EPCOS

Film Capacitors for Lighting Applications

Product Profile 2002

http://www.epcos.com

General

Since Thomas Edison invented the incandescent lamp in 1879, numerous developments have emerged to enhance lighting technology. Today, fluorescent lamps are the preferred light source for industrial and domestic applications. To produce more light with less energy, modern electronic light sources must deliver high luminous efficacy, energy savings and cost reductions. In addition, they must meet increasing demands for miniaturization.

EPCOS provides film capacitors for a wide range of lighting applications. Backed by decades of experience in designing, producing and marketing film capacitors for lighting, EPCOS works with customers worldwide in a spirit of partnership and cooperation.

To design the right film capacitor for each application, EPCOS professionals work closely with customers. Our lighting application team provides tailored solutions, followed by dedicated support through development, pre-production and production.

EPCOS production and warehouse facilities around the world offer world-class logistics whatever your location. Our motivated personnel, modern production equipment and intensive quality assurance ensure outstanding quality of your finished product. Equally important, our continuous commitment to cost reduction programs means EPCOS provides you with competitively priced products.

Global presence and matchless experience in film capacitors makes EPCOS the source for solutions for your particular lighting application.

In the following pages you will find an overview about our activities in the lighting sector. If you require further information, please contact us.

Trends

In the modern world, the success of today's light sources hinges on ecological, economic and design criteria.

Ecology

Ecological and economic aspects are related. Limited gas, oil and coal resources create ever-increasing energy costs. It has been estimated that industrial countries consume about 15 % of their electrical energy for lighting purposes.
As a result of the climate-protection conferences in Rio, Kyoto and The Hague, a new EU standard issued in 2000 aims to phase-out by 2005 conventional ballasts for lighting systems with low energy efficiency. The ambitious aim is to increase market share of electronic ballasts from 20 to 55 % by 2005. Ecology concerns are placing demanding requirements on electromagnetic interference. The increasing density of electronic devices in our environment requires the lighting industry to cut electromagnetic radiation.

Economy

The technical advantages of modern light sources must be affordable for the customer.
In order to achieve maximum market penetration and consumer acceptance, price differences must become smaller between conventional incandescent lamps and compact fluorescent lamps (CFLs), and between conventional and electronic ballasts.
Simply put, we must increase efficiency while decreasing costs. Continuous EPCOS cost-reduction projects for film capacitors will enable you to meet the challenge of this trend.

New design or "size matters"

To replace incandescent lamps by CFLs in private households means to meet esthetic expectations too. CFLs have to become smaller to fit in modern lighting fixtures. First the tube, now the ballast. After the successful introduction of the T5 fluorescent tube, small cross-sectional ballasts are presented to complete the trend toward size reduction.

EPCOS film capacitors give your lighting applications a bright future.

Plant Málaga, Spain

Plant Gravataí, Brazil

Plant Zhuhai, China

Plant Nashik, India

Compact Fluorescent Lamps (CFL)

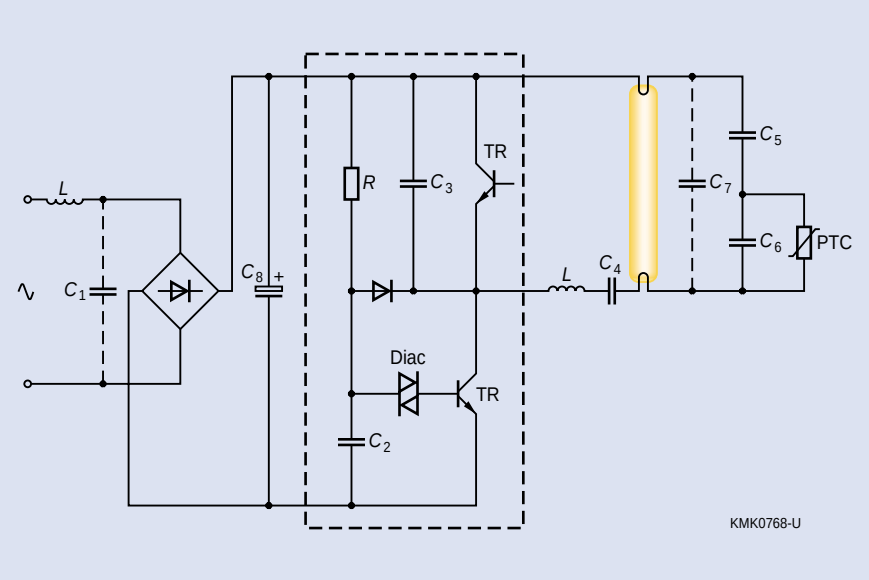
First compact fluorescent lamps impressed with their high efficiency and long lifetime (> 10 000 h). These features opened the door, especially to industrial customers.

Many private consumers on the other hand do not start an efficiency evaluation before they buy a lamp. They usually spend money in the fixture they want. Some of these fixtures even claim to be objects of art. Therefore CFLs have to look like incandescent lamps.

They have to fit physically and esthetically in the existing fixtures. The requested small design is limited by two major factors: the dimensions of the components and the heat resistance of the same.

New supercompact layouts of the lamp driver and the temperature radiation of the fluorescent tube generate up to 140 °C inside the socket of the CFL.

Manufacturers of compact fluorescent lamps designed cheaper lamp drivers in order to enter the low-price market segment. Accepting a certain decrease of the lifetime you can reduce the number of components by replacing the preheating circuit by one 1000 V film capacitor for cold lamp start.



Typical circuit diagram of a Compact Fluorescent Lamp (CFL)

EPCOS film capacitors are the solutions to face the future technical challenges:

- MKT SilverCap series B3256* of compact design in a wide range of sizes at low price
- MKN SilverCap series B32860 of compact design in a wide range of sizes at high temperatures up to 140 °C
- MKT MiniBlue series B32559 with small dimensions at minimum price
- MKP B3262* series in stacked-film technology with small dimensions for high perfomance

Capacitor	Function	Type	Series	Typical dv/dt	Rated voltage	Rated capacitance
C1	EMI suppression	X2	B3292*		275 Vac/300 Vac	47–100 nF
C2	Starting	MKT MKT/MKN	B32529/559 B32560/860		63 V	22–100 nF
C3	Snubbering	MKT MKT/MKN MKP	B32529/559 B32560/860 B32620	1 000 V/µs	630–1 000 V	680 pF–1.5 nF
C4	Blocking	MKT MKT/MKN	B32529/559 B32560/860		250–400 V	22–100 nF
C5	Preheating	MKT MKT/MKN	B32529/559 B32560/860	<300 V/µs	400–630 V	4.7–10 nF
C6	Striking	MKT MKT/MKN	B32529/559 B32560/860	<300 V/µs	400–630 V	1.5–15 nF
C7	Striking	MKT MKT/MKN	B32529/559 B32560/860	<500 V/µs	400–1 000 V	1.0–10 nF
C8	Filtering	Electrolytic capacitor	B43858 B43866 B43867		350–450 V	1.5–10 µF

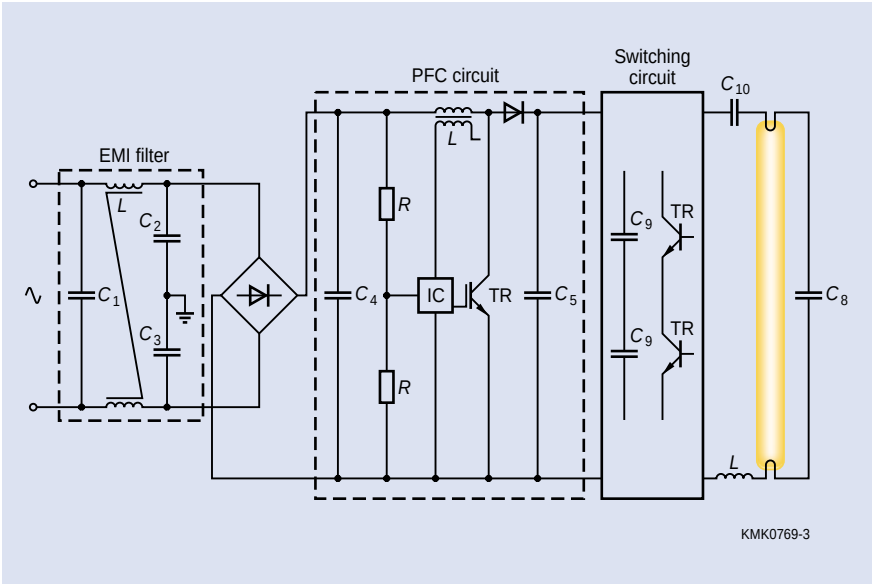
MKN capacitors for high temperature requirements

Electronic Ballast for Fluorescent Lamps

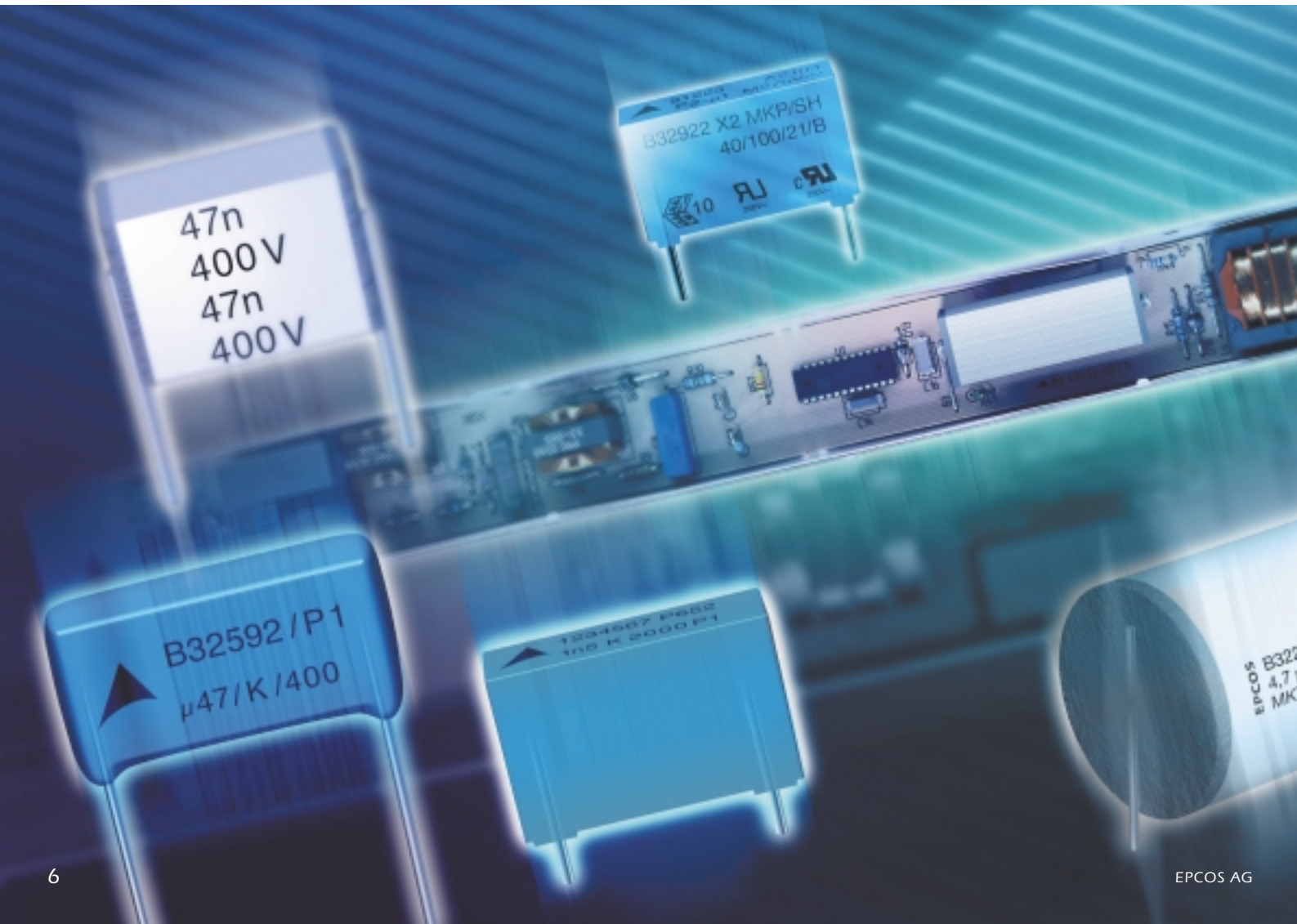
Fluorescent lamps have become the preferred source of light for many applications. After the introduction of the T5 tube generation, the ballasts must likewise become smaller.

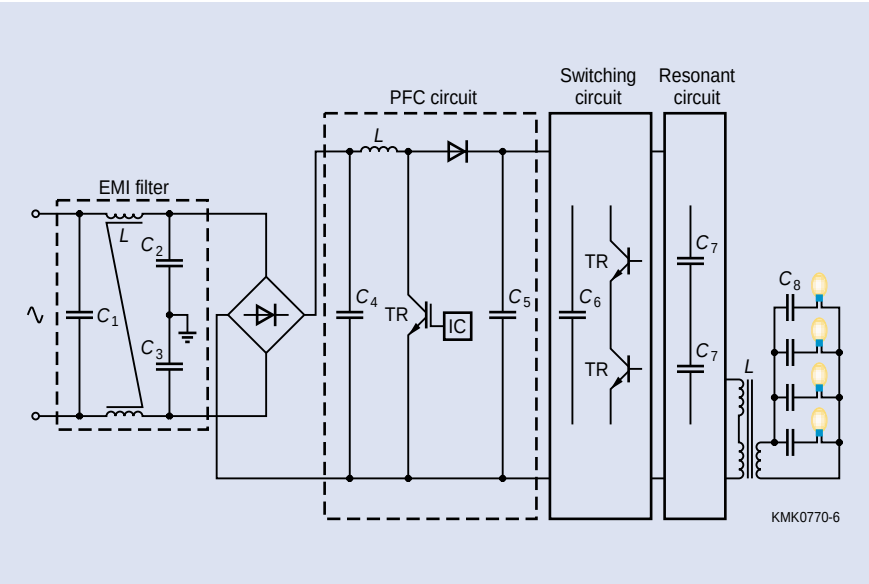
The EPCOS solutions are:

- MKT SilverCap series B3256* of compact design in a wide range of sizes at low price
- Special silent versions available on request
- New "low profile" boxed MKP and MKT capacitors (B3265*, B3252*) and EMI capacitors (B3292*)
- Special designed MKT capacitors (B3223*, B32564) for smoothing (C4) with capacitance change <5% during lifetime



Typical circuit diagram of an electronic ballast for the EU market





Typical circuit diagram of an electronic ballast for the US market (current feed resonant circuit with PFC)

US ballasts are normally used to control four lamps. They work on a "permanent ignition" principle. They must therefore satisfy tougher requirements in terms of self-heating and corona discharge than ballasts used in Europe.

Recommended EPCOS film capacitors:

- For high AC voltage at high frequency:
  Boxed and powder dipped MKP capacitors of B3265* and B3261* series
- For very high pulse strength:
  Boxed and powder dipped MFP capacitors of B3263* and B3268* series

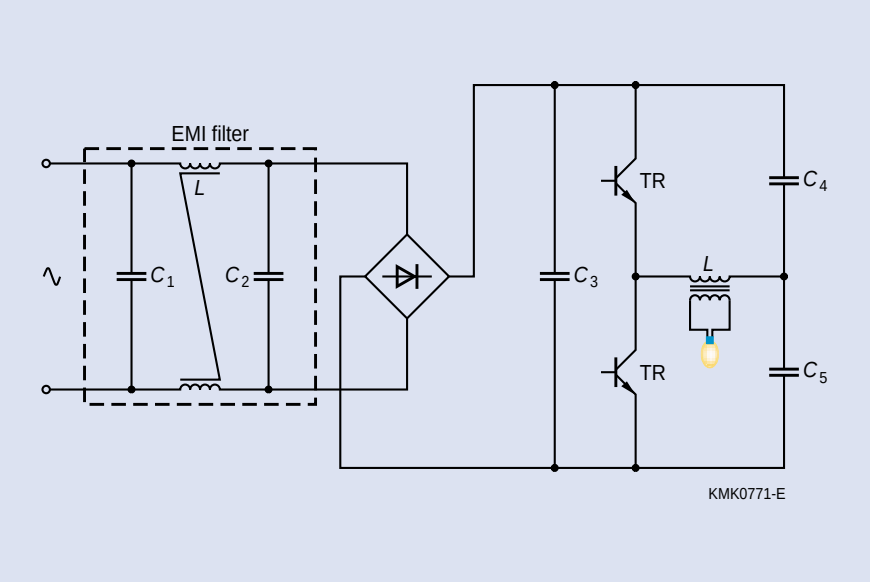
Capacitor	Function	Type	Series	Typical dv/dt	Rated voltage	Rated capacitance
C1	EMI suppression	X2	B81130 B3292*		275 Vac 275 Vac/300 Vac	47–470 nF
C1 (US)	EMI suppression (low cost alternative)	MKT	B3252* B3256*		400 V	100–470 nF
C2	EMI suppression	Y2	B81122		250 Vac	1–4.7 nF
C3	EMI suppression	Y2	B81122		250 Vac	1–4.7 nF
C4	Smoothing	MKT	B3252* B3256*		250–630 V	0.22–1 µF
C5	Smoothing	MKT	B3223* B3256*		350–480 V	4.7–15 µF
C6	Impuls	MKP	B3265* B3261*	<300 V/µs	630–1 600 Vdc 250–700 Vac	1.5–15 nF
C7 (US)	Resonance	MKP	B3265* B3261*	<300 V/µs	630–1 600 Vdc 250–700 Vac	4.7–10 nF
C8 (US)	Striking	MKP MFP	B3265* B3261* B3263*	<500 V/µs	1 000–2 500 Vdc 250–800 Vac	470 pF–10 nF
C9 (EU)	Snubbering	MKP	B3265*	<1000 V/µs	400–1 000 V	680 pF–2.2 nF
C10 (EU)	Blocking	MKP	B3265*	<300 V/µs	630 V	22–100 nF

Transformers for Halogen Lamps

Low-voltage halogen lamps are very much in vogue in modern lighting architecture and private households.
The transformers have to be small and operate quietly and reliably.

EPCOS has the suitable solution to meet these requirements:

- For "smoothing" MKT SilverCap series with low price and high flexibility
- For "snubbering" MKP capacitors with excellent self-healing for high voltage at high frequency:
  B32620…621 series in stacked-film technology for standard applications,
  B32651…652 series in wound-film technology, if high AC voltage is required



Typical circuit diagram of an electronic transformer

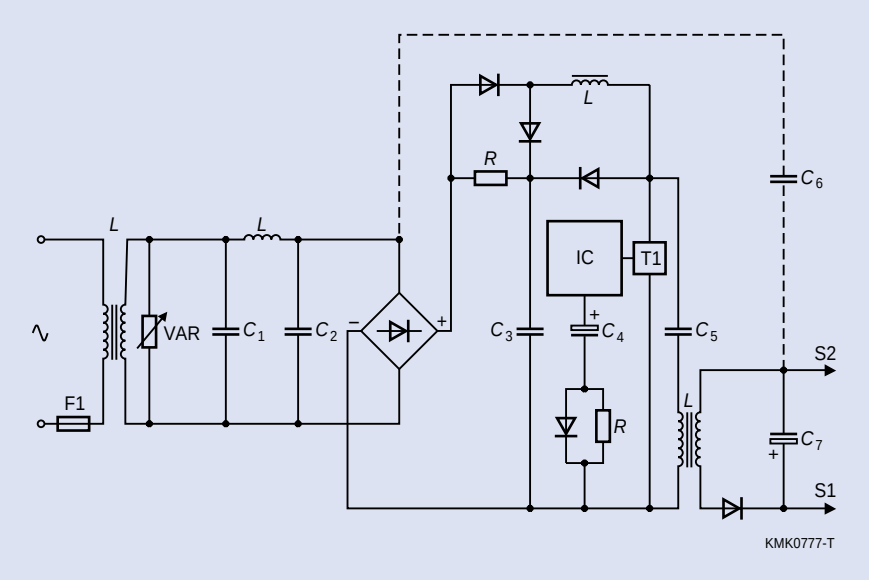
Capacitor	Function	Type	Series	Typical dv/dt	Rated voltage	Rated capacitance
C1	EMI suppression	X2	B3292*		275 Vac	100–470 nF
C2	EMI suppression	X2	B3292*		275 Vac	100–470 nF
C3	Smoothing	MKT	B3252* B3256*		400–500 V	22–330 nF
C4	Snubbering	MKP	B3262* B3265*	30–50 kHz	630–1 000 V	10–47 nF
C5	Snubbering	MKP	B3262* B3265*	30–50 kHz	630–1 000 V	10–47 nF

Electronic Ballast for Light Emitting Diodes (LED)

LEDs will become a future light source for automotive, traffic signals, contour lighting and even general lighting. Impressive features are the exceptional lifetime up to 100 000 h, shock-resistance, high efficiency, zero UV-radiation, and dimming capability, not to mention the small size.

EPCOS has innovative film capacitors for your innovative products:

- MKT B3256* series offers you high performance at flexible dimensions
- X2 B3292* series saves space due to its small size



Circuit diagram example of an electronic ballast for an LED module
Primary voltage: 230–240 Vac; Secondary voltage: 10–42 Vdc

Capacitor	Type	Series	Rated voltage	Rated capacitance
C1	MKT	B32561/B32562	250–630 V	0.1–0.47 µF
C2	MKT	B32561/B32562	250–630 V	0.1–0.47 µF
C3	MKT	B32562	630–1 000 V	2.2–10 nF
C4	Electrolytic capacitor	B41821/B41851	16–25 V	10–470 µF
C5	MKT	B32563	400–630 V	1.0–2.2 µF
C6	EMI suppression (Y1)	B81123	250 Vac	2.2 nF
C7	Electrolytic capacitor	B41821/B41851	16–25 V	10–470 µF

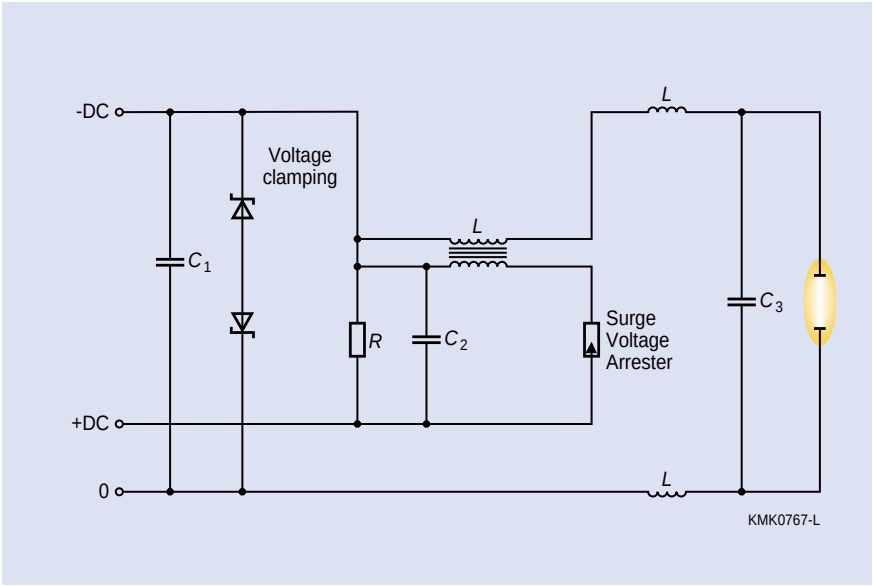
Electronic Ballast for Automotive HID Lamps

Ignition unit for HID lamps

For the ignition of the lamp, high current on the low voltage side is required.
EPCOS recommends:
MKN film capacitors, uncoated
B32861…862 series

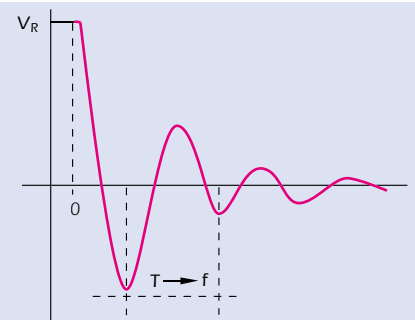
Advantages

- Low-profile, multipin, etc. available
- Perfect match with EPCOS' switching spark gap FS08X-1G
- High reliability
- High pulse strength (6 kV/µs)
- Max. current: 500 A
- Max. storage temperature: 170 °C
- Operating temperature: (–55 °C…+150 °C)
- Max. number of pulses: 200 000 pulses
- High vibration resistance



Typical circuit diagram for an ignition unit of HID lamps

Capacitor	Function	Type	Series	Typical dv/dt	Rated voltage	Rated capacitance
C1	Input	MKN	B3286*	10 000 V/µs	1 000 V	1–2.2 nF
C2	Igniton	MKN	B3286*	6 000 V/µs	1 000 V	70–120 nF
C3		Ceramic capacitor	B37871		500 V	6.8–1 000 pF



B32861…B32862: Discharge curve (ignition unit)

C_R nF	f MHz	dV/dt max. V/µs	k_0 MV²/µs
70	1.4	5 000	20
80	1.4	5 000	18
100	1.4	5 000	15
120	1.4	5 000	12
V = 800 V (switching spark gap)			

B32861…B32862: Discharge parameters

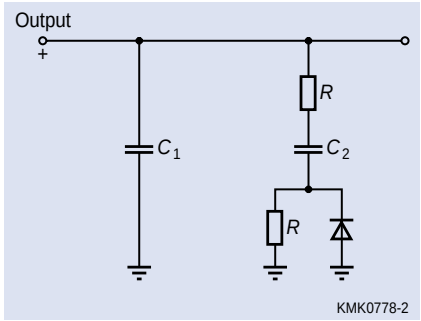
Electronic ballast for HID lamps

For filtering and voltage stabilization in the DC/DC converters of the ballast, high quality film capacitors are the suitable solution.

- MKT film capacitors in plastic case B32522…524 series
- Flame-retardant encapsulation (UL 94V-0)
- Epoxy resin sealing

Advantages

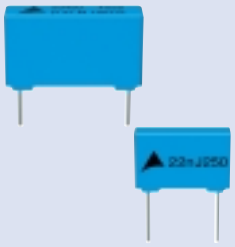
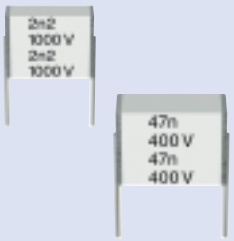
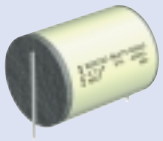
- High reliability
- High thermal stability (–55 °C…+125 °C)
- High pulse strength



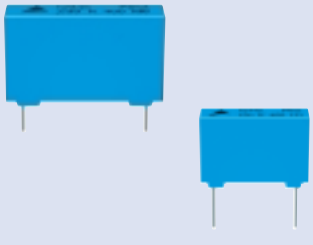
Circuit diagram example of an electronic ballast for HID lamps

Capacitor	Function	Type	Series	Rated voltage	Rated capacitance
C1	Output filtering	MKT	B3252*	250–400 V	0.15–1.0 µF
C2	Boost	MKT	B3252*	250–400 V	1.0–2.2 µF

Product Overview

	MKT MKN (B3286* series)				
Rated capacitance C_R					
	B32520 ... B32529	B32560 ... B32564 B32860 ... B32862	B32591... B32594	B32559	B32232
100 µF					
68 µF					
47 µF					
33 µF					
22 µF					
15 µF					
10 µF					4.7...10 µF 450 Vdc
6.8 µF					
4.7 µF					
3.3 µF					
2.2 µF					
1.5 µF					
1.0 µF					
0.68 µF					
0.47 µF					
0.33 µF	50 Vdc				
0.22 µF					
0.15 µF					
0.10 µF					
68 nF					
47 nF					
33 nF					
22 nF					
15 nF					
10 nF					
6.8 nF					
4.7 nF					
3.3 nF					
2.2 nF	63 Vdc	63 Vdc	100 Vdc	63 Vdc	
1.5 nF	100 Vdc	100 Vdc	250 Vdc	100 Vdc	
1.0 nF	250 Vdc	250 Vdc	400 Vdc	250 Vdc	
	400 Vdc	400 Vdc	630 Vdc	400 Vdc	
	630 Vdc	630 Vdc		630 Vdc	
		420Vdc		1000 Vdc	
		1000 Vdc			
Features	Plastic case (UL 94 V-0) Stacked-film/ wound-film technology	SilverCaps (uncoated) Flexible dimensions Stacked-film technology MKN capacitors for high temperatures	Powder dipped (UL 94 V-0) Stacked-film/ wound-film technology	MiniBlue (partially coated) Stacked-film technology	Special smoothing capacitors for long life electro- nic ballast

Metallized film capacitors have almost unlimited self-healing capability. Short circuits are thus largely nonexistent. They exhibit high pulse handling and ripple current capability.

	MKP			EMI suppresssion capacitors	
Rated capacitance C_R					
	B32620, B32621 B32651... B32656	B32612 ... B32614	B32669	B3292* X2	B81122 Y2
10 µF			250 Vac		
6.8 µF			250 Vac		
4.7 µF	250 Vdc			275 Vac	
3.3 µF	400 Vdc			300 Vac	
2.2 µF	630 Vdc	250 Vdc			
1.5 µF	1000 Vdc	400 Vdc			
1.0 µF	1250 Vdc	630 Vdc			
0.68 µF	1600 Vdc	1000 Vdc			
0.47 µF	2 000 Vdc	1600 Vdc			
0.33 µF		2000 Vdc			250 Vac
0.22 µF	160 Vdc				
0.15 µF	250 Vdc				
0.10 µF	400 Vdc				
68 nF	630 Vdc				
47 nF	1000 Vdc				
33 nF					
22 nF					
15 nF					
10 nF					
6.8 nF					
4.7 nF					
3.3 nF					
2.2 nF					
1.5 nF					
1.0 nF					
0.68 nF					
0.47 nF					
0.33 nF					
0.22 nF					
0.15 nF					
0.10 nF					
Features	Plastic case (UL 94 V-0) Stacked-film technology Wound-film technology	Powder dipped (UL 94 V-0) Wound-film technology	Axial	EMI suppression capacitors for extreme safety requirements. With all relevant marks of conformity and complying with the new European standard EN 132400	

For very high pulse strength the following MFP capacitors are available:
Boxed version, B3268* series (V_R = 630 to 2000 Vdc, C_R = 0.10 to 470 nF)
Powder dipped version, B3263* series (V_R = 630 to 3000 Vdc, C_R = 0.22 to 330 nF)

Technical Data

MKT capacitors
B3252*, B3256*, B32559

Climatic category in accordance with IEC 60068-1	55/125/56[1]			
Lower category temperature T_{min} Upper category temperature T_{max} Damp heat test	– 55 °C + 125 °C 56 days/40 °C/93 % relative humidity			
DC test voltage	1.4 · V_R, 2 s			
Category voltage V_C Operation with dc voltage or ac voltage V_{rms} up to 1 kHz	$T \leq$ 85 °C	$V_C = 1.0 \cdot V_R$	$V_{C,rms} = 1.0 \cdot V_{rms}$	
	$T \leq$ 100 °C	$V_C = 0.8 \cdot V_R$	$V_{C,rms} = 0.8 \cdot V_{rms}$	
	$T \leq$ 125 °C	$V_C = 0.5 \cdot V_R$	$V_{C,rms} = 0.5 \cdot V_{rms}$	
Operating voltage for short operating periods	$T \leq$ 85 °C	$V = 1.25 \cdot V_C$, max. 2 000 h	$V = 1.0 \cdot V_{C,rms}$, max. 2 000 h	
	$T \leq$ 100 °C	$V = 1.25 \cdot V_C$, max. 2 000 h	$V = 1.0 \cdot V_{C,rms}$, max. 2 000 h	
	$T \leq$ 125 °C	$V = 1.25 \cdot V_C$, max. 1000 h	$V = 1.0 \cdot V_{C,rms}$, max. 1000 h	
Dissipation factor tan δ (in 10^{-3}) at 20 °C (upper limit values)		$C_R \leq$ 0.1 µF	0.1 µF < $C_R \leq$ 1 µF	$C_R >$ 1 µF
	at 1 kHz	8	8	10
	at 10 kHz	15	15	–
	at 100 kHz	30	–	–
Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ at 20 °C, rel. humidity ≤ 65 % (minimum as-delivered values)	V_R	$C_R \leq$ 0.33 µF	$C_R >$ 0.33 µF	
	≤ 100 Vdc	3 750 MΩ	1 250 s	
	≥ 250 Vdc	7 500 MΩ	2 500 s	

Pulse handling capability

Maximum permissible voltage change per unit of time for non-sinusoidal voltages (pulse, sawtooth)

V_R	Max. rate of voltage rise V_{pp}/τ in V/µs (for $V_{pp} = V_R$)					
	Lead spacing					
	5 mm	7.5 mm	10 mm[2]	15 mm[2]	22.5 mm[2]	27.5 mm[2]
50 Vdc	200	–	–	–	–	–
63 Vdc	250	120	50	30	(3)	–
100 Vdc	300	150	75	50	50 (4)	25 (3)
250 Vdc	400	200	150	100 (10)	100 (6)	50 (4.5)
400 Vdc	600	275	175	125 (20)	125 (10)	60 (7.5)
630 Vdc	800	320	(20)	150 (25)	(15)	(12)
1000 Vdc	2000	700	–	–	–	–

For pulse characteristic k_0, refer to data book "Film Capacitors".

[1] Test criteria must be met after exposure to damp heat for 21 days.
[2] Values in brackets apply to wound capacitors.

MKP capacitors
B3265*/B3262*/B3261*

Climatic category in accordance with IEC 60068-1	55/100/56			
Lower category temperature T_{min} Upper category temperature T_{max} Damp heat test	– 55 °C + 100 °C 56 days/40 °C/93 % relative humidity			
DC test voltage	1.6 · V_R, 2 s			
Category voltage V_C Operation with dc voltage or ac voltage V_{rms} up to 1 kHz	T ≤ 85 °C	$V_C = 1.0 \cdot V_R$	$V_{C,rms} = 1.0 \cdot V_{rms}$	
	T ≤ 100 °C	$V_C = 0.8 \cdot V_R$	$V_{C,rms} = 0.8 \cdot V_{rms}$	
Operating voltage for short operating periods	T ≤ 85 °C	$V = 1.25 \cdot V_C$, max. 2 000 h	$V = 1.0 \cdot V_{C,rms}$, max. 2 000 h	
	T ≤ 100 °C	$V = 1.25 \cdot V_C$, max. 2 000 h	$V = 1.0 \cdot V_{C,rms}$, max. 2 000 h	
Dissipation factor tan δ (in 10^{-3}) at 20 °C (upper limit values)		$C_R \leq 0.1$ µF	0.1 µF < $C_R \leq 1$ µF	$C_R > 1$ µF
	at 1 kHz	–	0.5	0.5
	at 10 kHz	–	0.8	1.5
	at 100 kHz	5.0	–	–
Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ at 20 °C, rel. humidity ≤ 65 % (minimum as-delivered values)	$C_R \leq 0.33$ µF	$C_R > 0.33$ µF		
	100 GΩ	30 000 s		

Pulse handling capability

Maximum permissible voltage change per unit of time for non-sinusoidal voltages (pulse, sawtooth)

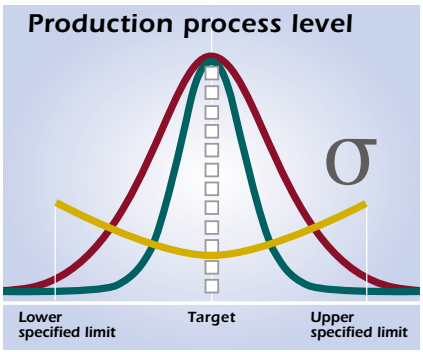
V_R	Max. rate of voltage rise V_{pp}/τ in V/µs (for $V_{pp} = V_R$)					
	Lead spacing					
	7.5 mm	10 mm	15 mm	22.5 mm	27.5 mm	37.5 mm
160 Vdc	750[1]	600[1)]	–	–	–	–
250 Vdc	1200[1]	900[1)]	200	120	50	–
400 Vdc	1500[1]	1050[1)]	300	150	70	–
630 Vdc	2700[1]	1800[1]	350	210	100	–
1000 Vdc (500 Vac)	3200[1]	2400[1]	400	350	225	90
1000 Vdc (600 Vac)	4000[1]	–	–	–	–	–
1250 Vdc	–	2000	800	750	500	140
1600 Vdc (500 Vac)	–	–	1500	1000	700	–
1600 Vdc (600 Vac)	–	–	–	–	–	210
1600 Vdc (700 Vac)	–	–	1900	–	–	–
2000 Vdc (700 Vac)	–	–	2200	1400	900	200
2000 Vdc (1000 Vac)	–	–	–	2000	–	–

For pulse characteristic k_0, refer to data book "Film Capacitors".

[1)] Stacked-film technology

Quality

The quality of our products and services has vital importance for EPCOS. Its prime objective is to bring maximum benefit to our customers worldwide. All our plants have been qualified in accordance to ISO9000, and those that supply automotive customers are also certified with QS9000.



Product development

We plan the quality of our products with multifunctional teams (Advanced Product Quality Planning). For this purpose we use following tools:

- Analysis on first samples
- FMEA for products and processes
- Quality Control Plans (QCP)
- Statistical Process Control (SPC)
- Process capability studies (Cmk)
- Production Parts Approval Process (PPAP)

Continuous improvement

Our production processes and organizational procedures are continuously improved.

- Quality targets definition (failure rates, customer complaints, response time, etc.)
- Quality controlling and monitoring (SPC, quality gates, reliability tests, internal audits)
- ABC analysis of failure causes
- Multifunctional action plan (8D report) for improvement

Certifications

Málaga (Spain):
ISO 9001, QS 9000
Gravataí (Brazil):
ISO 9001, QS 9000
Nashik (India):
ISO 9002
Zhuhai (China):
ISO 9002

Further EPCOS Products for Lighting Applications

Series	Technical data	Features	Type	CFL	Electronic ballast	Halogen lamps	LED	HID lamps (automotive)
Aluminum Electrolytic Capacitors, Axial-Leaded Types								
Standard version	V_R = 450 Vdc; C_R = 10...47 µF	High temperature (105 °C/2 000 h)	B43697		●	●		
High performance	V_R = 450 Vdc, C_R = 6.8...33 µF	Long useful life (105 °C/10 000 h)	B43698		●	●		
Compact	V_R = 450 Vdc, C_R = 10...47 µF	High voltage (550 V/85 °C/500 h)	B43699		●	●		
Aluminum Electrolytic Capacitors, Single Ended Types								
High performance	V_R = 250...450 Vdc; C_R = 6.8...47 µF	Long useful life (105 °C/10 000 h)	B43888	●	●	●		
High performance High temperature	V_R = 160...400 Vdc; C_R = 1.5...10 µF	High temperature (125 °C/2 000 h)	B43866	●				
	V_R = 160...350 Vdc; C_R = 1.5...10 µF	Very high temperature (140 °C/1 000 h)	B43867	●				
Tantalum Capacitors SMD								
HighCap	V_R = 4.0... 50 V C_R = 0.15...1 000 µF Case size: A, B, C, D, E	Highest volumetric efficiency High thermal stability (-55...125 °C) Excellent long term stability	B45196H			●	●	●
Performance	V_R = 4.0...50 V C_R = 0.1...150 µF Case size: A, B, C, D, E	Lowest fit rates (<0,8 fit) High thermal stability (-55...150 °C) Excellent long term stability	B45196P			●	●	●
Multilayer Chip Capacitors SMD								
C0G/NP0 EIA sizes: 0402...1210	V_R = 50, 100, 200 V C_R = (<1 pF) 1 pF...10 nF(E 12) Cap. tolerance ≥1 %;	High insulation resistance Low dissipation factor/inductance High reliable performance	B37871... B37949		●	●	●	
X7R EIA sizes: 0603...2220	V_R = 16...500 V C_R = 100 pF...10 µF (E12) Cap. tolerance ±5 %	High volumetric efficiency High insulation resistance High pulse strength	B37872... B37956		●	●	●	
NTC Thermistors SMD								
EIA size: 0402	R = 0.1...47 kΩ; $B_{(25/50)}$ = 3 470, 3 940, 4 390 K	Multilayer SMD NTC with inner electrodes High accuracy (ΔR ±5 %, ±3 %) B-value tolerance down to ±1.5 % Excellent long term ageing stability Superior resistance stability during soldering (ΔR <1 %)	B572**V2...		●	●	●	
EIA size: 0603	R = 0.047...680 kΩ; $B_{(25/50)}$ = 3 470, 3 940, 4 390 K		B573**V2...		●	●	●	
EIA size: 0805	R = 0.047...680 kΩ; $B_{(25/50)}$ = 3 470, 3 940, 4 390 K		B574**V2...		●	●	●	
PTC Thermistors								
Temperature sensors								
EIA size: 0805 SMD	T_{NAT} ± ΔT = 90...130 °C ± 5 °C R at T_{NAT} -ΔT: ≤ 5 500 Ω R at T_{NAT} +ΔT: ≥13 300 Ω	Overtemperature protection	B59701A...		●	●		
Leaded disk	T_{NAT} ± ΔT = 90...130 °C ± 5 °C R at T_{NAT} -ΔT: ≤ 550 Ω R at T_{NAT} +ΔT: ≥1 330 Ω	Overtemperature protection	B59100C...		●	●		
Overcurrent protection								
Primary protection	V_{max} = 265 V; I_R = 15...750 mA	Primary overcurrent protection	B598**C...		●	●		
Preheating PTC								
Leaded disk	Customized components	Preheating of electrodes Typ. 30 000 switching cycles	B59...	●	●			

Series	Technical data	Features	Type	CFL	Electronic ballast	Halogen lamps	LED	HID lamps (automotive)
Metal Oxide Varistors								
For 230 V mains, disk Ø 5...20 mm	Surge ratings 8/20 µs = 400 A (for Ø 5 mm) to 8 000 A (for Ø 20 mm)	Approvals: and	B722**S271		●	●	●	
For 110 V mains, disk Ø 5...20 mm		Approvals: and	B722**S131		●	●	●	
RF and VHF Chokes								
BC series	L_R = 1...4 700 µH I_R = 55...1 200 mA	Economic coil for suppr. and ignition Ambient temperature: up to 140 °C	B78108S B78148S	●	●	●		
LBC series	L_R = 1...100 000 µH I_R = 20...2 200 mA	Small size/High rated current Ambient temperature: up to 140 °C	B82144A B82144B	●		●	●	
HLBC series	L_R = 100...10 000 µH I_R = 110...860 mA	Small size Ambient temperature: up to 140 °C	B82145A	●		●	●	
VHF chokes	L_R = 1...420 µH I_R = 0.15...6 A	High resonance frequency	B8213*					●
	L_R = 3...1 200 µH I_R = 0.100...10 A	High resonance frequency	B82111E/B/C					●
Rod core chokes	L_R = 1...100 µH I_R = 2...30 A	Customized solutions	B82116					●
Chokes for Power Lines								
D core chokes	L_R = 3.3...100 mH I_R = 0.35...4.6 A	High self-resonance frequency Environmentally friendly High impulse load capacity	B82731... B82734		●	●		
Ring core chokes	L_R = 0.4...47 mH I_R = 0.3...3.6 A	High stray inductance High resonance frequency	B82721K B82722J		●	●		
Small ring core chokes	L_R =1.1...12 mH I_R = 0.3...2 A	Higher inductance values feasible	B82720A/K		●	●		
Slim line ring core chokes	Product range under development	Low profile Same pinning as B82720K	B82720L		●	●		
Transformers								
EF 16	L_1 = 0.95... 8.45 mH R_{DC} = 0.4... 20.0 Ω	Low stray inductance Low power loss Low temperature rise Low noise Long lifetime	B78310...	●	●			●
EF 20	L_1 = 0.15... 13.0 mH R_{DC} = 0,32... 17.0 Ω		B78311...	●	●			●
EF 25	L_1 = 0.58... 14.7 mH R_{DC} = 0.35... 4.0 Ω		B78313...	●	●			●
EVD 25	L_1 = 0.75... 20.0 mH R_{DC} = 0.6... 2.3 Ω		B78450...	●	●			●
EFD 25 Low Profile	L_1 = 1.6 mH; R_{DC} = 1.35 Ω Height <14.0 mm		B78326 P6390A5	●	●			●
Switching Spark Gaps								
FS	Nominal breakdown voltage = 800 V ± 15 % No. of switches = up to 400 000 Operating temp. = –40...+150 °C	Dimensions: Ø 8 mm, length 6 mm For automotive applications	FS08X1JM					●
SSG	Nominal breakdown voltage = 3000 V ± 20 % No. of switches = up to 1000 000 Operating temp. = –40...+125 °C	Dimensions Ø 8 mm, length 6 mm For projection applications	SSG3X1J	HID projection				

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