# PEH534, +105°C

## Overview

KEMET's PEH534 is a long-life electrolytic capacitor designed to offer high ripple current capability and low mounting cost. Low ESR is the result of a very low resistive paper/electrolyte system. Low ESR, together with the TDC thermal concept, gives the PEH534 a high ripple current capability.

## Applications

Typical applications for KEMET's PEH534 capacitor include switch mode power supplies (SMPS), drives, welding equipment, uninterruptible power supplies (UPS), and other power electronic applications where high current ratings and compact size are important.

## Benefits

- Snap-In
- 3,000 hours at +105°C ($V_R$, $I_R$ applied)
- PCB mounting
- Low ESR and ESL
- High ripple current

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## Part Number System

| PEH534 | J | BC | 456 | 0 | M | 2 |
|---|---|---|---|---|---|---|
| Series | Rated Voltage (VDC) | Size Code | Capacitance Code (µF) | Version | Capacitance Tolerance | Termination |
| Snap-In type Aluminum Electrolytic | J = 35<br>M = 63<br>P = 100<br>R = 200<br>S = 250<br>U = 350<br>V = 400<br>Y = 450 | See Dimension Table | The last two digits represent significant figures. The first digit indicates the total number digits. | 0 = Standard | M = ±20% | See Termination Table |



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## Performance Characteristics

| Item | Performance Characteristics | | |
|---|---|---|---|
| Capacitance Range | 150 – 22,000 µF | | |
| Rated Voltage | 35 – 450 VDC | | |
| Operating Temperature | –40 to +105°C | | |
| Capacitance Tolerance | ±20% at 100 Hz/+20°C | | |
| Operational Lifetime | D (mm) | Rated Voltage and Ripple Current at +105°C (hours) | Rated Voltage at +105°C (hours) |
| | 22 – 40 | 3,000 | 4,000 |
| Shelf Life | 4 years at +40°C 0 VDC | | |
| Leakage Current | I = 0.003 CV (µA) | | |
| | C = rated capacitance (µF), V = rated voltage (VDC). Voltage applied for 5 minutes at +20°C. | | |
| Vibration Test Specifications | Procedure | Requirements | |
| | 0.75 mm displacement amplitude or 10 g maximum acceleration. Vibration applied for three 2-hour sessions at 10 – 500 Hz (Capacitor clamped by body). | No leakage of electrolyte or other visible damage. Deviations in capacitance from initial measurements must not exceed: Δ C/C < 5% | |
| Standards | IEC 60384–4 long life grade 40/105/56, in accordance with CECC 30 301–809 | | |

## Test Method & Performance

| Endurance Life Test | | |
|---|---|---|
| Conditions | Performance | |
| Temperature | +105°C | |
| Test Duration | 2,000 hours | |
| Ripple Current | Maximum ripple current specified in table | |
| Voltage | The sum of DC voltage and the peak AC voltage must not exceed the rated voltage of the capacitor | |
| **Performance** | **The following specifications will be satisfied when the capacitor is tested at +20°C:** | |
| Capacitance Change | ≤ 160 V | Within 15% of the initial value |
| | > 160 V | Within 10% of the initial value |
| Equivalent Series Resistance | Does not exceed 200% of the initial value | |
| Leakage Current | Does not exceed leakage current limit | |

## Dimensions – Millimeters

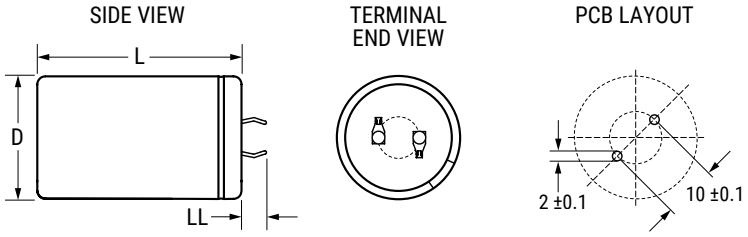
| D X L | Size Code | Dimensions in mm | | Approximate Weight Grams |
|---|---|---|---|---|
| | | D1 | L1 | |
| | | ±0.5 | ±1.0 | |
| 25 x 30 | BC | 25.5 | 31 | 21 |
| 25 x 35 | BD | 25.5 | 36 | 24 |
| 25 x 40 | BE | 25.5 | 41 | 27 |
| 25 x 45 | BF | 25.5 | 46 | 30 |
| 25 x 50 | BG | 25.5 | 51 | 33 |
| 30 x 25 | CB | 30.5 | 26 | 24 |
| 30 x 30 | CC | 30.5 | 31 | 29 |
| 30 x 35 | CD | 30.5 | 36 | 34 |
| 30 x 40 | CE | 30.5 | 41 | 39 |
| 30 x 45 | CF | 30.5 | 46 | 45 |
| 30 x 50 | CG | 30.5 | 51 | 51 |
| 35 x 25 | DB | 35.5 | 26 | 32 |
| 35 x 30 | DC | 35.5 | 31 | 40 |
| 35 x 35 | DD | 35.5 | 36 | 48 |
| 35 x 40 | DE | 35.5 | 41 | 56 |
| 35 x 45 | DF | 35.5 | 46 | 64 |
| 35 x 50 | DG | 35.5 | 51 | 72 |
| Note: Add 0.5 mm to D and 1 mm to L for Sleeving | | | | |

## Termination Tables

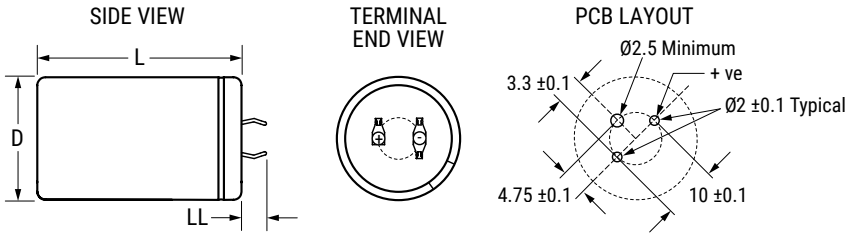
| Termination Code / Diameter (mm) | 2 | 2S | 3 | 4 | 4S |
|---|---|---|---|---|---|
| 25 | • | • | • | | |
| 30 | • | • | • | | |
| 35 | • | • | • | • | • |
| Mounting: These capacitors are designed to be mounted by their terminations alone and may be used in any position. Dummy pins on 4-pin decks must be isolated. | | | | | |

| Termination Code | Termination Style | LL ±1 |
|---|---|---|
| Standard Termination Option | | |
| 2 | 2 Pin | 6.3 |
| Other Termination Options | | |
| 2S | 2 Pin | 4.0 |
| 3 | 3 Pin | 4.0 |
| 4 | 4 Pin | 6.3 |
| 4S | 4 Pin | 4.0 |
| **Dimensions in mm** | | |

**Style 2/2S**




**Style 3**

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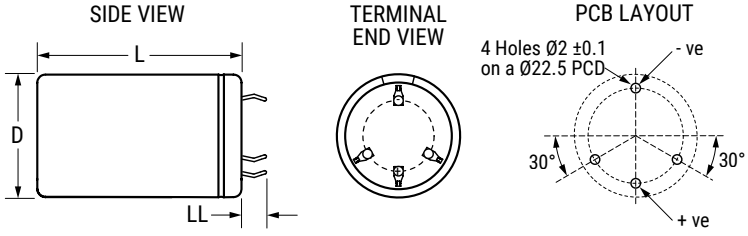


## Shelf Life

The capacitance, ESR and impedance of a capacitor will not change significantly after extended storage periods, however the leakage current will very slowly increase. KEMET products are particularly stable and allow a shelf life in excess of three years at 40°C. See sectional specification under each product series for specific data.

## Re-age (Reforming) Procedure

Apply the rated voltage to the capacitor at room temperature for a period of one hour, or until the leakage current has fallen to a steady value below the specified limit. During re-aging a maximum charging current of twice the specified leakage current or 5 mA (whichever is greater) is suggested.

## Reliability

The reliability of a component can be defined as the probability that it will perform satisfactorily under a given set of conditions for a given length of time.

In practice, it is impossible to predict with absolute certainty how any individual component will perform; thus, we must utilize probability theory. It is also necessary to clearly define the level of stress involved (e.g. operating voltage, ripple current, temperature and time). Finally, the meaning of satisfactory performance must be defined by specifying a set of conditions which determine the end of life of the component.

Reliability as a function of time, R(t), is normally expressed as: $R(t)=e^{-\lambda t}$
where R(t) is the probability that the component will perform satisfactorily for time t, and λ is the failure rate.

## Failure Rate

The failure rate is the number of components failing per unit time. The failure rate of most electronic components follows the characteristic pattern:

- Early failures are removed during the manufacturing process.
- The operational life is characterized by a constant failure rate.
- The wear out period is characterized by a rapidly increasing failure rate.

The failures in time (FIT) are given with a 60% confidence level for the various type codes. By convention, FIT is expressed as $1 \times 10^{-9}$ failures per hour. Failure rate is also expressed as a percentage of failures per 1,000 hours.
e.g., 100 FIT = $1 \times 10^{-7}$ failures per hour = 0.01%/1,000 hours

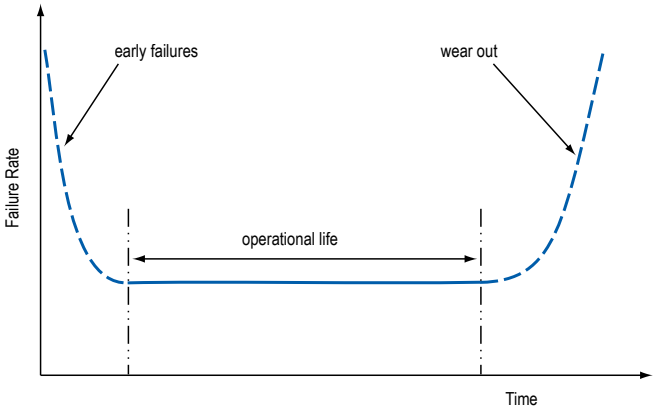
**End of Life Definition**
Catastrophic Failure: short circuit, open circuit or safety vent operation
Parametric Failure:

- Change in capacitance > ±10%
- Leakage current > specified limit
- ESR > 2 x initial ESR value

**MTBF**

The mean time between failures (MTBF) is simply the inverse of the failure rate.

MTBF= 1/λ




The failure rate is derived from our periodic test results. The failure rate ($\lambda_R$) is, therefore, only given at test temperature for life tests. An estimation is also given at 40°C. The expected failure rate for this capacitor range is based on our periodic test results for capacitors with structural similarity. Failure rate is frequently quoted in FIT (Failures In Time) where 1 FIT = 1 x $10^{-9}$ failures per hour. Failure rate per hour includes both catastrophic and parametric failures.

## Environmental Compliance

All Part Numbers in this datasheet are Reach and RoHS compliant.

As an environmentally conscious company, KEMET is working continuously with improvements concerning the environmental effects of both our capacitors and their production.

In Europe (RoHS Directive) and in some other geographical areas such as China, legislation has been put in place to prevent the use of some hazardous materials, such as lead (Pb), in electronic equipment. All products in this catalog are produced to help our customers' obligations to guarantee their products and fulfill these legislative requirements. The only material of concern in our products has been lead (Pb), which has been removed from all designs to fulfill the requirement of containing less than 0.1% of lead in any homogeneous material. KEMET will closely follow any changes in legislation worldwide and make any necessary changes in its products, whenever needed.

Some customer segments such as medical, military and automotive electronics may still require the use of lead in electrode coatings. To clarify the situation and distinguish products from each other, a special symbol is used on the packaging labels for RoHS compatible capacitors.

Due to customer requirements, there may appear additional markings such as lead-free (LF), or lead-free wires (LFW) on the label.

## Table 1 – Ratings & Part Number Reference

| VDC | Rated Capacitance | Size Code | Case Size | Ripple Current Maximum | | ESR Maximum | | Part Number |
|---|---|---|---|---|---|---|---|---|
| | 100 Hz 20°C (µF) | | D x L (mm) | 100 Hz 105°C (A) | 20 kHz 40°C (A) | 100 Hz 20°C (mΩ) | 100 kHz 20°C (mΩ) | |
| 35 | 5600 | BC | 25 x 30 | 2.3 | 7.6 | 54 | 43 | PEH534JBC4560M(1) |
| 35 | 6800 | BD | 25 x 35 | 2.7 | 9.0 | 43 | 34 | PEH534JBD4680M(1) |
| 35 | 6800 | CB | 30 x 25 | 2.9 | 9.8 | 40 | 31 | PEH534JCB4680M(1) |
| 35 | 8200 | BE | 25 x 40 | 3.1 | 10.2 | 36 | 28 | PEH534JBE4820M(1) |
| 35 | 8200 | CC | 30 x 30 | 3.5 | 12.1 | 31 | 23 | PEH534JCC4820M(1) |
| 35 | 8200 | DB | 35 x 25 | 3.1 | 10.0 | 37 | 29 | PEH534JDB4820M(1) |
| 35 | 10000 | BF | 25 x 45 | 3.5 | 11.3 | 31 | 24 | PEH534JBF5100M(1) |
| 35 | 10000 | CD | 30 x 35 | 4.1 | 14.3 | 25 | 18 | PEH534JCD5100M(1) |
| 35 | 15000 | CF | 30 x 45 | 5.3 | 17.8 | 17 | 13 | PEH534JCF5150M(1) |
| 35 | 15000 | DD | 35 x 35 | 4.5 | 14.4 | 21 | 17 | PEH534JDD5150M(1) |
| 35 | 22000 | DG | 35 x 50 | 6.2 | 20.1 | 14 | 11 | PEH534JDG5220M(1) |
| 63 | 2200 | BC | 25 x 30 | 1.9 | 6.9 | 92 | 43 | PEH534MBC4220M(1) |
| 63 | 3300 | BE | 25 x 40 | 2.5 | 9.3 | 61 | 34 | PEH534MBE4330M(1) |
| 63 | 3300 | CC | 30 x 30 | 2.7 | 10.6 | 56 | 31 | PEH534MCC4330M(1) |
| 63 | 4700 | CE | 30 x 40 | 3.6 | 14.0 | 39 | 28 | PEH534MCE4470M(1) |
| 63 | 4700 | DC | 35 x 30 | 3.1 | 11.2 | 44 | 23 | PEH534MDC4470M(1) |
| 63 | 5600 | CF | 30 x 45 | 4.0 | 15.6 | 33 | 29 | PEH534MCF4560M(1) |
| 63 | 5600 | DD | 35 x 35 | 3.7 | 13.3 | 36 | 24 | PEH534MDD4560M(1) |
| 63 | 6800 | CG | 30 x 50 | 4.5 | 17.1 | 28 | 18 | PEH534MCG4680M(1) |
| 63 | 6800 | DE | 35 x 40 | 4.2 | 15.2 | 30 | 13 | PEH534MDE4680M(1) |
| 63 | 8200 | DF | 35 x 45 | 4.7 | 16.8 | 26 | 17 | PEH534MDF4820M(1) |
| 63 | 10000 | DG | 35 x 50 | 5.2 | 18.4 | 22 | 11 | PEH534MDG5100M(1) |
| 100 | 1500 | BE | 25 x 40 | 1.9 | 7.0 | 140 | 110 | PEH534PBE4150M(1) |
| 100 | 1500 | CC | 30 x 30 | 2.0 | 7.4 | 130 | 100 | PEH534PCC4150M(1) |
| 100 | 2200 | CE | 30 x 40 | 2.6 | 9.8 | 91 | 70 | PEH534PCE4220M(1) |
| 100 | 2200 | DC | 35 x 30 | 2.4 | 8.8 | 96 | 75 | PEH534PDC4220M(1) |
| 100 | 3300 | CG | 30 x 50 | 3.3 | 12.4 | 62 | 48 | PEH534PCG4330M(1) |
| 100 | 3300 | DE | 35 x 40 | 3.3 | 11.7 | 64 | 50 | PEH534PDE4330M(1) |
| 100 | 3900 | DF | 35 x 45 | 3.6 | 13.1 | 54 | 43 | PEH534PDF4390M(1) |
| 100 | 4700 | DG | 35 x 50 | 4.1 | 14.5 | 46 | 36 | PEH534PDG4470M(1) |
| 200 | 470 | BD | 25 x 35 | 1.1 | 7.1 | 290 | 160 | PEH534RBD3470M(1) |
| 200 | 560 | BE | 25 x 40 | 1.3 | 8.0 | 250 | 130 | PEH534RBE3560M(1) |
| 200 | 560 | CC | 30 x 30 | 1.3 | 8.9 | 240 | 130 | PEH534RCC3560M(1) |
| 200 | 680 | BF | 25 x 45 | 1.4 | 8.9 | 200 | 110 | PEH534RBF3680M(1) |
| 200 | 680 | CD | 30 x 35 | 1.5 | 10.4 | 200 | 100 | PEH534RCD3680M(1) |
| 200 | 680 | DC | 35 x 30 | 1.5 | 9.8 | 200 | 110 | PEH534RDC3680M(1) |
| 200 | 820 | CE | 30 x 40 | 1.7 | 11.8 | 160 | 87 | PEH534RCE3820M(1) |
| 200 | 820 | DC | 35 x 30 | 1.6 | 9.8 | 170 | 93 | PEH534RDC3820M(1) |
| 200 | 1000 | CG | 30 x 50 | 2.0 | 13.9 | 130 | 71 | PEH534RCG4100M(1) |
| 200 | 1000 | DD | 35 x 35 | 1.9 | 11.6 | 140 | 75 | PEH534RDD4100M(1) |
| 200 | 1500 | DF | 35 x 45 | 2.5 | 14.7 | 93 | 51 | PEH534RDF4150M(1) |
| 250 | 390 | BE | 25 x 40 | 1.1 | 7.9 | 290 | 140 | PEH534SBE3390M(1) |
| 250 | 390 | CC | 30 x 30 | 1.1 | 8.7 | 280 | 140 | PEH534SCC3390M(1) |
| 250 | 470 | BF | 25 x 45 | 1.3 | 8.8 | 240 | 120 | PEH534SBF3470M(1) |
| 250 | 470 | CD | 30 x 35 | 1.3 | 10.1 | 240 | 110 | PEH534SCD3470M(1) |
| 250 | 470 | DC | 35 x 30 | 1.3 | 9.6 | 240 | 120 | PEH534SDC3470M(1) |
| 250 | 560 | BG | 25 x 50 | 1.4 | 9.6 | 200 | 100 | PEH534SBG3560M(1) |
| 250 | 560 | CE | 30 x 40 | 1.5 | 11.4 | 200 | 95 | PEH534SCE3560M(1) |
| 250 | 680 | CF | 30 x 45 | 1.7 | 12.8 | 160 | 79 | PEH534SCF3680M(1) |
| 250 | 680 | DD | 35 x 35 | 1.7 | 11.5 | 170 | 83 | PEH534SDD3680M(1) |
| 250 | 820 | CG | 30 x 50 | 1.9 | 14.2 | 140 | 66 | PEH534SCG3820M(1) |
| 250 | 820 | DE | 35 x 40 | 1.9 | 13.1 | 140 | 69 | PEH534SDE3820M(1) |
| 250 | 1000 | DF | 35 x 45 | 2.2 | 14.6 | 110 | 57 | PEH534SDF4100M(1) |
| 350 | 220 | BE | 25 x 40 | 0.9 | 5.8 | 560 | 350 | PEH534UBE3220M(1) |
| 350 | 220 | CC | 30 x 30 | 0.9 | 6.0 | 550 | 340 | PEH534UCC3220M(1) |
| 350 | 220 | DB | 35 x 25 | 0.9 | 5.8 | 560 | 350 | PEH534UDB3220M(1) |
| 350 | 330 | CE | 30 x 40 | 1.2 | 8.0 | 370 | 230 | PEH534UCE3330M(1) |
| 350 | 330 | DC | 35 x 30 | 1.2 | 7.4 | 370 | 230 | PEH534UDC3330M(1) |
| 350 | 390 | CF | 30 x 45 | 1.4 | 9.0 | 310 | 190 | PEH534UCF3390M(1) |
| 350 | 390 | DD | 35 x 35 | 1.4 | 8.6 | 320 | 200 | PEH534UDD3390M(1) |
| VDC | Rated Capacitance | Size Code | Case Size | Ripple Current | | ESR | | Part Number |

*(1) Termination code: See Termination Tables for available options.*

## Table 1 – Ratings & Part Number Reference cont.

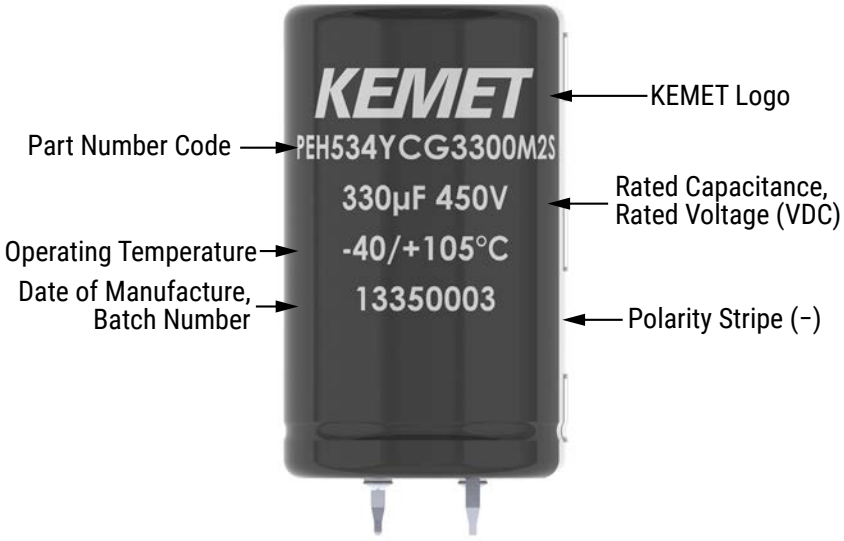
| VDC | Rated Capacitance | Size Code | Case Size | Ripple Current Maximum | | ESR Maximum | | Part Number |
|---|---|---|---|---|---|---|---|---|
| | 100 Hz 20°C (µF) | | D x L (mm) | 100 Hz 105°C (A) | 20 kHz 40°C (A) | 100 Hz 20°C (mΩ) | 100 kHz 20°C (mΩ) | |
| 350 | 470 | DE | 35 x 40 | 1.6 | 9.7 | 260 | 160 | PEH534UDE3470M(1) |
| 350 | 560 | DF | 35 x 45 | 1.8 | 10.9 | 220 | 140 | PEH534UDF3560M(1) |
| 400 | 150 | BD | 25 x 35 | 0.8 | 5.1 | 680 | 410 | PEH534VBD3150M(1) |
| 400 | 150 | CB | 30 x 25 | 0.8 | 5.2 | 680 | 400 | PEH534VCB3150M(1) |
| 400 | 220 | BF | 25 x 45 | 1.0 | 6.5 | 470 | 280 | PEH534VBF3220M(1) |
| 400 | 220 | CD | 30 x 35 | 1.0 | 7.1 | 460 | 270 | PEH534VCD3220M(1) |
| 400 | 220 | DC | 35 x 30 | 1.1 | 7.0 | 460 | 280 | PEH534VDC3220M(1) |
| 400 | 330 | CF | 30 x 45 | 1.4 | 9.2 | 310 | 180 | PEH534VCF3330M(1) |
| 400 | 330 | DD | 35 x 35 | 1.4 | 8.7 | 310 | 190 | PEH534VDD3330M(1) |
| 400 | 390 | CG | 30 x 50 | 1.5 | 10.2 | 260 | 160 | PEH534VCG3390M(1) |
| 400 | 390 | DE | 35 x 40 | 1.5 | 9.8 | 260 | 160 | PEH534VDE3390M(1) |
| 400 | 470 | DF | 35 x 45 | 1.8 | 11.1 | 220 | 130 | PEH534VDF3470M(1) |
| 400 | 560 | DG | 35 x 50 | 2.0 | 12.3 | 180 | 110 | PEH534VDG3560M(1) |
| 450 | 150 | BE | 25 x 40 | 0.9 | 5.8 | 570 | 330 | PEH534YBE3150M(1) |
| 450 | 150 | CC | 30 x 30 | 0.9 | 6.1 | 560 | 330 | PEH534YCC3150M(1) |
| 450 | 150 | DB | 35 x 25 | 0.9 | 5.9 | 570 | 330 | PEH534YDB3150M(1) |
| 450 | 220 | CE | 30 x 40 | 1.2 | 8.1 | 380 | 220 | PEH534YCE3220M(1) |
| 450 | 220 | DC | 35 x 30 | 1.2 | 7.5 | 390 | 230 | PEH534YDC3220M(1) |
| 450 | 330 | CG | 30 x 50 | 1.5 | 10.3 | 260 | 150 | PEH534YCG3330M(1) |
| 450 | 330 | DE | 35 x 40 | 1.5 | 9.9 | 260 | 150 | PEH534YDE3330M(1) |
| 450 | 390 | DF | 35 x 45 | 1.7 | 11.3 | 220 | 130 | PEH534YDF3390M(1) |
| 450 | 470 | DG | 35 x 50 | 1.9 | 12.4 | 180 | 110 | PEH534YDG3470M(1) |
| **VDC** | **Rated Capacitance** | **Size Code** | **Case Size** | **Ripple Current** | | **ESR** | | **Part Number** |

*(1) Termination code: See Termination Tables for available options.*

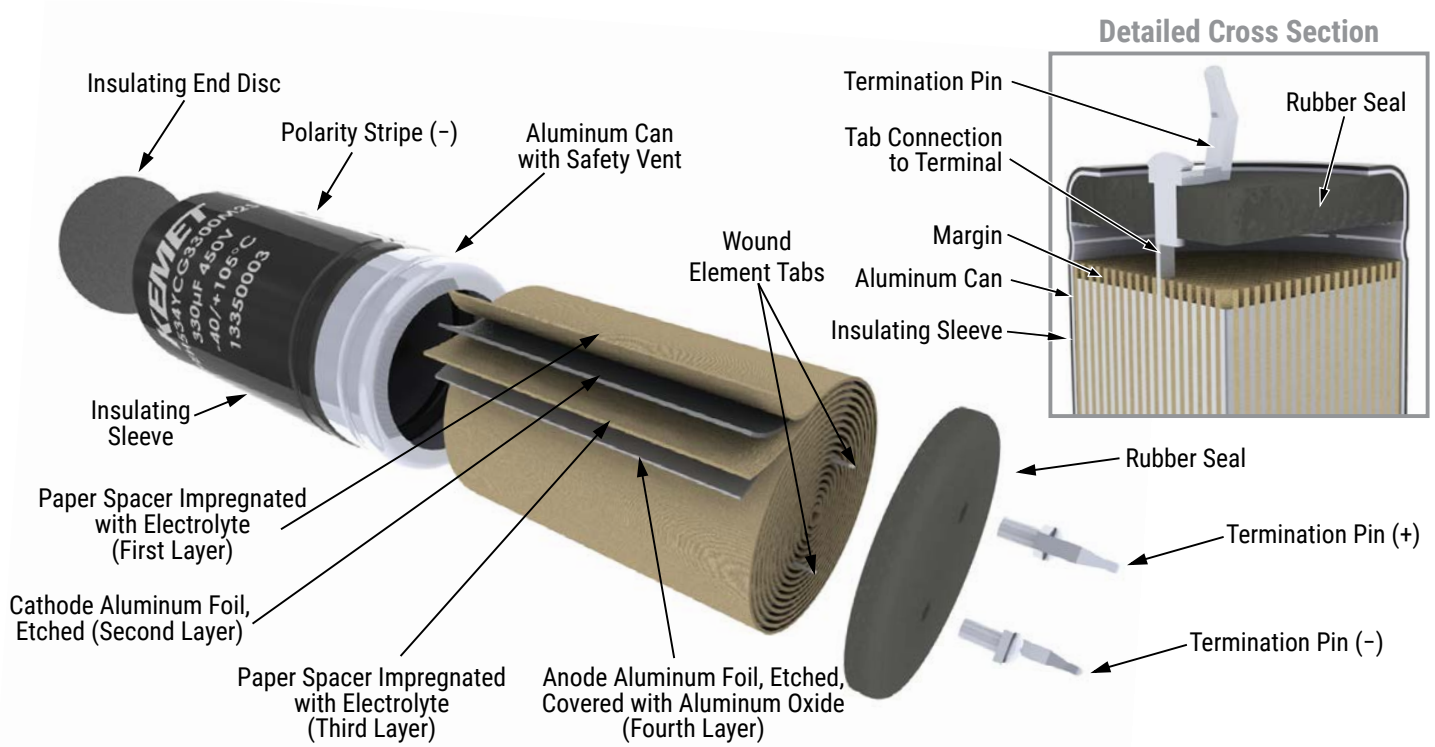
## Mechanical Data

The capacitor may be mounted in any position. PEH534 is supplied with an insulation sleeve. Voltage proof of the insulation sleeve = 2.5 kVDC (1 min). The minus pole is marked on the case surface. UL recognized sleeving is available for custom parts in this range, upon request. (UL No. E358957)

## Marking

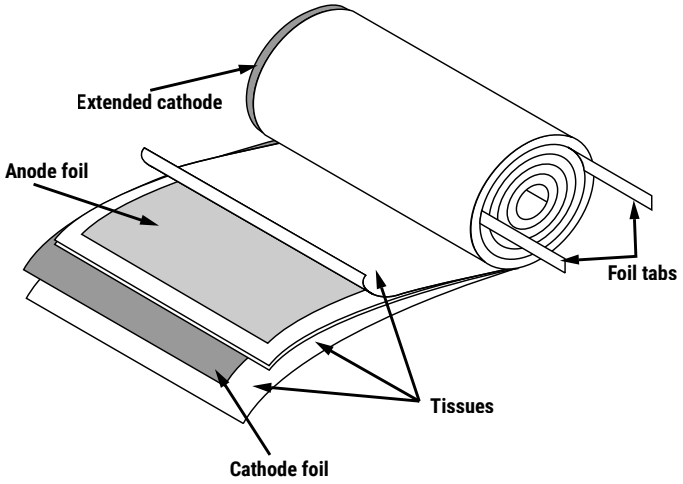



## Construction



## Construction Data

The manufacturing process begins with the anode foil being electrochemically etched to increase the surface area and then "formed" to produce the aluminum oxide layer. Both the anode and cathode foils are then interleaved with absorbent paper and wound into a cylinder. During the winding process, aluminum tabs are attached to each foil to provide the electrical contact.




The deck, complete with terminals, is attached to the tabs and then folded down to rest on top of the winding. The complete winding is impregnated with electrolyte before being housed in a suitable container, usually an aluminum can, and sealed. Throughout the process, all materials inside the housing must be maintained at the highest purity and be compatible with the electrolyte.

Each capacitor is aged and tested before being sleeved and packed. The purpose of aging is to repair any damage in the oxide layer and thus reduce the leakage current to a very low level. Aging is normally carried out at the rated temperature of the capacitor and is accomplished by applying voltage to the device while carefully controlling the supply current. The process may take several hours to complete.

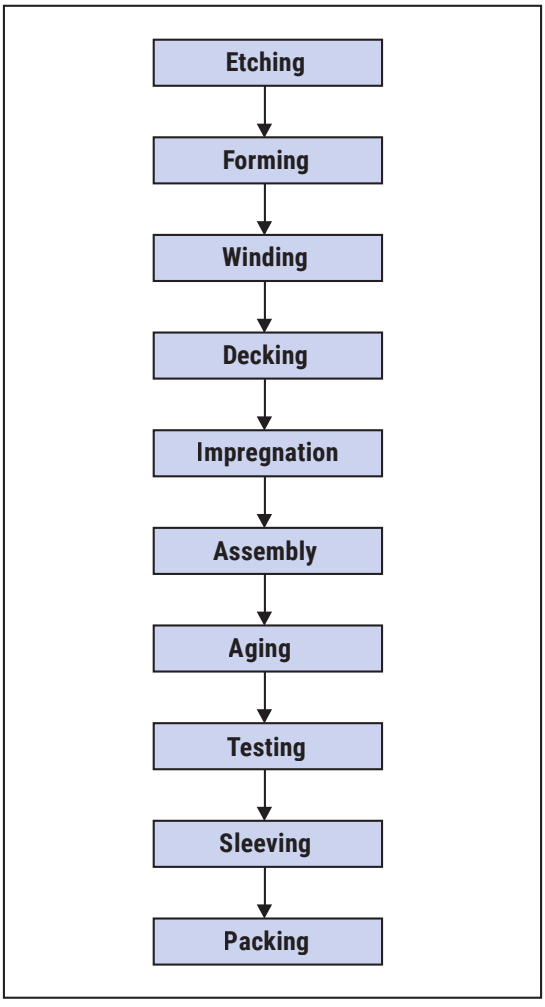
Damage to the oxide layer can occur due to variety of reasons:
- Slitting of the anode foil after forming
- Attaching the tabs to the anode foil
- Minor mechanical damage caused during winding

A sample from each batch is taken by the quality department after completion of the production process.

The following tests are applied and may be varied at the request of the customer. In this case the batch, or special procedure, will determine the course of action.

Electrical:
- Leakage current
- Capacitance
- ESR
- Impedance
- Tan Delta

Mechanical/Visual:
- Overall dimensions
- Torque test of mounting stud
- Print detail
- Box labels
- Packaging, including packed quantity



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Although KEMET designs and manufactures its products to the most stringent quality and safety standards, given the current state of the art, isolated component failures may still occur. Accordingly, customer applications which require a high degree of reliability or safety should employ suitable designs or other safeguards (such as installation of protective circuitry or redundancies) in order to ensure that the failure of an electrical component does not result in a risk of personal injury or property damage.

Although all product–related warnings, cautions and notes must be observed, the customer should not assume that all safety measures are indicted or that other measures may not be required.

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