# Film capacitors – High power capacitors

## ModCap – Plastic case modular series

**Series/Type:** **B25645**
**Ordering code:** **B25645*****K0*3**

Date: March 2022
Version: 3.0

### Construction

- Dielectric: Polypropylene film
- Non PCB, PU Resin (UL 94 V-0, Fire & smoke EN 45545-2 HL2 R22-HL3R23)
- Plastic case and cover (UL 94 V-0, Fire & smoke EN 45545-2HL2 R22-HL3R23)

Design A and B

### Features

- Modular design
- Self-healing technology
- Over-voltage capability

### Typical applications

- DC link for renewable energy converters (solar, wind).
- DC link for traction applications (locomotive, tramway, metro, light train inverters)
- DC link for industrial motor drive

### Terminals

- Optimized low inductance flat female terminals M6

### Technical data and specifications

| Characteristics | |
|---|---|
| Rated capacitance $C_R$ | Up to 3900 µF (see table) |
| Tolerance | K (±10%), other tolerances available up on request |
| Nominal voltage $V_N$ | 900 to 2300 V (see table) |
| Operation bandwidth (*) | Up to 50 kHz |
| Nominal current $I_N$ (1 kHz) | (see table) |
| Inductance ESL | Ca. 14 nH |
| $R_{th}$ (**) | Construction A: 1.4 K/W<br>Construction B: 1 K/W |

(*) RMS current value that corresponds to components above 50 kHz limited to 10% of total RMS. Maximum continuous losses defined for rated current at 1 kHz should not be exceed. ESR vs frequency graphs available in page 5 for losses calculation according to a specific current spectrum. For more accurate thermal calculation, please ask for FEA simulation according to your specific operation conditions.

(**) Calculated from $T_{amb}$ to Thot-Spot considering natural convection and no transfer of heat through the terminals. For more accurate thermal calculation, please ask for FEA simulation according to your specific operation conditions.

| **Maximum ratings** | |
|---|---|
| Maximum permissible voltage ($V_{max}$ ) | $V_N$ +10% (30 % of on-load daily duration)<br>$V_N$ +15% (up to 30 min daily)<br>$V_N$ +20% (up to 5 min daily)<br>$V_N$ +30% (up to 1 min daily) |
| Maximum permissible peak voltage | $V_N$ +50% for 30 ms is permitted 1000 times during the life of the capacitor |
| $V_{TC}$ (Isolation)<br>$V_{TC}$ (Extinction) | 5 kV<br>3 kV (<10 pC) |

The average applied voltage shall not be higher than the specified voltage.
It should be recognised that any significant period of operation at voltages above the rated one would reduce overall life.

| **Test data** | |
|---|---|
| Voltage Test between terminals ($V_{TT}$ ) | 1.5 • $V_N$, DC, 10 s (room temperature). |

| **Design data** | |
|---|---|
| Weight approx. | 3.7 kg (design A), 6.1 kg (design B) |
| Filling | Non PCB, PU resin |
| Fixing | 4 x Ø 6.5 mm |

| **Climatic category 40/75/56** | |
|---|---|
| Θ min | –40 ºC |
| Θ max | +75 ºC |
| Storage temperature | –40 …+85 ºC |
| **Θ** $_{hotspot}$ max. | +90 ºC |
| Humidity | av. rel. <93%, 25 g/m$^3$ max. |
| Time test | 56 days |
| Maximum altitude | 2000 m, higher altitude upon request |

| **Life expectancy** | |
|---|---|
| Lifetime *) | Up to 200 000 h, 80 ºC(*)/ 65000 h 90 ºC (**) |
| End of life criteria | C-loss: 3% |

(*) $V_N$, $I_N$ and 70 ºC $T_{amb}$ (80 ºC mean dielectric temperature)
(*) $V_N$, $I_N$ and 80 ºC $T_{amb}$ (90 ºC mean dielectric temperature)

| Terminals | |
|---|---|
| Terminations | 4x M6, 25 x 30 mm, contact area 60 mm$^2$ |
| Max. torque | 6 Nm |

| Reference standards | |
|---|---|
| IEC 61071 | (International Standard Capacitors for power electronics) |
| IEC 61881-1 | (International Standard Railway applications - Rolling stock equipment - Capacitors for power electronics) |
| EN 45545-2 | (Railway applications - Fire protection on railway vehicles) |

## Ordering codes

| $V_N$<br>V | $C_R$<br>µF | $I_N$<br>A | $I_S$<br>kA | Î<br>kA | Dimensions LxWxH<br>mm | Design | Ordering code |
|---|---|---|---|---|---|---|---|
| 900 | 2050 | 200 | 225 | 5 | 205x90x170 | A | B25645A9218K003 |
| | 3900 | 155 | 250 | 5 | 220x115x215 | B | B25645A9398K003 |
| 1000 | 1700 | 190 | 220 | 5 | 205x90x170 | A | B25645A1178K003 |
| | 3210 | 150 | 245 | 5 | 220x115x215 | B | B25645A1328K003 |
| 1100 | 1330 | 180 | 215 | 5 | 205x90x170 | A | B25645A1138K003 |
| | 2525 | 140 | 240 | 5 | 220x115x215 | B | B25645A1258K003 |
| 1250 | 1050 | 170 | 210 | 5 | 205x90x170 | A | B25645A1118K003 |
| | 1985 | 135 | 235 | 5 | 220x115x215 | B | B25645A1198K003 |
| 1350 | 980 | 160 | 205 | 5 | 205x90x170 | A | B25645A1108K013 |
| | 1865 | 130 | 230 | 5 | 220x115x215 | B | B25645A1188K003 |
| 1600 | 720 | 150 | 200 | 5 | 205x90x170 | A | B25645A1757K003 |
| | 1375 | 120 | 225 | 5 | 220x115x215 | B | B25645A1138K013 |
| 1800 | 535 | 140 | 195 | 5 | 205x90x170 | A | B25645A1567K003 |
| | 1025 | 115 | 220 | 5 | 220x115x215 | B | B25645A1108K003 |
| 2000 | 430 | 130 | 185 | 5 | 205x90x170 | A | B25645A2447K003 |
| | 820 | 110 | 210 | 5 | 220x115x215 | B | B25645A2827K003 |
| 2300 | 350 | 120 | 175 | 5 | 205x90x170 | A | B25645A2367K003 |
| | 670 | 105 | 200 | 5 | 220x115x215 | B | B25645A2677K003 |

**$V_N$ :** Nominal voltage

**$C_R$:** tolerance +/-10%

**$I_N$ :** Nominal current

**$I_S$ :** Surge current

**Î :** Repetitive peak current

*: Packing unit design A (4 caps/box).

**: Packing unit design B (3 caps/box).

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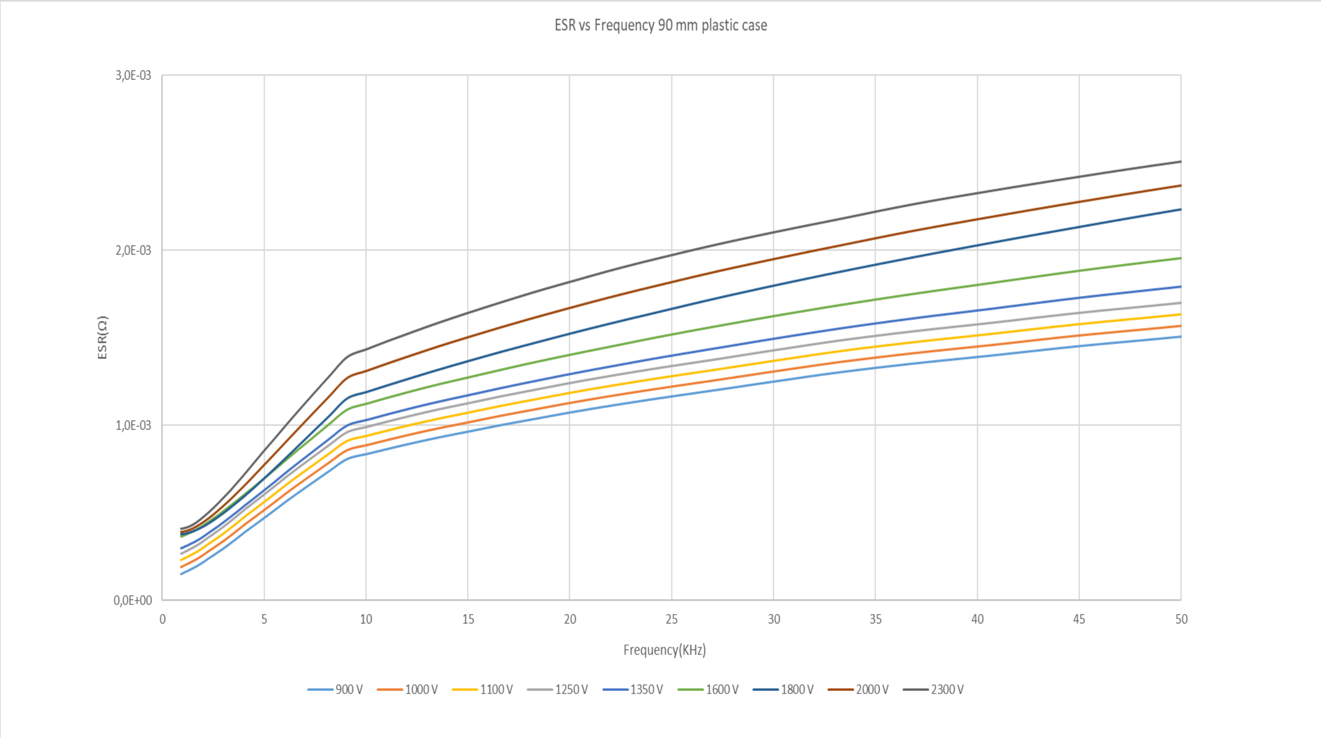
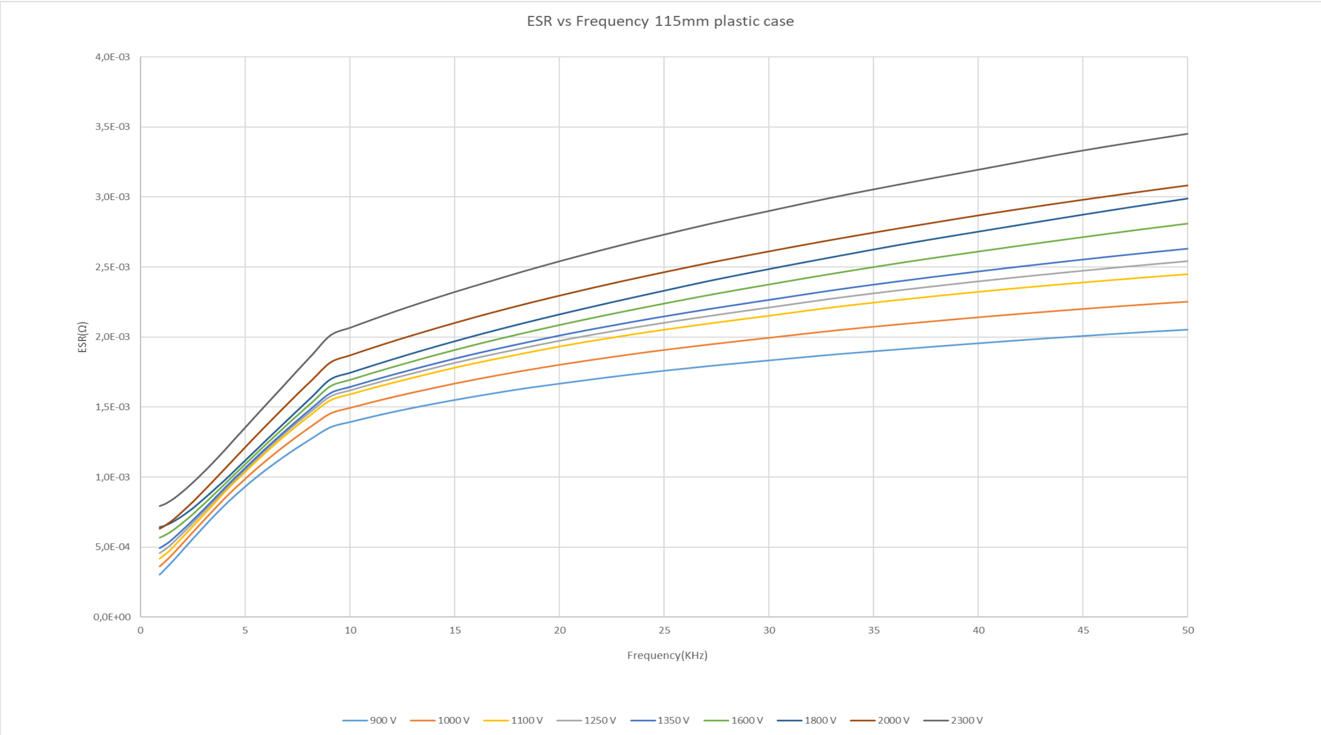
## ESR vs frequency




- No internal resonances

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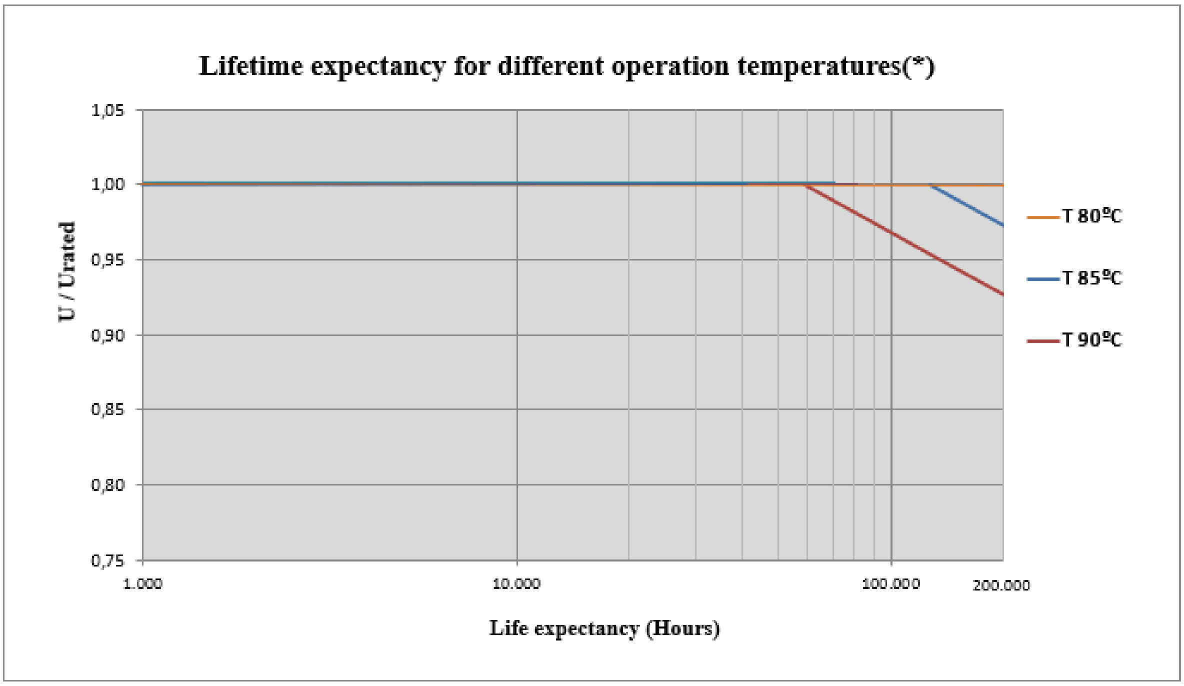
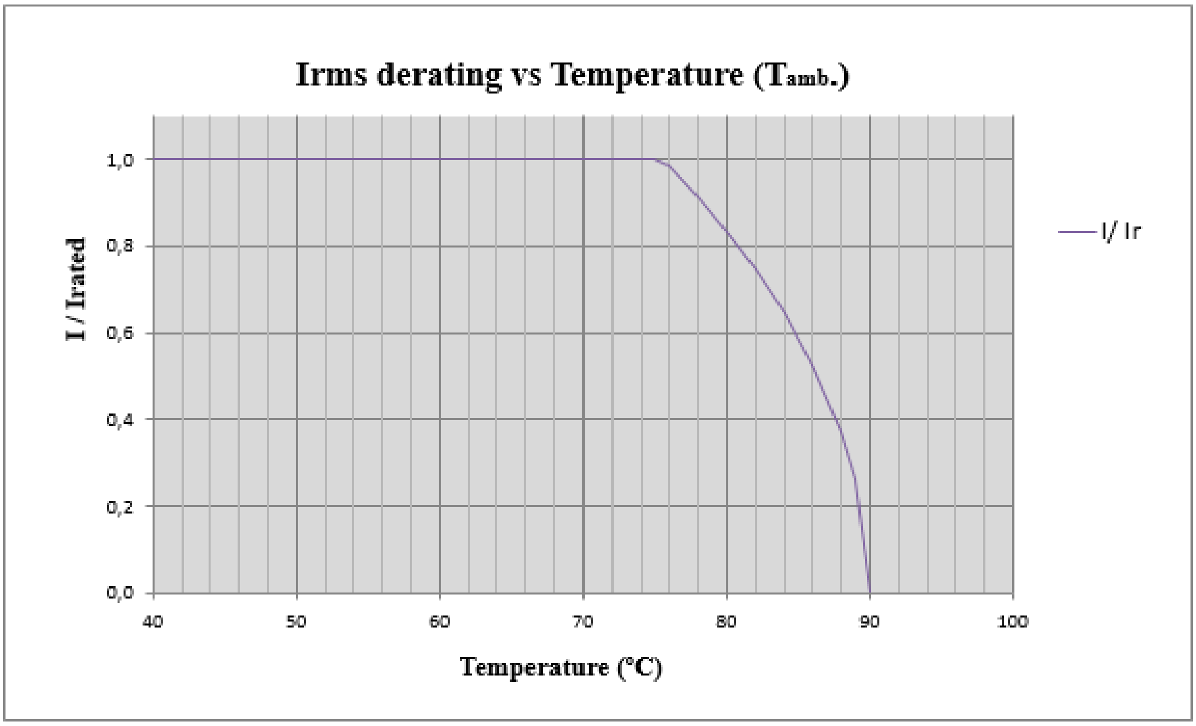
## Lifetime expectancy




(*) Homogeneous dielectric temperatures

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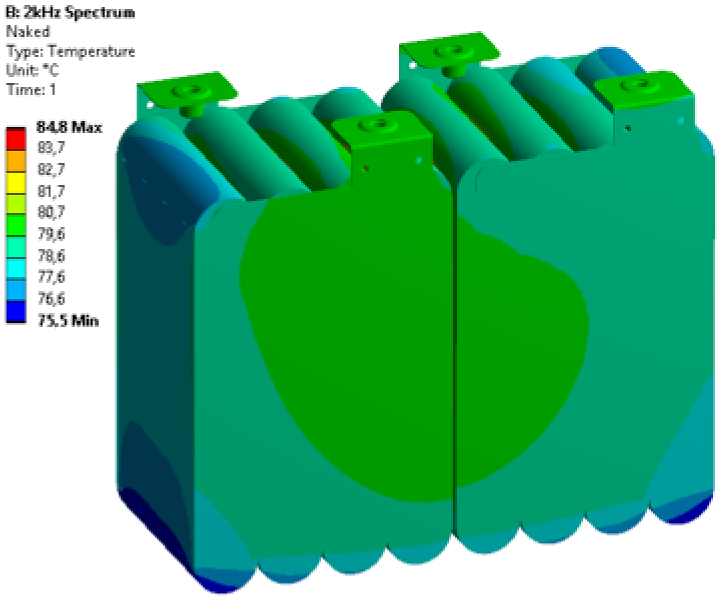
**Thermal stability under specific operation conditions (example)**

*Thermal map, naked capacitor*



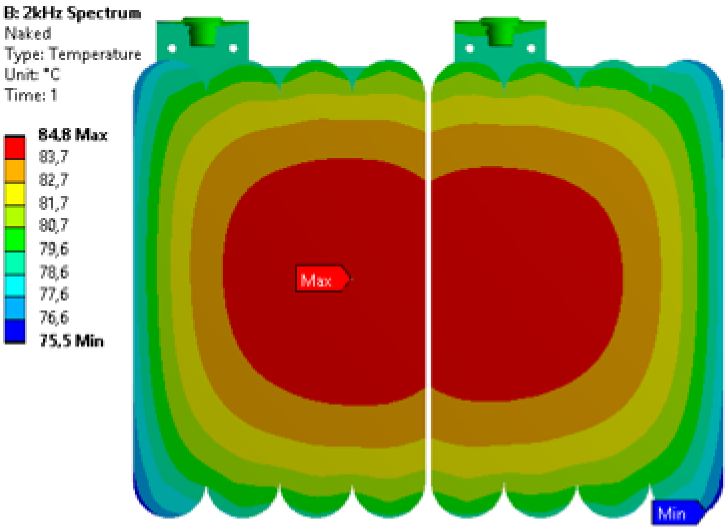

**MKK DC-R Modular series**:

- Capacitance: 1 mF
- Current: 155 A
- Power losses: **11 W**
- DeltaT = **15 K**

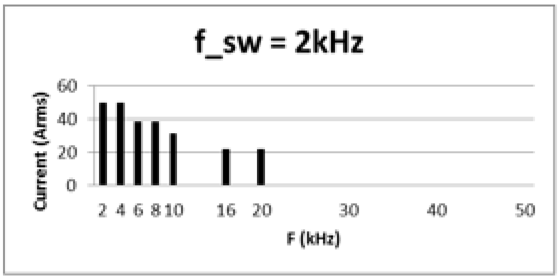
Boundary conditions considered:

- Ambient temp: 70 °C
- Busbar temp: 80 °C
- Natural convection

*Thermal map, cross section*




*Current spectrum considered*




Standard product – Customized solutions

- F.E.A. model available for specific simulation according to spectrum and boundary conditions defined by the customer

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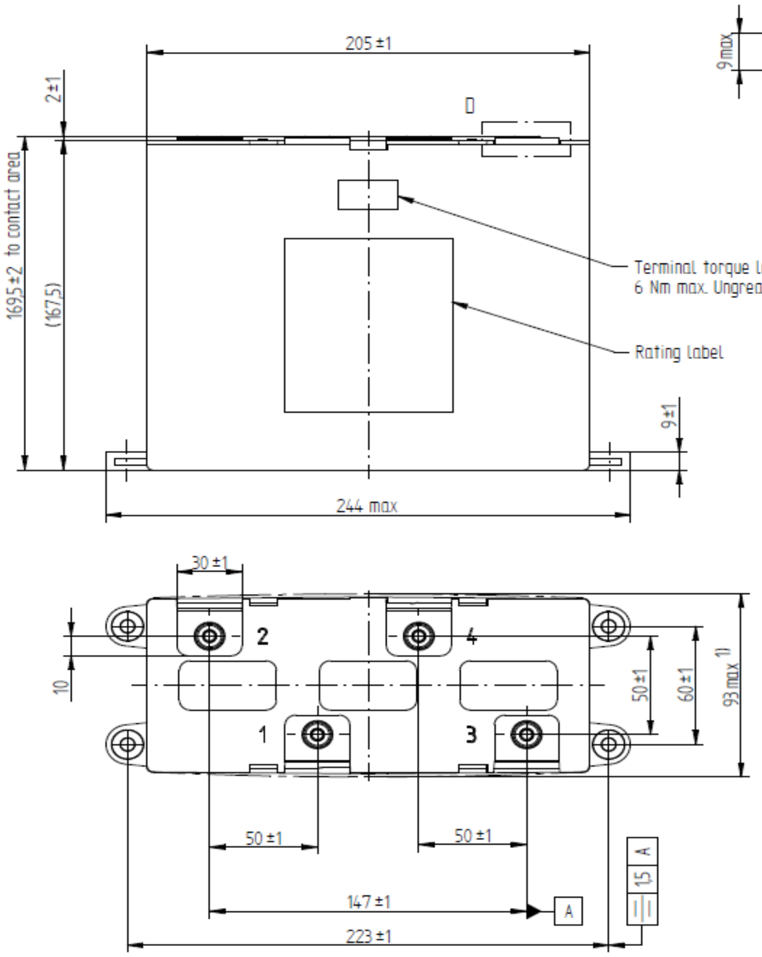
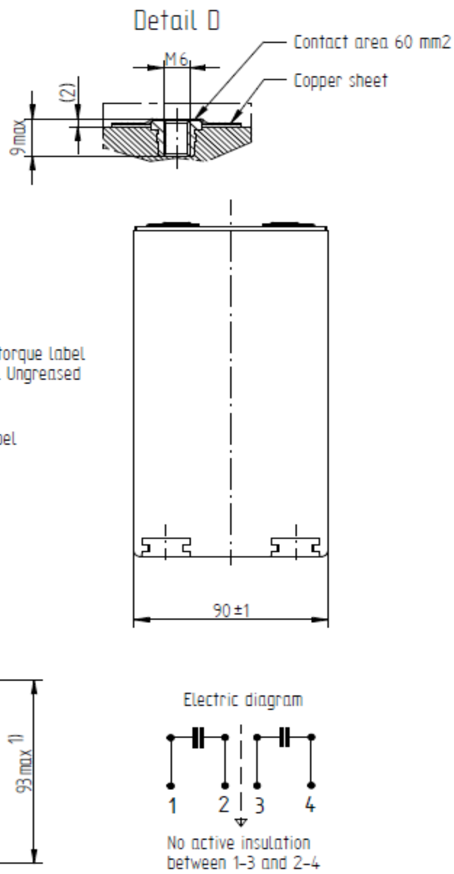
## Dimensional drawing

### Design A




Capacitor is divided in two independent capacitances.
Terminals 1 and 3 should have the same polarity.
Terminals 2 and 4 should have the same polarity.

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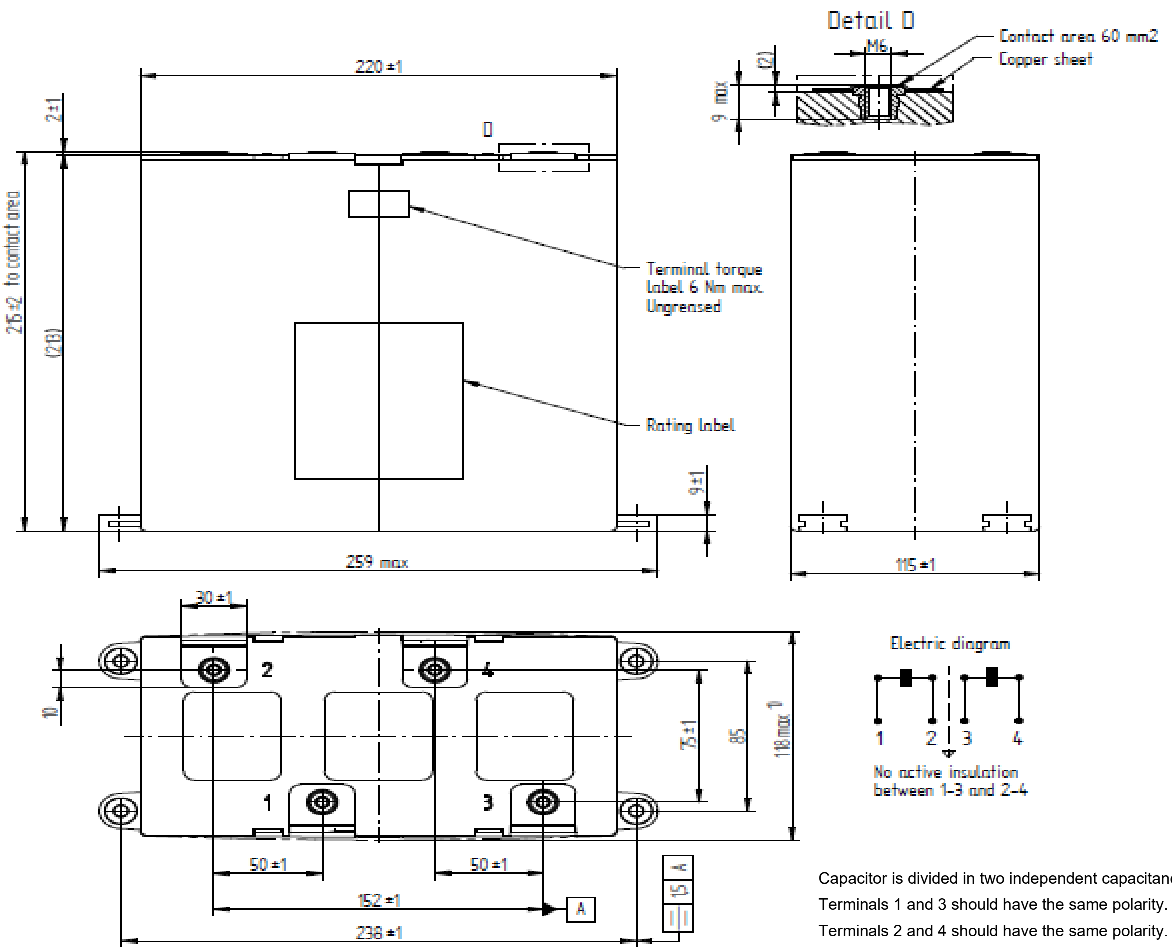
## Dimensional drawing

### Design B




Capacitor is divided in two independent capacitances.
Terminals 1 and 3 should have the same polarity.
Terminals 2 and 4 should have the same polarity.

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**General safety recommendations**

When employed in power electronics applications, the capacitors run with high energy and high currents.

The energy stored in capacitors may be lethal. To prevent any risks of shocks, the capacitor must be discharged with adequate means by qualified people and short-circuited between terminals before handling.

The screws supplied in the terminals of the capacitor are only to ensure the short circuit during transportation and storage, they should not be used for the final connection in the application.

The capacitor can contain dangerous residual charges even after long time without operation. For this reason, the electrical terminals must remain short-circuited until the capacitors are connected in the operating circuit.

TDK Electronics cannot predict all possible stresses that a Power Electronic Capacitors can be subjected to. There is a remaining probability of Power Electronic Capacitors showing malfunction due to excess temperature, overvoltage, wrong application, wrong installation, faulty maintenance, mechanical damage, operation at the limits of the specification or other reasons.

**Transportation and handling**

- The electrical terminals must not be used for grabbing or suspending the capacitor during transportation and handling.
- Do not handle the capacitor before it is discharged.
- Handle capacitors carefully, because they may still be charged even after disconnection due to faulty discharging devices.
- Protect the capacitor properly against over current and short circuit.
- Failure to follow cautions may result, worst case, in premature failures, bursting and fire.

**Fixing**

- The threaded screw 4x Ø 6.5 mm in the bottom of the capacitor has to be used for fixing.

**Storage and operating conditions**

Capacitors must never be stored outside the specified temperature and humidity ranges.
Capacitors may not be stored in corrosive atmospheres, particularly not when chlorides, sulfides, acids, alkalis, salts, organic solvents or similar substances are present.

**Risk minimization with protective devices for power electronic capacitors**

The German Electrical and Electronic Manufacturers' Association - ZVEI - is advising the implementation of protective devices when using power electronic capacitors as a suitable measure to eliminate danger to humans and property to the largest extend.
The utilization of protection devices will significantly reduce the risk of active capacitor failures which could occur due to the high amount of energy stored and the possibility of creating flammable gases [Ref 3].

TDK Electronics cannot predict all possible stresses, which a power electronic capacitor can be subjected to. There is a remaining probability of power electronic capacitors showing malfunction due to excess temperature, overvoltage, wrong application, wrong installation, faulty maintenance, mechanical damage, operation at the technical limits of the specification or other reasons.

As a member of ZVEI, TDK is recommending the use of power electronic capacitors equipped with appropriate protective devices, such as over-pressure switches and will be glad to provide concrete technical recommendations regarding Protective Devices during the creation of a power electronic capacitor specification.

TDK Electronics has collected profound experience in designing power electronic capacitors compliant with the international standards (see Ref.1 & 2.).

[Ref.1] IEC 61071: Capacitors for power electronics
[Ref.2] IEC 61881-1: Railway applications – Rolling stock equipment – Capacitors for power electronics
[Ref.3] ZVEI Power Capacitors Division - General Safety Data Sheet for Power Capacitors (https://www.zvei.org/en/association/divisions/power-capacitors-division/general-safety-recommendations-forpower-capacitors/)

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