



Product Brief 2011

Power Capacitors

MKK-DC / MKK-DCI (-H) / MKK-DC-R

Characteristics and properties

High performance gas-impregnated capacitors offered for applications with medium voltage from 1500 to 3000 V DC and medium currents, with clear advantages in terms of lightness and reduced cost.

Oil-impregnated capacitors are alternatives when applications demand high operating temperature and currents, resulting in critical heating that is more effectively evacuated by oil. This technology in oil is also more suitable for applications with high nominal voltages of >1800 V DC and/or high ripple voltages above 400 V RMS. Polyurethane resin-filled capacitors are offered in low voltage

applications with high currents due to their more simple construction with less components. The resin acts as insulator and heat conductor.

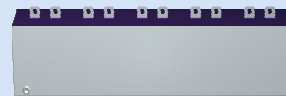
In those cases where due to constraints in the application, the design of choice as explained above is not advisable or appropriate, a special custom-made design with another technology is possible.

Applications

- DC-voltage applications for DC link
- Resonant filtering
- Frequency converters

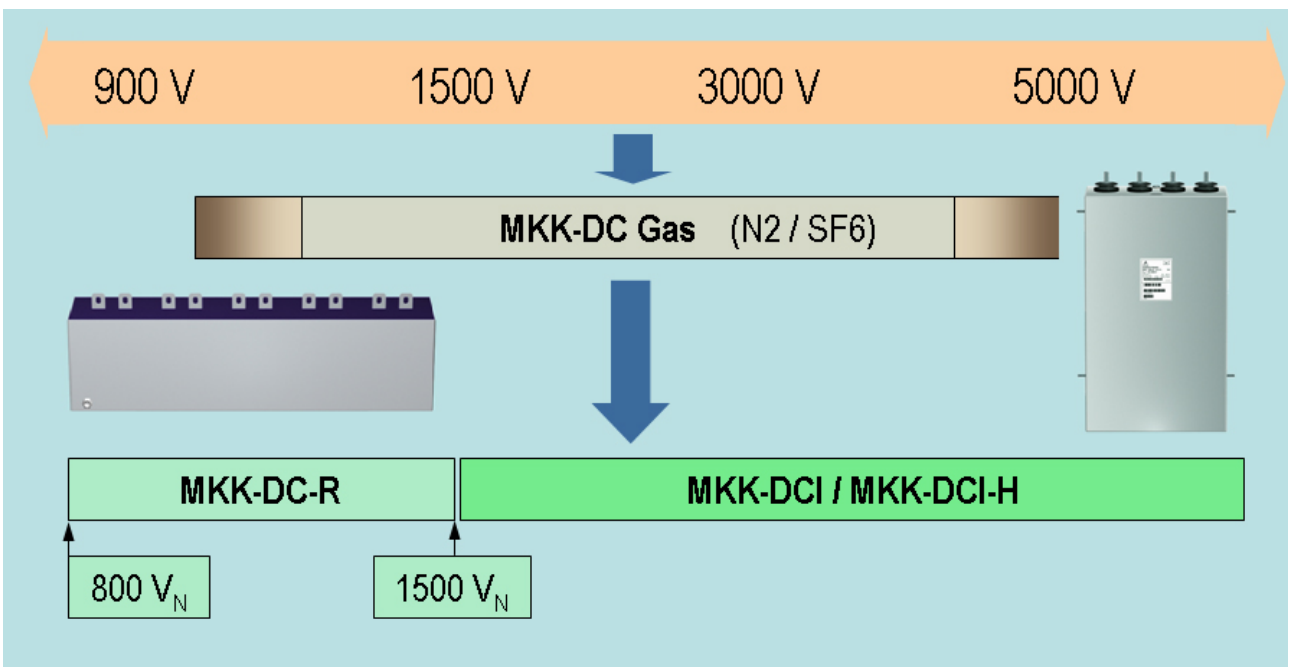
Housing

- Rectangular non-magnetic stainless steel case
- Ferric steel, aluminum



Power Capacitors

| Overview | | |
|---|--|---|
| MKK-DC B25650 | MKK-DCI / MKK-DCI-H B25750 | MKK-DC-R B25640 |
| <ul style="list-style-type: none"> • Dry (gas) • SF6, N2 • Flat winding | <ul style="list-style-type: none"> • Oil • Rapeseed oil • Flat winding | <ul style="list-style-type: none"> • Dry • Polyurethane resin • Flat winding |
| Applications | | |
| <ul style="list-style-type: none"> • < 3000 V DC • No AC ripple • Low temperature • DC link traction • State-of-the-art | <ul style="list-style-type: none"> • 1800 ... 6500 V DC • With AC ripple • Better thermal stability • Filter circuit | <ul style="list-style-type: none"> • 800 ... 1500 V DC • No AC ripple • Low temperature • DC link industrial • Best cost |



| Specification and electrical characteristics | |
|---|---|
| Capacitance | 100 ... 20 000 μ F |
| Tolerance | \pm 10% |
| Rated voltage | 800 ... 6500 V DC |
| Operating hot-spot temperature | -55 ... +85 $^{\circ}$ C |
| Lifetime at V_R and +70 $^{\circ}$ C hot-spot temperature | Up to 350 000 h |
| Stray inductance | Minimum values of down to 30 nH |
| Impregnation | Resin, gas and oil available |
| Test voltage between terminals | $1.5 \cdot V_R$ during 10 s |
| Test voltage between shorten-terminals and case | $(2 \cdot V_R + 1000) V_{RMS}$ at 50 Hz during 60 s |

Power Capacitors

MKK-DC/MKK-DCI/MKK-DCI-H: Mechanical considerations and construction

General description

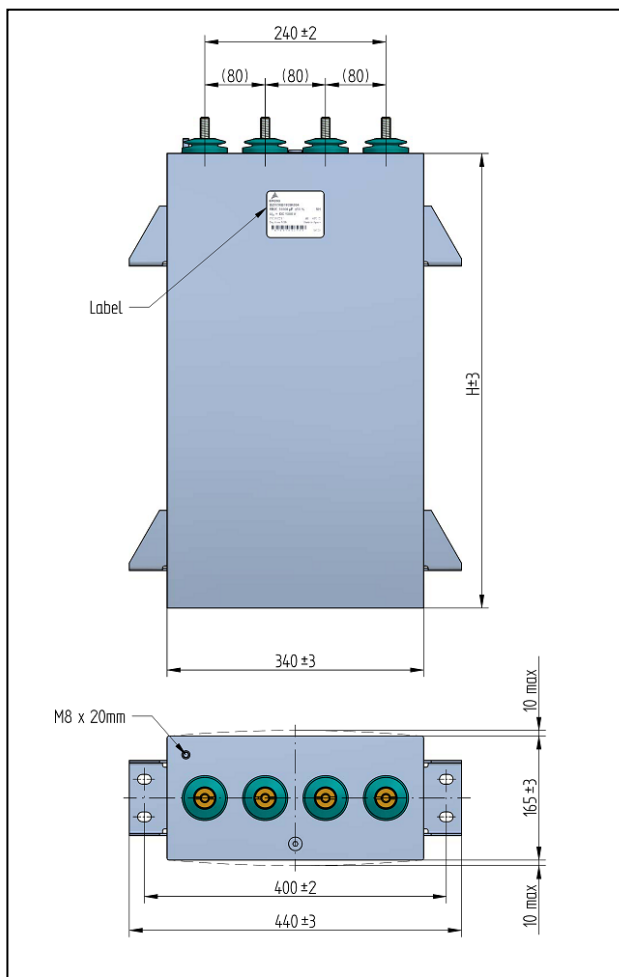
The MKK-DC/MKK-DCI/MKK-DCI-H capacitors are designed in rectangular cases made of austenitic stainless steel. The cases are hermetically welded and the surface is not painted. Fixing brackets and bolts are mounted to fix the capacitor. Bolts are used also for the ground connection.

Different types of terminals are available for the terminal connections.

The capacitors should be exclusively handled by the fixing brackets. In no case the terminals should be used to lift the capacitor.

Capacitors will usually be mounted upright (terminals on top), but can be mounted in any position keeping a distance of 25 mm minimum between large facets, to allow for thermal expansion and effective cooling.

Standard design



Dimensions

The following table shows the available standard dimensions. Deviations from these dimensions are available upon request.

Tolerances are indicated in the drawings as well as the maximum thermal expansions during normal operation conditions.

The label is located centered to the length and 50 mm from the top of the case.

Labeling: manufacturer (company logo), ordering code, connection diagram, version, rated capacitance, tolerance, weight, insulating voltage, IEC standard, country of origin, month/year of manufacturing.

| | H1 mm | H2 mm | H3 mm |
|-----------|----------|----------|----------|
| MKK-DC | 340 | 605 | 805 |
| MKK-DCI | 340 | 605 | |
| MKK-DCI-H | 340 | 605 | |

Terminals and connections

Standard terminals are available as shown below.

Brass bolts, tinned, with different metrics in male and possibility of female connection, are available upon request.

Insulation material of the terminal is Epoxy according to CTI 600.

The following table shows the maximum continuous currents acceptable (for a temperature increase in the terminals of +15 °C), the maximum torque and the contact surface of standard terminals.

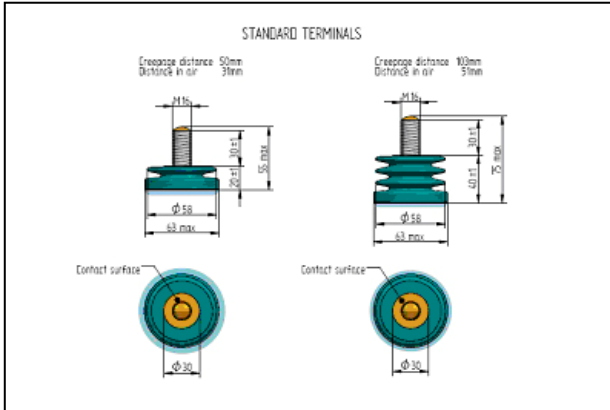
Other specific options are available upon request.

Please contact our local sales office.

| Terminal M16 | |
|-----------------|---------------------|
| Max. current | 265 A |
| Max. torque | 25 Nm |
| Contact surface | 505 mm ² |

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Standard terminals

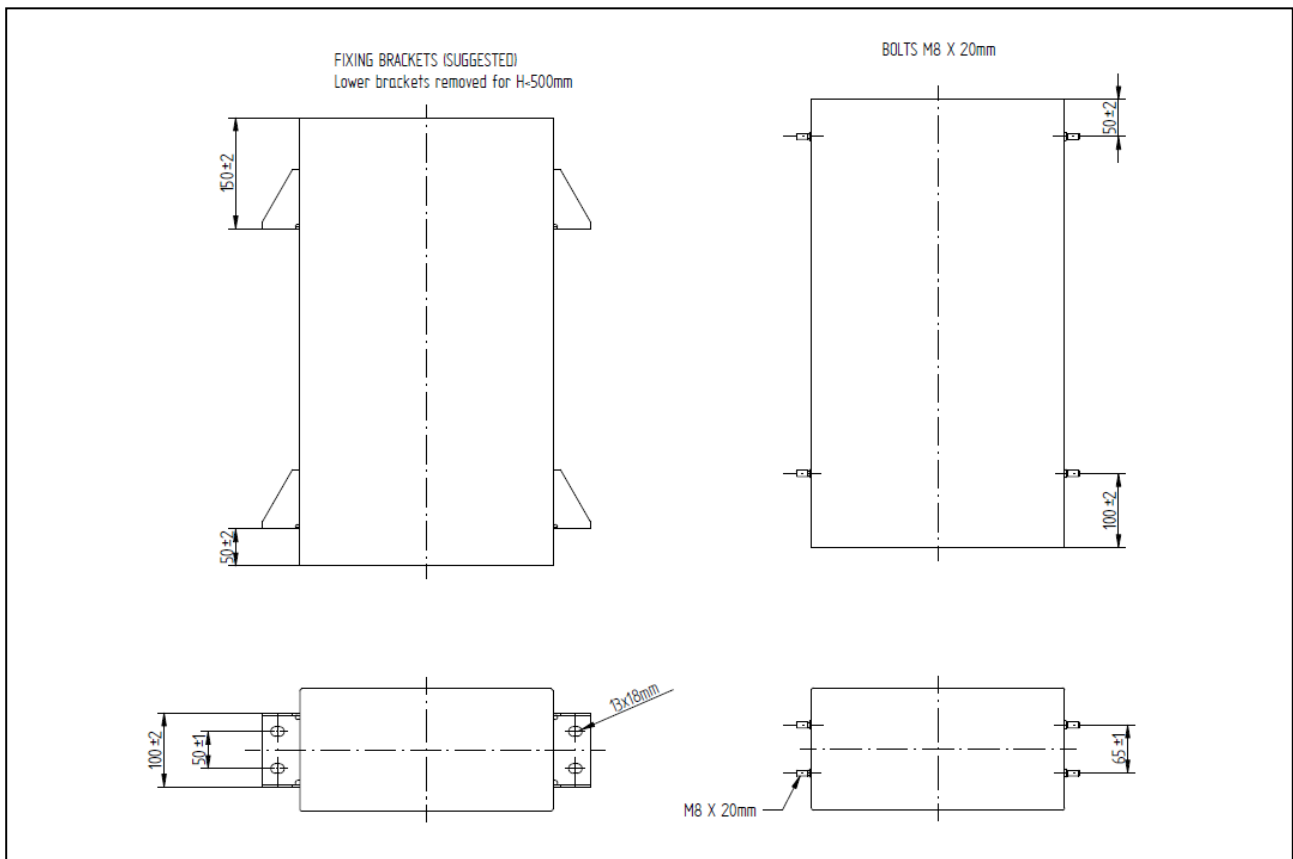
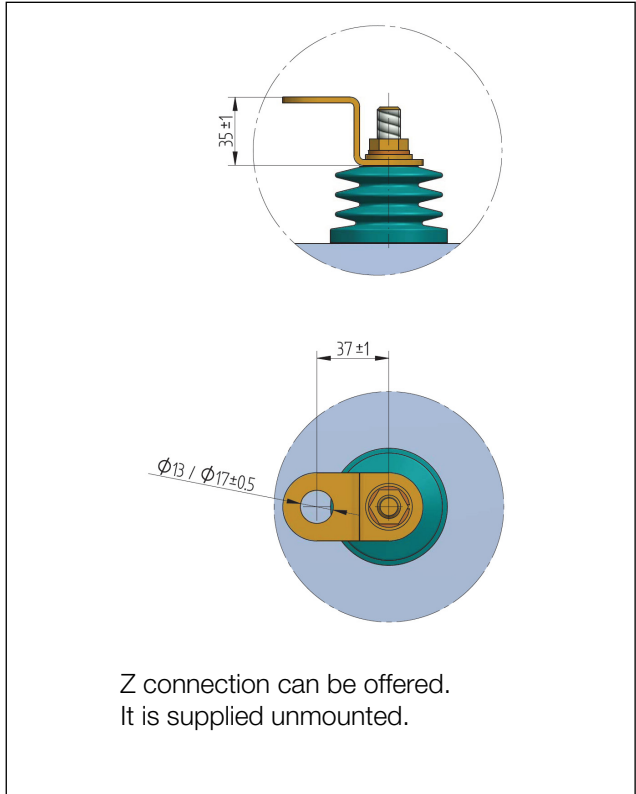


Fixing brackets

The standard fixing brackets of the cases are shown in the drawing below. For heights lower than 500 mm, the lower brackets are removed.

Upon request it is possible to substitute the fixing brackets by bolts (only for heights lower than 500 mm).

Other specific options are available upon request. Please contact our local sales office.



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MKK-DC-R: Mechanical considerations and construction

General description

The MKK-DC-R capacitors are designed in aluminum rectangular cases filled with resin.

Fixing brackets are available as shown below. For any other options, please contact our local sales office.

The standard connection terminals are shown in the drawing below. Otherwise brass bolts tinned with male and possibility of female connection are available upon request.

The capacitors should be exclusively handled by fixing brackets. In no case, the terminals should be used to lift the capacitor.

Capacitors will usually be mounted upright (terminals on top), but can be mounted in any position keeping a lateral space of 25 mm minimum.

Dimensions

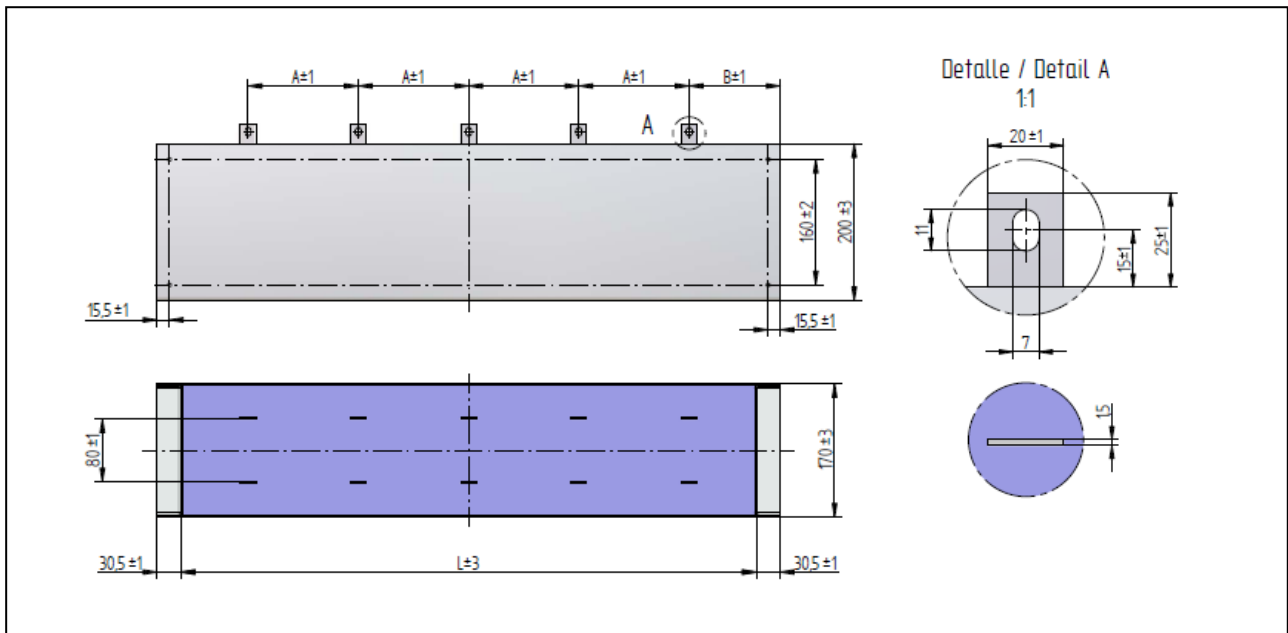
The table below shows the L dimension options and their relation to maximum current and number of terminal recommendable for low inductance option (inductance < 50 nH). Other dimensions are available on request.

Tolerances are indicated in the drawing.

Position of terminals (dimensions A and B) are changeable according to custom needs.

| | L1 mm | L2 mm | L3 mm |
|----------|----------|----------|----------|
| MKK-DC-R | 340 | 510 | 750 |

| Inductance < 50 nH | Number of terminals | $I_{eff(max)}$ A |
|--------------------|---------------------|---------------------|
| L1 | 6 | 210 |
| L2 | 8 | 270 |
| L3 | 10 | 350 |



Power Capacitors

Technical data example: B25650D1528K004

| Technical data | | |
|---------------------------------|-------------|---|
| Characteristics | | |
| C_R | 5200 | μF |
| Tolerance | ± 10 | % |
| V_R | 1800 | V DC |
| V_i | 1300 | V AC |
| W_N | 8420 | Ws |
| $I_{\text{eff, max}}$ | 300 | A |
| $I_{\text{eff, permanent}}$ | 216 | A |
| L_R | 49 | nH |
| $\tan\delta_0$ | 2 | 10^{-4} |
| ESR | 0.5 | $\text{m}\Omega$ |
| Maximum ratings | | |
| \hat{V} | 2200 | V |
| V_R | 2700 | V |
| \hat{I} | 36 | kA |
| \hat{I}_s | 312 | kA |
| dv/dt_{max} | 7 | $\text{V}/\mu\text{s}$ |
| dv/dt_s | 60 | $\text{V}/\mu\text{s}$ |
| Test data | | |
| $V_{\text{TT DC}}$ | 2700 | $\text{V}@10 \text{ s}$ |
| $V_{\text{TT AC}}$ | 3600 | $\text{V}@ 50 \text{ Hz}, 60 \text{ s}$ |
| $R_{\text{is XC}}$ | ≥ 2.78 | h |
| $\tan\delta_{(120 \text{ Hz})}$ | ≤ 17 | 10^{-4} |
| Climatic conditions | | |
| T_{min} | -50 | $^{\circ}\text{C}$ |
| $T_{\text{amb, max}}$ | +60 | $^{\circ}\text{C}$ |
| $T_{\text{Hotspot, max}}$ | +85 | $^{\circ}\text{C}$ |
| Humidity (av. rel.) | < 95 | % |
| Failure rate | 300 | fit |
| Estimated lifetime | 100 000 | h |
| T_{storage} | -50 ... +85 | $^{\circ}\text{C}$ |

| Technical data | | |
|---|------------|--------------------|
| Climatic category (DIN IEC 68 part 1 and 2) | | |
| V_{test} | +40 | $^{\circ}\text{C}$ |
| Rel. humidity | 93 | % |
| t_{test} | 56 | days |
| $\Delta C/C$ | ≤ 1 | % |
| $\Delta \tan\delta$ | ≤ 1 | 10^{-4} |
| $R_{\text{is XC}}$ | 10000 | s |
| Design data | | |
| Dimensions | | |
| L_{case} | 340 | mm |
| B_{case} | 162 | mm |
| H_{case} | 605 | mm |
| A_{terminal} | 80 | mm |
| Terminations | M12 x 30 | mm |
| Max. torque | 20 | Nm |
| Weight (approx.) | 40 | kg |
| Case extension ¹⁾ | 8 | mm |
| Impregnation | gas filled | |
| Fixing elements | acc. spec. | |
| Remarks | | |
| Project study | | |
| Overpressure switch recommended | | |

1) with normal conditions

Power Capacitors

Ordering code system

| | | | | | | | | |
|---|------------|------------|----------|----------|------------|----------|-----------|----------|
| | B25 | 650 | D | 2 | 108 | K | 00 | 4 |
| Power capacitor, self healing | | | | | | | | |
| Technology | | | | | | | | |
| 640 MKK-DC-R | | | | | | | | |
| 650 MKK-DC | | | | | | | | |
| 750 MKK-DCI and MKK-DCI-H | | | | | | | | |
| Evolution number | | | | | | | | |
| Rated voltage | | | | | | | | |
| 0 ≤ 1000 V | | | | | | | | |
| 1 ≥ 1000 V | | | | | | | | |
| 2 ≥ 2000 V | | | | | | | | |
| 3 ≥ 3000 V | | | | | | | | |
| 4 ≥ 4000 V | | | | | | | | |
| 5 ≥ 5000 V | | | | | | | | |
| 6 ≥ 6000 V | | | | | | | | |
| Rated capacitance | | | | | | | | |
| 108 = 1000 μF = 10 x 10 ⁸ pF | | | | | | | | |
| 107 = 100 F = 10 x 10 ⁷ pF | | | | | | | | |
| 106 = 10 μF = 10 x 10 ⁶ pF | | | | | | | | |
| 105 = 1 μF = 10 x 10 ⁵ pF | | | | | | | | |
| Tolerance | | | | | | | | |
| K = ±10 % | | | | | | | | |
| Code for capacitor version | | | | | | | | |
| Terminals | | | | | | | | |
| 4 = screw | | | | | | | | |

KLK1859-4

MKK-DC series, all types with 4 terminals

| C _R | V _R | I _{eff} @100Hz | V _s | dv/dt _s | ESR | Z _{th} | L _s | Ordering code |
|----------------|----------------|----------------------------|----------------|--------------------|-----|-----------------|----------------|-----------------|
| μF | V | A | V | V/μs | mW | °C/W | nH | |
| 8200 | 900 | 240 | 1350 | 30 | 0.5 | 0.7 | < 50 | B25650C9828K004 |
| 6000 | 1100 | 230 | 1650 | 40 | 0.6 | 0.7 | < 50 | B25650D1608K024 |
| 2600 | 1800 | 175 | 2700 | 60 | 0.8 | 0.9 | < 50 | B25650D1268K004 |
| 900 | 3000 | 150 | 4500 | 220 | 0.9 | 0.9 | < 50 | B25650D3907K004 |
| 630 | 3600 | 130 | 5400 | 260 | 1.1 | 1.0 | < 50 | B25650D3637K004 |
| 510 | 4000 | 120 | 6000 | 290 | 1.3 | 1.0 | < 50 | B25650D4517K004 |
| 195 | 6000 | 75 | 9000 | 750 | 2.4 | 1.0 | < 50 | B25650D6197K004 |

Dimensions L x W x H: 340 x 165 x 340 mm, weight 24 kg

| C _R | V _R | I _{eff} @100Hz | V _s | dv/dt _s | ESR | Z _{th} | L _s | Ordering code |
|----------------|----------------|----------------------------|----------------|--------------------|-----|-----------------|----------------|------------------|
| μF | V | A | V | V/μs | mW | °C/W | nH | |
| 16400 | 900 | 370 | 1350 | 30 | 0.4 | 0.3 | < 80 | B25650C9169K034 |
| 12000 | 1100 | 360 | 1650 | 40 | 0.4 | 0.3 | < 80 | B25650D1129K004 |
| 5200 | 1800 | 300 | 2700 | 60 | 0.5 | 0.4 | < 80 | B25650D1528K004* |
| 1800 | 3000 | 275 | 4500 | 220 | 0.6 | 0.5 | < 80 | B25650D3188K024 |
| 1250 | 3600 | 240 | 5400 | 260 | 0.7 | 0.5 | < 80 | B25650D3128K004 |
| 1000 | 4000 | 220 | 6000 | 290 | 0.8 | 0.5 | < 80 | B25650D4108K004 |
| 390 | 6000 | 145 | 9000 | 750 | 1.3 | 0.7 | < 80 | B25650D6397K004 |

Dimensions L x W x H: 340 x 165 x 605 mm, weight 40 kg

*) see technical data on page 6

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| C_R μF | V_R V | I_{eff} @100Hz A | V_s V | dv/dt_s V/us | ESR mW | Z_{th} $^{\circ}\text{C/W}$ | L_s nH | Ordering code |
|------------------------|------------|---------------------------------|------------|-------------------|-----------|---|-------------|-----------------|
| 2500 | 3000 | 340 | 4500 | 220 | 0.5 | 0.3 | < 100 | B25650D3258K024 |
| 1700 | 3600 | 300 | 5400 | 260 | 0.6 | 0.3 | < 100 | B25650D3178K004 |
| 1400 | 4000 | 290 | 6000 | 290 | 0.7 | 0.3 | < 100 | B25650D4148K004 |

Dimensions L x W x H: 340 x 165 x 805 mm, weight 52 kg

MKK-DCI series, all types with 4 terminals

| C_R μF | V_R V | I_{eff} @100Hz A | V_s V | dv/dt_s V/us | ESR mW | Z_{th} $^{\circ}\text{C/W}$ | L_s nH | Ordering code |
|------------------------|------------|---------------------------------|------------|-------------------|-----------|---|-------------|-----------------|
| 760 | 3500 | 170 | 5250 | 90 | 1.3 | 0.4 | < 50 | B25750D3767K004 |
| 610 | 3900 | 160 | 5850 | 100 | 1.5 | 0.4 | < 50 | B25750D3617K004 |
| 565 | 4100 | 160 | 6150 | 104 | 1.6 | 0.4 | < 50 | B25750D4567K004 |

Dimensions L x W x H: 340 x 165 x 340 mm, weight 26 kg

| C_R μF | V_R V | I_{eff} @100Hz A | V_s V | dv/dt_s V/us | ESR mW | Z_{th} $^{\circ}\text{C/W}$ | L_s nH | Ordering code |
|------------------------|------------|---------------------------------|------------|-------------------|-----------|---|-------------|-----------------|
| 1500 | 3500 | 300 | 5250 | 90 | 0.6 | 0.3 | < 80 | B25750D3158K004 |
| 1200 | 3900 | 290 | 5850 | 100 | 0.6 | 0.3 | < 80 | B25750D3128K004 |
| 1100 | 4100 | 290 | 6150 | 104 | 0.6 | 0.3 | < 80 | B25750D4118K004 |

Dimensions L x W x H: 340 x 165 x 605 mm, weight 44 kg

MKK-DCI-H series, all types with 4 terminals

| C_R μF | V_R V | I_{eff} @100Hz A | V_s V | dv/dt_s V/us | ESR mW | Z_{th} $^{\circ}\text{C/W}$ | L_s nH | Ordering code |
|------------------------|------------|---------------------------------|------------|-------------------|-----------|---|-------------|-----------------|
| 3400 | 1800 | 230 | 2700 | 50 | 0.7 | 0.4 | < 50 | B25750H1348K004 |
| 2700 | 2000 | 220 | 3000 | 60 | 0.7 | 0.4 | < 50 | B25750H2278K004 |
| 2200 | 2200 | 210 | 3300 | 65 | 0.7 | 0.4 | < 50 | B25750H2228K004 |
| 1500 | 2700 | 190 | 4000 | 80 | 0.9 | 0.4 | < 50 | B25750H2158K004 |
| 800 | 3600 | 220 | 5400 | 230 | 0.7 | 0.4 | < 50 | B25750H3807K004 |
| 500 | 4400 | 180 | 6600 | 280 | 0.9 | 0.4 | < 50 | B25750H4507K004 |
| 350 | 5400 | 160 | 8000 | 340 | 1.2 | 0.4 | < 50 | B25750H5357K004 |

Dimensions L x W x H: 340 x 165 x 340 mm, weight 30 kg

| C_R μF | V_R V | I_{eff} @100Hz A | V_s V | dv/dt_s V/us | ESR mW | Z_{th} $^{\circ}\text{C/W}$ | L_s nH | Ordering code |
|------------------------|------------|---------------------------------|------------|-------------------|-----------|---|-------------|-----------------|
| 6900 | 1800 | 370 | 2700 | 55 | 0.5 | 0.3 | < 80 | B25750H1698K004 |
| 5400 | 2000 | 360 | 3000 | 60 | 0.5 | 0.3 | < 80 | B25750H2548K004 |
| 4400 | 2200 | 350 | 3300 | 65 | 0.5 | 0.3 | < 80 | B25750H2448K004 |
| 3000 | 2700 | 320 | 4000 | 80 | 0.6 | 0.3 | < 80 | B25750H2308K004 |

Dimensions L x W x H: 340 x 165 x 605 mm, weight 50 kg

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MKK-DC-R series (terminal construction see page 5)

| C_R μF | V_R V | I_{eff} @100Hz A | V_s V | dv/dt_s V/us | ESR mW | Z_{th} $^{\circ}\text{C/W}$ | L_s nH | Ordering code |
|------------------------|------------|---------------------------------|------------|-------------------|-----------|---|-------------|-----------------|
| 5400 | 800 | 210 | 1200 | 30 | 0.7 | 0.6 | < 50 | B25640D8548K000 |
| 4300 | 900 | 200 | 1350 | 35 | 0.8 | 0.6 | < 50 | B25640D9438K000 |
| 3600 | 1000 | 190 | 1500 | 40 | 0.8 | 0.6 | < 50 | B25640D1368K000 |
| 3100 | 1100 | 190 | 1650 | 40 | 0.8 | 0.6 | < 50 | B25640D1318K000 |
| 2600 | 1200 | 180 | 1800 | 45 | 0.9 | 0.6 | < 50 | B25640D1268K000 |

Dimensions L x W x H: 340 x 170 x 200 mm, weight 18 kg

| C_R μF | V_R V | I_{eff} @100Hz A | V_s V | dv/dt_s V/us | ESR mW | Z_{th} $^{\circ}\text{C/W}$ | L_s nH | Ordering code |
|------------------------|------------|---------------------------------|------------|-------------------|-----------|---|-------------|-----------------|
| 8300 | 800 | 270 | 1200 | 30 | 0.5 | 0.5 | < 50 | B25640D8838K000 |
| 6700 | 900 | 260 | 1350 | 35 | 0.6 | 0.5 | < 50 | B25640D9678K000 |
| 5500 | 1000 | 260 | 1500 | 40 | 0.6 | 0.5 | < 50 | B25640D1558K000 |
| 4800 | 1100 | 250 | 1650 | 40 | 0.6 | 0.5 | < 50 | B25640D1488K000 |
| 4100 | 1200 | 240 | 1800 | 45 | 0.6 | 0.5 | < 50 | B25640D1418K000 |

Dimensions L x W x H: 510 x 170 x 200 mm, weight 26 kg

| C_R μF | V_R V | I_{eff} @100Hz A | V_s V | dv/dt_s V/us | ESR mW | Z_{th} $^{\circ}\text{C/W}$ | L_s nH | Ordering code |
|------------------------|------------|---------------------------------|------------|-------------------|-----------|---|-------------|-----------------|
| 12500 | 800 | 350 | 1200 | 30 | 0.5 | 0.4 | < 50 | B25640D8129K000 |
| 10100 | 900 | 350 | 1350 | 35 | 0.5 | 0.4 | < 50 | B25640D9109K000 |
| 8300 | 1000 | 340 | 1500 | 40 | 0.5 | 0.4 | < 50 | B25640D1838K000 |
| 7300 | 1100 | 340 | 1650 | 40 | 0.5 | 0.4 | < 50 | B25640D1738K000 |
| 6200 | 1200 | 330 | 1800 | 45 | 0.5 | 0.4 | < 50 | B25640D1628K000 |

Dimensions L x W x H: 750 x 170 x 200 mm, weight 32 kg

Lifetime

The end of life criterion is a capacitance loss higher than 3% compared to initial value.

| Capacitor | Lifetime | Hotspot temperature |
|----------------------|-----------|---------------------|
| MKK-DC MKK-DC-R | 100 000 h | +70 °C |
| MKK-DCI MKK-DCI-H | 150 000 h | +75 °C |

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