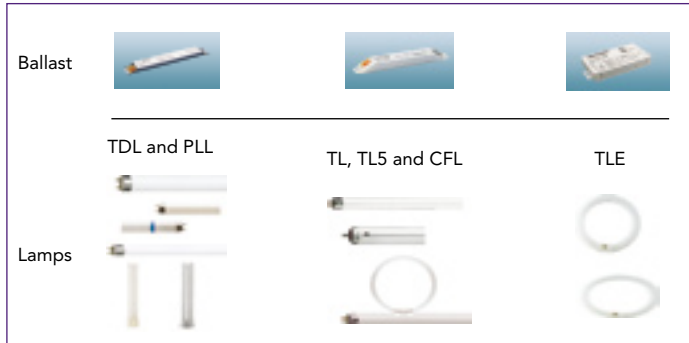
Boost PFC circuit



PFC benefits

- ▶ Fully compliant with regional regulations imposing restrictions on power factor and total harmonic distortion (THD) in high-power applications (>75W), including:
 - CCC or '3'C in China
 - IEC1000-3-2/EN61000-3-2 in Europe
 - '80plus policy' in America
 - JICC61000-3-2 in Japan
- ▶ Meets energy saving and 'green energy' trends to reduce electricity costs
- ▶ Optimizes and improves circuit performance
 - reduces mains harmonic content
 - decreases peak current at mains frequency
 - minimizes the electrolytic bulk capacitor used at PFC stage output
 - shrinks mains transformer size and weight
 - improves output regulation of downstream DC/DC converters

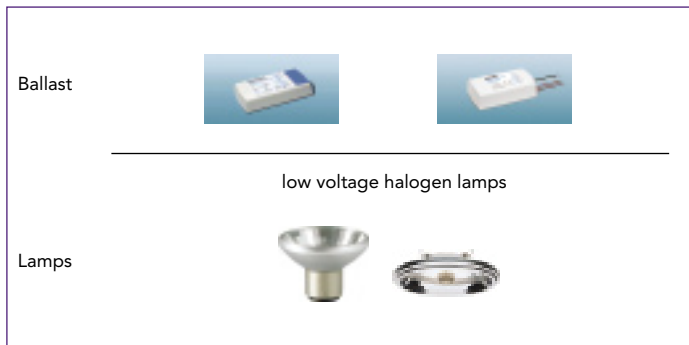
Electronic ballast for fluorescent lamps



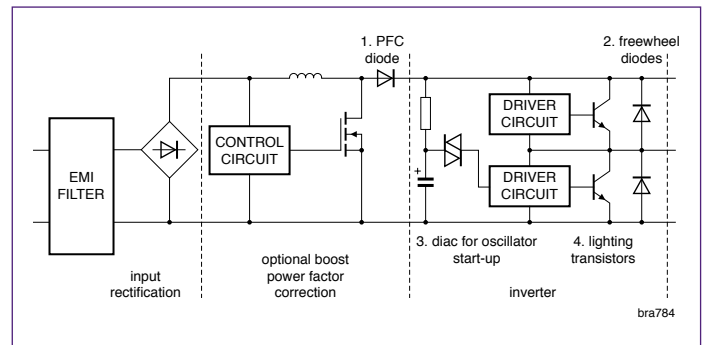
Electronic ballast for high intensity discharge lamps



Electronic ballast for halogen lamps



Consumer: TV display



Hyperfast & Ultrafast recovery diodes for PFC

| V_{RRM} (V) | IF(AV) (A) | t_{rr} (typ) @25 °C (V) | VF(typ) @150 °C (V) | D2PAK (SOT404) | TO220AC (SOD59) | TO220AB (SOT78) | SOD113 (2-pin SOT186A) | SOT186A (Isolated TO220AB) |
|---|---------------|---------------------------------|---------------------------|-------------------|--------------------|--------------------|------------------------------|----------------------------------|
| Hyperfast for Continuous Current Mode | | | | | | | | |
| 600 | 5 | 19 | 1.4 | BYC5B-600 | BYC5-600 | | BYC5X-600 | |
| 600 | 8 | 19 | 1.4 | BYC8B-600 | BYC8-600 | | BYC8X-600 | |
| 600 | 10 | 19 | 1.4 | BYC10B-600 | BYC10-600 | | BYC10X-600 | |
| 600 | 2x5 | 19 | 1.4 | | | BYC10-600CT | | |
| Ultrafast for Discontinuous or Critical Current Mode | | | | | | | | |
| 600 | 9 | 55 | 1 | BYV29B-600 | BYV29-600 | | BYV29X-600 | |
| 600 | 15 | 60 | 1.05 | | BYT79-600 | | BYT79X-600 | |
| 600 | 2x10 | 60 | 1.12 | | | BYV34-600 | | BYV34X-600 |
| 500 | 9 | 60 | 1.03 | | BYV29-500 | | BYV29X-500 | |
| 500 | 2x5 | 60 | 1.05 | | | BYV28-500 | | |
| 500 | 14 | 60 | 1.05 | | BYT79-500 | | | |
| 500 | 2x10 | 60 | 1.12 | | | BYV34-500 | | |
| 500 | 2x15 | 60 | 1.12 | | | BYV44-500 | | |

Diac for oscillator start-up

| $I_{(RM)}$ (A) | $V_{(BO)}$ (V) | $I_{(EO) max}$ (μ A) | SOD27 |
|-------------------|-------------------|------------------------------|----------|
| 2 | 28~36 | 50 | BR100/03 |

Ultrafast recovery diodes (for freewheel diodes and output rectifiers)

| V _{RRM} (V) | IF(AV) (A) | VF (V) | IF (A) | t _{rr} (ns) | DKPAK (SOT428) | D2PAK (SOT404) | SOD113 (2-pin SOT186A) | SOD59 (TO220AC) | SOT186A (Isolated TO220AB) | TO220AB (SOT78) | TO247 (SOT429) |
|-------------------------|---------------|-----------|-----------|-------------------------|-------------------|-------------------|------------------------------|--------------------|----------------------------------|--------------------|-------------------|
| 100 | 2x10 | 0.95 | 8 | 25 | | | | | | BYV32E-100 | |
| 150 | 8 | 0.895 | 8 | 25 | | | | BYW29E-150 | | | |
| 150 | 2x10 | 0.85 | 8 | 25 | | | | | | BYV32E-150 | |
| 150 | 2x15 | 0.85 | 15 | 28 | | | | | | BYV42E-150 | |
| 200 | 8 | 0.895 | 8 | 25 | BYW29ED-200 | | BYW29EX-200 | BYW29E-200 | | | |
| 200 | 2x5 | 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 | 2x10 | 0.85 | 8 | 25 | | BYV32EB-200 | | | | BYV32E-200 | |
| 200 | 2x15 | 0.82 | 15 | 28 | | | | | | | BYV72EW-200 |
| 200 | 2x15 | 0.85 | 15 | 28 | | | | | | BYV42E-200 | |
| 200 | 2x20 | 0.85 | 20 | 30 | | | | | | | BYQ40EW-200 |
| 300 | 2x5 | 1.05 | 5 | 60 | | | | | | BYT28-300 | |
| 400 | 9 | 1.03 | 8 | 60 | | | | BYV29-400 | | | |
| 400 | 2x10 | 1.05 | 10 | 60 | | | | | | | |
| 400 | 2x15 | 1.12 | 15 | 60 | | | | | | | |
| 500 | 9 | 1.03 | 8 | 60 | | | BYV29X-500 | BYV29-500 | | | |
| 500 | 2x5 | 1.05 | 5 | 60 | | | | | | BYT28-500 | |
| 500 | 14 | 1.05 | 15 | 60 | | | | BYT79-500 | | | |
| 500 | 2x10 | 1.05 | 10 | 60 | | | | | | BYV34-500 | |
| 500 | 2x15 | 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 | | | | |
| 600 | 2x10 | 1.12 | | 60 | | | | | BYV34X-600 | BYV34-600 | |
| 600 | 15 | 1.05 | | 60 | | | BYT79X-600 | BYT79-600 | | | |
| 800 | 8 | 1.5 | 8 | 75 | | | | BYR29-800 | | | |

Lighting transistors

| V _{CESM} (V) | IC(DC) (A) | IC (sat) (A) | t _f (max) (µs) | SOT82 | TO220AB (SOT78) | SOT186A (isolated TO220AB) | TO92 (SOT54) | D2-PAK (SOT404) | D-PAK (SOT 428) |
|--------------------------|---------------|--------------------|---------------------------------|--------|--------------------|----------------------------------|-----------------|--------------------|--------------------|
| 700 | 1 | 0.5 | 0.05 | | | | BUJ100 | | |
| 700 | 1 | 0.5 | 0.05 | | | | | | |
| 700 | 4 | 3 | 0.033 | | BUJ103A | BUJ103AX | | | BUJ103AD |
| 700 | 4 | 2 | 0.16 | | PHE13005 | | | | |
| 700 | 8 | 4 | 0.045 | | BUJ105A | | | BUJ105AB | BUJ105AD |
| 700 | 8 | 5 | 0.04 | | PHE13007 | | | | |
| 700 | 10 | 6 | 0.05 | | BUJ106A | | | | |
| 700 | 12 | 6 | 0.15 | | PHE13009 | | | | |
| 800 | 0.5 | | 0.28 | BUX86P | | | | | |
| 1000 | 0.5 | | 0.28 | BUX87P | | | | | |
| 1000 | 2 | 1 | 0.4 | | BUX85 | | | | |
| 1000 | 5 | 2.5 | 0.8 | | BUT11A | BUT11AX | | | |
| 1000 | 5 | 2.5 | 0.8 | | BUT11AI | | | | |
| 1000 | 5 | 3 | 0.145 | | BUJ303A | | | | |
| 1000 | 6 | 4 | 0.03 | | | | | | |
| 1000 | 6 | 4 | 0.8 | | BUT18A | | | | |
| 1000 | 8 | 5 | 0.8 | | | BUT12AX | | | |
| 1000 | 8 | 5 | 0.8 | | BUT12AI | | | | |
| 1050 | 5 | 3 | 0.45 | | BUJ303B | | | | |
| 1200 | 6 | 2 | 0.17 | | BUJ403A | | | | |

Lighting transistor selection guide

| Topology | | Voltage fed push pull | | Current fed push pull | | Current fed half bridge | | Voltage fed half bridge | |
|-------------|---------|-----------------------|------|-----------------------|---------|-------------------------|----------|-------------------------|------|
| A.C. Supply | 120V | BUJ100 | 25W | BUX87P | 13W | BUJ100 | 20W | BUJ100 | 13W |
| | | | | BUX85 | 55W | | | | |
| | | BUT11AI | 80W | BUT11A | 140W | BUT11AI | 70W | BUT11AI | 40W |
| | | PHE13005 | 100W | BUT11AI | 140W | PHE13005 | 80W | PHE13005 | 50W |
| | | BUJ103A | 110W | BUT11AX | 140W | BUJ103A | 90W | BUJ103A | 55W |
| | | BUT12AI | 120W | BUT18A | 160W | BUT12AI | 100W | BUT12AI | 60W |
| | | PHE13007 | 170W | BUJ303A | 170W | PHE13007 | 135W | PHE13007 | 85W |
| | | BUJ105A | 180W | BUJ303B | 170W | BUJ105A | 145W | BUJ105A | 90W |
| | | BUJ105AB | 180W | BUT12AI | 220W | BUJ105AB | 145W | BUJ105AB | 90W |
| | | PHE13009 | 210W | BUT12AX | 220W | PHE13009 | 165W | PHE13009 | 105W |
| | BUJ106A | 220W | | | BUJ106A | 175W | BUJ106A | 110W | |
| | BUJ403A | 215W | | | BUX87P | 13W | BUJ100 | 25W | |
| | | | | | BUX85 | 55W | BUJ100B | 25W | |
| | | | | | BUT11A | 140W | BUT11AI | 80W | |
| | | | | | BUT11AI | 140W | PHE13005 | 100W | |
| | | | | | BUT11AX | 140W | BUJ103A | 110W | |
| | | | | | BUT18A | 160W | BUT12AI | 120W | |
| | | | | | BUJ303A | 170W | PHE13007 | 170W | |
| | | | | | BUJ303B | 170W | BUJ105A | 180W | |
| | | | | | BUT12AI | 220W | BUJ105AB | 180W | |
| | | | | BUT12AX | 220W | PHE13009 | 210W | | |
| | | | | | | BUJ106A | 220W | | |

Bipolar diodes in various PFC power applications

| Computer | Consumer | Telecom | Lighting |
|--|--|------------------------|----------|
| Desktop File server Notebook adapter | Adapter Plasma TV LCD TV CRT TV | AC/DC converter UPS | Ballast |



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