

## Film Capacitors

### Metallized Polypropylene Film Capacitors (MKP)

**Series/Type:** B32774 ... B32778

**Date:** February 2017

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**Recommended applications**

- Frequency converters
- Industrial and high-end power supplies
- Solar inverters

**Climatic**

- Max. operating temperature: 105 °C (case)
- Climatic category (IEC 60068-1): 40/105/56

**Construction**

- Dielectric: Polypropylene (MKP)
- Plastic case (UL 94 V-0)
- Epoxy resin sealing (UL 94 V-0)

**Features**

- Capacitance values up to 480  $\mu\text{F}$
- High CV product, compact
- Good self-healing properties
- Over-voltage capability
- Low losses with high current capability
- High reliability
- Long useful life
- RoHS-compatible

**Terminals**

- Parallel wire leads, lead-free tinned
- 2-pin, 4-pin and 12-pin versions
- Standard lead lengths: 6 – 1 mm

**Marking**

Manufacturer's logo and lot number, date code, rated capacitance (coded), capacitance tolerance (code letter) and rated DC voltage

**Delivery mode**

Bulk (untaped)



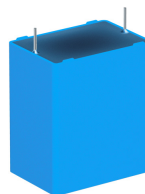
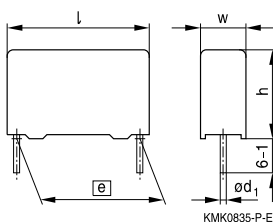
## Dimensional drawings

Dimensions in mm

| Number of wires | Lead spacing $[e] \pm 0.4$ | Lead diameter $d_1 \pm 0.05$ | Type    |
|-----------------|----------------------------|------------------------------|---------|
| 2-pin           | 27.5                       | 0.8                          | B32774D |
| 2-pin           | 37.5                       | 1.0                          | B32776E |
| 2-pin           | 37.5                       | 1.0                          | B32776T |
| 4-pin           | 37.5                       | 1.2                          | B32776G |
| 4-pin           | 37.5                       | 1.2                          | B32776T |
| 4-pin           | 52.5                       | 1.2                          | B32778T |
| 4-pin           | 52.5                       | 1.2                          | B32778G |
| 12-pin          | 52.5                       | 1.2                          | B32778J |

## Dimensional drawings 2-pin versions

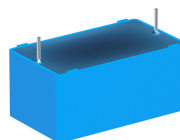
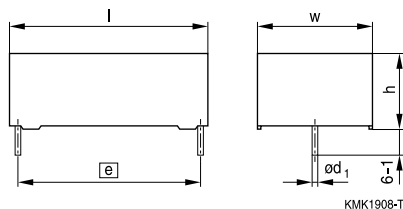
### B32774D, B32776E



|                              | B32774D | B32776E |
|------------------------------|---------|---------|
| Lead spacing $[e] \pm 0.4$ : | 27.5    | 37.5    |
| Lead diameter $d_1$ :        | 0.8     | 1.0     |

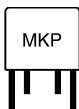
(Dimensions in mm)

### B32776T (low profile)



|                              |      |
|------------------------------|------|
| Lead spacing $[e] \pm 0.4$ : | 37.5 |
| Lead diameter $d_1$ :        | 1.0  |

(Dimensions in mm)

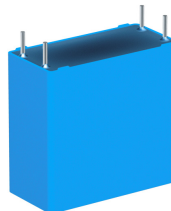
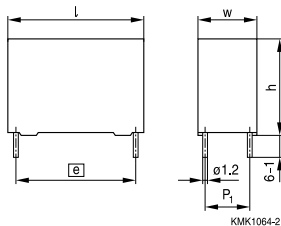


**B32774 ... B32778**

**MKP DC link – high density series up to 480  $\mu$ F**

**Dimensional drawings 4-pin versions**

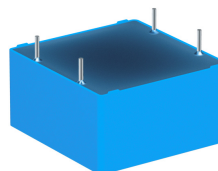
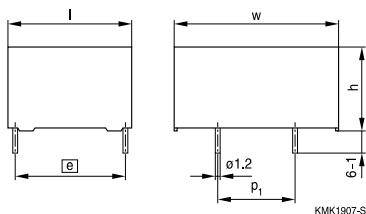
**B32776G, B32778G**



|                            | B32776G | B32778G |
|----------------------------|---------|---------|
| Lead spacing $e \pm 0.4$ : | 37.5    | 52.5    |
| Lead diameter $d_1$ :      | 1.2     | 1.2     |

(Dimensions in mm)

**B32776T, B32778T (low profile)**

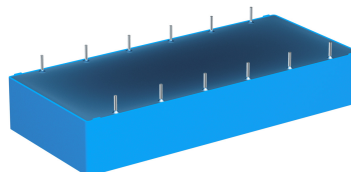
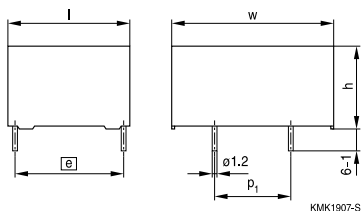


|                            | B32776T | B32778T |
|----------------------------|---------|---------|
| Lead spacing $e \pm 0.4$ : | 37.5    | 52.5    |
| Lead diameter $d_1$ :      | 1.2     | 1.2     |

(Dimensions in mm)

**Dimensional drawing 12-pin version**

**B32778J**



|                            |      |
|----------------------------|------|
| Lead spacing $e \pm 0.4$ : | 52.5 |
| Lead diameter $d_1$ :      | 1.2  |

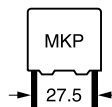
(Dimensions in mm)


**Overview of available types**

| Lead spacing     | 27.5 mm |     |      |      | 37.5 mm |     |     |     |      |      |
|------------------|---------|-----|------|------|---------|-----|-----|-----|------|------|
| Type             | B32774  |     |      |      | B32776  |     |     |     |      |      |
| Page             | 7       |     |      |      | 8       |     |     |     |      |      |
| $V_R$ (V DC)     | 450     | 800 | 1100 | 1300 | 450     | 575 | 800 | 900 | 1100 | 1300 |
| $C_R$ ( $\mu$ F) |         |     |      |      |         |     |     |     |      |      |
| 1.5              |         |     |      |      |         |     |     |     |      |      |
| 2.0              |         |     |      |      |         |     |     |     |      |      |
| 2.7              |         |     |      |      |         |     |     |     |      |      |
| 3.0              |         |     |      |      |         |     |     |     |      |      |
| 3.3              |         |     |      |      |         |     |     |     |      |      |
| 3.5              |         |     |      |      |         |     |     |     |      |      |
| 3.9              |         |     |      |      |         |     |     |     |      |      |
| 5.0              |         |     |      |      |         |     |     |     |      |      |
| 6.8              |         |     |      |      |         |     |     |     |      |      |
| 7.0              |         |     |      |      |         |     |     |     |      |      |
| 7.5              |         |     |      |      |         |     |     |     |      |      |
| 8.0              |         |     |      |      |         |     |     |     |      |      |
| 8.5              |         |     |      |      |         |     |     |     |      |      |
| 9.0              |         |     |      |      |         |     |     |     |      |      |
| 10               |         |     |      |      |         |     |     |     |      |      |
| 12               |         |     |      |      |         |     |     |     |      |      |
| 13               |         |     |      |      |         |     |     |     |      |      |
| 14               |         |     |      |      |         |     |     |     |      |      |
| 15               |         |     |      |      |         |     |     |     |      |      |
| 16               |         |     |      |      |         |     |     |     |      |      |
| 20               |         |     |      |      |         |     |     |     |      |      |
| 22               |         |     |      |      |         |     |     |     |      |      |
| 25               |         |     |      |      |         |     |     |     |      |      |
| 30               |         |     |      |      |         |     |     |     |      |      |
| 35               |         |     |      |      |         |     |     |     |      |      |
| 40               |         |     |      |      |         |     |     |     |      |      |
| 45               |         |     |      |      |         |     |     |     |      |      |
| 50               |         |     |      |      |         |     |     |     |      |      |
| 60               |         |     |      |      |         |     |     |     |      |      |
| 65               |         |     |      |      |         |     |     |     |      |      |


**B32774 ... B32778**
**MKP DC link – high density series up to 480  $\mu\text{F}$** 

|                         |         |     |     |     |      |      |
|-------------------------|---------|-----|-----|-----|------|------|
| Lead spacing            | 52.5 mm |     |     |     |      |      |
| Type                    | B32778  |     |     |     |      |      |
| Page                    | 11      |     |     |     |      |      |
| $V_R$ (V DC)            | 450     | 575 | 800 | 900 | 1100 | 1300 |
| $C_R$ ( $\mu\text{F}$ ) |         |     |     |     |      |      |
| 14                      |         |     |     |     |      |      |
| 20                      |         |     |     |     |      |      |
| 25                      |         |     |     |     |      |      |
| 27                      |         |     |     |     |      |      |
| 30                      |         |     |     |     |      |      |
| 35                      |         |     |     |     |      |      |
| 38                      |         |     |     |     |      |      |
| 40                      |         |     |     |     |      |      |
| 42                      |         |     |     |     |      |      |
| 45                      |         |     |     |     |      |      |
| 50                      |         |     |     |     |      |      |
| 55                      |         |     |     |     |      |      |
| 58                      |         |     |     |     |      |      |
| 60                      |         |     |     |     |      |      |
| 70                      |         |     |     |     |      |      |
| 75                      |         |     |     |     |      |      |
| 80                      |         |     |     |     |      |      |
| 90                      |         |     |     |     |      |      |
| 100                     |         |     |     |     |      |      |
| 110                     |         |     |     |     |      |      |
| 120                     |         |     |     |     |      |      |
| 130                     |         |     |     |     |      |      |
| 150                     |         |     |     |     |      |      |
| 170                     |         |     |     |     |      |      |
| 180                     |         |     |     |     |      |      |
| 200                     |         |     |     |     |      |      |
| 210                     |         |     |     |     |      |      |
| 270                     |         |     |     |     |      |      |
| 360                     |         |     |     |     |      |      |
| 480                     |         |     |     |     |      |      |


**Ordering codes and packing units (lead spacing 27.5 mm)**

| $C_{R1}$ <sup>1)</sup>  | Max. dimensions<br>$w \times h \times l$ | $P_1$ | Ordering code<br>(composition see<br>below) | $I_{RMS,max}$ <sup>2)</sup><br>70 °C<br>10 kHz<br>A | $ESR_{typ}$<br>70 °C<br>10 kHz<br>m $\Omega$ | $ESL_{typ}$ <sup>3)</sup><br>70 °C<br>10 kHz<br>nH | $\tan \delta$<br>1 kHz<br>10 <sup>-3</sup> | $\tan \delta$<br>10 kHz<br>10 <sup>-3</sup> | pcs.<br>MOQ |
|---|--|-------|---|---|--|--|--|---|-------------|
| $\mu$ F   | mm                                       | mm    |   |   |  |  |  |   |             |
| <b><math>V_{R,70\text{ °C}} = 450\text{ V DC}, V_{op,85\text{ °C}} = 450\text{ V DC}</math></b>   |  |       |   |   |  |  |  |   |             |
| 5.0   | 11.0 × 21.0 × 31.5                       | –     | B32774D4505+000                             | 5.0   | 21.1   | 19.0   | 1.2  | 10.7  | 2352        |
| 10.0  | 15.0 × 24.5 × 31.5                       | –     | B32774D4106+000                             | 8.0   | 10.9   | 24.0   | 1.2  | 11.0  | 1680        |
| 22.0  | 22.0 × 36.5 × 31.5                       | –     | B32774D4226+000                             | 14.5  | 5.4  | 30.0   | 1.3  | 12.1  | 784         |
| <b><math>V_{R,70\text{ °C}} = 800\text{ V DC}, V_{op,85\text{ °C}} = 700\text{ V DC}</math></b>   |  |       |   |   |  |  |  |   |             |
| 3.0   | 11.0 × 21.0 × 31.5                       | –     | B32774D8305+000                             | 4.5   | 24.8   | 19.0   | 0.9  | 7.6   | 2352        |
| 5.0   | 14.0 × 24.5 × 31.5                       | –     | B32774D8505+000                             | 6.5   | 15.3   | 23.0   | 0.9  | 7.7   | 1848        |
| 12.0  | 22.0 × 36.5 × 31.5                       | –     | B32774D8126+000                             | 13.0  | 6.8  | 34.0   | 1.0  | 8.3   | 784         |
| <b><math>V_{R,70\text{ °C}} = 1100\text{ V DC}, V_{op,85\text{ °C}} = 920\text{ V DC}</math></b>  |  |       |   |   |  |  |  |   |             |
| 2.0   | 12.5 × 21.5 × 31.5                       | –     | B32774D0205+000                             | 4.5   | 26.3   | 19.0   | 0.7  | 5.3   | 2100        |
| 3.3   | 18.0 × 27.5 × 31.5                       | –     | B32774D0335+000                             | 7.0   | 16.2   | 22.0   | 0.7  | 5.4   | 1428        |
| 5.0   | 19.0 × 30.0 × 31.5                       | –     | B32774D0505+000                             | 9.0   | 10.9   | 27.0   | 0.7  | 5.5   | 896         |
| 7.0   | 22.0 × 36.5 × 31.5                       | –     | B32774D0705+000                             | 12.0  | 8.1  | 30.0   | 0.7  | 5.8   | 784         |
| <b><math>V_{R,70\text{ °C}} = 1300\text{ V DC}, V_{op,85\text{ °C}} = 1100\text{ V DC}</math></b> |  |       |   |   |  |  |  |   |             |
| 1.5   | 12.5 × 21.5 × 31.5                       | –     | B32774D1155K000                             | 4.4   | 31.3   | 20.0   | 0.6  | 4.8   | 2100        |
| 3.0   | 18.0 × 27.5 × 31.5                       | –     | B32774D1305K000                             | 7.0   | 16.0   | 24.0   | 0.6  | 4.9   | 1428        |
| 5.0   | 22.0 × 36.5 × 31.5                       | –     | B32774D1505K000                             | 10.5  | 9.8  | 33.0   | 0.7  | 5.1   | 784         |

MOQ = Minimum Order Quantity, consisting of 4 packing units.

Intermediate capacitance values are available on request.

**Composition of ordering code**

+ = Capacitance tolerance code:

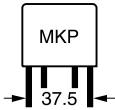
J =  $\pm 5\%$

K =  $\pm 10\%$

1) Capacitance value measured at 1 kHz

2) Max ripple current  $I_{RMS}$  at 70 °C, 10 kHz for  $\Delta T \leq 20\text{ °C}$  at  $\Delta ESR_{typ} \leq \pm 5\%$

3) Typical ESL value measured at resonance frequency (see specific graphs of Z vs freq)


**B32776**
**MKP DC link – high density series – up to 480  $\mu$ F**
**Ordering codes and packing units (lead spacing 37.5 mm)**

| $C_R^{1)}$   | Max. dimensions<br>$w \times h \times l$ | $P_1$ | Ordering code<br>(composition see<br>below) | $I_{RMS,max}^{2)}$   | $ESR_{typ}$                   | $ESL_{typ}^{3)}$      | $\tan \delta$             | $\tan \delta$              | pcs.<br>MOQ |
|--|--|-------|---|----------------------|-------------------------------|-----------------------|---------------------------|----------------------------|-------------|
|  |  |       |   | 70 °C<br>10 kHz<br>A | 70 °C<br>10 kHz<br>m $\Omega$ | 70 °C<br>10 kHz<br>nH | 1 kHz<br>10 <sup>-3</sup> | 10 kHz<br>10 <sup>-3</sup> |             |
| $\mu$ F  | mm                                       | mm    |   |                      |                               |                       |                           |                            |             |
| <b><math>V_{R,70^\circ C} = 450</math> V DC, <math>V_{op,85^\circ C} = 450</math> V DC</b> |  |       |   |                      |                               |                       |                           |                            |             |
| 12   | 24.0 × 15.0 × 41.5                       | –     | B32776T4126K000                             | 7.0                  | 17.1                          | 19.0                  | 2.2                       | 21.0                       | 1040        |
| 16   | 24.0 × 19.0 × 41.5                       | –     | B32776T4166K000                             | 8.0                  | 13.0                          | 18.0                  | 2.3                       | 21.2                       | 780         |
| 30   | 20.0 × 39.5 × 41.5                       | 10.2  | B32776G4306+000                             | 14.0                 | 7.0                           | 11.0                  | 2.3                       | 21.3                       | 640         |
| 30   | 20.0 × 39.5 × 41.5                       | –     | B32776E4306+000                             | 14.0                 | 7.3                           | 28.0                  | 2.4                       | 22.3                       | 640         |
| 35   | 28.0 × 37.0 × 42.0                       | 10.2  | B32776G4356+000                             | 16.5                 | 6.0                           | 10.0                  | 2.3                       | 21.4                       | 440         |
| 35   | 28.0 × 37.0 × 42.0                       | –     | B32776E4356+000                             | 16.0                 | 6.4                           | 24.0                  | 2.4                       | 22.6                       | 440         |
| 40   | 28.0 × 37.0 × 42.0                       | 10.2  | B32776G4406+000                             | 17.5                 | 5.3                           | 11.0                  | 2.3                       | 21.4                       | 440         |
| 40   | 28.0 × 37.0 × 42.0                       | –     | B32776E4406+000                             | 17.0                 | 5.6                           | 26.0                  | 2.4                       | 22.7                       | 440         |
| 40   | 43.0 × 22.0 × 41.5                       | 20.3  | B32776T4406K000                             | 17.0                 | 5.2                           | 13.0                  | 2.3                       | 21.2                       | 280         |
| 50   | 28.0 × 42.5 × 41.5                       | 10.2  | B32776G4506+000                             | 20.0                 | 4.3                           | 12.0                  | 2.3                       | 21.7                       | 440         |
| 50   | 28.0 × 42.5 × 41.5                       | –     | B32776E4506+000                             | 19.0                 | 4.7                           | 30.0                  | 2.5                       | 23.8                       | 440         |
| 60   | 30.0 × 45.0 × 42.0                       | 20.3  | B32776G4606+000                             | 23.5                 | 3.6                           | 14.0                  | 2.4                       | 22.3                       | 400         |
| 60   | 30.0 × 45.0 × 42.0                       | –     | B32776E4606+000                             | 22.0                 | 4.0                           | 32.0                  | 2.5                       | 24.2                       | 400         |
| 65   | 33.0 × 48.0 × 42.0                       | 20.3  | B32776G4656+000                             | 25.5                 | 3.3                           | 14.0                  | 2.3                       | 22.2                       | 180         |
| <b><math>V_{R,70^\circ C} = 575</math> V DC, <math>V_{op,85^\circ C} = 500</math> V DC</b> |  |       |   |                      |                               |                       |                           |                            |             |
| 8.5  | 24.0 × 15.0 × 41.5                       | –     | B32776T5855+000                             | 6.5                  | 19.9                          | 19.0                  | 1.9                       | 17.2                       | 1040        |
| 12   | 24.0 × 19.0 × 41.5                       | –     | B32776T5126K000                             | 8.0                  | 14.4                          | 18.0                  | 1.9                       | 17.4                       | 780         |
| 25   | 20.0 × 39.5 × 41.5                       | 10.2  | B32776G5256K000                             | 14.0                 | 7.0                           | 12.0                  | 1.9                       | 17.5                       | 640         |
| 25   | 20.0 × 39.5 × 41.5                       | –     | B32776E5256K000                             | 13.5                 | 7.4                           | 28.0                  | 2.0                       | 18.3                       | 640         |
| 30   | 28.0 × 37.0 × 42.0                       | 10.2  | B32776G5306K000                             | 16.5                 | 5.8                           | 11.0                  | 1.9                       | 17.6                       | 440         |
| 30   | 28.0 × 37.0 × 42.0                       | –     | B32776E5306K000                             | 16.5                 | 6.1                           | 26.0                  | 2.0                       | 18.5                       | 440         |
| 30   | 43.0 × 22.0 × 41.5                       | 20.3  | B32776T5306K000                             | 16.5                 | 5.8                           | 13.0                  | 1.9                       | 17.3                       | 280         |
| 35   | 28.0 × 42.5 × 41.5                       | 10.2  | B32776G5356+000                             | 19.0                 | 5.0                           | 12.0                  | 1.9                       | 17.8                       | 440         |
| 35   | 28.0 × 42.5 × 41.5                       | –     | B32776E5356+000                             | 18.0                 | 5.3                           | 29.0                  | 2.0                       | 19.0                       | 440         |
| 45   | 30.0 × 45.0 × 42.0                       | 20.3  | B32776G5456K000                             | 22.0                 | 4.0                           | 13.0                  | 1.9                       | 17.9                       | 400         |
| 45   | 30.0 × 45.0 × 42.0                       | –     | B32776E5456K000                             | 21.0                 | 4.4                           | 32.0                  | 2.1                       | 19.7                       | 400         |
| 50   | 33.0 × 48.0 × 42.0                       | 20.3  | B32776G5506K000                             | 25.0                 | 3.5                           | 14.0                  | 2.0                       | 18.1                       | 180         |

MOQ = Minimum Order Quantity, consisting of 4 packing units.  
Intermediate capacitance values are available on request.

**Composition of ordering code**

+ = Capacitance tolerance code:

J =  $\pm 5\%$

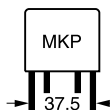
K =  $\pm 10\%$

1) Capacitance value measured at 1 kHz

2) Max ripple current  $I_{RMS}$  at 70 °C, 10 kHz for  $\Delta T \leq 20$  °C at  $\Delta ESR_{typ} \leq \pm 5\%$

3) Typical ESL value measured at resonance frequency (see specific graphs of Z vs freq)




**Ordering codes and packing units (lead spacing 37.5 mm)**

| $C_R^{1)}$   | Max. dimensions<br>$w \times h \times l$ | $P_1$ | Ordering code<br>(composition see<br>below) | $I_{RMS,max}^{2)}$   | $ESR_{typ}$                   | $ESL_{typ}^{3)}$      | $\tan \delta$             | $\tan \delta$              | pcs.<br>MOQ |
|--|--|-------|---|----------------------|-------------------------------|-----------------------|---------------------------|----------------------------|-------------|
| $\mu$ F  | mm                                       | mm    |   | 70 °C<br>10 kHz<br>A | 70 °C<br>10 kHz<br>m $\Omega$ | 70 °C<br>10 kHz<br>nH | 1 kHz<br>10 <sup>-3</sup> | 10 kHz<br>10 <sup>-3</sup> |             |
| <b><math>V_{R,70^\circ C} = 800</math> V DC, <math>V_{op,85^\circ C} = 700</math> V DC</b> |  |       |   |                      |                               |                       |                           |                            |             |
| 6.8  | 24.0 × 15.0 × 41.5                       | –     | B32776T8685+000                             | 6.0                  | 22.1                          | 18.0                  | 1.7                       | 15.1                       | 1040        |
| 8.5  | 24.0 × 19.0 × 41.5                       | –     | B32776T8855+000                             | 7.5                  | 17.8                          | 18.0                  | 1.7                       | 15.1                       | 780         |
| 14   | 18.0 × 32.5 × 41.5                       | –     | B32776E8146+000                             | 10.0                 | 11.5                          | 23.0                  | 1.8                       | 16.3                       | 720         |
| 15   | 20.0 × 39.5 × 41.5                       | 10.2  | B32776G8156+000                             | 12.0                 | 9.6                           | 10.0                  | 1.7                       | 15.2                       | 640         |
| 15   | 20.0 × 39.5 × 41.5                       | –     | B32776E8156+000                             | 11.5                 | 10.3                          | 24.0                  | 1.7                       | 15.7                       | 640         |
| 20   | 28.0 × 37.0 × 42.0                       | 10.2  | B32776G8206+000                             | 14.5                 | 7.5                           | 10.0                  | 1.7                       | 15.3                       | 440         |
| 20   | 28.0 × 37.0 × 42.0                       | –     | B32776E8206+000                             | 14.5                 | 7.8                           | 24.0                  | 1.7                       | 15.9                       | 440         |
| 20   | 43.0 × 22.0 × 41.5                       | 20.3  | B32776T8206K000                             | 14.5                 | 7.2                           | 14.0                  | 1.7                       | 15.1                       | 280         |
| 22   | 28.0 × 37.0 × 42.0                       | 10.2  | B32776G8226+000                             | 15.5                 | 6.8                           | 11.0                  | 1.7                       | 15.3                       | 440         |
| 22   | 28.0 × 37.0 × 42.0                       | –     | B32776E8226+000                             | 15.0                 | 7.1                           | 25.0                  | 1.7                       | 16.0                       | 440         |
| 25   | 28.0 × 42.5 × 41.5                       | 10.2  | B32776G8256+000                             | 17.0                 | 6.1                           | 11.0                  | 1.7                       | 15.4                       | 440         |
| 25   | 28.0 × 42.5 × 41.5                       | –     | B32776E8256+000                             | 16.5                 | 6.4                           | 28.0                  | 1.8                       | 16.3                       | 440         |
| 30   | 30.0 × 45.0 × 42.0                       | 20.3  | B32776G8306+000                             | 19.5                 | 5.1                           | 12.0                  | 1.7                       | 15.6                       | 400         |
| 30   | 30.0 × 45.0 × 42.0                       | –     | B32776E8306+000                             | 19.0                 | 5.5                           | 30.0                  | 1.8                       | 16.7                       | 400         |
| 35   | 33.0 × 48.0 × 42.0                       | 20.3  | B32776G8356+000                             | 22.0                 | 4.3                           | 14.0                  | 1.7                       | 15.7                       | 180         |
| <b><math>V_{R,70^\circ C} = 900</math> V DC, <math>V_{op,85^\circ C} = 800</math> V DC</b> |  |       |   |                      |                               |                       |                           |                            |             |
| 5  | 24.0 × 15.0 × 41.5                       | –     | B32776T9505+000                             | 5.5                  | 26.1                          | 19.0                  | 1.5                       | 13.4                       | 1040        |
| 7.5  | 24.0 × 19.0 × 41.5                       | –     | B32776T9755K000                             | 7.5                  | 17.8                          | 18.0                  | 1.5                       | 13.5                       | 780         |
| 15   | 20.0 × 39.5 × 41.5                       | 10.2  | B32776G9156K000                             | 12.5                 | 9.1                           | 12.0                  | 1.5                       | 13.6                       | 640         |
| 15   | 20.0 × 39.5 × 41.5                       | –     | B32776E9156K000                             | 12.0                 | 9.4                           | 28.0                  | 1.5                       | 14.1                       | 640         |
| 16   | 43.0 × 22.0 × 41.5                       | 20.3  | B32776T9166K000                             | 14.0                 | 8.1                           | 14.0                  | 1.5                       | 13.5                       | 280         |
| 20   | 28.0 × 37.0 × 42.0                       | 10.2  | B32776G9206K000                             | 15.0                 | 7.0                           | 11.0                  | 1.5                       | 13.6                       | 440         |
| 20   | 28.0 × 37.0 × 42.0                       | –     | B32776E9206K000                             | 15.0                 | 7.3                           | 26.0                  | 1.6                       | 14.2                       | 440         |
| 22   | 28.0 × 42.5 × 41.5                       | 10.2  | B32776G9226K000                             | 17.0                 | 6.3                           | 12.0                  | 1.5                       | 13.7                       | 440         |
| 22   | 28.0 × 42.5 × 41.5                       | –     | B32776E9226K000                             | 16.5                 | 6.6                           | 29.0                  | 1.6                       | 14.5                       | 440         |
| 25   | 30.0 × 45.0 × 42.0                       | 20.3  | B32776G9256+000                             | 19.0                 | 5.5                           | 13.0                  | 1.5                       | 13.8                       | 400         |
| 25   | 30.0 × 45.0 × 42.0                       | –     | B32776E9256+000                             | 18.5                 | 5.9                           | 32.0                  | 1.6                       | 14.7                       | 400         |
| 30   | 33.0 × 48.0 × 42.0                       | 20.3  | B32776G9306+000                             | 21.5                 | 4.7                           | 14.0                  | 1.5                       | 13.9                       | 180         |

MOQ = Minimum Order Quantity, consisting of 4 packing units.

Intermediate capacitance values are available on request.

**Composition of ordering code**

+ = Capacitance tolerance code:

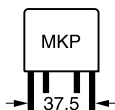
J =  $\pm 5\%$

K =  $\pm 10\%$

1) Capacitance value measured at 1 kHz

2) Max ripple current  $I_{RMS}$  at 70 °C, 10 kHz for  $\Delta T \leq 20$  °C at  $\Delta ESR_{typ} \leq \pm 5\%$

3) Typical ESL value measured at resonance frequency (see specific graphs of Z vs freq)


**B32776**
**MKP DC link – high density series – up to 480  $\mu$ F**
**Ordering codes and packing units (lead spacing 37.5 mm)**

| $C_R^{1)}$   | Max. dimensions<br>$w \times h \times l$ | $P_1$ | Ordering code<br>(composition see<br>below) | $I_{RMS,max}^{2)}$<br>70 °C<br>10 kHz<br>A | $ESR_{typ}$<br>70 °C<br>10 kHz<br>m $\Omega$ | $ESL_{typ}^{3)}$<br>70 °C<br>10 kHz<br>nH | $\tan \delta$<br>1 kHz<br>$10^{-3}$ | $\tan \delta$<br>10 kHz<br>$10^{-3}$ | pcs.<br>MOQ |
|--|--|-------|---|--|--|---|-------------------------------------|--------------------------------------|-------------|
| $\mu$ F  | mm                                       | mm    |   |  |  |   |                                     |                                      |             |
| <b><math>V_{R,70^\circ C} = 1100</math> V DC, <math>V_{op,85^\circ C} = 920</math> V DC</b>  |  |       |   |  |  |   |                                     |                                      |             |
| 3.9  | 24.0 × 15.0 × 41.5                       | –     | B32776T0395+000                             | 5.0  | 30.5   | 18.0                                      | 1.4                                 | 12.1                                 | 1040        |
| 5  | 24.0 × 19.0 × 41.5                       | –     | B32776T0505+000                             | 6.5  | 23.6   | 18.0                                      | 1.4                                 | 12.1                                 | 780         |
| 12   | 20.0 × 39.5 × 41.5                       | 10.2  | B32776G0126+000                             | 12.0                                       | 10.2   | 12.0                                      | 1.4                                 | 12.2                                 | 640         |
| 12   | 20.0 × 39.5 × 41.5                       | –     | B32776E0126+000                             | 11.5                                       | 10.5   | 28.0                                      | 1.4                                 | 12.6                                 | 640         |
| 13   | 43.0 × 22.0 × 41.5                       | 20.3  | B32776T0136K000                             | 13.0                                       | 8.9  | 14.0                                      | 1.4                                 | 12.1                                 | 280         |
| 14   | 28.0 × 37.0 × 42.0                       | 10.2  | B32776G0146+000                             | 13.5                                       | 8.7  | 21.0                                      | 1.4                                 | 12.2                                 | 440         |
| 14   | 28.0 × 37.0 × 42.0                       | –     | B32776E0146+000                             | 13.5                                       | 9.0  | 25.0                                      | 1.4                                 | 12.6                                 | 440         |
| 16   | 28.0 × 42.5 × 41.5                       | 10.2  | B32776G0166+000                             | 15.5                                       | 7.4  | 12.0                                      | 1.4                                 | 12.3                                 | 440         |
| 16   | 28.0 × 42.5 × 41.5                       | –     | B32776E0166+000                             | 15.0                                       | 7.8  | 30.0                                      | 1.4                                 | 12.9                                 | 440         |
| 20   | 30.0 × 45.0 × 42.0                       | 20.3  | B32776G0206+000                             | 18.0                                       | 6.0  | 14.0                                      | 1.4                                 | 12.4                                 | 400         |
| 20   | 30.0 × 45.0 × 42.0                       | –     | B32776E0206+000                             | 17.5                                       | 6.5  | 32.0                                      | 1.4                                 | 13.1                                 | 400         |
| 22   | 33.0 × 48.0 × 42.0                       | 20.3  | B32776G0226+000                             | 21.0                                       | 4.9  | 15.0                                      | 1.3                                 | 11.4                                 | 180         |
| <b><math>V_{R,70^\circ C} = 1300</math> V DC, <math>V_{op,85^\circ C} = 1100</math> V DC</b> |  |       |   |  |  |   |                                     |                                      |             |
| 2.7  | 24.0 × 15.0 × 41.5                       | –     | B32776T1275+000                             | 5.0  | 34.7   | 19.0                                      | 1.1                                 | 9.6                                  | 1040        |
| 3.5  | 24.0 × 19.0 × 41.5                       | –     | B32776T1355+000                             | 6.0  | 27.4   | 18.0                                      | 1.1                                 | 9.7                                  | 780         |
| 8.0  | 20.0 × 39.5 × 41.5                       | 10.2  | B32776G1805+000                             | 11.0                                       | 12.1   | 12.0                                      | 1.1                                 | 9.7                                  | 640         |
| 8.0  | 20.0 × 39.5 × 41.5                       | –     | B32776E1805+000                             | 10.5                                       | 12.4   | 24.0                                      | 1.2                                 | 10.0                                 | 640         |
| 9.0  | 43.0 × 22.0 × 41.5                       | 20.3  | B32776T1905K000                             | 12.0                                       | 10.7   | 13.0                                      | 1.1                                 | 9.7                                  | 280         |
| 10   | 28.0 × 37.0 × 42.0                       | 10.2  | B32776G1106+000                             | 13.0                                       | 9.6  | 11.0                                      | 1.1                                 | 9.7                                  | 440         |
| 10   | 28.0 × 37.0 × 42.0                       | –     | B32776E1106+000                             | 12.5                                       | 9.9  | 26.0                                      | 1.2                                 | 10.0                                 | 440         |
| 12   | 28.0 × 42.5 × 41.5                       | 10.2  | B32776G1126+000                             | 14.5                                       | 8.1  | 12.0                                      | 1.1                                 | 9.8                                  | 440         |
| 12   | 28.0 × 42.5 × 41.5                       | –     | B32776E1126+000                             | 14.0                                       | 8.5  | 28.0                                      | 1.2                                 | 10.1                                 | 440         |
| 14   | 30.0 × 45.0 × 42.0                       | 20.3  | B32776G1146+000                             | 17.0                                       | 6.8  | 14.0                                      | 1.1                                 | 10.1                                 | 400         |
| 14   | 30.0 × 45.0 × 42.0                       | –     | B32776E1146+000                             | 16.5                                       | 7.3  | 32.0                                      | 1.2                                 | 10.4                                 | 400         |
| 16   | 33.0 × 48.0 × 42.0                       | 20.3  | B32776G1166+000                             | 19.0                                       | 6.0  | 15.0                                      | 1.1                                 | 9.9                                  | 180         |

MOQ = Minimum Order Quantity, consisting of 4 packing units.

Intermediate capacitance values are available on request.

**Composition of ordering code**

+ = Capacitance tolerance code:

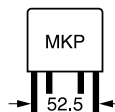
 J =  $\pm 5\%$ 

 K =  $\pm 10\%$ 

1) Capacitance value measured at 1 kHz

 2) Max ripple current  $I_{RMS}$  at 70 °C, 10 kHz for  $\Delta T \leq 20$  °C at  $\Delta ESR_{typ} \leq \pm 5\%$ 

3) Typical ESL value measured at resonance frequency (see specific graphs of Z vs freq)


**Ordering codes and packing units (lead spacing 52.5 mm,  $P_1 = 20.3$  mm)**

| $C_R^{1)}$   | Max. dimensions<br>$w \times h \times l$ | Ordering code<br>(composition see<br>below) | $I_{RMS,max}^{2)}$<br>70 °C<br>10 kHz<br>A | $ESR_{typ}$<br>70 °C<br>10 kHz<br>m $\Omega$ | $ESL_{typ}^{3)}$<br>70 °C<br>10 kHz<br>nH | $\tan \delta$<br>1 kHz<br>$10^{-3}$ | $\tan \delta$<br>10 kHz<br>$10^{-3}$ | pcs.<br>MOQ |
|--|--|---|--|--|---|-------------------------------------|--------------------------------------|-------------|
| $\mu$ F  | mm                                       |   |  |  |   |                                     |                                      |             |
| <b><math>V_{R,70\text{ °C}} = 450</math> V DC, <math>V_{op,85\text{ °C}} = 450</math> V DC</b> |  |   |  |  |   |                                     |                                      |             |
| 55   | 43.0 × 24.0 × 57.5                       | B32778T4556K000                             | 16.5                                       | 7.2  | 13.0                                      | 4.3                                 | 41.7                                 | 420         |
| 75   | 30.0 × 45.0 × 57.5                       | B32778G4756+000                             | 21.0                                       | 5.6  | 12.0                                      | 4.4                                 | 42.6                                 | 280         |
| 80   | 30.0 × 45.0 × 57.5                       | B32778G4806+000                             | 21.5                                       | 5.3  | 13.0                                      | 4.4                                 | 42.7                                 | 280         |
| 100  | 35.0 × 50.0 × 57.5                       | B32778G4107+000                             | 26.0                                       | 4.3  | 14.0                                      | 4.5                                 | 43.3                                 | 108         |
| 110  | 35.0 × 50.0 × 57.5                       | B32778G4117K000                             | 27.0                                       | 3.9  | 15.0                                      | 4.5                                 | 43.6                                 | 108         |
| 150  | 130.0 × 24.0 × 57.5                      | B32778J4157K000                             | 43.5                                       | 2.7  | 4.0                                       | 4.4                                 | 42.1                                 | 80          |
| 170  | 45.0 × 57.0 × 57.5                       | B32778G4177+000                             | 36.5                                       | 2.6  | 17.0                                      | 4.6                                 | 45.7                                 | 140         |
| 180  | 60.0 × 45.0 × 57.5                       | B32778G4187+000                             | 39.0                                       | 2.5  | 19.0                                      | 4.6                                 | 44.6                                 | 200         |
| 480  | 130.0 × 58.0 × 57.5                      | B32778J4487K000                             | 79.5                                       | 0.9  | 6.0                                       | 4.8                                 | 45.4                                 | 40          |
| <b><math>V_{R,70\text{ °C}} = 575</math> V DC, <math>V_{op,85\text{ °C}} = 500</math> V DC</b> |  |   |  |  |   |                                     |                                      |             |
| 40   | 43.0 × 24.0 × 57.5                       | B32778T5406K000                             | 15.5                                       | 8.5  | 13.0                                      | 3.6                                 | 34.5                                 | 420         |
| 60   | 30.0 × 45.0 × 57.5                       | B32778G5606+000                             | 20.5                                       | 5.8  | 13.0                                      | 3.7                                 | 35.3                                 | 280         |
| 80   | 35.0 × 50.0 × 57.5                       | B32778G5806+000                             | 25.5                                       | 4.4  | 15.0                                      | 3.7                                 | 36.0                                 | 108         |
| 110  | 130.0 × 24.0 × 57.5                      | B32778J5117K000                             | 40.5                                       | 3.0  | 5.0                                       | 3.6                                 | 34.5                                 | 80          |
| 120  | 45.0 × 57.0 × 57.5                       | B32778G5127+000                             | 34.5                                       | 3.1  | 17.0                                      | 3.8                                 | 37.2                                 | 140         |
| 130  | 60.0 × 45.0 × 57.5                       | B32778G5137+000                             | 36.5                                       | 2.8  | 19.0                                      | 3.8                                 | 36.7                                 | 200         |
| 360  | 130.0 × 58.0 × 57.5                      | B32778J5367K000                             | 75.0                                       | 1.0  | 6.0                                       | 4.0                                 | 37.3                                 | 40          |
| <b><math>V_{R,70\text{ °C}} = 800</math> V DC, <math>V_{op,85\text{ °C}} = 700</math> V DC</b> |  |   |  |  |   |                                     |                                      |             |
| 30   | 43.0 × 24.0 × 57.5                       | B32778T8306K000                             | 14.5                                       | 9.8  | 14.0                                      | 3.2                                 | 30.2                                 | 420         |
| 45   | 30.0 × 45.0 × 57.5                       | B32778G8456+000                             | 19.5                                       | 6.6  | 14.0                                      | 3.2                                 | 30.9                                 | 280         |
| 50   | 30.0 × 45.0 × 57.5                       | B32778G8506+000                             | 20.0                                       | 6.3  | 13.0                                      | 3.2                                 | 30.9                                 | 280         |
| 55   | 35.0 × 50.0 × 57.5                       | B32778G8556+000                             | 23.0                                       | 5.6  | 14.0                                      | 3.2                                 | 31.1                                 | 108         |
| 60   | 35.0 × 50.0 × 57.5                       | B32778G8606+000                             | 23.5                                       | 5.1  | 15.0                                      | 3.3                                 | 31.2                                 | 108         |
| 80   | 130.0 × 24.0 × 57.5                      | B32778J8806K000                             | 37.5                                       | 3.6  | 4.0                                       | 3.2                                 | 30.2                                 | 80          |
| 90   | 45.0 × 57.0 × 57.5                       | B32778G8906+000                             | 32.5                                       | 3.5  | 17.0                                      | 3.3                                 | 32.2                                 | 140         |
| 100  | 60.0 × 45.0 × 57.5                       | B32778G8107+000                             | 34.5                                       | 3.2  | 19.0                                      | 3.3                                 | 31.9                                 | 200         |
| 270  | 130.0 × 58.0 × 57.5                      | B32778J8277K000                             | 70.5                                       | 1.2  | 6.0                                       | 3.5                                 | 32.4                                 | 40          |

MOQ = Minimum Order Quantity, consisting of 4 packing units.

Intermediate capacitance values are available on request.

**Composition of ordering code**

+ = Capacitance tolerance code:

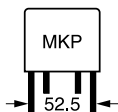
J =  $\pm 5\%$

K =  $\pm 10\%$

1) Capacitance value measured at 1 kHz

2) Max ripple current  $I_{RMS}$  at 70 °C, 10 kHz for  $\Delta T \leq 20$  °C at  $\Delta ESR_{typ} \leq \pm 5\%$

3) Typical ESL value measured at resonance frequency (see specific graphs of Z vs freq)


**B32778**
**MKP DC link – high density series – up to 480  $\mu$ F**
**Ordering codes and packing units (lead spacing 52.5 mm,  $P_1 = 20.3$  mm)**

| $C_R^{1)}$   | Max. dimensions<br>$w \times h \times l$ | Ordering code<br>(composition see<br>below) | $I_{RMS,max}^{2)}$<br>70 °C<br>10 kHz<br>A | $ESR_{typ}$<br>70 °C<br>10 kHz<br>m $\Omega$ | $ESL_{typ}^{3)}$<br>70 °C<br>10 kHz<br>nH | $\tan \delta$<br>1 kHz<br>$10^{-3}$ | $\tan \delta$<br>10 kHz<br>$10^{-3}$ | pcs.<br>MOQ |
|--|--|---|--|--|---|-------------------------------------|--------------------------------------|-------------|
| $\mu$ F  | mm                                       |   |  |  |   |                                     |                                      |             |
| <b><math>V_{R,70\text{ °C}} = 900</math> V DC, <math>V_{op,85\text{ °C}} = 800</math> V DC</b>   |  |   |  |  |   |                                     |                                      |             |
| 25   | 43.0 × 24.0 × 57.5                       | B32778T9256K000                             | 13.5                                       | 10.7   | 13.0                                      | 2.8                                 | 26.8                                 | 420         |
| 35   | 30.0 × 45.0 × 57.5                       | B32778G9356+000                             | 18.0                                       | 7.7  | 13.0                                      | 2.9                                 | 27.3                                 | 280         |
| 50   | 35.0 × 50.0 × 57.5                       | B32778G9506K000                             | 22.5                                       | 5.6  | 15.0                                      | 2.9                                 | 27.7                                 | 108         |
| 70   | 45.0 × 57.0 × 57.5                       | B32778G9706+000                             | 31.0                                       | 3.8  | 18.0                                      | 3.0                                 | 28.5                                 | 140         |
| 70   | 130.0 × 24.0 × 57.5                      | B32778J9706K000                             | 36.0                                       | 3.8  | 4.0                                       | 2.9                                 | 27.2                                 | 80          |
| 75   | 60.0 × 45.0 × 57.5                       | B32778G9756+000                             | 32.5                                       | 3.6  | 20.0                                      | 2.9                                 | 28.2                                 | 200         |
| 210  | 130.0 × 58.0 × 57.5                      | B32778J9217K000                             | 66.0                                       | 1.3  | 6.0                                       | 3.1                                 | 28.6                                 | 40          |
| <b><math>V_{R,70\text{ °C}} = 1100</math> V DC, <math>V_{op,85\text{ °C}} = 920</math> V DC</b>  |  |   |  |  |   |                                     |                                      |             |
| 20   | 43.0 × 24.0 × 57.5                       | B32778T0206K000                             | 13.0                                       | 11.9   | 13.0                                      | 2.6                                 | 24.1                                 | 420         |
| 30   | 30.0 × 45.0 × 57.5                       | B32778G0306+000                             | 17.5                                       | 8.2  | 13.0                                      | 2.6                                 | 24.5                                 | 280         |
| 40   | 35.0 × 50.0 × 57.5                       | B32778G0406+000                             | 21.5                                       | 6.2  | 15.0                                      | 2.7                                 | 25.9                                 | 108         |
| 58   | 45.0 × 57.0 × 57.5                       | B32778G0586+000                             | 29.0                                       | 4.3  | 17.0                                      | 2.7                                 | 25.4                                 | 140         |
| 60   | 60.0 × 45.0 × 57.5                       | B32778G0606+000                             | 30.5                                       | 4.0  | 19.0                                      | 2.7                                 | 25.2                                 | 200         |
| 60   | 130.0 × 24.0 × 57.5                      | B32778J0606K000                             | 34.5                                       | 4.1  | 4.0                                       | 2.7                                 | 25.1                                 | 80          |
| 200  | 130.0 × 58.0 × 57.5                      | B32778J0207K000                             | 66.0                                       | 1.4  | 6.0                                       | 3.0                                 | 26.8                                 | 40          |
| <b><math>V_{R,70\text{ °C}} = 1300</math> V DC, <math>V_{op,85\text{ °C}} = 1100</math> V DC</b> |  |   |  |  |   |                                     |                                      |             |
| 14   | 43.0 × 24.0 × 57.5                       | B32778T1146K000                             | 12.0                                       | 13.8   | 13.0                                      | 2.1                                 | 19.5                                 | 420         |
| 20   | 30.0 × 45.0 × 57.5                       | B32778G1206+000                             | 16.0                                       | 9.7  | 13.0                                      | 2.1                                 | 19.8                                 | 280         |
| 25   | 35.0 × 50.0 × 57.5                       | B32778G1256+000                             | 19.0                                       | 7.8  | 15.0                                      | 2.1                                 | 19.9                                 | 108         |
| 27   | 35.0 × 50.0 × 57.5                       | B32778G1276+000                             | 19.5                                       | 7.3  | 15.0                                      | 2.1                                 | 20.0                                 | 108         |
| 38   | 130.0 × 24.0 × 57.5                      | B32778J1386K000                             | 31.5                                       | 5.1  | 4.0                                       | 2.1                                 | 19.5                                 | 80          |
| 40   | 45.0 × 57.0 × 57.5                       | B32778G1406+000                             | 26.5                                       | 5.0  | 17.0                                      | 2.2                                 | 20.3                                 | 140         |
| 42   | 60.0 × 45.0 × 57.5                       | B32778G1426+000                             | 28.0                                       | 4.7  | 19.0                                      | 2.2                                 | 20.2                                 | 200         |
| 120  | 130.0 × 58.0 × 57.5                      | B32778J1127K000                             | 58.5                                       | 1.7  | 6.0                                       | 2.3                                 | 20.5                                 | 40          |

MOQ = Minimum Order Quantity, consisting of 4 packing units.

Intermediate capacitance values are available on request.

**Composition of ordering code**

+= Capacitance tolerance code:

 J =  $\pm 5\%$ 

 K =  $\pm 10\%$ 

1) Capacitance value measured at 1 kHz

 2) Max ripple current  $I_{RMS}$  at 70 °C, 10 kHz for  $\Delta T \leq 20$  °C at  $\Delta ESR_{typ} \leq \pm 5\%$ 

3) Typical ESL value measured at resonance frequency (see specific graphs of Z vs freq)



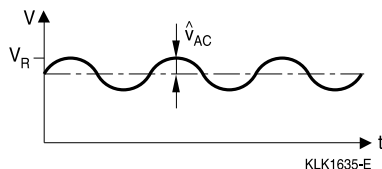
### Technical data

Reference standard: IEC 61071.

All data given at  $T = 20\text{ }^{\circ}\text{C}$ , unless otherwise specified.

|  |  |  |
|--|--|--|
| Operating temperature range (case)   | Max. operating temperature, $T_{op,max}$   | +105 $^{\circ}\text{C}$  |
|  | Upper category temperature $T_{max}$   | +105 $^{\circ}\text{C}$  |
|  | Lower category temperature $T_{min}$   | -40 $^{\circ}\text{C}$   |
| Insulation Resistance $R_{ins}$<br>given as time constant<br>$\tau = C_R \cdot R_{ins}$ , rel. humidity $\leq 65\%$<br>(minimum as-delivered values) | $\tau > 10\,000\text{ s}$ (after 1 min.)<br>For $V_R \geq 500\text{ V}$ measured at 500 V<br>For $V_R < 500\text{ V}$ measured at $V_R$  |  |
| DC test voltage between terminals (10 s)   | $1.5 \cdot V_R$  |  |
| Voltage test terminal to case (10 s)   | 2110 V AC, 50 Hz   |  |
| Pulse Handling Capability (V/ $\mu$ s)   | $I_P$ (A) / C ( $\mu$ F)   |  |
| Reliability: Failure rate $\lambda$  | 10 fit ( $\leq 1 \cdot 10^{-9}/\text{h}$ ) at $0.5 \cdot V_R$ , 40 $^{\circ}\text{C}$<br>For conversion to other operating conditions and temperatures, refer to chapter "Quality, 2 Reliability". |  |
| Service life $t_{SL}$  | 100 000 h at $V_R$ and 70 $^{\circ}\text{C}$   |  |
|  | $V_R$ (V DC)   | 450    575    800    900    1100    1300   |
| Continuous operation voltage<br>$V_{op}$ (V DC) at 70 $^{\circ}\text{C}$   |  | 450    575    800    900    1100    1300   |
| Continuous operation voltage<br>$V_{op}$ (V DC) at 85 $^{\circ}\text{C}$   |  | 450    500    700    800    920    1100  |
| For temperatures between<br>85 $^{\circ}\text{C}$ and 105 $^{\circ}\text{C}$   |  | 1.33%/ $^{\circ}\text{C}$ of $V_{op}$ derating compared to $V_{op}$ at 85 $^{\circ}\text{C}$ |

### Typical waveforms



Restrictions:

$V_R$ : Maximum operating peak voltage of either polarity but of a non-reversing waveform, for which the capacitor has been designed for continuous operation.

$$\hat{V}_{AC} \leq 0.2 \cdot V_R$$



**B32774 ... B32778**

**MKP DC link – high density series up to 480  $\mu$ F**

| Overvoltage      | Maximum duration within one day | Observation       |
|------------------|---------------------------------|-------------------|
| $1.1 \cdot V_R$  | 30% of on-load duration         | System regulation |
| $1.15 \cdot V_R$ | 30 min.                         | System regulation |
| $1.2 \cdot V_R$  | 5 min.                          | System regulation |
| $1.3 \cdot V_R$  | 1 min.                          | System regulation |

NOTE 1 An overvoltage equal to  $1.5 \cdot V_R$  for 30 ms is permitted 1000 times during the life of the capacitor.

The amplitudes of the overvoltages that may be tolerated without significant reduction in the life time of the capacitor depend on their duration, the number of application and the capacitor temperature.

In addition these values assume that the overvoltages may appear when the internal temperature of the capacitor is less than 0 °C but within the temperature category.

NOTE 2 The average applied voltage must not be higher than the specified voltage.

### Pulse handling capability

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

Note:

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

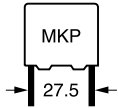
#### dV/dt values

| Lead spacing        | 27.5 mm |     |      |      | 37.5 mm |     |     |     |      |      |
|---------------------|---------|-----|------|------|---------|-----|-----|-----|------|------|
| Type                | B32774  |     |      |      | B32776  |     |     |     |      |      |
| $V_R$ (V DC)        | 450     | 800 | 1100 | 1300 | 450     | 575 | 800 | 900 | 1100 | 1300 |
| dV/dt in V/ $\mu$ s | 30      | 40  | 75   | 100  | 21      | 22  | 22  | 35  | 54   | 73   |

| Lead spacing        | 52.5 mm |     |     |     |      |      |
|---------------------|---------|-----|-----|-----|------|------|
| Type                | B32778  |     |     |     |      |      |
| $V_R$ (V DC)        | 450     | 575 | 800 | 900 | 1100 | 1300 |
| dV/dt in V/ $\mu$ s | 14      | 14  | 15  | 22  | 35   | 50   |

**B32774**

**MKP DC link – high density series – up to 480  $\mu$ F**

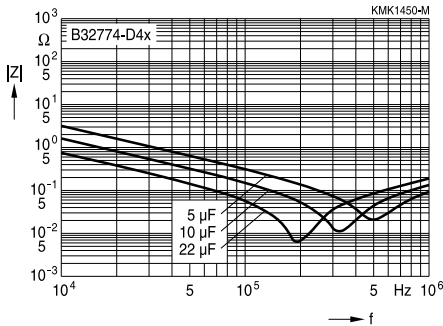


**Characteristics curves**

Additional technical information can be found under "Design support" on [www.epcos.com](http://www.epcos.com)

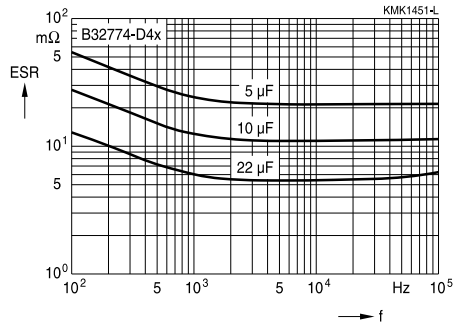
**Impedance Z versus frequency f**  
(typical values)

**Lead spacing 27.5 mm / B32774D4\***



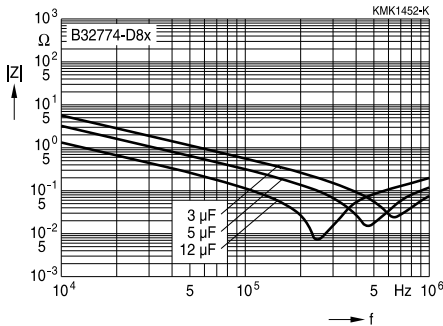
**ESR versus frequency f**  
(typical values)

**Lead spacing 27.5 mm / B32774D4\***



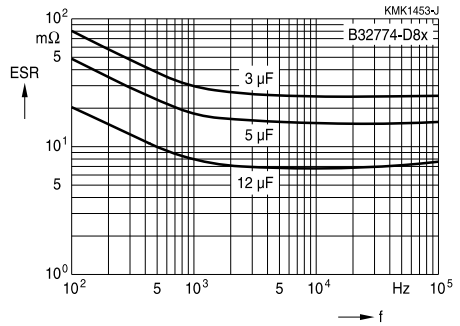
**Impedance Z versus frequency f**  
(typical values)

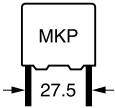
**Lead spacing 27.5 mm / B32774D8\***



**ESR versus frequency f**  
(typical values)

**Lead spacing 27.5 mm / B32774D8\***





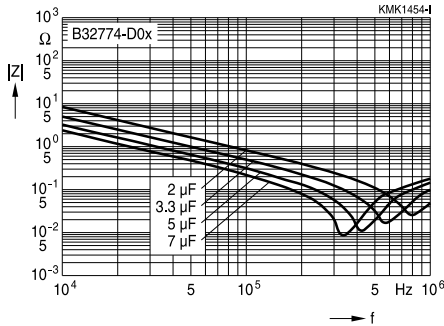
**B32774**

**MKP DC link – high density series – up to 480  $\mu\text{F}$**

**Characteristics curves**

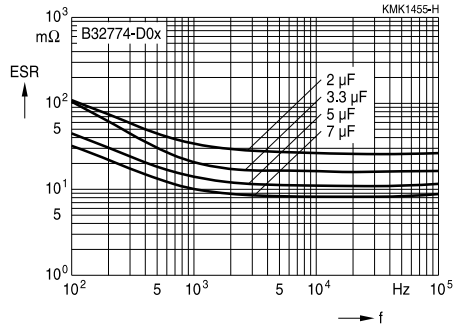
**Impedance Z versus frequency f**  
(typical values)

**Lead spacing 27.5 mm / B32774D0\***



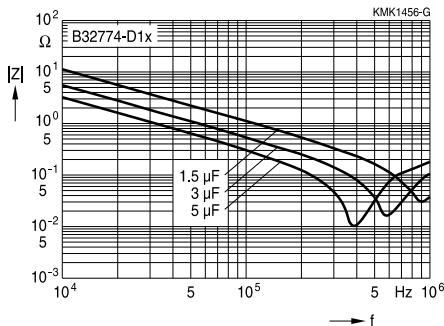
**ESR versus frequency f**  
(typical values)

**Lead spacing 27.5 mm / B32774D0\***



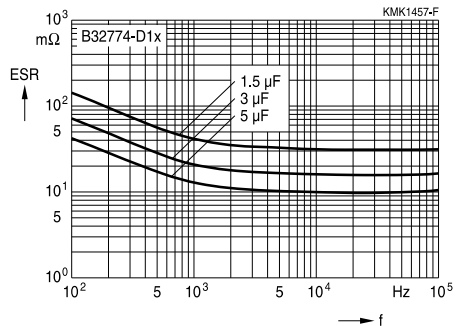
**Impedance Z versus frequency f**  
(typical values)

**Lead spacing 27.5 mm / B32774D1\***



**ESR versus frequency f**  
(typical values)

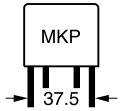
**Lead spacing 27.5 mm / B32774D1\***





**B32776**

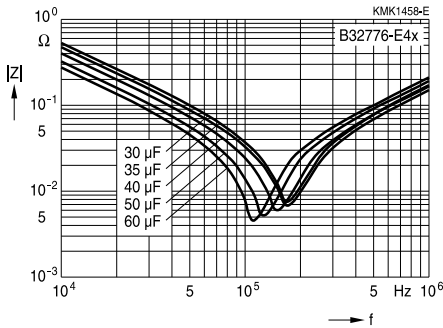
**MKP DC link – high density series – up to 480  $\mu\text{F}$**



**Characteristics curves**

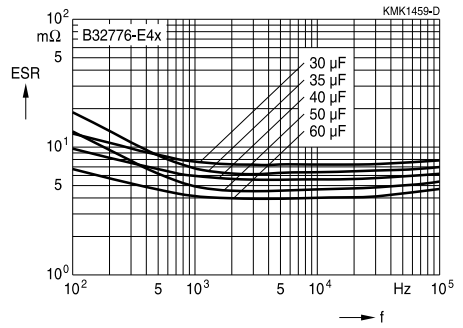
**Impedance Z versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-E4x**



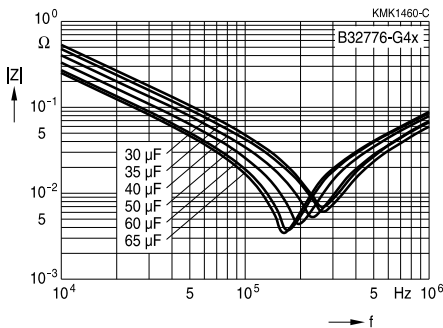
**ESR versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-E4x**



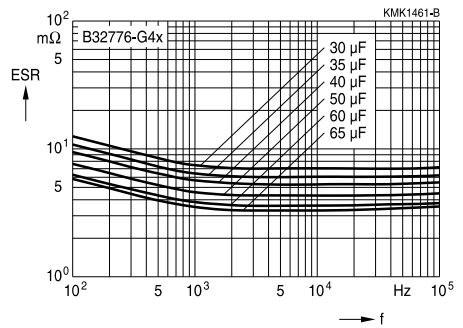
**Impedance Z versus frequency f**  
(typical values)

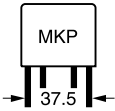
**Lead spacing 37.5 mm / B32776-G4x**



**ESR versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-G4x**





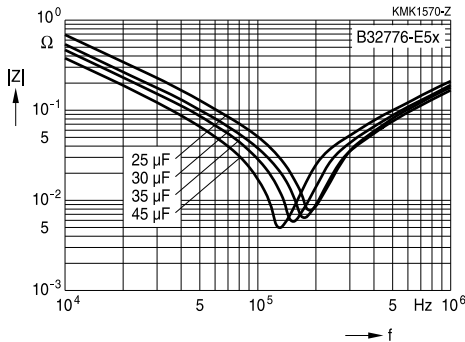
**B32776**

**MKP DC link – high density series – up to 480  $\mu\text{F}$**

**Characteristics curves**

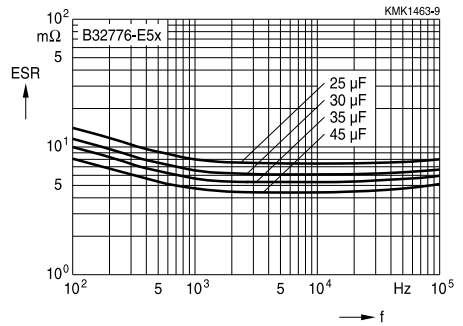
**Impedance Z versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-E5x**



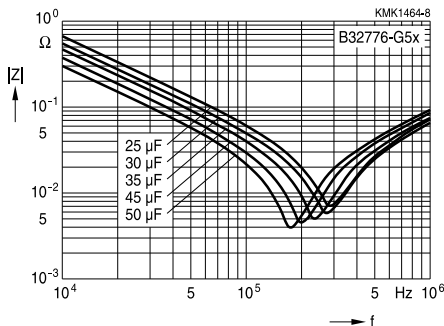
**ESR versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-E5x**



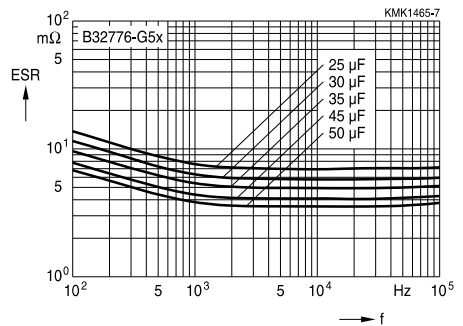
**Impedance Z versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-G5x**



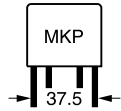
**ESR versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-G5x**



**B32776**

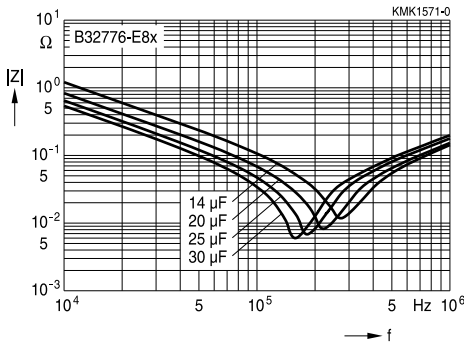
**MKP DC link – high density series – up to 480  $\mu\text{F}$**



**Characteristics curves**

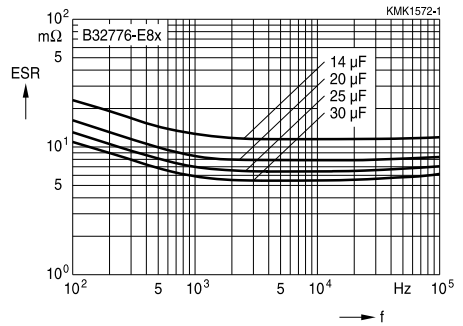
**Impedance Z versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-E8x**



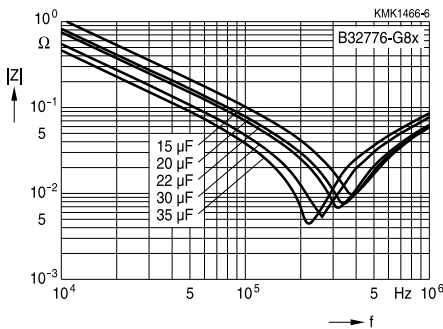
**ESR versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-E8x**



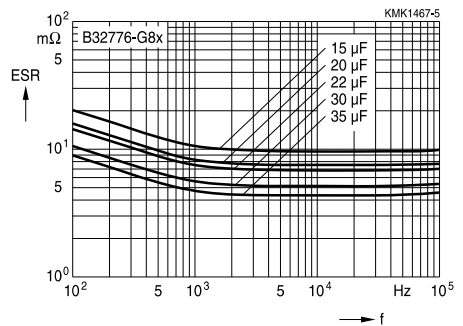
**Impedance Z versus frequency f**  
(typical values)

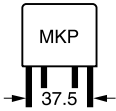
**Lead spacing 37.5 mm / B32776-G8x**



**ESR versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-G8x**





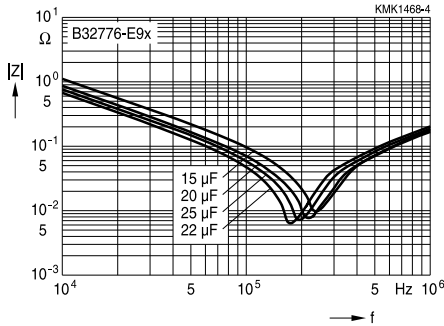
**B32776**

**MKP DC link – high density series – up to 480  $\mu\text{F}$**

**Characteristics curves**

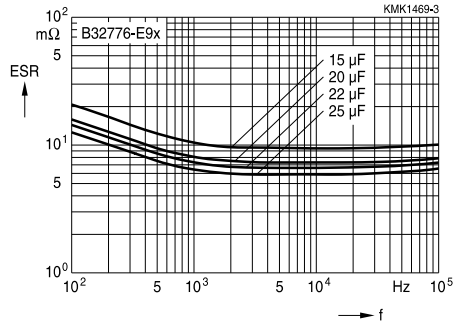
**Impedance Z versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-E9x**



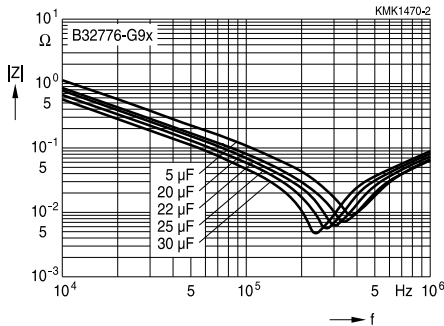
**ESR versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-E9x**



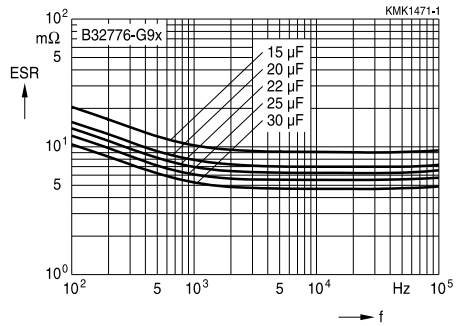
**Impedance Z versus frequency f**  
(typical values)

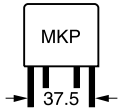
**Lead spacing 37.5 mm / B32776-G9x**



**ESR versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-G9x**

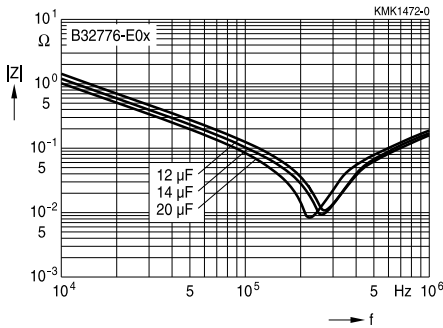




**Characteristics curves**

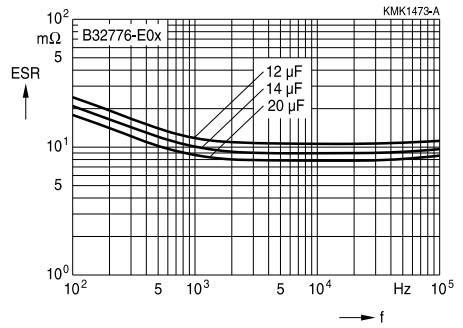
**Impedance Z versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-E0x**



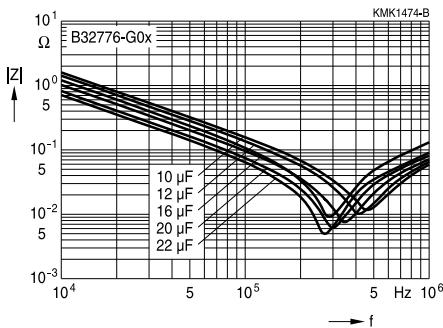
**ESR versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-E0x**



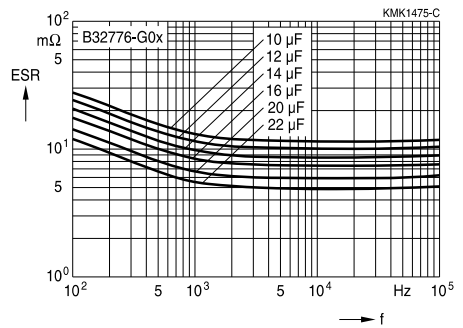
**Impedance Z versus frequency f**  
(typical values)

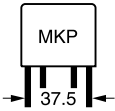
**Lead spacing 37.5 mm / B32776-G0x**



**ESR versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-G0x**





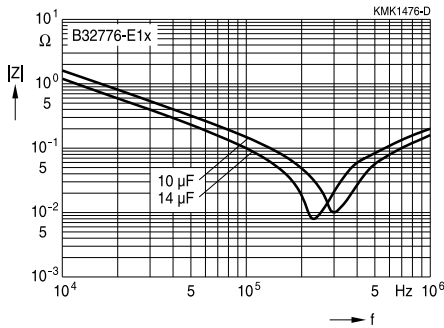
**B32776**

**MKP DC link – high density series – up to 480  $\mu\text{F}$**

**Characteristics curves**

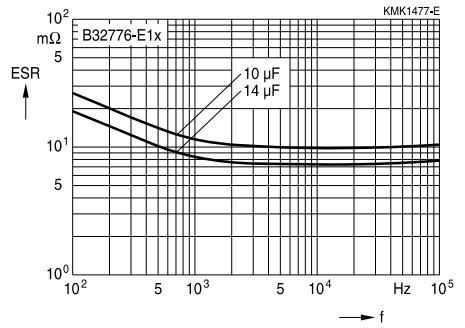
**Impedance Z versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-E1x**



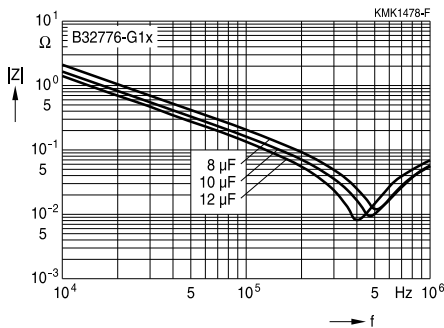
**ESR versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-E1x**



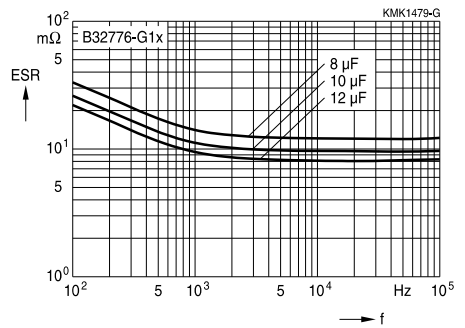
**Impedance Z versus frequency f**  
(typical values)

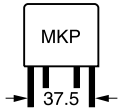
**Lead spacing 37.5 mm / B32776-G1x**



**ESR versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-G1x**

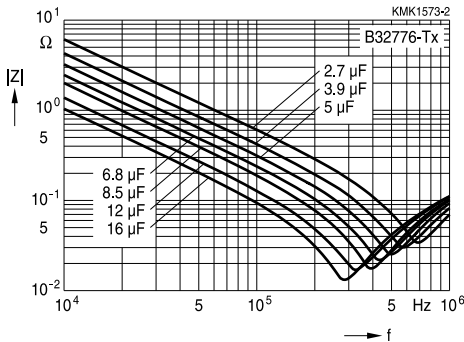




**Characteristics curves**

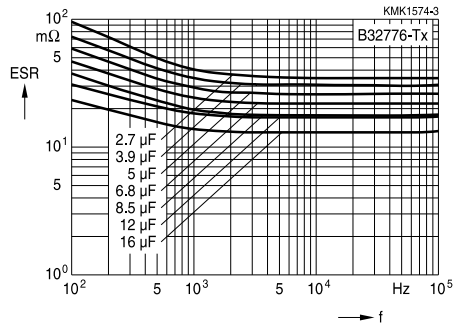
**Impedance Z versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-Tx / 2-pins**



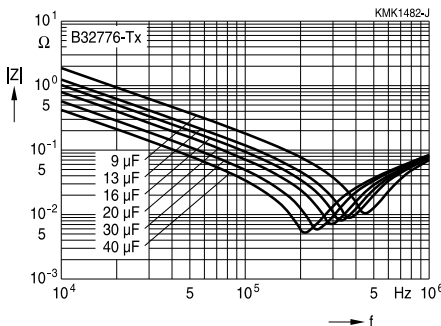
**ESR versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-Tx / 2-pins**



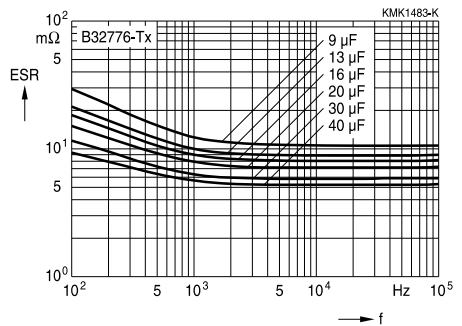
**Impedance Z versus frequency f**  
(typical values)

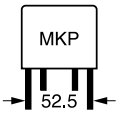
**Lead spacing 37.5 mm / B32776-Tx / 4-pins**



**ESR versus frequency f**  
(typical values)

**Lead spacing 37.5 mm / B32776-Tx / 4-pins**





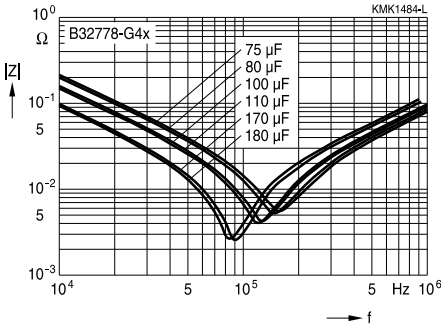
**B32778**

**MKP DC link – high density series – up to 480  $\mu\text{F}$**

**Characteristics curves**

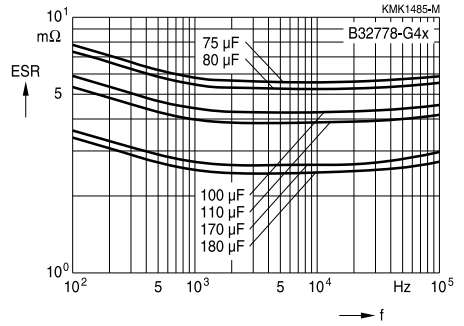
**Impedance Z versus frequency f**  
(typical values)

**Lead spacing 52.5 mm / B32778-G4x**



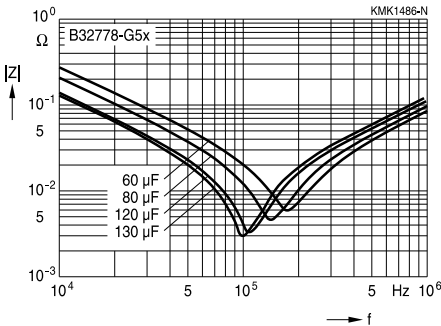
**ESR versus frequency f**  
(typical values)

**Lead spacing 52.5 mm / B32778-G4x**



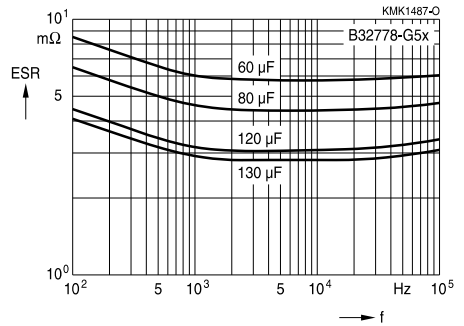
**Impedance Z versus frequency f**  
(typical values)

**Lead spacing 52.5 mm / B32778-G5x**



**ESR versus frequency f**  
(typical values)

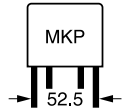
**Lead spacing 52.5 mm / B32778-G5x**





**B32778**

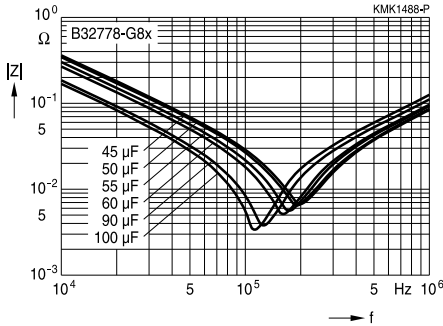
**MKP DC link – high density series – up to 480  $\mu$ F**



**Characteristics curves**

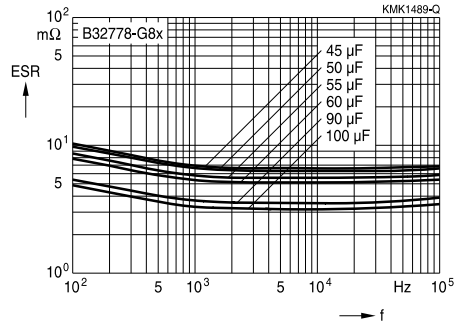
**Impedance Z versus frequency f**  
(typical values)

**Lead spacing 52.5 mm / B32778-G8x**



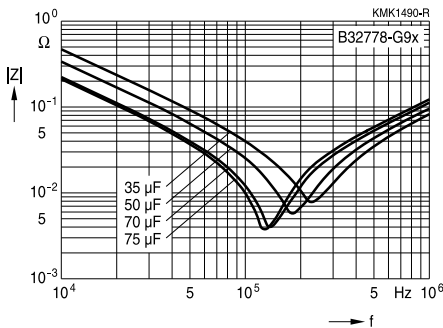
**ESR versus frequency f**  
(typical values)

**Lead spacing 52.5 mm / B32778-G8x**



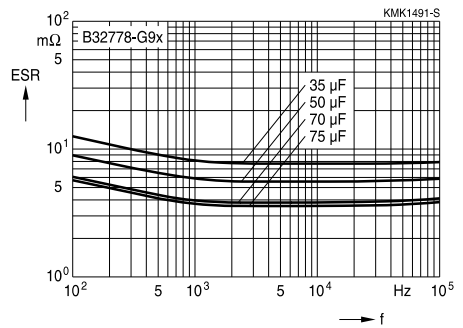
**Impedance Z versus frequency f**  
(typical values)

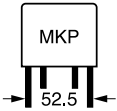
**Lead spacing 52.5 mm / B32778-G9x**



**ESR versus frequency f**  
(typical values)

**Lead spacing 52.5 mm / B32778-G9x**





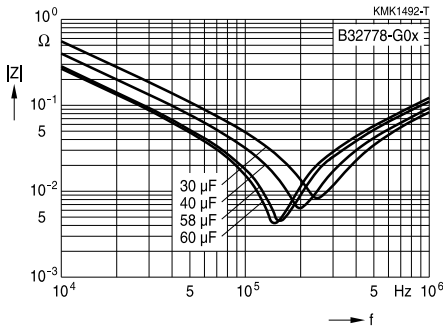
**B32778**

**MKP DC link – high density series – up to 480  $\mu\text{F}$**

**Characteristics curves**

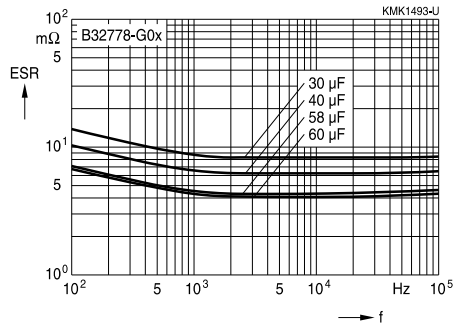
**Impedance Z versus frequency f**  
(typical values)

**Lead spacing 52.5 mm / B32778-G0x**



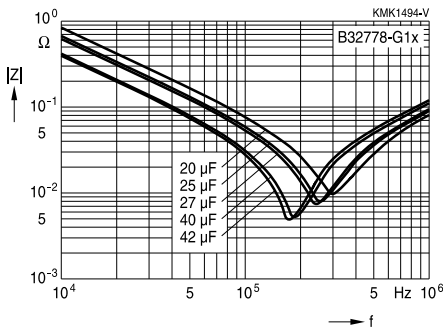
**ESR versus frequency f**  
(typical values)

**Lead spacing 52.5 mm / B32778-G0x**



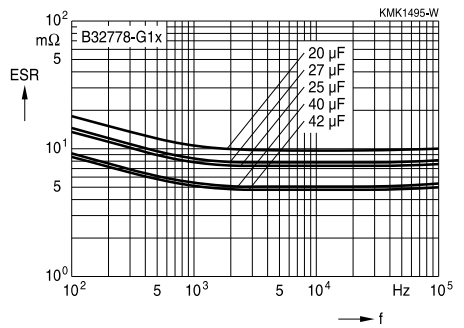
**Impedance Z versus frequency f**  
(typical values)

**Lead spacing 52.5 mm / B32778-G1x**



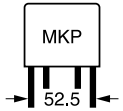
**ESR versus frequency f**  
(typical values)

**Lead spacing 52.5 mm / B32778-G1x**



**B32778**

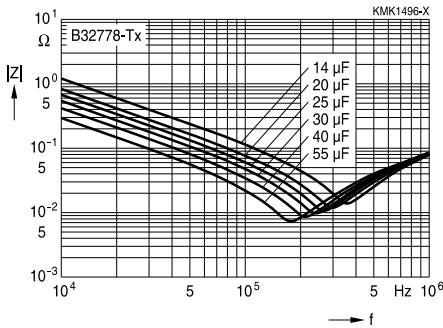
**MKP DC link – high density series – up to 480  $\mu$ F**



**Characteristics curves**

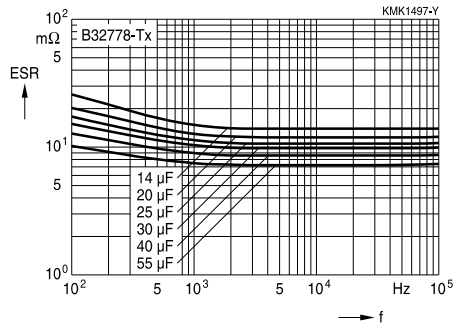
**Impedance Z versus frequency f**  
(typical values)

**Lead spacing 52.5 mm / B32778-Tx**



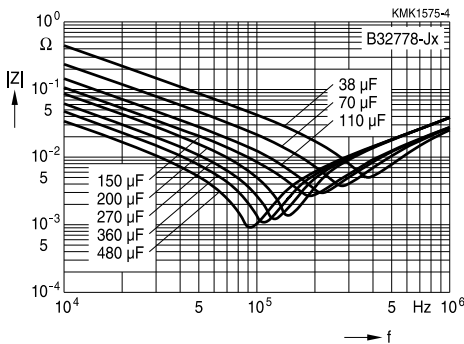
**ESR versus frequency f**  
(typical values)

**Lead spacing 52.5 mm / B32778-Tx**



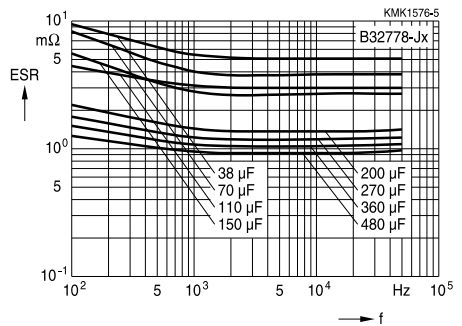
**Impedance Z versus frequency f**  
(typical values)

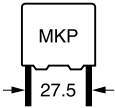
**Lead spacing 52.5 mm / B32778-Jx**



**ESR versus frequency f**  
(typical values)

**Lead spacing 52.5 mm / B32778-Jx**





**B32774**

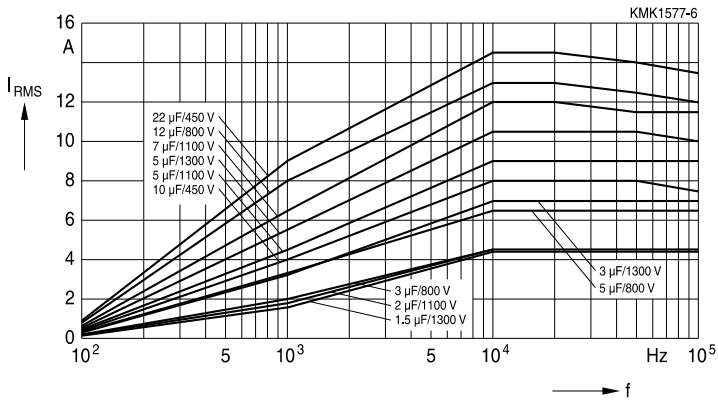
**MKP DC link – high density series – up to 480  $\mu$ F**

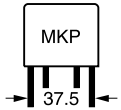
**Characteristics curves**

**Permissible current  $I_{RMS}$  versus frequency  $f$  at 70 °C**

**Lead spacing 27.5 mm**

B32774-Dx



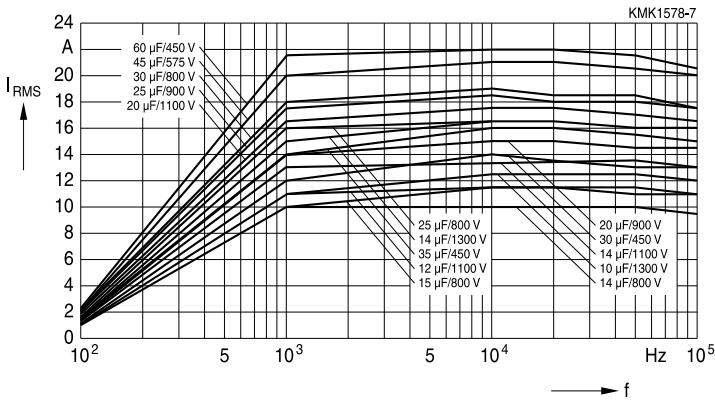


Characteristics curves

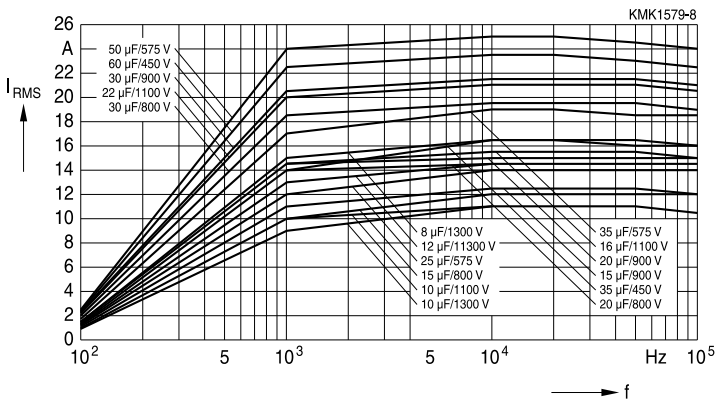
Permissible current  $I_{\text{RMS}}$  versus frequency  $f$  at 70 °C

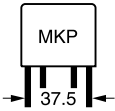
Lead spacing 37.5 mm

B32776-Ex



B32776-Gx





**B32776**

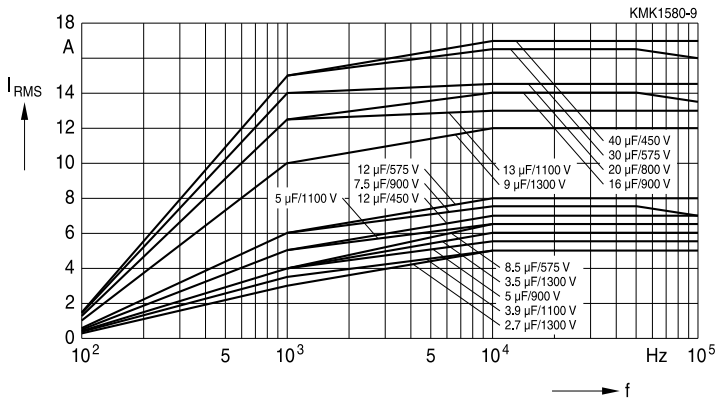
**MKP DC link – high density series – up to 480  $\mu\text{F}$**

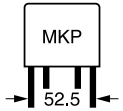
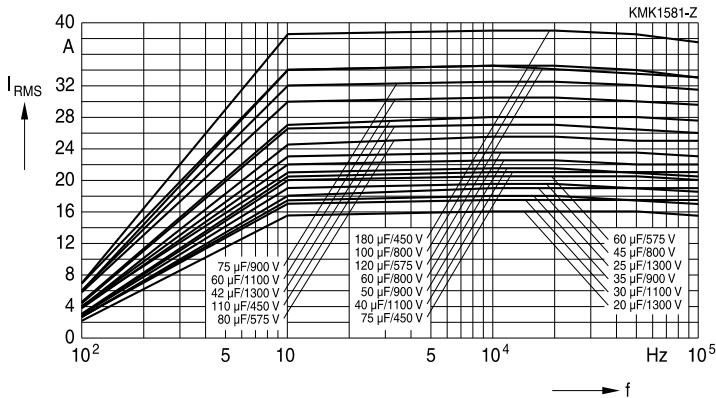
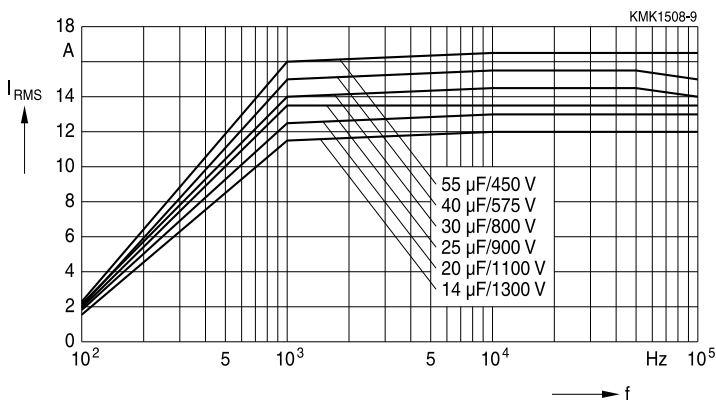
**Characteristics curves**

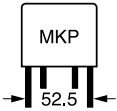
**Permissible current  $I_{\text{RMS}}$  versus frequency  $f$  at 70 °C**

**Lead spacing 37.5 mm**

B32776-Tx




**Characteristics curves**
**Permissible current  $I_{\text{RMS}}$  versus frequency  $f$  at 70 ° C**
**Lead spacing 52.5 mm**
**B32778-Gx, 4 pins**

**B32778-Tx, 4 pins**




**B32778**

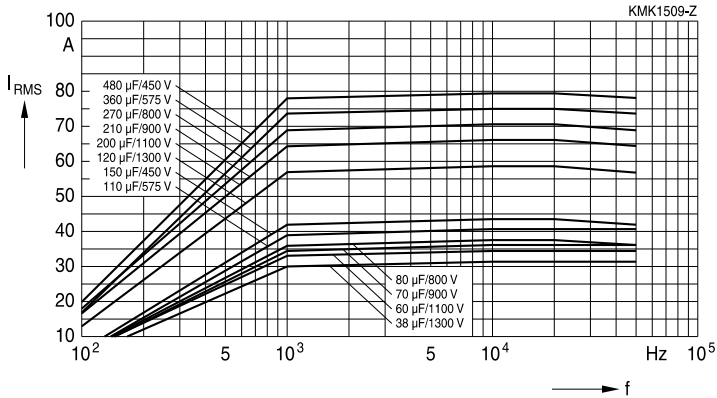
**MKP DC link – high density series – up to 480  $\mu$ F**

**Characteristics curves**

**Permissible current  $I_{RMS}$  versus frequency  $f$  at 70 °C**

**Lead spacing 52.5 mm**

**B32778-Jx, 12 pins**



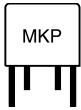




**Curves Characteristics (I<sub>rms</sub> derating vs temperature)**



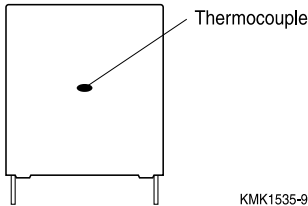
Maximum I<sub>RMS</sub> current as function of the ambient temperature:  $I_{RMS}(T_A) = \text{Factor} \times I_{RMS}(70\text{ °C})$



**B32774 ... B32778**

**MKP DC link – high density series up to 480  $\mu$ F**

**Heat transference for self heating calculation**



KMK1535-9

Figure 1

| Box dimensions |        |        | Equivalent heat coefficient |
|----------------|--------|--------|-----------------------------|
| w (mm)         | h (mm) | l (mm) | G (mW/°C)                   |
| 11.0           | 19.0   | 31.5   | 25                          |
| 11.0           | 21.0   | 31.5   | 28                          |
| 12.5           | 21.5   | 31.5   | 30                          |
| 13.5           | 23.0   | 31.5   | 32                          |
| 14.0           | 24.5   | 31.5   | 35                          |
| 15.0           | 24.5   | 31.5   | 36                          |
| 16.0           | 32.0   | 31.5   | 45                          |
| 18.0           | 27.5   | 31.5   | 44                          |
| 18.0           | 33.0   | 31.5   | 48                          |
| 19.0           | 30.0   | 31.5   | 48                          |
| 20.0           | 11.0   | 31.5   | 65                          |
| 21.0           | 31.0   | 31.5   | 51                          |
| 22.0           | 36.5   | 31.5   | 58                          |
| 12.0           | 22.0   | 41.5   | 70                          |
| 14.0           | 25.0   | 41.5   | 43                          |
| 16.0           | 28.5   | 41.5   | 50                          |
| 18.0           | 32.5   | 41.5   | 59                          |
| 20.0           | 39.5   | 41.5   | 72                          |
| 24.0           | 19.0   | 41.5   | 50                          |
| 24.0           | 15.0   | 41.5   | 44                          |
| 28.0           | 37.0   | 42.0   | 83                          |
| 28.0           | 42.5   | 41.5   | 90                          |
| 30.0           | 45.0   | 42.0   | 100                         |
| 33.0           | 48.0   | 42.0   | 100                         |
| 43.0           | 22.0   | 41.5   | 80                          |
| 30.0           | 45.0   | 57.5   | 125                         |
| 35.0           | 50.0   | 57.5   | 145                         |
| 43.0           | 24.0   | 57.5   | 103                         |
| 45.0           | 57.0   | 57.5   | 185                         |
| 60.0           | 45.0   | 57.5   | 192                         |
| 130.0          | 24.0   | 57.5   | 200                         |
| 130.0          | 58.0   | 57.5   | 300                         |

The equivalent heat coefficient "**G (mW/°C)**" is given for measuring the temperature on the lateral surface of the plastic box as figure1 shows. By using a thermocouple and avoiding effect of radiation and convection the temperature measured during operation conditions should be a result of the dissipated power divided by the equivalent heat coefficient.



### Self Heating by power dissipation & equivalent heat coefficient

The  $I_{RMS}$  and consequently the power dissipation must be limited during operation in order to not exceed the maximum limit of  $\Delta T$  allowed for this series.  $\Delta T_{max}$  given for this series is equal or lower than 20 °C at rated temperature (70 °C), for higher ambient temperatures  $\Delta T_{max}(T)$  will have the same derating factor than  $I_{RMS}$  vs temperature and then an equivalent derating as per: ambient temperatures  $\Delta T_{max}(T)$  will have the same derating factor than  $I_{RMS}$  vs temperature and then an equivalent derating as per:

$$\Delta T_{max}(T) = (\text{Factor})^2 \times \Delta T(70\text{ °C}).$$

For any particular  $I_{RMS}$  the  $\Delta T$  may be calculated by:

$$\Delta T(\text{°C}) = P_{dis}(\text{mW}) / G(\text{mW/°C}).$$

Where  $\Delta T(\text{°C})$  is the difference between the temperature measured on the box (see figure 1) and the ambient temperature when capacitor is working during normal operation;

$$\Delta T(\text{°C}) = T_{op}(\text{°C}) - T_A(\text{°C}).$$

It represents the increasing of temperature provoked by the  $I_{RMS}$  during operation.

$G(\text{mW/°C})$  is the equivalent heat coefficient described above and  $P_{dis}(\text{mW})$  is the dissipated power defined by:

$$P_{dis}(\text{mW}) = ESR_{typ}(\text{m}\Omega) \times I_{rms}^2(\text{A}_{RMS}).$$

### Example for thermal calculation:

We will take as reference B32778G0306K (30 μF/1100 V) type for thermal calculation.

Considering the following load and capacitor characteristics:

$I_{RMS}$  : 12 A<sub>RMS</sub> at 20 kHz       $T_A$ : 85 °C      30 × 45 × 57.5 box  
 $G(\text{mW/°C})$ : 125

Then we have to find the  $ESR_{typ}$  at 20 kHz what is approx . 8.2 mΩ.

So according to:

$$P_{dis}(\text{mW}) = ESR_{typ}(\text{m}\Omega) \times I_{rms}^2(\text{A}_{RMS})$$

we have the following:

$$P_{dis}(\text{mW}) = 8.2\text{ m}\Omega \times 12\text{ A}_{RMS}^2 = 1181\text{ mW}$$

and as per:

$$\Delta T(\text{°C}) = P_{dis}(\text{mW}) / G(\text{mW/°C})$$

we have the following:

$$\Delta T(\text{°C}) = 1181(\text{mW}) / 125(\text{mW/°C}) = 9.5\text{ °C}.$$

What is below of the

$$\Delta T_{max}(85\text{ °C}) = (\text{Factor})^2 \times \Delta T(70\text{ °C}) = (0.7)^2 \times 20\text{ °C} = 9.8\text{ °C}.$$

On the other hand we may confirm that max  $I_{RMS}$  at 20 kHz at 70 °C = 17.5 A<sub>RMS</sub>

And then max  $I_{RMS}$  for 85 °C of ambient temperature is defined as follows:

$$I_{RMS}(85\text{ °C}) = \text{Factor} \times I_{RMS}(70\text{ °C}) = 0.7 \times 17.5\text{ A}_{RMS} = 12.25\text{ A}_{RMS}.$$

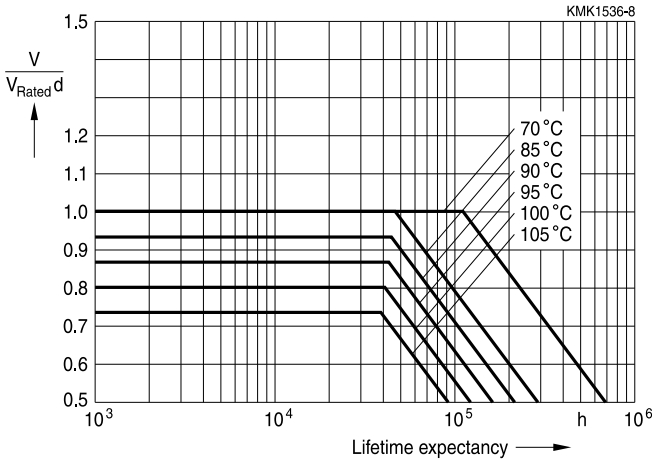
What confirms once again that  $I_{RMS}$  (12 A<sub>RMS</sub> at 20 kHz) is below the max specified for such frequency and ambient temperature.



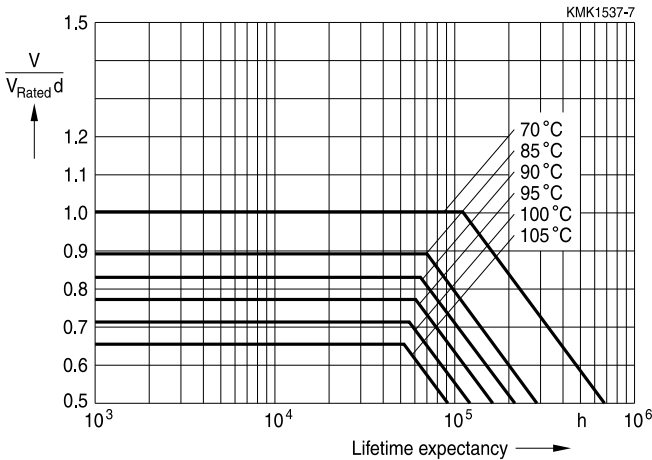
**B32774 ... B32778**

**MKP DC link – high density series up to 480  $\mu$ F**

**Life time expectancy - typical curve (450 V DC / B3277x-X4)**



**Life time expectancy - typical curve (575 V DC / 800 V DC / 900 V DC / 1100 V DC / 1300 V DC / B3277X-5/8/9/0/1)**



Note: Confidence level of 95%


**Testing and Standards**

| Test  | Reference                          | Conditions of test  | Performance requirements  |               |                         |      |                          |      |  |
|---|------------------------------------|---|---|---------------|-------------------------|------|--------------------------|------|--|
| Electrical Parameters<br>(Routine test)     | IEC 61071-11                       | Voltage between terminals,<br>1.5 $V_R$ , during 10 s<br>Insulation resistance, $R_{INS}$ at<br>$V_R$ if $V_R < 500$ V or<br>500 V if $V_R \geq 500$ V<br>Capacitance, C at 1 kHz<br>(room temperature)<br>Dissipation factor, $\tan \delta$ at<br>1/10 kHz (room temperature)  | Within specified limits   |               |                         |      |                          |      |  |
| Robustness of terminations<br>(Type test)   | IEC 60068-2-21                     | Tensile strength (test Ua1)<br><table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>Wire diameter</td> <td>Tensile force</td> </tr> <tr> <td><math>0.5 &lt; d_1 \leq 0.8</math> mm</td> <td>10 N</td> </tr> <tr> <td><math>0.8 &lt; d_1 \leq 1.25</math> mm</td> <td>20 N</td> </tr> </table> | Wire diameter   | Tensile force | $0.5 < d_1 \leq 0.8$ mm | 10 N | $0.8 < d_1 \leq 1.25$ mm | 20 N | Capacitance and $\tan \delta$<br>within specified limits |
| Wire diameter                               | Tensile force                      |   |   |               |                         |      |                          |      |  |
| $0.5 < d_1 \leq 0.8$ mm                     | 10 N                               |   |   |               |                         |      |                          |      |  |
| $0.8 < d_1 \leq 1.25$ mm                    | 20 N                               |   |   |               |                         |      |                          |      |  |
| Resistance to soldering heat<br>(Type test) | IEC 60068-2-20, test Tb, method 1A | Solder bath temperature at<br>$260 \pm 5$ °C, immersion for<br>10 seconds   | $\Delta C/C_0 \leq 2\%$<br>$\Delta \tan \delta \leq 0.002$  |               |                         |      |                          |      |  |
| Rapid change of temperature<br>(Type test)  | IEC 60384-16                       | $T_A$ = lower category temperature<br>$T_B$ = upper category temperature<br>Five cycles, duration $t = 30$ min.   | $ \Delta C/C_0  \leq 2\%$<br>$\Delta \tan \delta \leq 0.002$<br>$R_{INS} \geq 50\%$ of initial limit                      |               |                         |      |                          |      |  |
| Vibration<br>(Type test)                    | IEC 60384-16                       | Test $F_C$ : vibration sinusoidal<br>Displacement: 0.75 mm<br>Acceleration: 98 $m/s^2$<br>Frequency: 10 Hz ... 500 Hz<br>Test duration: 3 orthogonal axes,<br>2 hours each axe  | No visible damage   |               |                         |      |                          |      |  |
| Bump<br>(Type test)                         | IEC 60384-16                       | Test Eb: Total 4000 bumps with<br>390 $m/s^2$ mounted on PCB<br>6 ms duration   | No visible damage<br>$ \Delta C/C_0  \leq 2\%$<br>$\Delta \tan \delta \leq 0.002$<br>$R_{INS} \geq 50\%$ of initial limit |               |                         |      |                          |      |  |
| Climatic sequence<br>(Type test)            | IEC 60384-16                       | Dry heat $T_b$ / 16 h.<br>Damp heat cyclic, 1st cycle<br>+ 55 °C / 24h / 95% ... 100% RH<br>Cold $T_a$ / 2h<br>Damp heat cyclic, 5 cycles<br>+ 55 °C / 24h / 95% ... 100% RH  | No visible damage<br>$ \Delta C/C_0  \leq 3\%$<br>$\Delta \tan \delta \leq 0.001$<br>$R_{INS} \geq 50\%$ of initial limit |               |                         |      |                          |      |  |



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**MKP DC link – high density series up to 480  $\mu$ F**

| Test                               | Reference    | Conditions of test   | Performance requirements   |
|------------------------------------|--------------|--|--|
| Damp Heat Steady State (Type test) | IEC 60384-16 | Test Ca<br>40 °C / 93% RH / 56 days  | No visible damage<br>$ \Delta C/C_0  \leq 5\%$<br>$ \Delta \tan \delta  \leq 0.005$<br>$R_{INS} \geq 50\%$ of initial limit          |
| Endurance (Type test)              | IEC 60384-16 | 70 °C / 1.25 $V_R$ / 1000 hours or<br>85 °C / 1.25 $V_{op}$ / 1000 hours or<br>100 °C / 1.25 $V_{op}$ / 1000 hours | No visible damage<br>$ \Delta C/C_0  \leq 5\%$ at 1 kHz<br>$ \Delta \tan \delta  \leq 0.005$<br>$R_{INS} \geq 50\%$ of initial limit |

## 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 $\pm$ 5 °C  |
| Soldering time          | 2.0 $\pm$ 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 $\geq$ 90%, free-flowing solder |

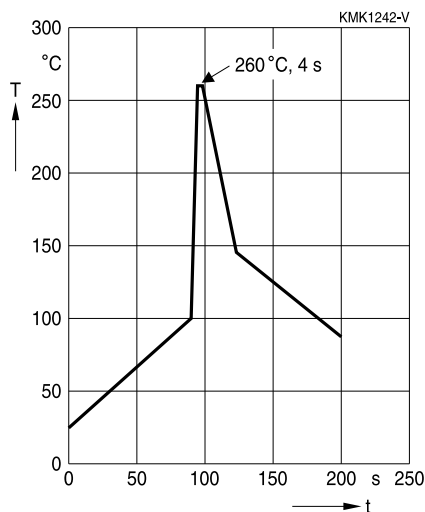


## 1.2 Resistance to soldering heat

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

Conditions:

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



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



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MKP DC link – high density series up to 480  $\mu\text{F}$

### 1.3 General notes on soldering

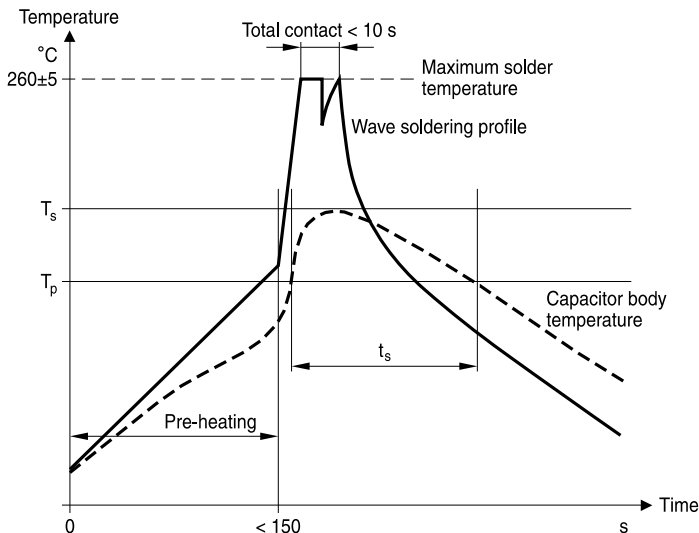
Permissible heat exposure loads on film capacitors are primarily characterized by the upper category temperature  $T_{\text{max}}$ . Long exposure to temperatures above this type-related temperature limit can lead to changes in the plastic dielectric and thus change irreversibly a capacitor's electrical 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:

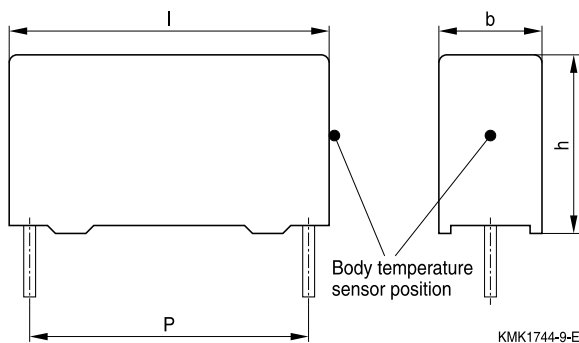


$T_s$ : Capacitor body maximum temperature at wave soldering

$T_p$ : Capacitor body maximum temperature at pre-heating

KMK1745-A-E





Body temperature should follow the description below:

- MKP capacitor
  - During pre-heating:  $T_p \leq 110 \text{ }^\circ\text{C}$
  - During soldering:  $T_s \leq 120 \text{ }^\circ\text{C}$ ,  $t_s \leq 45 \text{ s}$
- MKT capacitor
  - During pre-heating:  $T_p \leq 125 \text{ }^\circ\text{C}$
  - During soldering:  $T_s \leq 160 \text{ }^\circ\text{C}$ ,  $t_s \leq 45 \text{ s}$

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  $\leq 120 \text{ }^\circ\text{C}$ .

One recommended condition for manual soldering is that the tip of the soldering iron should be  $< 360 \text{ }^\circ\text{C}$  and the soldering contact time should be no longer than 3 seconds.

For uncoated MKT capacitors with lead spacings  $\leq 10 \text{ mm}$  (B32560/B32561) the following measures are recommended:

- pre-heating to not more than  $110 \text{ }^\circ\text{C}$  in the preheater phase
- rapid cooling after soldering

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



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## 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.

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

| Topic  | Safety information  | Reference chapter<br>"Mounting guidelines"         |
|--|---|--|
| Soldering                                      | Do not exceed the specified time or temperature limits during soldering.  | 1 "Soldering"                                      |
| Cleaning                                       | Use only suitable solvents for cleaning capacitors.   | 2 "Cleaning"                                       |
| Embedding of capacitors in finished assemblies | When embedding finished circuit assemblies in plastic resins, chemical and thermal influences must be taken into account.<br>Caution: Consult us first, if you also wish to embed other uncoated component types! | 3 "Embedding of capacitors in finished assemblies" |



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## Symbols and terms

| Symbol               | English   | German  |
|----------------------|---|---|
| $\alpha$             | Heat transfer coefficient   | Wärmeübergangszahl  |
| $\alpha_C$           | Temperature coefficient of capacitance                                    | Temperaturkoeffizient der Kapazität   |
| A                    | Capacitor surface area  | Kondensatoroberfläche   |
| $\beta_C$            | Humidity coefficient of capacitance                                       | Feuchtekoeffizient der Kapazität  |
| C                    | Capacitance   | Kapazität   |
| $C_R$                | Rated capacitance   | Nennkapazität   |
| $\Delta C$           | Absolute capacitance change   | Absolute Kapazitätsänderung   |
| $\Delta C/C$         | 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   |
| $\Delta t$           | Time interval   | Zeitintervall   |
| $\Delta T$           | Absolute temperature change (self-heating)                                | Absolute Temperaturänderung (Selbsterwärmung)                                   |
| $\Delta \tan \delta$ | 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  |
| $f_1$                | Frequency limit for reducing permissible AC voltage due to thermal limits | Grenzfrequenz für thermisch bedingte Reduzierung der zulässigen Wechselspannung |
| $f_2$                | Frequency limit for reducing permissible AC voltage due to current limit  | Grenzfrequenz für strombedingte Reduzierung der zulässigen Wechselspannung      |
| $f_r$                | Resonant frequency  | Resonanzfrequenz  |
| $F_D$                | Thermal acceleration factor for diffusion                                 | Therm. Beschleunigungsfaktor zur Diffusion                                      |
| $F_T$                | Derating factor   | Deratingfaktor  |
| i                    | Current (peak)  | Stromspitze   |
| $I_C$                | Category current (max. continuous current)                                | Kategoriestrom (max. Dauerstrom)  |



| Symbol           | English  | German  |
|------------------|--|---|
| $I_{RMS}$        | (Sinusoidal) alternating current, root-mean-square value | (Sinusförmiger) Wechselstrom                      |
| $i_z$            | Capacitance drift  | Inkonstanz der Kapazität                          |
| $k_0$            | Pulse characteristic                                     | Impuls Kennwert                                   |
| $L_S$            | Series inductance  | Serieninduktivität                                |
| $\lambda$        | Failure rate   | Ausfallrate                                       |
| $\lambda_0$      | Constant failure rate during useful service life         | Konstante Ausfallrate in der Nutzungsphase        |
| $\lambda_{test}$ | Failure rate, determined by tests                        | Experimentell ermittelte Ausfallrate              |
| $P_{diss}$       | Dissipated power   | Abgegebene Verlustleistung                        |
| $P_{gen}$        | Generated power  | Erzeugte Verlustleistung                          |
| $Q$              | Heat energy  | Wärmeenergie                                      |
| $\rho$           | 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 (Feuchtestest)                        |
| $t$              | Time   | Zeit  |
| $T$              | Temperature  | Temperatur  |
| $\tau$           | Time constant  | Zeitkonstante                                     |
| $\tan \delta$    | Dissipation factor                                       | Verlustfaktor                                     |
| $\tan \delta_D$  | Dielectric component of dissipation factor               | Dielektrischer Anteil des Verlustfaktors          |
| $\tan \delta_P$  | Parallel component of dissipation factor                 | Parallelanteil des Verlustfaktors                 |
| $\tan \delta_S$  | Series component of dissipation factor                   | Serienanteil des Verlustfaktors                   |
| $T_A$            | Temperature of the air surrounding the component         | Temperatur der Luft, die das Bauteil umgibt       |
| $T_{max}$        | Upper category temperature                               | Obere Kategorietemperatur                         |
| $T_{min}$        | Lower category temperature                               | Untere Kategorietemperatur                        |
| $t_{OL}$         | Operating life at operating temperature and voltage      | Betriebszeit bei Betriebstemperatur und -spannung |
| $T_{op}$         | Operating temperature, $T_A + \Delta T$                  | Betriebstemperatur, $T_A + \Delta T$              |
| $T_R$            | Rated temperature  | Nenntemperatur                                    |
| $T_{ref}$        | Reference temperature                                    | Referenztemperatur                                |
| $t_{SL}$         | Reference service life                                   | Referenz-Lebensdauer                              |



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| Symbol      | English   | German                                      |
|-------------|---|---|
| $V_{AC}$    | AC voltage  | Wechselspannung                             |
| $V_C$       | Category voltage  | Kategoriespannung                           |
| $V_{C,RMS}$ | Category AC voltage   | (Sinusförmige)<br>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                                |
| $\hat{V}_R$ | Amplitude of rated AC voltage                               | Amplitude der Nenn-Wechselspannung          |
| $V_{RMS}$   | (Sinusoidal) alternating voltage,<br>root-mean-square value | (Sinusförmige) Wechselspannung              |
| $V_{SC}$    | S-correction voltage  | Spannung bei Anwendung "S-correction"       |
| $V_{sn}$    | Snubber capacitor voltage                                   | Spannung bei Anwendung<br>"Beschaltung"     |
| $Z$         | Impedance   | Scheinwiderstand                            |
| $e$         | Lead spacing  | Rastermaß                                   |

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## Important notes

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