Film capacitors – Power electronic capacitors

xEVCap Lead Wire

Series/Type: **B25654A*001**
Ordering Code: **Ordering Code**

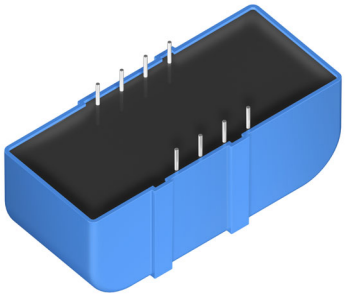
Date: July 2024

Applications

- DC-link for main traction inverters
- For parallel connection through busbars
- Passenger cars, buses, trucks, commercial vehicles, machinery tools

Climatic

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



Construction

- Dielectric: Polypropylene (MKP)
- Plastic case (UL 94 V-0)
- Epoxy resin sealing (UL 94 V-1)

Features

- Scalable and modular for different power levels and densities
- WBG semiconductors compatible
- Good self-healing properties
- Overvoltage capability
- Low ESR and low ESL
- RoHS-compatible
- Reference standard: IEC TS 63337:2024
- AEC-Q200 rev E compliant

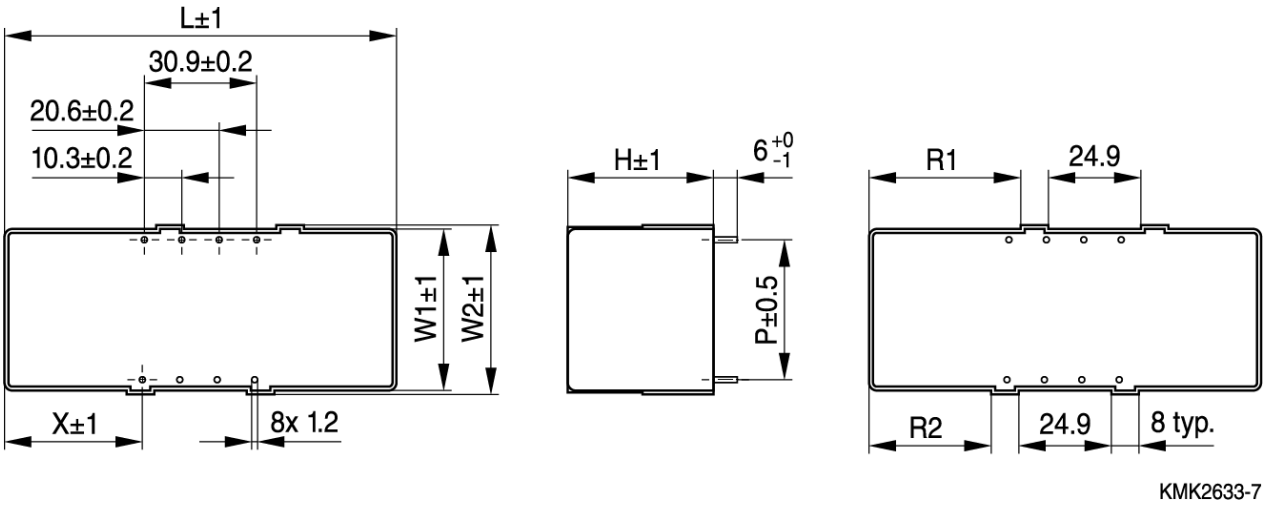
Terminals

- Lead wire, lead-free tinned

Delivery mode

- Bulk (untaped)

Dimensional Drawings



(all dimensions in mm.)

Version	Length L	Width W1	Width W2	Height H	Pitch P	X	R1	R2	Weight (g)
A	85	47	49.5	40.5	40.5	27	30	22	260
B	97.5	35.5	38	42.5	29	33.5	36	28.3	270
C	109	47	49.5	40.5	40.5	39	42	34	340

Lead diameter – Ø1.2 mm, lead height - 6 mm.
P - Refers to center of lead wire terminal.
X - Refers to distance from outer edge of housing to center of lead.
Weight tolerance ±15%

Technical data and ordering codes

Electrical parameters are typical values, given at room temperature and relative humidity ≤65%.

C_N 120 Hz µf	Dimensions version	Ordering code	I_{max} 1) 10 kHz A	ESL 2) 1 MHz nH	ESR 3) 10 kHz mΩ	Î kA	I_s kA	MOQ pcs
V_R (105 °C) = 500 V DC ; V_{MAX} = 525 V 4) ; V_s = 665 V								
200	A	B25654A5207K001	40	17	1.13	2.1	6	64
270	C	B25654A5277K001	50	17	0.89	2.8	8	48
V_R = 650 V DC ; V_{MAX} = 750 V 4) ; V_s = 900 V								
115	B	B25654A6117K001	60	14	0.51	2	6	60
130	A	B25654A6137K001	42	17	0.89	1.6	5	64
175	C	B25654A6177K001	55	17	0.66	2.2	6.5	48
V_R (105 °C) = 850 V DC ; V_{MAX} = 890 V 4) ; V_s = 1200 V								
80	B	B25654A8806K001	56	14	0.57	1.7	5.2	60
100	A	B25654A8107K001	40	17	1.04	1.4	4.2	64
135	C	B25654A8137K001	50	17	0.78	1.9	5.8	48
V_R (105 °C) = 920 V DC ; V_{MAX} = 950 V 4) ; V_s = 1250 V								
60	B	B25654A9606K001	55	14	0.65	1.5	4.7	60
75	A	B25654A9756K001	35	17	1.18	1.2	3.8	64
110	C	B25654A9117K001	45	17	0.89	1.6	5.1	48

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

Composition of ordering code

K = ±10% capacitance tolerance, J = ±5% capacitance tolerance upon request
001 = Lead wire terminals

Characteristics curves

Additional technical information can be found under “Design support” on www.tdk-electronics.tdk.com.

1) Maximum hot spot temperature inside of each of the capacitor elements shall be limited to 105 °C.
Insulation resistance R_{ISO} given as time constant $\tau = C_N \bullet R_{Iso} > 10\,000$ s (after 1 minute), minimum as delivered values.

2) Typical ESL values measured with kelvin clips by impedance analyzer.

3) Maximum ESR is 1.5 ● ESR typical at 10 kHz.

4) V_{MAX} - Maximum voltage that can be applied to the capacitors at 105 °C for 100 h.

Testing and Standards

Type test, applied at Room Temperature otherwise is indicated.

Test	Reference	Test condition	Performance requirement
Electrical characterization	IEC TS 63337:2024	• Capacitance at 120 Hz • ESR at 10 kHz • ESL > 1 MHz • External Insulation to case, V_{TC}, 60 seconds: 2830 V if $V_R \leq 500$ V DC otherwise $\sqrt{2} \times (2 \times V_R + 1\,000)$ V DC • High Voltage between terminals V_{TT} = 1.5* V_R, 60 seconds • High Voltage between terminals and case, 60 seconds • R_{Iso} at Rated voltage, 60 seconds	Within specified limits
High Temperature Exposure (Storage)	AEC Q200 Rev E	• Unpowered, 1000 hours • Upper temp.: 105 °C • Measurement at 24±4 hours after test conclusion	No visible damage $\lvert\Delta C/C_0\rvert \leq 5\%$ $\lvert\Delta ESR/ESR_0\rvert \leq 100\%$
Temperature Cycling	AEC Q200 Rev E	• Unpowered • 1000 Cycles • Lower Temp of the chamber: –55 °C • Upper Temp of the Chamber: +105 °C • Dwell time: 30 minutes • Transition Time: 1 minute maximum • Measurement at least 24 hours after test conclusion	No visible damage $\lvert\Delta C/C_0\rvert \leq 5\%$ $\lvert\Delta ESR/ESR_0\rvert \leq 200\%$
Humidity Bias	AEC Q200 Rev E	• Rated Voltage • 1000 hours • 40 °C/93%RH • Measurement at 24±4 hours after test conclusion	No visible damage $\lvert\Delta C/C_0\rvert \leq 5\%$ $\lvert\Delta ESR/ESR_0\rvert \leq 100\%$
High Temperature Operating Life	AEC Q200 Rev E	• 1000 hours • Temperature of the Chamber: 105 °C • 100% of rated voltage (VR) • Measurement at 24±4 hours after test conclusion	No visible damage $\lvert\Delta C/C_0\rvert \leq 5\%$ $\lvert\Delta ESR/ESR_0\rvert \leq 100\%$
External Visual	AEC Q200 Rev E	• Inspect component construction, marking and workmanship	Within specified limits
Physical Dimensions	AEC Q200 Rev E	• Verify physical dimensions to the applicable component specification	Within specified limits
Terminal Strength for radial THT components	AEC Q200 Rev E	• Test Condition A 20N	Within specified limits

Test	Reference	Test condition	Performance requirement
Mechanical Shock	AEC Q200 Rev E	• Condition C	Within specified limits
Vibration	AEC Q200 Rev E	• 5 *g* for 20 minutes • 12 cycles each of 3 orientations • Tested in a full assembly with external fixation to case • Test from 10 Hz - 2000 Hz	No visible damage Within specified limits
Resistance to Soldering Heat	AEC Q200 Rev E	• Condition B	
Solderability	AEC Q200 Rev E	• Method A1, Coating Durability Category 2 • Magnification 50x	
Flammability	AEC Q200 Rev E	• Not required: Exposed resins and plastics are V-1, V-0	

Mounting guidelines

Soldering

Solderability of leads

The solderability of terminal leads is tested to IEC 60068-2-20:2008, test Ta, method 1. Before a solderability test is carried out, terminals are subjected to accelerated ageing (to IEC 60068-2-2:2007, test Ba: 4 h exposure to dry heat at 155 °C). Since the ageing temperature is far higher than the upper category temperature of the capacitors, the terminal wires should be cut off from the capacitor before the ageing procedure to prevent the solderability being impaired by the products of any capacitor decomposition that might occur.

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

Resistance to soldering heat

Resistance to soldering heat is tested to IEC 60068-2-20:2008, test Tb, method 1.
Conditions:

Solder bath temperature	260 ±5 °C
Soldering time	10 ±1 s
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 ΔC/C0 tan ∂	 No visible damage ±5% As specified in sectional specification

General notes on soldering

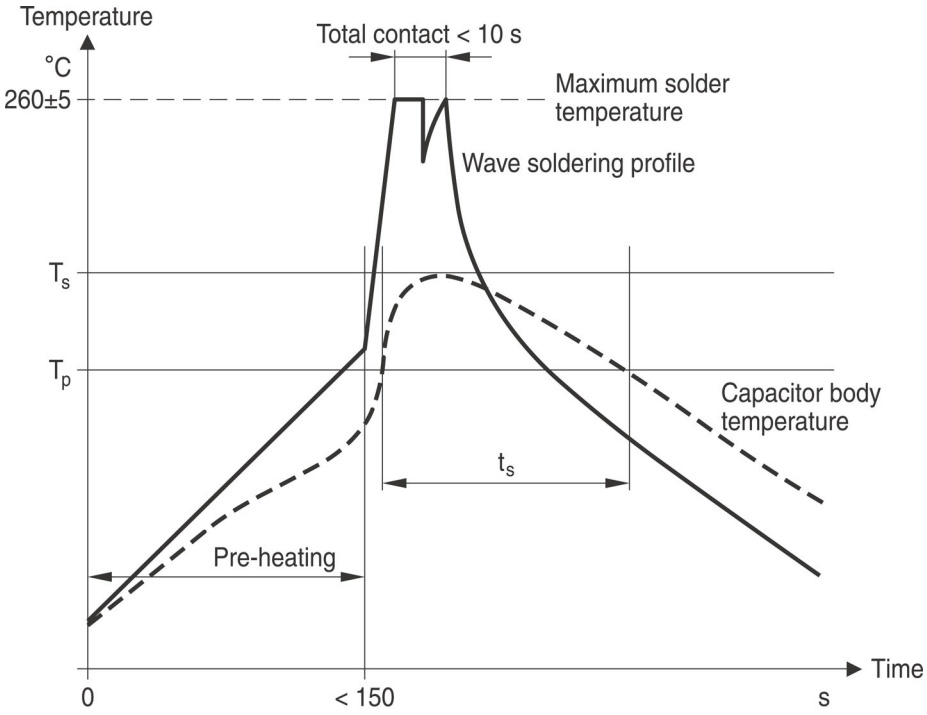
Permissible heat exposure loads on film capacitors are primarily characterized by the upper category temperature Tmax. Long exposure to temperatures above this type-related temperature limit can lead to changes in the plastic dielectric and thus change irreversibly a capacitor's electrical characteristics.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

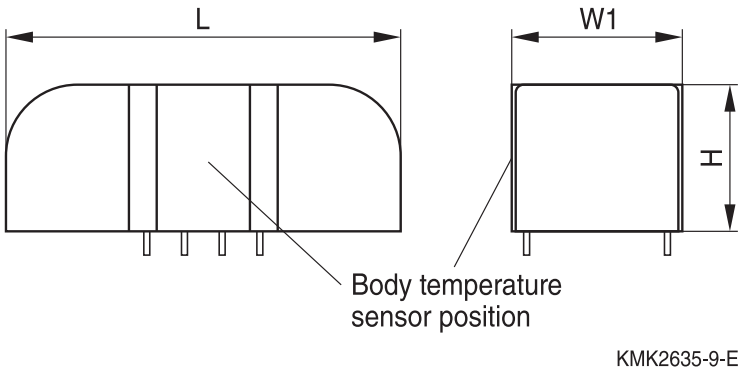
Recommendations

As a reference, the recommended wave soldering profile for film capacitors for PCB mounting in a wave soldering process is as follows:



T_s: Capacitor body maximum temperature at wave soldering
T_p: Capacitor body maximum temperature at pre-heating

KMK1745-A-E



KMK2635-9-E

Body temperature should follow the description below:

- During pre-heating: T_p ≤110 °C
- During soldering: T_s ≤120 °C, ts ≤45 s

When SMD components are used together with leaded ones, the film capacitors should not pass into the SMD adhesive curing oven. The leaded components should be assembled after the SMD curing step. Leaded film capacitors are not suitable for reflow soldering. In order to ensure proper conditions for manual or selective soldering, the body temperature of the capacitor (T_S) must be ≤120 °C.

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

Cleaning

To determine whether the following solvents, often used to remove flux residues and other substances, are suitable for the capacitors described, refer to the table below:

Type	Ethanol, isopropanol, n-propanol	n-propanol-water mixtures, water with surface tension-reducing tensides (neutral)
xEVCap	Suitable	Unsuitable

Even when suitable solvents are used, a reversible change of the electrical characteristics may occur in uncoated capacitors immediately after they are washed. Thus, it is always recommended to dry the components (e.g. 4 h at 70 °C) before they are subjected to subsequent electrical testing.

Caution:

Consult us first if you wish to embed uncoated types!

Embedding of capacitors in finished assemblies

In many applications, finished circuit assemblies are embedded in plastic resins. In this case, both chemical and thermal influences of the embedding ("potting") and curing processes must be taken into account.
Our experience has shown that the following potting materials can be recommended: non-flexible epoxy resins with acid-anhydride hardeners; chemically inert, non-conducting fillers; maximum curing temperature of 100 °C.

Caution:

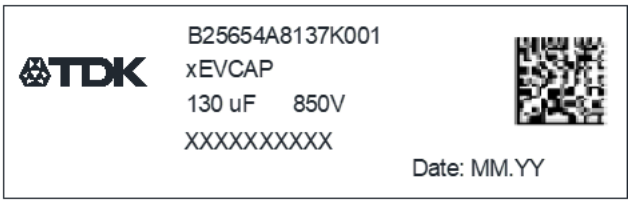
Consult us first if you wish to embed uncoated types!

Product Marking Specification

Ordering code example

B	25654	A	5	107	K
Components class	Series	xEVCAP type	Rated voltage	Rated capacitance	Capacitance tolerance
Passive components		Version	5 = 500Vdc 6 = 650Vdc 8 = 850Vdc 9 = 920Vdc	10^7 pF =100 µF	K =±10%

Example for label (label or laser print on housing)



Explanation of label text

B25654A8137K001	TDK part no.
xEVCAP	Product type
130µF 850V	Rated capacitance and nominal voltage
XXXXXXXXX	Lot number / part Identifier
Date: MM. YY	Manufacturing month and year

Content of DMC code:

Same as the label text

Cautions and warnings

- The maximum hot spot temperature inside of each of the capacitor elements is limited to 105 °C.
- Any exceedance of the maximum temperature of 105 °C inside each of the capacitor elements will significantly reduce its lifetime.
- These parameters describe the estimated values calculated for a vehicle with an electric power train but shall not be deemed as an extension of the agreed warranty periods.
- In case of mechanical damage, capacitors must not be used at all.
- The energy stored in capacitors may be lethal. To prevent any chance of shock, discharge and short-circuit the capacitor before handling.
- Failure to follow cautions may result, worst case, in premature failures, bursting and fire.
- Tinned Cu terminals of the capacitor may lead to the occurrence of whisker during capacitor supply, storage and/or during application of the capacitor. Factors for the occurrence of whisker are not determinable and outside TDK's responsibility. Therefore, customer shall be solely responsible for the risk analysis and necessary safety measures related to the occurrence of whisker.

Safety

- Electrical or mechanical misapplication of capacitors may be hazardous. Personal injury or property damage may result from bursting of the capacitor or from expulsion of melted material due to mechanical disruption of the capacitor.
- Ensure good, effective grounding for capacitor enclosures.
- Observe appropriate safety precautions during operation (self recharging phenomena and the high energy stored in capacitors).
- Handle capacitors carefully, because they may still be charged even after disconnection.
- The terminals of capacitors, connected bus bars and cables as well as other devices may also be energized.

Thermal load

After installation of the capacitor it is necessary to verify that maximum hot-spot temperature is not exceeded at extreme service conditions.

Mechanical protection

The capacitor has to be installed in a way that mechanical damages, terminal bending and dents in the case are avoided.

Storage and operating conditions

Do not use or store capacitors in corrosive atmosphere, especially where chloride gas, sulfide gas, acid, alkali, salt or the like are present. In dusty environments regular maintenance and cleaning especially of the terminals is required to avoid conductive path between phases and/or phases and ground.

Service life expectancy and disposal

Electrical components do not have an unlimited service life expectancy; this applies to self-healing capacitors too. The maximum service life expectancy may vary depending on the application the capacitor is used in. TDK capacitors can be disposed through the standard process in place for uncritical industrial and automotive electronics components. Considering common government regulations they do not include quantities of critical substances, that would make a special treatment necessary. In case of uncertainty for your country please consult a local waste requirements specialist.

Display of ordering codes for TDK Electronics products

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

Symbols and terms

C_N	Nominal capacitance
V_R or U_R	Rated DC-voltage of a capacitor
V_{MAX} or U_{MAX}	Maximum permissible voltage that can be applied to the capacitors for specified duration at the specified temperature
$I_{\_max}$	Maximum RMS capacitor current for continuous operation at 10 kHz
ESR	Equivalent series resistance, measured at 10 kHz
V_s	Non-recurrent surge voltage
î	Max. current transient amplitude during continuous operation
I_s	Admissible peak current transient for a limited number of time (typical value: 1000 times during operation time)
V_{TT} or U_{TT}	Test voltage for capacitor, applied between terminal and terminal
V_{TC} or U_{TC}	Test voltage for capacitor, applied between terminal and case
R_{Iso}	Insulation resistance between capacitor terminals, measured at rated voltage for 60 s
T_{min}	Lowest permitted ambient working temperature
T_{max}	Highest permitted ambient working temperature

Note

Symbol “U” or “V” can be used indistinctly for the physical magnitude of voltage (electric potential difference). “U” is widely used in reference IEC standards while “V” is also widely used in datasheets and specifications.

Important notes

The following applies to all products named in this publication:

1 Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application**. As a rule we are either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether a product with the properties described in the product specification is suitable for use in a particular customer application.

2 We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified**. In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or life-saving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.

3 **The warnings, cautions and product-specific notes must be observed**.

4 In order to satisfy certain technical requirements, **some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as hazardous)**. Useful information on this will be found in our Material Data Sheets on the Internet (www.tdk-electronics.tdk.com/material). Should you have any more detailed questions, please contact our sales offices.

5 We constantly strive to improve our products. Consequently, **the products described in this publication may change from time to time**. The same is true of the corresponding product specifications. Please check therefore to what extent product descriptions and specifications contained in this publication are still applicable before or when you place an order.
We also **reserve the right to discontinue production and delivery of products**. Consequently, we cannot guarantee that all products named in this publication will always be available. The aforementioned does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.

6 Unless otherwise agreed in individual contracts, **all orders are subject to our General Terms and Conditions of Supply**.

7 **Our manufacturing sites serving the automotive business apply the IATF 16949 standard**. The IATF certifications confirm our compliance with requirements regarding the quality management system in the automotive industry. Referring to customer requirements and customer specific requirements (“CSR”) TDK always has and will continue to have the policy of respecting individual agreements. Even if IATF 16949 may appear to support the acceptance of unilateral requirements, we hereby like to emphasize that **only requirements mutually agreed upon can and will be implemented in our Quality Management System**. For clarification purposes we like to point out that obligations from IATF 16949 shall only become legally binding if individually agreed upon.

8 The trade names EPCOS, CarXield, CeraCharge, CeraDiode, CeraLink, CeraPad, CeraPlas, CSMP, CTVS, DeltaCap, DigiSiMic, FilterCap, FormFit, InsuGate, LeaXield, MediPlas, MiniBlue, MiniCell, MKD, MKK, ModCap, MotorCap, PCC, PhaseCap, PhaseCube, PhaseMod, PhiCap, PiezoBrush, PlasmaBrush, PowerHap, PQSine, PQvar, SIFERRIT, SIFI, SIKOREL, SilverCap, SIMDAD, SiMic, SIMID, SineFormer, SIOV, SurfIND, ThermoFuse, WindCap, XieldCap are **trademarks registered or pending** in Europe and in other countries. Further information will be found on the Internet at www.tdk-electronics.tdk.com/trademarks.

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