

# **Film Capacitors**

EMI Suppression Capacitors (MKP)

Series/Type: B32922H/J ... B32926H/J

Date: June 2018

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#### X2 / 305 V AC

#### **Typical applications**

- X2 class for interference suppression
- "Across the line" applications
- Severe ambient conditions
- For connections in series with the mains
- Capacitive power supply
- Energy meters

#### Climatic

- Max. operating temperature: 110 °C
- Climatic category (IEC 60068-1:2013): 40/110/56

#### Construction

- Dielectric: metallised polypropylene (MKP)
- Wound film technology
- Plastic case (UL 94 V-0)
- Epoxy resin sealing (UL 94 V-0)

#### **Features**

- Self-healing properties
- High stability of capacitance value
- AEC-Q200D compliant

#### **Terminals**

- Parallel wire leads
- Lead-free tinned
- Standard lead lengths: 6-1 mm
- Special lead lengths available on request

#### Marking

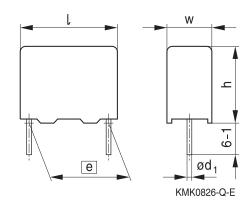
Manufacturer's logo, lot number, date code, rated capacitance (coded), cap. tolerance (code letter), rated AC voltage, series number, sub-class (X2), dielectric code (MKP), climatic category, passive flammability category, approvals

#### **Delivery mode**

Bulk (untaped)
Taped (Ammo pack or reel)
For taping details, refer to chapter
"Taping and packing"

#### **Dimensional drawings**

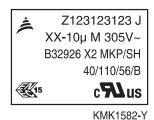
#### **Drawing A1**



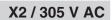
#### Dimensions in mm

Number of wires	Lead spacing <u>e</u> ±0.4	Lead diameter d <sub>1</sub> ±0.05	Туре
2-pin	15.0	0.8	B32922 H/J
2-pin	22.5	0.8	B32923 H/J
2-pin	27.5	0.8	B32924 H/J
2-pin	37.5	1.0	B32926 H/J

#### Marking Example









# **Approvals**

Approval marks	Standards	Certificate
<b>E</b> 15	EN 60384-14:2014 IEC 60384-14:2013	ENEC-00812 (approved by UL)
c <b>91</b> us	UL 60384-14:2014 CSA E60384-14:2013	E97863 (approved by UL)

# Overview of available types

<del> </del>	·-	00 =		
Lead spacing	15 mm	22.5 mm	27.5 mm	37.5 mm
Type	B32922H/J	B32923H/J	B32924H/J	B32926H/J
C <sub>R</sub> (μF)				
0.10				
0.15				
0.2				
0.22				
0.33				
0.410				
0.47				
0.56				
0.68				
0.82				
1.0				
1.5				
2.2				
3.3				
4.7				
6.8				
8.2				
10				
15				





#### X2/305 V AC

#### Ordering codes and packing units

Lead	C <sub>R</sub>	Max. dimensions	Ordering code	Ammo	Reel	Untaped
spacing		$w \times h \times I$	(composition see	pack		
mm	μF	mm	below)	pcs./MOQ	pcs./MOQ	pcs./MOQ
15	0.10	$6.0 \times 11.0 \times 18.0$	B32922H3104+***	3840	4400	4000
	0.15	$7.0 \times 12.5 \times 18.0$	B32922H3154+***	3320	3600	4000
	0.20	$8.0 \times 14.0 \times 18.0$	B32922H3204+***	2920	3000	2000
	0.22	$8.0 \times 14.0 \times 18.0$	B32922H3224M***	2920	3000	2000
	0.22	$8.5 \times 14.5 \times 18.0$	B32922J3224+***	2720	2800	2000
	0.33	$9.0 \times 17.5 \times 18.0$	B32922H3334+***	2560	2800	2000
	0.47	$11.0 \times 18.5 \times 18.0$	B32922H3474+***	_	2200	1200
22.5	0.22	$7.0\times16.0\times26.5$	B32923H3224+***	2320	2400	2520
	0.33	$8.5 \times 16.5 \times 26.5$	B32923J3334+***	1920	2000	2040
	0.41	$8.5 \times 16.5 \times 26.5$	B32923H3414M***	1920	2000	2040
	0.47	$10.5 \times 16.5 \times 26.5$	B32923H3474+***	1560	1600	2160
	0.56	$10.5 \times 18.5 \times 26.5$	B32923H3564+***	1560	1600	2160
	0.68	$10.5 \times 18.5 \times 26.5$	B32923H3684M***	1560	1600	2160
	0.68	$11.0 \times 20.5 \times 26.5$	B32923J3684+***	_	_	2040
	0.82	$11.0 \times 20.5 \times 26.5$	B32923H3824+***	_	_	2040
	1.0	$12.0 \times 22.0 \times 26.5$	B32923H3105+***	_	_	1800
	1.5	$14.5 \times 29.5 \times 26.5$	B32923H3155+***	_	_	1040
-	2.2	$14.5 \times 29.5 \times 26.5$	B32923H3225M***	_	_	1040

MOQ = Minimum Order Quantity, consisting of 4 packing units. Further intermediate capacitance values on request.

#### Composition of ordering code

+ = Capacitance tolerance code:

 $M = \pm 20\%$  $K = \pm 10\%$ 

\*\*\* = Packaging code:

289 = Straight terminals, Ammo pack for lead spacing 15 mm and 22.5 mm

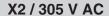
189 = Straight terminals, Reel

003 = Straight terminals, untaped

(lead length 3.2 ±0.3 mm)

000 = Straight terminals, untaped (lead length 6-1 mm)







#### Ordering codes and packing units

Lead	C <sub>R</sub>	Max. dimensions	Ordering code	Ammo	Reel	Untaped
spacing		$w \times h \times I$	(composition see	pack		
mm	μF	mm	below)	pcs./MOQ	pcs./MOQ	pcs./MOQ
27.5	0.68	$11.0 \times 19.0 \times 31.5$	B32924H3684+***	_	1400	1280
	1.0	$11.0 \times 21.0 \times 31.5$	B32924H3105+***	_	1400	1280
	1.5	$13.5 \times 23.0 \times 31.5$	B32924H3155M***	_	1000	1040
	1.5	$14.0 \times 24.5 \times 31.5$	B32924J3155+***	_	_	1040
	2.2	$16.0 \times 32.0 \times 31.5$	B32924J3225+***	_	_	880
	2.2	$18.0 \times 27.5 \times 31.5$	B32924H3225+***	_	_	800
	3.3	$18.0 \times 33.0 \times 31.5$	B32924J3335+***	_	_	800
	3.3	$19.0 \times 30.0 \times 31.5$	B32924H3335M***	_	_	720
	4.7	$22.0 \times 36.5 \times 31.5$	B32924H3475+***	_	_	640
37.5	2.2	$14.0 \times 25.0 \times 42.0$	B32926H3225+***	_	_	1380
	3.3	$16.0 \times 28.5 \times 42.0$	B32926H3335+***	_	_	800
	4.7	$18.0 \times 32.5 \times 42.0$	B32926H3475+***	_	_	720
	6.8	$20.0 \times 39.5 \times 42.0$	B32926H3685+***	_	_	640
	8.2	$28.0 \times 37.0 \times 42.0$	B32926J3825+***	_	_	440
	10.0	$28.0 \times 37.0 \times 42.0$	B32926H3106M***	_	_	440
	10.0	$28.0 \times 42.5 \times 42.0$	B32926J3106+***	_	_	440
	15.0	$33.0 \times 48.0 \times 42.0$	B32926H3156+***	_	_	180

MOQ = Minimum Order Quantity, consisting of 4 packing units. Further intermediate capacitance values on request.

#### Composition of ordering code

+ = Capacitance tolerance code:

 $M = \pm 20\%$ 

 $K = \pm 10\%$ 

\*\*\* = Packaging code:

289 = Straight terminals, Ammo pack for lead spacing 15 mm and 22.5 mm

189 = Straight terminals, Reel

003 = Straight terminals, untaped (lead length 3.2 ±0.3 mm)

000 = Straight terminals, untaped

(lead length 6-1 mm)





#### X2 / 305 V AC

## **Technical data and specifications**

Reference standard: IEC 60384-14:2013/UL 60384-14:2014 and AEC-Q200D. All data given at T = 20 °C, unless otherwise specified.

Rated AC voltage	305 V AC (50/60 Hz)				
(IEC 60384-14:2013)					
Maximum continuous DC voltage $V_{\text{DC}}$	630 V DC				
DC voltage test	Between ter	Between terminals: 1312 V DC / 2 s			
The repetition of this DC voltage test r	nay damage	the capacit	or. Special	care mu	ıst be taken in
case of use several capacitors in a pa	rallel configu	ration.			
Max. operating temperature T <sub>op,max</sub>	+110 °C				
Dissipation factor tan δ (in 10 <sup>-3</sup> )	at	C <sub>R</sub> ≤0.1 μF	0.1μF <c<sub>F</c<sub>	<sub>R</sub> ≤2.2 μF	C <sub>R</sub> >2.2 μF
at 20 °C (upper limit values)	1 kHz	1.0	1.0		2.0
	100 kHz	5.0	_		_
Insulation resistance $R_{ins}$ (in $G\Omega$ )	$C_R \le 0.33 \ \mu F$		$C_R > 0.33$	μF	
or time constant $\tau = C_R \cdot R_{ins}$ (in s)	100 GΩ		30 000 s		
at 20 °C, rel. humidity ≤ 65%					
(minimum as-delivered values)					
Operating AC voltage V <sub>op</sub>	$T_{op} \le 110  ^{\circ}C$	;	$V_{op} = V_{AC}$	<sub>C</sub> (continuously)	
at high temperature	$T_{op} \le 110  ^{\circ}C$	)	$V_{op} = 1.25$	5 · V <sub>AC</sub> (1000 h)	
Passive flammability category	В				
Damp heat test			Test 1:	,	Test 2:
	Temperatur	e:	85 °C ±2 °	С	60 °C ±2 °C
	Relative hur	midity (RH):	85% ±2%		95% ±2%
	Test duratio	n:	1000 h		1000 h
	Voltage valu	ie:	240 V AC,	50 Hz	240 V AC, 50 Hz
Limit values after damp heat test	Capacitance	o chango IA	C/Cl	≤ 10%	
Limit values after damp fleat test		•			0 ( . 4 )
	Dissipation factor change $\Delta \tan \delta$				³ (at 1 kHz)
					I spacing
					and 22.5 mm
	Dissipation factor change $\Delta tan \delta$				
			for lead spacing		
			27.5 mm and 37.5 mm		
	$\Delta$ tan $\delta$ /tan $\delta$		$\leq$ 2000% (at 10 kHz)		
	Insulation re	sistance R	ns	$\geq$ 200 M $\Omega$	



X2/305 V AC



#### Pulse handling capability

"dV/dt" represents the maximum permissible voltage change per unit of time for non-sinusoidal voltages, expressed in  $V/\mu s$ .

" $k_0$ " represents the maximum permissible pulse characteristic of the waveform applied to the capacitor, expressed in  $V^2/\mu s$ .

#### Note:

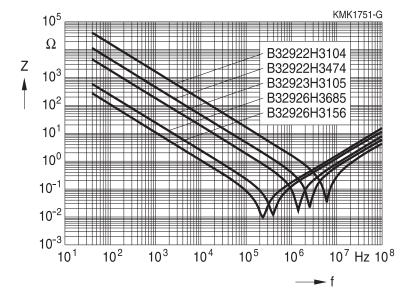
The values of dV/dt and  $k_0$  provided below must not be exceeded in order to avoid damaging the capacitor.

#### dV/dt and ko values

Lead spacing	15 mm	22.5 mm	27.5 mm	37.5 mm
dV/dt in V/μs	340	170	120	80
k <sub>0</sub> in V²/μs	292400	146200	103200	68800

#### Impedance Z versus frequency f

(typical values)



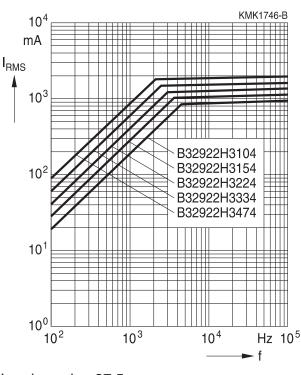




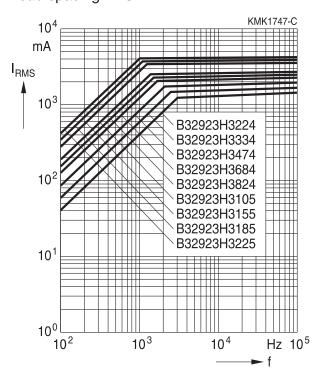
#### X2 / 305 V AC

# Permissible AC current $I_{RMS}$ versus frequency f (for sinusoidal waveform, TA $\leq$ 90 °C and $\Delta$ ESR <100% from receipt condition)

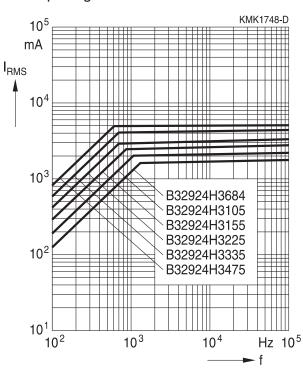
#### Lead spacing 15 mm



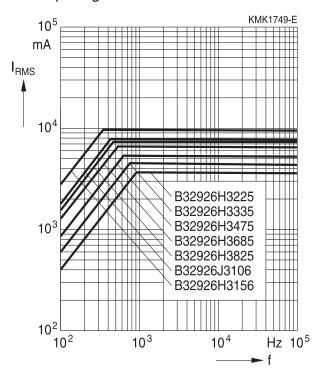
#### Lead spacing 22.5 mm



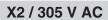
#### Lead spacing 27.5 mm



Lead spacing 37.5 mm









## **Testing and Standards**

Test	Reference	<b>Conditions of test</b>		Performance requirements
Electrical	IEC	Voltage Proof:		Within specified limits
parameters	60384-14:2013	Between terminals:		
		$4.3 \times V_R$ (DC), 2s		
		Terminals and enclo	osure:	
		2 V <sub>R</sub> + 1500 V AC		
		Insulation resistance	e, R <sub>ins</sub>	
		Capacitance, C		
		Dissipation factor, to	an δ	
Robustness	IEC	Tensile strength (te	st Ua1)	Capacitance and $tan \delta$
of termina-	60068-2-21:2006	Wire diameter	Tensile	within specified limits
tions			force	
		$0.5 < d_1 \le 0.8 \text{ mm}$	10 N	
		$0.8 < d_1 \le 1.25 \text{ mm}$	20 N	
Resistance	IEC	Solder bath tempera	ature at	$\Delta C/C_0 \le 5\%$
to soldering	60068-2-20.2008,	260 ±5 °C, immersion	on for	tan $\delta$ within specified limits
heat	test Tb,	10 seconds		·
	method 1A			
Rapid	IEC	T <sub>A</sub> = lower category	temperature	No visible damage
change of	60384-14:2013	$T_B$ = upper category	temperature	$ \Delta C/C_0  \leq 5\%$
temperature		Five cycles, duratio	n t = 30 min.	tan $\delta$ within specified limits
Vibration	IEC	Test F <sub>C</sub> : vibration si	nusoidal	No visible damage
	60384-14:2013	Displacement: 0.75	mm	
		Accleration: 98 m/s	2	
		Frequency: 10 Hz	. 500 Hz	
		Test duration: 3 orth	nogonal axes,	
		2 hours each axe		
Bump	IEC	Test Eb: Total 4000	0 bumps with	No visible damage
	60384-14:2013	400 m/s <sup>2</sup> mounted on PCB		$ \Delta C/C_0  \le 5\%$
		6 ms duration		tan $\delta$ within specified limits
Damp heat,	IEC	Test Ca		No visible damage
steady	60384-14:2013	40 °C / 93% RH / 56 days		$ \Delta C/C_0  \le 5\%$
state				$ \Delta \tan \delta  \le 0.008$ for C $\le 1 \mu$ F
				$ \Delta \tan \delta  \le 0.005 \text{ for C} > 1 \mu\text{F}$
				Voltage proof
				$R_{ins} \ge 50\%$ of initial limit





#### X2/305 V AC

Test	Reference	Conditions of test	Performance requirements
Impulse	IEC	3 impulses	No visible damage
test	60384-14:2013	$T_{\rm B}$ / 1.25 $V_{\rm R}$ / 1000 hours,	$ \Delta C/C_0  \leq 10\%$
Endurance		1000 V <sub>RMS</sub> for 0.1 s every hour	$ \Delta \tan \delta  \le 0.008$ for $C \le 1 \mu F$
			$ \Delta \tan \delta  \le 0.005$ for C > 1 $\mu$ F
			Voltage proof
			$R_{ins} \ge 50\%$ of initial limit
Passive	IEC	Flame applied for a period of	В
flammability	60384-14:2013	time depending on capacitor	
		volume	
Active	IEC	20 discharges at 2.5 kV + V <sub>R</sub>	The cheesecloth shall not
flammability	60384-14:2013		burn with a flame

#### **Mounting guidelines**

#### 1 Soldering

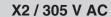
#### 1.1 Solderability of leads

The solderability of terminal leads is tested to IEC 60068-2-20, test Ta, method 1.

Before a solderability test is carried out, terminals are subjected to accelerated ageing (to IEC 60068-2-2, test Ba: 4 h exposure to dry heat at 155 °C). Since the ageing temperature is far higher than the upper category temperature of the capacitors, the terminal wires should be cut off from the capacitor before the ageing procedure to prevent the solderability being impaired by the products of any capacitor decomposition that might occur.

Solder bath temperature	235 ±5 °C
Soldering time	2.0 ±0.5 s
Immersion depth	2.0 +0/-0.5 mm from capacitor body or seating plane
Evaluation criteria:	
Visual inspection	Wetting of wire surface by new solder ≥90%, free-flowing solder



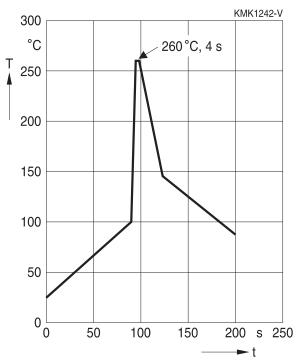




## 1.2 Resistance to soldering heat

Resistance to soldering heat is tested to IEC 60068-2-20, test Tb, method 1. Conditions:

Series	s	Solder bath temperature	Soldering time
MKT	boxed (except $2.5 \times 6.5 \times 7.2$ mm) coated uncoated (lead spacing >10 mm)	260 ±5 °C	10 ±1 s
MFP			
MKP	(lead spacing >7.5 mm)		
MKT	boxed (case $2.5 \times 6.5 \times 7.2$ mm)		5 ±1 s
MKP	(lead spacing ≤7.5 mm)		<4 s
MKT	uncoated (lead spacing ≤10 mm) insulated (B32559)		recommended soldering profile for MKT uncoated (lead spacing ≤ 10 mm) and insulated (B32559)



Immersion depth	2.0 + 0/-0.5 mm from capacitor body or seating plane
·	
Shield	Heat-absorbing board, $(1.5 \pm 0.5)$ mm thick, between
	capacitor body and liquid solder
Evaluation criteria:	
Visual inspection	No visible damage
.0/0	2% for MKT/MKP/MFP
$\Delta C/C_0$	5% for EMI suppression capacitors
$tan \delta$	As specified in sectional specification





#### X2 / 305 V AC

#### 1.3 General notes on soldering

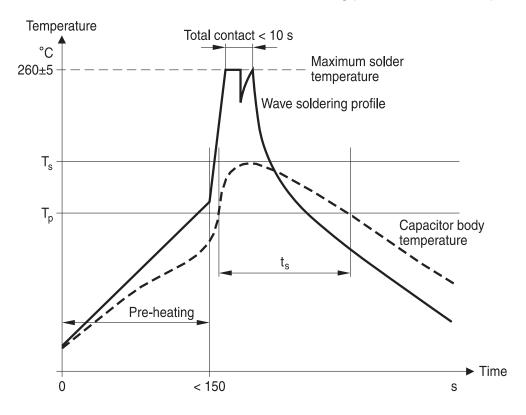
Permissible heat exposure loads on film capacitors are primarily characterized by the upper category temperature  $T_{\text{max}}$ . Long exposure to temperatures above this type-related temperature limit can lead to changes in the plastic dielectric and thus change irreversibly a capacitor's electrical characteristics. For short exposures (as in practical soldering processes) the heat load (and thus the possible effects on a capacitor) will also depend on other factors like:

- Pre-heating temperature and time
- Forced cooling immediately after soldering
- Terminal characteristics: diameter, length, thermal resistance, special configurations (e.g. crimping)
- Height of capacitor above solder bath
- Shadowing by neighboring components
- Additional heating due to heat dissipation by neighboring components
- Use of solder-resist coatings

The overheating associated with some of these factors can usually be reduced by suitable countermeasures. For example, if a pre-heating step cannot be avoided, an additional or reinforced cooling process may possibly have to be included.

#### **EPCOS** recommendations

As a reference, the recommended wave soldering profile for our film capacitors is as follows:

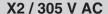


T<sub>s</sub>: Capacitor body maximum temperature at wave soldering

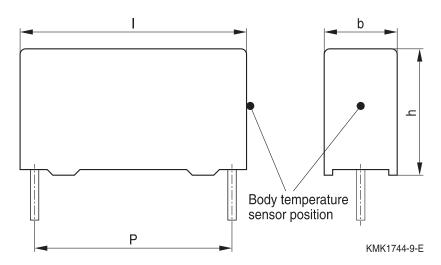
T<sub>p</sub>: Capacitor body maximum temperature at pre-heating

KMK1745-A-E









Body temperature should follow the description below:

MKP capacitor

During pre-heating:  $T_p \le 110 \, ^{\circ}\text{C}$ During soldering:  $T_s \le 120 \, ^{\circ}\text{C}$ ,  $t_s \le 45 \, \text{s}$ 

MKT capacitor

During pre-heating:  $T_p \le 125$  °C During soldering:  $T_s \le 160$  °C,  $t_s \le 45$  s

When SMD components are used together with leaded ones, the film capacitors should not pass into the SMD adhesive curing oven. The leaded components should be assembled after the SMD curing step.

Leaded film capacitors are not suitable for reflow soldering.

In order to ensure proper conditions for manual or selective soldering, the body temperature of the capacitor  $(T_s)$  must be  $\leq 120$  °C.

One recommended condition for manual soldering is that the tip of the soldering iron should be <360 °C and the soldering contact time should be no longer than 3 seconds.

For uncoated MKT capacitors with lead spacings ≤10 mm (B32560/B32561) the following measures are recommended:

- pre-heating to not more than 110 °C in the preheater phase
- rapid cooling after soldering

Please refer to EPCOS Film Capacitor Data Book in case more details are needed.





#### X2 / 305 V AC

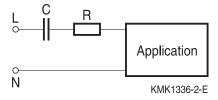
#### Application note for the different possible X1 / X2 positions

# In series with the powerline (i.e. capacitive power supply)

Typical Applications:

- Power meters
- ECUs for white goods and household appliances
- Different sensor applications
- Severe ambient conditions

#### **Basic circuit**



#### Required features

- High capacitance stability over the lifetime
- Narrow tolerances for a controlled current supply

#### **Recommended EPCOS product series**

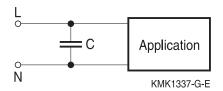
- B3293\* (305 V AC) heavy duty with EN approval for X2 (UL Q1/2010)
- B3265\* MKP series standard MKP capacitor without safety approvals
- B3267\*L MKP series standard MKP capacitor without safety approvals
- B3292\*H/J (305 V AC), severe ambient condition, approved as X2

### In parallel with the powerline

Typical Applications:

Standard X2 are used parallel over the mains for reducing electromagnetic interferences coming from the grid. For such purposes they must meet the applicable EMC directives and standards.

#### **Basic circuit**



#### **Required features**

- Standard safety approvals (ENEC, UL, CSA, CQC)
- High pulse load capability
- Withstand surge voltages

#### **Recommended EPCOS product series**

- B3292\*C/D (305 V AC) standard series, approved as X2
- B3291\* (330 V AC), approved as X1
- B3291\* (530 V AC), approved as X1
- B3292\*H/J (305 V AC), severe ambient condition, approved as X2



X2 / 305 V AC



#### **Cautions and warnings**

- Do not exceed the upper category temperature (UCT).
- Do not apply any mechanical stress to the capacitor terminals.
- Avoid any compressive, tensile or flexural stress.
- Do not move the capacitor after it has been soldered to the PC board.
- Do not pick up the PC board by the soldered capacitor.
- Do not place the capacitor on a PC board whose PTH hole spacing differs from the specified lead spacing.
- Do not exceed the specified time or temperature limits during soldering.
- Avoid external energy inputs, such as fire or electricity.
- Avoid overload of the capacitors.
- Consult us if application is with severe temperature and humidity condition.
- There are no serviceable or repairable parts inside the capacitor. Opening the capacitor or any attempts to open or repair the capacitor will void the warranty and liability of EPCOS.
- Please note that the standards referred to in this publication may have been revised in the meantime.

The table below summarizes the safety instructions that must always be observed. A detailed description can be found in the relevant sections of the chapters "General technical information" and "Mounting guidelines".

Topic	Safety information	Reference chapter "General technical information"
Storage	Make sure that capacitors are stored within the specified	4.5
conditions	range of time, temperature and humidity conditions.	"Storage conditions"
Flammability	Avoid external energy, such as fire or electricity (passive	5.3
	flammability), avoid overload of the capacitors (active	"Flammability"
	flammability) and consider the flammability of materials.	
Resistance to	Do not exceed the tested ability to withstand vibration.	5.2
vibration	The capacitors are tested to IEC 60068-2-6:2007.	"Resistance to
	EPCOS offers film capacitors specially designed for	vibration"
	operation under more severe vibration regimes such as	
	those found in automotive applications. Consult our	
	catalog "Film Capacitors for Automotive Electronics".	

Topic	Safety information	Reference chapter "Mounting guidelines"
Soldering	Do not exceed the specified time or temperature limits	1 "Soldering"
	during soldering.	
Cleaning	Use only suitable solvents for cleaning capacitors.	2 "Cleaning"





#### X2 / 305 V AC

Topic	Safety information	Reference chapter
		"Mounting guidelines"
Embedding of	When embedding finished circuit assemblies in plastic	3 "Embedding of
capacitors in	resins, chemical and thermal influences must be taken	capacitors in finished
finished	into account.	assemblies"
assemblies	Caution: Consult us first, if you also wish to embed other	
	uncoated component types!	

#### **Design of EMI Capacitors**

EPCOS EMI capacitors use polypropylene (PP) film metalized with a thin layer of Zinc (Zn). The following key points have made this design suitable to IEC/UL testing, holding a minimum size.

- Overvoltage AC capability with very high temperature Endurance test of IEC 60384-14:2013 (4th edition) / UL 60384-14:2014 (2nd edition) must be performed at  $1.25 \times V_R$  at maximum temperature, during 1000 hours, with a capacitance drift less than 10%.
- Higher breakdown voltage withstanding if compared to other film metallizations, like Aluminum. IEC 60384-14:2013 (4<sup>th</sup> edition) / UL 60384-14:2014 (2<sup>nd</sup> edition) establishes high voltage tests performed at  $4.3 \times V_R 1$  minute, impulse testing at 2500 V for C = 1 µF and active flammability tests.
- Damp heat steady state: 40 °C/ 93% RH / 56 days. (without voltage or current load)

#### Effect of humidity on capacitance stability

Long contact of a film capacitor with humidity can produce irreversible effects. Direct contact with liquid water or excess exposure to high ambient humidity or dew will eventually remove the film metallization and thus destroy the capacitor. Plastic boxed capacitors must be properly tested in the final application at the worst expected conditions of temperature and humidity in order to check if any parameter drift may provoke a circuit malfunction.

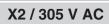
In case of penetration of humidity through the film, the layer of Zinc can be degraded, specially under AC operation (change of polarity), accelerated by the temperature, provoking an increment of the serial resistance of the electrode and eventually a reduction of the capacitance value. For DC operation, the parameter drift is much less.

Plastic boxes and resins can not protect 100% against humidity. Metal enclosures, resin potting or coatings or similar measures by customers in their applications will offer additional protection against humidity penetration.

#### Display of ordering codes for EPCOS products

The ordering code for one and the same product can be represented differently in data sheets, data books, other publications and the website of EPCOS, or in order-related documents such as shipping notes, order confirmations and product labels. The varying representations of the ordering codes are due to different processes employed and do not affect the specifications of the respective products. Detailed information can be found on the Internet under www.epcos.com/orderingcodes.







# Symbols and terms

Symbol	English	German
α	Heat transfer coefficient	Wärmeübergangszahl
$\alpha_{\text{C}}$	Temperature coefficient of capacitance	Temperaturkoeffizient der Kapazität
Α	Capacitor surface area	Kondensatoroberfläche
$\beta_{C}$	Humidity coefficient of capacitance	Feuchtekoeffizient der Kapazität
С	Capacitance	Kapazität
$C_R$	Rated capacitance	Nennkapazität
ΔC	Absolute capacitance change	Absolute Kapazitätsänderung
ΔC/C	Relative capacitance change (relative deviation of actual value)	Relative Kapazitätsänderung (relative Abweichung vom Ist-Wert)
$\Delta C/C_R$	Capacitance tolerance (relative deviation from rated capacitance)	Kapazitätstoleranz (relative Abweichung vom Nennwert)
dt	Time differential	Differentielle Zeit
Δt	Time interval	Zeitintervall
ΔΤ	Absolute temperature change (self-heating)	Absolute Temperaturänderung (Selbsterwärmung)
∆tan δ	Absolute change of dissipation factor	Absolute Änderung des Verlustfaktors
$\Delta V$	Absolute voltage change	Absolute Spannungsänderung
dV/dt	Time differential of voltage function (rate of voltage rise)	Differentielle Spannungsänderung (Spannungsflankensteilheit)
$\Delta V/\Delta t$	Voltage change per time interval	Spannungsänderung pro Zeitintervall
E	Activation energy for diffusion	Aktivierungsenergie zur Diffusion
ESL	Self-inductance	Eigeninduktivität
ESR	Equivalent series resistance	Ersatz-Serienwiderstand
f	Frequency	Frequenz
f <sub>1</sub>	Frequency limit for reducing permissible AC voltage due to thermal limits	Grenzfrequenz für thermisch bedingte Reduzierung der zulässigen Wechselspannung
<b>f</b> <sub>2</sub>	Frequency limit for reducing permissible AC voltage due to current limit	Grenzfrequenz für strombedingte Reduzierung der zulässigen Wechselspannung
f <sub>r</sub>	Resonant frequency	Resonanzfrequenz
$F_{\mathtt{D}}$	Thermal acceleration factor for diffusion	Therm. Beschleunigungsfaktor zur Diffusion
F <sub>T</sub>	Derating factor	Deratingfaktor
i	Current (peak)	Stromspitze
I <sub>C</sub>	Category current (max. continuous current)	Kategoriestrom (max. Dauerstrom)

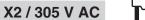




## X2/305 V AC

Symbol	English	German
I <sub>RMS</sub>	(Sinusoidal) alternating current,	(Sinusförmiger) Wechselstrom
	root-mean-square value	
$i_z$	Capacitance drift	Inkonstanz der Kapazität
$k_0$	Pulse characteristic	Impulskennwert
Ls	Series inductance	Serieninduktivität
λ	Failure rate	Ausfallrate
$\lambda_{o}$	Constant failure rate during useful	Konstante Ausfallrate in der
	service life	Nutzungsphase
$\lambda_{\text{test}}$	Failure rate, determined by tests	Experimentell ermittelte Ausfallrate
$P_{diss}$	Dissipated power	Abgegebene Verlustleistung
$P_{gen}$	Generated power	Erzeugte Verlustleistung
Q	Heat energy	Wärmeenergie
ρ	Density of water vapor in air	Dichte von Wasserdampf in Luft
R	Universal molar constant for gases	Allg. Molarkonstante für Gas
R	Ohmic resistance of discharge circuit	Ohmscher Widerstand des
		Entladekreises
$R_{i}$	Internal resistance	Innenwiderstand
$R_{ins}$	Insulation resistance	Isolationswiderstand
$R_P$	Parallel resistance	Parallelwiderstand
$R_s$	Series resistance	Serienwiderstand
S	severity (humidity test)	Schärfegrad (Feuchtetest)
t	Time	Zeit
Т	Temperature	Temperatur
τ	Time constant	Zeitkonstante
tan $\delta$	Dissipation factor	Verlustfaktor
tan $\delta_{\scriptscriptstyle D}$	Dielectric component of dissipation factor	Dielektrischer Anteil des Verlustfaktors
tan $\delta_{P}$	Parallel component of dissipation factor	Parallelanteil des Verlfustfaktors
tan $\delta_{\text{S}}$	Series component of dissipation factor	Serienanteil des Verlustfaktors
T <sub>A</sub>	Temperature of the air surrounding the component	Temperatur der Luft, die das Bauteil umgibt
$T_{max}$	Upper category temperature	Obere Kategorietemperatur
T <sub>min</sub>	Lower category temperature	Untere Kategorietemperatur
t <sub>OL</sub>	Operating life at operating temperature	Betriebszeit bei Betriebstemperatur und
-	and voltage	-spannung
$T_op$	Operating temperature, $T_A + \Delta T$	Beriebstemperatur, $T_A + \Delta T$
T <sub>R</sub>	Rated temperature	Nenntemperatur
$T_{ref}$	Reference temperature	Referenztemperatur
$t_{SL}$	Reference service life	Referenz-Lebensdauer







Symbol	English	German
$V_{AC}$	AC voltage	Wechselspannung
$V_{C}$	Category voltage	Kategoriespannung
$V_{C,RMS}$	Category AC voltage	(Sinusförmige)
		Kategorie-Wechselspannung
$V_{CD}$	Corona-discharge onset voltage	Teilentlade-Einsatzspannung
$V_{ch}$	Charging voltage	Ladespannung
$V_{DC}$	DC voltage	Gleichspannung
$V_{FB}$	Fly-back capacitor voltage	Spannung (Flyback)
$V_{i}$	Input voltage	Eingangsspannung
$V_{o}$	Output voltage	Ausgangssspannung
$V_{op}$	Operating voltage	Betriebsspannung
$V_p$	Peak pulse voltage	Impuls-Spitzenspannung
$V_{pp}$	Peak-to-peak voltage Impedance	Spannungshub
$V_R$	Rated voltage	Nennspannung
Ŷ <sub>R</sub>	Amplitude of rated AC voltage	Amplitude der Nenn-Wechselspannung
$V_{RMS}$	(Sinusoidal) alternating voltage,	(Sinusförmige) Wechselspannung
	root-mean-square value	
$V_{SC}$	S-correction voltage	Spannung bei Anwendung "S-correction"
$V_{sn}$	Snubber capacitor voltage	Spannung bei Anwendung
		"Beschaltung"
Z	Impedance	Scheinwiderstand
е	Lead spacing	Rastermaß



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The following applies to all products named in this publication:

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