8.5 Aplicaciones industriales de la Electrónica de Potencia: iluminación

Light-emitting diode

From Wikipedia, the free encyclopedia

"LED" redirects here. For other uses, see LED (disambiguation).
This article is about the basics of light emitting diodes. For application to area lighting, see LED lamp.
Not to be confused with LCD.

A **light-emitting diode** (**LED**) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor.[5] White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.[6]

Appearing as practical electronic components in 1962, the earliest LEDs emitted low-intensity infrared (IR) light.[7] Infrared LEDs are used in remote-control circuits, such as those used with a wide variety of consumer electronics. The first visible-light LEDs were of low intensity and limited to red. Modern LEDs are available across the visible, ultraviolet (UV), and infrared wavelengths, with high light output.

Early LEDs were often used as indicator lamps, replacing small incandescent bulbs, and in seven-segment displays. Recent developments have produced high-output white light LEDs suitable for room and outdoor area lighting. LEDs have led to new displays and sensors, while their high switching rates are useful in advanced communications technology.

LEDs have many advantages over incandescent light sources, including lower energy consumption, longer lifetime, improved physical robustness, smaller size, and faster switching. LEDs are used in applications as diverse as aviation lighting, automotive headlamps, advertising, general lighting, traffic signals, camera flashes, lighted wallpaper, horticultural grow lights, and medical devices.[8]

Unlike a laser, the light emitted from an LED is neither spectrally coherent nor even highly monochromatic. However, its spectrum is sufficiently narrow that it appears to the human eye as a pure (saturated) color.[9][10] Also unlike most lasers, its radiation is not spatially coherent, so it cannot approach the very high brightnesses characteristic of lasers.

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Light-emitting diode (LED)

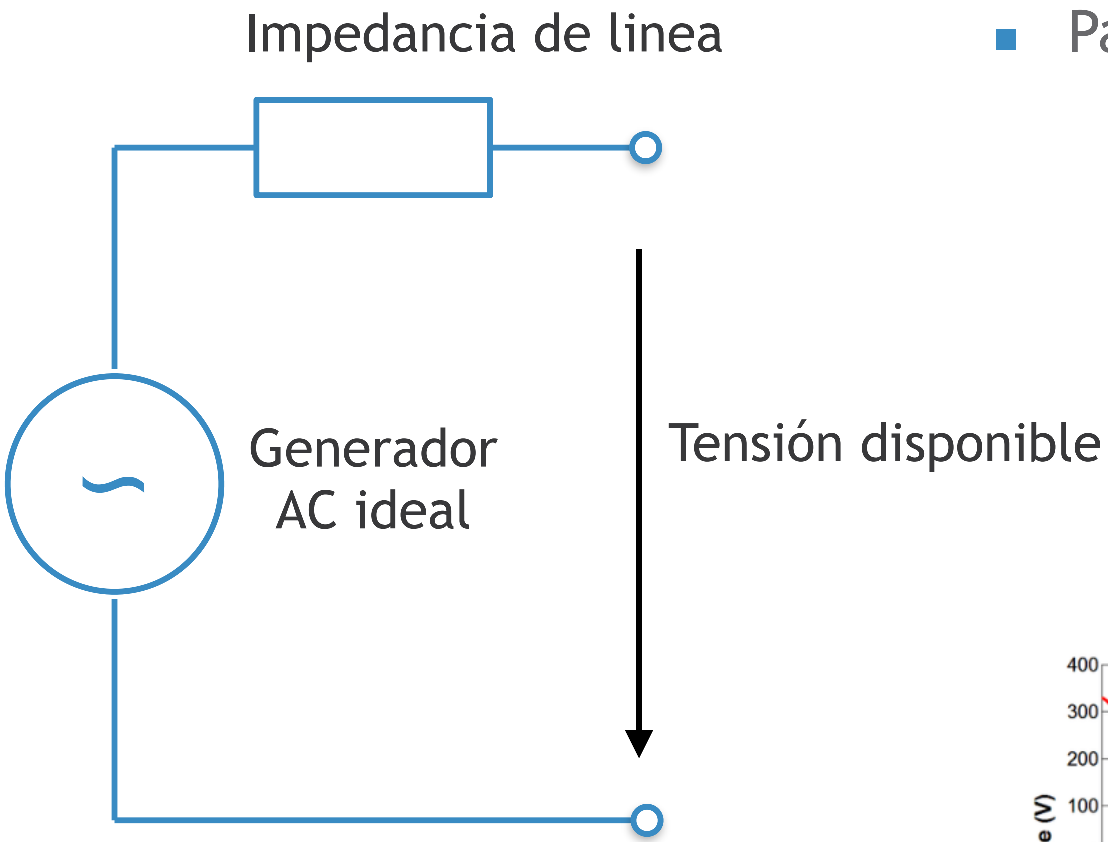
Blue, green, and red LEDs in 5 mm diffused case

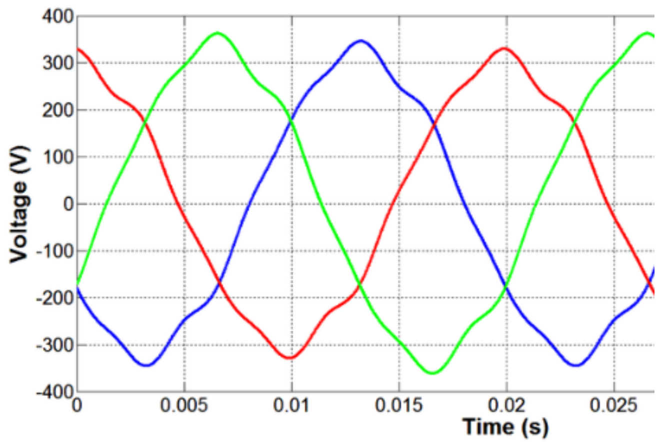
Working principle	Electroluminescence
Invented	H. J. Round (1907)[1] Oleg Losev (1927)[2] James R. Biard (1961)[3] Nick Holonyak (1962)[4]
First production	October 1962
Pin configuration	Anode and cathode

Electronic symbol

Circuito equivalente de la red monofásica

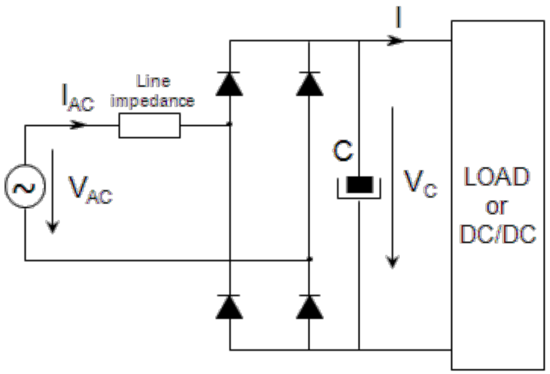
- Impedancia normalizada
  - Parte resistiva 0.4Ω
  - Parte inductiva 800μH

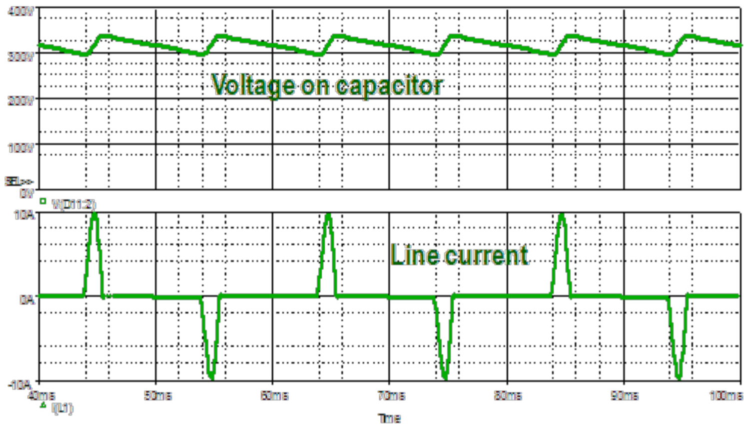




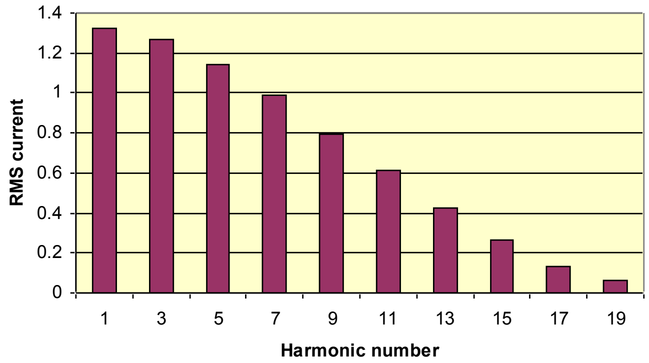
La impedancia de la red tiene un gran impacto en el funcionamiento de los circuitos

Rectificador de 300W y filtro por condensador

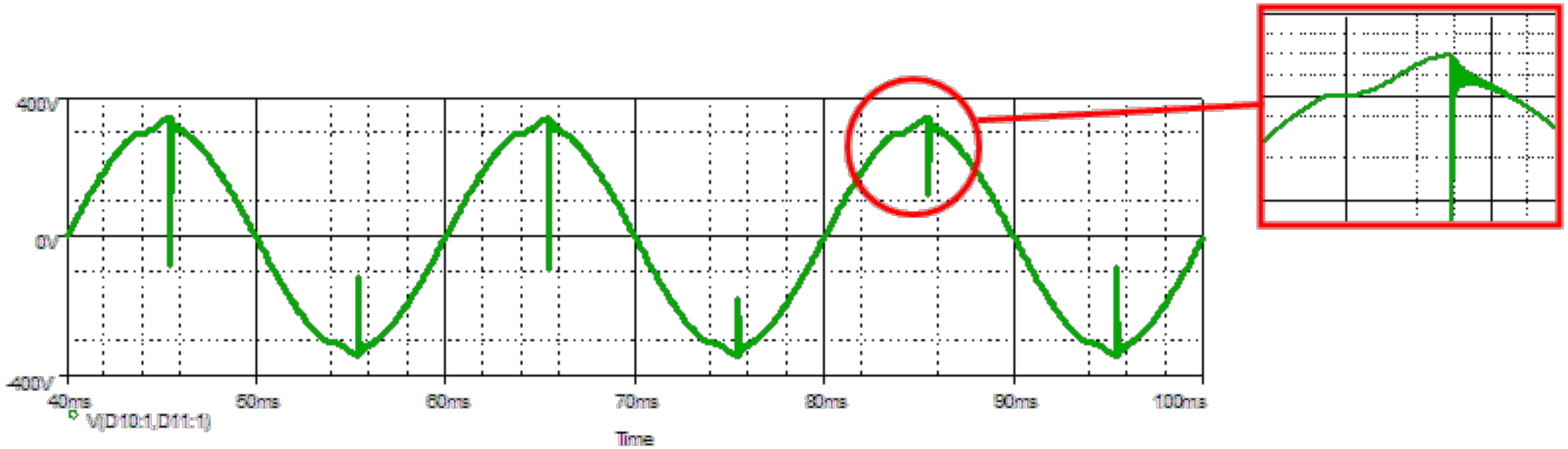




- Muy alta corriente eficaz (2.63A en lugar de 1.30A)



- Distorsión de tensión



Los armónicos de corriente generados por la carga junto con la impudencia de la red distorsionan la tensión

Definición de factor de potencia

$$P.F. = \frac{Active\ power}{Aparent\ power} = \frac{\frac{1}{T}\int_0^T u(t)\cdot i(t)dt}{\sqrt{\frac{1}{T}\int_0^T u^2(t)dt}\cdot\sqrt{\frac{1}{T}\int_0^T i^2(t)dt}}$$

- Si la tensión es sinusoidal:

$$P.F. = \frac{I_{1,RMS}}{I_{RMS}}\cdot\cos\phi = k_d\cdot k_\phi$$

- El factor de potencia depende de:
  - **El contenido armónico de la corriente**
  - **Desfase entre la tensión y la corriente**
- El FP es igual al cos ϕ <u>SÓLO</u> si tanto la tensión como la corriente son sinusoidales

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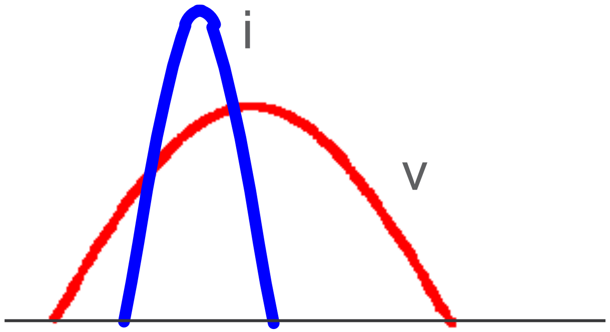
Ejemplos de factor de potencia

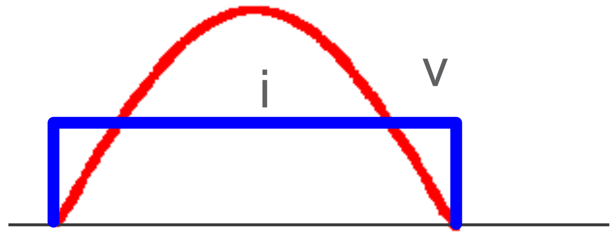
$k_d < 1 \quad k_\theta < 1$



I_{RMS}=2.63A

P.F. = 0.50   T.H.D.= 172%

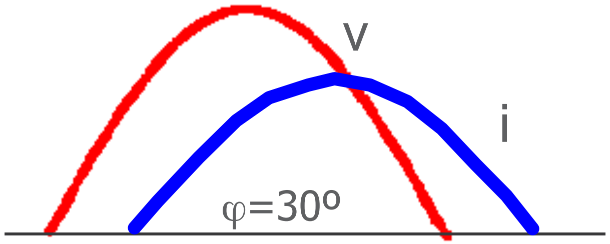
$k_d < 1 \quad k_\theta = 1$



I_{RMS}=1.44A

P.F. = 0.90   T.H.D. = 47%

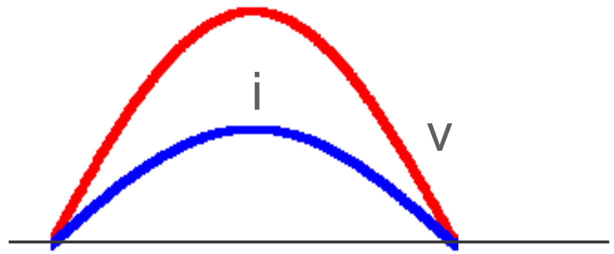
$k_d = 1 \quad k_\theta < 1$



I_{RMS}=1.50A

P.F. = 0.87   T.H.D. = 0%

$k_d = 1 \quad k_\theta = 1$



I_{RMS}=1.30A

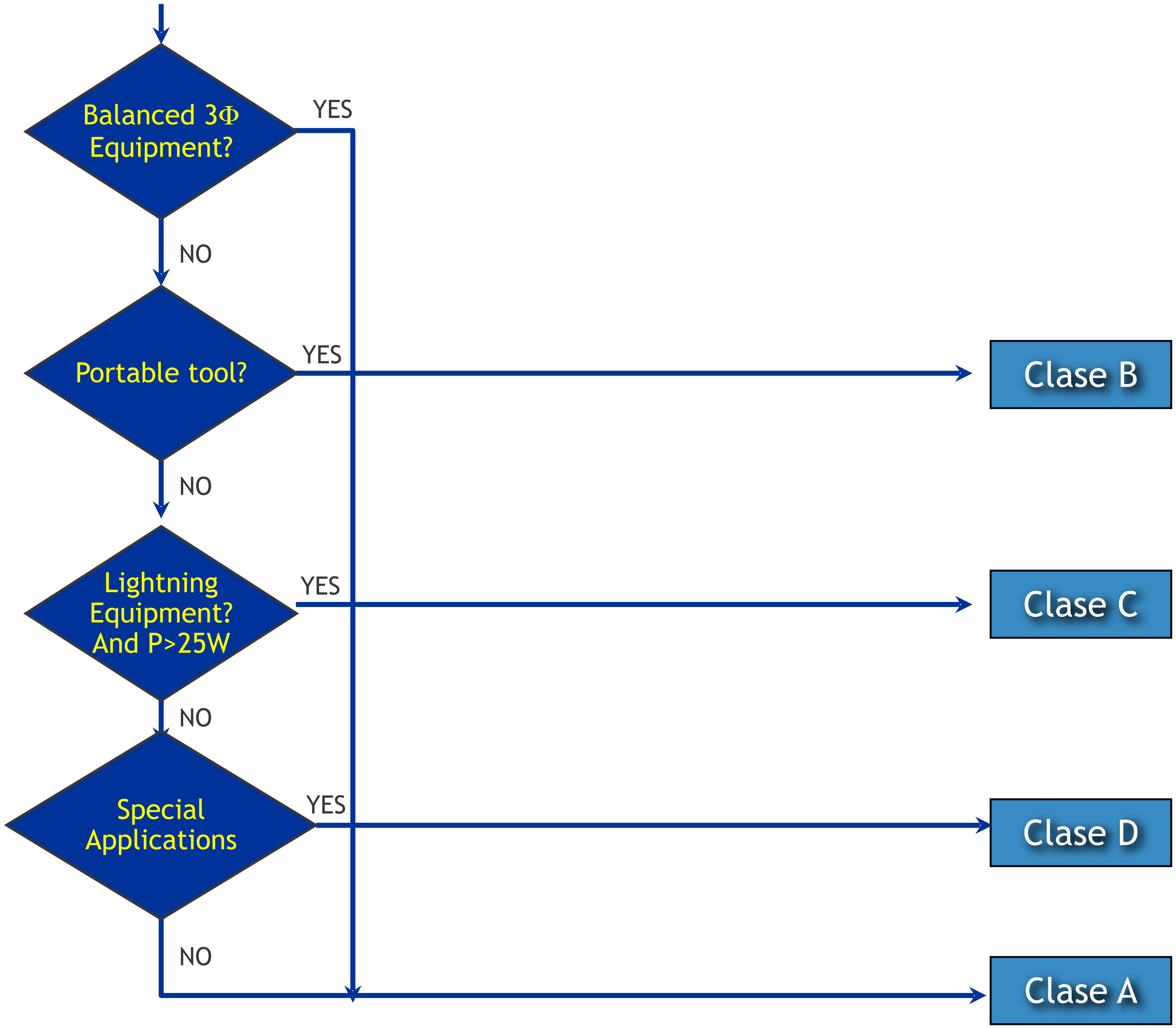
P.F. = 1.00   T.H.D. = 0%

Regulación

EN 61000-3-2	Europea (enero 2001). Límites para la corrientes armónicas para equipos de menos de 16A por fase
IEEE 519	IEEE Recommended practices and requirements for harmonic control in electrical power systems

Ninguna requiere un factor de potencia unidad

Flujograma de la Regulación EN61000-3-2



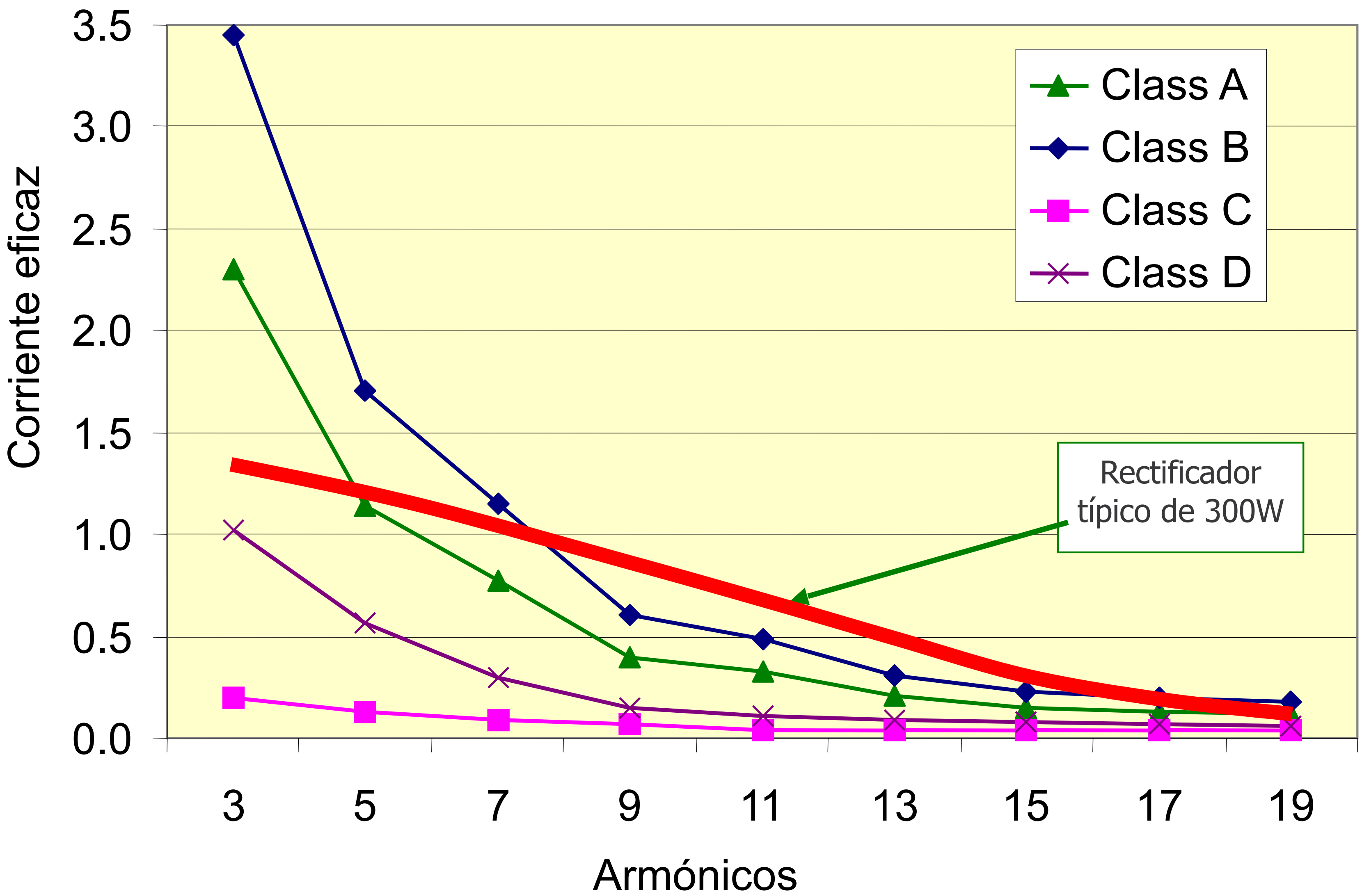
Límites impuestos por la regulación EN61000-3-2

		Clase A	Clase B	Clase C	Clase D	
		A_{RMS}	A_{RMS}	%	A_{RMS}	mA/W
Armónicos impares	*3*	2.30	3.45	30*PF.	2.30	3.40
	5	1.14	1.71	10	1.14	1.90
	7	0.77	1.15	7	0.77	1.00
	9	0.40	0.60	5	0.40	0.50
	11	0.33	0.49	3	0.33	0.35
	13	0.21	0.31	3	0.21	0.29
	15 a 39	2.25/n	3.375/n	3	2.25/n	3.85/n
Armónicos pares	*2*	1.08	1.62	2		
	4	0.43	0.64			
	6	0.30	0.45			
	8 a 40	1.84/n	2.76/n			
		Límites absolutos	Límites absolutos	Límites relativos	Límites relativos y absolutos	

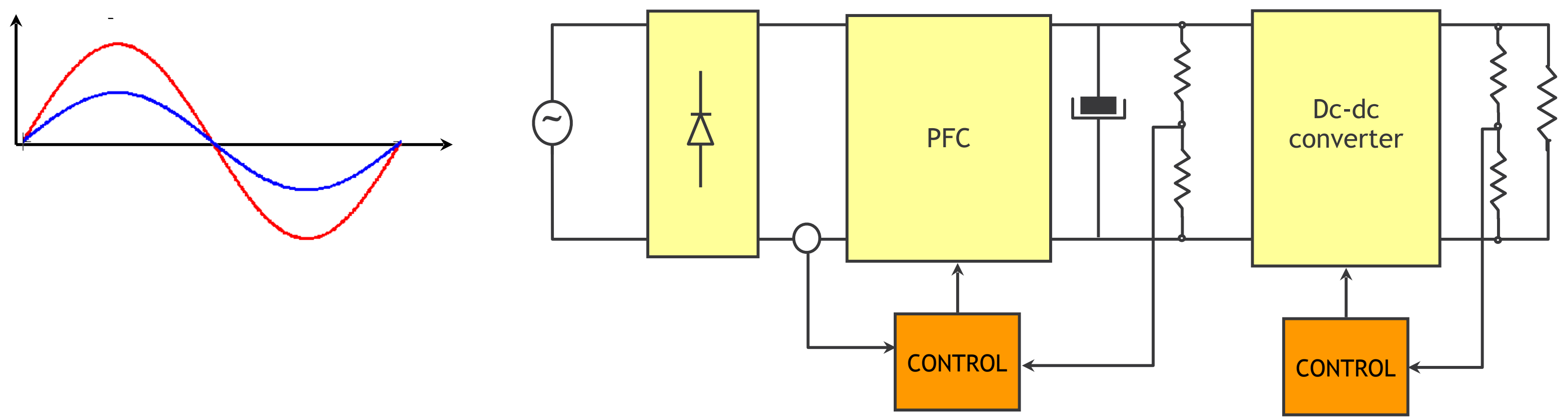
La clase C suele ser la más restrictiva

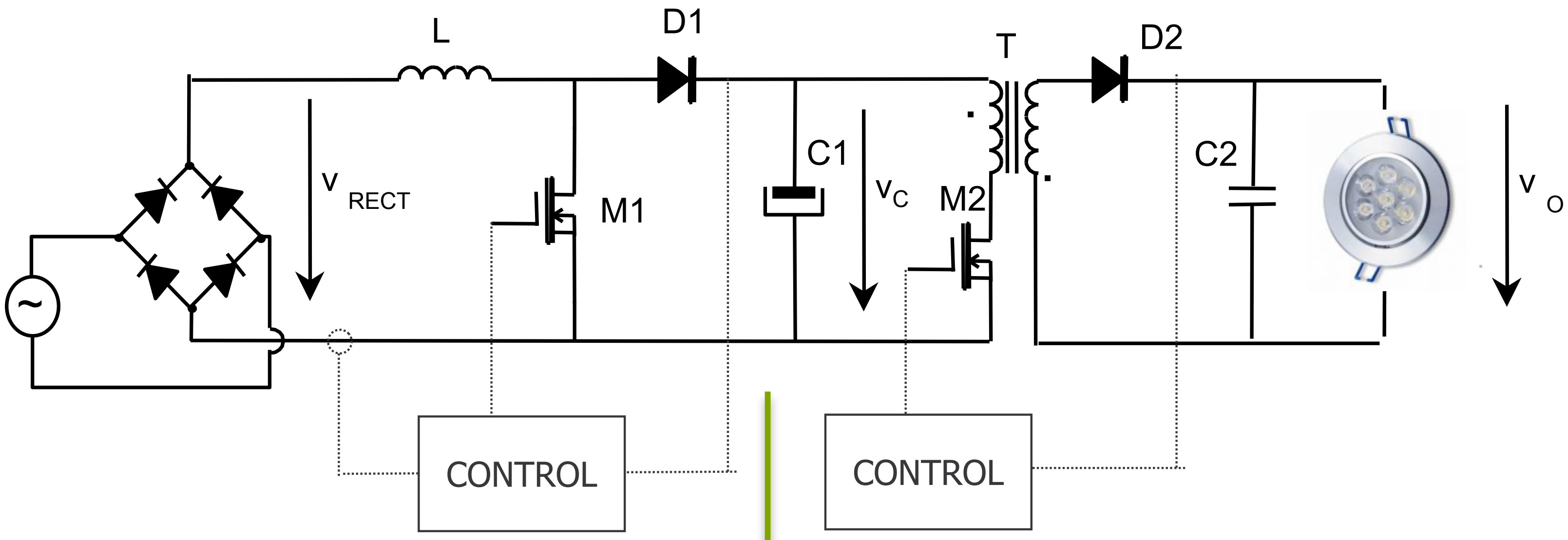
Límites impuestos por EN61000-3-2

Ejemplo para 300W con V_{AC}=230V



Circuito para alimentar LEDs





Rectificador de alta frecuencia mediante convertidor elevador

Convertidor dc-dc mediante convertidor flyback