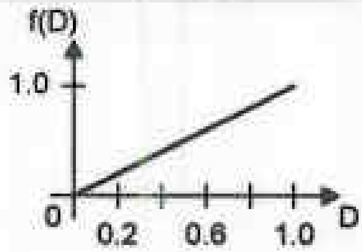
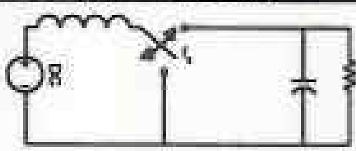
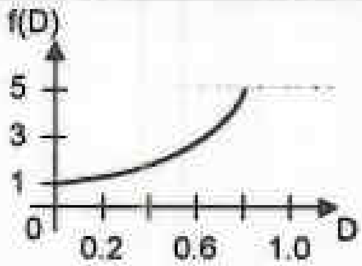
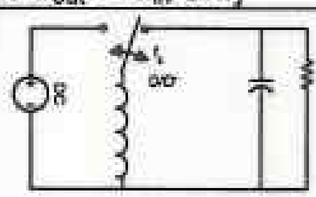
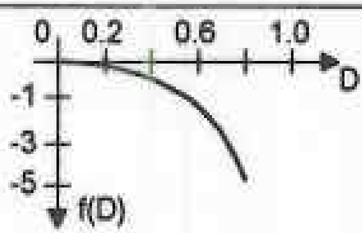
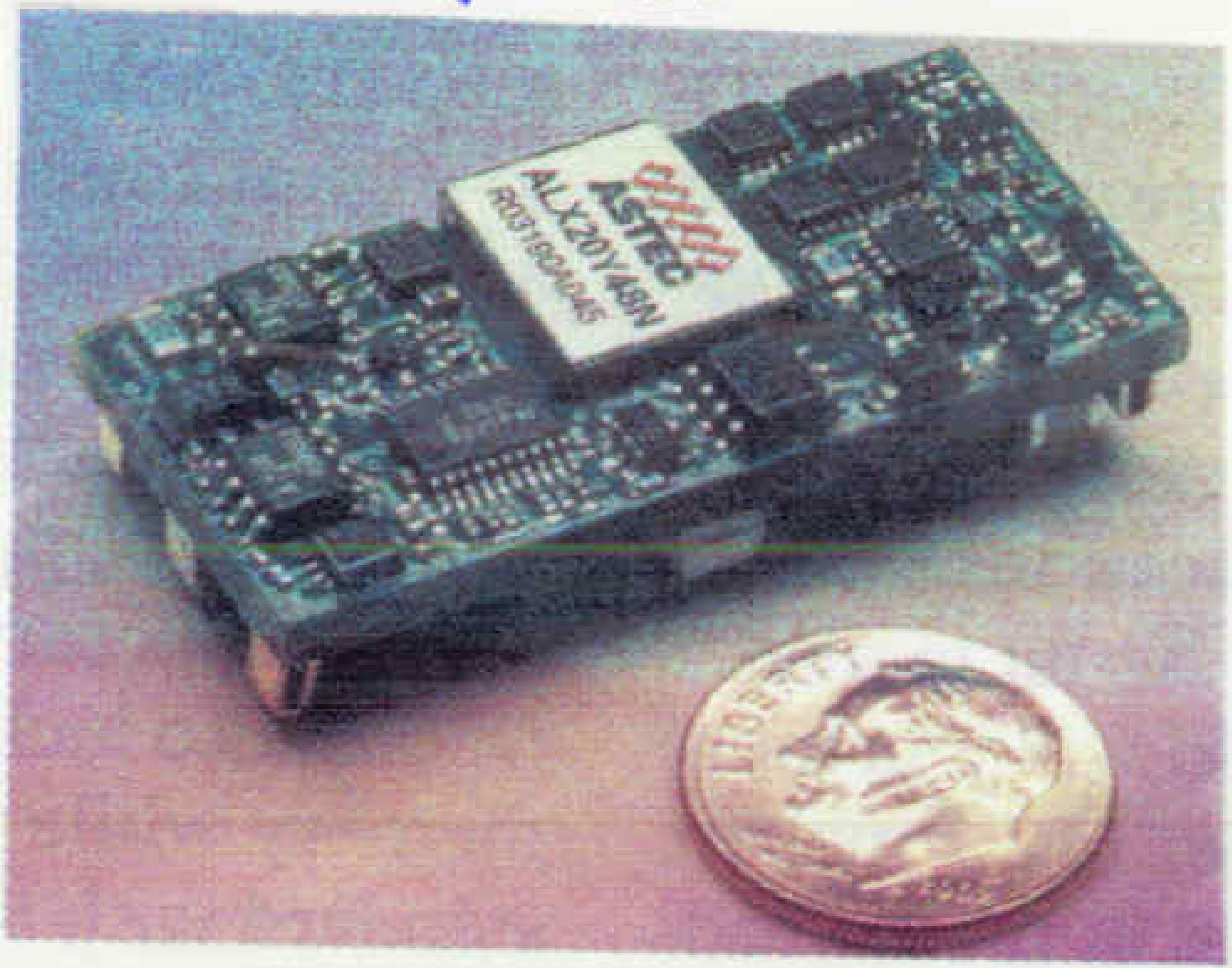
L2

SIMPLE SWITCH MODE CONVERTERS

 BUCK The buck is limited in that $V_{out} < V_{in}$ only		$V_L = V_o$ or $V_{DC} - V_o$ •$f(D) = D$ •Never get negative output •$V_o(min) = 0$
 BOOST The boost is limited in that $V_{out} > V_{in}$ only		•$f(D) = 1/(1-D)$ •Never get zero output: $V_o(min) \neq 0$ $V_L = V_{DC} - V_o$ or V_o
 BUCK-BOOST The buck-boost is limited to negative voltages		•$f(D) = -D/(1-D)$ •Inverting output w.r.t. V_g $V_L = V_o = -V_{DC}$ for $D = ½$

4. UNSYMMETRIC i_L AND v_C WAVEFORMS OF EQUAL INTEGRATED AREA IN THE ABOVE THREE CONVERTERS

Paper #1 Astec



ALX series provides up to 20 A and 50 W for datacom and wireless apps.

Examples

1. Find the de Broglie wavelength of the following particles:
(i) an electron in a semiconductor having average thermal velocity at $T = 300$ K and an effective mass of $m_e^* = 0{\cdot}1m_0$,
(ii) a helium atom having thermal energy at $T = 300$ K,
(iii) an α-particle (He^4 nucleus) of kinetic energy 10 MeV.
2. A typical operating voltage of an electron microscope is 50 kV.
(i) What is the smallest distance that it could possibly resolve?
(ii) What energy of neutrons could achieve the same resolution?
(iii) What are the main factors determining the actual resolution of an electron microscope?
3. Electrons accelerated by a potential of 70 V are incident perpendicularly on the surface of a single crystal metal. The crystal planes are parallel to the metal surface and have a (cubic) lattice spacing of 0·252 nm. Sketch how the intensity of the scattered electron beam would vary with angle.
4. A beam of electrons of 10 keV energy passes perpendicularly through a very thin (of the order of a few nanometres) foil of our previous single crystal metal. Determine the diffraction pattern obtained on a photographic plate placed 0·1 m behind the specimen. How will the diffraction pattern be modified for a polycrystalline specimen? (Hint: Treat the lattice as a two dimensional array.)
5. Consider again an electron beam incident upon a thin metal foil but look upon the electrons as particles having a certain kinetic energy. In experiments with aluminium foils (J. Geiger and K. Wittmaack, *Zeitschrift für Physik*, 195, 44, 1966) it was found that a certain fraction of the electrons passing through the metal had a loss of energy of 14·97 eV. We could explain this loss as being the creation of a particle of that much energy. But what particle? It cannot be a photon (a transverse electromagnetic wave in the wave picture) because an electron in motion sets up no transverse waves. It must be a particle that responds to a longitudinal electric field. So it might be a plasma wave of frequency ω_p which we could call a 'plasmon' in the particle picture. The energy of this particle would be $\hbar\omega_p$.

Calculate the value of $\hbar\omega_p$ for aluminium assuming three free electrons per atom. Compare it with the characteristic energy loss found.

The density of aluminium is 2700 kg/m³ and its atomic weight is 27.

3. The electron

That's how $\hbar$ is, said Pooh.

A. A. MILNE *When we were six*

3.1. Introduction

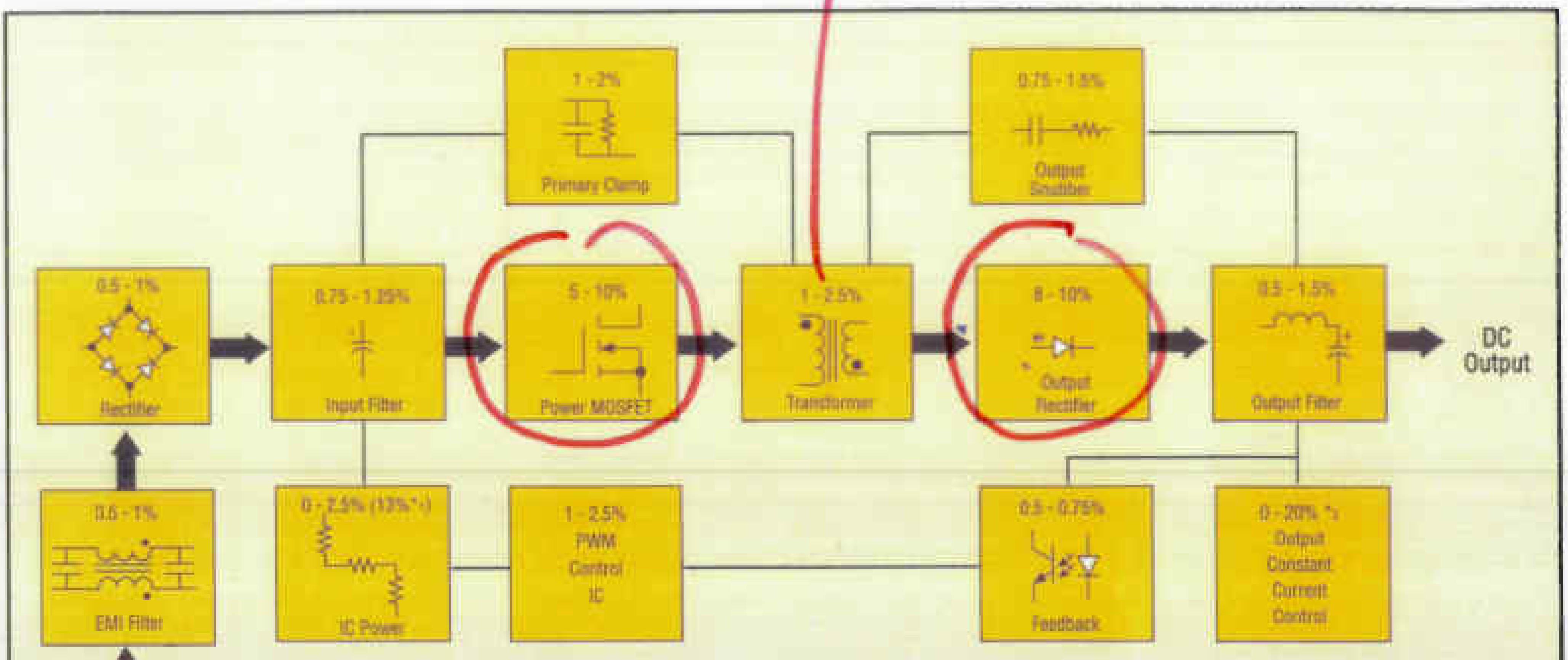
WE have seen that some experimental results can be explained if we regard the electron as a particle, whereas the explanation of some other experiments is possible only if we look upon our electron as a wave. Now which is it? Is it a particle or is it a wave? It is neither, it is an electron.

An electron is an electron; this seems a somewhat tautological definition. What does it mean? I want to say by this that we don't have to regard the electron as something else, something we are already familiar with. It helps, of course, to know that the electron sometimes behaves as a particle because we have some intuitive idea of what particles are supposed to do. It is helpful to know that the electron may behave as a wave because we know a lot about waves. But we don't have to look at the electron as something else. It is sufficient to say that an electron is an electron as long as we have some means of predicting its properties.

How can we predict what an electron will do? Well, how can we predict any physical phenomena? We need some mathematical relationship between the variables. Prediction and mathematics are intimately connected in science—or are they? Can we make predictions without any mathematics at all? We can. Seeing, for example, dark heavy clouds gathering in the sky we may say that 'it's going to rain' and on a large number of occasions we'll be right. But this is not really a very profound and accurate prediction. We are unable to specify *how* dark the clouds should be for a certain amount of rain, and we would find it hard to guess the temporal variation of the positions of the clouds. So, as you know very well, meteorology is not yet an exact science.

In physics fairly good predictions are needed because otherwise it is difficult to get further money for research. In engineering the importance of predictions can hardly be overestimated. If the designer of a bridge or of a telephone exchange makes some wrong predictions, this mistake may bring upon him the full legal apparatus of the state

? * smaller than 60 Hz Trf

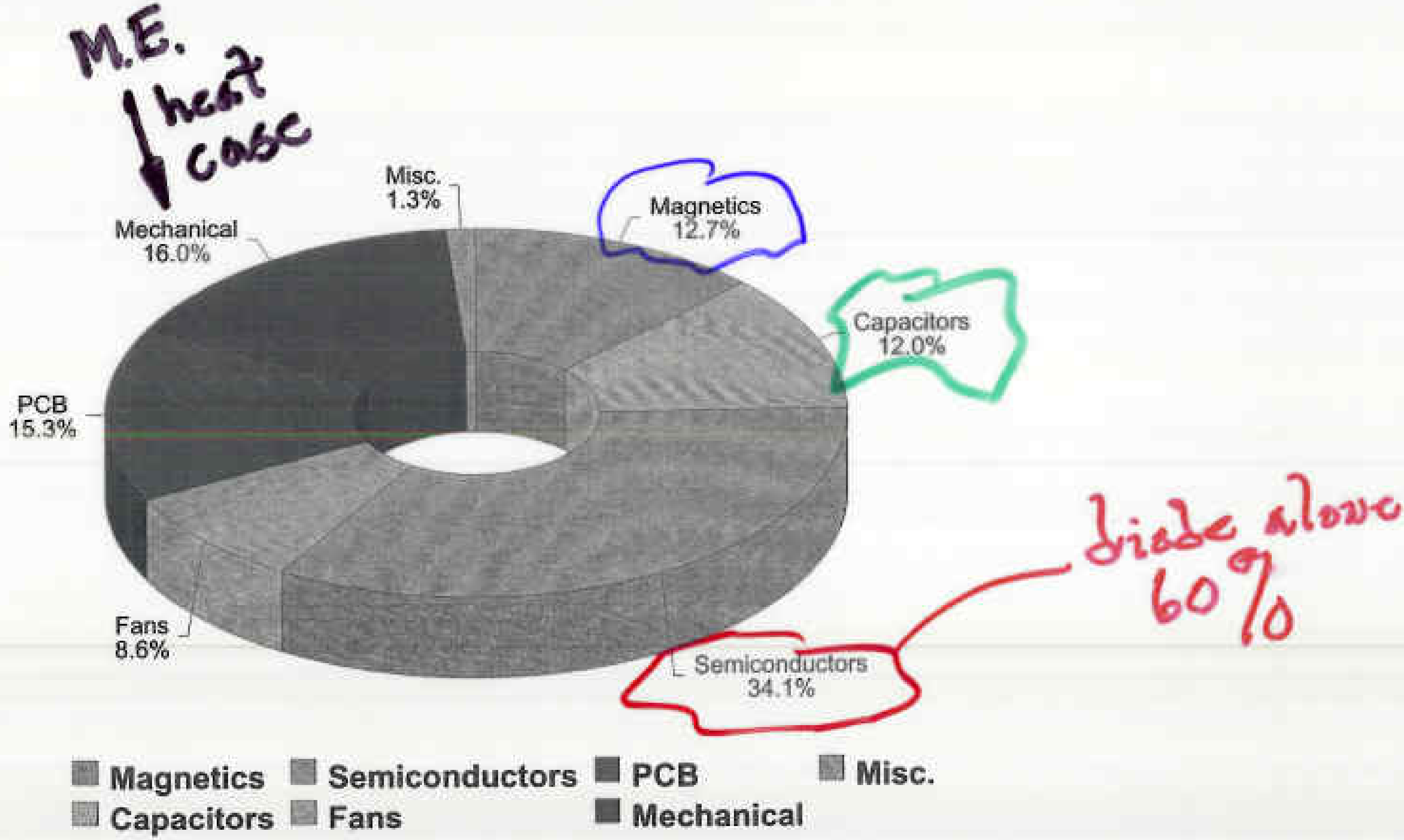


*1 Start-up current losses can be very high in a low-power charger and adapter, especially if the turn-on time is short and the circuit is not disabled after start-up.

*2 The higher dissipation in a simple CC circuit occurs only at full load. The circuit is usually only used in chargers that deliver under 5 W, meaning that it still may meet the CEC standards.

Fig. 2. *Block diagram of the power-consuming circuits within a SMPS.*

Bulk Power (AC/DC) Cost



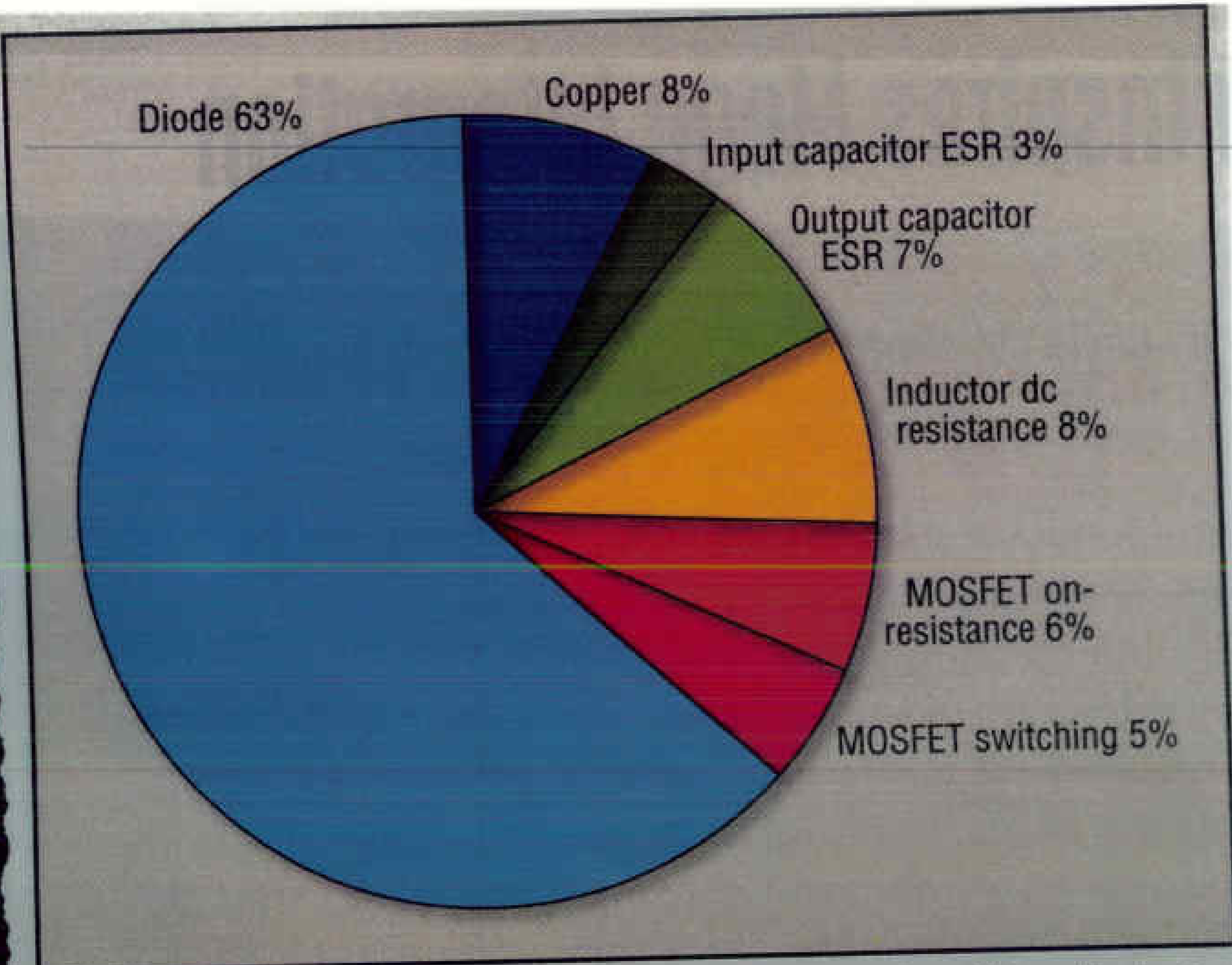


Fig. 6. *Power loss caused by the freewheeling diode should be eliminated to increase the converter's efficiency.*

Diode is over in losses

- hot spot to cool
- max fsw limit
-

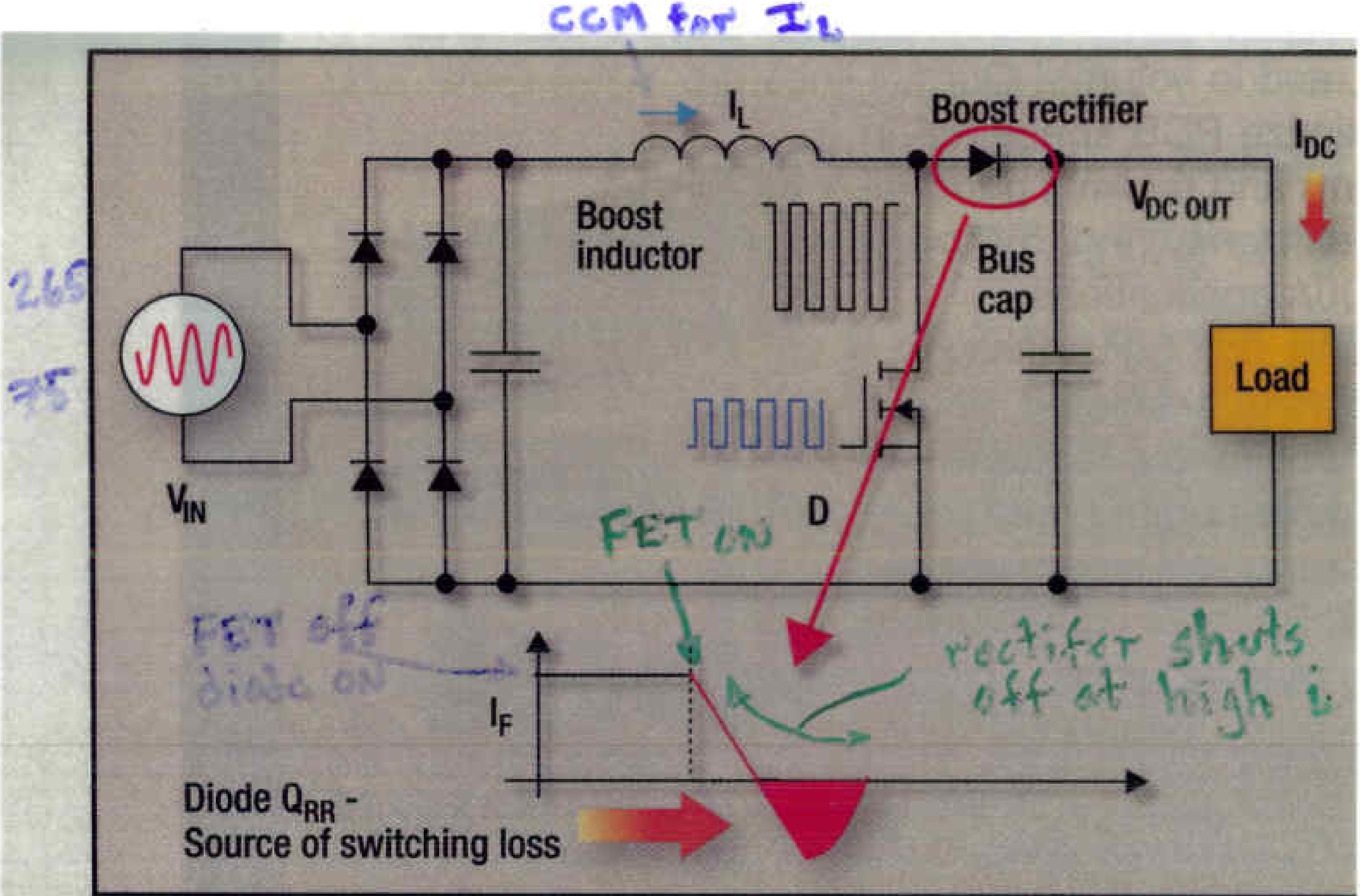


Fig. 1. *In the basic single-phase boost PFC converter, the boost rectifier's Q_{RR} produces significant switching losses.*