# ALP/T 20/22 Series, +85°C

## Overview

KEMET's ALP/T 20 Series of capacitors features low ESR, high ripple current ratings and outstandingly good high frequency impedance. KEMET's ALP/T 22 Series of capacitors has the same features as the ALP/T 20 Series, but with a very high CV per unit volume.

## Applications

It should be pointed out that the ALP solder pin and ranges are an older design; as such, they should not be considered for any new applications. Details are incorporated herein, primarily, for maintenance/replacement purposes.

## Benefits

- Solder tag (ALT) and DIN standard solder pin (ALP)
- Long life, up to 26,000 hours at +85°C
- ALC snap-in should be considered for new designs


## Part Number System

| ALP | 20A | 682 | AB | 010 | |
|---|---|---|---|---|---|
| Series | Version | Capacitance Code (µF) | Size Code | Voltage (VDC) | |
| ALP = Solder pin<br>ALT = Solder tag | 20A, 22A = Standard | First 2 digits equals first 2 significant figures, 3rd digit is number of zeros | See Dimension Table | 010 = 10<br>025 = 25<br>040 = 40<br>063 = 63<br>100 = 100 | 200 = 200<br>250 = 250<br>385 = 385<br>400 = 400<br>450 = 450 |

## Performance Characteristics

| Item | Performance Characteristics | | |
|---|---|---|---|
| Capacitance Range | 22 – 150,000 µF | | |
| Rated Voltage | 40 – 450 VDC | | |
| Operational Temperature Range | -40 to +85°C | | |
| Storage Temperature Range | -55 to +85°C | | |
| Capacitance Tolerance | ALP/T 20 | -10/+30%, ±20% | at 100 Hz / +20°C |
| | ALP/T 22 | ±20% | |
| Operational Lifetime | Diameter | Rated Voltage and Ripple Current at +85°C (hours) | |
| | 25 | 12,000 | |
| | 30 | 15,000 | |
| | 35 | 18,000 | |
| | 40 | 26,000 | |
| End of Life Requirement | Δ C/C < ±10%, ESR < 2 x initial ESR value, IL < initial specified limit | | |
| Shelf Life | 2,000 hours at +85°C or 30,000 hours at +40°C 0 VDC | | |
| Leakage Current | I = 0.003 CV or 6,000 (µA, whichever is smaller) | | |
| | C = rated capacitance (µF), V = rated voltage (VDC). Voltage applied for 5 minutes at +20°C. | | |
| Standards | IEC 60384–4, DIN 41238, BS CECC 30301–033 (ALP/T20 only) | | |

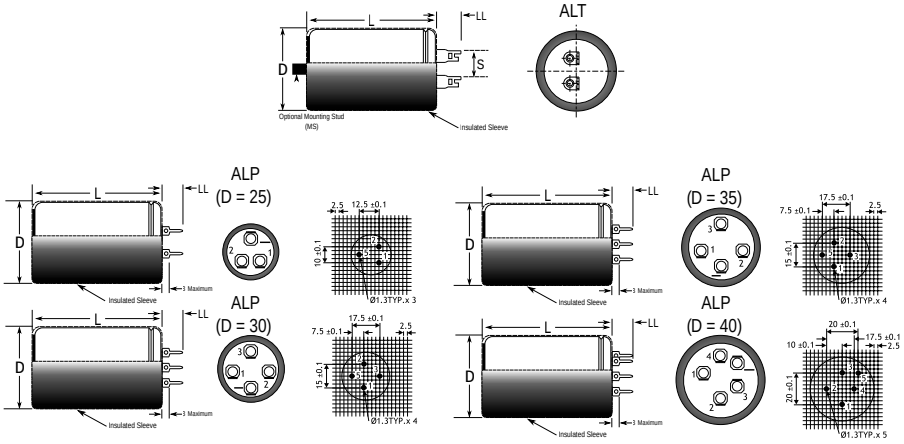
## Surge Voltage

| Condition | Voltage (VDC) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 40 | 63 | 100 | 200 | 385 | 400 | 450 |
| ≤ 30 s surge, 1,000 cycles at +85°C | 46 | 72.5 | 115 | 230 | 423.5 | 440 | 495 |

## Test Method & Performance

| Endurance Life Test | | |
|---|---|---|
| Conditions | Performance | |
| Temperature | +85°C | |
| Test Duration | 5,000 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 | ≤ 100 V | Within 15% of the initial value |
| | > 100 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 | |

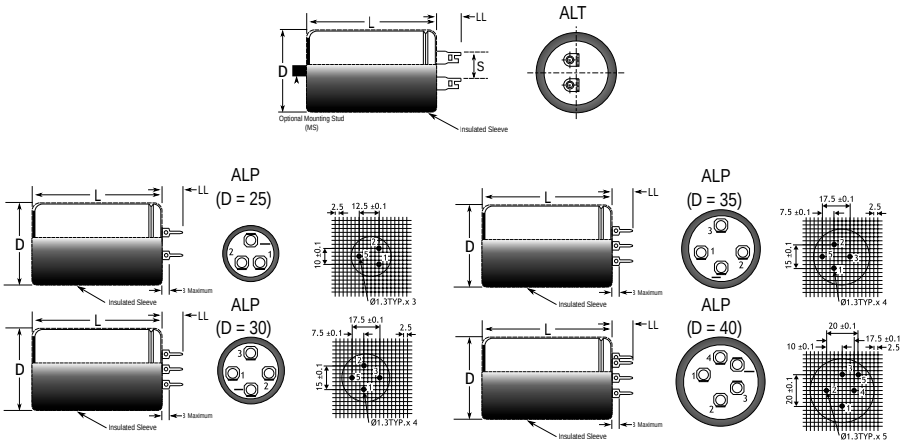
## Dimensions – Millimeters (ALP)




| Size Code | Dimensions in mm | | |
|---|---|---|---|
| | D | L | LL |
| | ±1 | ±2 | ±0.5 |
| AB | 25 | 45 | 7.5 |
| BB | 30 | 45 | 7.5 |
| CB | 35 | 45 | 7.5 |
| CD | 35 | 55 | 7.5 |
| DB | 40 | 45 | 7.5 |
| DD | 40 | 55 | 7.5 |
| DE | 40 | 75 | 7.5 |
| DF | 40 | 105 | 7.5 |

Note: Dimensions include sleeving

## Dimensions – Millimeters (ALT)




| Size Code | Dimensions in mm | | | | Mounting Stud (M x H) | Mounting Clip |
|---|---|---|---|---|---|---|
| | D | L | S | LL | | |
| | ±1 | ±2 | ±0.5 | ±1 | Nominal | |
| AA | 25 | 35 | 10 | 10 | M8 x 12 | V2/H1 |
| AB | 25 | 45 | 10 | 10 | M8 x 12 | V2/H1 |
| BB | 30 | 45 | 10 | 10 | M8 x 12 | |
| CB | 35 | 45 | 10 | 10 | M8 x 12 | V3/H2 |
| CD | 35 | 55 | 10 | 10 | M8 x 12 | V3/H2 |
| DB | 40 | 45 | 10 | 10 | M8 x 12 | V9 |
| DD | 40 | 55 | 10 | 10 | M8 x 12 | V9 |
| DE | 40 | 75 | 10 | 10 | M8 x 12 | V9 |
| DF | 40 | 105 | 10 | 10 | M8 x 12 | V9 |
| Note: Dimensions include sleeving | | | | | | |

## 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

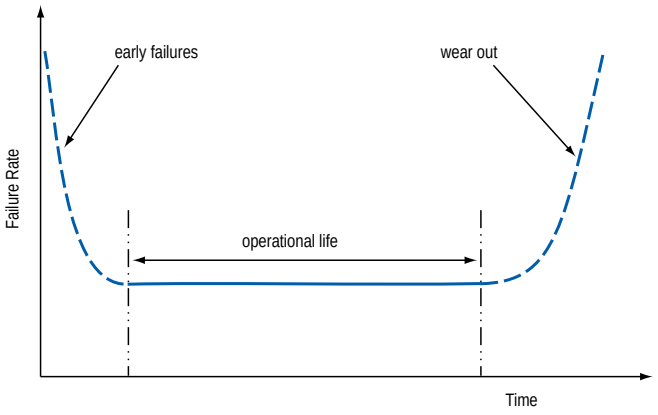
**End of Life Definition**
Catastrophic Failure: short circuit, open circuit or safety vent operation
Parametric Failure:

- 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




## Environmental Compliance

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 like 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 world wide and makes 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.

Because of customer requirements, there may appear additional markings such as LF = Lead Free or LFW = Lead Free Wires on the label.

Pb

RoHS Compliant

## Table 1 – Ratings & Part Number Reference

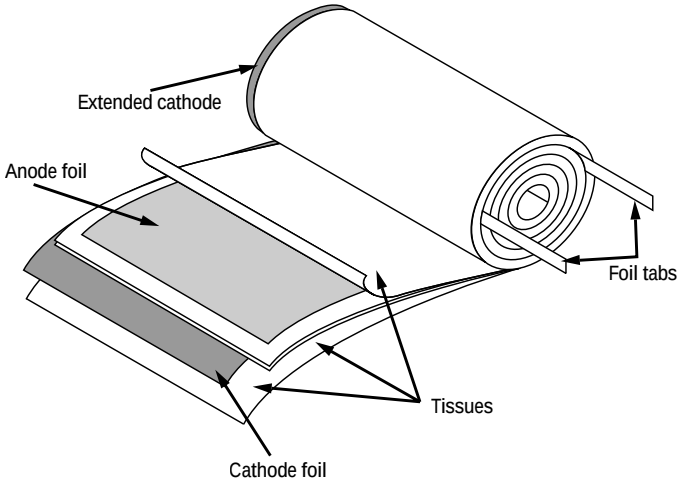
| VDC | Rated Capacitance (µF) | Capacitance Tolerance | Size Code | Case Size | Part Number |
|---|---|---|---|---|---|
| 10 | 6800 | -10/+30% | AB | 25 x 45 | ALP20A682AB010 |
| 16 | 6800 | -10/+30% | BB | 30 x 45 | ALP20A682BB016 |
| 16 | 10000 | -10/+30% | CB | 35 x 45 | ALP20A103CB016 |
| 16 | 10000 | 20% | AB | 25 x 45 | ALP22A103AB016 |
| 16 | 47000 | 20% | DD | 40 x 55 | ALP22A473DD016 |
| 25 | 6800 | 20% | AB | 25 x 45 | ALP22A682AB025 |
| 25 | 15000 | 20% | CB | 35 x 45 | ALP22A153CB025 |
| 40 | 2200 | -10/+30% | AB | 25 x 45 | ALP20A222AB040 |
| 40 | 4700 | -10/+30% | CB | 35 x 45 | ALP20A472CB040 |
| 40 | 4700 | 20% | AB | 25 x 45 | ALP22A472AB040 |
| 40 | 6800 | -10/+30% | CD | 35 x 55 | ALP20A682CD040 |
| 40 | 6800 | 20% | BB | 30 x 45 | ALP22A682BB040 |
| 40 | 10000 | -10/+30% | DD | 40 x 55 | ALP20A103DD040 |
| 40 | 10000 | 20% | CB | 35 x 45 | ALP22A103CB040 |
| 40 | 15000 | 20% | CD | 35 x 55 | ALP22A153CD040 |
| 40 | 22000 | 20% | DD | 40 x 55 | ALP22A223DD040 |
| 63 | 2200 | -10/+30% | BB | 30 x 45 | ALP20A222BB063 |
| 63 | 2700 | 20% | AB | 25 x 45 | ALP22A272AB063 |
| 63 | 3300 | -10/+30% | CB | 35 x 45 | ALP20A332CB063 |
| 63 | 4700 | -10/+30% | CD | 35 x 55 | ALP20A472CD063 |
| 63 | 4700 | 20% | BB | 30 x 45 | ALP22A472BB063 |
| 63 | 6800 | -10/+30% | DD | 40 x 55 | ALP20A682DD063 |
| 63 | 10000 | -10/+30% | DE | 40 x 75 | ALP20A103DE063 |
| 63 | 10000 | 20% | DD | 40 x 55 | ALP22A103DD063 |
| 63 | 10000 | 20% | CD | 35 x 55 | ALP22A103CD063 |
| 63 | 15000 | -10/+30% | DF | 40 x 105 | ALP20A153DF063 |
| 63 | 15000 | 20% | DE | 40 x 75 | ALP22A153DE063 |
| 100 | 1000 | 20% | AB | 25 x 45 | ALP22A102AB100 |
| 100 | 4700 | -10/+30% | DE | 40 x 75 | ALP20A472DE100 |
| 100 | 4700 | 20% | DD | 40 x 55 | ALP22A472DD100 |
| 100 | 10000 | 20% | DF | 40 x 105 | ALP22A103DF100 |
| 200 | 220 | 20% | AB | 25 x 45 | ALP22A221AB200 |
| 200 | 680 | 20% | DB | 40 x 45 | ALP22A681DB200 |
| 200 | 680 | 20% | CD | 35 x 55 | ALP22A681CD200 |
| 200 | 1000 | 20% | DD | 40 x 55 | ALP22A102DD200 |
| 200 | 2200 | 20% | DF | 40 x 105 | ALP22A222DF200 |
| 250 | 1000 | -10/+30% | DE | 40 x 75 | ALP20A102DE250 |
| 385 | 220 | 20% | CB | 35 x 45 | ALP22A221CB385 |
| 385 | 470 | 20% | DD | 40 x 55 | ALP22A471DD385 |
| 385 | 680 | 20% | DE | 40 x 75 | ALP22A681DE385 |
| 385 | 1000 | 20% | DF | 40 x 105 | ALP22A102DF385 |
| 400 | 100 | -10/+30% | BB | 30 x 45 | ALP20A101BB400 |
| 450 | 100 | 20% | BB | 30 x 45 | ALP22A101BB450 |
| 450 | 220 | 20% | CD | 35 x 55 | ALP22A221CD450 |
| 450 | 470 | -10/+30% | DF | 40 x 105 | ALP20A471DF450 |
| 450 | 470 | 20% | DE | 40 x 75 | ALP22A471DE450 |
| 450 | 680 | 20% | DF | 40 x 105 | ALP22A681DF450 |
| 450 | 820 | 20% | DF | 40 x 105 | ALP22A821DF450 |
| 450 | 1000 | 20% | DE | 40 x 75 | ALP22A102DE450 |
| **VDC** | **Rated Capacitance (µF)** | **Capacitance Tolerance** | **Size Code** | **Case Size** | **Part Number** |

## Print Detail

- KEMET Logo
- Rated capacitance
- Capacitance tolerance
- Rated voltage
- Climatic Category
- Date of manufacture & Batch No.
- Article code

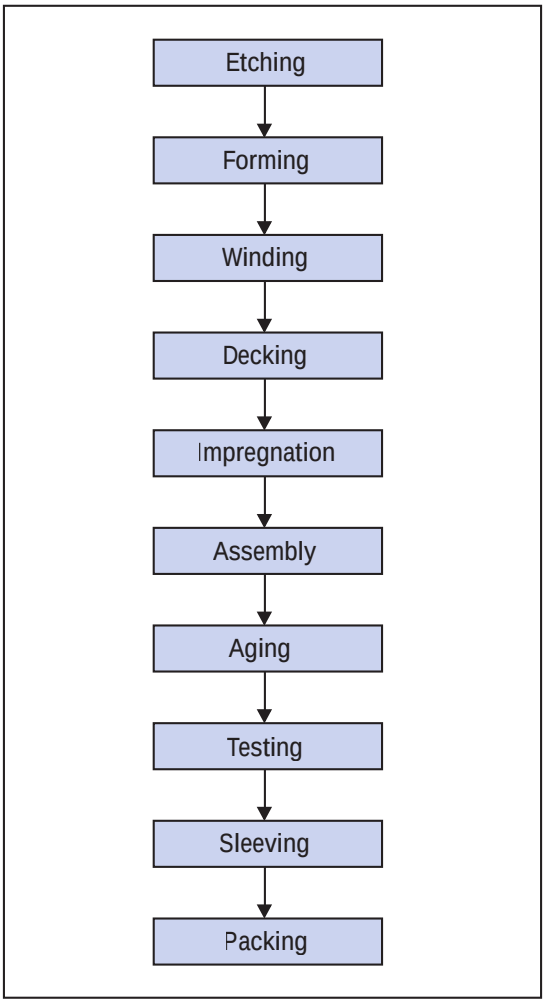
## Construction

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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## Other KEMET Resources

| Tools | |
|---|---|
| Resource | Location |
| Configure A Part: CapEdge | http://capacitoredge.kemet.com |
| SPICE & FIT Software | http://www.kemet.com/spice |
| Search Our FAQs: KnowledgeEdge | http://www.kemet.com/keask |
| Electrolytic LifeCalculator | http://www.kemet.com:8080/elc |

| Product Information | |
|---|---|
| Resource | Location |
| Products | http://www.kemet.com/products |
| Technical Resources (Including Soldering Techniques) | http://www.kemet.com/technicalpapers |
| RoHS Statement | http://www.kemet.com/rohs |
| Quality Documents | http://www.kemet.com/qualitydocuments |

| Product Request | |
|---|---|
| Resource | Location |
| Sample Request | http://www.kemet.com/sample |
| Engineering Kit Request | http://www.kemet.com/kits |

| Contact | |
|---|---|
| Resource | Location |
| Website | www.kemet.com |
| Contact Us | http://www.kemet.com/contact |
| Investor Relations | http://www.kemet.com/ir |
| Call Us | 1-877-MyKEMET |
| Twitter | http://twitter.com/kemetcapacitors |

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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.

Digitally signed by Jeannette Calvo
DN: c=US, st=FL, l=Fort Lauderdale, o=KEMET Corp., ou=Marketing Communications, cn=Jeannette Calvo, email=jeannettecalvo@kemet.com
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