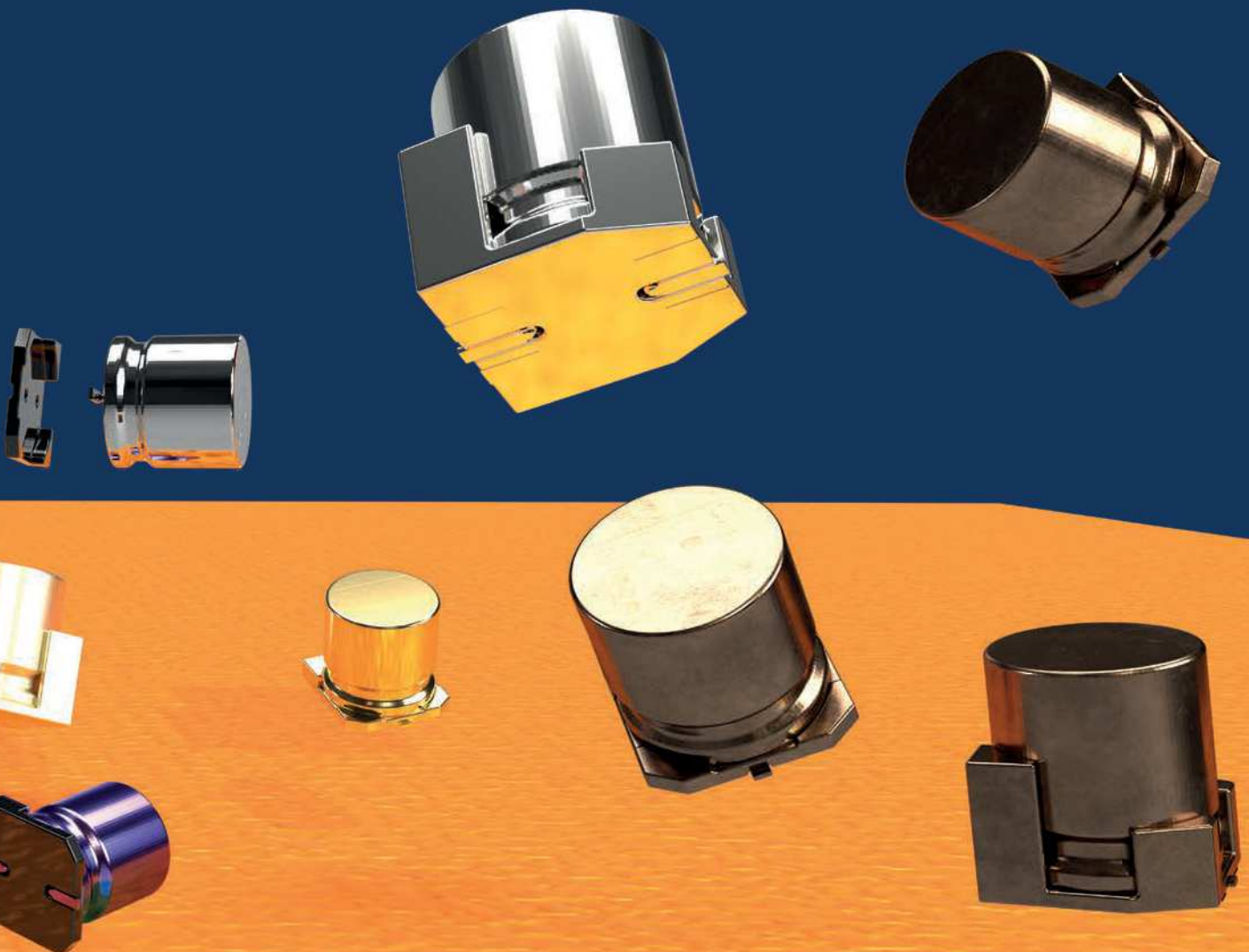


# CAPXON

## ELECTROLYTIC CAPACITORS

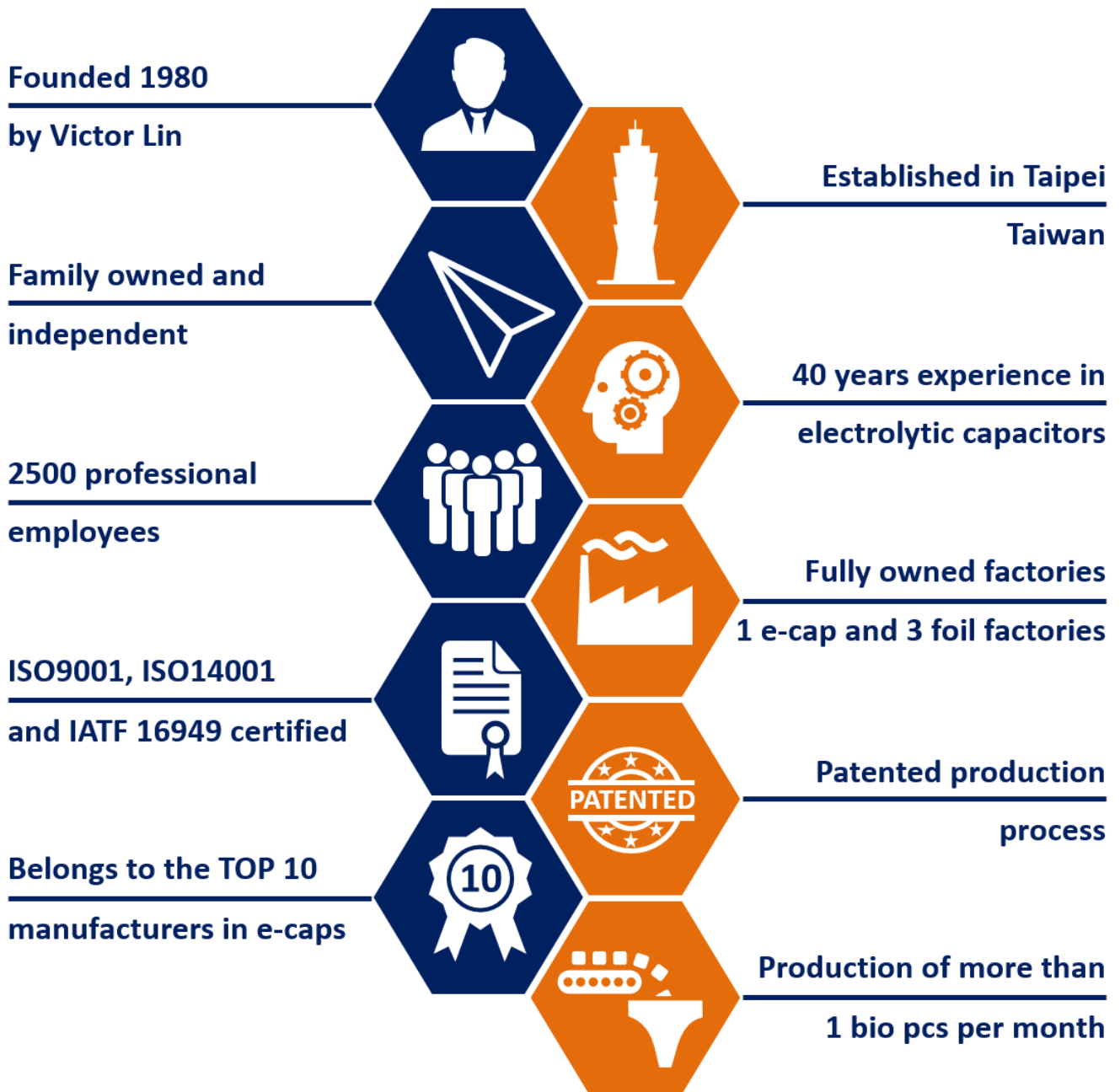
SMD TYPE CAPACITORS  
(Liquid Electrolyte)



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## 10 FACTS ABOUT CAPXON



## A WORLD OF ELECTROLYTIC CAPACITORS

CapXon's know-how in Electrolytic Capacitors covers technologies with aluminium foil. These are Aluminum Electrolytics, Solid Conductive Polymers and the combination known as Hybrid Conductive Polymers:

Aluminum Electrolytic	Description	Features
	<p>Rated Voltage • <math>V_R</math></p> <p>Cathode Material</p> <p>Self-healing of Dielectric</p> <p>Package</p> <p>Stability</p> <p>Lifetime</p> <p>Reliability</p>	<p>4 VDC to 650 VDC</p> <p>Liquid Electrolyte</p> <p>Yes</p> <p>Widest range in all sizes</p> <p>Reduced performance at low temperature</p> <p>Limited life at high temperature</p> <p>Automotive  AEC-Q200 qualified</p>
Solid Conductive Polymer	Description	Features
	<p>Rated Voltage • <math>V_R</math></p> <p>Cathode Material</p> <p>Self-Healing of Dielectric</p> <p>ESR</p> <p>Stability</p> <p>Lifetime</p> <p>Reliability</p>	<p>2.5 VDC to 100 VDC</p> <p>Solid Conductive Polymer</p> <p>No</p> <p>Ultra-low ESR at high frequency</p> <p>Stable for low and high temperature</p> <p>Very stable and long life - no dry out</p> <p>Only internal standard qualification</p>
Hybrid Conductive Polymer	Description	Features
	<p>Rated Voltage • <math>V_R</math></p> <p>Cathode Material</p> <p>Self-Healing of Dielectric</p> <p>ESR</p> <p>Stability</p> <p>Leakage Current • <math>I_{LEAK}</math></p> <p>Reliability</p>	<p>16 VDC to 400 VDC</p> <p>Solid Conductive Polymer &amp; Liquid Electrolyte</p> <p>Yes</p> <p>Very low ESR at high frequency</p> <p>Even more stable than liquid type</p> <p>Lower leakage current than Solid Conductive Polymer Type</p> <p>Automotive  AEC-Q200 qualified</p>

## COMPARISON OF ELECTROLYTIC CAPACITOR TECHNOLOGIES

Characteristics	Aluminum Electrolytic Capacitor	Solid Conductive Polymer Capacitor	Hybrid Conductive Polymer Capacitor
ESR at High Frequency	● (120 ~ 1 000 mΩ)	++ (7 ~ 15 mΩ)	+ (20 ~ 30 mΩ)
Leakage Current · I <sub>LEAK</sub>	++ (0.01·C <sub>R</sub> ·V <sub>R</sub> )	● (0.2·C <sub>R</sub> ·V <sub>R</sub> )	++ (0.01·C <sub>R</sub> ·V <sub>R</sub> )
Ripple Current · I <sub>R</sub>	● (~ 600 mA)	++ (2 000 ~ 7 000 mA)	+ (2 000 ~ 3 000 mA)
Rated Voltage · V <sub>R</sub>	++ (~ 700 V)	● (~ 100 V)	+ (~ 400 V)
Operating Temperature Characteristics	+ (-40 ~ + 125 °C)	+ (-55 ~ + 125 °C)	++ (-55 ~ + 150 °C)
Low Temperature Characteristics	● (-40 ~ + 125 °C)	++ (-55 ~ + 125 °C)	+ (-55 ~ + 150 °C)
Lifetime	● (105 °C / 3 000h)	++ (105 °C / 5 000h)	++ (105 °C / 10 000h)
Failure Mode	+ Open	● Short	+ Open

++ ... best performance

+ ... well performance

● ... basic performance

## CERTIFICATION ACCORDING TO INTERNATIONAL STANDARDS

Quality, the environment, safety, and conservation of resources are the focus of our daily added value.

To meet the high requirements in the electronics industry, CapXon, as a global company, is certified according to the highest international standards. In this way, we ensure that all procedures and processes in our company are always structured and continuously optimized based on the valid and defined requirements.

CapXon is certified according to the following standards:



ISO 9001



ISO 14001



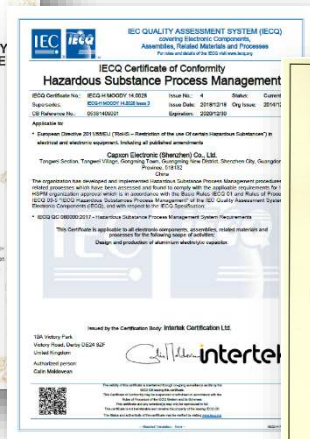
IATF 16949



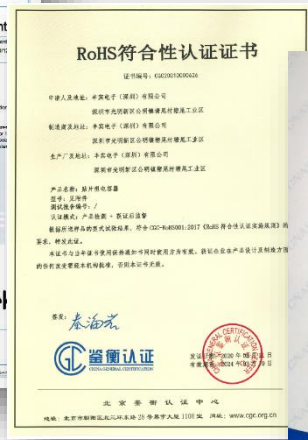
ISO 50001



OHSAS 18001



OC 080000



China RoHS



ISO/IEC 17025



### SMART PRODUCTION

Since 1980 CapXon focuses on research, development and manufacturing of Aluminum Electrolytic Capacitors and is a leading brand with its own capacitor production in Shenzhen and its own foil production in Yichang, Qinghai and Baotou. 40 years of experience give us a deep understanding of foil material, high performance electrolytes, advance lead wire technology, conductive polymer and electrochemical systems.

Precision equipment ensures the quality of key components



Capacitor production for all core technologies as Aluminium Electrolytic, Solid Conductive and Hybrid Conductive Polymer capacitors with R&D and Quality headquarters in Shenzhen

Development of our own production process and machinery with the highest grade of automated production equipment and software



### ADVANCED TECHNOLOGY

Only with the best production equipment and well-trained staff is it possible to maintain and expand the market position. Every year CapXon invests very large sums in machine, software and the education for our more than 2500 employees. To recognize deviation immediately during the production process, CapXon uses various precise inspection equipment.

All productions are qualified with strict specifications and every operation is monitored and measured at the machine



The products and the production meet the requirements of all industries even Medical or Automotive

Automated and full controlled manufacturing process





**NEW RESEARCH**

Highly roughened and formed anode foils are the heart of every Aluminum Electrolytic Capacitor. CapXon has been conducting intensive research and development for decades to bring low-voltage and high-voltage films into new spheres and at the same time to optimize processability and durability. The electrolytes and conductive polymers used on the cathode side are subject to a continuous improvement process, taking commercial and technical aspects into account.

Electrolyte and polymer development to achieve maximum product reliability and a long life



High grade etching foil, high grade forming foil through consistent further development to the limit of what is technically feasible

Well-equipped ISO/IEC 17025: 2005 accredited laboratories for research, analysis and testing



## COMPONENT RELIABILITY DATA

In this section, the main parameters for predictive reliability and availability calculations are explained and in which way CapXon can provide you with such data.

### FAILURE RATE $\lambda$

The failure rate  $\lambda$  describes the frequency which components possibly fail. The failure rate describes how many defects can be expected, if you run the application in operation for a certain time.

The failure rate can be calculated as following:

$$(1) \quad \lambda = \frac{n}{N \cdot t}$$

- n ... Number of defect components
- N ... Number of tested components
- t ... Amount of operating hours

### FAILURE CRITERIA

Capacitors will show certain wear-out phenomenon's by aging and so as times goes by the capacitors can possibly change their electrical performance.

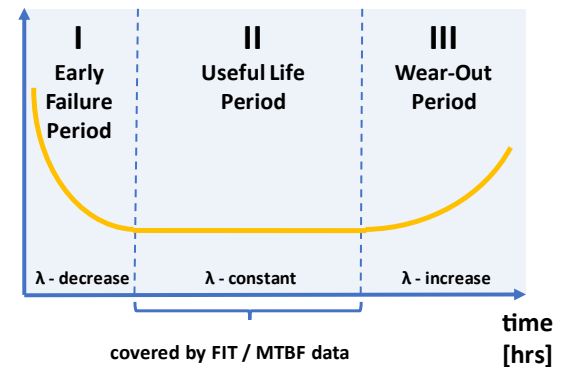
**As soon as the component is no longer fulfilling their electrical spec, stated features or with customer agreed parameters, the status of capacitor is seen as in failure mode or defect. This does not necessarily mean that the application will fail. An essential influence are the design and dimensioning by customer, which lead to major impact on possible failure modes and fail criteria for the application itself.**

All given data by CapXon is just concerning the failure mode cases of the single component and is not representing the complexity of complete applications, assembled systems nor full electronic PCB boards.

### BATHTUB CURVE

It's a widely used model within the reliability engineering to describe the expected failure rates over the whole application lifetime / product life cycle.

$\lambda$  - Failure Rate



*Bathtub curve*

**The Bathtub Curve states the failure rate behaviour within the three different product life cycle stages. These are the Early Failure Period, the Useful Life Period and the Wear Out Period.**

With production control, monitoring and quality assurance, it is possible to reduce the early failures to a best possible minimum.

Failures within the Useful Life Period, which are described as FIT or MTBF value, are defined as events of coincidence and are not representing any systematic or epidemic failures.

### FIT – FAILURES IN TIME

FIT - Failures In Time is the common way to describe the expected failure rate for electronics.

**The FIT values describe certain failure rate within the useful life period and provides the basis for calculations, assumptions and extrapolation of reliability and availability to gather the understanding for expected failures / defects. These calculated figures are used to decide whether the component is a proper choice for the desired use case. Additionally, it need to be clarified whether redundancies are necessary and which redundancies are needed to fulfil the desired mission profile of an application.**

The unit FIT defines the expected amount of failures per application hour.

$$(2) \quad 1 \text{ FIT} = \frac{10^{-9}}{h} = \frac{10^{-9} \text{ failures}}{\text{per operating hour}}$$

So as higher the stated FIT value is, as higher the statistical chance of defect is.

Please find the following example of a failure rate test determined by a useful life test:

- Number of failures  $n = 2$
- Number of tested components  $N = 10\ 000$
- Operating hours  $t = 20\ 000\ h$

$$(3) \quad \lambda = \frac{n}{N \cdot t} = \frac{2}{10\ 000 \cdot 20\ 000\ h} = 10\ FIT$$

$$(4) \quad 10\ FIT = \frac{10^{-8}}{h} = \frac{0.001\%}{1\ 000\ h}$$

## MTBF - MEANTIME BETWEEN FAILURES

It's the predicted elapsed time between inherent failures of an electronic system during normal operation. The MTBF can be calculated as arithmetic mean / average time between failures of a system.

Assuming a constant failure rate, the MTBF can be easily calculated by reciprocal value of the Failure Rate  $\lambda$ :

$$(5) \quad MTBF = \frac{1}{\lambda}$$

MTBF is just a different way to describe the failure rate and can be easily converted to FIT and vice versa:

$$(6) \quad MTBF = \frac{10^9\ h}{FIT} = \frac{114\ 000\ years}{FIT}$$

$$(7) \quad FIT = \frac{10^9\ h}{MTBF} = \frac{114\ 000\ years}{MTBF}$$

The **MTBF** values are just covering the useful life period (flat middle section) of the bathtub curve. Because of this, a FIT or MTBF value can't be extrapolated to estimate the service lifetime for a component. FIT or MTBF values doesn't cover the higher failure rates of the wear-out period, where the expected failure rate would be higher due to occurring wear-out phenomenon's.

## LIFETIME TESTS

Due to the fact that all electrolytic capacitors show aging behaviour and a possible drift of electrical parameters over usage time, lifetime tests are performed by manufacturers to describe the related reliability and performance of a certain capacitor. Different product series as well as the single product itself can provide very different lifetime performance. So, these test results are given to select the proper product in relation to the applied stress profile of application to gain the desired application performance within the whole product life cycle.

**There are various names (e.g. Endurance, Load Life, Useful Life, Operational Life, Life Expectancy, Shelf Life, ...) and different lifetime tests that are existing within the industry. Please kindly check the specific test specification and given data for the capacitor before design-in.**

Sadly, there is no standardized naming and test criteria existing, given by any international accepted standard committee for all the lifetime tests, which are applied to electrolytic capacitors. Customers need to compare competitor products carefully with each other to see if test specifications are similar or different.

Please see particular datasheets for the specific test results and criteria of an individual product of CapXon.

Again, please note that the criteria of failure are given by the test specification limits of the dedicated lifetime test and as soon as a component is not fulfilling these given limits, it is rated as a failure. So, failure does not necessarily mean defect or breakdown of application. It is just describing that the drift of electrical performance is bigger than the checked limits of the particular test. It doesn't matter whether the measured C value is lower as the allowed test limit or the component is in a failure mode of open circuit, both cases are treated the same as a failure. Design and dimensioning of application will arrange how much drift of electrical parameters can be accepted for the individual capacitor. For example, when the rate of capacitance change is becoming critical within the application is defined by customer design. The lifetime tests are in place to provide a common and industry-wide comparable performance index of the capacitors.

**As manufacturer, we can state and check how fast a drift of capacitance and further parameters will happen. Dimensioning within application design will set how long an error-free operation is possible. A proper dimensioning can enlarge the acceptable drift and so the lifetime performance. But be aware, if it is not done properly or component is overstressed, it also can shorten the expected lifetime performance. Please be aware to check dimensioning and drift estimation to assure your product performance for the desired lifetime.** For support with lifetime estimations and dimensioning, we are pleased to support you and feel free to get in touch with our technical support.

In the following section CapXon's lifetime tests, which are performed with our products, are described in detail.

## ENDURANCE

The Endurance test of the product checks the performance of its electrical parameters, such as capacitance change, leakage current and dissipation factor on their behaviour over time at a predetermined test setup of electrical stress and ambient condition.

Depending on the product series, the Endurance test is performed according to one of the settings below:

### Setting 1 - applying Endurance test:

- max. Temperature
- $V_R$  - Rated Voltage

### Setting 2 - applying Endurance test:

- max. Temperature
- $V_R$  - Rated Voltage
- $I_R$  - Rated Ripple

Setting 1 is in accordance to the IEC 60364-4 / JIS 51001-4 test criteria and Setting 2 is enlarging the electrical stress setup with additional appliance of  $I_R$ , to get a more representative result in comparison to possible real-life application stress.

The Endurance test is performed within product qualification at the stage of internal product validation and is repeated periodically for product requalification.

## USEFUL LIFE

To get more representative understanding of lifetime performance for typical capacitor use, the useful life test represents such criteria.

The applied electrical stress is like the Endurance test - Setting 2. The test specification limits are wider as the endurance test specification, but as described the applied electrical stress stays similar. So, a larger acceptable drift of electrical parameters results in a larger expected lifetime. This represents the operational frame which is set by customer at dimensioning the capacitor specification for their application and the possible borders of an error-free operation.

Also, we state a FIT value related to the useful life test. These failure rate describes the deviation / possibility of occurrence of failures within the useful life period when the settings of useful life test are applied. This is related to the middle section of the bathtub curve the so-called useful life period (see above page 12 - Bathtub Curve of Product Reliability).

In the datasheet you will find the following phrase:

Failure Rate (during useful Life): 1%/1 000h with a confidence level of 60%. As a result, this is like a 10 000 FIT:

$$\lambda = \frac{1\%}{h} = 10\,000 \text{ FIT} = 10\,000 \text{ failures} * 10^{-9h}$$

### Example:

If you have 8 000 components running in applications for 5 000 hours with the test conditions applied like the useful life test, you can estimate the number of components that show a higher drift as given by the useful life test spec borders as follows:

- Number of components  $N = 8\,000$
- Operating hours  $t = 5\,000 \text{ h}$

$$\lambda = \frac{n}{N * t}$$

$$n = \lambda * N * t = \frac{1\%}{1\,000h} * 8\,000 * 5\,000h = 400$$

This means that when there are 8 000 pcs in operation for 5 000 hours at the maximum possible operating conditions (max. temp.,  $V_R$  &  $I_R$  similar to useful life test criteria) an amount of 400 products (with a confidence level of 60%) can be expected to show a higher drift as given in the test spec.

## SHELF LIFE

The shelf life test simulates the aging of the capacitor, if it is just stressed with ambient temperature without any electrical load. The shelf life is not defining the possible storage time of the capacitor but just to describe the aging situation before mounting / PCB assembly.

The Shelf Life test criteria shall be satisfied, if the capacitor was restored to 20°C and following a conditioning by voltage treatment in accordance with 4.1 of JIS 5101-4 was applied, before measuring the capacitor.

**LIFETIME TEST EXAMPLES**

**Example 1** - Useful Life, Endurance (Setting 1) and Shelf life tests of SMD types – HV Series:

Lifetime Test		
Endurance 105°C (V <sub>a</sub> applied)	Test	2000 hours
	ΔC/C	≤ ±30% of initial measured value
	tanδ	≤ 300% of initial specified value
	I <sub>leak</sub>	≤ the initial specified value
Shelf Life 105°C (None)	Test	1000 hours
	ΔC/C	≤ ±30% of initial measured value
	tanδ	≤ 300% of initial specified value
	I <sub>leak</sub>	≤ the initial specified value
Resistance to Soldering Heat	The capacitors shall be kept on a hot plate maintained at 250°C for 30 seconds. After removing from the hot plate and restored at room temperature, they meet the characteristic requirements listed below	
	ΔC/C	Within ±10% of initial value
	tanδ	Less than specified value
	I <sub>leak</sub>	Less than specified value

**Example 2** - of Useful Life, Endurance (Setting 2) and Shelf life tests of Radial types – GF Series

Lifetime Test			
Endurance 105°C (V <sub>a</sub> & I <sub>a</sub> applied)	Test	2000 hours	ø D 5 ~ 6.3 mm
		3000 hours	ø D 8 mm
		5000 hours	ø D ≥ 10 mm
	ΔC/C	≤ ±20% of initial measured value	
	tanδ	≤ 200% of initial specified value	
Shelf Life 105°C (None)	Test	1000 hours	
		ΔC/C ≤ ±20% of initial measured value	
		tanδ ≤ 200% of initial specified value	
		I <sub>leak</sub> ≤ the initial specified value	

**Example 3** - of Useful Life, Endurance (Setting 2) and Shelf life tests of Snap In types – HU Series:

Lifetime Test		V <sub>a</sub> ≤ 100V	V <sub>a</sub> > 100V
Useful Life 105°C (V <sub>a</sub> & I <sub>a</sub> applied)	Test	5000 hours	8000 hours
	ΔC/C	≤ ±30% of initial measured value	≤ ±20% of initial measured value
	tanδ	≤ 300% of initial specified value	≤ 200% of initial specified value
	I <sub>leak</sub>	≤ the initial specified value	≤ the initial specified value
Endurance 105°C (V <sub>a</sub> applied)	Test	3000 hours	
	ΔC/C	≤ ±15% of initial measured value	≤ ±10% of initial measured value
	tanδ	≤ 130% of initial specified value	≤ 130% of initial specified value
	I <sub>leak</sub>	≤ the initial specified value	≤ the initial specified value
Shelf Life 105°C (None)	Test	1000 hours	
		ΔC/C ≤ ±15% of initial measured value	
		tanδ ≤ 130% of initial specified value	
		I <sub>leak</sub> ≤ the initial specified value	

**Example 4** - Useful Life, Endurance (Setting 2) and Shelf life tests of Screw types – RK Series:

Lifetime Test			
Useful Life 105°C (V <sub>a</sub> & I <sub>a</sub> applied)	Test	4000 hours	
	ΔC/C	≤ ±45% of initial measured value	
	tanδ	≤ 300% of initial specified value	
	I <sub>leak</sub>	≤ the initial specified value	
Endurance 105°C (V <sub>a</sub> applied)	Test	2000 hours	
	ΔC/C	≤ ±15% of initial measured value	
	tanδ	≤ 130% of initial specified value	
	I <sub>leak</sub>	≤ the initial specified value	
Shelf Life 105°C (None)	Test	1000 hours	
		ΔC/C ≤ ±15% of initial measured value	
		tanδ ≤ 130% of initial specified value	
		I <sub>leak</sub> ≤ the initial specified value	

**TELCORDIA SR-332**

This industry-wide accepted standard provides data and tools for reliability predictions of components, devices or full hardware units of electronic equipment. Telcordia (for-

merly Bellcore). With the given figures and data, it is possible to assure system availability and to gather the desired system reliability.

**FIT & MTBF DATA OF CAPXON PRODUCTS**

CapXon provides FIT & MTBF values based on Telcordia SR332 standard for all components. From our perspective, it provides more reliable prediction because it is more specific and detailed than MIL-217 or Siemens SN 29500.

Please find the FIT values for CapXon components and application-based reliability prediction calculations on the following page.

The table of SMD / RADIAL / Snap-In is covering all Electrolytic Technologies – Liquid, Solid and Hybrid Electrolytic Capacitors in SMD & Radial.

The table of Screw capacitors is just concerning Liquid Aluminum Electrolytic Capacitors.



Mounting Type	SMD / Radial / Snap-In					
	100%		75%		50%	
Electrical Stress						
Operating Temp. [°C]	$\lambda$ [FIT]	$\sigma$ [FIT]	$\lambda$ [FIT]	$\sigma$ [FIT]	$\lambda$ [FIT]	$\sigma$ [FIT]
≤ 30	1,19	0,28	0,65	0,15	0,36	0,08
35	1,52	0,35	0,84	0,19	0,46	0,11
40	1,94	0,45	1,06	0,25	0,58	0,14
45	2,45	0,57	1,34	0,31	0,74	0,17
50	3,07	0,71	1,68	0,39	0,92	0,22
55	3,82	0,89	2,10	0,49	1,15	0,27
60	4,72	1,10	2,59	0,60	1,42	0,33
65	5,80	1,35	3,19	0,74	1,75	0,41
70	7,09	1,65	3,89	0,91	2,14	0,50
75	8,61	2,01	4,73	1,10	2,59	0,60
80	10,40	2,42	5,71	1,33	3,13	0,73
85	12,50	2,91	6,86	1,60	3,76	0,88
90	14,94	3,48	8,20	1,91	4,50	1,05
95	17,78	4,14	9,76	2,27	5,35	1,25
100	21,05	4,90	11,55	2,69	6,34	1,48
105	24,82	5,78	13,62	3,17	7,47	1,74
110	29,13	6,78	15,99	3,72	8,77	2,04
115	34,05	7,93	18,69	4,35	10,26	2,39
120	39,65	9,23	21,76	5,07	11,94	2,78
125	45,99	10,71	25,24	5,88	13,85	3,23
130	53,15	12,38	29,17	6,79	16,01	3,73
135	61,20	14,25	33,59	7,82	18,43	4,29
140	70,24	16,36	38,55	8,98	21,15	4,93
145	80,34	18,71	44,09	10,27	24,20	5,64
150	91,60	21,33	50,27	11,71	27,59	6,43

Table 1: FIT values for SMD, Radial, Snap-In

**Remark:** Above values are only valid within the max. specified temperature range of the particular component. All given FIT data is meant for lifetime predictions only and is not representing any warranty.

For particular products (e.g. screw capacitors) within the datasheet, further FIT or MTBF data is added and in such a case, this substitutes the general information stated above.

Mounting Type	Screw terminal					
	100%		75%		50%	
Electrical Stress						
Operating Temp. [°C]	$\lambda$ [FIT]	$\sigma$ [FIT]	$\lambda$ [FIT]	$\sigma$ [FIT]	$\lambda$ [FIT]	$\sigma$ [FIT]
≤ 30	34,20	24,43	18,77	13,40	10,30	7,36
35	43,85	31,32	24,06	17,19	13,21	9,43
40	55,78	39,84	30,61	21,87	16,80	12,00
45	70,42	50,30	38,65	27,61	21,21	15,15
50	88,27	63,05	48,44	34,60	26,59	18,99
55	109,88	78,48	60,30	43,07	33,09	23,64
60	135,88	97,06	74,57	53,27	40,93	29,23
65	166,99	119,28	91,65	65,46	50,30	35,93
70	203,99	145,71	111,95	79,97	61,44	43,89
75	247,76	176,97	135,97	97,12	74,62	53,30
80	299,26	213,76	164,24	117,31	90,14	64,38
85	359,57	256,84	197,34	140,96	108,30	77,36
90	429,86	307,04	235,91	168,51	129,47	92,48
95	511,39	365,28	280,66	200,47	154,03	110,02
100	605,57	432,55	332,34	237,39	182,39	130,28
105	713,89	509,92	391,79	279,85	215,02	153,59

Table 2: FIT values for Screw types

$\lambda$  - Mean Component Failure Rate

$\sigma$  - Standard Deviation of Component Failure Rate

## CALCULATION OF FIT VALUE FOR APPLICATION CASE

By using the given Telcordia SR-332 figures and by the assumption that the failure rate follows a gamma distribution, the FIT value can be calculated with given mean  $\lambda$  and standard deviation  $\sigma$  (see section tables in section 8.8) and desired UCL - Upper Confidence Level as follows:

$$\text{shape } \kappa = \left( \frac{\lambda}{\sigma} \right)^2$$

$$\text{scale } \theta = \frac{\sigma^2}{\lambda}$$

The desired FIT value for the application case is the P% quantile of the gamma distribution and it can be calculated by the inverse cumulative gamma distribution with the shape  $\kappa$  and scale  $\theta$  parameters as follows:

$$\lambda_{P\%UCL} = G^{-1}(P/100; \kappa; \theta)$$

If the shape  $\kappa$  parameter is >100 the FIT can also be calculated by using the P% quantile of the normal distribution, by inverse cumulative distribution of normal distribution with mean  $\lambda$  and standard deviation  $\sigma$ :

$$\lambda_{P\%UCL} = N^{-1}(P/100; \lambda; \sigma)$$

Customer need to define which UCL is desired for the reliability prediction for their application case (typical values for UCL are e.g. 60%,90%, 95%, 99%).

## CALCULATION EXAMPLE

### Example 1:

GF Series – Radial type  
Aluminum Electrolytic Capacitor

@ 70°C and 75% electrical stress  
Upper Confidence Level (UCL) = 90%

Values according to table 1 at page 16:

$\lambda = 3.89$  FIT /  $\sigma = 0.91$  FIT

$$\text{shape } \kappa = \left( \frac{3.89}{0.91} \right)^2 = 18.27$$

$$\text{scale } \theta = \frac{0.91^2}{3.89} = 0.21$$

$$\lambda_{90\%UCL} = G^{-1}(90/100; 18.27; 0.21) = 5.02 \text{ FIT}$$

In Microsoft Excel you can solve this with the following formula:

International / American Excel Version:  
=GAMMAINV(0.9,18.27,0.21)

European Excel Version:  
=GAMMAINV(0,9;18,27;0,21)

### Example 2:

RG Series - Screw type  
Aluminum Electrolytic Capacitor

@ 60°C and 75% electrical stress  
Upper Confidence Level (UCL) = 90%

Values according to table 2 at page 16:

$\lambda = 74.57$  FIT /  $\sigma = 53,27$  FIT

$$\text{shape } \kappa = \left( \frac{74.57}{53.27} \right)^2 = 2.01$$

$$\text{scale } \theta = \frac{0.91^2}{3.89} = 38.05 \text{ FIT}$$

$$\lambda_{90\%UCL} = G^{-1}(90/100; 2.01; 38.05) = 148.57 \text{ FIT}$$

In Microsoft Excel you can solve this with the following formula:

International / American Excel Version:  
=GAMMAINV(0.9,2.01,38.05)

European Excel Version:  
=GAMMAINV(0,9;2,01;38,05)

## QUALITY MANAGEMENT SYSTEM

We are committed and living the principle of **QUALITY FIRST - to offer highly satisfying products and service to the customer**. This global aim is shared by the CapXon quality and environmental management system and part of our business philosophy:

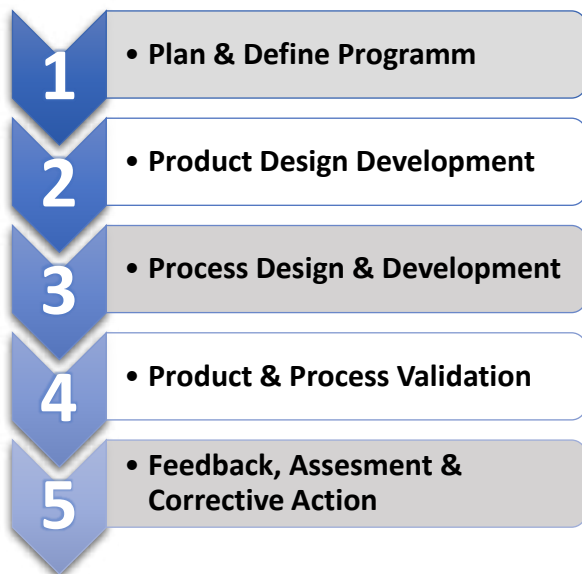
## QUALITY MANAGEMENT SYSTEM CERTIFICATION

In accordance with our quality commitment, CapXon quality management is certified by **ISO 9001** and **IATF 16949**. The certification covers our production plants as well as our sales organization. This standard is applied throughout the company and is used to implement, monitor and to proceed the CapXon quality policy in all process steps.

## PRODUCT AND PROCESS QUALITY

Our product and process development follows the sequence and phases of **APQP – Advance Product Quality Planning**:

### 5 Phases of APQP



Quality tools such quality tools, including **5S, PDCA, FMEA, (DFMEA & PFMEA), MSA, APQP, PPAP, SPC** and others, are in place to minimize risks, provide constant monitoring and ensure continuous improvements in conjunction with regular internal audits and QM reviews.

## QUALITY ASSURANCE

For our sample checks, we refer to **AQL - Acceptable Quality Level** figures, which are based on a random sampling

plan in accordance with **MIL-STD-1916**. Referring to instructions of this standard, a delivered lot will be accepted with a probability of 90%, if the percentage of non-conformance does not exceed the stated AQL figure. As a general internal target, the percentage of non-conformance in deliveries from CapXon is significantly below the AQL figure. The acceptance value we apply to non-conform components is  $c=0$ .

## INCOMING GOODS INSPECTION BY CUSTOMER

We recommend applying planned random sampling checks in accordance with MIL-STD-1916, is compliant with MIL STD 105 D and IEC 60410, for incoming goods inspection. The test methods, which shall be applied, are laid down in the relevant standards.

## ENVIRONMENTAL MANAGEMENT

### Environmental Policy

CapXon defines internally the following environmental protection principles:

- comply with the given law & regulations
- observe and act to reduce pollution
- produce cleanly
- reduce the consumption and save resources
- cut down usage of toxic substances
- make continuous improvements
- protect the environment

## ENVIRONMENTAL MANAGEMENT SYSTEM CERTIFICATION

CapXon environmental management system is certified in accordance with ISO 14001 and is applied throughout the whole company as well as CapXon's environmental policy is implemented.

## ENVIRONMENTAL HAZARDOUS SUBSTANCES FREE MANAGEMENT SYSTEM

To show our commitment to protect the environment and people, CapXon drives a sustainable effort to produce environment-friendly products.

IECQ QC 080000 HSPM - Hazardous Substance Process Management, which is based on the quality management system of ISO 9001.

The CapXon QC080000 based HSF management system is company-wide applied for implementing the CapXon environmental Hazardous Substances management and that CapXon products effectively in the management of hazardous substances.

## ENERGY MANAGEMENT SYSTEM

CapXon establishes comprehensive energy use management in accordance with the requirements of ISO 50001 Energy Management System in order to meet the social responsibility of low carbon environmental protection and efficiency

## CERTIFICATION IN ACCORDANCE TO ISO 14001, ISO 50001, QC 080000

The CapXon Group operates an environmental management system that conforms to the requirements of **ISO 14001** and is mandatory for all plants. The CapXon Group operates an Energy management system that conforms to the requirements of **ISO 50001** and is mandatory for all plants. The CapXon Group operates an environmental **Hazardous Substances Free management system** that conforms to the requirements of QC 080000 and is mandatory for all plants. The company certificate is posted on the CapXon internet: ([www.capxongroup.com](http://www.capxongroup.com)).

## RoHS COMPLIANCE

The abbreviation **RoHS** is usually called **Restriction of Hazardous Substances**, the full term is the short term for the **Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment** and is referring to the EU directive 2011/65/EU. The RoHS 2 – 2011/65/Eu substituted the former RoHS 1- 2002/95/EC.

The aim of RoHS is to banish Hazardous Substances of electronic waste, which can harm the environment and others. Based on this regulation, we as component manufacturer, need to design, observe and control that such hazardous materials are fully avoided and reduced to the max. Moreover, it's possible to replace them by adequate non concerned materials within the given limitations .

For all by RoHS scoped materials (excluding exempt products) the maximum permitted concentrations are:

**all concerned materials** (except Cd)

- 0,1% / 1000ppm

**Cadmium -Cd:**

- 0,01% or 100ppm

These limitations for the restricted materials focus on each homogeneous material within the product. So, the limitations are concerning each individual / single substance or part, which can be separated mechanically (e.g. aluminum can, rubber sealant) and are not apply to the weight of the whole component itself.

Last update of RoHS was Directive (EU) 2015/863, which was published on 2015-03-31 and implemented by 2019-07-22. According to this directive, the following ten substances are restricted:

- **Pb** - Lead
- **Hg**- Mercury
- **Cd** - Cadmium
- **Cr<sup>+6</sup>** - Hexavalent chromium
- **PBB** - Polybrominated biphenyls
- **PBDE** - Polybrominated diphenyl ether
- **DEHP** - Bis (2-ethylhexyl) phthalate
- **BBP** - Butyl benzyl phthalate
- **DBP** - Dibutyl phthalate
- **DIBP** - Diisobutyl phthalate

By the update DEHP, BBP, DBP and DIBP were added to the list of hazardous substances.

Since 2011 RoHS compliance is mandatory to be able to get CE approval.

## C-RoHS / CHINA RoHS COMPLIANCE

The common speech so called China RoHS means the conformance to **SJ/T 11363-2006** for electrical components and assemblies and is fully called **Administrative Measure on the Control of Pollution Caused by Electronic Information Products**.

In China RoHS, the following substances are banned because they are considered as environmentally hazardous:

- **Pb** - Lead
- **Hg**- Mercury
- **Cd** - Cadmium
- **Cr<sup>+6</sup>** - Hexavalent chromium
- **PBB** - Polybrominated biphenyls
- **PBDE** - Polybrominated diphenyl ether

Since December 2012, CapXon has provided China RoHS certification for our products and certifications.

## SONY GP CERTIFICATION

Since Nov 2011, CapXon has been certified as Green Partner by SONY and we are running an environmental management system that continuously meet the requirements of the SONY Green Partner Program and we are working in

accordance with the Sony environmental quality assurance. The Certificate is listed by **SONY GP Certificate No.: FC012746**

## REACH CERTIFICATION

REACH is the abbreviation for Registration, Evaluation, Authorization of Chemicals and by Regulation (EC) No 1907 /2006 it is

So each manufacturer or importer, who is shipping goods to the European Union, need to declare and be compliant according to REACH, if within the shipped goods a substance, which is listed out SVHC-List (Substances of Very High Concern) is included and overall a total mass of bigger a ton per year is imported.

CapXon is working in accordance with REACH requirements and certification is available for our products.

## ROHS & REACH MARKING

Within our datasheets, we mark the RoHS and REACH compliance with our "RoHS & REACH compliant"- marking, please see marking below for reference:



## HALOGEN FREE (HF)

The Halogen Free requirements are based on customer and environmental regulations on management and control requirements of halogens, such as the **European Directive 2002/95/EC, IEC 61249-2-21, Montreal Protocol on Substances that Deplete the Ozone Layer and Controls the Stockholm joint pledge about durable organic pollutant.**

Concerned by the halogen-free initiative are elements like:

- **Fluorine**
- **Chlorine**
- **Bromine**
- **Iodine**
- **Astatine**

In case of fire, these elements can release toxic fumes, which could harm humans and can also cause corrosion of metals.

CapXon is using halogen-free materials for all our electrolytic capacitors. Since 31<sup>st</sup> of Oct 2009 all products meet the halogen-free requirements.

## BANNED AND ENVIRONMENTAL HAZARDOUS SUBSTANCES IN COMPONENTS

As a manufacturer of passive components, we develop our products focussing on sustainability. In order to guarantee a standardized procedure within CapXon, a mandatory avoidance list of Environmental Hazardous Substances with special interest is part of our environmental management system. The planning and development instructions include regulations and guidelines that aim to identify environmental aspects and to optimize products as well as processes with respect to material usage and environmental compliance to design them with sparing use of resources and to substitute hazardous substances as far as possible.

The environmental officer provides support in the assessment of the environmental impacts of our development projects and as part of our environmental management these aspects are checked and recorded in internal design reviews.



## AEC-Q200 & AUTOMOTIVE REQUIREMENTS

To serve the high standards of automotive applications, CapXon provides AEC-Q200 versions for many of their product series.

If AEC-Q200 version is available, the product series or single component is marked with the following marking on the datasheet:



Marking of components with references in reliability testing to AEC-Q200

The AEC-Q200 versions are different in case of reliability testing, production monitoring and available material declaration. For details, please see the table below:

	Standard Version	AEC-Q200 Version
<b>Reliability Testing</b>		
Tests according to internal specification	✓	✓
Tests according to AEC-Q200 applied test range related to product	✗	✓
<b>Production Monitoring</b>		
Production & documentation in accordance with ISO 9001	✓	✓
Production & documentation in accordance with IATF 16949	✗	✓
<b>Compliance and Declarations</b>		
RoHS & REACH compliance	✓	✓
IMDS entry available (on request)	✗	✓
PPAP (on request)	✗	✓

Table 9: Differences between standard and AEC-Q200 components

### AEC-Q200

The AEC-Q200 was issued as a global reliability test standard by the AEC - Automotive Electronics Council. The overall aim of this standard is to define the minimum stress test driven qualification requirements and references of test conditions for qualification of passive components.

AEC-Q200 qualified components are highly qualified products for critical surroundings and can withstand the harsh and challenging usage conditions of an automotive environment.

For Aluminum Electrolytic Capacitors, concerning all technologies of Liquid Aluminum Electrolytic, Solid and hybrid types, the AEC-Q200 claims a test plan of 27 different reliability tests (e.g.: Temperature Cycling, Vibration, Biased Humidity, Surge Voltage, ...) with a sample size of about 77 pcs. and a maximum test duration of particular test of about 1000 hours.

By AEC-Q200 at least the temperature range of -40°C to 105°C need to be tested and applicable for Aluminum Electrolytic Capacitors, if not, differently specified by datasheet.

In case of AEC-Q200 version, reliability testing is performed for the dedicated components in addition to CapXon's internal qualification setup as well as additional agreed requirements between CapXon and their customers.

### PPAP

PPAP – Production Part Approval Process is a documentation to assure quality of supplier and their production process within the automotive supply chain.

The PPAP covers and ensure the following aspects:

- Manufacturability and meeting all given quality requirements
- Design records and specification requirements
- Manufacturing process can consistently meet all component requirements

For our AEC-Q200 components, we provide PPAP Level 3 on request, which is providing product samples as well as the complete supporting data.

### IMDS

The IMDS – International Material Database System contains information about the used materials within the build-up of the component.

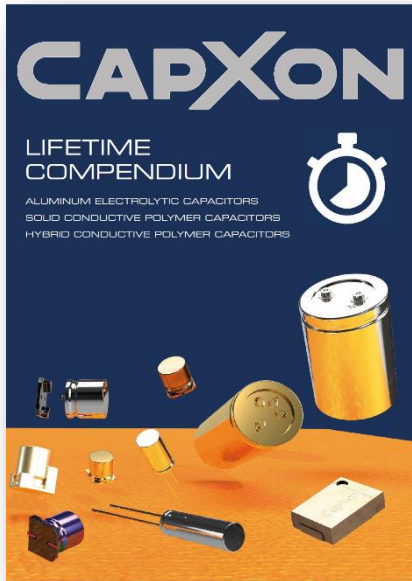
With IMDS, it is possible to monitor and control hazardous substances and prohibited substances down to the single component. IMDS is mainly used to fulfil various reporting requirements of automotive manufacturers.

For all our AEC-Q200 components and in case of an automotive use case, we provide IMDS entries on request. For further information, visit our website <http://www.capxongroup.com/en/> or contact CapXon directly.

### LIFETIME ESTIMATION • LIFETIME COMPENDIUM

The accurate estimation of the lifetime of components is one of the elementary considerations of any electronic assembly. If electrolytic capacitors are not properly designed for the application environment and load, they will inevitably lead to a disproportionate change in their electrical performance or, in the worst case, failure of the capacitor. CapXon's lifetime compendium helps users to calculate and estimate the expected lifetime of **Aluminum Electrolytic Capacitors**.

The lifetime compendium is available to download from our website [http://www.capxongroup.com/files/Lifetime%20Compendium\\_EN.pdf](http://www.capxongroup.com/files/Lifetime%20Compendium_EN.pdf)



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### Technical Background

**LIFETIME COMPENDIUM**

structure of the component. To explain and calculate the additional heating, the relationship of the thermal resistance, or the ability of electronic components to dissipate heat.

Like all electronic components, electrolytic capacitors are not ideal components, but have losses that give off in the form of heat under load. For all electronic components, the cooler the component, the longer the expected lifetime.

For e-caps the ohmic losses are grouped under the term "ESR" for Equivalent Series Resistance. These include the ohmic losses resulting from the terminals of the capacitor, the contact connections of the terminals, the contact resistance of the electrode contacting and the dielectric losses, also referred to as a dissipation factor tan δ.

(1)  $P_{\Sigma} = I_{\Sigma}^2 \cdot ESR$

WITH

- $P_{\Sigma}$  Internal power losses [W]
- $I_{\Sigma}$  Ripple current flowing in the capacitor [A-RMS]
- $ESR$  Equivalent series resistance [Ω]

(2)  $P_T = \frac{P_{\Sigma}}{A} \cdot \beta$

WITH

- $P_T$  Thermal power [W]
- $\Delta T_c$  Core temperature rise (°C) by internal heating due to the application current
- $R_{th}$  Thermal resistance of the electrolytic capacitor [K/W]
- $\beta$  Radiation coefficient [W/(cm²·K)]
- $A$  Surface of the capacitor [cm²]

(4)  $\Delta T_c = \frac{P_T}{\beta \cdot A}$

**DETERMINATION OF THE CORE TEMPERATURE INCREASE  $\Delta T_c$ .**

To calculate the lifetime, the determination of  $\Delta T_c$ , core temperature rise due to the application current in the capacitor, is necessary.

This can be done in different ways:

- Temperature measurement of core temperature  $T_c$

By this very precise method, a thermocouple (usually a K sensor) is inserted into the capacitor, which is possible only during the production of the e-cap, and determines the core temperature  $T_c$  over time. The ambient temperature  $T_a$  is measured secondarily.

Fig. 2: Thermal output of the e-cap via convection, radiation and dissipation

If the thermal power  $P_T$  is now equal to the internal power losses  $P_{\Sigma}$ , the temperature increase caused by the alternating current flowing in the capacitor and in which heat generation and dissipation are in equilibrium can be determined.

Fig. 4: Snap-in capacitor with integrated thermocouple for measuring the core temperature

The integration of a temperature sensor is not that simple and only possible with electrolytic capacitors with some.

### Calculation base

**LIFETIME COMPENDIUM**

For all CapXon high-performance series ≤ 200V, see table 3

(8)  $I_{\Sigma} = I_{\Delta} + K_{Temp} \cdot K_{Apply} = I_{\Delta} \cdot 2 \cdot \frac{100 - T_c}{100 - T_a}$

WITH

- $I_{\Sigma}$  Ripple current influence
- $\Delta T_c$  Core temperature increase (°C) by internal heating due to the application current
- $T_c$  Core temperature (°C) by internal heating due to the application current
- $T_a$  Ambient temperature [°C]
- $K_{Temp}$  Temperature rise due to the application current
- $K_{Apply}$  Maximum permissible core temperature rise due to the permissible rated alternating current

Upper operating temperature $T_c$	80°C	100°C	115°C	≥ 120°C
Temperature rise $\Delta T_c$	30°C	50°C	65°C	70°C

Table 3: Maximum permissible core temperature rise due to the permissible rated alternating current

**HIGH VOLTAGE E-CAPS (≥ 160V) WITH LIQUID ELECTROLYTES**

Under the low voltage electrolytic capacitors are described in the previous chapter, in e-cap series with ≥ 160V another factor influencing the life-time is added: the operating voltage is applied to the electrolytic capacitor. It is known that the nominal voltage of the capacitor  $V_N$  (the thermal stress on its dielectric decreases, which in turn leads to an extension of the service life). For all cases  $V_N$  between 80% to 100% of  $V_N$ , take for calculations  $V_{0.8V}$ .

$K_{Apply}$	$K_{Voltage}$	Type	Product	CapXon series
1	1	Kadial	$V_N$ (1, 1.5, 2) 30V, 50V, 63V, 80V, 100V, 125V, 150V, 160V, 180V, 200V	30V, 50V, 63V, 80V, 100V, 125V, 150V, 160V, 180V, 200V
1	1	Snap-in	$V_N$ (1, 1.5, 2) 30V, 50V, 63V, 80V, 100V, 125V, 150V, 160V, 180V, 200V	30V, 50V, 63V, 80V, 100V, 125V, 150V, 160V, 180V, 200V
1	1	Scrap terminal	$V_N$ (1, 1.5, 2) 30V, 50V, 63V, 80V, 100V, 125V, 150V, 160V, 180V, 200V	30V, 50V, 63V, 80V, 100V, 125V, 150V, 160V, 180V, 200V

Table 2: Influence of the application current and the application voltage on CapXon high-voltage series

$K_{Apply}$	$K_{Voltage}$	Type	Product	CapXon series
1	1.5	Kadial	$V_N$ (1.5, 1.5, 1.5, 1.5, 1.5, 1.5)	1.5V, 1.5V, 1.5V, 1.5V, 1.5V, 1.5V

Table 2: Influence of the application current and application voltage on CapXon high voltage series for use in lightning application

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### Application example

**LIFETIME COMPENDIUM**

**CALCULATION EXAMPLE - OUTPUT FILTER CAP - IN A SWITCH MODE POWER SUPPLY**

Fig. 1: Principal diagram for switching mode power supply with active PFC and galvanically isolated output

Output voltage: 24V  
 Rated filter: 100µF @ 50V  
 Operating cycles: 200,000 during the operating period of 10 years

Operation under different conditions according to the following table:

Operation in Mode 1	Operation in Mode 2	Stand / Standby
Duty cycle $D_{max}$ : 0.85	Duty cycle $D_{max}$ : 0.85	Duty cycle $D_{max}$ : 0.20
Ambient temperature $T_a$ : 20°C	Ambient temperature $T_a$ : 20°C	Ambient temperature $T_a$ : 40°C

Frequency f [kHz]	I [A-RMS]	f [kHz]	I [A-RMS]	Frequency f [kHz]	I [A-RMS]
10kHz	1.5A	30kHz	1.8A	100kHz	0.05A
30kHz	1A	100kHz	1.2A	300kHz	0.7A
100kHz	0.8A	300kHz	0.6A		

Table 16: Requirement profile for the calculation example - switched-mode power supply

Selected Type: **GF561M035G250ETA**

Rated capacitance C <sub>r</sub>	Rated voltage V <sub>N</sub>	Rated current I <sub>N</sub>	Dimension $\phi \times L$	Endurance
500µF	35V	2.64A @ 100kHz/105°C	10mm x 25mm	5000h @ 100°C

Table 17: Main parameter GF561M035G250ETA

### Graphical estimation

**LIFETIME COMPENDIUM**

The first step is to calculate the equivalent ripple current  $I_{\Sigma}$  and  $I_{\Sigma,eq}$  as well as the resulting RMS value  $I_{RMS}$ .

WITH

(15)  $I_{\Sigma,eq} = \frac{I_{\Sigma}}{K_f}$

(16)  $I_{RMS} = \sqrt{I_{Eq1}^2 + I_{Eq2}^2 + \dots + I_{Eqn}^2}$

The necessary ripple current correction factors are shown in table 14. Extract data sheet 001 series

Frequency [kHz]	50	100	300	1k	2.5k
Ripple current correction factor $K_f$	0.8	1.0	1.2	1.5	1.4

Table 20: Ripple current correction factor for the CapXon series

Eqn.: 120Hz current 1:  $I_{Eq1} = \frac{I_{\Sigma}}{K_f} = 20A$

Eqn.: 120Hz current 2:  $I_{Eq2} = \frac{I_{\Sigma}}{K_f} = 11.4A$

RMS value:  $I_{RMS} = \sqrt{20^2 + 11.4^2} = 23A$

In the second step, the ripple current ratio  $I_{\Sigma,eq}$  can be calculated with

Ripple current ratio:  $\frac{I_{\Sigma,eq}}{I_N} = \frac{20A}{8A} = 2.5$

Fig. 3: Nomogram for the CapXon series with intersection point for the application example

The ripple current ratio and the ambient temperature of 60°C show the intersection of the graph in the nomogram. The useful life is between the 50,000h and 100,000h curve, exactly at 60,000h and meets the minimum requirement of > 40,000h.

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## TECHNICAL NOTES • TECHNICAL COMPENDIUM

Due to their compact design, **Aluminum Electrolytic Capacitors** are the most common high-capacitance storage and filter elements in electronics. Like all electronic components, they do not have an “ideal” electrical behavior, they have losses. Their properties are very dependent on temperature and frequency. Detailed knowledge of these components is an absolute must for all electronics developers, especially for power supplies and converters.

The CapXon Technical Compendium describes the basics, electrical parameters, production steps, provides suggestions for the selection of suitable capacitors and design rules for reliable and long-lasting operation.

The technical compendium is available to download from our website [http://www.capxongroup.com/files/Technical%20Compendium\\_EN.pdf](http://www.capxongroup.com/files/Technical%20Compendium_EN.pdf)



### Basics

**1. BASICS**

Aluminum Electrolytic Capacitors are by far the most important and common high-capacitance storage or filter capacitors in electronic devices.

The enormous importance of electrolytic capacitors is related to their properties:

- Extremely high CV (capacitance per volume) values on the smallest volume
- High dielectric strength of even the thinnest layers (2 to a 10<sup>7</sup> V/cm)
- Relatively high dielectric constant ε (epsilon) of oxides
- Etching ability of aluminum, which allows a surface enlargement of up to 200 times and thus a dramatic space reduction
- Very wide range of design and dimensions

**1.1. BASIC STRUCTURE OF A CAPACITOR**

When voltage is applied between both conducting electrode plates, a certain amount of charge Q will be stored in the dielectric surface by a proportional relative voltage. The proportional constant is designating the ability of the capacitor to store energy in electric field.

The capacitance can be calculated using the amount of charge and the applied voltage

$$C = \frac{Q}{U}$$

**1.2. CONSTRUCTION OF ALUMINUM ELECTROLYTIC CAPACITORS**

All Aluminum Electrolytic Capacitors are based on the knowledge that an oxide layer, which is electrochemically produced on aluminum, allows current to pass in one direction and blocks the current in the other direction, like the principle of a semiconductor diode. Even very thin layers enable very high dielectric strength. The oxide layer thus forms the dielectric of the capacitor.

The oxide layer has a porous structure, even before it is processed in order to achieve an optimal electrical connection of this rough surface, a conductive liquid, the electrolyte, is used. The liquid penetrates the pores and wets the coarse layer. The electrolyte is in turn contacted electrically via a second aluminum foil (current supply foil).

**WITH**

- C Capacitance [F]
- Q Charge [C]
- U Applied voltage [V]

$$C = \epsilon_0 \cdot \epsilon_r \cdot \frac{A}{d}$$

**WITH**

- ε<sub>0</sub> Absolutely Permittivity (8.85 · 10<sup>-12</sup> F/m)
- ε<sub>r</sub> Relative Permittivity [F/m] – depending on used dielectric material
- A Surface of capacitor electrode [m<sup>2</sup>]
- d Distance between the capacitor plates [m]

**Fig. 1: Basic structure of a point capacitor**  
The capacitance can be calculated using the amount of charge and the applied voltage

**Fig. 2: Sectional view of an aluminum electrolytic capacitor**

### Production steps

**2. PRODUCTION STEPS**

To achieve the highest level of reliability for all our products, CapXon only uses 99.99% pure aluminum in its electrolytic capacitors. Foreign atoms on the surface in connection with the electrolyte would lead to corrosion.

**Raw material Aluminum foil**

**Foil etching**

The surface of the aluminum foil is enlarged by 50 to 200 times by etching. At CapXon, this is done in its own factory using appropriate continuous baths. The etching process, especially of high-quality high-voltage foils, requires enormous know-how and decades of experience. The electrolyte thin foils (20 – 100µm) have to be mechanically stable enough to survive the further manufacturing steps like multiple etching, washing, drying, chemical rinsing without damage. Only a high understanding of the complex processing of etched aluminum foils are the guarantee for an aluminum electrolytic capacitor of the highest quality!

**Foil forming**

The oxide layer required as a dielectric is produced electrochemically on the oxide foil after the roughening process (etching) by immersing the foil in a bath with boric acid or similar chemical and applying voltage during the process. The process is called forming. Over time, the layer thickness increases, while the current decreases and the voltage on the oxide layer increases. At first very strongly then increasingly a maximum value. Depending on the bath composition, rated voltages of 650V or higher can be achieved.

**Cutting**

**Contacting and winding**

**Impregnation**

**Assembling**

**Rubber sealing (uvf)**

**Sleeve and marking**

**Aging**

**Finishing and packaging**

**Fig. 3: Production steps - from foil to capacitor**  
The processing of the foils, the so-called etching process, the forming and the subsequent manufacture of the electrolyte

## Electrical parameters

**4.3. STABILITY OF ELECTRICAL PARAMETERS**

If we compare the solid polymer or hybrid polymer technology with other capacitors designs, the advantage becomes clear:

The capacitance of ceramic capacitors reduces for high capacitance types with the applied voltage, the advantage becomes clear.

Ceramic materials like X7R, X7E, Y4T or Z5U are ferroelectric materials and classified as class 2 ceramics. As higher the applied voltage is lower the permittivity, i.e. lower the capacitance value. The capacitance measured as applied at higher voltage may drop to 50% of the value measured with the standardized measurement voltage of 5.0 or 2.0V, what that means for the circuit in filters or memory applications need not be further elaborated here. This is the reason for harmonic distortions in audio applications.

**Fig. 23: Change in capacitance as a function of the applied voltage for an MLCC and a polymer capacitor**

**4.4. EXTREMELY LONG LIFE**

In order to achieve a high capacity in the smallest space at the same time acceptable costs remained so far only the way to use aluminum capacitors with liquid electrolyte.

Apart from the temperature and frequency-related disadvantages, the lifetime of these capacitors must always be considered.

The use of a liquid electrolyte results in changes in electrical properties over time.

As a result, an aluminum electrolytic capacitor slowly but constantly loses electrolyte during the time - the component is driving out. The lower the temperature of the capacitor, the slower the desiccation process, hence a longer life.

## Capacitor selection

**6.2. HIGH FREQUENCY OUTPUT SMOOTHING**

In the output stage on the secondary side, a rectification and smoothing circuit converts the AC voltage supplied by the full-bridge MOSFET into the desired DC voltage. For example, 2.2VDC. The smoothing circuit can consist of capacitors or the combination of capacitor and inductor. See Fig. 59. The output current smooth ripples in the rectified voltage and also ensure the stability during transient increase in the load current.

**Fig. 27: Output smoothing capacitors in a Flyback SMPS**

When the MOSFET is not turned on, no current flows through the secondary diode and the output capacitors must supply the load with power. When the MOSFET is turned off, the diode conducts, supplies the load and charges the output capacitor too.

The selection of the output capacitors depends on the tolerable peak-peak ripple voltage (V<sub>ripple</sub>) and the ripple current (IRMS). Since the load filter only has ripple voltage, corresponding capacitors with very low ESR / impedance and very high ripple currents are to be selected.

**Function:**

- Output smoothing and ensure stability during transient increase in the load current

**Requirements:**

- High ripple current
- Low impedance / ESR to reduce output ripple
- Long lifetime
- Small dimensions
- High temperatures (≥ 100°C)

CapXon recommends the technologies and series listed in table 30 for output smoothing.

Technology	Type	Series	Normal	Low ESR	High CV	125°C	150°C	160°C
Aluminum Electrolytic	SMC	RM	RL	RLH	PL	SL	SL	SL
SMC	FD	FL	FLH	PL	PLV	PLV	PLV	PLV
Conductive Polymer	SMC	PS	PP	PL	PLV	PLV	PLV	PLV
Hybrid	SMC	-	AL	AL	-	AC	AN	AN
Bi-polar Electrolytic	SMC	-	AS	-	-	AT	AL	AL

**Table 30: Recommended capacitor series for output smoothing**

**6.3. BUFFERING**

The block diagram in Fig. 38 shows a microcontroller (µC) that is supplied by a linear voltage regulator, whose output voltage is 5V. In the application we assume a steadily under load operation with minimal power consumption and an operating mode of the µC. As standby current (I<sub>standby</sub>) and an operating current between 10mA and 100mA are necessary for the µC. The threshold value between standby and operating current is therefore 30mA, which leads to a sudden current requirement of the µC and rise times of 100ns on the linear regulator.

**Fig. 38: Simple µC power supply circuit**

These rise times are too fast for the connected voltage regulator, so that the control loop does not yet react and there is a voltage drop at the input of the µC. The result would be an unstable operation of the µC, misoperation of binary values or, in the worst case, a system crash.

## Design rules

**7.1. ARRANGEMENT**

Never arrange electrolytic capacitors near hot components such as heat sinks, transformers, power semiconductors etc. to avoid thermal heating of the liquid electrolyte.

**7.3. CLEARANCE / OVERPRESSURE VENT**

During operation, current flows through the capacitor and the ohmic losses, accompanied by ESR, create conduction in the form of heat.

The hydrogen released inside the electrolytic capacitor increases the internal pressure. If the internal pressure is too high, the overpressure vent opens and the gas escapes in a controlled manner.

In order not to impair the functioning of the vent, a minimum distance to other components must be maintained above.

No conducting tracks, wires or other circuit parts may be arranged above the valve.

**Fig. 36: Recommended distance for optimal cooling**

If possible, leave the half diameter between the electrolytic capacitor for optimal cooling of the heat-sensitive component.

**7.2. CONDUCTOR TRACKS**

Make conductor tracks sufficiently thick. Especially at high IRMS currents the track can be very hot. If the proximity effect is ignored, large widths at 25µm down to half! Power: 100W, 200µm thickness or more.

Power	Track thickness
Very low	35µm
> 25W	100µm
> 100W	200µm

**Table 31: Recommended track thickness for high IRMS current**

No other conductor tracks may run under an electrolytic capacitor and the minimum distance to the housing should be 3mm or more.

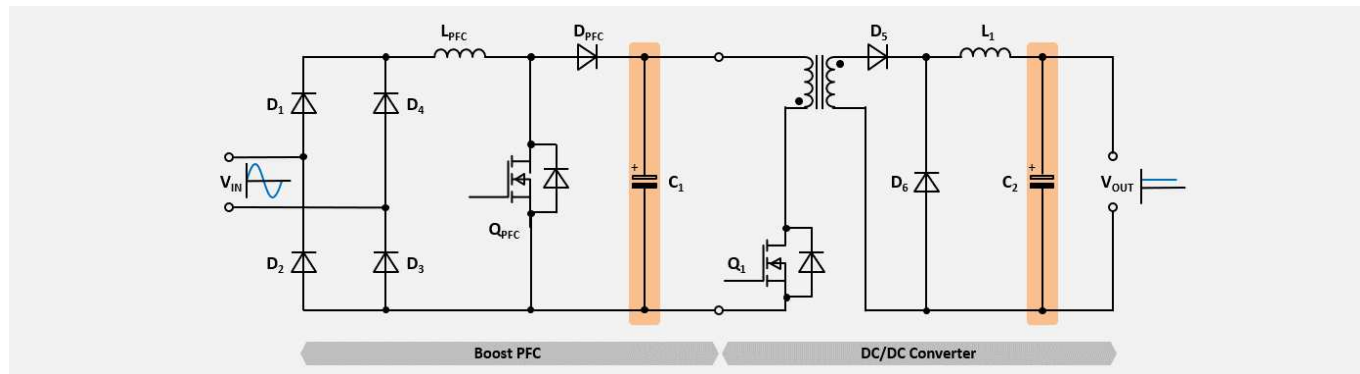
Case diameter Ø	Clearance distance CI
4mm to 16mm	Min. 2mm
16mm to 35mm	Min. 3mm
> 40mm	Min. 4mm

**Table 32: Recommended minimum clearance distance between top-side capacitor and device case**



## SWITCH MODE POWER SUPPLY (SMPS)

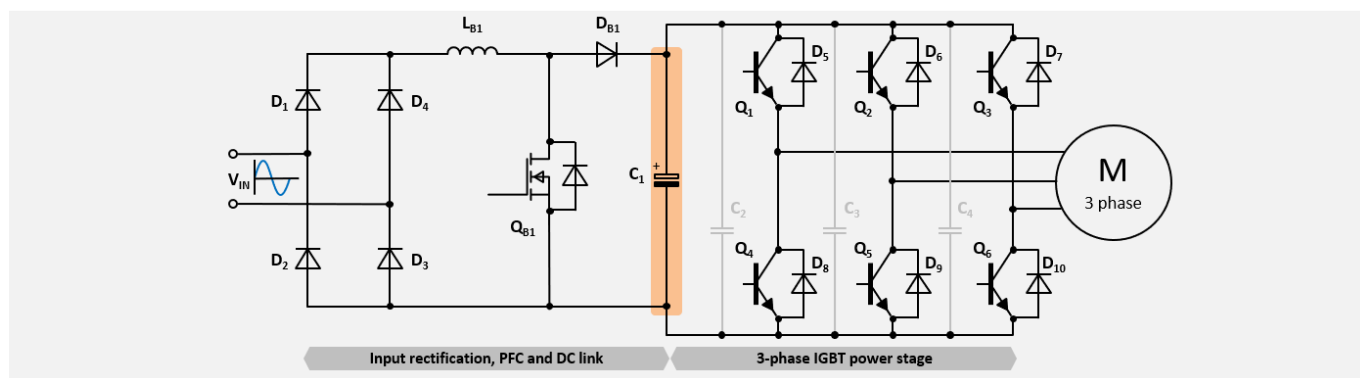
Example of a Switch Mode Power Supply with boost Power Factor Correction (PFC) and downstream DC/DC converter in Fly-back topology with recommended products.



Designation	Circuit	Purpose	Specification	Series	Part Number
C <sub>1</sub>	Boost PFC	Inductor ripple current filtering	100µF; 400V; 105°C; Radial; 2000h D18xL31.5mm; 0.53A@120Hz	KM	KM101M400K315A
C <sub>1</sub>	Boost PFC	Inductor ripple current filtering	470µF; 450V; 105°C; Snap-In ; 5000h D35xL45mm; 1.94A@120Hz	HP	HP471M450P450A
C <sub>2</sub>	DC/DC Converter	Output filtering	470µF; 25V; 105°C; SMD; 2000h D10xL10.5mm; 0.65A@100kHz	DV	DV471M025G105A
C <sub>2</sub>	DC/DC Converter	Output filtering	1000µF; 25V; 105°C; Radial; 10000h D13xL20mm; 1.91A@100kHz	FH	FH102M025I200A
C <sub>2</sub>	DC/DC Converter	Output filtering	82µF; 25V; 105°C; Radial; 2000h D8xL11.5mm; 4.1A@100kHz	PS	PS820M025F115A

## INDUSTRIAL MOTOR DRIVE

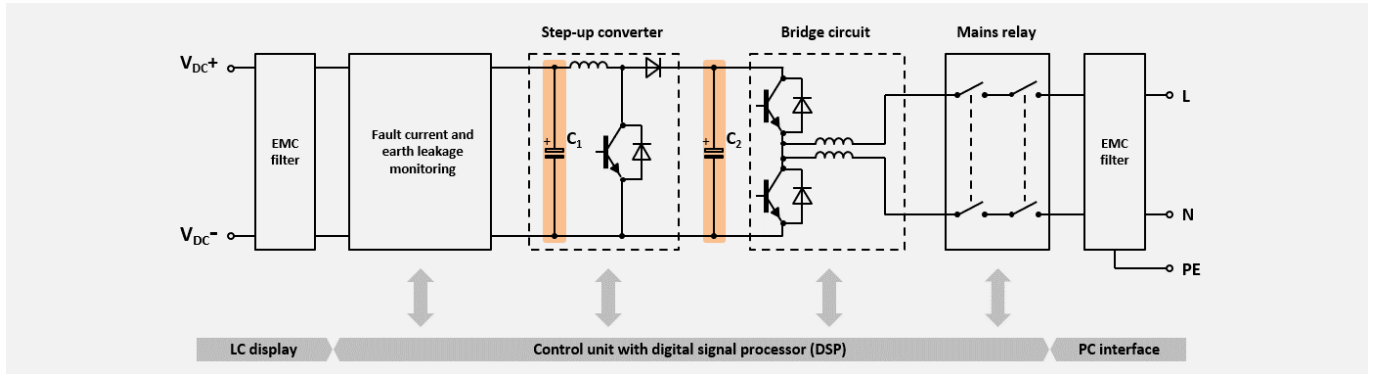
Example of a typical industrial motor drive for pumps, fans or compressors. The power circuit consist input rectifier, Power Factor Correction (PFC), DC link bank and 3-phase IGBT power stage. CapXon offers the full range of DC link solutions in electrolyte technology



Designation	Circuit	Purpose	Specification	Series	Part Number
C <sub>1</sub>	DC link bank	Energy storage and supply	560µF; 450V; 85°C; Snap-In; 7000h D30xL50mm; 3.17A@120Hz	UC	UC561M450O500A
C <sub>1</sub>	DC link bank	Energy storage and supply	470µF; 500V; 85°C; Snap-In; 10000h D35xL55mm; 2.99A@120Hz	UD	UD471M500P550A
C <sub>1</sub>	DC link bank	Energy storage and supply	680µF; 450V; 105°C; Snap-In; 8000h D35xL60mm; 2.94A@120Hz	UK	UK681M450P600A
C <sub>1</sub>	DC link bank	Energy storage and supply	680µF; 450V; 105°C; Snap-In; 10000h D35xL55mm; 3A@120Hz	UL	UL821M450Q550A

## PHOTO VOLTAIC INVERTER

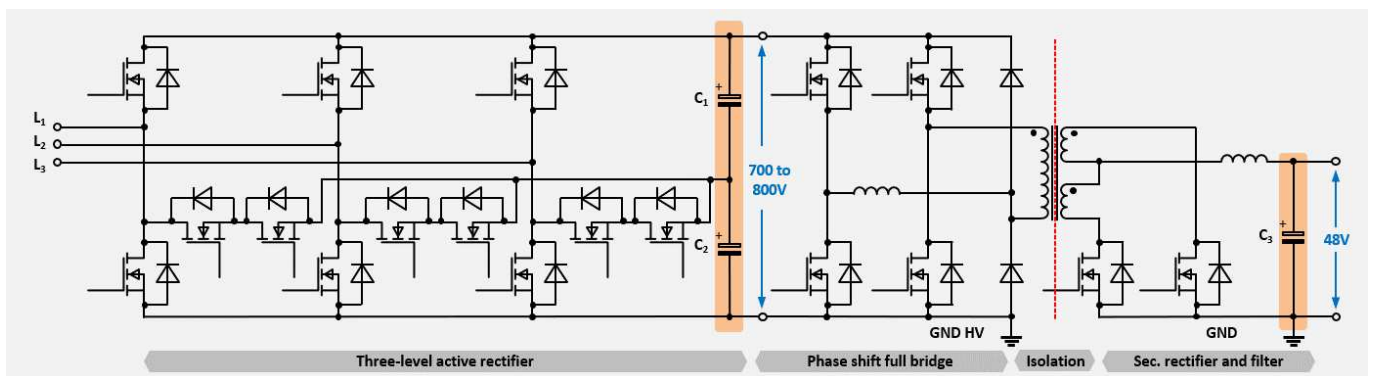
Block diagram of the power circuit of a photo voltaic inverter with EMC filter, monitoring circuit, step-up converter, bridge circuit, and mains relay with recommended products.



Designation	Circuit	Purpose	Specification	Series	Part Number
C <sub>1</sub> , C <sub>2</sub>	Step-up + DC link	Energy storage and supply	680µF; 500V; 105°C; Snap-In; 5000h D40xL60mm; 3A@120Hz	UJ	UJ681M500Q600A
C <sub>1</sub> , C <sub>2</sub>	Step-up + DC link	Energy storage and supply	5600µF; 450V; 105°C; Screw; 20000h D63.5xL165mm; 21.7@120Hz	RX	RX562M450SA65A
C <sub>1</sub> , C <sub>2</sub>	Step-up + DC link	Energy storage and supply	470µF; 450V; 105°C; Snap-In; 10000h D30xL50mm; 1.97A@120Hz	UL	UL471M450O500A
C <sub>1</sub> , C <sub>2</sub>	Step-up + DC link	Energy storage and supply	1000µF; 450V; 105°C; Screw; 8000h D51xL80mm; 4.6A@120Hz	RH	RH102M350R800A

## 3-PHASE HIGH VOLTAGE BATTERY CHARGER

Principal circuit of a 3-phase high voltage battery charger for bidirectional applications such as electric vehicle charging (e-cars, fork-lift trucks, transport vehicles with recommend products for the active rectifier and output filter.

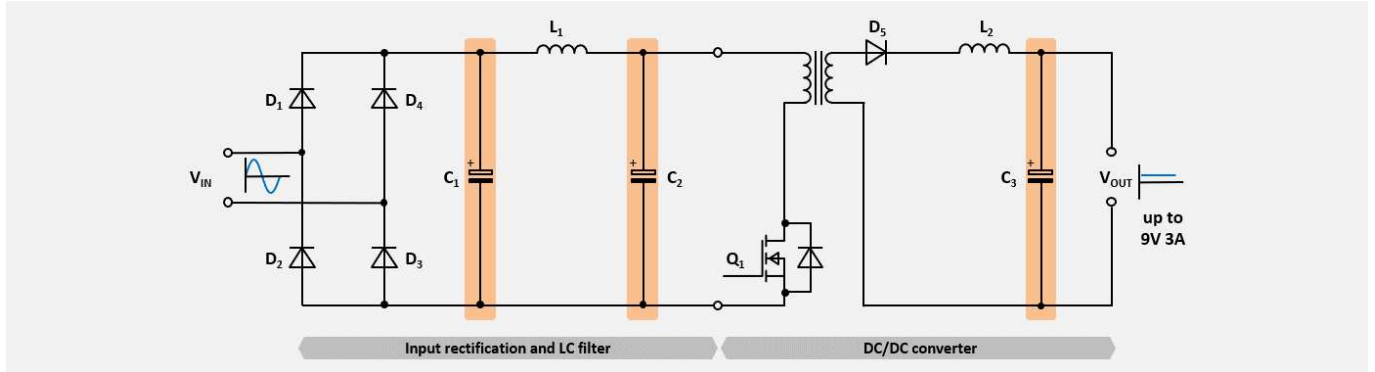


Designation	Circuit	Purpose	Specification	Series	Part Number
C <sub>1</sub> , C <sub>2</sub>	Three-level active rectifier	Energy storage and supply	2200µF; 450V; 85°C; Snap-In; 7000h D45xL90mm; 8.5A@120Hz	UC	UC222M450V900A
C <sub>1</sub> , C <sub>2</sub>	Three-level active rectifier	Energy storage and supply	1000µF; 500V; 105°C; Snap-In; 5000h D40xL80mm; 4.68A@120Hz	UJ	UJ102M500Q800A
C <sub>3</sub>	Output filter	Output buffering and ensure stability	56µF; 63V; 105°C; Radial; 10000h D10xL12.5mm; 2.4A@100kHz	AS	AS560M063G125PTA
C <sub>3</sub>	Output filter	Output buffering and ensure stability	150µF; 63V; 105°C; Radial; 2000h D10xL18mm; 3A@100kHz	PH	PH151M063G125PTA



**27W PORTABLE POWER USB-C ADAPTER**

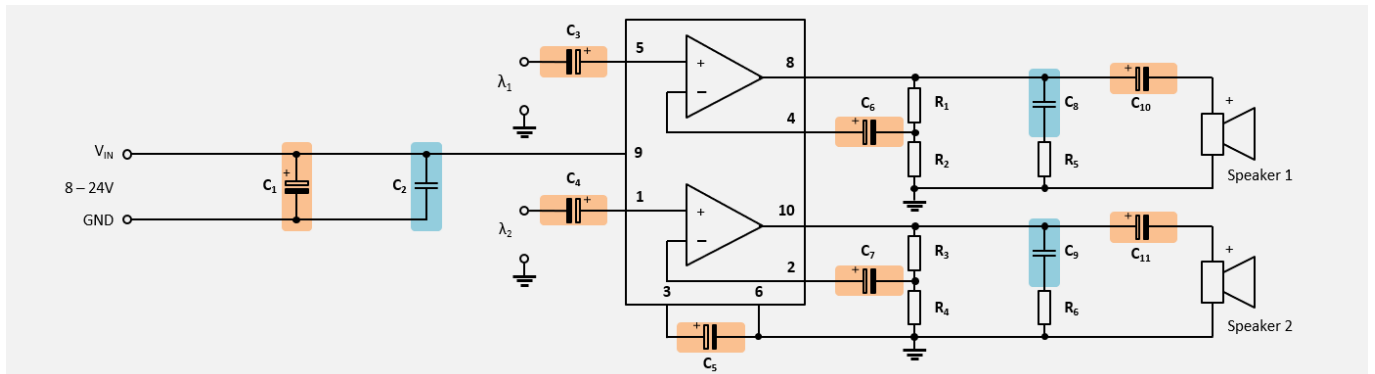
Example of a portable power adapter for USB-C laptops, smartphones and tablets with recommend products for the LC filter and to ensure stability (smoothing) during transient increase in the load voltage.



Designation	Circuit	Purpose	Specification	Series	Part Number
C <sub>1</sub> , C <sub>2</sub>	LC filter	Input filtering	22µF; 400V; 105°C; Radial; 2000h D10xL25mm; 0.125A@120Hz	KM	KM220M400G250A
C <sub>1</sub> , C <sub>2</sub>	LC filter	Input filtering	15µF; 400V; 105°C; Radial; 5000h D10xL20mm; 0.24A@120Hz	KF	KF150M400G200A
C <sub>3</sub>	DC/DC converter	Output filtering	470µF; 16V; 105°C; Radial; 2000h D5.5xL11mm; 2.69A@100kHz	PX	PX471M016C090P
C <sub>3</sub>	DC/DC converter	Output filtering	330µF; 12V; 105°C; Radial; 2000h D5xL9mm; 2.69A@100kHz	PX	PX331M012C090P

**AUDIO SPEAKER**

Example of an active audio speaker with treble and bass and the recommend products for the NF filter as well as the acoustic coupling.



Designation	Circuit	Purpose	Specification	Series	Part Number
C <sub>1</sub> , C <sub>3</sub> , C <sub>4</sub> , C <sub>5</sub> C <sub>6</sub> , C <sub>7</sub> , C <sub>10</sub> , C <sub>11</sub>	Audio speaker	NF filter	470µF; 35V; 85°C; Radial; 2000h D10xL16mm; 0.63A@120Hz	RW	RW471M035G160A
C <sub>2</sub> , C <sub>8</sub> , C <sub>9</sub>	Audio speaker	Acoustic coupling	47µF; 35V; 85°C; Radial; 2000h D10xL12.5mm; 0.15A@120Hz	NR	NR470M035G125ETA

## TECHNICAL TERMS

Item	Description	SI units
$V_R$	Rated voltage	V
$V_S$	Surge voltage	V
$V_{Ripple\_AC}$	Ripple voltage	V
$V_{Reverse}$	Reverse voltage	V
$V_A$	Application voltage, operating voltage	A
$I_R$	Rated ripple current, rated alternating current	A
$I_A$	Application current, operating current	A
$I_{A\_Max}$	Maximum application current, maximum operating current	A
$I_{Leak}$	Leakage current	A
$T_{0\_Max}$	Upper category temperature	°C
$T_{0\_Min}$	Lower category temperature	°C
$T_A$	Application temperature, operating temperature	°C
$T_S$	Capacitor surface temperature	°C
$\Delta T_0$	Core temperature increase by internal heating due to rated ripple current	°C
$\Delta T_A$	Core temperature increase by internal heating due to application ripple current	°C
$C_R$	Rated capacitance	F
$\Delta C$	Capacitance tolerance	%
$C/C_R$	Capacitance drift	-
$\tan \delta$	Dissipation factor	-
$Z$	Impedance	$\Omega$
ESR	Equivalent series resistance	$\Omega$
ESL	Equivalent series inductance	H
$X_C$	Capacitive reactance	$\Omega$
$X_L$	Inductive reactance	$\Omega$
f	Frequency	Hz
$\omega$	Angular frequency	Hz
$\lambda$	FIT = failure in time	-
$K_f$	Multiplier for ripple current vs. frequency	-
$K_T$	Multiplier for ripple current vs. temperature	-
$K_0$	Dielectric constant derating coefficient at high temperature	-
$L_0$	Specified lifetime at max. capacitor temperature, rated voltage (and rated ripple current)	h
$L_A$	Expected lifetime at application conditions	h

### OVERVIEW - SMD ALUMINUM ELECTROLYTIC CAPACITORS



#### Features



Series	Page	AEC-Q200	Bi-Polar	High Temperature	High Voltage	Long Life	Low ESR	Low Leakage	Standard	Ultra Long Life	Ultra Low ESR	Vibration Proof	Temperature Range (°C)		Voltage Range (V)		Capacitance Range (µF)		Endurance (hours)
KV	27						•						-40	+85	6.3	50	1	330	1000
NV	31		•										-40	+85	6.3	50	1	560	2000
LV	35	•			•				•			•	-40	+85	4	450	1	6800	2000
EV	43	•							•			•	-55	+105	6.3	50	1	1500	1000
HV	48	•			•	•						•	-55	+105	6.3	100	1	6800	2000
JV	56	•				•						•	-40	+105	160	450	2.2	68	
DV	60	•					•					•	-55	+105	6.3	100	1	6800	2000 to 5000
RV	67	•									•	•	-55	+105	6.3	100	1	6800	2000 to 5000
MV	73									•			-40	+105	160	450	2.2	68	
CV	77	•								•	•	•	-40	+105	6.3	50	1	1000	5000
TV	81	•		•								•	-40	+125	10	450	1	330	1000 to 2000

### KV SERIES ■ LOW LEAKAGE 85°C TYPE

#### KEY FEATURES



LOW LEAKAGE

- ALUMINUM ELECTROLYTIC CAPACITOR ■ SMD type
- Endurance: 85°C ■ 1000 hours
- Low leakage current,  $I_{LEAK} \leq 0.002 \cdot C_R \cdot V_R$  or  $0.4\mu A$
- Small dimensions
- Ideal for high density mounting



#### SPECIFICATIONS

Items		Performance Characteristics						
Operating Temperature Range		-40 ~ +85°C						
Rated Voltage Range	$V_R$	6.3 ~ 50V DC						
Surge Voltage	$V_S$	$V_S = 1.15 \cdot V_R$						
Capacitance Range	$C_R$	1 ~ 330 $\mu F$						
Cap. Tolerance	$\Delta C$	$\pm 20\%$ (120Hz ■ 20°C)						
Leakage Current (20°C ■ $V_R$ applied)	$I_{LEAK}$	$\leq 0.002 \cdot C_R \cdot V_R$ or $0.4\mu A$ , whichever is greater ■ After 2 minutes [ $I_{LEAK}$ ( $\mu A$ ) ; $C_R$ ( $\mu F$ ) ; $V_R$ (V) ]						
Dissipation Factor % (20°C ■ 120Hz)	$\tan\delta$	$V_R$ (V DC)	6.3	10	16	25	35	50
		$\tan\delta$ (%)	26	22	18	16	14	12
Low Temperature Characteristics at 120Hz	Z ratio max.	$V_R$ (V DC)	6.3	10	16	25	35	50
		Z-25°C/Z+20°C	4	3	2	2	2	2
		Z-40°C/Z+20°C	8	6	4	3	3	3
Lifetime Test								
Endurance 85°C ( $V_R$ applied)	Test	<b>1 000 hours</b>						
	$\Delta C/C_R$	$\leq \pm 25\%$ of initial measured value						
	$\tan\delta$	$\leq 200\%$ of initial specified value						
	$I_{Leak}$	$\leq$ the initial specified value						
Shelf Life 85°C ( $V_R = 0$ )	Test	<b>1 000 hours</b>						
	$\Delta C/C_R$	$\leq \pm 25\%$ of initial measured value						
	$\tan\delta$	$\leq 200\%$ of initial specified value						
	$I_{Leak}$	$\leq$ the initial specified value						
		Before measurement: Restore capacitor to 20°C, apply $V_R$ for 30 min according JIS-C-5101-4						
Resistance to Soldering Heat	The capacitors shall be kept on a hot plate maintained at 250°C for 30 seconds. After removing from the hot plate and restored at room temperature, they meet the characteristic requirements listed below							
	$\Delta C/C_R$	Within $\pm 10\%$ of initial value						
	$\tan\delta$	Less than specified value						
	$I_{Leak}$	Less than specified value						

**STANDARD RATINGS**

Part number shows blister tape on paper reel

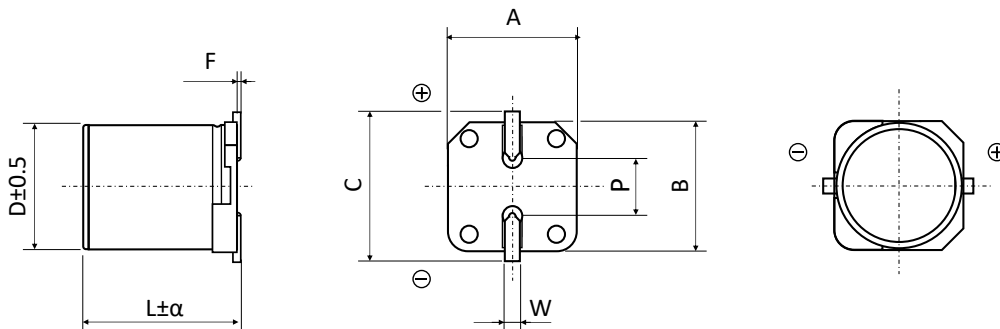
$V_R$ (V)	$C_R$ ( $\mu F$ )	$\phi D$ (mm)	L (mm)	$I_R$ = Max. Ripple Current +85°C - 120Hz (mA rms)	CapXon Part Number
6.3	10	4	5.5	15	KV100M6R3B055ETR
	22	4	5.5	28	KV220M6R3B055ETR
	33	4	5.5	37	KV330M6R3B055ETR
	47	4	5.5	45	KV470M6R3B055ETR
	100	5	5.5	70	KV101M6R3C055ETR
	220	6.3	7.7	102	KV221M6R3E077ETR
	220	8	6.5	110	KV221M6R3F065ETR
	330	6.3	7.7	155	KV331M6R3E077ETR
	330	8	6.5	170	KV331M6R3F065ETR
10	10	4	5.5	23	KV100M010B055ETR
	22	4	5.5	33	KV220M010B055ETR
	33	5	5.5	41	KV330M010C055ETR
	47	6.3	5.5	52	KV470M010E055ETR
	100	6.3	7.7	75	KV101M010E077ETR
	100	8	6.5	80	KV101M010F065ETR
	220	6.3	7.7	125	KV221M010E077ETR
	220	8	6.5	135	KV221M010F065ETR
16	4.7	4	5.5	10	KV4R7M016B055ETR
	10	4	5.5	23	KV100M016B055ETR
	22	5	5.5	37	KV220M016C055ETR
	33	6.3	5.5	49	KV330M016E055ETR
	47	6.3	5.5	58	KV470M016E055ETR
	100	6.3	7.7	85	KV101M016E077ETR
	100	8	6.5	92	KV101M016F065ETR
25	3.3	4	5.5	10	KV3R3M025B055ETR
	4.7	4	5.5	16	KV4R7M025B055ETR
	10	4	5.5	27	KV100M025B055ETR
	22	5	5.5	42	KV220M025C055ETR
	33	6.3	5.5	52	KV330M025E055ETR
	47	6.3	7.7	65	KV470M025E077ETR
	47	8	6.5	70	KV470M025F065ETR
	100	6.3	7.7	102	KV101M025E077ETR
	100	8	6.5	110	KV101M025F065ETR
35	2.2	4	5.5	8.4	KV2R2M035B055ETR
	3.3	4	5.5	15	KV3R3M035B055ETR
	4.7	4	5.5	18	KV4R7M035B055ETR
	10	6.3	5.5	29	KV100M035E055ETR
	22	6.3	5.5	46	KV220M035E055ETR
	33	6.3	7.7	58	KV330M035E077ETR
	33	8	6.5	62	KV330M035F065ETR
	47	6.3	7.7	75	KV470M035E077ETR
	47	8	6.5	80	KV470M035F065ETR



**STANDARD RATINGS**

Part number shows blister tape on paper reel

$V_R$ (V)	$C_R$ ( $\mu F$ )	$\phi D$ (mm)	L (mm)	$I_R$ - Max. Ripple Current +85°C - 120Hz (mA rms)	CapXon Part Number
50	1	4	5.5	8.4	KV010M050B055ETR
	2.2	4	5.5	13	KV2R2M050B055ETR
	3.3	4	5.5	17	KV3R3M050B055ETR
	4.7	6.3	5.5	20	KV4R7M050E055ETR
	10	6.3	5.5	33	KV100M050E055ETR
	22	6.3	7.7	48	KV220M050E077ETR
	22	8	6.5	52	KV220M050F065ETR
	33	6.3	7.7	66	KV330M050E077ETR
	33	8	6.5	71	KV330M050F065ETR

**DIMENSIONS STANDARD PACKAGE - All dimensions in mm**


$\phi D$	L	$\alpha$	$A \pm 0.2$	$B \pm 0.2$	$C \pm 0.2$	F	$P \pm 0.2$	W
4.0	5.5	Max	4.3	4.3	4.9	0.3 max.	1.0	0.5 to 0.8
5.0	5.5	Max	5.3	5.3	5.9	0.3 max.	1.4	0.5 to 0.8
6.3	5.5	0.2	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
6.3	7.7	Max	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
8.0	6.5	Max	8.3	8.3	9.0	0.3 max.	2.3	0.5 to 0.8

**MULTIPLIER  $K_f$  for RIPPLE CURRENT vs. FREQUENCY**

$C_R$ ( $\mu F$ ) / Frequency (Hz)	50/60	100/120	500	1k	$\geq 10k$
$1 \leq C_R \leq 100$	0.8	1	1.2	1.3	1.5
$100 < C_R \leq 330$	0.8	1	1.1	1.15	1.2

**PRECAUTIONS, GUIDELINES AND PACKAGING INFORMATION**

Unless otherwise agreed in individual specifications, all products are subject to our “General Precautions and Guidelines” as well as our “Packaging Information”. Please refer to the following links in the table.

General Precautions and Guidelines	Packaging Information Liquid SMD
Page 104	Page 95



### DISCLAIMER

All product related data (e.g. specification, statements and general information) are subject to change without any notice. It is necessary that the customer observes all product related technical / application information and handling instructions.

CapXon products are designed and manufactured according to severe quality and safety standards. Under no circumstance, CapXon warrants that any CapXon product is suitable for the purposes intended for your application, even CapXon knows the application. It is customer's duty and obligation to check and make sure that CapXon products are suitable for the purposes intended and select the correct and proper CapXon product. Customers are requested to perform a sufficient validation and reliability evaluation to assure needed safety level and reliability performance by suitable designs and to apply proper safeguards (e.g. redundancies, protective circuits).

Particular operating conditions (ambient temperature, ripple current, voltage, thermal resistance, etc.) as well as storage, production or assembly may affect the performance and the lifetime of the capacitor. Please consult CapXon for lifetime estimation, failure mode considerations or worst-case scenarios according to the product technology, product tolerances / deviations or change of the characteristics of the capacitor due to shipment, storage, handling, production and usage.

For aerospace or military application, life-saving, life-sustaining, safety critical applications or any application where failure may cause severe personal injury or death, please consult us before design-in the capacitor in your application.

Except for the written expressed warranties, CapXon does not impliedly, by assumption or whatever else, warrant, undertake, promise any other warranty or guaranty for any CapXon product.

For further information, please visit our website [www.capxongroup.com](http://www.capxongroup.com) or contact CapXon directly.

### NV SERIES ■ BI-POLAR 85°C TYPE

#### KEY FEATURES

- ALUMINUM ELECTROLYTIC CAPACITOR ■ SMD type
- Endurance: 85°C ■ 2 000 hours
- Bi-Polar, Non-polarized type
- Small dimensions
- Ideal for high density mounting



#### SPECIFICATIONS

Items		Performance Characteristics						
Operating Temperature Range		-40 ~ +85°C						
Rated Voltage Range	$V_R$	6.3 ~ 50V DC						
Surge Voltage	$V_S$	$V_S = 1.15 \cdot V_R$						
Capacitance Range	$C_R$	1 ~ 560 $\mu$ F						
Cap. Tolerance	$\Delta C$	$\pm 20\%$ (120Hz ■ 20°C)						
Leakage Current (20°C ■ $V_R$ applied)	$I_{LEAK}$	$\leq 0.05 \cdot C_R \cdot V_R$ or 10 $\mu$ A, whichever is greater ■ After 2 minutes [ $I_{LEAK}$ ( $\mu$ A) ; $C_R$ ( $\mu$ F) ; $V_R$ (V) ]						
Dissipation Factor % (20°C ■ 120Hz)	tan $\delta$	$V_R$ (V DC)	6.3	10	16	25	35	50
		tan $\delta$ (%)	24	20	17	17	15	15
Low Temperature Characteristics at 120Hz	Z ratio max.	$V_R$ (V DC)	6.3	10	16	25	35	50
		Z-25°C/Z+20°C	4	3	2	2	2	2
		Z-40°C/Z+20°C	8	6	4	3	3	3
Lifetime Test								
Endurance 85°C ( $V_R$ applied)	Test	<b>2 000 hours</b>						
	$\Delta C/C_R$	$\leq \pm 25\%$ of initial measured value						
	tan $\delta$	$\leq 200\%$ of initial specified value						
	$I_{Leak}$	$\leq$ the initial specified value						
Shelf Life 85°C ( $V_R = 0$ )	Test	<b>1 000 hours</b>						
	$\Delta C/C_R$	$\leq \pm 25\%$ of initial measured value						
	tan $\delta$	$\leq 200\%$ of initial specified value						
	$I_{Leak}$	$\leq$ the initial specified value						
		Before measurement: Restore capacitor to 20°C, apply $V_R$ for 30 min according JIS-C-5101-4						
Resistance to Soldering Heat	The capacitors shall be kept on a hot plate maintained at 250°C for 30 seconds. After removing from the hot plate and restored at room temperature, they meet the characteristic requirements listed below							
	$\Delta C/C_R$	Within $\pm 10\%$ of initial value						
	tan $\delta$	Less than specified value						
	$I_{Leak}$	Less than specified value						

**STANDARD RATINGS**

Part number shows blister tape on paper reel

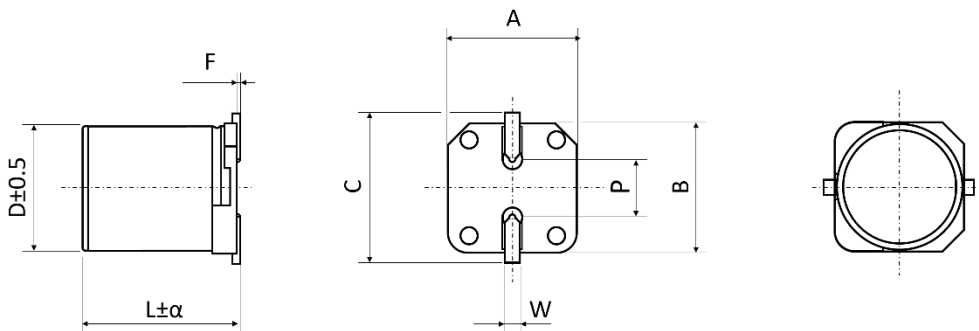
$V_R$ (V)	$C_R$ ( $\mu F$ )	$\phi D$ (mm)	L (mm)	$I_R$ - Max. Ripple Current +85°C - 120Hz (mA rms)	CapXon Part Number
6.3	10	4	5.5	15	NV100M6R3B055ETR
	22	4	5.5	28	NV220M6R3B055ETR
	22	5	5.5	32	NV220M6R3C055ETR
	33	5	5.5	37	NV330M6R3C055ETR
	47	6.3	5.5	45	NV470M6R3E055ETR
	100	6.3	7.7	65	NV101M6R3E077ETR
	100	8	6.5	70	NV101M6R3F065ETR
	220	8	10.5	120	NV221M6R3F105ETR
	330	8	10.5	160	NV331M6R3F105ETR
	470	10	10.5	190	NV471M6R3G105ETR
560	10	10.5	220	NV561M6R3G105ETR	
10	10	4	5.5	17	NV100M010B055ETR
	22	5	5.5	33	NV220M010C055ETR
	22	6.3	5.5	37	NV220M010E055ETR
	33	6.3	5.5	41	NV330M010E055ETR
	47	6.3	5.5	50	NV470M010E055ETR
	100	6.3	7.7	75	NV101M010E077ETR
	100	8	6.5	80	NV101M010F065ETR
	220	8	10.5	150	NV221M010F105ETR
	330	10	10.5	180	NV331M010G105ETR
	16	3.3	4	5.5	12
4.7		4	5.5	12	NV4R7M016B055ETR
10		4	5.5	23	NV100M016B055ETR
10		5	5.5	23	NV100M016C055ETR
22		5	5.5	37	NV220M016C055ETR
22		6.3	5.5	37	NV220M016E055ETR
33		6.3	5.5	49	NV330M016E055ETR
47		6.3	7.7	51	NV470M016E077ETR
47		8	6.5	55	NV470M016F065ETR
100		8	10.5	100	NV101M016F105ETR
220	10	10.5	170	NV221M016G105ETR	
25	3.3	4	5.5	12	NV3R3M025B055ETR
	3.3	5	5.5	12	NV3R3M025C055ETR
	4.7	4	5.5	16	NV4R7M025B055ETR
	4.7	5	5.5	16	NV4R7M025C055ETR
	10	5	5.5	27	NV100M025C055ETR
	10	6.3	5.5	27	NV100M025E055ETR
	22	6.3	5.5	40	NV220M025E055ETR
	33	6.3	7.7	51	NV330M025E077ETR
	33	8	6.5	55	NV330M025F065ETR
	47	6.3	7.7	56	NV470M025E077ETR
	47	8	6.5	60	NV470M025F065ETR
	100	8	10.5	130	NV101M025F105ETR

### STANDARD RATINGS

Part number shows blister tape on paper reel

$V_R$ (V)	$C_R$ ( $\mu F$ )	$\phi D$ (mm)	L (mm)	$I_R$ - Max. Ripple Current +85°C - 120Hz (mA rms)	CapXon Part Number
35	2.2	4	5.5	8.4	NV2R2M035B055ETR
	3.3	4	5.5	16	NV3R3M035B055ETR
	3.3	5	5.5	16	NV3R3M035C055ETR
	4.7	4	5.5	18	NV4R7M035B055ETR
	4.7	5	5.5	18	NV4R7M035C055ETR
	10	6.3	5.5	29	NV100M035E055ETR
	22	6.3	5.5	45	NV220M035E055ETR
	33	8	10.5	58	NV330M035F105ETR
	47	8	10.5	64	NV470M035F105ETR
50	1	4	5.5	8.4	NV010M050B055ETR
	2.2	4	5.5	13	NV2R2M050B055ETR
	2.2	5	5.5	13	NV2R2M050C055ETR
	3.3	4	5.5	17	NV3R3M050B055ETR
	3.3	5	5.5	17	NV3R3M050C055ETR
	4.7	5	5.5	20	NV4R7M050C055ETR
	4.7	6.3	5.5	20	NV4R7M050E055ETR
	10	6.3	5.5	32	NV100M050E055ETR
	22	8	10.5	60	NV220M050F105ETR
	33	10	10.5	75	NV330M050G105ETR
	47	10	10.5	100	NV470M050G105ETR

### DIMENSIONS STANDARD PACKAGE - All dimensions in mm





$\phi D$	L	$\alpha$	$A \pm 0.2$	$B \pm 0.2$	$C \pm 0.2$	F	$P \pm 0.2$	W
4.0	5.5	Max	4.3	4.3	4.9	0.3 max.	1.0	0.5 to 0.8
5.0	5.5	Max	5.3	5.3	5.9	0.3 max.	1.4	0.5 to 0.8
6.3	5.5	0.2	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
6.3	7.7	Max	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
8.0	6.5	Max	8.3	8.3	9.0	0.3 max.	2.3	0.5 to 0.8
8.0	10.5	Max	8.3	8.3	9.0	0.3 max.	3.1	0.7 to 1.1
10.0	10.5	Max	10.3	10.3	11.0	0.3 max.	4.5	0.7 to 1.1

**MULTIPLIER  $K_f$  for RIPPLE CURRENT vs. FREQUENCY**

$C_R$ ( $\mu F$ ) / Frequency (Hz)	50/60	100/120	500	1k	$\geq 10k$
$1 \leq C_R \leq 560$	0.8	1	1.2	1.3	1.5

**PRECAUTIONS, GUIDELINES AND PACKAGING INFORMATION**

Unless otherwise agreed in individual specifications, all products are subject to our “General Precautions and Guidelines” as well as our “Packaging Information”. Please refer to the following links in the table.

	
General Precautions and Guidelines	Packaging Information Liquid SMD
Page 104	Page 95

**DISCLAIMER**

All product related data (e.g. specification, statements and general information) are subject to change without any notice. It is necessary that the customer observes all product related technical / application information and handling instructions.

CapXon products are designed and manufactured according to severe quality and safety standards. Under no circumstance, CapXon warrants that any CapXon product is suitable for the purposes intended for your application, even CapXon knows the application. It is customer's duty and obligation to check and make sure that CapXon products are suitable for the purposes intended and select the correct and proper CapXon product. Customers are requested to perform a sufficient validation and reliability evaluation to assure needed safety level and reliability performance by suitable designs and to apply proper safeguards (e.g. redundancies, protective circuits).

Particular operating conditions (ambient temperature, ripple current, voltage, thermal resistance, etc.) as well as storage, production or assembly may affect the performance and the lifetime of the capacitor. Please consult CapXon for lifetime estimation, failure mode considerations or worst-case scenarios according to the product technology, product tolerances / deviations or change of the characteristics of the capacitor due to shipment, storage, handling, production and usage.

For aerospace or military application, life-saving, life-sustaining, safety critical applications or any application where failure may cause severe personal injury or death, please consult us before design-in the capacitor in your application.

Except for the written expressed warranties, CapXon does not impliedly, by assumption or whatever else, warrant, undertake, promise any other warranty or guaranty for any CapXon product.

For further information, please visit our website [www.capxongroup.com](http://www.capxongroup.com) or contact CapXon directly.



### LV SERIES ■ HIGH VOLTAGE, AUTOMOTIVE 85°C TYPE

#### KEY FEATURES



- ALUMINUM ELECTROLYTIC CAPACITOR ■ SMD type
- Endurance: 85°C ■ 2 000 hours
- Low ESR and high ripple current
- Vibration-proof (VP) version (up to 30g) available upon request
- AEC-Q200 version available



#### SPECIFICATIONS

Items		Performance Characteristics													
Operating Temperature Range		-40 ~ +85°C													
Rated Voltage Range	V <sub>R</sub>	4 ~ 100V DC						160 ~ 450V DC							
Surge Voltage	V <sub>S</sub>	(V <sub>R</sub> ≤ 315V): V <sub>S</sub> = 1.15·V <sub>R</sub>						(V <sub>R</sub> > 315V): V <sub>S</sub> = 1.10·V <sub>R</sub>							
Capacitance Range	C <sub>R</sub>	1 ~ 6800μF						3.3 ~ 68μF							
Cap. Tolerance	ΔC	±20% (120Hz ■ 20°C)													
Leakage Current (20°C ■ V <sub>R</sub> applied)	I <sub>LEAK</sub>	≤ 0.01·C <sub>R</sub> ·V <sub>R</sub> or 3μA						≤ 0.04·C <sub>R</sub> ·V <sub>R</sub> + 100μA							
		Whichever is greater ■ After 2 minutes						After 1 minute							
		[ I <sub>LEAK</sub> (μA) ; C <sub>R</sub> (μF) ; V <sub>R</sub> (V) ]													
Dissipation Factor % (20°C ■ 120Hz)	tanδ	V <sub>R</sub> (V DC)	4	6.3	10	16	25	35	50	63	80	100	160 ~ 250	>250	
		∅ 4 ~ 6.3	42	30	22	18	16	14	14	12	12	10	-	-	
		∅ 8 ~ 10	45	34	26	20	16	14	14	12	12	10	15	20	
		≥ ∅ 12.5	45	40	36	24	18	15	14	12	12	10	15	20	
Low Temperature Characteristics at 120Hz	Z ratio max.	V <sub>R</sub> (V DC)	4	6.3	10	16	25	35	50	63	80	100	160 ~ 250	400	450
		Z-25°C/Z+20°C	7	4	3	2	2	2	2	3	3	3	3	6	6
		Z-40°C/Z+20°C	15	8	8	4	4	3	3	4	4	4	6	10	15

Lifetime Test			
Endurance 85°C (V <sub>R</sub> applied)	Test	<b>2 000 hours</b>	
	ΔC/C <sub>R</sub>	≤ ±25% of initial measured value	
	tanδ	≤ 200% of initial specified value	
	I <sub>Leak</sub>	≤ the initial specified value	
Shelf Life 85°C (V <sub>R</sub> = 0)	Test	<b>1 000 hours</b>	
	ΔC/C <sub>R</sub>	≤ ±25% of initial measured value	
	tanδ	≤ 200% of initial specified value	
	I <sub>Leak</sub>	≤ the initial specified value	
Before measurement: Restore capacitor to 20°C, apply V <sub>R</sub> for 30 min according JIS-C-5101-4			
Resistance to Soldering Heat	The capacitors shall be kept on a hot plate maintained at 250°C for 30 seconds. After removing from the hot plate and restored at room temperature, they meet the characteristic requirements listed below		
	ΔC/C <sub>R</sub>	Within ±10% of initial value	
	tanδ	Less than specified value	
	I <sub>Leak</sub>	Less than specified value	

**STANDARD RATINGS**

Part number shows blister tape on paper reel

V <sub>R</sub> (V)	Standard	C <sub>R</sub> (μF)	ø D (mm)	L (mm)	I <sub>R</sub> - Max. Ripple Current +85°C - 120Hz (mA rms)	CapXon Part Number	
	Vibration-proof						
4	•	47	4	5.5	28	LV470M004B055ETR □□	
	•	100	5	5.5	34	LV101M004C055ETR □□	
	•	• <sup>1</sup>	150	6.3	6.1	50	LV151M004E061ETR □□
	•	•	220	6.3	5.5	61	LV221M004E055ETR □□
	•	•	330	6.3	7.7	135	LV331M004E077ETR □□
	•	•	330	8	6.5	145	LV331M004F065ETR □□
	•	•	470	8	6.5	180	LV471M004F065ETR □□
	•	•	470	8	10.5	220	LV471M004F105ETR □□
	•	•	560	8	10.5	242	LV561M004F105ETR □□
	•	•	680	8	10.5	285	LV681M004F105ETR □□
	•	•	1000	10	10.5	370	LV102M004G105ETR □□
	•	•	1200	10	10.5	410	LV122M004G105ETR □□
	•	•	1500	10	10.5	470	LV152M004G105ETR □□
6.3	•	22	4	5.5	29	LV220M6R3B055ETR □□	
	•	33	4	5.5	33	LV330M6R3B055ETR □□	
	•	33	5	5.5	37	LV330M6R3C055ETR □□	
	•	47	4	5.5	40	LV470M6R3B055ETR □□	
	•	47	5	5.5	46	LV470M6R3C055ETR □□	
	•	100	5	5.5	70	LV101M6R3C055ETR □□	
	•	• <sup>1</sup>	100	6.3	6.1	85	LV101M6R3E061ETR □□
	•	• <sup>1</sup>	150	6.3	6.1	100	LV151M6R3E061ETR □□
	•	• <sup>1</sup>	220	6.3	6.1	130	LV221M6R3E061ETR □□
	•	•	220	6.3	7.7	141	LV221M6R3E077ETR □□
	•	•	220	8	6.5	150	LV221M6R3F065ETR □□
	•	•	330	6.3	7.7	197	LV331M6R3E077ETR □□
	•	•	330	8	6.5	210	LV331M6R3F065ETR □□
	•	•	470	8	10.5	380	LV471M6R3F105ETR □□
	•	•	560	8	10.5	410	LV561M6R3F105ETR □□
	•	•	680	8	10.5	460	LV681M6R3F105ETR □□
	•	•	1000	8	10.5	480	LV102M6R3F105ETR □□
	•	•	1000	10	10.5	500	LV102M6R3G105ETR □□
	•	•	1200	10	10.5	510	LV122M6R3G105ETR □□
	•	•	1500	10	10.5	530	LV152M6R3G105ETR □□
•	•	3300	12.5	14	750	LV332M6R3Z140ETR □□	
•	•	6800	16	17	1330	LV682M6R3J170ETR □□	
10	•	10	4	5.5	21	LV100M010B055ETR □□	
	•	22	4	5.5	33	LV220M010B055ETR □□	
	•	22	5	5.5	37	LV220M010C055ETR □□	
	•	33	4	5.5	41	LV330M010B055ETR □□	
	•	33	5	5.5	43	LV330M010C055ETR □□	
	•	47	5	5.5	52	LV470M010C055ETR □□	
	•	100	6.3	5.5	76	LV101M010E055ETR □□	
	•	• <sup>1</sup>	150	6.3	6.1	88	LV151M010E061ETR □□
	•	•	220	6.3	7.7	170	LV221M010E077ETR □□

□□ see description at end of standard ratings

 •<sup>1</sup>: Consult CapXon for availability

**STANDARD RATINGS**

Part number shows blister tape on paper reel

V <sub>R</sub> (V)	Standard	C <sub>R</sub> (μF)	ø D (mm)	L (mm)	I <sub>R</sub> - Max. Ripple Current +85°C - 120Hz (mA rms)	CapXon Part Number
	Vibration-proof					
10	●	220	8	6.5	190	LV221M010F065ETR □□
	● ●	330	8	10.5	330	LV331M010F105ETR □□
	● ●	470	8	10.5	420	LV471M010F105ETR □□
	● ●	560	10	10.5	450	LV561M010G105ETR □□
	● ●	680	10	10.5	480	LV681M010G105ETR □□
	● ●	1000	10	10.5	510	LV102M010G105ETR □□
	● ●	2200	12.5	14	730	LV222M010Z140ETR □□
	● ●	4700	16	17	1200	LV472M010J170ETR □□
16	●	10	4	5.5	23	LV100M016B055ETR □□
	●	22	4	5.5	37	LV220M016B055ETR □□
	●	33	5	5.5	45	LV330M016C055ETR □□
	●	47	5	5.5	50	LV470M016C055ETR □□
	●	47	6.3	5.5	60	LV470M016E055ETR □□
	●	100	6.3	5.5	100	LV101M016E055ETR □□
	● ● <sup>1</sup>	100	6.3	6.1	108	LV101M016E061ETR □□
	● ●	150	6.3	7.7	135	LV151M016E077ETR □□
	● ●	220	6.3	7.7	185	LV221M016E077ETR □□
	● ●	220	8	10.5	290	LV221M016F105ETR □□
	● ●	330	8	10.5	330	LV331M016F105ETR □□
	● ●	470	8	10.5	430	LV471M016F105ETR □□
	● ●	470	10	10.5	460	LV471M016G105ETR □□
	● ●	560	10	10.5	500	LV561M016G105ETR □□
	● ●	680	10	10.5	550	LV681M016G105ETR □□
	● ●	1000	12.5	14	600	LV102M016Z140ETR □□
	● ●	1200	12.5	14	660	LV122M016Z140ETR □□
	● ●	1500	12.5	14	710	LV152M016Z140ETR □□
● ●	3300	16	17	1200	LV332M016J170ETR □□	
25	●	4.7	4	5.5	18	LV47R7M025B055ETR □□
	●	10	4	5.5	27	LV100M025B055ETR □□
	●	22	5	5.5	40	LV220M025C055ETR □□
	●	22	6.3	5.5	46	LV220M025E055ETR □□
	●	33	5	5.5	46	LV330M025C055ETR □□
	●	33	6.3	5.5	54	LV330M025E055ETR □□
	●	47	6.3	5.5	60	LV470M025E055ETR □□
	● ● <sup>1</sup>	47	6.3	6.1	68	LV470M025E061ETR □□
	● ●	100	6.3	7.7	150	LV101M025E077ETR □□
	●	100	8	6.5	160	LV101M025F065ETR □□
	● ●	150	8	10.5	200	LV151M025F105ETR □□
	● ●	220	8	10.5	300	LV221M025F105ETR □□
	● ●	330	8	10.5	390	LV331M025F105ETR □□
	● ●	330	10	10.5	450	LV331M025G105ETR □□
	● ●	470	10	10.5	480	LV471M025G105ETR □□
	● ●	560	12.5	14	520	LV561M025Z140ETR □□
	● ●	680	12.5	14	580	LV681M025Z140ETR □□

□□ see description at end of standard ratings

 ●<sup>1</sup>: Consult CapXon for availability

**STANDARD RATINGS**

Part number shows blister tape on paper reel

V <sub>R</sub> (V)	Standard		C <sub>R</sub> (μF)	ø D (mm)	L (mm)	I <sub>R</sub> - Max. Ripple Current +85°C - 120Hz (mA rms)	CapXon Part Number
	Standard	Vibration-proof					
25	●	●	1000	12.5	14	660	LV102M025Z140ETR □□
	●	●	2200	16	17	1150	LV222M025J170ETR □□
35	●		4.7	4	5.5	18	LV4R7M035B055ETR □□
	●		10	4	5.5	29	LV100M035B055ETR □□
	●		22	5	5.5	45	LV220M035C055ETR □□
	●		22	6.3	5.5	48	LV220M035E055ETR □□
	●		33	6.3	5.5	58	LV330M035E055ETR □□
	●		47	6.3	5.5	65	LV470M035E055ETR □□
	●	● <sup>1</sup>	47	6.3	6.1	70	LV470M035E061ETR □□
	●		47	8	6.5	115	LV470M035F065ETR □□
	●	●	100	6.3	7.7	250	LV101M035E077ETR □□
	●	●	100	8	10.5	280	LV101M035F105ETR □□
	●	●	150	8	10.5	300	LV151M035F105ETR □□
	●	●	220	8	10.5	350	LV221M035F105ETR □□
	●	●	220	10	10.5	400	LV221M035G105ETR □□
	●	●	330	10	10.5	460	LV331M035G105ETR □□
	●	●	470	12.5	14	590	LV471M035Z140ETR □□
	●	●	560	12.5	14	600	LV561M035Z140ETR □□
	●	●	680	12.5	14	610	LV681M035Z140ETR □□
	●	●	1500	16	17	1060	LV152M035J170ETR □□
50	●		1	4	5.5	8.4	LV010M050B055ETR □□
	●		2.2	4	5.5	14	LV2R2M050B055ETR □□
	●		3.3	4	5.5	17	LV3R3M050B055ETR □□
	●		4.7	4	5.5	22	LV4R7M050B055ETR □□
	●		10	5	5.5	30	LV100M050C055ETR □□
	●		10	6.3	5.5	35	LV100M050E055ETR □□
	●	● <sup>1</sup>	22	6.3	6.1	60	LV220M050E061ETR □□
	●	●	22	6.3	7.7	75	LV220M050E077ETR □□
	●		22	8	6.5	80	LV220M050F065ETR □□
	●	●	33	6.3	7.7	188	LV330M050E077ETR □□
	●		33	8	6.5	200	LV330M050F065ETR □□
	●	●	47	6.3	7.7	225	LV470M050E077ETR □□
	●		47	8	6.5	240	LV470M050F065ETR □□
	●	●	100	8	10.5	300	LV101M050F105ETR □□
	●	●	150	10	10.5	320	LV151M050G105ETR □□
	●	●	220	10	10.5	450	LV221M050G105ETR □□
	●	●	330	12.5	14	520	LV331M050Z140ETR □□
	●	●	470	16	17	925	LV471M050J170ETR □□
●	●	1000	16	17	940	LV102M050J170ETR □□	

□□ see description at end of standard ratings

 ●<sup>1</sup>: Consult CapXon for availability

**STANDARD RATINGS**

Part number shows blister tape on paper reel

V <sub>R</sub> (V)	Standard		C <sub>R</sub> (μF)	ø D (mm)	L (mm)	I <sub>R</sub> - Max. Ripple Current +85°C - 120Hz (mA rms)	CapXon Part Number
	Standard	Vibration-proof					
63	•		1	4	5.5	8.4	LV010M063B055ETR □□
	•		2.2	4	5.5	14	LV2R2M063B055ETR □□
	•		3.3	5	5.5	18	LV3R3M063C055ETR □□
	•		4.7	5	5.5	23	LV4R7M063C055ETR □□
	•		4.7	6.3	5.5	27	LV4R7M063E055ETR □□
	•		10	6.3	5.5	35	LV100M063E055ETR □□
	•	•	22	6.3	7.7	75	LV220M063E077ETR □□
	•		22	8	6.5	75	LV220M063F065ETR □□
	•	•	33	8	10.5	160	LV330M063F105ETR □□
	•	•	47	8	10.5	170	LV470M063F105ETR □□
	•	•	100	10	10.5	270	LV101M063G105ETR □□
	•	•	100	12.5	14	340	LV101M063Z140ETR □□
	•	•	150	12.5	14	380	LV151M063Z140ETR □□
	•	•	220	12.5	14	460	LV221M063Z140ETR □□
	•	•	330	16	17	560	LV331M063J170ETR □□
•	•	470	16	17	700	LV471M063J170ETR □□	
80	•		1	4	5.5	8	LV010M080B055ETR □□
	•		2.2	5	5.5	16	LV2R2M080C055ETR □□
	•		3.3	6.3	5.5	25	LV3R3M080E055ETR □□
	•		4.7	6.3	5.5	30	LV4R7M080E055ETR □□
	•	•	10	6.3	7.7	40	LV100M080E077ETR □□
	•	•	22	6.3	7.7	70	LV220M080E077ETR □□
	•	•	33	8	10.5	160	LV330M080F105ETR □□
	•	•	47	10	10.5	195	LV470M080G105ETR □□
	•	•	100	12.5	14	380	LV101M080Z140ETR □□
	•	•	150	12.5	14	450	LV151M080Z140ETR □□
	•	•	220	16	17	550	LV221M080J170ETR □□
100	•		1	4	5.5	8	LV010M100B055ETR □□
	•		2.2	6.3	5.5	18	LV2R2M100E055ETR □□
	•	• <sup>1</sup>	2.2	6.3	6.1	20	LV2R2M100E061ETR □□
	•		3.3	6.3	5.5	25	LV3R3M100E055ETR □□
	•	• <sup>1</sup>	3.3	6.3	6.1	28	LV3R3M100E061ETR □□
	•	•	4.7	6.3	7.7	38	LV4R7M100E077ETR □□
	•		4.7	8	6.5	38	LV4R7M100F065ETR □□
	•	•	10	6.3	7.7	50	LV100M100E077ETR □□
	•	•	22	8	10.5	120	LV220M100F105ETR □□
	•	•	33	10	10.5	190	LV330M100G105ETR □□
	•	•	47	12.5	14	330	LV470M100Z140ETR □□
	•	•	100	12.5	14	380	LV101M100Z140ETR □□
	•	•	150	16	17	560	LV151M100J170ETR □□

□□ see description at end of standard ratings

 •<sup>1</sup>: Consult CapXon for availability

**STANDARD RATINGS**

Part number shows blister tape on paper reel

V <sub>R</sub> (V)	Standard	Vibration-proof	C <sub>R</sub> (μF)	ø D (mm)	L (mm)	I <sub>R</sub> - Max. Ripple Current +85°C - 120Hz (mA rms)	CapXon Part Number
	●	●					
160	●	●	10	8	10.5	70	LV100M160F105ETR ☐☐
	●	●	12	8	10.5	80	LV120M160F105ETR ☐☐
	●	●	18	10	10.5	100	LV180M160G105ETR ☐☐
	●	●	22	10	10.5	150	LV220M160G105ETR ☐☐
	●	●	27	12.5	14	235	LV270M160Z140ETR ☐☐
	●	●	33	12.5	14	250	LV330M160Z140ETR ☐☐
	●	●	39	12.5	14	270	LV390M160Z140ETR ☐☐
	●	●	47	16	17	400	LV470M160J170ETR ☐☐
200	●	●	10	10	10.5	100	LV100M200G105ETR ☐☐
	●	●	10	12.5	14	130	LV100M200Z140ETR ☐☐
	●	●	22	12.5	14	235	LV220M200Z140ETR ☐☐
	●	●	27	12.5	14	250	LV270M200Z140ETR ☐☐
	●	●	33	12.5	14	270	LV330M200Z140ETR ☐☐
	●	●	39	16	17	370	LV390M200J170ETR ☐☐
	●	●	47	16	17	420	LV470M200J170ETR ☐☐
	●	●	68	16	17	520	LV680M200J170ETR ☐☐
250	●	●	4.7	8	10.5	70	LV4R7M250F105ETR ☐☐
	●	●	6.8	10	10.5	95	LV6R8M250G105ETR ☐☐
	●	●	10	10	10.5	115	LV100M250G105ETR ☐☐
	●	●	15	12.5	14	180	LV150M250Z140ETR ☐☐
	●	●	22	16	17	280	LV220M250J170ETR ☐☐
	●	●	27	16	17	305	LV270M250J170ETR ☐☐
	●	●	33	16	17	340	LV330M250J170ETR ☐☐
	●	●	39	16	17	370	LV390M250J170ETR ☐☐
400	●	●	47	16	17	430	LV470M250J170ETR ☐☐
	●	●	3.3	10	10.5	50	LV3R3M400G105ETR ☐☐
	●	●	4.7	10	10.5	90	LV4R7M400G105ETR ☐☐
	●	●	4.7	12.5	14	115	LV4R7M400Z140ETR ☐☐
	●	●	6.8	12.5	14	130	LV6R8M400Z140ETR ☐☐
	●	●	8.2	12.5	14	140	LV8R2M400Z140ETR ☐☐
	●	●	10	12.5	14	145	LV100M400Z140ETR ☐☐
	●	●	10	16	17	160	LV100M400J170ETR ☐☐
	●	●	12	16	17	175	LV120M400J170ETR ☐☐
	●	●	15	16	17	170	LV150M400J170ETR ☐☐
	●	●	18	16	17	195	LV180M400J170ETR ☐☐
●	●	22	16	17	235	LV220M400J170ETR ☐☐	

☐☐ see description at end of standard ratings

 ●<sup>1</sup>: Consult CapXon for availability



## STANDARD RATINGS

Part number shows blister tape on paper reel

$V_R$ (V)	Standard	Vibration-proof	$C_R$ ( $\mu F$ )	$\phi D$ (mm)	L (mm)	$I_R$ - Max. Ripple Current +85°C - 120Hz (mA rms)	CapXon Part Number
	•	•					
450	•	•	4.7	12.5	14	115	LV4R7M450Z14OETR □□
	•	•	6.8	12.5	14	130	LV6R8M450Z14OETR □□
	•	•	8.2	12.5	14	140	LV8R2M450Z14OETR □□
	•	•	10	12.5	14	145	LV100M450Z14OETR □□
	•	•	10	16	17	160	LV100M450J17OETR □□
	•	•	12	16	17	175	LV120M450J17OETR □□
	•	•	15	16	17	170	LV150M450J17OETR □□
	•	•	18	16	17	195	LV180M450J17OETR □□
	•	•	22	16	17	235	LV220M450J17OETR □□

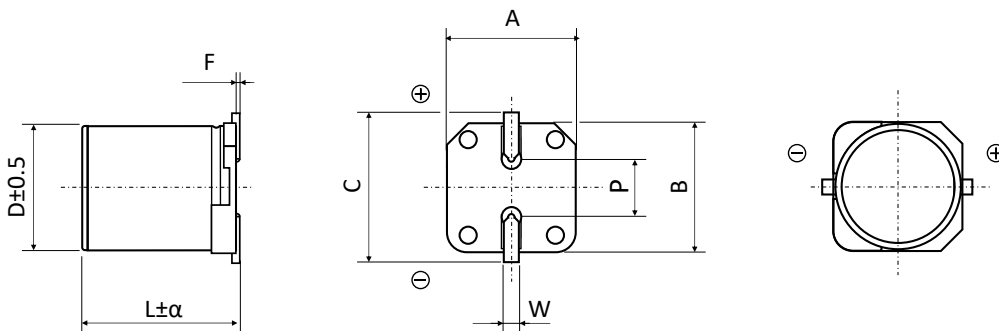
□□: Enter **blank** for Standard package

□□: Enter **X** for AEC-Q200

□□: Enter **W** for Vibration proof version

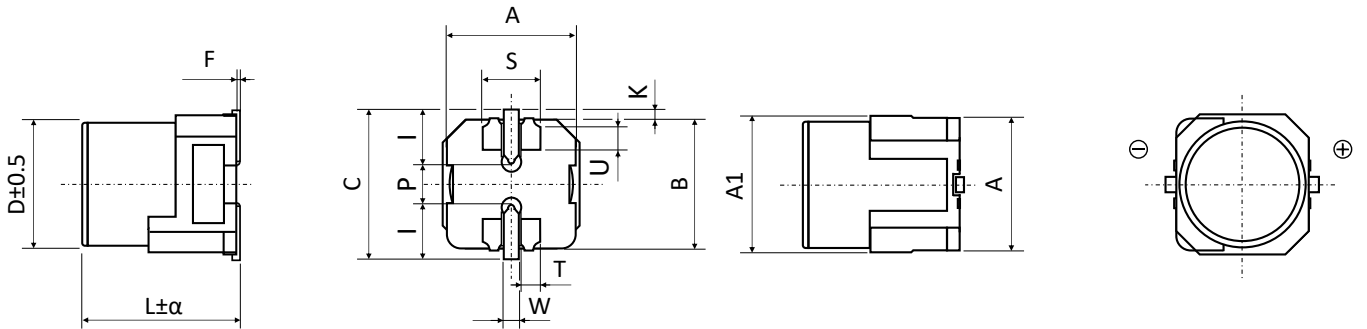
□□: Enter **XW** for AEC-Q200 and Vibration proof version

## DIMENSIONS STANDARD PACKAGE ▪ All dimensions in mm



$\phi D$	L	$\alpha$	A $\pm 0.2$	B $\pm 0.2$	C $\pm 0.2$	F	P $\pm 0.2$	W
4.0	5.5	Max	4.3	4.3	4.9	0.3 max.	1.0	0.5 to 0.8
5.0	5.5	Max	5.3	5.3	5.9	0.3 max.	1.4	0.5 to 0.8
6.3	5.5	0.2	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
6.3	6.1	Max	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
6.3	7.7	Max	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
8.0	6.5	Max	8.3	8.3	9.0	0.3 max.	2.3	0.5 to 0.8
8.0	10.5	Max	8.3	8.3	9.0	0.3 max.	3.1	0.7 to 1.1
10.0	10.5	Max	10.3	10.3	11.0	0.3 max.	4.5	0.7 to 1.1
12.5	14.0	Max	13.0	13.0	13.9	0.3 max.	4.5	1 to 1.4
16.0	17.0	0.5	17.0	17.0	18.0	0.3 max.	6.6	1 to 1.4

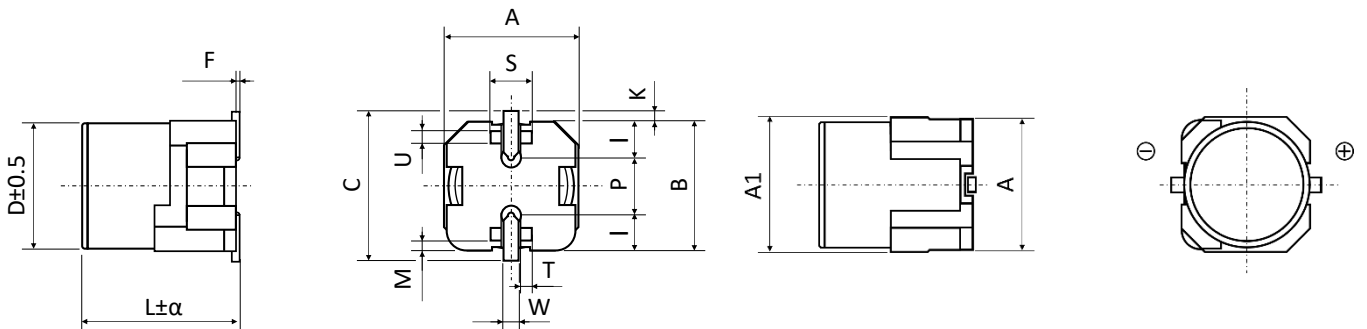
## DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D6.3 ▪ All dimensions in mm



ø D	L	α	A ± 0.2	A1 (max.)	B ± 0.2	C (max.)	F	K
6.3	6.1	0.3	6.6	7.1	6.6	7.8	0 to 0.15	0.35 +0.15/-0.2
6.3	8.0	0.3	6.6	7.1	6.6	7.8	0 to 0.15	0.35 +0.15/-0.2

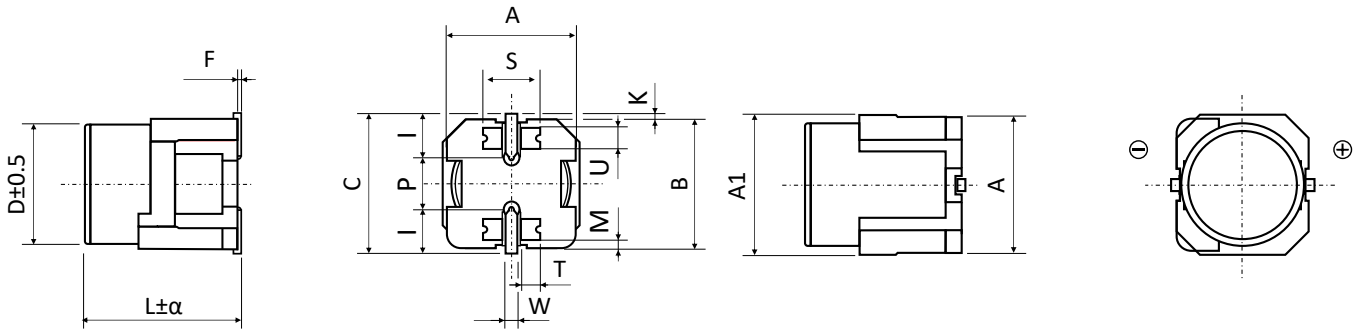
ø D	L	P ± 0.2	S ± 0.1	I ± 0.1	T ± 0.1	U ± 0.1	W ± 0.1
6.3	6.1	2.2	2.9	2.4	1.1	1.55	0.65
6.3	8.0	2.2	2.9	2.4	1.1	1.55	0.65

## DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D8 and D10 ▪ All dimensions in mm



ø D	L	α	A ± 0.2	A1 (max.)	B ± 0.2	C (max.)	F	K ± 0.2
8.0	10.5	0.5	8.3	8.8	8.3	10.0	0 to 0.15	0.7
10.0	10.5	0.5	10.3	10.8	10.3	12.0	0 to 0.15	0.7

ø D	L	P ± 0.2	S ± 0.1	I ± 0.1	T ± 0.1	U ± 0.1	W ± 0.1	M ± 0.1
8.0	10.5	3.1	3	3.4	1.4	0.7	1.2	0.7
10.0	10.5	4.6	3.3	3.5	1.5	0.8	1.2	0.9

**DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D12.5 and D16** ▪ All dimensions in mm


$\phi D$	L	$\alpha$	$A \pm 0.2$	A1 (max.)	$B \pm 0.2$	C (max.)	F	$K \pm 0.3$
12.5	14.0	1.0	13.5	13.5	13.5	15.0	0 to 0.15	0.7
16.0	17.0	1.0	17.0	17.0	17.0	19.0	0 to 0.15	0.7

$\phi D$	L	$P \pm 0.2$	$S \pm 0.1$	$I \pm 0.1$	$T \pm 0.1$	$U \pm 0.1$	$W \pm 0.1$	$M \pm 0.1$
12.5	14.0	4.4	6.0	4.7	2.0	2.2	1.2	0.95
16.0	17.0	6.7	5.8	5.5	2.0	3.0	1.4	1.0

**MULTIPLIER  $K_f$  for RIPPLE CURRENT vs. FREQUENCY**

$C_R$ ( $\mu F$ ) / Frequency (Hz)	50/60	100/120	500	1k	$\geq 10k$
$1 \leq C_R \leq 100$	0.8	1	1.2	1.3	1.5
$100 < C_R \leq 6800$	0.8	1	1.1	1.15	1.2

**PRECAUTIONS, GUIDELINES AND PACKAGING INFORMATION**

Unless otherwise agreed in individual specifications, all products are subject to our “General Precautions and Guidelines” as well as our “Packaging Information”. Please refer to the following links in the table.

General Precautions and Guidelines	Packaging Information Liquid SMD
Page 104	Page 95



### DISCLAIMER

All product related data (e.g. specification, statements and general information) are subject to change without any notice. It is necessary that the customer observes all product related technical / application information and handling instructions.

CapXon products are designed and manufactured according to severe quality and safety standards. Under no circumstance, CapXon warrants that any CapXon product is suitable for the purposes intended for your application, even CapXon knows the application. It is customer's duty and obligation to check and make sure that CapXon products are suitable for the purposes intended and select the correct and proper CapXon product. Customers are requested to perform a sufficient validation and reliability evaluation to assure needed safety level and reliability performance by suitable designs and to apply proper safeguards (e.g. redundancies, protective circuits).

Particular operating conditions (ambient temperature, ripple current, voltage, thermal resistance, etc.) as well as storage, production or assembly may affect the performance and the lifetime of the capacitor. Please consult CapXon for lifetime estimation, failure mode considerations or worst-case scenarios according to the product technology, product tolerances / deviations or change of the characteristics of the capacitor due to shipment, storage, handling, production and usage.

For aerospace or military application, life-saving, life-sustaining, safety critical applications or any application where failure may cause severe personal injury or death, please consult us before design-in the capacitor in your application.

Except for the written expressed warranties, CapXon does not impliedly, by assumption or whatever else, warrant, undertake, promise any other warranty or guaranty for any CapXon product.

For further information, please visit our website [www.capxongroup.com](http://www.capxongroup.com) or contact CapXon directly.

### EV SERIES ■ STANDARD, AUTOMOTIVE 105°C TYPE

#### KEY FEATURES



- ALUMINUM ELECTROLYTIC CAPACITOR ■ SMD type
- Endurance: 105°C ■ 1 000 hours
- Small dimensions
- Vibration-proof (VP) version (up to 30g) available upon request
- AEC-Q200 version available



#### SPECIFICATIONS

Items		Performance Characteristics						
Operating Temperature Range		-55 ~ +105°C						
Rated Voltage Range	$V_R$	6.3 ~ 50V DC						
Surge Voltage	$V_S$	$V_S = 1.15 \cdot V_R$						
Capacitance Range	$C_R$	1 ~ 1500 $\mu$ F						
Cap. Tolerance	$\Delta C$	$\pm 20\%$ (120Hz ■ 20°C)						
Leakage Current (20°C ■ $V_R$ applied)	$I_{LEAK}$	$\leq 0.01 \cdot C_R \cdot V_R$ or 3 $\mu$ A, whichever is greater ■ After 2 minutes [ $I_{LEAK}$ ( $\mu$ A) ; $C_R$ ( $\mu$ F) ; $V_R$ (V) ]						
Dissipation Factor % (20°C ■ 120Hz)	$\tan \delta$	$V_R$ (V DC)	6.3	10	16	25	35	50
		$\phi 4$ to 6.3	30	24	20	18	16	14
		$\phi 8$ to 10	35	28	24	18	16	14
Low Temperature Characteristics at 120Hz	Z ratio max.	$V_R$ (V DC)	6.3	10	16	25	35	50
		Z-25°C/Z+20°C	4	3	2	2	2	2
		Z-40°C/Z+20°C	6	6	4	4	3	3
		Z-55°C/Z+20°C	8	8	6	4	3	3
Lifetime Test								
Endurance 105°C ( $V_R$ applied)	Test	1 000 hours						
	$\Delta C/C_R$	$\leq \pm 25\%$ of initial measured value					$\leq 16V$	
		$\leq \pm 20\%$ of initial measured value					$\geq 25V$	
	$\tan \delta$	$\leq 200\%$ of initial specified value						
$I_{Leak}$	$\leq$ the initial specified value							
Shelf Life 105°C ( $V_R = 0$ )	Test	1 000 hours						
	$\Delta C/C_R$	$\leq \pm 25\%$ of initial measured value					$\leq 16V$	
		$\leq \pm 20\%$ of initial measured value					$\geq 25V$	
	$\tan \delta$	$\leq 200\%$ of initial specified value						
$I_{Leak}$	$\leq$ the initial specified value							
		Before measurement: Restore capacitor to 20°C, apply $V_R$ for 30 min acc. JIS-C-5101-4						
Resistance to Soldering Heat	The capacitors shall be kept on a hot plate maintained at 250°C for 30 seconds. After removing from the hot plate and restored at room temperature, they meet the characteristic requirements listed below							
	$\Delta C/C_R$	Within $\pm 10\%$ of initial value						
	$\tan \delta$	Less than specified value						
	$I_{Leak}$	Less than specified value						

**STANDARD RATINGS**

Part number shows blister tape on paper reel

V <sub>R</sub> (V)	Standard	C <sub>R</sub> (μF)	ø D (mm)	L (mm)	I <sub>R</sub> - Max. Ripple Current +105°C - 120Hz (mA rms)	CapXon Part Number	
	Vibration-proof						
6.3	•	22	4	5.5	22	EV220M6R3B055ETR □□	
	•	33	4	5.5	30	EV330M6R3B055ETR □□	
	•	47	4	5.5	36	EV470M6R3B055ETR □□	
	•	100	5	5.5	60	EV101M6R3C055ETR □□	
	•	150	6.3	5.5	86	EV151M6R3E055ETR □□	
	•	220	6.3	5.5	89	EV221M6R3E055ETR □□	
	•	•	220	6.3	7.7	102	EV221M6R3E077ETR □□
	•	•	220	8	6.5	102	EV221M6R3F065ETR □□
	•	•	330	6.3	7.7	105	EV331M6R3E077ETR □□
	•	•	330	8	6.5	105	EV331M6R3F065ETR □□
	•	•	470	8	10.5	210	EV471M6R3F105ETR □□
	•	•	1000	8	10.5	202	EV102M6R3F105ETR □□
	•	•	1000	10	10.5	230	EV102M6R3G105ETR □□
	•	•	1500	10	10.5	310	EV152M6R3G105ETR □□
10	•	22	4	5.5	27	EV220M010B055ETR □□	
	•	33	4	5.5	25	EV330M010B055ETR □□	
	•	33	5	5.5	40	EV330M010C055ETR □□	
	•	47	5	5.5	46	EV470M010C055ETR □□	
	•	100	5	5.5	52	EV101M010C055ETR □□	
	•	100	6.3	5.5	60	EV101M010E055ETR □□	
	•	150	6.3	5.5	86	EV151M010E055ETR □□	
	•	•	220	6.3	7.7	105	EV221M010E077ETR □□
	•	•	220	8	6.5	105	EV221M010F065ETR □□
	•	•	330	8	10.5	195	EV331M010F105ETR □□
	•	•	470	8	10.5	210	EV471M010F105ETR □□
	•	•	1000	10	10.5	310	EV102M010G105ETR □□
16	•	10	4	5.5	18	EV100M016B055ETR □□	
	•	22	4	5.5	30	EV220M016B055ETR □□	
	•	33	5	5.5	40	EV330M016C055ETR □□	
	•	47	5	5.5	51	EV470M016C055ETR □□	
	•	100	6.3	5.5	60	EV101M016E055ETR □□	
	•	•	150	6.3	7.7	95	EV151M016E077ETR □□
	•	•	150	8	6.5	95	EV151M016F065ETR □□
	•	•	220	6.3	7.7	105	EV221M016E077ETR □□
	•	•	330	8	10.5	195	EV331M016F105ETR □□
	•	•	470	8	10.5	210	EV471M016F105ETR □□
25	•	4.7	4	5.5	16	EV470M025B055ETR □□	
	•	10	4	5.5	26	EV100M025B055ETR □□	
	•	22	5	5.5	38	EV220M025C055ETR □□	
	•	33	5	5.5	48	EV330M025C055ETR □□	
	•	47	6.3	5.5	63	EV470M025E055ETR □□	
	•	•	100	6.3	7.7	91	EV101M025E077ETR □□
	•	•	100	8	6.5	91	EV101M025F065ETR □□
	•	•	150	8	10.5	140	EV151M025F105ETR □□

□□ see description at end of standard ratings



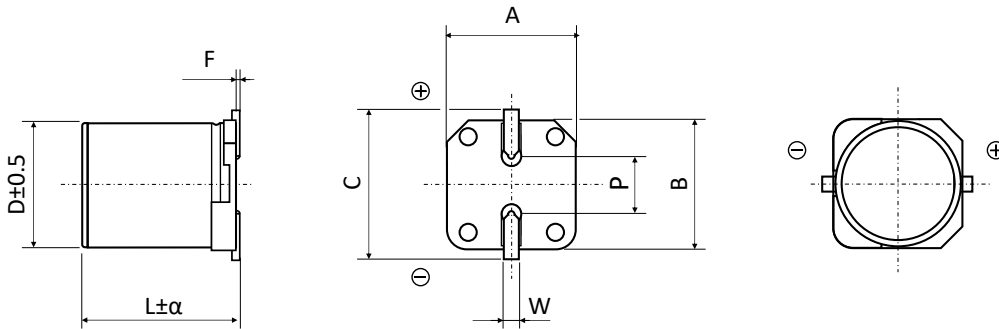
## STANDARD RATINGS

Part number shows blister tape on paper reel

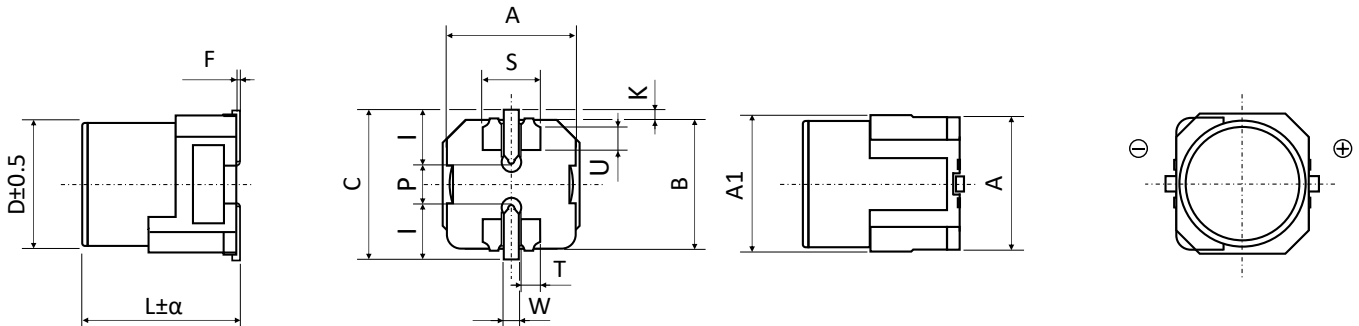
V <sub>R</sub> (V)	Standard		C <sub>R</sub> (μF)	ø D (mm)	L (mm)	I <sub>R</sub> - Max. Ripple Current +105°C - 120Hz (mA rms)	CapXon Part Number	
	Standard	Vibration-proof						
25	•	•	220	8	10.5	155	EV221M025F105ETR □□	
	•	•	330	8	10.5	175	EV331M025F105ETR □□	
	•	•	330	10	10.5	198	EV331M025G105ETR □□	
	•	•	470	10	10.5	300	EV471M025G105ETR □□	
35	•		4.7	4	5.5	16	EV47M035B055ETR □□	
	•		10	4	5.5	27	EV100M035B055ETR □□	
	•		22	5	5.5	37	EV220M035C055ETR □□	
	•		22	6.3	5.5	42	EV220M035E055ETR □□	
	•		33	6.3	5.5	50	EV330M035E055ETR □□	
	•	•	33	6.3	7.7	58	EV330M035E077ETR □□	
	•		47	6.3	5.5	58	EV470M035E055ETR □□	
	•	•	47	6.3	7.7	66	EV470M035E077ETR □□	
	•	•	100	6.3	7.7	84	EV101M035E077ETR □□	
	•		100	8	6.5	84	EV101M035F065ETR □□	
	•	•	150	8	10.5	155	EV151M035F105ETR □□	
	•	•	220	8	10.5	167	EV221M035F105ETR □□	
	•	•	220	10	10.5	190	EV221M035G105ETR □□	
	•	•	330	10	10.5	300	EV331M035G105ETR □□	
	50	•		1	4	5.5	6.3	EV010M050B055ETR □□
		•		2.2	4	5.5	11	EV22M050B055ETR □□
•			3.3	4	5.5	14	EV33M050B055ETR □□	
•			4.7	4	5.5	19	EV47M050B055ETR □□	
•			4.7	5	5.5	22	EV47M050C055ETR □□	
•			10	5	5.5	29	EV100M050C055ETR □□	
•			10	6.3	5.5	33	EV100M050E055ETR □□	
•			22	6.3	5.5	51	EV220M050E055ETR □□	
•		•	33	6.3	7.7	60	EV330M050E077ETR □□	
•			33	8	6.5	60	EV330M050F065ETR □□	
•			47	6.3	7.7	66	EV470M050E077ETR □□	
•			47	8	6.5	66	EV470M050F065ETR □□	
•		•	100	8	10.5	140	EV101M050F105ETR □□	
•		•	150	10	10.5	180	EV151M050G105ETR □□	
•		•	220	10	10.5	220	EV221M050G105ETR □□	

□□: Enter **blank** for Standard package  
 □□: Enter **W** for Vibration proof version

□□: Enter **X** for AEC-Q200  
 □□: Enter **XW** for AEC-Q200 and Vibration proof version

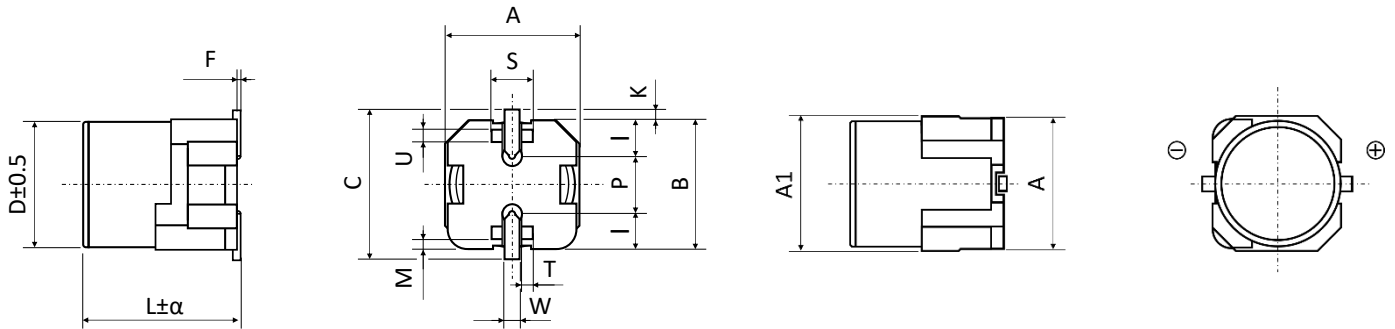
**DIMENSIONS STANDARD PACKAGE** ▪ All dimensions in mm


∅ D	L	α	A ± 0.2	B ± 0.2	C ± 0.2	F	P ± 0.2	W
4.0	5.5	Max	4.3	4.3	4.9	0.3 max.	1.0	0.5 to 0.8
5.0	5.5	Max	5.3	5.3	5.9	0.3 max.	1.4	0.5 to 0.8
6.3	5.5	0.2	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
6.3	7.7	Max	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
8.0	6.5	Max	8.3	8.3	9.0	0.3 max.	2.3	0.5 to 0.8
8.0	10.5	Max	8.3	8.3	9.0	0.3 max.	3.1	0.7 to 1.1
10.0	10.5	Max	10.3	10.3	11.0	0.3 max.	4.5	0.7 to 1.1

**DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D6.3** ▪ All dimensions in mm


∅ D	L	α	A ± 0.2	A1 (max.)	B ± 0.2	C (max.)	F	K
6.3	8.0	0.3	6.6	7.1	6.6	7.8	0 to 0.15	0.35 +0.15/-0.2

∅ D	L	P ± 0.2	S ± 0.1	I ± 0.1	T ± 0.1	U ± 0.1	W ± 0.1
6.3	8.0	2.2	2.9	2.4	1.1	1.55	0.65

**DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D8 and D10 ▪ All dimensions in mm**


$\phi D$	L	$\alpha$	$A \pm 0.2$	A1 (max.)	$B \pm 0.2$	C (max.)	F	$K \pm 0.2$
8.0	10.5	0.5	8.3	8.8	8.3	10.0	0 to 0.15	0.7
10.0	10.5	0.5	10.3	10.8	10.3	12.0	0 to 0.15	0.7

$\phi D$	L	$P \pm 0.2$	$S \pm 0.1$	$I \pm 0.1$	$T \pm 0.1$	$U \pm 0.1$	$W \pm 0.1$	$M \pm 0.1$
8.0	10.5	3.1	3	3.4	1.4	0.7	1.2	0.7
10.0	10.5	4.6	3.3	3.5	1.5	0.8	1.2	0.9

**MULTIPLIER  $K_f$  for RIPPLE CURRENT vs. FREQUENCY**

$C_R$ ( $\mu F$ ) / Frequency (Hz)	50/60	100/120	500	1k	$\geq 10k$
$1 \leq C_R \leq 100$	0.8	1	1.2	1.3	1.5
$100 < C_R \leq 1500$	0.8	1	1.1	1.15	1.2

**PRECAUTIONS, GUIDELINES AND PACKAGING INFORMATION**

Unless otherwise agreed in individual specifications, all products are subject to our “General Precautions and Guidelines” as well as our “Packaging Information”. Please refer to the following links in the table.

General Precautions and Guidelines	Packaging Information Liquid SMD
Page 104	Page 95



### DISCLAIMER

All product related data (e.g. specification, statements and general information) are subject to change without any notice. It is necessary that the customer observes all product related technical / application information and handling instructions.

CapXon products are designed and manufactured according to severe quality and safety standards. Under no circumstance, CapXon warrants that any CapXon product is suitable for the purposes intended for your application, even CapXon knows the application. It is customer's duty and obligation to check and make sure that CapXon products are suitable for the purposes intended and select the correct and proper CapXon product. Customers are requested to perform a sufficient validation and reliability evaluation to assure needed safety level and reliability performance by suitable designs and to apply proper safeguards (e.g. redundancies, protective circuits).

Particular operating conditions (ambient temperature, ripple current, voltage, thermal resistance, etc.) as well as storage, production or assembly may affect the performance and the lifetime of the capacitor. Please consult CapXon for lifetime estimation, failure mode considerations or worst-case scenarios according to the product technology, product tolerances / deviations or change of the characteristics of the capacitor due to shipment, storage, handling, production and usage.

For aerospace or military application, life-saving, life-sustaining, safety critical applications or any application where failure may cause severe personal injury or death, please consult us before design-in the capacitor in your application.

Except for the written expressed warranties, CapXon does not impliedly, by assumption or whatever else, warrant, undertake, promise any other warranty or guaranty for any CapXon product.

For further information, please visit our website [www.capxongroup.com](http://www.capxongroup.com) or contact CapXon directly.

### HV SERIES ▪ HIGH VOLTAGE, AUTOMOTIVE 105°C TYPE

#### KEY FEATURES



- ALUMINUM ELECTROLYTIC CAPACITOR ▪ SMD type
- Endurance: 105°C ▪ 2 000 hours
- Low ESR and high ripple current
- Vibration-proof (VP) version (up to 30g) available upon request
- AEC-Q200 version available



#### SPECIFICATIONS

Items		Performance Characteristics												
Operating Temperature Range		-55 ~ +105°C						-40 ~ +105°C						
Rated Voltage Range	V <sub>R</sub>	6.3 ~ 100V DC						160 ~ 450V DC						
Surge Voltage	V <sub>S</sub>	(V <sub>R</sub> ≤ 315V): V <sub>S</sub> = 1.15·V <sub>R</sub>						(V <sub>R</sub> > 315V): V <sub>S</sub> = 1.10·V <sub>R</sub>						
Capacitance Range	C <sub>R</sub>	1 ~ 6800μF						2.2 ~ 68μF						
Cap. Tolerance	ΔC	±20% (120Hz ▪ 20°C)												
Leakage Current (20°C ▪ V <sub>R</sub> applied)	I <sub>LEAK</sub>	≤ 0.01·C <sub>R</sub> ·V <sub>R</sub> or 3μA						≤ 0.04·C <sub>R</sub> ·V <sub>R</sub> + 100μA						
		Whichever is greater ▪ After 2 minutes						After 1 minute						
		[ I <sub>LEAK</sub> (μA) ; C <sub>R</sub> (μF) ; V <sub>R</sub> (V) ]												
Dissipation Factor % (20°C ▪ 120Hz)	tanδ	V <sub>R</sub> (V DC)	6.3	10	16	25	35	50	63	80	100	160 ~ 250	>250	
		∅ 4 ~ 6.3	30	24	20	16	14	14	12	10	10	-	-	
		∅ 8 ~ 10	35	26	24	18	14	14	12	10	10	15	20	
		≥ ∅ 12.5	37	34	24	18	14	14	12	10	10	15	20	
Low Temperature Characteristics at 120Hz	Z ratio max.	V <sub>R</sub> (V DC)	6.3	10	16	25	35	50	63	80	100	160 ~ 250	400	450
		Z-25°C/Z+20°C	6	4	4	3	2	2	2	3	3	3	6	6
		Z-40°C/Z+20°C	12	10	8	6	4	4	4	4	4	6	10	15
		Z-55°C/Z+20°C	14	12	10	6	4	4	4	4	4	6	10	15
Lifetime Test														
Endurance 105°C (V <sub>R</sub> applied)	Test	2 000 hours												
	ΔC/C <sub>R</sub>	≤ ±30% of initial measured value												
	tanδ	≤ 300% of initial specified value												
	I <sub>Leak</sub>	≤ the initial specified value												
Shelf Life 105°C (V <sub>R</sub> = 0)	Test	1 000 hours												
	ΔC/C <sub>R</sub>	≤ ±30% of initial measured value												
	tanδ	≤ 300% of initial specified value												
	I <sub>Leak</sub>	≤ the initial specified value												
		Before measurement: Restore capacitor to 20°C, apply V <sub>R</sub> for 30 min according JIS-C-5101-4												
Resistance to Soldering Heat	The capacitors shall be kept on a hot plate maintained at 250°C for 30 seconds. After removing from the hot plate and restored at room temperature, they meet the characteristic requirements listed below													
	ΔC/C <sub>R</sub>	Within ±10% of initial value												
	tanδ	Less than specified value												
	I <sub>Leak</sub>	Less than specified value												



**STANDARD RATINGS**

Part number shows blister tape on paper reel

V <sub>R</sub> (V)	Standard	C <sub>R</sub> (μF)	ø D (mm)	L (mm)	I <sub>R</sub> - Max. Ripple Current +105°C - 120Hz (mA rms)	CapXon Part Number	
	Vibration-proof						
6.3	•	22	4	5.5	23	HV220M6R3B055ETR □□	
	•	33	4	5.5	28	HV330M6R3B055ETR □□	
	•	47	4	5.5	37	HV470M6R3B055ETR □□	
	•	47	5	5.5	40	HV470M6R3C055ETR □□	
	•	100	5	5.5	46	HV101M6R3C055ETR □□	
	•	100	6.3	5.5	57	HV101M6R3E055ETR □□	
	•	150	6.3	5.5	70	HV151M6R3E055ETR □□	
	•	150	8	6.5	90	HV151M6R3F065ETR □□	
	•	•	220	6.3	7.7	90	HV221M6R3E077ETR □□
	•	•	220	8	6.5	130	HV221M6R3F065ETR □□
	•	•	330	6.3	7.7	140	HV331M6R3E077ETR □□
	•	•	330	8	10.5	170	HV331M6R3F105ETR □□
	•	•	470	8	10.5	210	HV471M6R3F105ETR □□
	•	•	560	8	10.5	310	HV561M6R3F105ETR □□
	•	•	680	8	10.5	330	HV681M6R3F105ETR □□
	•	•	680	10	10.5	370	HV681M6R3G105ETR □□
	•	•	1000	8	10.5	420	HV102M6R3F105ETR □□
	•	•	1000	10	10.5	480	HV102M6R3G105ETR □□
	10	•	22	4	5.5	25	HV220M010B055ETR □□
		•	33	4	5.5	34	HV330M010B055ETR □□
•		47	5	5.5	42	HV470M010C055ETR □□	
•		100	6.3	5.5	55	HV101M010E055ETR □□	
•		100	8	6.5	60	HV101M010F065ETR □□	
•		150	6.3	5.5	90	HV151M010E055ETR □□	
•		150	8	6.5	110	HV151M010F065ETR □□	
•		•	220	6.3	7.7	140	HV221M010E077ETR □□
•		•	220	8	6.5	160	HV221M010F065ETR □□
•		•	330	8	10.5	195	HV331M010F105ETR □□
•		•	470	8	10.5	350	HV471M010F105ETR □□
•		•	470	10	10.5	420	HV471M010G105ETR □□
•		•	560	10	10.5	450	HV561M010G105ETR □□
•		•	680	10	10.5	480	HV681M010G105ETR □□
•		•	1000	10	10.5	530	HV102M010G105ETR □□
•		•	1200	12.5	14	570	HV122M010Z140ETR □□
•		•	1500	12.5	14	750	HV152M010Z140ETR □□
•		•	4700	16	17	880	HV472M010J170ETR □□

□□ see description at end of standard ratings

 •<sup>1</sup>: Consult CapXon for availability

**STANDARD RATINGS**

Part number shows blister tape on paper reel

V <sub>R</sub> (V)	Standard	C <sub>R</sub> (μF)	ø D (mm)	L (mm)	I <sub>R</sub> - Max. Ripple Current +105°C - 120Hz (mA rms)	CapXon Part Number	
	Vibration-proof						
16	•	10	4	5.5	20	HV100M016B055ETR □□	
	•	22	4	5.5	31	HV220M016B055ETR □□	
	•	22	5	5.5	35	HV220M016C055ETR □□	
	•	33	5	5.5	36	HV330M016C055ETR □□	
	•	33	6.3	5.5	40	HV330M016E055ETR □□	
	•	47	5	5.5	45	HV470M016C055ETR □□	
	•	47	6.3	5.5	56	HV470M016E055ETR □□	
	•	•	100	6.3	7.7	58	HV101M016E077ETR □□
	•	•	100	8	6.5	62	HV101M016F065ETR □□
	•	•	150	6.3	7.7	125	HV151M016E077ETR □□
	•	•	150	8	6.5	140	HV151M016F065ETR □□
	•	•	220	6.3	7.7	170	HV221M016E077ETR □□
	•	•	220	8	10.5	185	HV221M016F105ETR □□
	•	•	330	8	10.5	250	HV331M016F105ETR □□
	•	•	470	8	10.5	370	HV471M016F105ETR □□
	•	•	470	10	10.5	420	HV471M016G105ETR □□
	•	•	560	10	10.5	480	HV561M016G105ETR □□
	•	•	680	10	10.5	540	HV681M016G105ETR □□
	•	•	1000	12.5	14	580	HV102M016Z140ETR □□
	•	•	1200	12.5	14	590	HV122M016Z140ETR □□
•	•	1500	12.5	14	620	HV152M016Z140ETR □□	
•	•	3300	16	17	850	HV332M016J170ETR □□	
25	•	4.7	4	5.5	12	HV4R7M025B055ETR □□	
	•	10	4	5.5	22	HV100M025B055ETR □□	
	•	22	5	5.5	38	HV220M025C055ETR □□	
	•	33	6.3	5.5	48	HV330M025E055ETR □□	
	•	•	47	6.3	7.7	56	HV470M025E077ETR □□
	•	•	47	8	6.5	60	HV470M025F065ETR □□
	•	•	100	6.3	7.7	110	HV101M025E077ETR □□
	•	•	100	8	10.5	160	HV101M025F105ETR □□
	•	•	150	8	10.5	175	HV151M025F105ETR □□
	•	•	220	8	10.5	180	HV221M025F105ETR □□
	•	•	220	10	10.5	190	HV221M025G105ETR □□
	•	•	330	8	10.5	290	HV331M025F105ETR □□
	•	•	470	10	10.5	440	HV471M025G105ETR □□
	•	•	560	12.5	14	490	HV561M025Z140ETR □□
	•	•	680	12.5	14	510	HV681M025Z140ETR □□
	•	•	1000	12.5	14	600	HV102M025Z140ETR □□
	•	•	2200	16	17	805	HV222M025J170ETR □□
	35	•	4.7	4	5.5	14	HV4R7M035B055ETR □□
•		10	4	5.5	24	HV100M035B055ETR □□	
•		22	5	5.5	40	HV220M035C055ETR □□	
•		22	6.3	5.5	46	HV220M035E055ETR □□	
•		•	33	6.3	7.7	47	HV330M035E077ETR □□

□□ see description at end of standard ratings

 •<sup>1</sup>: Consult CapXon for availability

### STANDARD RATINGS

Part number shows blister tape on paper reel

V <sub>R</sub> (V)			C <sub>R</sub> (μF)	ø D (mm)	L (mm)	I <sub>R</sub> - Max. Ripple Current +105°C - 120Hz (mA rms)	CapXon Part Number
	Standard	Vibration-proof					
35	●		33	8	6.5	50	HV330M035F065ETR □□
	●	●	47	6.3	7.7	60	HV470M035E077ETR □□
	●		47	8	6.5	65	HV470M035F065ETR □□
	●	●	100	6.3	7.7	130	HV101M035E077ETR □□
	●	●	100	8	10.5	180	HV101M035F105ETR □□
	●	●	150	8	10.5	190	HV151M035F105ETR □□
	●	●	220	8	10.5	250	HV221M035F105ETR □□
	●	●	220	10	10.5	280	HV221M035G105ETR □□
	●	●	330	10	10.5	360	HV331M035G105ETR □□
	●	●	470	12.5	14	460	HV471M035Z140ETR □□
	●	●	560	12.5	14	500	HV561M035Z140ETR □□
	●	●	1500	16	17	740	HV152M035J170ETR □□
50	●		1	4	5.5	8.4	HV010M050B055ETR □□
	●		2.2	4	5.5	11	HV2R2M050B055ETR □□
	●		3.3	4	5.5	13	HV3R3M050B055ETR □□
	●		4.7	4	5.5	18	HV4R7M050B055ETR □□
	●		10	6.3	5.5	28	HV100M050E055ETR □□
	●	●	22	6.3	7.7	50	HV220M050E077ETR □□
	●		22	8	6.5	55	HV220M050F065ETR □□
	●	●	33	6.3	7.7	95	HV330M050E077ETR □□
	●	●	33	8	10.5	135	HV330M050F105ETR □□
	●	●	47	6.3	7.7	115	HV470M050E077ETR □□
	●	●	47	8	10.5	155	HV470M050F105ETR □□
	●	●	100	10	10.5	315	HV101M050G105ETR □□
	●	●	150	10	10.5	330	HV151M050G105ETR □□
	●	●	220	10	10.5	350	HV221M050G105ETR □□
	●	●	330	12.5	14	400	HV331M050Z140ETR □□
	●	●	470	16	17	570	HV471M050J170ETR □□
●	●	1000	16	17	655	HV102M050J170ETR □□	
63	●		1	4	5.5	7	HV010M063B055ETR □□
	●		2.2	4	5.5	11	HV2R2M063B055ETR □□
	●		3.3	5	5.5	14	HV3R3M063C055ETR □□
	●		4.7	5	5.5	22	HV4R7M063C055ETR □□
	●		10	6.3	5.5	40	HV100M063E055ETR □□
	●	●	22	6.3	7.7	58	HV220M063E077ETR □□
	●	●	33	8	10.5	112	HV330M063F105ETR □□
	●	●	47	8	10.5	119	HV470M063F105ETR □□
	●	●	100	10	10.5	280	HV101M063G105ETR □□
	●	●	220	12.5	14	300	HV221M063Z140ETR □□
	●	●	470	16	17	630	HV471M063J170ETR □□

□□ see description at end of standard ratings

●<sup>1</sup>: Consult CapXon for availability

**STANDARD RATINGS**

Part number shows blister tape on paper reel

V <sub>R</sub> (V)	Standard		C <sub>R</sub> (μF)	ø D (mm)	L (mm)	I <sub>R</sub> - Max. Ripple Current +105°C - 120Hz (mA rms)	CapXon Part Number
	Standard	Vibration-proof					
80	•		1	4	5.5	7	HV010M080B055ETR □□
	•		2.2	5	5.5	12	HV2R2M080C055ETR □□
	•		3.3	6.3	5.5	17	HV3R3M080E055ETR □□
	•		4.7	6.3	5.5	25	HV4R7M080E055ETR □□
	•	•	10	6.3	7.7	35	HV100M080E077ETR □□
	•	•	22	6.3	7.7	58	HV220M080E077ETR □□
	•	•	33	8	10.5	112	HV330M080F105ETR □□
	•	•	47	10	10.5	160	HV470M080G105ETR □□
	•	•	100	12.5	14	380	HV101M080Z140ETR □□
	•	•	150	16	17	500	HV151M080J170ETR □□
	•	•	220	16	17	600	HV221M080J170ETR □□
100	•		1	4	5.5	7	HV010M100B055ETR □□
	•	• <sup>1</sup>	2.2	6.3	6.1	15	HV2R2M100E061ETR □□
	•		2.2	6.3	5.5	13	HV2R2M100E055ETR □□
	•	• <sup>1</sup>	3.3	6.3	6.1	20	HV3R3M100E061ETR □□
	•	•	4.7	6.3	7.7	28	HV4R7M100E077ETR □□
	•	•	10	6.3	7.7	35	HV100M100E077ETR □□
	•	•	22	8	10.5	85	HV220M100F105ETR □□
	•	•	33	10	10.5	135	HV330M100G105ETR □□
	•	•	47	12.5	14	240	HV470M100Z140ETR □□
	•	•	150	16	17	500	HV151M100J170ETR □□
	160	•	•	10	8	10.5	57
•		•	12	8	10.5	60	HV120M160F105ETR □□
•		•	18	10	10.5	65	HV180M160G105ETR □□
•		•	22	10	10.5	70	HV220M160G105ETR □□
•		•	27	12.5	14	85	HV270M160Z140ETR □□
•		•	33	12.5	14	95	HV330M160Z140ETR □□
•		•	39	12.5	14	105	HV390M160Z140ETR □□
•		•	47	16	17	260	HV470M160J170ETR □□
•		•	68	16	17	300	HV680M160J170ETR □□
200	•	•	10	10	10.5	64	HV100M200G105ETR □□
	•	•	10	12.5	14	80	HV100M200Z140ETR □□
	•	•	22	12.5	14	105	HV220M200Z140ETR □□
	•	•	27	12.5	14	115	HV270M200Z140ETR □□
	•	•	33	12.5	14	170	HV330M200Z140ETR □□
	•	•	33	16	17	220	HV330M200J170ETR □□
	•	•	47	16	17	260	HV470M200J170ETR □□

□□ see description at end of standard ratings

 •<sup>1</sup>: Consult CapXon for availability

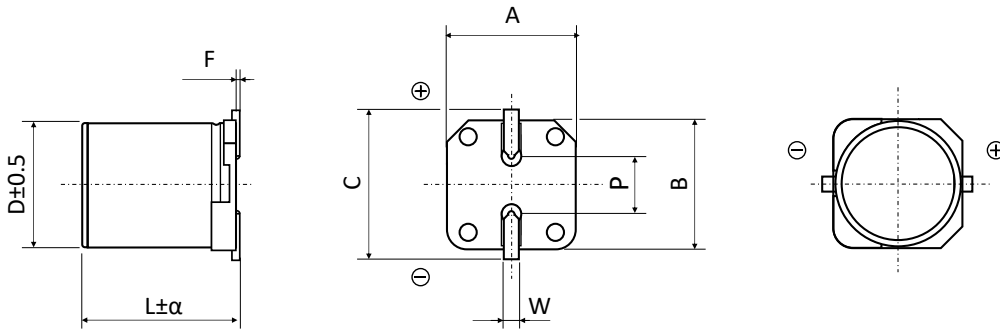
## STANDARD RATINGS

Part number shows blister tape on paper reel

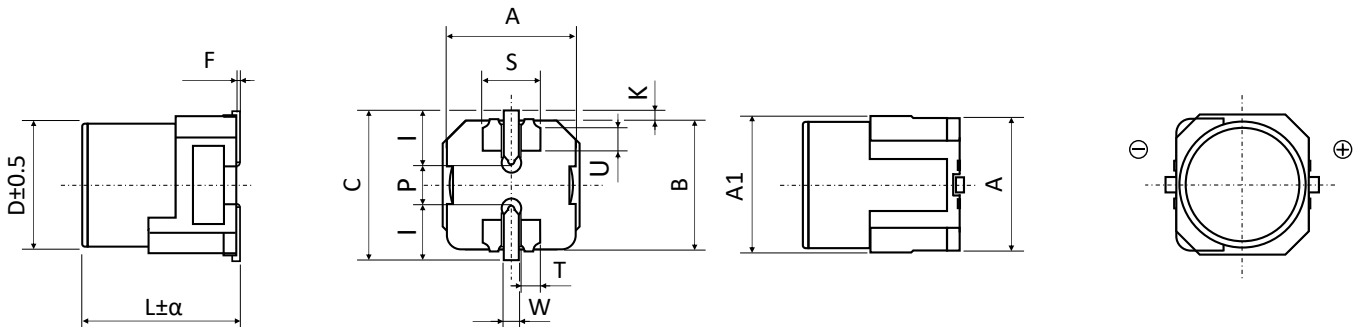
V <sub>R</sub> (V)			C <sub>R</sub> (μF)	ø D (mm)	L (mm)	I <sub>R</sub> - Max. Ripple Current +105°C - 120Hz (mA rms)	CapXon Part Number
	Standard	Vibration-proof					
250	•	•	4.7	8	10.5	50	HV4R7M250F105ETR □□
	•	•	6.8	10	10.5	60	HV6R8M250G105ETR □□
	•	•	10	10	10.5	75	HV100M250G105ETR □□
	•	•	15	12.5	14	120	HV150M250Z140ETR □□
	•	•	22	16	17	180	HV220M250J170ETR □□
	•	•	27	16	17	200	HV270M250J170ETR □□
	•	•	33	16	17	230	HV330M250J170ETR □□
	•	•	39	16	17	260	HV390M250J170ETR □□
400	•	•	47	16	17	285	HV470M250J170ETR □□
	•	•	2.2	8	10.5	27	HV2R2M400F105ETR □□
	•	•	3.3	8	10.5	34	HV3R3M400F105ETR □□
	•	•	3.9	10	10.5	40	HV3R9M400G105ETR □□
	•	•	4.7	10	10.5	40	HV4R7M400G105ETR □□
	•	•	4.7	12.5	14	50	HV4R7M400Z140ETR □□
	•	•	6.8	12.5	14	60	HV6R8M400Z140ETR □□
	•	•	8.2	12.5	14	65	HV8R2M400Z140ETR □□
	•	•	10	12.5	14	70	HV100M400Z140ETR □□
	•	•	10	16	17	85	HV100M400J170ETR □□
	•	•	12	16	17	95	HV120M400J170ETR □□
	•	•	22	16	17	120	HV220M400J170ETR □□
450	•	•	3.3	10	10.5	40	HV3R3M450G105ETR □□
	•	•	3.9	10	10.5	40	HV3R9M450G105ETR □□
	•	•	4.7	12.5	14	50	HV4R7M450Z140ETR □□
	•	•	6.8	12.5	14	60	HV6R8M450Z140ETR □□
	•	•	8.2	12.5	14	65	HV8R2M450Z140ETR □□
	•	•	10	12.5	14	70	HV100M450Z140ETR □□
	•	•	10	16	17	85	HV100M450J170ETR □□
	•	•	12	16	17	95	HV120M450J170ETR □□
	•	•	15	16	17	100	HV150M450J170ETR □□
	•	•	22	16	17	120	HV220M450J170ETR □□

□□: Enter **blank** for Standard package  
 □□: Enter **W** for Vibration proof version

□□: Enter **X** for AEC-Q200  
 □□: Enter **XW** for AEC-Q200 and Vibration proof version

**DIMENSIONS STANDARD PACKAGE** ▪ All dimensions in mm


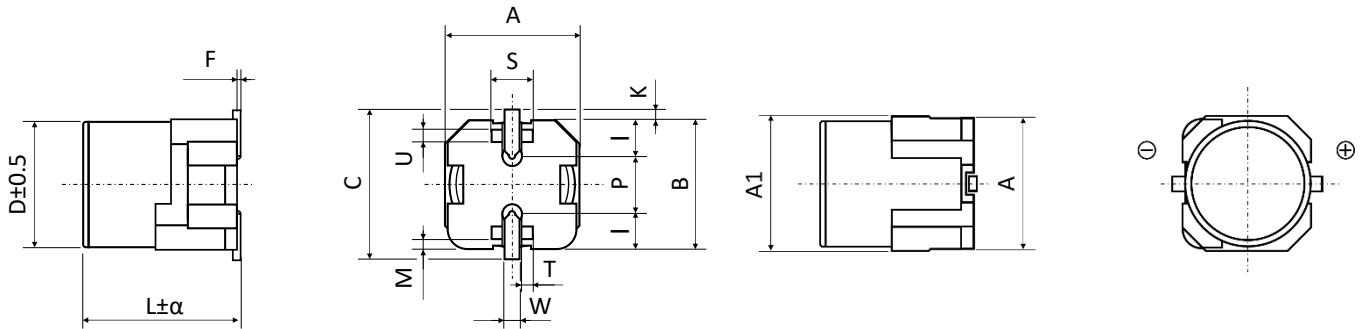
∅ D	L	α	A ± 0.2	B ± 0.2	C ± 0.2	F	P ± 0.2	W
4.0	5.5	Max	4.3	4.3	4.9	0.3 max.	1.0	0.5 to 0.8
5.0	5.5	Max	5.3	5.3	5.9	0.3 max.	1.4	0.5 to 0.8
6.3	5.5	0.2	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
6.3	6.1	Max	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
6.3	7.7	Max	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
8.0	6.5	Max	8.3	8.3	9.0	0.3 max.	2.3	0.5 to 0.8
8.0	10.5	Max	8.3	8.3	9.0	0.3 max.	3.1	0.7 to 1.1
10.0	10.5	Max	10.3	10.3	11.0	0.3 max.	4.5	0.7 to 1.1
12.5	14.0	Max	13.0	13.0	13.9	0.3 max.	4.5	1 to 1.4
16.0	17.0	0.5	17.0	17.0	18.0	0.3 max.	6.6	1 to 1.4

**DIMENSIONS VP PACKAGE (VIBRATION-PROOF) ∅ D6.3** ▪ All dimensions in mm


∅ D	L	α	A ± 0.2	A1 (max.)	B ± 0.2	C (max.)	F	K
6.3	6.1	0.3	6.6	7.1	6.6	7.8	0 to 0.15	0.35 +0.15/-0.2
6.3	8.0	0.3	6.6	7.1	6.6	7.8	0 to 0.15	0.35 +0.15/-0.2

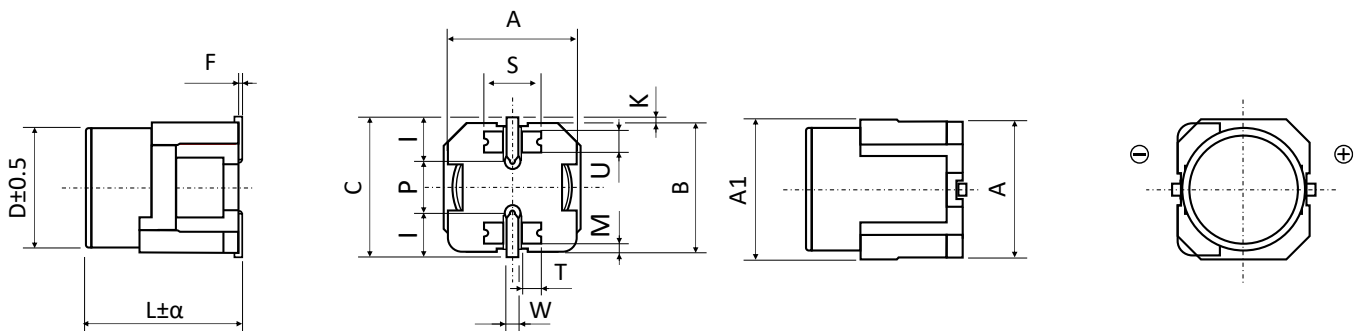
∅ D	L	P ± 0.2	S ± 0.1	I ± 0.1	T ± 0.1	U ± 0.1	W ± 0.1
6.3	6.1	2.2	2.9	2.4	1.1	1.55	0.65
6.3	8.0	2.2	2.9	2.4	1.1	1.55	0.65



**DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D8 and D10** ▪ All dimensions in mm


ø D	L	α	A ± 0.2	A1 (max.)	B ± 0.2	C (max.)	F	K ± 0.2
8.0	10.5	0.5	8.3	8.8	8.3	10.0	0 to 0.15	0.7
10.0	10.5	0.5	10.3	10.8	10.3	12.0	0 to 0.15	0.7

ø D	L	P ± 0.2	S ± 0.1	I ± 0.1	T ± 0.1	U ± 0.1	W ± 0.1	M ± 0.1
8.0	10.5	3.1	3	3.4	1.4	0.7	1.2	0.7
10.0	10.5	4.6	3.3	3.5	1.5	0.8	1.2	0.9

**DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D12.5 and D16** ▪ All dimensions in mm


ø D	L	α	A ± 0.2	A1 (max.)	B ± 0.2	C (max.)	F	K ± 0.3
12.5	14.0	1.0	13.5	13.5	13.5	15.0	0 to 0.15	0.7
16.0	17.0	1.0	17.0	17.0	17.0	19.0	0 to 0.15	0.7



ø D	L	P ± 0.2	S ± 0.1	I ± 0.1	T ± 0.1	U ± 0.1	W ± 0.1	M ± 0.1
12.5	14.0	4.4	6.0	4.7	2.0	2.2	1.2	0.95
16.0	17.0	6.7	5.8	5.5	2.0	3.0	1.4	1.0

**MULTIPLIER  $K_f$  for RIPPLE CURRENT vs. FREQUENCY**

$C_R$ (μF) / Frequency (Hz)	50/60	100/120	500	1k	≥ 10k
$1 \leq C_R \leq 100$	0.8	1	1.2	1.3	1.5
$100 < C_R \leq 6800$	0.8	1	1.1	1.15	1.2

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<p>General Precautions and Guidelines</p>	<p>Packaging Information Liquid SMD</p>
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**DISCLAIMER**

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CapXon products are designed and manufactured according to severe quality and safety standards. Under no circumstance, CapXon warrants that any CapXon product is suitable for the purposes intended for your application, even CapXon knows the application. It is customer's duty and obligation to check and make sure that CapXon products are suitable for the purposes intended and select the correct and proper CapXon product. Customers are requested to perform a sufficient validation and reliability evaluation to assure needed safety level and reliability performance by suitable designs and to apply proper safeguards (e.g. redundancies, protective circuits).

Particular operating conditions (ambient temperature, ripple current, voltage, thermal resistance, etc.) as well as storage, production or assembly may affect the performance and the lifetime of the capacitor. Please consult CapXon for lifetime estimation, failure mode considerations or worst-case scenarios according to the product technology, product tolerances / deviations or change of the characteristics of the capacitor due to shipment, storage, handling, production and usage.

For aerospace or military application, life-saving, life-sustaining, safety critical applications or any application where failure may cause severe personal injury or death, please consult us before design-in the capacitor in your application.

Except for the written expressed warranties, CapXon does not impliedly, by assumption or whatever else, warrant, undertake, promise any other warranty or guaranty for any CapXon product.

For further information, please visit our website [www.capxongroup.com](http://www.capxongroup.com) or contact CapXon directly.

### JV SERIES ■ LONG LIFE, AUTOMOTIVE 105°C TYPE

#### KEY FEATURES



- ALUMINUM ELECTROLYTIC CAPACITOR ■ SMD type
- Endurance: 105°C ■ 3 000 hours
- Small dimensions
- Vibration-proof (VP) version (up to 30g) available upon request
- AEC-Q200 version available



#### SPECIFICATIONS

Items		Performance Characteristics						
Operating Temperature Range		-55 ~ +105°C						
Rated Voltage Range	$V_R$	6.3 ~ 50V DC						
Surge Voltage	$V_S$	$V_S = 1.15 \cdot V_R$						
Capacitance Range	$C_R$	1 ~ 1000 $\mu$ F						
Cap. Tolerance	$\Delta C$	$\pm 20\%$ (120Hz ■ 20°C)						
Leakage Current (20°C ■ $V_R$ applied)	$I_{LEAK}$	$\leq 0.01 \cdot C_R \cdot V_R$ or 3 $\mu$ A, whichever is greater ■ After 2 minutes [ $I_{LEAK}$ ( $\mu$ A) ; $C_R$ ( $\mu$ F) ; $V_R$ (V) ]						
Dissipation Factor % (20°C ■ 120Hz)	$\tan \delta$	$V_R$ (V DC)	6.3	10	16	25	35	50
		$\tan \delta$	28	24	20	16	13	12
Low Temperature Characteristics at 120Hz	Z ratio max.	$V_R$ (V DC)	6.3	10	16	25	35	50
		Z-25°C/Z+20°C	4	3	2	2	2	2
		Z-40°C/Z+20°C	10	7	5	3	3	3
		Z-55°C/Z+20°C	12	10	6	5	4	4

Lifetime Test			
Endurance 105°C ( $V_R$ applied)	Test	<b>3 000 hours</b>	
	$\Delta C/C_R$	$\leq \pm 30\%$ of initial measured value	
	$\tan \delta$	$\leq 300\%$ of initial specified value	
	$I_{Leak}$	$\leq$ the initial specified value	
Shelf Life 105°C ( $V_R = 0$ )	Test	<b>1 000 hours</b>	
	$\Delta C/C_R$	$\leq \pm 30\%$ of initial measured value	
	$\tan \delta$	$\leq 300\%$ of initial specified value	
	$I_{Leak}$	$\leq$ the initial specified value	
Before measurement: Restore capacitor to 20°C, apply $V_R$ for 30 min according JIS-C-5101-4			
Resistance to Soldering Heat	The capacitors shall be kept on a hot plate maintained at 250°C for 30 seconds. After removing from the hot plate and restored at room temperature, they meet the characteristic requirements listed below		
	$\Delta C/C_R$	Within $\pm 10\%$ of initial value	
	$\tan \delta$	Less than specified value	
	$I_{Leak}$	Less than specified value	

**STANDARD RATINGS**

Part number shows blister tape on paper reel

V <sub>R</sub> (V)	Standard	C <sub>R</sub> (μF)	ø D (mm)	L (mm)	I <sub>R</sub> - Max. Ripple Current +105°C - 120Hz (mA rms)	CapXon Part Number	
	Vibration-proof						
6.3	•	22	4	5.5	22	JV220M6R3B055ETR □□	
	•	33	5	5.5	33	JV330M6R3C055ETR □□	
	•	47	5	5.5	36	JV470M6R3C055ETR □□	
	•	100	6.3	5.5	68	JV101M6R3E055ETR □□	
	•	•	220	6.3	7.7	120	JV221M6R3E077ETR □□
	•	•	330	8	10.5	230	JV331M6R3F105ETR □□
	•	•	470	10	10.5	290	JV471M6R3G105ETR □□
	•	•	1000	10	10.5	360	JV102M6R3G105ETR □□
10	•	22	5	5.5	30	JV220M010C055ETR □□	
	•	33	5	5.5	35	JV330M010C055ETR □□	
	•	47	6.3	5.5	52	JV470M010E055ETR □□	
	•	•	100	6.3	7.7	81	JV101M010E077ETR □□
	•	•	220	8	10.5	142	JV221M010F105ETR □□
	•	•	330	10	10.5	280	JV331M010G105ETR □□
	•	•	470	10	10.5	305	JV471M010G105ETR □□
	16	•	10	4	5.5	18	JV100M016B055ETR □□
•		22	5	5.5	31	JV220M016C055ETR □□	
•		33	6.3	5.5	48	JV330M016E055ETR □□	
•		47	6.3	5.5	51	JV470M016E055ETR □□	
•		•	100	6.3	7.7	83	JV101M016E077ETR □□
•		•	220	10	10.5	222	JV221M016G105ETR □□
•		•	330	10	10.5	305	JV331M016G105ETR □□
•		•	470	10	10.5	330	JV471M016G105ETR □□
25	•	4.7	4	5.5	16	JV4R7M025B055ETR □□	
	•	10	4	5.5	26	JV100M025B055ETR □□	
	•	22	6.3	5.5	44	JV220M025E055ETR □□	
	•	33	6.3	5.5	50	JV330M025E055ETR □□	
	•	•	47	6.3	7.7	66	JV470M025E077ETR □□
	•	•	100	8	10.5	118	JV101M025F105ETR □□
	•	•	220	10	10.5	300	JV221M025G105ETR □□
	•	•	330	10	10.5	395	JV331M025G105ETR □□
35	•	4.7	4	5.5	16	JV4R7M035B055ETR □□	
	•	10	5	5.5	27	JV100M035C055ETR □□	
	•	22	6.3	5.5	45	JV220M035E055ETR □□	
	•	•	33	6.3	7.7	58	JV330M035E077ETR □□
	•	•	47	8	10.5	93	JV470M035F105ETR □□
	•	•	100	10	10.5	155	JV101M035G105ETR □□
	•	•	220	10	10.5	340	JV221M035G105ETR □□
	•	•	330	10	10.5	420	JV331M035G105ETR □□

□□ see description at end of standard ratings

## STANDARD RATINGS

Part number shows blister tape on paper reel

$V_R$ (V)	Standard	Vibration-proof	$C_R$ ( $\mu F$ )	$\phi D$ (mm)	L (mm)	$I_R$ - Max. Ripple Current +105°C - 120Hz (mA rms)	CapXon Part Number
50	•		1	4	5.5	8	JV010M050B055ETR □□
	•		2.2	4	5.5	12	JV2R2M050B055ETR □□
	•		3.3	4	5.5	17	JV3R3M050B055ETR □□
	•		4.7	5	5.5	22	JV4R7M050C055ETR □□
	•		10	6.3	5.5	33	JV100M050E055ETR □□
	•	•	22	6.3	7.7	58	JV220M050E077ETR □□
	•	•	33	8	10.5	140	JV330M050F105ETR □□
	•	•	47	8	10.5	170	JV470M050F105ETR □□
	•	•	100	10	10.5	300	JV101M050G105ETR □□

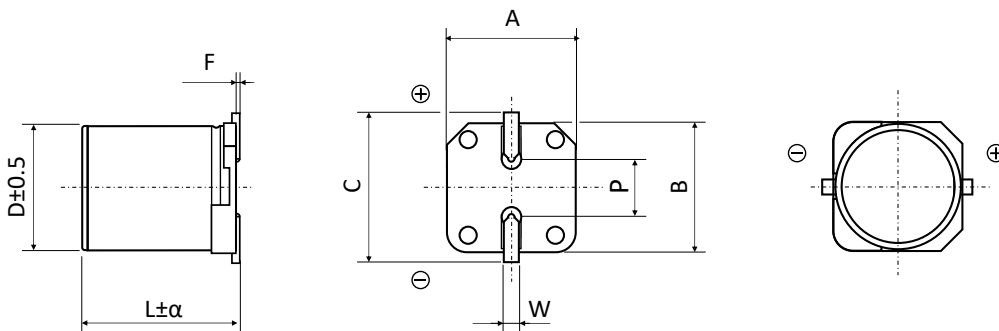
□□: Enter **blank** for Standard package

□□: Enter **X** for AEC-Q200

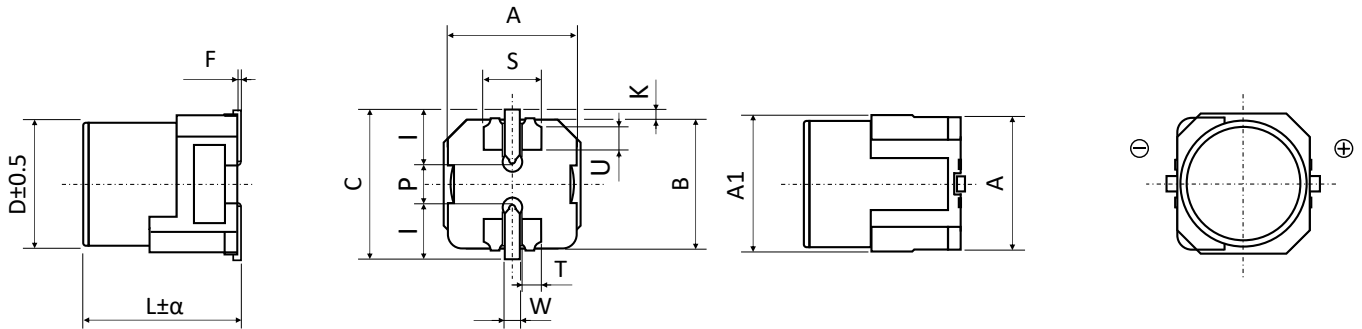
□□: Enter **W** for Vibration proof version

□□: Enter **XW** for AEC-Q200 and Vibration proof version

## DIMENSIONS STANDARD PACKAGE - All dimensions in mm

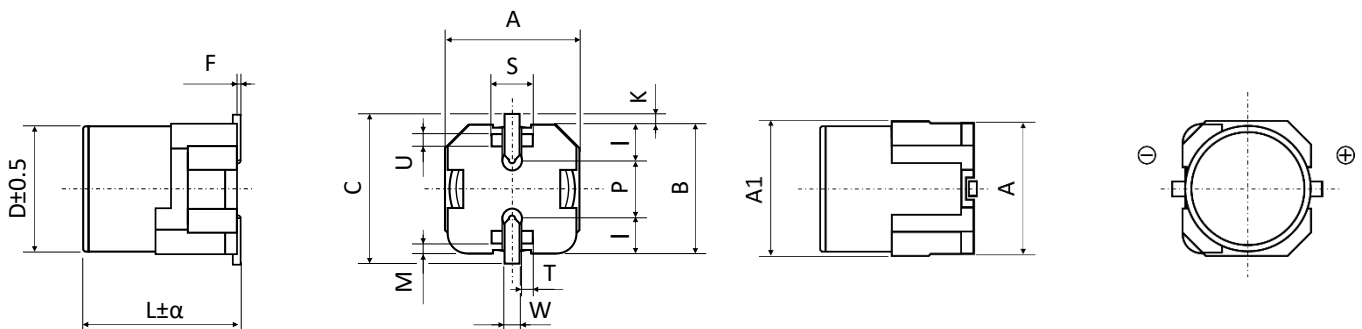


$\phi D$	L	$\alpha$	$A \pm 0.2$	$B \pm 0.2$	$C \pm 0.2$	F	$P \pm 0.2$	W
4.0	5.5	Max	4.3	4.3	4.9	0.3 max.	1.0	0.5 to 0.8
5.0	5.5	Max	5.3	5.3	5.9	0.3 max.	1.4	0.5 to 0.8
6.3	5.5	0.2	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
6.3	7.7	Max	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
8.0	10.5	Max	8.3	8.3	9.0	0.3 max.	3.1	0.7 to 1.1
10.0	10.5	Max	10.3	10.3	11.0	0.3 max.	4.5	0.7 to 1.1

**DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D6.3** ▪ All dimensions in mm


ø D	L	α	A ± 0.2	A1 (max.)	B ± 0.2	C (max.)	F	K
6.3	8.0	0.3	6.6	7.1	6.6	7.8	0 to 0.15	0.35 +0.15/-0.2

ø D	L	P ± 0.2	S ± 0.1	I ± 0.1	T ± 0.1	U ± 0.1	W ± 0.1
6.3	8.0	2.2	2.9	2.4	1.1	1.55	0.65

**DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D8 and D10** ▪ All dimensions in mm


ø D	L	α	A ± 0.2	A1 (max.)	B ± 0.2	C (max.)	F	K ± 0.2
8.0	10.5	0.5	8.3	8.8	8.3	10.0	0 to 0.15	0.7
10.0	10.5	0.5	10.3	10.8	10.3	12.0	0 to 0.15	0.7

ø D	L	P ± 0.2	S ± 0.1	I ± 0.1	T ± 0.1	U ± 0.1	W ± 0.1	M ± 0.1
8.0	10.5	3.1	3	3.4	1.4	0.7	1.2	0.7
10.0	10.5	4.6	3.3	3.5	1.5	0.8	1.2	0.9



**MULTIPLIER K<sub>f</sub> for RIPPLE CURRENT vs. FREQUENCY**

C <sub>R</sub> (µF) / Frequency (Hz)	50/60	100/120	500	1k	≥ 10k
1 ≤ C <sub>R</sub> ≤ 100	0.8	1	1.2	1.3	1.5
100 < C <sub>R</sub> ≤ 1000	0.8	1	1.1	1.15	1.2



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**DISCLAIMER**

All product related data (e.g. specification, statements and general information) are subject to change without any notice. It is necessary that the customer observes all product related technical / application information and handling instructions.

CapXon products are designed and manufactured according to severe quality and safety standards. Under no circumstance, CapXon warrants that any CapXon product is suitable for the purposes intended for your application, even CapXon knows the application. It is customer's duty and obligation to check and make sure that CapXon products are suitable for the purposes intended and select the correct and proper CapXon product. Customers are requested to perform a sufficient validation and reliability evaluation to assure needed safety level and reliability performance by suitable designs and to apply proper safeguards (e.g. redundancies, protective circuits).

Particular operating conditions (ambient temperature, ripple current, voltage, thermal resistance, etc.) as well as storage, production or assembly may affect the performance and the lifetime of the capacitor. Please consult CapXon for lifetime estimation, failure mode considerations or worst-case scenarios according to the product technology, product tolerances / deviations or change of the characteristics of the capacitor due to shipment, storage, handling, production and usage.

For aerospace or military application, life-saving, life-sustaining, safety critical applications or any application where failure may cause severe personal injury or death, please consult us before design-in the capacitor in your application.

Except for the written expressed warranties, CapXon does not impliedly, by assumption or whatever else, warrant, undertake, promise any other warranty or guaranty for any CapXon product.

For further information, please visit our website [www.capxongroup.com](http://www.capxongroup.com) or contact CapXon directly.

### DV SERIES - LOW IMPEDANCE, AUTOMOTIVE 105°C TYPE

#### KEY FEATURES



- ALUMINUM ELECTROLYTIC CAPACITOR - SMD type
- Endurance: 105°C - 2 000 hours up to 5 000 hours
- Low impedance type
- Vibration-proof (VP) version (up to 30g) available upon request
- AEC-Q200 version available



#### SPECIFICATIONS

Items		Performance Characteristics									
Operating Temperature Range		-55 ~ +105°C									
Rated Voltage Range	$V_R$	6.3 ~ 100V DC									
Surge Voltage	$V_S$	$V_S = 1.15 \cdot V_R$									
Capacitance Range	$C_R$	1 ~ 6800 $\mu$ F									
Cap. Tolerance	$\Delta C$	$\pm 20\%$ (120Hz - 20°C)									
Leakage Current (20°C - $V_R$ applied)	$I_{LEAK}$	$\leq 0.01 \cdot C_R \cdot V_R$ or 3 $\mu$ A, whichever is greater - After 2 minutes [ $I_{LEAK}$ ( $\mu$ A) ; $C_R$ ( $\mu$ F) ; $V_R$ (V) ]									
Dissipation Factor % (20°C - 120Hz)	$\tan\delta$	$V_R$ (V DC)	6.3	10	16	25	35	50	63	80	100
		$\tan\delta$	24	19	16	14	14	12	10	9	8
Low Temperature Characteristics at 120Hz	Z ratio max.	$V_R$ (V DC)	6.3	10	16	25	35	50	63	80	100
		Z-25°C/Z+20°C	2	2	2	2	2	2	2	2	2
		Z-40°C/Z+20°C	8	6	4	4	3	3	3	3	3
		Z-55°C/Z+20°C	12	10	6	6	4	4	4	4	4
Lifetime Test											
Endurance 105°C ( $V_R$ applied)	Test	5 000 hours								$\geq \varnothing 12.5$ mm	
	Test	2 000 hours								$< \varnothing 12.5$ mm	
	$\Delta C/C_R$	$\leq \pm 30\%$ of initial measured value									
	$\tan\delta$	$\leq 300\%$ of initial specified value									
	$I_{Leak}$	$\leq$ the initial specified value									
Shelf Life 105°C ( $V_R = 0$ )	Test	1 000 hours									
	$\Delta C/C_R$	$\leq \pm 30\%$ of initial measured value									
	$\tan\delta$	$\leq 300\%$ of initial specified value									
	$I_{Leak}$	$\leq$ the initial specified value									
Resistance to Soldering Heat	Before measurement: Restore capacitor to 20°C, apply $V_R$ for 30 min according JIS-C-5101-4										
	The capacitors shall be kept on a hot plate maintained at 250°C for 30 seconds. After removing from the hot plate and restored at room temperature, they meet the characteristic requirements listed below										
	$\Delta C/C_R$	Within $\pm 10\%$ of initial value									
	$\tan\delta$	Less than specified value									
	$I_{Leak}$	Less than specified value									

**STANDARD RATINGS**

Part number shows blister tape on paper reel

V <sub>R</sub> (V)	Standard	C <sub>R</sub> (μF)	ø D (mm)	L (mm)	Z - Max. Impedance +20°C - 100kHz (mΩ)	I <sub>R</sub> - Max. Ripple Current +105°C - 100kHz (mA rms)	CapXon Part Number	
	Vibration-proof							
6.3	•	22	4	5.5	2200	75	DV220M6R3B055ETR □□	
	•	27	4	5.5	1980	79	DV270M6R3B055ETR □□	
	•	33	4	5.5	1900	82	DV330M6R3B055ETR □□	
	•	33	5	5.5	1300	130	DV330M6R3C055ETR □□	
	•	47	4	5.5	1880	86	DV470M6R3B055ETR □□	
	•	47	5	5.5	1100	150	DV470M6R3C055ETR □□	
	•	56	5	5.5	1100	150	DV560M6R3C055ETR □□	
	•	68	5	5.5	900	160	DV680M6R3C055ETR □□	
	•	68	6.3	5.5	550	220	DV680M6R3E055ETR □□	
	•	100	5	5.5	800	170	DV101M6R3C055ETR □□	
	•	100	6.3	5.5	530	230	DV101M6R3E055ETR □□	
	•	150	6.3	5.5	510	235	DV151M6R3E055ETR □□	
	•	150	8	6.5	480	250	DV151M6R3F065ETR □□	
	•	•	220	6.3	7.7	450	260	DV221M6R3E077ETR □□
	•	•	220	6.3	5.5	480	240	DV221M6R3E055ETR □□
	•	•	330	6.3	7.7	360	275	DV331M6R3E077ETR □□
	•	•	330	8	6.5	340	290	DV331M6R3F065ETR □□
	•	•	470	8	10.5	280	450	DV471M6R3F105ETR □□
	•	•	680	8	10.5	250	500	DV681M6R3F105ETR □□
	•	•	1000	8	10.5	200	530	DV102M6R3F105ETR □□
	•	•	1000	10	10.5	170	570	DV102M6R3G105ETR □□
•	•	1200	10	10.5	160	600	DV122M6R3G105ETR □□	
•	•	1500	10	10.5	130	650	DV152M6R3G105ETR □□	
•	•	1800	10	10.5	80	860	DV182M6R3G105ETR □□	
•	•	3300	12.5	14	80	1100	DV332M6R3Z140ETR □□	
•	•	6800	16	17	52	1250	DV682M6R3J170ETR □□	
10	•	22	4	5.5	2200	80	DV220M010B055ETR □□	
	•	27	5	5.5	1900	125	DV270M010C055ETR □□	
	•	33	4	5.5	1850	90	DV330M010B055ETR □□	
	•	33	5	5.5	1200	150	DV330M010C055ETR □□	
	•	47	5	5.5	1100	165	DV470M010C055ETR □□	
	•	47	6.3	5.5	590	180	DV470M010E055ETR □□	
	•	56	6.3	5.5	570	210	DV560M010E055ETR □□	
	•	68	6.3	5.5	550	220	DV680M010E055ETR □□	
	•	100	5	5.5	800	210	DV101M010C055ETR □□	
	•	100	6.3	5.5	530	240	DV101M010E055ETR □□	
	•	150	6.3	5.5	490	250	DV151M010E055ETR □□	
	•	150	8	6.5	470	260	DV151M010F065ETR □□	
	•	•	220	6.3	7.7	440	270	DV221M010E077ETR □□
	•	•	220	8	6.5	400	285	DV221M010F065ETR □□
	•	•	330	8	10.5	250	500	DV331M010F105ETR □□
	•	•	470	8	10.5	250	550	DV471M010F105ETR □□
	•	•	680	10	10.5	200	680	DV681M010G105ETR □□

□□ see description at end of standard ratings

**STANDARD RATINGS**

Part number shows blister tape on paper reel

V <sub>R</sub> (V)	Standard	Vibration-proof	C <sub>R</sub> (μF)	ø D (mm)	L (mm)	Z - Max. Impedance +20°C - 100kHz (mΩ)	I <sub>R</sub> - Max. Ripple Current +105°C - 100kHz (mA rms)	CapXon Part Number
10	•	•	1000	10	10.5	150	740	DV102M010G105ETR ☐☐
	•	•	2200	12.5	14	80	1100	DV222M010Z140ETR ☐☐
	•	•	4700	16	17	52	1250	DV472M010J170ETR ☐☐
16	•		10	4	5.5	2200	80	DV100M016B055ETR ☐☐
	•		15	4	5.5	2000	85	DV150M016B055ETR ☐☐
	•		22	4	5.5	1980	90	DV220M016B055ETR ☐☐
	•		22	5	5.5	1600	140	DV220M016C055ETR ☐☐
	•		27	5	5.5	740	170	DV270M016C055ETR ☐☐
	•		33	6.3	5.5	600	185	DV330M016E055ETR ☐☐
	•		47	5	5.5	1050	195	DV470M016C055ETR ☐☐
	•		47	6.3	5.5	580	210	DV470M016E055ETR ☐☐
	•		56	6.3	5.5	560	220	DV560M016E055ETR ☐☐
	•		68	6.3	5.5	540	230	DV680M016E055ETR ☐☐
	•		68	8	6.5	500	240	DV680M016F065ETR ☐☐
	•		100	6.3	5.5	520	255	DV101M016E055ETR ☐☐
	•	•	150	6.3	7.7	450	265	DV151M016E077ETR ☐☐
	•		150	8	6.5	440	270	DV151M016F065ETR ☐☐
	•	•	220	6.3	7.7	430	275	DV221M016E077ETR ☐☐
	•		220	8	6.5	410	285	DV221M016F065ETR ☐☐
	•	•	330	8	10.5	250	550	DV331M016F105ETR ☐☐
	•	•	470	8	10.5	220	590	DV471M016F105ETR ☐☐
	•	•	680	10	10.5	160	720	DV681M016G105ETR ☐☐
	•	•	1500	12.5	14	80	1100	DV152M016Z140ETR ☐☐
•	•	3300	16	17	52	1250	DV332M016J170ETR ☐☐	
25	•		6.8	4	5.5	2800	70	DV6R8M025B055ETR ☐☐
	•		10	4	5.5	2100	85	DV100M025B055ETR ☐☐
	•		15	5	5.5	1900	125	DV150M025C055ETR ☐☐
	•		22	5	5.5	1200	145	DV220M025C055ETR ☐☐
	•		22	6.3	5.5	1150	160	DV220M025E055ETR ☐☐
	•		27	6.3	5.5	620	200	DV270M025E055ETR ☐☐
	•		33	5	5.5	1050	160	DV330M025C055ETR ☐☐
	•		33	6.3	5.5	580	220	DV330M025E055ETR ☐☐
	•	•	47	6.3	7.7	540	230	DV470M025E077ETR ☐☐
	•		47	6.3	5.5	560	220	DV470M025E055ETR ☐☐
	•		56	6.3	5.5	540	230	DV560M025E055ETR ☐☐
	•		68	6.3	5.5	480	240	DV680M025E055ETR ☐☐
	•		68	8	6.5	450	260	DV680M025F065ETR ☐☐
	•	•	100	6.3	7.7	380	290	DV101M025E077ETR ☐☐
	•		100	8	6.5	360	300	DV101M025F065ETR ☐☐
	•	•	150	8	10.5	250	480	DV151M025F105ETR ☐☐
	•	•	220	8	10.5	220	530	DV221M025F105ETR ☐☐
	•	•	330	8	10.5	200	570	DV331M025F105ETR ☐☐
	•	•	470	10	10.5	150	650	DV471M025G105ETR ☐☐

☐☐ see description at end of standard ratings

**STANDARD RATINGS**

Part number shows blister tape on paper reel

V <sub>R</sub> (V)			C <sub>R</sub> (μF)	ø D (mm)	L (mm)	Z - Max. Impedance +20°C - 100kHz (mΩ)	I <sub>R</sub> - Max. Ripple Current +105°C - 100kHz (mA rms)	CapXon Part Number
	Standard	Vibration-proof						
25	•	•	1000	12.5	14	80	1100	DV102M025Z140ETR ☐☐
	•	•	2200	16	17	52	1250	DV222M025J170ETR ☐☐
35	•		3.3	4	5.5	2800	80	DV3R3M035B055ETR ☐☐
	•		4.7	4	5.5	2500	85	DV4R7M035B055ETR ☐☐
	•		6.8	4	5.5	2200	88	DV6R8M035B055ETR ☐☐
	•		10	4	5.5	2000	90	DV100M035B055ETR ☐☐
	•		10	5	5.5	1400	125	DV100M035C055ETR ☐☐
	•		15	5	5.5	1200	140	DV150M035C055ETR ☐☐
	•		22	5	5.5	1100	155	DV220M035C055ETR ☐☐
	•		22	6.3	5.5	1050	170	DV220M035E055ETR ☐☐
	•		27	6.3	5.5	600	210	DV270M035E055ETR ☐☐
	•		33	6.3	5.5	540	230	DV330M035E055ETR ☐☐
	•		33	8	6.5	510	260	DV330M035F065ETR ☐☐
	•		47	6.3	5.5	530	240	DV470M035E055ETR ☐☐
	•		47	8	6.5	490	250	DV470M035F065ETR ☐☐
	•	•	56	6.3	7.7	490	250	DV560M035E077ETR ☐☐
	•	•	68	6.3	7.7	400	265	DV680M035E077ETR ☐☐
	•	•	100	6.3	7.7	380	300	DV101M035E077ETR ☐☐
	•	•	100	8	10.5	280	420	DV101M035F105ETR ☐☐
	•	•	150	8	10.5	240	510	DV151M035F105ETR ☐☐
	•	•	220	8	10.5	210	570	DV221M035F105ETR ☐☐
	•	•	330	10	10.5	150	650	DV331M035G105ETR ☐☐
50	•		1	4	5.5	4500	55	DV010M050B055ETR ☐☐
	•		2.2	4	5.5	4500	55	DV2R2M050B055ETR ☐☐
	•		3.3	4	5.5	4500	55	DV3R3M050B055ETR ☐☐
	•		4.7	4	5.5	4500	55	DV4R7M050B055ETR ☐☐
	•		6.8	5	5.5	3800	75	DV6R8M050C055ETR ☐☐
	•		10	5	5.5	2800	95	DV100M050C055ETR ☐☐
	•		10	6.3	5.5	2200	130	DV100M050E055ETR ☐☐
	•		15	6.3	5.5	1600	140	DV150M050E055ETR ☐☐
	•		22	6.3	5.5	1300	150	DV220M050E055ETR ☐☐
	•	•	27	6.3	7.7	1200	180	DV270M050E077ETR ☐☐
	•	•	33	6.3	7.7	710	190	DV330M050E077ETR ☐☐
	•		33	8	6.5	700	200	DV330M050F065ETR ☐☐
	•	•	47	6.3	7.7	700	230	DV470M050E077ETR ☐☐
	•		47	8	6.5	690	240	DV470M050F065ETR ☐☐
	•	•	56	8	10.5	520	300	DV560M050F105ETR ☐☐
	•	•	68	8	10.5	500	320	DV680M050F105ETR ☐☐
	•	•	100	8	10.5	460	350	DV101M050F105ETR ☐☐
	•	•	150	10	10.5	250	600	DV151M050G105ETR ☐☐

☐☐ see description at end of standard ratings

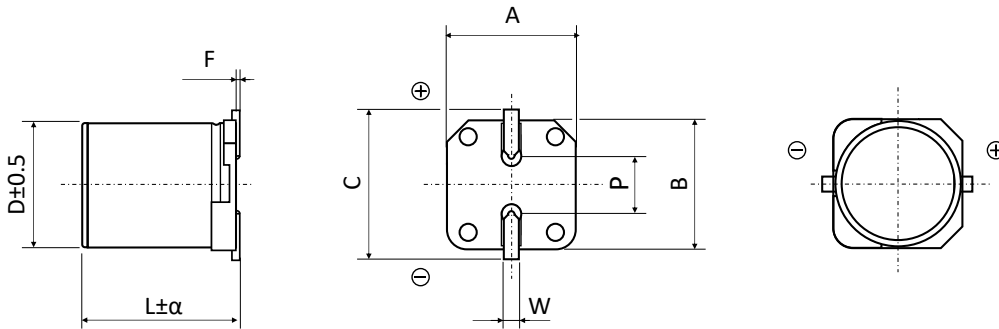
## STANDARD RATINGS

Part number shows blister tape on paper reel

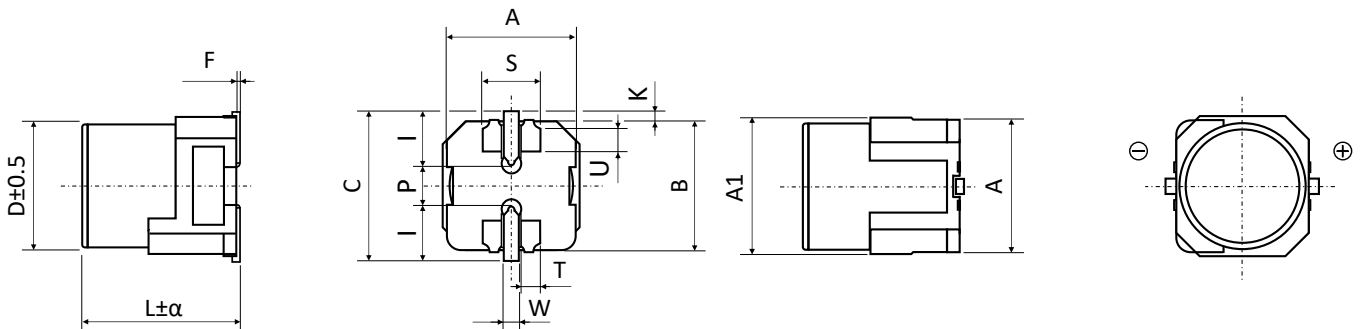
V <sub>R</sub> (V)	Vibration-proof		C <sub>R</sub> (μF)	ø D (mm)	L (mm)	Z - Max. Impedance +20°C - 100kHz (mΩ)	I <sub>R</sub> - Max. Ripple Current +105°C - 100kHz (mA rms)	CapXon Part Number
	Standard							
50	•	•	220	10	10.5	230	650	DV221M050G105ETR □□
	•	•	330	12.5	14	210	800	DV331M050Z140ETR □□
	•	•	1000	16	17	78	1000	DV102M050J170ETR □□
63	•		4.7	5	5.5	2800	45	DV4R7M063C055ETR □□
	•		10	6.3	5.5	1600	80	DV100M063E055ETR □□
	•	•	22	6.3	7.7	1100	150	DV220M063E077ETR □□
	•	•	33	8	10.5	800	230	DV330M063F105ETR □□
	•	•	47	8	10.5	550	260	DV470M063F105ETR □□
	•	•	68	10	10.5	400	380	DV680M063G105ETR □□
	•	•	100	10	10.5	280	400	DV101M063G105ETR □□
	•	•	100	12.5	14	260	520	DV101M063Z140ETR □□
	•	•	150	12.5	14	200	780	DV151M063Z140ETR □□
	•	•	220	12.5	14	180	810	DV221M063Z140ETR □□
	•	•	470	16	17	85	1390	DV471M063J170ETR □□
80	•		4.7	6.3	5.5	3800	50	DV4R7M080E055ETR □□
	•	•	10	6.3	7.7	3000	70	DV100M080E077ETR □□
	•	•	22	6.3	7.7	1700	110	DV220M080E077ETR □□
	•	•	33	8	10.5	1100	200	DV330M080F105ETR □□
	•	•	47	10	10.5	900	320	DV470M080G105ETR □□
	•	•	68	10	10.5	650	490	DV680M080G105ETR □□
	•	•	100	12.5	14	420	580	DV101M080Z140ETR □□
	•	•	220	16	17	260	930	DV221M080J170ETR □□
100	•	•	10	6.3	7.7	4000	65	DV100M100E077ETR □□
	•	•	22	8	10.5	2000	110	DV220M100F105ETR □□
	•	•	33	10	10.5	1300	180	DV330M100G105ETR □□
	•	•	47	10	10.5	1000	370	DV470M100G105ETR □□
	•	•	47	12.5	14	950	480	DV470M100Z140ETR □□
	•	•	68	12.5	14	600	580	DV680M100Z140ETR □□
	•	•	100	12.5	14	500	620	DV101M100Z140ETR □□
	•	•	220	16	17	280	1050	DV221M100J170ETR □□

□□: Enter **blank** for Standard package  
 □□: Enter **W** for Vibration proof version

□□: Enter **X** for AEC-Q200  
 □□: Enter **XW** for AEC-Q200 and Vibration proof version

**DIMENSIONS STANDARD PACKAGE** ▪ All dimensions in mm


∅ D	L	α	A ± 0.2	B ± 0.2	C ± 0.2	F	P ± 0.2	W
4.0	5.5	Max	4.3	4.3	4.9	0.3 max.	1.0	0.5 to 0.8
5.0	5.5	Max	5.3	5.3	5.9	0.3 max.	1.4	0.5 to 0.8
6.3	5.5	0.2	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
6.3	7.7	Max	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
8.0	6.5	Max	8.3	8.3	9.0	0.3 max.	2.3	0.5 to 0.8
8.0	10.5	Max	8.3	8.3	9.0	0.3 max.	3.1	0.7 to 1.1
10.0	10.5	Max	10.3	10.3	11.0	0.3 max.	4.5	0.7 to 1.1
12.5	14.0	Max	13.0	13.0	13.9	0.3 max.	4.5	1 to 1.4
16.0	17.0	0.5	17.0	17.0	18.0	0.3 max.	6.6	1 to 1.4

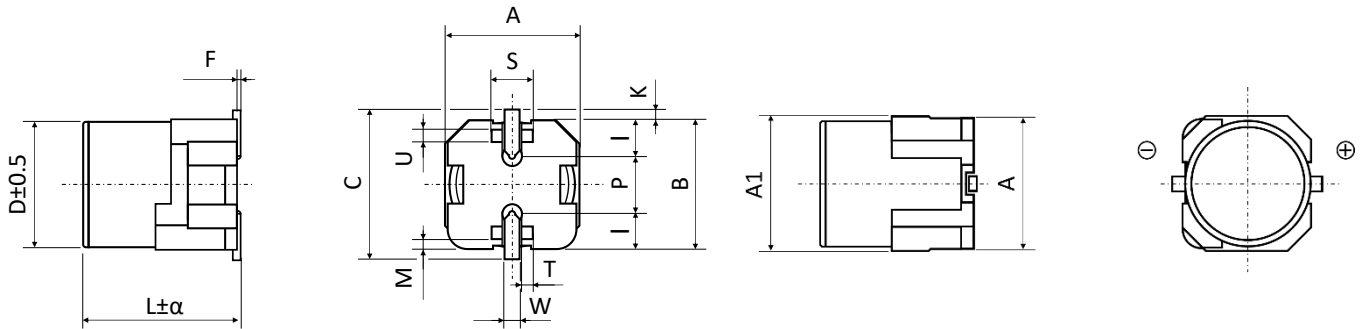
**DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D6.3** ▪ All dimensions in mm


∅ D	L	α	A ± 0.2	A1 (max.)	B ± 0.2	C (max.)	F	K
6.3	8.0	0.3	6.6	7.1	6.6	7.8	0 to 0.15	0.35 +0.15/-0.2

∅ D	L	P ± 0.2	S ± 0.1	I ± 0.1	T ± 0.1	U ± 0.1	W ± 0.1
6.3	8.0	2.2	2.9	2.4	1.1	1.55	0.65



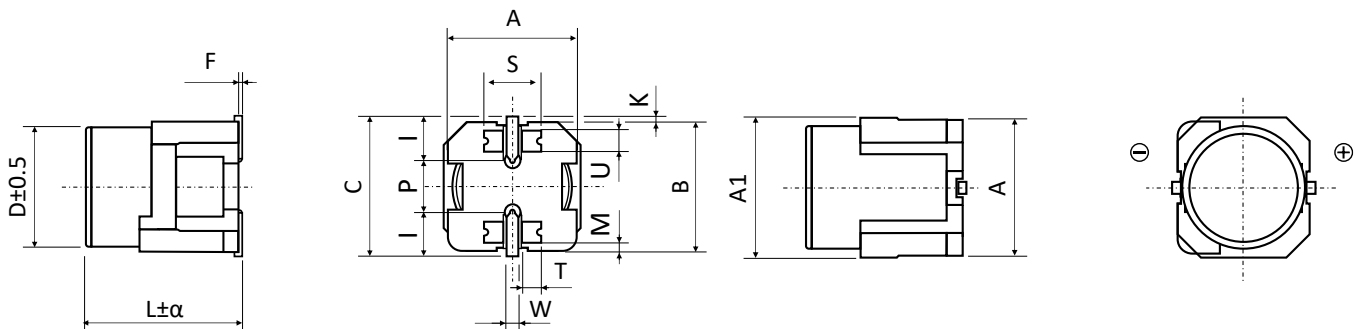
### DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D8 and D10 ▪ All dimensions in mm



ø D	L	α	A ± 0.2	A1 (max.)	B ± 0.2	C (max.)	F	K ± 0.2
8.0	10.5	0.5	8.3	8.8	8.3	10.0	0 to 0.15	0.7
10.0	10.5	0.5	10.3	10.8	10.3	12.0	0 to 0.15	0.7

ø D	L	P ± 0.2	S ± 0.1	I ± 0.1	T ± 0.1	U ± 0.1	W ± 0.1	M ± 0.1
8.0	10.5	3.1	3	3.4	1.4	0.7	1.2	0.7
10.0	10.5	4.6	3.3	3.5	1.5	0.8	1.2	0.9

### DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D12.5 and D16 ▪ All dimensions in mm



ø D	L	α	A ± 0.2	A1 (max.)	B ± 0.2	C (max.)	F	K ± 0.3
12.5	14.0	1.0	13.5	13.5	13.5	15.0	0 to 0.15	0.7
16.0	17.0	1.0	17.0	17.0	17.0	19.0	0 to 0.15	0.7

ø D	L	P ± 0.2	S ± 0.1	I ± 0.1	T ± 0.1	U ± 0.1	W ± 0.1	M ± 0.1
12.5	14.0	4.4	6.0	4.7	2.0	2.2	1.2	0.95
16.0	17.0	6.7	5.8	5.5	2.0	3.0	1.4	1.0

**MULTIPLIER  $K_f$  for RIPPLE CURRENT vs. FREQUENCY**

$C_R$ ( $\mu$ F) / Frequency (Hz)	50/60	100/120	500	1k	10k	50k ~ 100k
$1 \leq C_R \leq 10$	0.47	0.59	0.76	0.85	0.97	1
$10 < C_R \leq 6800$	0.52	0.65	0.8	0.89	0.97	1

**PRECAUTIONS, GUIDELINES AND PACKAGING INFORMATION**

Unless otherwise agreed in individual specifications, all products are subject to our “General Precautions and Guidelines” as well as our “Packaging Information”. Please refer to the following links in the table.

General Precautions and Guidelines	Packaging Information Liquid SMD
Page 104	Page 95

**DISCLAIMER**

All product related data (e.g. specification, statements and general information) are subject to change without any notice. It is necessary that the customer observes all product related technical / application information and handling instructions.

CapXon products are designed and manufactured according to severe quality and safety standards. Under no circumstance, CapXon warrants that any CapXon product is suitable for the purposes intended for your application, even CapXon knows the application. It is customer's duty and obligation to check and make sure that CapXon products are suitable for the purposes intended and select the correct and proper CapXon product. Customers are requested to perform a sufficient validation and reliability evaluation to assure needed safety level and reliability performance by suitable designs and to apply proper safeguards (e.g. redundancies, protective circuits).

Particular operating conditions (ambient temperature, ripple current, voltage, thermal resistance, etc.) as well as storage, production or assembly may affect the performance and the lifetime of the capacitor. Please consult CapXon for lifetime estimation, failure mode considerations or worst-case scenarios according to the product technology, product tolerances / deviations or change of the characteristics of the capacitor due to shipment, storage, handling, production and usage.

For aerospace or military application, life-saving, life-sustaining, safety critical applications or any application where failure may cause severe personal injury or death, please consult us before design-in the capacitor in your application.

Except for the written expressed warranties, CapXon does not impliedly, by assumption or whatever else, warrant, undertake, promise any other warranty or guaranty for any CapXon product.

For further information, please visit our website [www.capxongroup.com](http://www.capxongroup.com) or contact CapXon directly.

### RV SERIES ■ HIGH VOLTAGE, AUTOMOTIVE 105°C TYPE

#### KEY FEATURES



- ALUMINUM ELECTROLYTIC CAPACITOR ■ SMD type
- Endurance: 105°C ■ 2 000 hours up to 5 000 hours
- High voltage and low impedance
- Vibration-proof (VP) version (up to 30g) available upon request
- AEC-Q200 version available



#### SPECIFICATIONS

Items		Performance Characteristics												
Operating Temperature Range		-55 ~ +105°C						-40 ~ +105°C						
Rated Voltage Range	V <sub>R</sub>	6.3 ~ 100V DC						160 ~ 450V DC						
Surge Voltage	V <sub>S</sub>	(V <sub>R</sub> ≤ 315V): V <sub>S</sub> = 1.15·V <sub>R</sub>						(V <sub>R</sub> > 315V): V <sub>S</sub> = 1.10·V <sub>R</sub>						
Capacitance Range	C <sub>R</sub>	1 ~ 6800μF						2.2 ~ 68μF						
Cap. Tolerance	ΔC	±20% (120Hz ■ 20°C)												
Leakage Current (20°C - V <sub>R</sub> applied)	I <sub>LEAK</sub>	≤ 0.01·C <sub>R</sub> ·V <sub>R</sub> or 3μA						≤ 0.04·C <sub>R</sub> ·V <sub>R</sub> + 100μA						
		Whichever is greater ■ After 2 minutes						After 1 minute						
		[ I <sub>LEAK</sub> (μA) ; C <sub>R</sub> (μF) ; V <sub>R</sub> (V) ]												
Dissipation Factor % (20°C - 120Hz)	tanδ	V <sub>R</sub> (V DC)	6.3	10	16	25	35	50	63	80	100	160 ~ 250	>250	
		tanδ (%)	22	19	16	14	14	12	10	9	8	15	20	
Low Temperature Characteristics at 120Hz	Z ratio max.	V <sub>R</sub> (V DC)	6.3	10	16	25	35	50	63	80	100	160 ~ 250	400	450
		Z-25°C/Z+20°C	4	3	2	2	2	2	2	2	2	3	6	6
		Z-40°C/Z+20°C	8	6	4	4	3	3	3	3	3	6	10	15
		Z-55°C/Z+20°C	12	10	6	6	4	4	4	4	4	-	-	-

Lifetime Test			
Endurance 105°C (V <sub>R</sub> applied)	Test	<b>5 000 hours</b>	> Ø 6.3mm
		<b>2 000 hours</b>	≤ Ø 6.3mm
	ΔC/C <sub>R</sub>	≤ ±30% of initial measured value	
	tanδ	≤ 300% of initial specified value	
	I <sub>Leak</sub>	≤ the initial specified value	
Shelf Life 105°C (V <sub>R</sub> = 0)	Test	<b>1 000 hours</b>	
	ΔC/C <sub>R</sub>	≤ ±30% of initial measured value	
	tanδ	≤ 300% of initial specified value	
	I <sub>Leak</sub>	≤ the initial specified value	
Before measurement: Restore capacitor to 20°C, apply V <sub>R</sub> for 30 min according JIS-C-5101-4			
Resistance to Soldering Heat	The capacitors shall be kept on a hot plate maintained at 250°C for 30 seconds. After removing from the hot plate and restored at room temperature, they meet the characteristic requirements listed below		
	ΔC/C <sub>R</sub>	Within ±10% of initial value	
	tanδ	Less than specified value	
	I <sub>Leak</sub>	Less than specified value	

**STANDARD RATINGS**

Part number shows blister tape on paper reel

V <sub>R</sub> (V)	Standard	C <sub>R</sub> (µF)	ø D (mm)	L (mm)	Z - Max. Impedance +20°C - 100kHz (mΩ)	I <sub>R</sub> - Max. Ripple Current +105°C - 100kHz (mA rms)	CapXon Part Number
	Vibration-proof						
6.3	•	22	4	5.5	1350	80	RV220M6R3B055ETR □□
	•	33	4	5.5	1350	85	RV330M6R3B055ETR □□
	•	47	5	5.5	800	160	RV470M6R3C055ETR □□
	•	100	6.3	5.5	440	240	RV101M6R3E055ETR □□
	•	150	6.3	5.5	440	240	RV151M6R3E055ETR □□
	• •	220	6.3	7.7	360	280	RV221M6R3E077ETR □□
	• •	330	6.3	7.7	320	350	RV331M6R3E077ETR □□
	• •	330	8	10.5	170	450	RV331M6R3F105ETR □□
	• •	470	8	10.5	170	500	RV471M6R3F105ETR □□
	• •	680	8	10.5	170	550	RV681M6R3F105ETR □□
	• •	1000	8	10.5	170	550	RV102M6R3F105ETR □□
	• •	1500	10	10.5	90	690	RV152M6R3G105ETR □□
	• •	3300	12.5	14	66	1150	RV332M6R3Z140ETR □□
	• •	6800	16	17	35	1800	RV682M6R3J170ETR □□
10	•	22	4	5.5	1350	90	RV220M010B055ETR □□
	•	33	5	5.5	800	160	RV330M010C055ETR □□
	•	47	6.3	5.5	440	230	RV470M010E055ETR □□
	•	100	6.3	5.5	440	240	RV101M010E055ETR □□
	•	150	6.3	5.5	440	250	RV151M010E055ETR □□
	• •	220	6.3	7.7	360	280	RV221M010E077ETR □□
	• •	330	8	10.5	170	500	RV331M010F105ETR □□
	• •	470	8	10.5	170	550	RV471M010F105ETR □□
	• •	680	10	10.5	90	690	RV681M010G105ETR □□
	• •	1000	10	10.5	90	690	RV102M010G105ETR □□
	• •	2200	12.5	14	66	1150	RV222M010Z140ETR □□
	• •	4700	16	17	35	1800	RV472M010J170ETR □□
16	•	10	4	5.5	2100	90	RV100M016B055ETR □□
	•	22	5	5.5	800	150	RV220M016C055ETR □□
	•	33	6.3	5.5	440	230	RV330M016E055ETR □□
	•	47	6.3	5.5	440	230	RV470M016E055ETR □□
	•	100	6.3	5.5	440	255	RV101M016E055ETR □□
	• •	150	6.3	7.7	360	280	RV151M016E077ETR □□
	• •	220	6.3	7.7	360	280	RV221M016E077ETR □□
	• •	330	8	10.5	170	550	RV331M016F105ETR □□
	• •	470	8	10.5	170	600	RV471M016F105ETR □□
	• •	470	10	10.5	90	670	RV471M016G105ETR □□
	• •	680	10	10.5	90	750	RV681M016G105ETR □□
	• •	1500	12.5	14	66	1150	RV152M016Z140ETR □□
• •	3300	16	17	35	1800	RV332M016J170ETR □□	
25	•	10	4	5.5	2100	90	RV100M025B055ETR □□
	•	22	5	5.5	800	150	RV220M025C055ETR □□
	•	33	6.3	5.5	440	230	RV330M025E055ETR □□
	•	47	6.3	5.5	440	230	RV470M025E055ETR □□
	• •	100	6.3	7.7	360	300	RV101M025E077ETR □□

□□ see description at end of standard ratings

**STANDARD RATINGS**

Part number shows blister tape on paper reel

V <sub>R</sub> (V)	Standard	Vibration-proof	C <sub>R</sub> (µF)	ø D (mm)	L (mm)	Z - Max. Impedance +20°C - 100kHz (mΩ)	I <sub>R</sub> - Max. Ripple Current +105°C - 100kHz (mA rms)	CapXon Part Number
25	•	•	150	8	10.5	170	500	RV151M025F105ETR □□
	•	•	220	8	10.5	170	550	RV221M025F105ETR □□
	•	•	330	8	10.5	170	600	RV331M025F105ETR □□
	•	•	470	10	10.5	90	670	RV471M025G105ETR □□
	•	•	1000	12.5	14	66	1150	RV102M025Z140ETR □□
	•	•	2200	16	17	35	1800	RV222M025J170ETR □□
35	•		4.7	4	5.5	1900	90	RV4R7M035B055ETR □□
	•		10	5	5.5	800	150	RV100M035C055ETR □□
	•		22	6.3	5.5	440	230	RV220M035E055ETR □□
	•		33	6.3	5.5	440	230	RV330M035E055ETR □□
	•		47	6.3	5.5	440	240	RV470M035E055ETR □□
	•	•	100	8	10.5	170	450	RV101M035F105ETR □□
	•	•	150	8	10.5	170	550	RV151M035F105ETR □□
	•	•	220	8	10.5	160	600	RV221M035F105ETR □□
	•	•	220	10	10.5	90	670	RV221M035G105ETR □□
	•	•	330	10	10.5	80	850	RV331M035G105ETR □□
	•	•	470	12.5	14	66	1150	RV471M035Z140ETR □□
	•	•	680	12.5	14	66	1150	RV681M035Z140ETR □□
50	•		1	4	5.5	4400	60	RV010M050B055ETR □□
	•		2.2	4	5.5	3900	60	RV2R2M050B055ETR □□
	•		3.3	4	5.5	3900	60	RV3R3M050B055ETR □□
	•		4.7	4	5.5	3900	75	RV4R7M050B055ETR □□
	•		4.7	5	5.5	1520	85	RV4R7M050C055ETR □□
	•		10	6.3	5.5	1400	165	RV100M050E055ETR □□
	•		22	6.3	5.5	1200	165	RV220M050E055ETR □□
	•	•	33	6.3	7.7	680	185	RV330M050E077ETR □□
	•	•	47	6.3	7.7	680	185	RV470M050E077ETR □□
	•	•	68	8	10.5	340	300	RV680M050F105ETR □□
	•	•	100	8	10.5	340	350	RV101M050F105ETR □□
	•	•	100	10	10.5	250	555	RV101M050G105ETR □□
	•	•	150	10	10.5	250	555	RV151M050G105ETR □□
	•	•	220	10	10.5	230	600	RV221M050G105ETR □□
	•	•	470	16	17	73	1610	RV471M050J170ETR □□
	•	•	680	16	17	73	1610	RV681M050J170ETR □□
•	•	1000	16	17	73	1610	RV102M050J170ETR □□	
63	•		4.7	5	5.5	2600	50	RV4R7M063C055ETR □□
	•		10	6.3	5.5	1500	80	RV100M063E055ETR □□
	•	•	22	6.3	7.7	1000	120	RV220M063E077ETR □□
	•	•	33	8	10.5	700	250	RV330M063F105ETR □□
	•	•	47	8	10.5	650	280	RV470M063F105ETR □□
	•	•	68	10	10.5	380	400	RV680M063G105ETR □□
•	•	100	10	10.5	240	420	RV101M063G105ETR □□	

□□ see description at end of standard ratings

**STANDARD RATINGS**

Part number shows blister tape on paper reel

V <sub>R</sub> (V)	Standard	Vibration-proof	C <sub>R</sub> (µF)	ø D (mm)	L (mm)	Z - Max. Impedance +20°C - 100kHz (mΩ)	I <sub>R</sub> - Max. Ripple Current +105°C - 100kHz (mA rms)	CapXon Part Number
63	•	•	100	12.5	14	220	540	RV101M063Z140ETR ☐☐
	•	•	150	12.5	14	180	800	RV151M063Z140ETR ☐☐
	•	•	220	12.5	14	160	830	RV221M063Z140ETR ☐☐
	•	•	470	16	17	82	1410	RV471M063J170ETR ☐☐
80	•	•	10	6.3	7.7	2600	60	RV100M080E077ETR ☐☐
	•	•	22	8	10.5	1700	130	RV220M080F105ETR ☐☐
	•	•	33	8	10.5	1600	140	RV330M080F105ETR ☐☐
	•	•	47	10	10.5	700	210	RV470M080G105ETR ☐☐
	•	•	68	12.5	14	500	500	RV680M080Z140ETR ☐☐
	•	•	100	12.5	14	450	550	RV101M080Z140ETR ☐☐
	•	•	150	12.5	14	420	600	RV151M080Z140ETR ☐☐
	•	•	220	16	17	380	700	RV221M080J170ETR ☐☐
	•	•	330	16	17	320	800	RV331M080J170ETR ☐☐
	100	•	•	10	6.3	7.7	3900	65
•		•	22	8	10.5	1900	130	RV220M100F105ETR ☐☐
•		•	33	10	10.5	1250	200	RV330M100G105ETR ☐☐
•		•	47	10	10.5	950	390	RV470M100G105ETR ☐☐
•		•	47	12.5	14	900	500	RV470M100Z140ETR ☐☐
•		•	68	12.5	14	570	600	RV680M100Z140ETR ☐☐
•		•	100	12.5	14	480	640	RV101M100Z140ETR ☐☐
•		•	100	16	17	450	800	RV101M100J170ETR ☐☐
160	•	•	10	8	10.5	-	88	RV100M160F105ETR ☐☐
	•	•	18	10	10.5	-	104	RV180M160G105ETR ☐☐
	•	•	22	10	10.5	-	112	RV220M160G105ETR ☐☐
	•	•	27	12.5	14	-	136	RV270M160Z140ETR ☐☐
	•	•	33	12.5	14	-	152	RV330M160Z140ETR ☐☐
	•	•	47	16	17	-	416	RV470M160J170ETR ☐☐
	•	•	68	16	17	-	480	RV680M160J170ETR ☐☐
200	•	•	10	12.5	14	-	128	RV100M200Z140ETR ☐☐
	•	•	22	12.5	14	-	168	RV220M200Z140ETR ☐☐
	•	•	27	12.5	14	-	184	RV270M200Z140ETR ☐☐
	•	•	33	16	17	-	352	RV330M200J170ETR ☐☐
	•	•	47	16	17	-	416	RV470M200J170ETR ☐☐
250	•	•	4.7	8	10.5	-	80	RV47M250F105ETR ☐☐
	•	•	4.7	12.5	14	-	104	RV47M250Z140ETR ☐☐
	•	•	6.8	10	10.5	-	96	RV68M250G105ETR ☐☐
	•	•	6.8	12.5	14	-	125	RV68M250Z140ETR ☐☐
	•	•	10	10	10.5	-	120	RV100M250G105ETR ☐☐
	•	•	15	12.5	14	-	192	RV150M250Z140ETR ☐☐
	•	•	22	16	17	-	288	RV220M250J170ETR ☐☐
400	•	•	2.2	8	10.5	-	40	RV2R2M400F105ETR ☐☐
	•	•	3.3	8	10.5	-	48	RV3R3M400F105ETR ☐☐
	•	•	3.9	10	10.5	-	56	RV3R9M400G105ETR ☐☐
	•	•	4.7	10	10.5	-	64	RV47M400G105ETR ☐☐

☐☐ see description at end of standard ratings

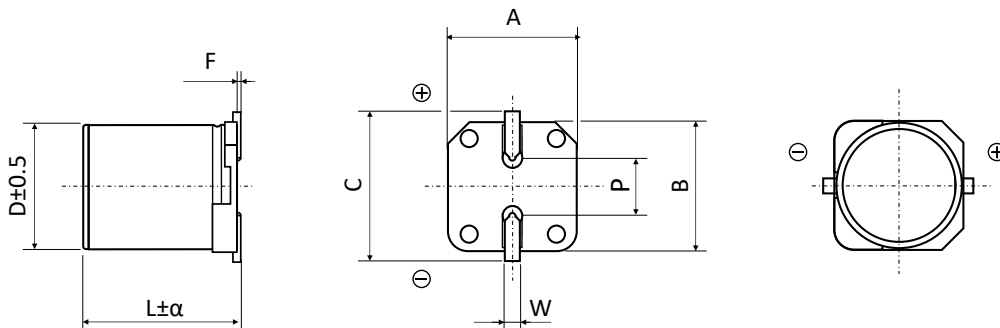
**STANDARD RATINGS**

Part number shows blister tape on paper reel

$V_R$ (V)	Standard	Vibration-proof	$C_R$ ( $\mu$ F)	$\phi D$ (mm)	L (mm)	Z - Max. Impedance +20°C - 100kHz (m $\Omega$ )	$I_R$ - Max. Ripple Current +105°C - 100kHz (mA rms)	CapXon Part Number
	•	•						
400	•	•	6.8	12.5	14	-	96	RV6R8M400Z140ETR □□
	•	•	8.2	12.5	14	-	104	RV8R2M400Z140ETR □□
	•	•	10	12.5	14	-	112	RV100M400Z140ETR □□
	•	•	12	16	17	-	152	RV120M400J170ETR □□
	•	•	22	16	17	-	192	RV220M400J170ETR □□
450	•	•	3.3	10	10.5	-	64	RV3R3M450G105ETR □□
	•	•	3.9	10	10.5	-	64	RV3R9M450G105ETR □□
	•	•	4.7	12.5	14	-	80	RV4R7M450Z140ETR □□
	•	•	6.8	12.5	14	-	96	RV6R8M450Z140ETR □□
	•	•	8.2	12.5	14	-	104	RV8R2M450Z140ETR □□
	•	•	10	12.5	14	-	112	RV100M450Z140ETR □□
	•	•	12	16	17	-	144	RV120M450J170ETR □□
	•	•	15	16	17	-	160	RV150M450J170ETR □□

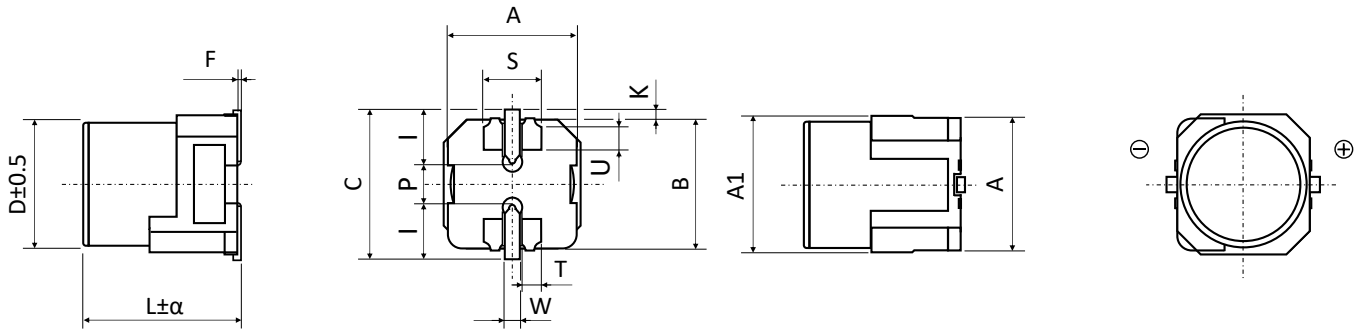
□□: Enter **blank** for Standard package  
 □□: Enter **W** for Vibration proof version

□□: Enter **X** for AEC-Q200  
 □□: Enter **XW** for AEC-Q200 and Vibration proof version

**DIMENSIONS STANDARD PACKAGE - All dimensions in mm**


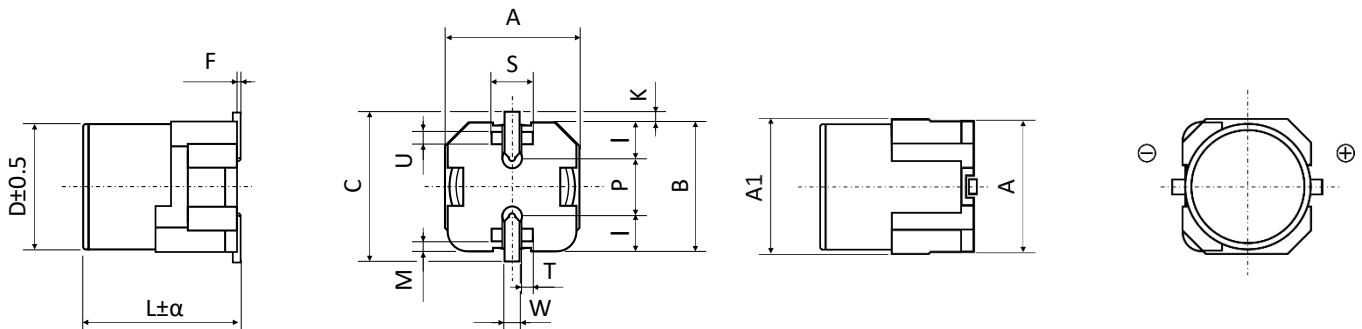
$\phi D$	L	$\alpha$	$A \pm 0.2$	$B \pm 0.2$	$C \pm 0.2$	F	$P \pm 0.2$	W
4.0	5.5	Max	4.3	4.3	4.9	0.3 max.	1.0	0.5 to 0.8
5.0	5.5	Max	5.3	5.3	5.9	0.3 max.	1.4	0.5 to 0.8
6.3	5.5	0.2	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
6.3	7.7	Max	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
8.0	10.5	Max	8.3	8.3	9.0	0.3 max.	3.1	0.7 to 1.1
10.0	10.5	Max	10.3	10.3	11.0	0.3 max.	4.5	0.7 to 1.1
12.5	14.0	Max	13.0	13.0	13.9	0.3 max.	4.5	1 to 1.4
16.0	17.0	0.5	17.0	17.0	18.0	0.3 max.	6.6	1 to 1.4



**DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D6.3** ▪ All dimensions in mm


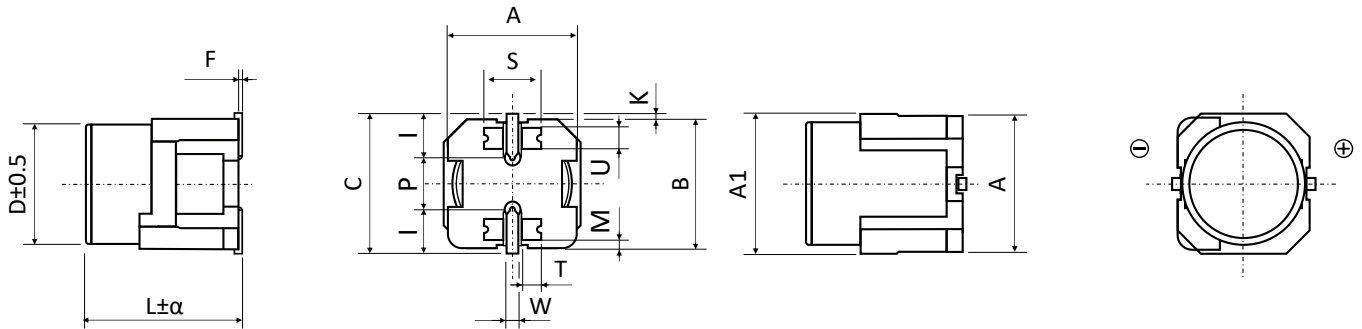
ø D	L	α	A ± 0.2	A1 (max.)	B ± 0.2	C (max.)	F	K
6.3	8.0	0.3	6.6	7.1	6.6	7.8	0 to 0.15	0.35 +0.15/-0.2

ø D	L	P ± 0.2	S ± 0.1	I ± 0.1	T ± 0.1	U ± 0.1	W ± 0.1
6.3	8.0	2.2	2.9	2.4	1.1	1.55	0.65

**DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D8 and D10** ▪ All dimensions in mm


ø D	L	α	A ± 0.2	A1 (max.)	B ± 0.2	C (max.)	F	K ± 0.2
8.0	10.5	0.5	8.3	8.8	8.3	10.0	0 to 0.15	0.7
10.0	10.5	0.5	10.3	10.8	10.3	12.0	0 to 0.15	0.7

ø D	L	P ± 0.2	S ± 0.1	I ± 0.1	T ± 0.1	U ± 0.1	W ± 0.1	M ± 0.1
8.0	10.5	3.1	3	3.4	1.4	0.7	1.2	0.7
10.0	10.5	4.6	3.3	3.5	1.5	0.8	1.2	0.9

**DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D12.5 and D16** ▪ All dimensions in mm


ø D	L	α	A ± 0.2	A1 (max.)	B ± 0.2	C (max.)	F	K ± 0.3
12.5	14.0	1.0	13.5	13.5	13.5	15.0	0 to 0.15	0.7
16.0	17.0	1.0	17.0	17.0	17.0	19.0	0 to 0.15	0.7

ø D	L	P ± 0.2	S ± 0.1	I ± 0.1	T ± 0.1	U ± 0.1	W ± 0.1	M ± 0.1
12.5	14.0	4.4	6.0	4.7	2.0	2.2	1.2	0.95
16.0	17.0	6.7	5.8	5.5	2.0	3.0	1.4	1.0

**MULTIPLIER  $K_f$  for RIPPLE CURRENT vs. FREQUENCY**
**< 160V**

$C_R$ (µF) / Frequency (Hz)	50/60	100/120	500	1k	10k	50k ~ 100k
$1 \leq C_R \leq 10$	0.47	0.59	0.76	0.85	0.97	1
$10 < C_R \leq 6800$	0.52	0.65	0.8	0.89	0.97	1

**≥ 160V**

$C_R$ (µF) / Frequency (Hz)	50/60	100/120	400	1k	10k	50k ~ 100k
$2.2 \leq C_R \leq 68$	0.5	0.63	0.78	0.88	0.97	1

**PRECAUTIONS, GUIDELINES AND PACKAGING INFORMATION**

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General Precautions and Guidelines	Packaging Information Liquid SMD
Page 104	Page 95



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Particular operating conditions (ambient temperature, ripple current, voltage, thermal resistance, etc.) as well as storage, production or assembly may affect the performance and the lifetime of the capacitor. Please consult CapXon for lifetime estimation, failure mode considerations or worst-case scenarios according to the product technology, product tolerances / deviations or change of the characteristics of the capacitor due to shipment, storage, handling, production and usage.

For aerospace or military application, life-saving, life-sustaining, safety critical applications or any application where failure may cause severe personal injury or death, please consult us before design-in the capacitor in your application.

Except for the written expressed warranties, CapXon does not impliedly, by assumption or whatever else, warrant, undertake, promise any other warranty or guaranty for any CapXon product.

For further information, please visit our website [www.capxongroup.com](http://www.capxongroup.com) or contact CapXon directly.

### MV SERIES ■ LONG LIFE 105°C TYPE

#### KEY FEATURES



- ALUMINUM ELECTROLYTIC CAPACITOR ■ SMD type
- Endurance: 105°C ■ 5 000 hours
- Long life type
- Small dimensions
- Ideal for high density mounting



#### SPECIFICATIONS

Items		Performance Characteristics						
Operating Temperature Range		-40 ~ +105°C						
Rated Voltage Range	$V_R$	6.3 ~ 50V DC						
Surge Voltage	$V_S$	$V_S = 1.15 \cdot V_R$						
Capacitance Range	$C_R$	1 ~ 1000 $\mu$ F						
Cap. Tolerance	$\Delta C$	$\pm 20\%$ (120Hz ■ 20°C)						
Leakage Current (20°C ■ $V_R$ applied)	$I_{LEAK}$	$\leq 0.01 \cdot C_R \cdot V_R$ or 3 $\mu$ A, whichever is greater ■ After 2 minutes [ $I_{LEAK}$ ( $\mu$ A) ; $C_R$ ( $\mu$ F) ; $V_R$ (V) ]						
Dissipation Factor % (20°C ■ 120Hz)	tan $\delta$	$V_R$ (V DC)	6.3	10	16	25	35	50
		tan $\delta$	32	28	22	16	13	12
Low Temperature Characteristics at 120Hz	Z ratio max.	$V_R$ (V DC)	6.3	10	16	25	35	50
		Z-25°C/Z+20°C	4	3	2	2	2	2
		Z-40°C/Z+20°C	10	7	5	3	3	3

Lifetime Test			
Endurance 105°C ( $V_R$ applied)	Test	<b>5 000 hours</b>	
	$\Delta C/C_R$	$\leq \pm 30\%$ of initial measured value	
	tan $\delta$	$\leq 300\%$ of initial specified value	
	$I_{Leak}$	$\leq$ the initial specified value	
Shelf Life 105°C ( $V_R = 0$ )	Test	<b>1 000 hours</b>	
	$\Delta C/C_R$	$\leq \pm 30\%$ of initial measured value	
	tan $\delta$	$\leq 300\%$ of initial specified value	
	$I_{Leak}$	$\leq$ the initial specified value	
Before measurement: Restore capacitor to 20°C, apply $V_R$ for 30 min according JIS-C-5101-4			
Resistance to Soldering Heat	The capacitors shall be kept on a hot plate maintained at 250°C for 30 seconds. After removing from the hot plate and restored at room temperature, they meet the characteristic requirements listed below		
	$\Delta C/C_R$	Within $\pm 10\%$ of initial value	
	tan $\delta$	Less than specified value	
	$I_{Leak}$	Less than specified value	

**STANDARD RATINGS**

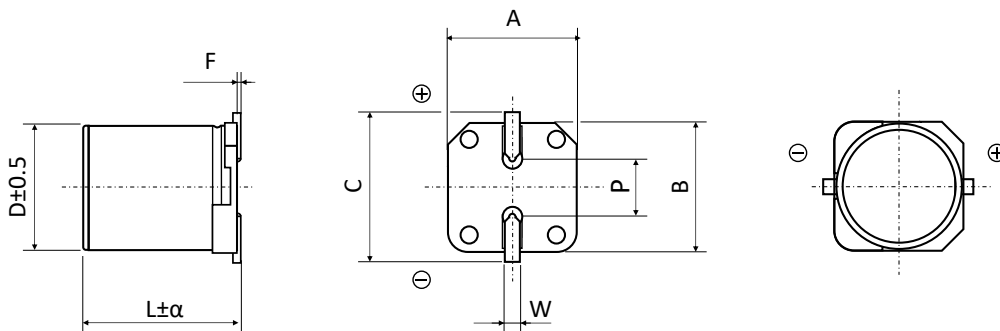
Part number shows blister tape on paper reel

$V_R$ (V)	$C_R$ ( $\mu F$ )	$\phi D$ (mm)	L (mm)	$I_R$ - Max. Ripple Current +105°C - 120Hz (mA rms)	CapXon Part Number
6.3	22	4	5.5	22	MV220M6R3B055ETR
	33	5	5.5	32	MV330M6R3C055ETR
	47	5	5.5	36	MV470M6R3C055ETR
	100	6.3	5.5	60	MV101M6R3E055ETR
	220	6.3	7.7	110	MV221M6R3E077ETR
	330	8	10.5	160	MV331M6R3F105ETR
	470	10	10.5	260	MV471M6R3G105ETR
	1000	10	10.5	340	MV102M6R3G105ETR
10	22	5	5.5	28	MV220M010C055ETR
	33	5	5.5	34	MV330M010C055ETR
	47	6.3	5.5	48	MV470M010E055ETR
	100	6.3	7.7	79	MV101M010E077ETR
	220	8	10.5	140	MV221M010F105ETR
	330	8	10.5	210	MV331M010F105ETR
	330	10	10.5	240	MV331M010G105ETR
	470	8	10.5	250	MV471M010F105ETR
	470	10	10.5	280	MV471M010G105ETR
	1000	10	10.5	410	MV102M010G105ETR
16	10	4	5.5	17	MV100M016B055ETR
	22	4	5.5	26	MV220M016B055ETR
	22	5	5.5	30	MV220M016C055ETR
	33	6.3	5.5	44	MV330M016E055ETR
	47	6.3	5.5	50	MV470M016E055ETR
	100	6.3	7.7	81	MV101M016E077ETR
	220	8	10.5	190	MV221M016F105ETR
	220	10	10.5	216	MV221M016G105ETR
	330	10	10.5	300	MV331M016G105ETR
	470	10	10.5	320	MV471M016G105ETR
25	4.7	4	5.5	13	MV4R7M025B055ETR
	10	4	5.5	23	MV100M025B055ETR
	22	5	5.5	35	MV220M025C055ETR
	22	6.3	5.5	40	MV220M025E055ETR
	33	6.3	5.5	48	MV330M025E055ETR
	47	6.3	7.7	63	MV470M025E077ETR
	100	6.3	7.7	88	MV101M025E077ETR
	100	8	10.5	116	MV101M025F105ETR
	220	10	10.5	240	MV221M025G105ETR
	330	10	10.5	375	MV331M025G105ETR
	470	10	10.5	450	MV471M025G105ETR
	35	4.7	4	5.5	15
10		5	5.5	25	MV100M035C055ETR
22		6.3	5.5	42	MV220M035E055ETR
33		6.3	7.7	57	MV330M035E077ETR
47		8	10.5	92	MV470M035F105ETR
100		8	10.5	130	MV101M035F105ETR

**STANDARD RATINGS**

Part number shows blister tape on paper reel

$V_R$ (V)	$C_R$ ( $\mu F$ )	$\phi D$ (mm)	L (mm)	$I_R$ - Max. Ripple Current +105°C - 120Hz (mA rms)	CapXon Part Number
35	100	10	10.5	150	MV101M035G105ETR
	220	10	10.5	280	MV221M035G105ETR
	330	10	10.5	390	MV331M035G105ETR
50	1	4	5.5	6.2	MV010M050B055ETR
	2.2	4	5.5	11	MV2R2M050B055ETR
	3.3	4	5.5	14	MV3R3M050B055ETR
	4.7	5	5.5	19	MV4R7M050C055ETR
	10	6.3	5.5	30	MV100M050E055ETR
	22	6.3	7.7	52	MV220M050E077ETR
	33	8	10.5	80	MV330M050F105ETR
	47	8	10.5	95	MV470M050F105ETR
	100	10	10.5	160	MV101M050G105ETR

**DIMENSIONS STANDARD PACKAGE** - All dimensions in mm




$\phi D$	L	$\alpha$	$A \pm 0.2$	$B \pm 0.2$	$C \pm 0.2$	F	$P \pm 0.2$	W
4.0	5.5	Max	4.3	4.3	4.9	0.3 max.	1.0	0.5 to 0.8
5.0	5.5	Max	5.3	5.3	5.9	0.3 max.	1.4	0.5 to 0.8
6.3	5.5	0.2	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
6.3	7.7	Max	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
8.0	10.5	Max	8.3	8.3	9.0	0.3 max.	3.1	0.7 to 1.1
10.0	10.5	Max	10.3	10.3	11.0	0.3 max.	4.5	0.7 to 1.1

**MULTIPLIER  $K_f$  for RIPPLE CURRENT vs. FREQUENCY**

$C_R$ ( $\mu F$ ) / Frequency (Hz)	50/60	100/120	500	1k	$\geq 10k$
$1 \leq C_R \leq 100$	0.8	1	1.2	1.3	1.5
$100 < C_R \leq 1000$	0.8	1	1.1	1.15	1.2

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<p>General Precautions and Guidelines</p>	<p>Packaging Information Liquid SMD</p>
<p>Page 104</p>	<p>Page 95</p>

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Particular operating conditions (ambient temperature, ripple current, voltage, thermal resistance, etc.) as well as storage, production or assembly may affect the performance and the lifetime of the capacitor. Please consult CapXon for lifetime estimation, failure mode considerations or worst-case scenarios according to the product technology, product tolerances / deviations or change of the characteristics of the capacitor due to shipment, storage, handling, production and usage.

For aerospace or military application, life-saving, life-sustaining, safety critical applications or any application where failure may cause severe personal injury or death, please consult us before design-in the capacitor in your application.

Except for the written expressed warranties, CapXon does not impliedly, by assumption or whatever else, warrant, undertake, promise any other warranty or guaranty for any CapXon product.

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### CV SERIES ■ LONG LIFE, AUTOMOTIVE 105°C TYPE

#### KEY FEATURES



- ALUMINUM ELECTROLYTIC CAPACITOR ■ SMD type
- Endurance: 105°C ■ 7000 hours
- Low impedance and high ripple current
- Vibration-proof (VP) version (up to 30g) available upon request
- AEC-Q200 version available



#### SPECIFICATIONS

Items		Performance Characteristics						
Operating Temperature Range		-40 ~ +105°C						
Rated Voltage Range	$V_R$	6.3 ~ 50V DC						
Surge Voltage	$V_S$	$V_S = 1.15 \cdot V_R$						
Capacitance Range	$C_R$	22 ~ 1500 $\mu$ F						
Cap. Tolerance	$\Delta C$	$\pm 20\%$ (120Hz ■ 20°C)						
Leakage Current (20°C ■ $V_R$ applied)	$I_{LEAK}$	$\leq 0.01 \cdot C_R \cdot V_R$ or 3 $\mu$ A, whichever is greater ■ After 2 minutes [ $I_{LEAK}$ ( $\mu$ A) ; $C_R$ ( $\mu$ F) ; $V_R$ (V) ]						
Dissipation Factor % (20°C ■ 120Hz)	tan $\delta$	$V_R$ (V DC)	6.3	10	16	25	35	50
		tan $\delta$	32	28	26	16	14	14
Low Temperature Characteristics at 120Hz	Z ratio max.	$V_R$ (V DC)	6.3	10	16	25	35	50
		Z-25°C/Z+20°C	4	3	2	2	2	2
		Z-40°C/Z+20°C	8	6	4	4	3	3
Lifetime Test								
Endurance 105°C ( $V_R$ applied)	Test	<b>7 000 hours</b>						
	$\Delta C/C_R$	$\leq \pm 30\%$ of initial measured value						
	tan $\delta$	$\leq 300\%$ of initial specified value						
	$I_{Leak}$	$\leq$ the initial specified value						
Shelf Life 105°C ( $V_R = 0$ )	Test	<b>1 000 hours</b>						
	$\Delta C/C_R$	$\leq \pm 30\%$ of initial measured value						
	tan $\delta$	$\leq 300\%$ of initial specified value						
	$I_{Leak}$	$\leq$ the initial specified value						
Resistance to Soldering Heat	Before measurement: Restore capacitor to 20°C, apply $V_R$ for 30 min according JIS-C-5101-4							
	The capacitors shall be kept on a hot plate maintained at 250°C for 30 seconds. After removing from the hot plate and restored at room temperature, they meet the characteristic requirements listed below							
	$\Delta C/C_R$	Within $\pm 10\%$ of initial value						
	tan $\delta$	Less than specified value						
	$I_{Leak}$	Less than specified value						

**STANDARD RATINGS**

Part number shows blister tape on paper reel

V <sub>R</sub> (V)	Standard	Vibration-proof	C <sub>R</sub> (μF)	ø D (mm)	L (mm)	Z - Max. Impedance +20°C - 100kHz (mΩ)	I <sub>R</sub> - Max. Ripple Current +105°C - 100kHz (mA rms)	CapXon Part Number
	•	•						
6.3	•	•	100	6.3	7.7	1100	140	CV101M6R3E077ETR □□
	•	•	150	6.3	7.7	900	180	CV151M6R3E077ETR □□
	•	•	220	6.3	7.7	750	230	CV221M6R3E077ETR □□
	•	•	330	8	10.5	500	400	CV331M6R3F105ETR □□
	•	•	470	8	10.5	220	600	CV471M6R3F105ETR □□
	•	•	680	10	10.5	200	700	CV681M6R3G105ETR □□
	•	•	1000	12.5	14	100	1100	CV102M6R3Z140ETR □□
10	•	•	100	6.3	7.7	1100	140	CV101M010E077ETR □□
	•	•	150	6.3	7.7	900	180	CV151M010E077ETR □□
	•	•	220	6.3	7.7	750	230	CV221M010E077ETR □□
	•	•	330	8	10.5	500	400	CV331M010F105ETR □□
	•	•	470	8	10.5	220	600	CV471M010F105ETR □□
	•	•	680	10	10.5	200	700	CV681M010G105ETR □□
	•	•	1000	12.5	14	100	1100	CV102M010Z140ETR □□
16	•	•	100	6.3	7.7	1100	140	CV101M016E077ETR □□
	•	•	150	8	10.5	600	250	CV151M016F105ETR □□
	•	•	220	8	10.5	400	280	CV221M016F105ETR □□
	•	•	330	8	10.5	220	600	CV331M016F105ETR □□
	•	•	470	8	10.5	220	600	CV471M016F105ETR □□
	•	•	470	10	10.5	160	850	CV471M016G105ETR □□
	•	•	680	12.5	14	100	1100	CV681M016Z140ETR □□
25	•	•	1000	16	17	80	1500	CV102M016J170ETR □□
	•	•	22	6.3	7.7	1500	95	CV220M025E077ETR □□
	•	•	33	6.3	7.7	1300	120	CV330M025E077ETR □□
	•	•	47	6.3	7.7	1100	140	CV470M025E077ETR □□
	•	•	100	8	10.5	700	280	CV101M025F105ETR □□
	•	•	150	8	10.5	600	380	CV151M025F105ETR □□
	•	•	220	8	10.5	220	600	CV221M025F105ETR □□
	•	•	330	8	10.5	200	650	CV331M025F105ETR □□
	•	•	390	10	10.5	190	750	CV391M025G105ETR □□
	•	•	470	10	10.5	160	850	CV471M025G105ETR □□
35	•	•	680	12.5	14	100	1100	CV681M025Z140ETR □□
	•	•	1000	16	17	80	1500	CV102M025J170ETR □□
	•	•	47	6.3	7.7	1000	230	CV470M035E077ETR □□
	•	•	100	8	10.5	220	600	CV101M035F105ETR □□
	•	•	220	10	10.5	160	850	CV221M035G105ETR □□
	•	•	330	12.5	14	100	1100	CV331M035Z140ETR □□
	•	•	470	16	17	80	1500	CV471M035J170ETR □□

□□ see description at end of standard ratings

### STANDARD RATINGS

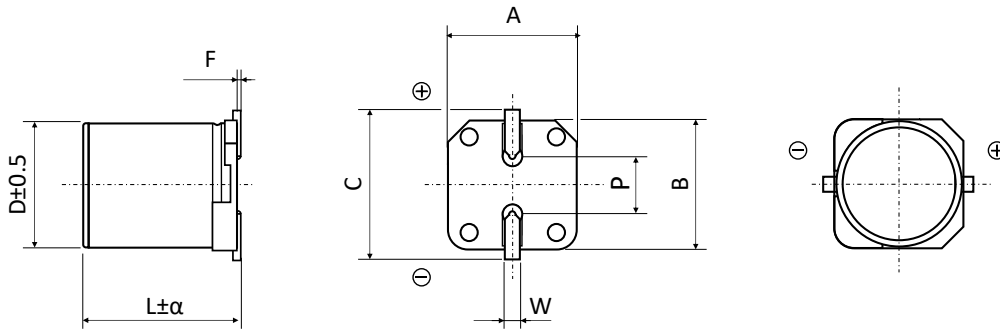
Part number shows blister tape on paper reel

$V_R$ (V)	Standard		$C_R$ ( $\mu$ F)	$\phi D$ (mm)	L (mm)	Z - Max. Impedance +20°C • 100kHz (m $\Omega$ )	$I_R$ - Max. Ripple Current +105°C • 100kHz (mA rms)	CapXon Part Number
	Standard	Vibration-proof						
50	•	•	47	8	10.5	530	350	CV470M050F105ETR
	•	•	100	8	10.5	530	350	CV101M050F105ETR
	•	•	100	10	10.5	510	400	CV101M050G105ETR
	•	•	150	10	10.5	480	450	CV151M050G105ETR
	•	•	220	12.5	14	400	850	CV221M050Z140ETR
	•	•	330	16	17	300	1100	CV331M050J170ETR

□□: Enter **blank** for Standard package  
 □□: Enter **W** for Vibration proof version

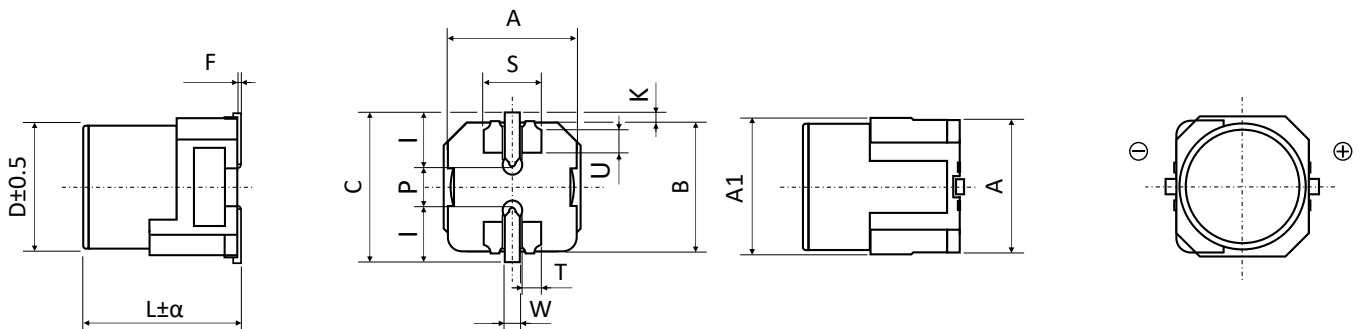
□□: Enter **X** for AEC-Q200  
 □□: Enter **XW** for AEC-Q200 and Vibration proof version

### DIMENSIONS STANDARD PACKAGE ▀ All dimensions in mm



$\phi D$	L	$\alpha$	$A \pm 0.2$	$B \pm 0.2$	$C \pm 0.2$	F	$P \pm 0.2$	W
6.3	7.7	Max	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
8.0	10.5	Max	8.3	8.3	9.0	0.3 max.	3.1	0.7 to 1.1
10.0	10.5	Max	10.3	10.3	11.0	0.3 max.	4.5	0.7 to 1.1
12.5	14.0	Max	13.0	13.0	13.9	0.3 max.	4.5	1 to 1.4
16.0	17.0	0.5	17.0	17.0	18.0	0.3 max.	6.6	1 to 1.4

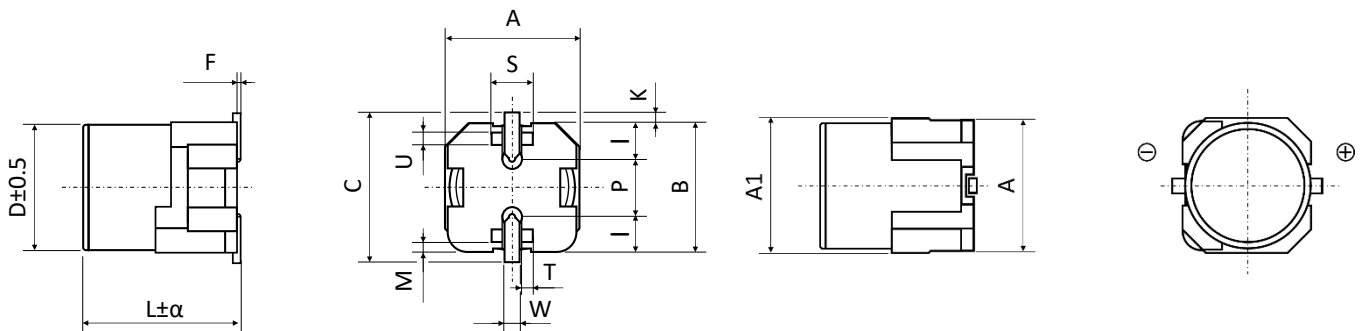
### DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D6.3 ▀ All dimensions in mm



**DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D6.3** ▪ All dimensions in mm

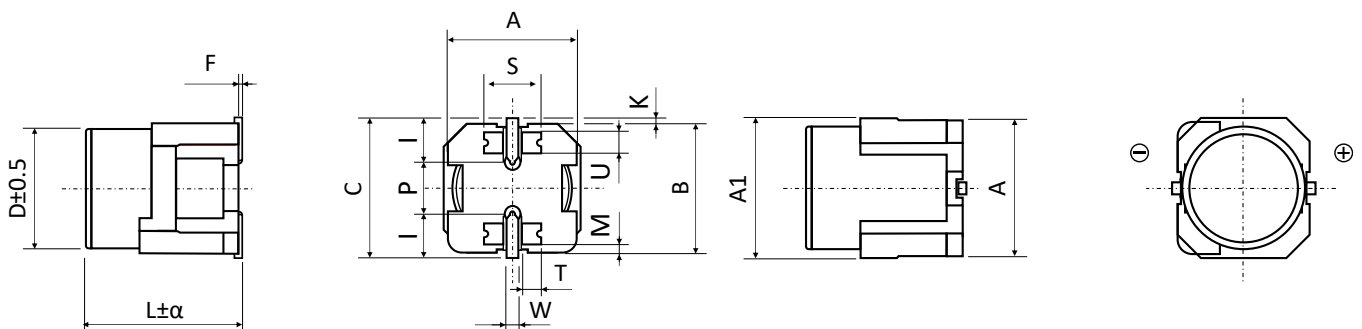
ø D	L	α	A ± 0.2	A1 (max.)	B ± 0.2	C (max.)	F	K
6.3	8.0	0.3	6.6	7.1	6.6	7.8	0 to 0.15	0.35 +0.15/-0.2

ø D	L	P ± 0.2	S ± 0.1	I ± 0.1	T ± 0.1	U ± 0.1	W ± 0.1
6.3	8.0	2.2	2.9	2.4	1.1	1.55	0.65

**DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D8 and D10** ▪ All dimensions in mm


ø D	L	α	A ± 0.2	A1 (max.)	B ± 0.2	C (max.)	F	K ± 0.2
8.0	10.5	0.5	8.3	8.8	8.3	10.0	0 to 0.15	0.7
10.0	10.5	0.5	10.3	10.8	10.3	12.0	0 to 0.15	0.7

ø D	L	P ± 0.2	S ± 0.1	I ± 0.1	T ± 0.1	U ± 0.1	W ± 0.1	M ± 0.1
8.0	10.5	3.1	3	3.4	1.4	0.7	1.2	0.7
10.0	10.5	4.6	3.3	3.5	1.5	0.8	1.2	0.9

**DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D12.5 and D16** ▪ All dimensions in mm


ø D	L	α	A ± 0.2	A1 (max.)	B ± 0.2	C (max.)	F	K ± 0.3
12.5	14.0	1.0	13.5	13.5	13.5	15.0	0 to 0.15	0.7
16.0	17.0	1.0	17.0	17.0	17.0	19.0	0 to 0.15	0.7

ø D	L	P ± 0.2	S ± 0.1	I ± 0.1	T ± 0.1	U ± 0.1	W ± 0.1	M ± 0.1
12.5	14.0	4.4	6.0	4.7	2.0	2.2	1.2	0.95
16.0	17.0	6.7	5.8	5.5	2.0	3.0	1.4	1.0

**MULTIPLIER  $K_f$  for RIPPLE CURRENT vs. FREQUENCY**

$C_R$ ( $\mu\text{F}$ ) / Frequency (Hz)	50/60	100/120	500	1k	10k ~ 100k
$22 \leq C_R \leq 100$	0.53	0.67	0.8	0.87	1
$100 < C_R \leq 1500$	0.67	0.83	0.92	0.96	1

**PRECAUTIONS, GUIDELINES AND PACKAGING INFORMATION**

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General Precautions and Guidelines	Packaging Information Liquid SMD
Page 104	Page 95

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CapXon products are designed and manufactured according to severe quality and safety standards. Under no circumstance, CapXon warrants that any CapXon product is suitable for the purposes intended for your application, even CapXon knows the application. It is customer's duty and obligation to check and make sure that CapXon products are suitable for the purposes intended and select the correct and proper CapXon product. Customers are requested to perform a sufficient validation and reliability evaluation to assure needed safety level and reliability performance by suitable designs and to apply proper safeguards (e.g. redundancies, protective circuits).

Particular operating conditions (ambient temperature, ripple current, voltage, thermal resistance, etc.) as well as storage, production or assembly may affect the performance and the lifetime of the capacitor. Please consult CapXon for lifetime estimation, failure mode considerations or worst-case scenarios according to the product technology, product tolerances / deviations or change of the characteristics of the capacitor due to shipment, storage, handling, production and usage.

For aerospace or military application, life-saving, life-sustaining, safety critical applications or any application where failure may cause severe personal injury or death, please consult us before design-in the capacitor in your application.

Except for the written expressed warranties, CapXon does not impliedly, by assumption or whatever else, warrant, undertake, promise any other warranty or guaranty for any CapXon product.

For further information, please visit our website [www.capxongroup.com](http://www.capxongroup.com) or contact CapXon directly.

### TV SERIES ■ HIGH TEMP., AUTOMOTIVE 125°C TYPE

#### KEY FEATURES



- ALUMINUM ELECTROLYTIC CAPACITOR ■ SMD type
- Endurance: 125°C ■ 1 000 hours up to 2 000 hours
- Especially for applications with high ambient temperatures
- Vibration-proof (VP) version (up to 30g) available upon request
- AEC-Q200 version available



#### SPECIFICATIONS

Items		Performance Characteristics										
Operating Temperature Range		-40 ~ +125°C										
Rated Voltage Range	V <sub>R</sub>	10 ~ 50V DC					160 ~ 450V DC					
Surge Voltage	V <sub>S</sub>	(V <sub>R</sub> ≤ 315V): V <sub>S</sub> = 1.15·V <sub>R</sub>					(V <sub>R</sub> > 315V): V <sub>S</sub> = 1.10·V <sub>R</sub>					
Capacitance Range	C <sub>R</sub>	10 ~ 330μF					1 ~ 18μF					
Cap. Tolerance	ΔC	±20% (120Hz ■ 20°C)										
Leakage Current (20°C - V <sub>R</sub> applied)	I <sub>LEAK</sub>	≤ 0.03·C <sub>R</sub> ·V <sub>R</sub> or 3μA					≤ 0.04·C <sub>R</sub> ·V <sub>R</sub> + 100μA					
		Whichever is greater ■ After 1 minute					After 1 minute					
		[ I <sub>LEAK</sub> (μA) ; C <sub>R</sub> (μF) ; V <sub>R</sub> (V) ]										
Dissipation Factor % (20°C - 120Hz)	tanδ	V <sub>R</sub> (V DC)	10	16	25	35	50	160	200	250	400	450
		tanδ (%)	32	24	21	18	18	20	20	25	25	30
Low Temperature Characteristics at 120Hz	Z ratio max.	V <sub>R</sub> (V DC)	10	16	25	35	50	160	200	250	400	450
		Z-25°C/Z+20°C	12	8	6	4	4	8	8	8	12	15
		Z-40°C/Z+20°C	14	8	6	4	4	-	-	-	-	-
Lifetime Test												
Endurance 125°C (V <sub>R</sub> applied)	Test	2 000 hours					∅ 8 x 10.5mm & ∅ 10 x 10.5mm					
		1 000 hours					∅ 6.3 x 7.7mm & ∅ 8 x 6.5mm					
	ΔC/C <sub>R</sub>	≤ ±30% of initial measured value										
	tanδ	≤ 300% of initial specified value										
Shelf Life 125°C (V <sub>R</sub> = 0)	Test	1 000 hours										
		ΔC/C <sub>R</sub>	≤ ±30% of initial measured value									
	tanδ	≤ 300% of initial specified value										
	I <sub>Leak</sub>	≤ the initial specified value										
		Before measurement: Restore capacitor to 20°C, apply V <sub>R</sub> for 30 min according JIS-C-5101-4										
Resistance to Soldering Heat	The capacitors shall be kept on a hot plate maintained at 250°C for 30 seconds. After removing from the hot plate and restored at room temperature, they meet the characteristic requirements listed below											
	ΔC/C <sub>R</sub>	Within ±10% of initial value										
	tanδ	Less than specified value										
	I <sub>Leak</sub>	Less than specified value										

## STANDARD RATINGS

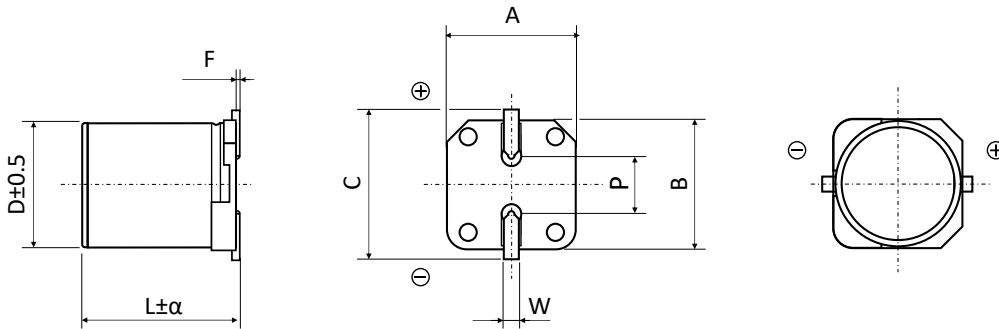
Part number shows blister tape on paper reel

V <sub>R</sub> (V)	Standard	Vibration-proof	C <sub>R</sub> (μF)	ø D (mm)	L (mm)	I <sub>R</sub> - Max. Ripple Current +125°C - 120Hz (mA rms)	CapXon Part Number
10	•	•	100	6.3	7.7	53	TV101M010E077ETR □□
	•		100	8	6.5	58	TV101M010F065ETR □□
	•	•	220	8	10.5	90	TV221M010F105ETR □□
	•	•	330	10	10.5	112	TV331M010G105ETR □□
16	•	•	100	8	10.5	66	TV101M016F105ETR □□
	•	•	220	10	10.5	102	TV221M016G105ETR □□
25	•	•	47	6.3	7.7	45	TV470M025E077ETR □□
	•		47	8	6.5	48	TV470M025F065ETR □□
	•	•	100	8	10.5	74	TV101M025F105ETR □□
	•	•	220	10	10.5	116	TV221M025G105ETR □□
35	•	•	33	6.3	7.7	40	TV330M035E077ETR □□
	•		33	8	6.5	44	TV330M035F065ETR □□
	•	•	47	8	10.5	52	TV470M035F105ETR □□
	•	•	100	10	10.5	80	TV101M035G105ETR □□
50	•	•	10	6.3	7.7	22	TV100M050E077ETR □□
	•		10	8	6.5	24	TV100M050F065ETR □□
	•	•	22	6.3	7.7	35	TV220M050E077ETR □□
	•		22	8	6.5	38	TV220M050F065ETR □□
	•	•	33	8	10.5	46	TV330M050F105ETR □□
	•	•	47	10	10.5	58	TV470M050G105ETR □□
160	•	•	6.8	8	10.5	42	TV6R8M160F105ETR □□
	•	•	10	10	10.5	59	TV100M160G105ETR □□
	•	•	18	10	10.5	65	TV180M160G105ETR □□
200	•	•	4.7	8	10.5	36	TV4R7M200F105ETR □□
	•	•	6.8	10	10.5	59	TV6R8M200G105ETR □□
	•	•	10	10	10.5	59	TV100M200G105ETR □□
250	•	•	3.3	8	10.5	28	TV3R3M250F105ETR □□
	•	•	4.7	10	10.5	59	TV4R7M250G105ETR □□
400	•	•	1	8	10.5	27	TV010M400F105ETR □□
	•	•	1.8	8	10.5	30	TV1R8M400F105ETR □□
	•	•	2.2	8	10.5	33	TV2R2M400F105ETR □□
	•	•	2.2	10	10.5	37	TV2R2M400G105ETR □□
	•	•	3.3	8	10.5	36	TV3R3M400F105ETR □□
	•	•	3.3	10	10.5	39	TV3R3M400G105ETR □□
	•	•	4.7	10	10.5	46	TV4R7M400G105ETR □□
	•	•	5.6	10	10.5	50	TV5R6M400G105ETR □□
450	•	•	2.2	8	10.5	28	TV2R2M450F105ETR □□
	•	•	3.3	10	10.5	32	TV3R3M450G105ETR □□
	•	•	3.9	10	10.5	38	TV3R9M450G105ETR □□

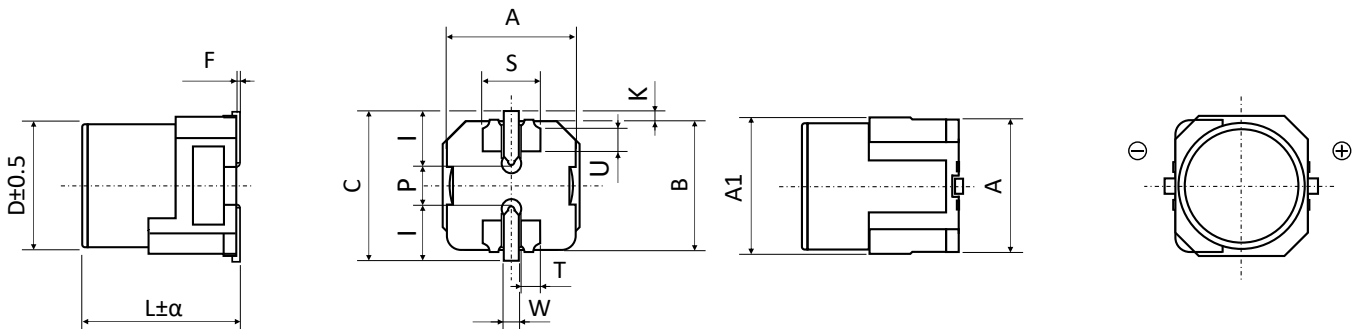
□□: Enter **blank** for Standard package  
 □□: Enter **W** for Vibration proof version

□□: Enter **X** for AEC-Q200  
 □□: Enter **XW** for AEC-Q200 and Vibration proof version



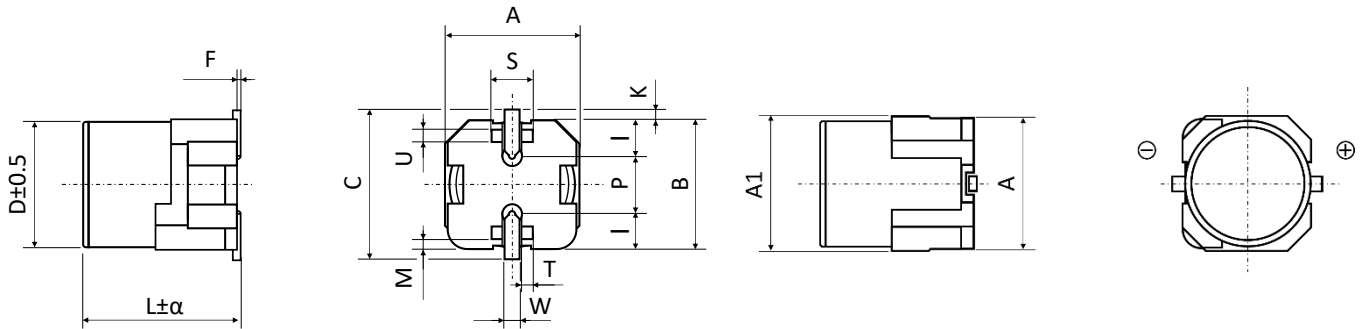
**DIMENSIONS STANDARD PACKAGE** ▪ All dimensions in mm


$\phi D$	L	$\alpha$	$A \pm 0.2$	$B \pm 0.2$	$C \pm 0.2$	F	$P \pm 0.2$	W
6.3	7.7	Max	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
8.0	6.5	Max	8.3	8.3	9.0	0.3 max.	2.3	0.5 to 0.8
8.0	10.5	Max	8.3	8.3	9.0	0.3 max.	3.1	0.7 to 1.1
10.0	10.5	Max	10.3	10.3	11.0	0.3 max.	4.5	0.7 to 1.1

**DIMENSIONS VP PACKAGE (VIBRATION-PROOF)  $\phi D6.3$**  ▪ All dimensions in mm


$\phi D$	L	$\alpha$	$A \pm 0.2$	A1 (max.)	$B \pm 0.2$	C (max.)	F	K
6.3	8.0	0.3	6.6	7.1	6.6	7.8	0 to 0.15	0.35 +0.15/-0.2

$\phi D$	L	$P \pm 0.2$	$S \pm 0.1$	$I \pm 0.1$	$T \pm 0.1$	$U \pm 0.1$	$W \pm 0.1$
6.3	8.0	2.2	2.9	2.4	1.1	1.55	0.65

**DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D8 and D10 ▪ All dimensions in mm**


$\phi D$	L	$\alpha$	$A \pm 0.2$	A1 (max.)	$B \pm 0.2$	C (max.)	F	$K \pm 0.2$
8.0	10.5	0.5	8.3	8.8	8.3	10.0	0 to 0.15	0.7
10.0	10.5	0.5	10.3	10.8	10.3	12.0	0 to 0.15	0.7

$\phi D$	L	$P \pm 0.2$	$S \pm 0.1$	$I \pm 0.1$	$T \pm 0.1$	$U \pm 0.1$	$W \pm 0.1$	$M \pm 0.1$
8.0	10.5	3.1	3	3.4	1.4	0.7	1.2	0.7
10.0	10.5	4.6	3.3	3.5	1.5	0.8	1.2	0.9

**MULTIPLIER  $K_f$  for RIPPLE CURRENT vs. FREQUENCY**

$C_R$ ( $\mu F$ ) / Frequency (Hz)	50/60	100/120	500	1k	10k ~ 100k
$1 \leq C_R \leq 47$	0.8	1	1.2	1.3	1.5
$100 < C_R \leq 330$	0.8	1	1.1	1.15	1.2

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For aerospace or military application, life-saving, life-sustaining, safety critical applications or any application where failure may cause severe personal injury or death, please consult us before design-in the capacitor in your application.

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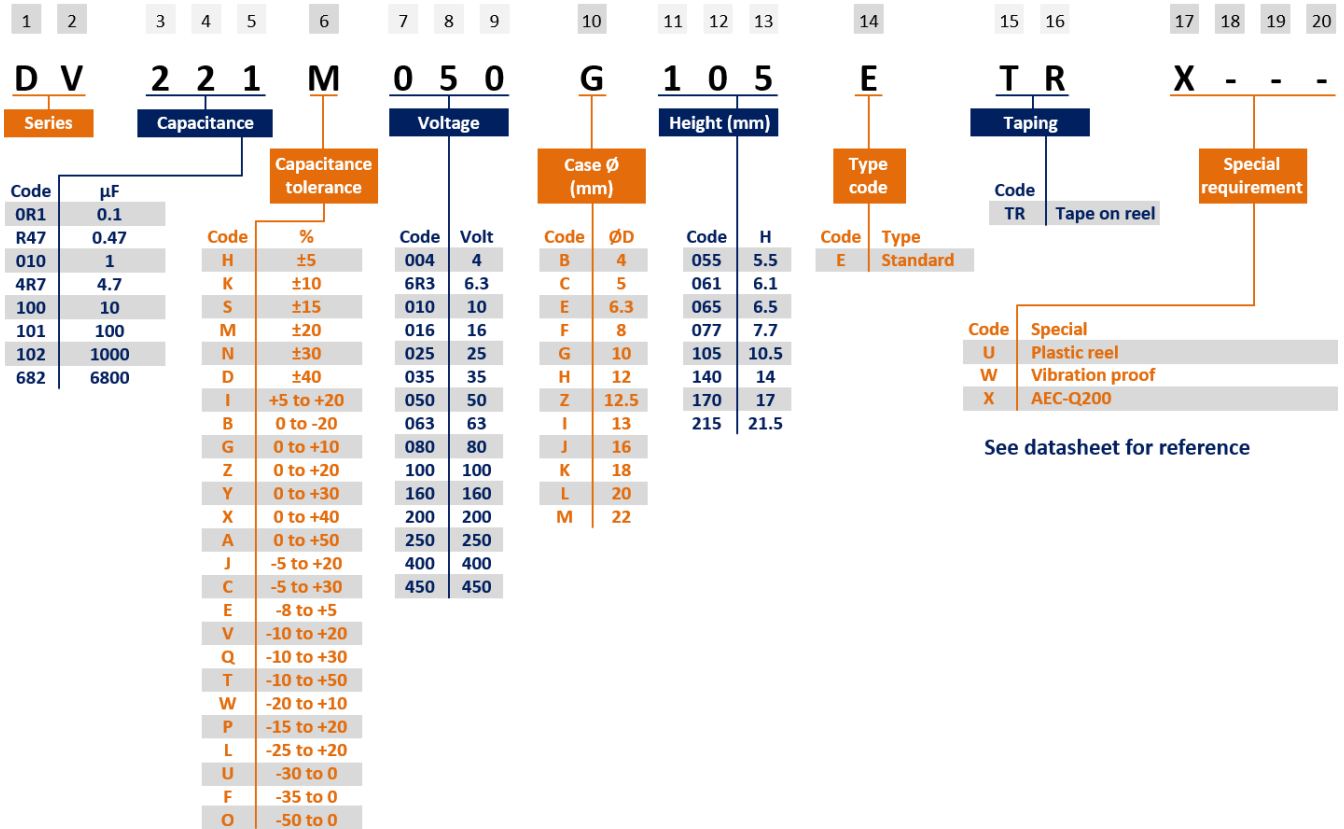
For further information, please visit our website [www.capxongroup.com](http://www.capxongroup.com) or contact CapXon directly.

### PRODUCT CODE - SMD ALUMINUM ELECTROLYTIC CAPACITORS



SMD type example:

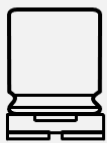
DV series ▪ 220µF ▪ 50V ▪ ±20% ▪ Ø 10mm ▪ L 10.5mm ▪ Tape & Reel ▪ AEC-Q200



Please consult CapXon for further assistance

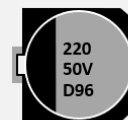
### MARKING - SMD ALUMINUM ELECTROLYTIC CAPACITORS

#### Aluminum Electrolytic Capacitor - SMD type



220: Nominal capacitance (µF)  
 50V: Rated voltage (V) ▪ Standard type  
 50X: Rated voltage (V) ▪ AEC-Q200 type  
 (-) polarity (Cathode indicate)  
 D: DV Series  
 96: Production datacode year/month (ex. 2019/June)

Top view  
Standard type

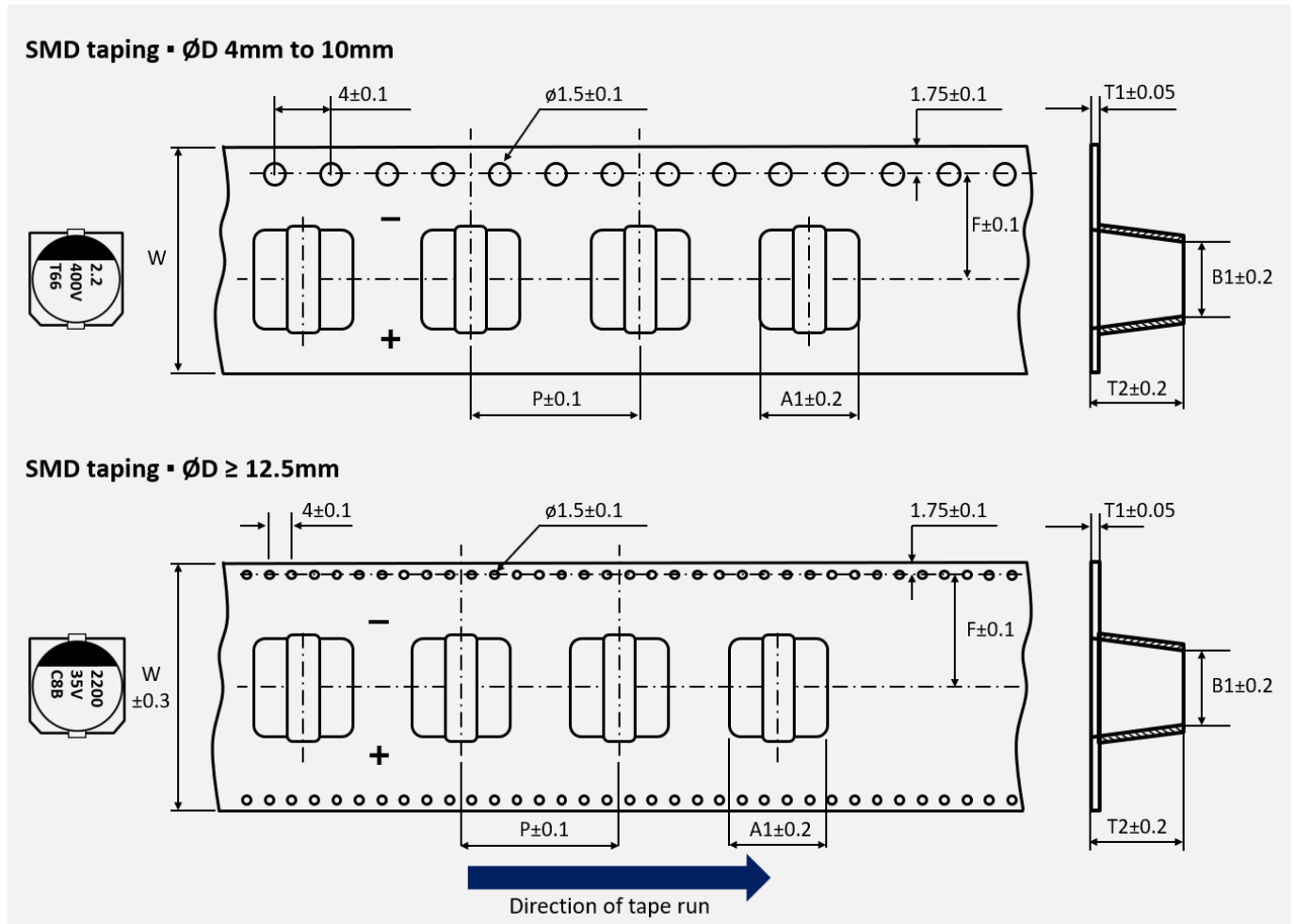


Top view  
AEC-Q200 type



Digits	Description
1 <sup>st</sup>	Last digit of the year
2 <sup>nd</sup>	Month 1, 2, 3...9, A (10), B (11), C (12)

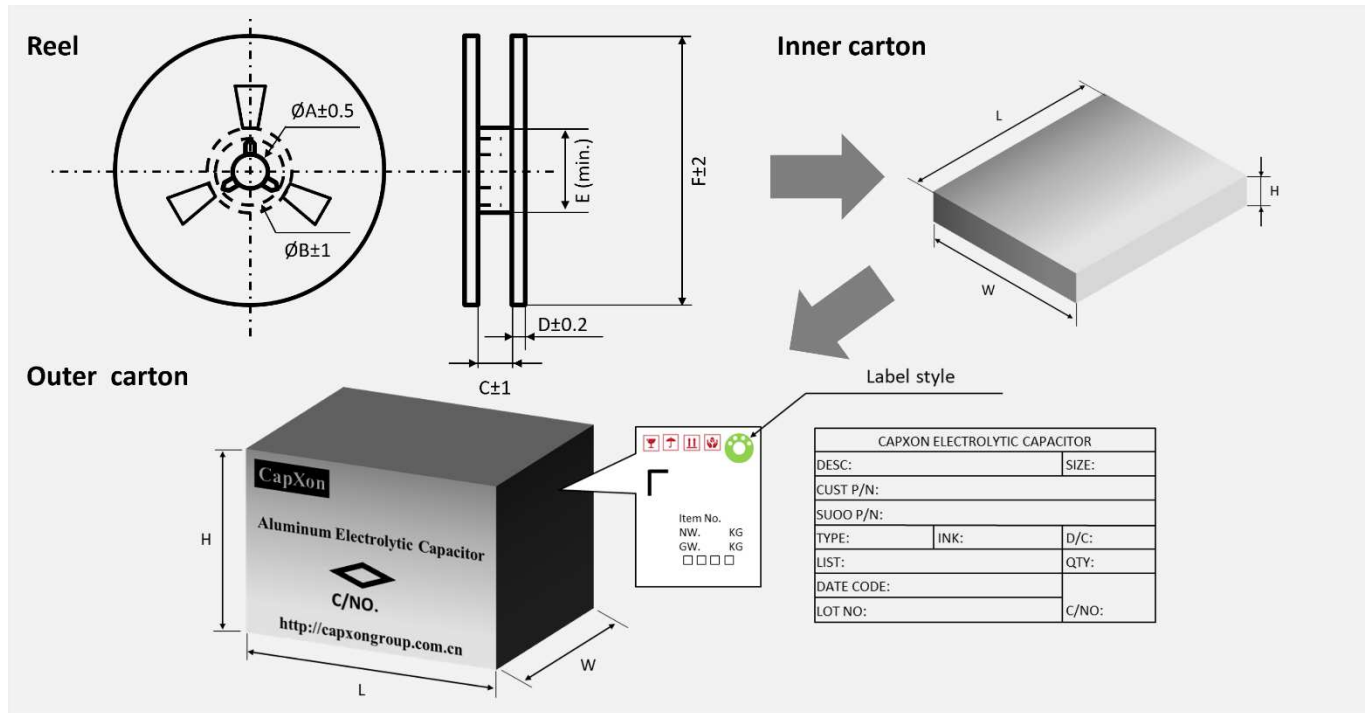
### TAPING • SMD ALUMINUM ELECTROLYTIC CAPACITORS • REEL PACK



All dimensions in mm

Ø D x L	4 x 5.5	5 x 5.5	6.3 x 5.5	6.3 x 6.1	6.3 x 7.7	8 x 6.5	8 x 10.5	10 x 10.5	12.5 x 14	16 x 17	16 x 21.5	18 x 16.5	18 x 21.5
W	12	12	16	16	16	16	24	24	32	44	44	44	44
P	8	12	12	12	12	12	16	16	24	28	32	32	32
F	5.5	5.5	7.5	7.5	7.5	7.5	11.5	11.5	14.2	20.2	20.2	20.2	20.2
A1	4.7	5.7	7	7	7	8.7	8.7	10.7	13.9	17.5	17.5	19.5	19.5
B1	4.7	5.7	7	7	7	8.7	8.7	10.7	13.9	17.5	17.5	19.5	19.5
T1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5
T2	5.7	5.7	5.7	6.2	8.1	7	11	11	14.5	17.5	23	17.5	23

### TAPING • SMD ALUMINUM ELECTROLYTIC CAPACITORS • REEL PACK • PAPER REEL



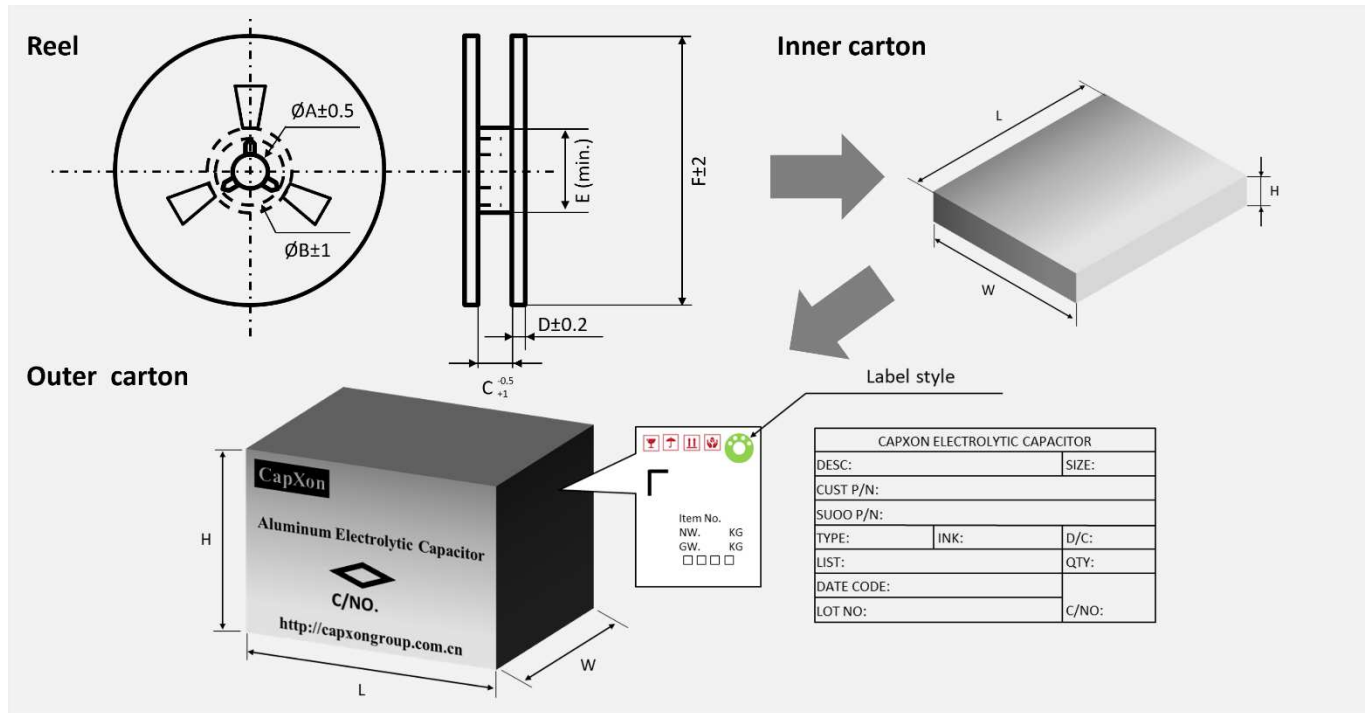
Ø D (mm)	L (mm)	Reel quantity (pcs)	Inner box quantity (pcs)	Inner box size L x W x H (mm)	Outer box quantity (pcs)	Outer box size L x W x H (mm)	Country of origin	Tariff number
4	5.5	2000	10000	400 x 390 x 106	30000	425 x 412 x 340	China	85322200
5	5.5	1000	5000	400 x 390 x 106	15000	425 x 412 x 340	China	85322200
6.3	5.5	1000	4000	400 x 390 x 106	12000	425 x 412 x 340	China	85322200
	6.1	1000	4000	400 x 390 x 106	12000	425 x 412 x 340	China	85322200
	7.7	900	3600	400 x 390 x 106	10800	425 x 412 x 340	China	85322200
8	6.5	1000	4000	400 x 390 x 106	12000	425 x 412 x 340	China	85322200
	10.5	500	1500	400 x 390 x 106	4500	425 x 412 x 340	China	85322200
10	10.5	500	1500	400 x 390 x 106	4500	425 x 412 x 340	China	85322200
12.5	14	200	600	400 x 390 x 130	1800	430 x 420 x 422	China	85322200
16	17	125	250	400 x 390 x 106	750	425 x 412 x 340	China	85322200
	21.5	100	200	400 x 390 x 106	600	425 x 412 x 340	China	85322200
18	16.5	125	250	400 x 390 x 106	750	425 x 412 x 340	China	85322200
	21.5	100	200	400 x 390 x 106	600	425 x 412 x 340	China	85322200

#### All reel dimensions in mm

D	4	5	5	6.3	6.3	6.3	6.3	8	8	8	8	10	10	10	10	12.5	16	16	18	18
L	5.5	5.5	5.8	5.5	5.8	6.1	7.7	6.5	7.7	10.5	11.7	8.7	10.5	12.4	16.5	14	17	21.5	16.5	21.5
A	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
B	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
C	14	14	14	18	18	18	18	18	18	26	26	26	26	26	26	34	46	46	46	46
D	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
E	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
F	380	380	380	380	380	380	380	380	380	380	380	380	380	380	380	380	380	380	380	380

Remark: Standard = Paper reel

### TAPING • SMD ALUMINUM ELECTROLYTIC CAPACITORS • REEL PACK • PLASTIC REEL



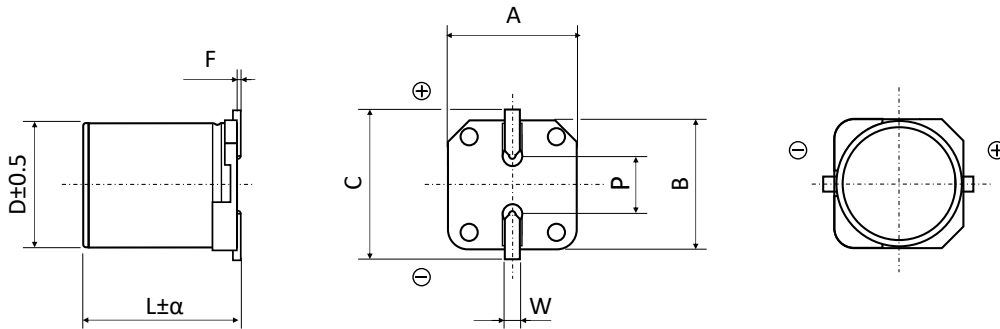
Ø D (mm)	L (mm)	Reel quantity (pcs)	Inner box quantity (pcs)	Inner box size L x W x H (mm)	Outer box quantity (pcs)	Outer box size L x W x H (mm)	Country of origin	Tariff number
4	5.5	2000	10000	400 x 390 x 106	30000	425 x 412 x 340	China	85322200
5	5.5	1000	5000	400 x 390 x 106	15000	425 x 412 x 340	China	85322200
6.3	5.5	1000	4000	400 x 390 x 106	12000	425 x 412 x 340	China	85322200
	6.1	1000	4000	400 x 390 x 106	12000	425 x 412 x 340	China	85322200
	7.7	900	3600	400 x 390 x 106	10800	425 x 412 x 340	China	85322200
8	6.5	1000	4000	400 x 390 x 106	12000	425 x 412 x 340	China	85322200
	10.5	500	1500	400 x 390 x 106	4500	425 x 412 x 340	China	85322200
10	10.5	500	1500	400 x 390 x 106	4500	425 x 412 x 340	China	85322200
12.5	14	200	600	400 x 390 x 130	1800	430 x 420 x 422	China	85322200
16	17	125	250	400 x 390 x 106	750	425 x 412 x 340	China	85322200
	21.5	100	200	400 x 390 x 106	600	425 x 412 x 340	China	85322200
18	16.5	125	250	400 x 390 x 106	750	425 x 412 x 340	China	85322200
	21.5	100	200	400 x 390 x 106	600	425 x 412 x 340	China	85322200

#### All reel dimensions in mm

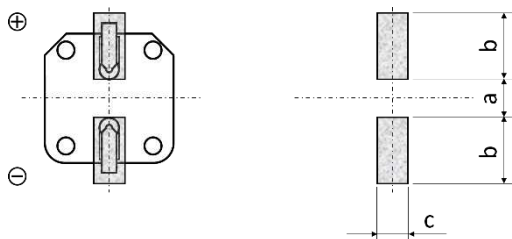
D	4	5	5	6.3	6.3	6.3	6.3	8	8	8	8	10	10	10	10	12.5	16	16	18	18
L	5.5	5.5	5.8	5.5	5.8	6.1	7.7	6.5	7.7	10.5	11.7	8.7	10.5	12.4	16.5	14	17	21.5	16.5	21.5
A	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
B	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5
C	14	14	14	18	18	18	18	18	18	26	26	26	26	26	26	34	46	46	46	46
D	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
E	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
F	380	380	380	380	380	380	380	380	380	380	380	380	380	380	380	380	380	380	380	380

Remark: Plastic reel = Add code "U" at the end of the part number



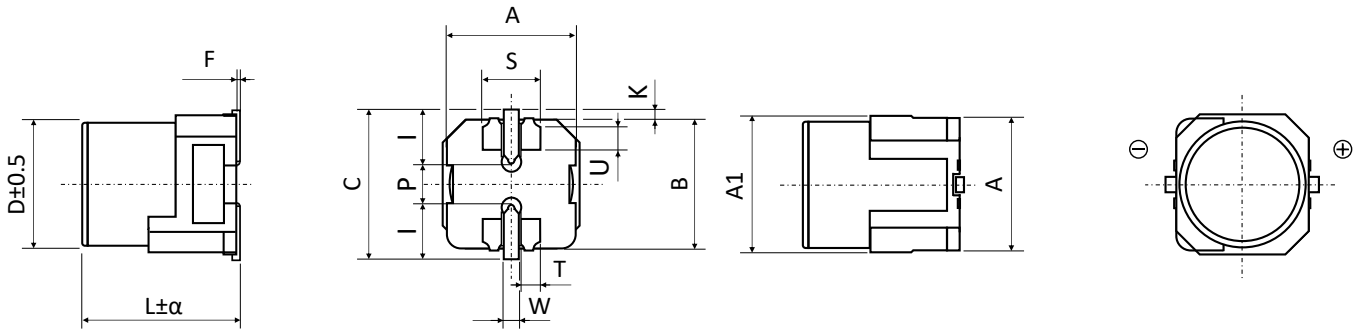
**DIMENSIONS STANDARD PACKAGE** ▪ All dimensions in mm


$\varnothing D$	L	$\alpha$	$A \pm 0.2$	$B \pm 0.2$	$C \pm 0.2$	F	$P \pm 0.2$	W
4.0	5.5	Max	4.3	4.3	4.9	0.3 max.	1.0	0.5 to 0.8
5.0	5.5	Max	5.3	5.3	5.9	0.3 max.	1.4	0.5 to 0.8
6.3	5.5	0.2	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
6.3	6.1	Max	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
6.3	7.7	Max	6.6	6.6	7.2	0.3 max.	2.2	0.5 to 0.8
8.0	6.5	Max	8.3	8.3	9.0	0.3 max.	2.3	0.5 to 0.8
8.0	10.5	Max	8.3	8.3	9.0	0.3 max.	3.1	0.7 to 1.1
10.0	10.5	Max	10.3	10.3	11.0	0.3 max.	4.5	0.7 to 1.1
12.5	14.0	Max	13.0	13.0	13.9	0.3 max.	4.5	1.0 to 1.4
16.0	17.0	0.5	17.0	17.0	18.0	0.3 max.	6.6	1.0 to 1.4
16.0	21.5	0.5	17.0	17.0	18.0	0.3 max.	6.6	1.0 to 1.4
18.0	16.5	0.5	19.0	19.0	20.0	0.3 max.	6.6	1.0 to 1.4
18.0	21.5	0.5	19.0	19.0	20.0	0.3 max.	6.6	1.0 to 1.4

**PAD LAYOUT STANDARD PACKAGE** ▪ All dimensions in mm


$\varnothing D$	L	a	b	c
4.0	5.5	1.0	2.6	1.6
5.0	5.5	1.4	3.0	1.6
6.3	5.5	2.1	3.5	1.6
6.3	6.1	2.1	3.5	1.6
6.3	7.7	2.1	3.5	1.6
8.0	6.5	2.1	4.5	1.6
8.0	10.5	2.8	4.2	1.9
10.0	10.5	4.3	4.4	1.9
12.5	14.0	4.3	5.8	2.5
16.0	17.0	6.0	6.5	3.5
16.0	21.5	6.0	6.5	3.5
18.0	16.5	6.0	7.5	3.5
18.0	21.5	6.0	7.5	3.5

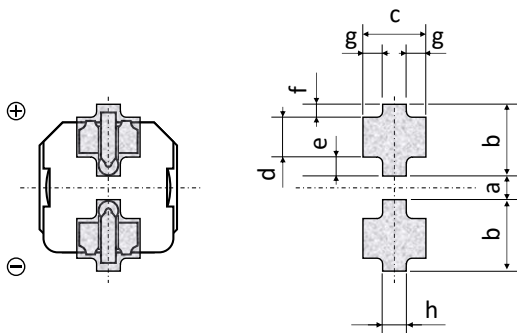
**DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D6.3 ▪ All dimensions in mm**



$\phi D$	L	$\alpha$	$A \pm 0.2$	A1 (max.)	$B \pm 0.2$	C (max.)	F	K
6.3	6.1	0.3	6.6	7.1	6.6	7.8	0 to 0.15	0.35 +0.15/-0.2
6.3	8.0	0.3	6.6	7.1	6.6	7.8	0 to 0.15	0.35 +0.15/-0.2

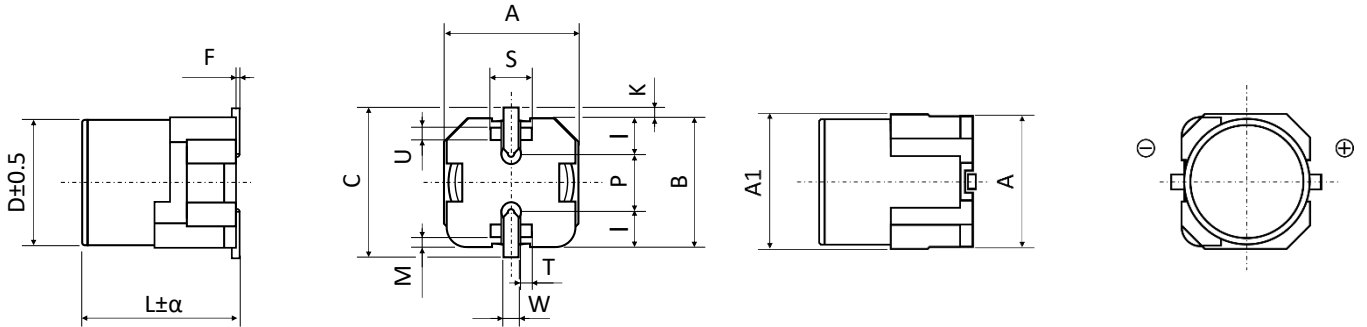
$\phi D$	L	$P \pm 0.2$	$S \pm 0.1$	$I \pm 0.1$	$T \pm 0.1$	$U \pm 0.1$	$W \pm 0.1$
6.3	6.1	2.2	2.9	2.4	1.1	1.55	0.65
6.3	8.0	2.2	2.9	2.4	1.1	1.55	0.65

**PAD LAYOUT VP PACKAGE (VIBRATION-PROOF) Ø D6.3 ▪ All dimensions in mm**



$\phi D$	L	a	b	c	d	e	f	g	h
6.3	6.1	1.2	3.6	3.2	2.0	0.95	0.65	1.0	1.2
6.3	8.0	1.2	3.6	3.2	2.0	0.95	0.65	1.0	1.2

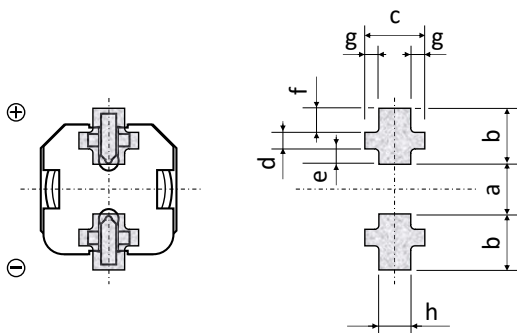
### DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D8 and D10 ▪ All dimensions in mm



Ø D	L	α	A ± 0.2	A1 (max.)	B ± 0.2	C (max.)	F	K ± 0.2
8.0	10.5	0.5	8.3	8.8	8.3	10.0	0 to 0.15	0.7
10.0	10.5	0.5	10.3	10.8	10.3	12.0	0 to 0.15	0.7
10.0	12.5	0.5	10.3	10.8	10.3	12.0	0 to 0.15	0.7
10.0	13.5	0.5	10.3	10.8	10.3	12.0	0 to 0.15	0.7

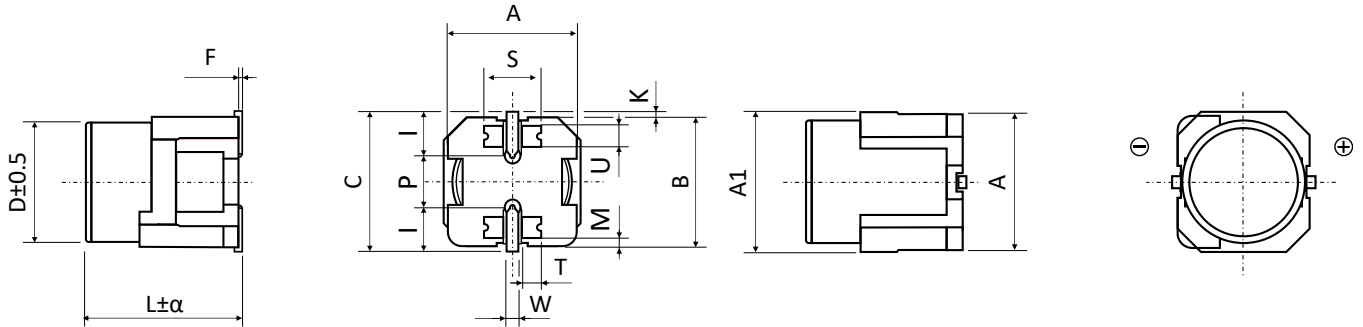
Ø D	L	P ± 0.2	S ± 0.1	I ± 0.1	T ± 0.1	U ± 0.1	W ± 0.1	M ± 0.1
8.0	10.5	3.1	3	3.4	1.4	0.7	1.2	0.7
10.0	10.5	4.6	3.3	3.5	1.5	0.8	1.2	0.9
10.0	12.5	4.6	3.3	3.5	1.5	0.8	1.2	0.9
10.0	13.5	4.6	3.3	3.5	1.5	0.8	1.2	0.9

### PAD LAYOUT VP PACKAGE (VIBRATION-PROOF) Ø D8 and D10 ▪ All dimensions in mm



Ø D	L	a	b	c	d	e	f	g	h
8.0	10.5	2.7	4.0	4.7	1.3	1.0	1.7	1.1	2.5
10.0	10.5	3.9	4.4	4.7	1.3	1.2	1.9	1.1	2.5
10.0	12.5	3.9	4.4	4.7	1.3	1.2	1.9	1.1	2.5
10.0	13.5	3.9	4.4	4.7	1.3	1.2	1.9	1.1	2.5

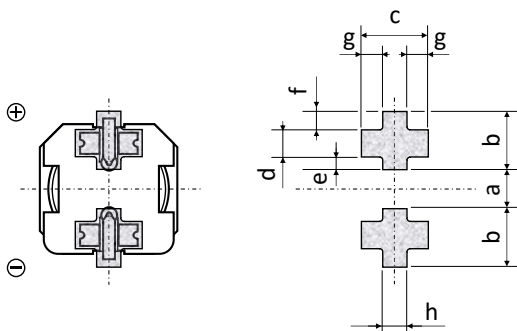
**DIMENSIONS VP PACKAGE (VIBRATION-PROOF) Ø D12.5, D16 and D18 ▪ All dimensions in mm**



ø D	L	α	A ± 0.2	A1 (max.)	B ± 0.2	C (max.)	F	K ± 0.3
12.5	14.0	1.0	13.5	13.5	13.5	15.0	0 to 0.15	0.7
12.5	16.0	1.0	13.5	13.5	13.5	15.0	0 to 0.15	0.7
16.0	17.0	1.0	17.0	17.0	17.0	19.0	0 to 0.15	0.7
16.0	21.5	1.0	17.0	17.0	17.0	19.0	0 to 0.15	0.7
18.0	16.5	1.0	19.0	19.0	19.0	21.0	0 to 0.15	0.7
18.0	21.5	1.0	19.0	19.0	19.0	21.0	0 to 0.15	0.7

ø D	L	P ± 0.2	S ± 0.1	I ± 0.1	T ± 0.1	U ± 0.1	W ± 0.1	M ± 0.1
12.5	14.0	4.4	6.0	4.7	2.0	2.2	1.2	0.95
12.5	16.0	4.4	6.0	4.7	2.0	2.2	1.2	0.95
16.0	17.0	6.7	5.8	5.5	2.0	3.0	1.4	1.0
16.0	21.5	6.7	5.8	5.5	2.0	3.0	1.4	1.0
18.0	16.5	6.7	5.8	6.7	2.1	3.0	1.4	1.5
18.0	21.5	6.7	5.8	6.7	2.1	3.0	1.4	1.5

**PAD LAYOUT VP PACKAGE (VIBRATION-PROOF) Ø D12.5, D16 and D18 ▪ All dimensions in mm**

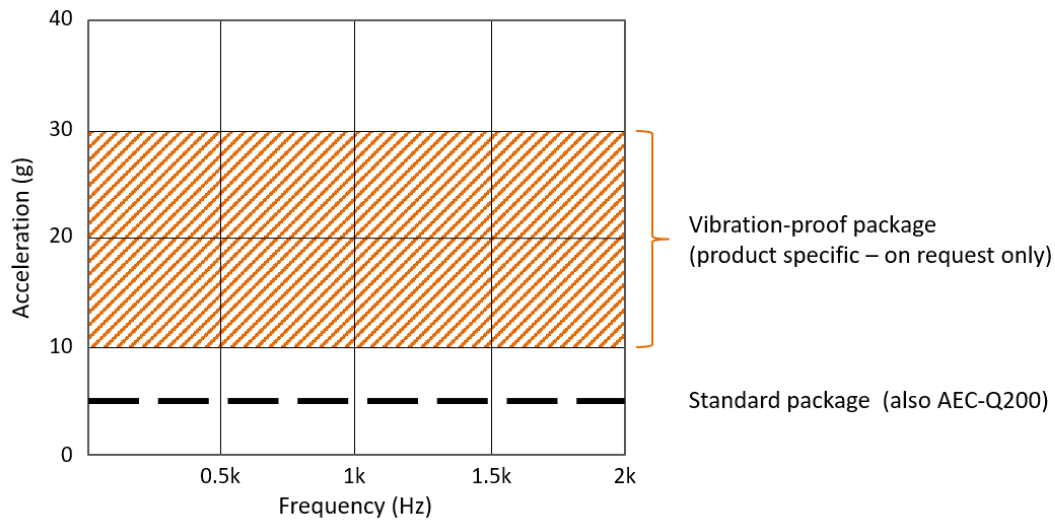


ø D	L	a	b	c	d	e	f	g	h
12.5	14.0	3.9	6.0	6.9	2.8	1.3	1.9	2.2	2.5
12.5	16.0	3.9	6.0	6.9	2.8	1.3	1.9	2.2	2.5
16.0	17.0	5.8	6.8	6.2	3.6	1.3	1.9	1.7	2.8
16.0	21.5	5.8	6.8	6.2	3.6	1.3	1.9	1.7	2.8
18.0	16.5	5.8	7.3	6.2	3.6	1.8	1.9	1.7	2.8
18.0	21.5	5.8	7.3	6.2	3.6	1.8	1.9	1.7	2.8

### VIBRATION SPECIFICATION ▪ STANDARD AND VIBRATION PROOF PACKAGE



Package	Test Standard	Condition	Determinant Standard
Standard package	IEC 60384-1 IEC 60384-18 IEC 60068-2-6 MIL-STD 202 Method 204	<ol style="list-style-type: none"> <li>10Hz ~ 2kHz ~ 10Hz (20 minutes)</li> <li>Amplitude (single peak): 0.35 mm (at 10 ~ 55Hz)</li> <li>Acceleration: 49m/s<sup>2</sup> (5g at 55 ~ 2kHz)</li> <li>X, Y, Z directions, 4 hours per direction, total 12 hours</li> </ol>	<ol style="list-style-type: none"> <li><math>\Delta C/C \leq \pm 5\%</math> of initial value</li> <li>DF <math>\leq</math> stated limit</li> <li>LC <math>\leq</math> stated limit</li> <li>No visible damage</li> <li>No leakage of electrolyte</li> </ol>
Vibration-proof package		<ol style="list-style-type: none"> <li>Consult CapXon for test details</li> </ol>	<ol style="list-style-type: none"> <li>Consult CapXon for test details</li> </ol>



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## **1. GENERAL PRECAUTIONS & GUIDELINES**

In the following Precautions and Guidelines, CapXon provides instructions and requirements to assure a proper handling and desired performance of capacitors. Firstly, all general information is given, which applies to all technologies. The following chapters provides additional instructions specifically about technology and mounting style, which completes the full set of instructions.

### **1.1. GENERAL - ALL TYPES -**

#### **1.1.1. POLARITY**

All conventional Electrolytic Capacitors have a polarity due to the internal construction. This polarity is marked on the component by printing on the top of component or on the sleeve of Aluminum Electrolytic Capacitors, including Radial, Snap-In and Screw types.

Any reverse voltage can cause short circuit breakdown of capacitor or leakage of electrolyte. Electrolytic Capacitors isn't designed for AC-voltage supply and only meant for DC-voltage applications.

For an application where polarity in circuit can be reversed or unknown, specific bi-polar aluminium electrolytic capacitors shall be used. We offer such components within our product range.

#### **1.1.2. OVERVOLTAGE**

Overvoltage can damage the capacitor and can cause a drastic increase in leakage current, which possibly shortens the lifetime of the capacitor. In a worst case, short circuit failure mode can happen. As a result, do not apply any continuous or temporary overvoltage.

The applied operating voltage, which is applied to the capacitor, should not exceed the rated voltage of the capacitor.

#### **1.1.3. OPERATING TEMPERATURE**

Only operate the capacitor within the limits of allowed temperature range, which is specified by datasheet. Be aware that the sum of thermal stress by ambient condition plus electrical stress is the main driving factor for aging. As the thermal stress level gets higher, the expected capacitor lifetime would be lower.

A drop in applied temperature, ambient condition or cooling within application can enlarge the expected lifetime of

the capacitor. For details, please see further documentation of lifetime estimation.

#### **1.1.4. RIPPLE CURRENT**

The applied ripple current shall not exceed the stated max. ripple current  $I_R$  on the datasheet at the specific frequency.

When capacitors are overstressed by ripple, it can generate massive heat inside the capacitor, which can result in deterioration, vent operation or capacitor breakage.

#### **1.1.5. CHARGE AND DISCHARGING**

Frequent and quick charge / discharge generates heat inside the capacitor and can cause possible increase of leakage current, reduction of the expected lifetime, decrease of capacitance, vent operation or breakage.

For such applications please see design rules or consult our technical support for assistance.

#### **1.1.6. SOLDERING CONDITIONS**

For recommended reflow solder profile, please see additional information at Section 2. Soldering Instructions.

Soldering by vapor phase for SMD types or any hand soldering are not recommended. No permission is released by CapXon side either. In case of such a usage, customer need to validate solder result and applied component stress within their own manufacturing process.

#### **1.1.7. MSL – MOISTURE SENSITIVE LEVEL (ONLY FOR SMD TYPES)**

Our standard SMD components are rated according to JEDEC J-STD020 with MSL1. Construction of this part does not include hygroscopic critical materials and are not prone to delamination or popcorn effects. Only SMD MLPC types of the Solid Conductive Polymer components have MSL3. Moreover, only this type requires additional actions or specific handling in factory floor by customer such as handling or storing the goods after opening the package in accordance to JEDEC J-STD020.

#### **1.1.8. RESISTANCE TO CHEMICALS AND SOLVENTS FOR WASHING, GLUING, FILLING AND COATING**

Due to the wide variety of suppliers and different chemical formulas of washing, gluing, filling and coating materials, the individually used material and appliance process need to be validated by customer itself. It is not possible to provide any global material usage approval from our side.



CapXon can provide additional information, including combination of chemicals which could be critical to the component behavior and can support measurements of component performance after appliance of washing, gluing, filling or coating materials. For specific support, please kindly contact our technical support for further advices.

### 1.1.9. CLEANING AND WASHING

Do not wash the assembled capacitors with the following cleaning agents:

- **Xylene**
  - can cause deterioration of the rubber seal material
- **Halogenated solvents**
  - can cause corrosion and electrical failure modes
- **Petroleum based solvents**
  - can cause degeneration of the rubber seal material
- **Alkali based solvents**
  - can cause corrosion and dissolving of aluminum can
- **Acetone**
  - component marking possibly dissolve

After finishing cleaning and washing, the below points need to be verified by customer:

Dry all solvents properly from PCB as well as capacitor surface sufficiently and apply air blower or air knife, with temperatures within the temperature range of the product specification, if needed.

Monitor pH value, conductivity, specific gravity and water content of cleaning solvents to be sure of possible contaminations and pollution. Contaminations can negatively affect the performance of the capacitor.

### 1.1.10. GLUING, FILLING OR COATING

It is not allowed to use any gluing (adhesives), filling or coating materials, which contains halogenated solvents. Halogen ions are critical, because they can diffuse or creep in the capacitor through rubber sealing and can possibly damage the internal capacitor element /structure result in serious failure modes for the capacitor.

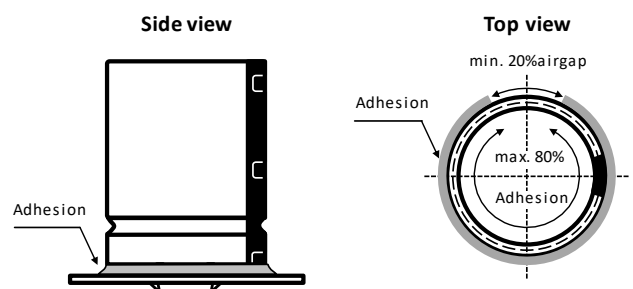
Additionally, please pay attention to the following points:

- Make sure that the surface of capacitor and the area between component bottom / rubber sealant is dry and clean before appliance of gluing, filling or coating material. It is important to avoid any contamination with chemical residues (e.g. flux residues, cleaning).
- Please follow and meet the stated gluing, coating, filling, heating and curing instructions from manufacturer or supplier of such materials. Be aware of possi-

ble shrinkage of such materials. Verify that the hardening was properly done and that no solvents / agents do remain.

- There should be no excessive heat nor mechanical pressure /stress at any stages from the production on customer side. Be aware of the possible material shrinkage of used material. High material shrinkage which leads to damage on capacitor is not CapXon's responsibility.
- The used materials of gluing, coating or filling can possibly react with the marking of component and this can change optical appearance such as the appearance and legibility.
- If the rubber seal surface is fully covered by gluing, filling or coating material, it is no longer possible to have a natural diffusion of gas between the inside of the capacitor and the ambient. So, to avoid such situation, it's strongly recommended to block maximum 80% of the sealed section on the bottom side of the capacitor.

Please find the example below of how gluing could be applied on Radial and Snap-In types.



*Gluing reference example of a Snap-In capacitor*

### 1.1.11. OPERATION AND ENVIRONMENT

As long as the application is powered, in operation and cap is not discharged, the user is never permitted to touch the electric terminals of the capacitor directly or to bridge the terminals by hand or any other conductive liquid or solid material. Otherwise, a short circuit of terminals can happen and a hard discharge can damage capacitor / application as well as it can harm the operator.

Within operation, please avoid the following environmental conditions to assure proper capacitor operation:

- high vibration, shocks or mechanical stress. For tested and allowed conditions, please see available references or contact us for details
- avoid direct sunlight, ozone and any kind of radiation or ultraviolet rays
- corrosive or toxic gases (e.g. ammonium, chlorine)

and compounds, bromine and compounds, hydrogen sulfide, sulfuric acid)

- ambient with high amount of damp condensation, water or types of oil

### 1.1.12. MECHANICAL STRESS

Best possible, avoid mechanical stress for the capacitor and do not apply any excessive mechanical stress to the lead wire pins or terminal.

After mounting, do not lift nor carry the PCB assembly by just grabbing the capacitor to pick up the board.

### 1.1.13. STORAGE

In case of long-term storage without applying voltage to the capacitor, leakage current tends to increase.

By applying the rated voltage before usage, the dielectric layer of aluminium oxide and leakage current can be stabilized.

If the capacitor is for more than 12 months, it is recommended to apply the DC rated voltage  $V_R$  for 30 minutes through 1k $\Omega$  protective series resistor.

The storage conditions for storage on customer side should be monitored and controlled to a temperature of 5°C up to 35°C and less than 75% rel. humidity.

### 1.1.14. DISPOSAL

Please follow your local governmental and organizational restrictions for disposal and if needed, contact your local responsible for correct handling.

In case of incineration, punch holes in the aluminum can in advanced to avoid explosion of capacitor and then burn with at least 800°C, otherwise it can result toxic gas.

## 1.2. ALUMINUM ELECTROLYTIC & HYBRID CONDUCTIVE POLYMER CAPACITORS - ALL MOUNTING STYLES -

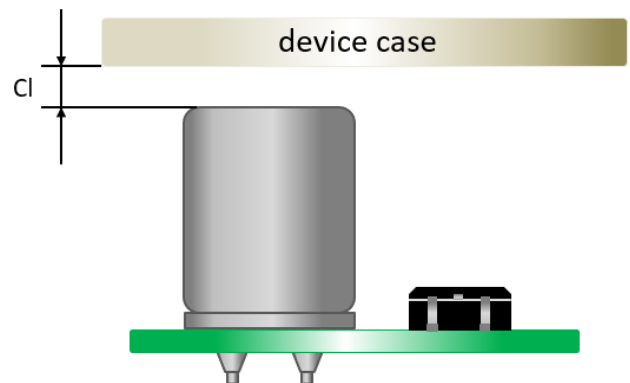
### 1.2.1. VENT & VENT OPERATION AT EMERGENCY

As a safety feature, most our regular electrolytic capacitors have a so-called vent, which is a pre-determined breaking point. In case of overstressed component, it can lead to internal gassing and due to this an internal overpressure will

result in vent operation. So, the vent will open to release such pressure and gas can become visible. If user detects vent operation or gassing out of the capacitor when operating, disconnect the application immediately from power supply to turn it off directly. If it can't be turned off, the capacitor or the conductive liquid / gas of electrolyte can result in short-circuits, which can dramatically damage the application.

Please notice to avoid being near with body or face above or in direction of capacitors vent when powered. When the running application is overstressed, gas leakage by vent is possible. By this gas with temperatures higher than 100°C can occur and can hurt human body and face. In such an event, if contact with skin, wash it immediately with plenty of water and soap. If contact with eyes, rinse immediately (e.g. eye shower) with plenty of water. If gas is inhaled, gargle right away with plenty of water. For all three cases, please consult a doctor for medical advices.

For proper operation of vent, consider space between the vent and covering surfaces (e.g. housing) as stated at the table below, it is strongly recommended for your mechanical construction / build-up of your product:



*Minimum distance to be observed for the safe operation of the capacitor*

Case diameter $\phi$	Clearance distance Cl
6.3mm to 16mm	Min. 2mm
18mm to 35mm	Min. 3mm
$\geq 40$ mm	Min. 5mm

*Recommended minimum clearance distance between topline capacitor and device case*

If such a space is not provided, the vent will not operate completely or even cannot open in case of overpressure.

Case sizes which are smaller than 6.3mm in diameter have no vent on top, for these no space need to be considered.

### **1.2.2. SLEEVE MATERIAL (NOT FOR SMD)**

The standard sleeve material for the majority of our Radial, Snap-In and Screw mounting capacitors is PET and for some series PVC is used as sleeve material. When sleeve is exposed to xylene, toluene or similar and afterwards exposed to high heat, the sleeve may be cracked or damaged.

The sleeve is not used as insulating material or layer and does not insulate capacitor to surroundings. For needed insulation, further actions need to be considered by customer and please follow our recommended design rules.

Sleeves are applied for all Aluminum Electrolytic Capacitors with Radial, Snap-In or Screw mounting and if desired for further customized solutions.

## **1.3. ALUMINUM ELECTROLYTIC - RADIAL TYPE -**

### **1.3.1. PIN CUTTING & BENDING**

Please take absolute care when cutting or bending pins, that the pin is fixed mechanically in direction of rubber sealant. It is necessary that the mechanical force while cutting and bending, which results in pulling or pressing force on pin, does not stress the inner construction of capacitor element or to damage the rubber sealant. Excessive pulling or pressing force on the pin with missing fixation can result in damage of internal pin to capacitor element connection and also the sealing can be weakened. So, please take care to assure appropriate cutting and bending. Do not pre-damage the capacitors and shorten their lifetime performance by incorrect handling.

### **1.3.2. SOLDERING**

For recommended wave solder profile, please see additional solder instruction at section 2.5.

Improper soldering conditions may shrink or break the sleeve. Additionally, excessive heat can damage the internal capacitor element as terminals and lead wires conduct heat into the capacitor.

## **1.4. ALUMINUM ELECTROLYTIC CAPACITORS - SCREW TYPE -**

### **1.4.1. MAINTENANCE**

A regular inspection is recommended when screw capacitors are used at industrial applications. Before inspection, make sure to turn off the power, discharge screw capacitors carefully and do not apply mechanical force or pressure to the terminal to avoid damage. Inspection items are as stated below:

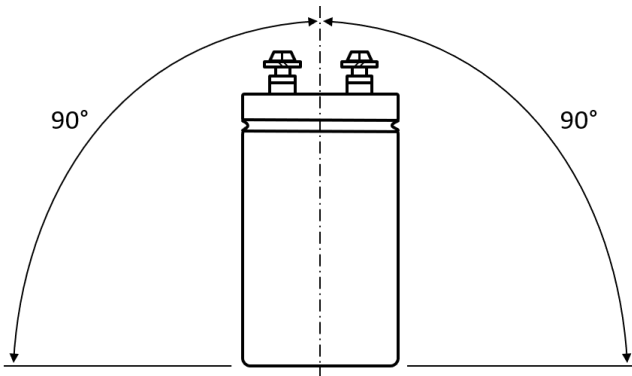
- Check on outer damage, deformation and electrolyte leakage
- Check electrical performance: leakage current, capacitance, DF value and other product specifications. If there is any abnormality detected, make sure a capacitor replacement will be done and handled properly

### **1.4.2. MOUNTING & INSTALLATION**

Make sure capacitors rated capacitance, rated voltage and polarity is according to spec before installation. Please confirm that capacitors and circuit board terminal pitch is consistent to each other before installation. It may cause stress to internal capacitor element through the terminal. If the pitch is different, mounting was done nevertheless and strong mechanical stress was applied. In such case, this can cause short-circuit and other failure modes. Machine automated force and lead torque strength must be controlled properly when mounting happens with automated machine.

### **1.4.3. MOUNTING DIRECTION OF SCREW TYPE CAPACITORS**

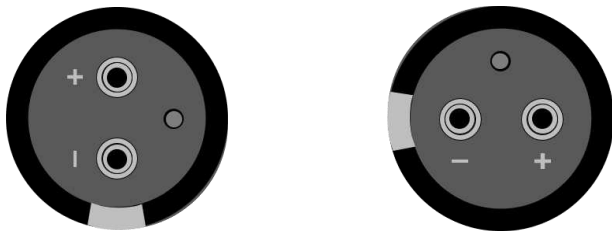
To avoid screw capacitor breakage / explosion, it is not allowed to be mounted with the safety vent downwards to ground, because vent can't function properly when mounted with vent to bottom side and existing gas pressure cannot release properly. Recommended mounting method is shown as figure below, to avoid any safety vent downwards installation. So, capacitor should be mounted with screw terminals up as shown below:



*Recommended mounting direction*

**1.4.4. HORIZONTAL MOUNTING**

For horizontal mounting following mounting is strongly recommended. Anode terminal in upper position with safety vent in horizontal position as figure below on left side or safety vent in upper position with anode and cathode terminal in horizontal as figure below on right side.



*Recommended mounting position, also in accordance to EIAJ RCR-2367C*

It may not damage capacitors directly, but an electrolyte leakage may happen, if installed by other mounting method in horizontal direction.

**1.5. SOLID CONDUCTIVE POLYMER CAPACITORS**

**1.5.1. APPLICATION RESTRICTIONS**

The leakage current of Solid Conductive Polymer Capacitors may vary which depends on thermal stress.

Please don't use Solid Conductive Polymer Capacitors in the following types of applications / circuits:

- High-impedance circuits - which are meant to sustain voltages
- Coupling circuits

- Time constant circuits - in addition to the leakage current fluctuation, capacitance may also fluctuate, which depends on operational temperature and humidity. The fluctuation of the capacitance may cause problems, if it is used as a time constant capacitor, which is extremely sensitive to the fluctuation of the capacitance. So, do not use it as a time constant capacitor.
- Other circuits - which are significantly affected by leakage current. If you want to use 2 or more capacitors in a series connection, please contact us before usage.

**1.5.2. SUDDEN CHARGE AND DISCHARGE**

Do not use the capacitor in circuits when capacitor is repetitively charged and discharged rapidly. If repetitively and rapid charging and discharging stresses the capacitor, it can result in reduction of capacitance or may cause further damage due to internal heating. The usage of a protective circuit is recommended to ensure reliability, when rush currents exceeds 10 times of capacitors allowed max. ripple current  $I_R$ , but never more than max. 10A. When measuring the leakage current, a protective resistor (1 kΩ) must be inserted to the circuit during the charge and discharge.

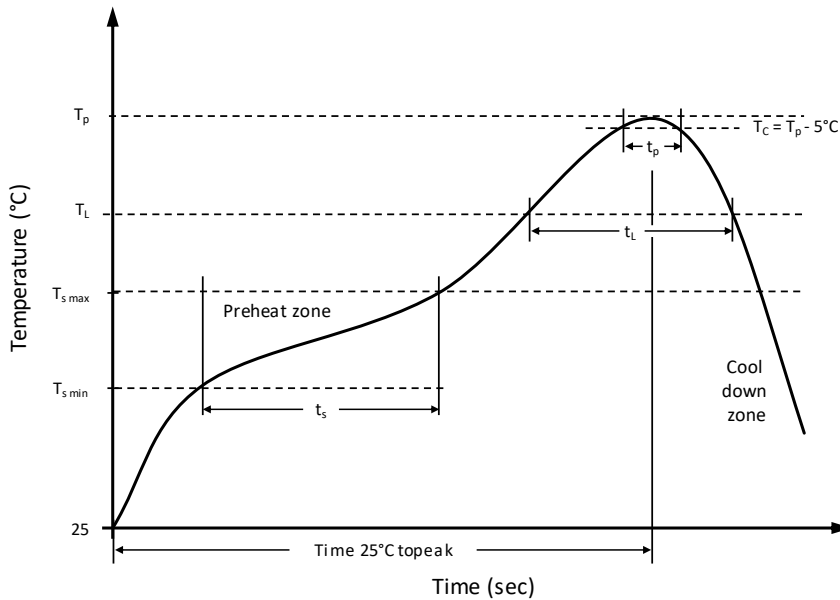
## 2. SOLDERING INSTRUCTIONS

In the following sections CapXon’s leadfree solder profiles are stated in detail.

### 2.1. REFLOW SOLDERING - SMD – ALUMINUM ELECTROLYTIC CAPACITORS



#### Recommended reflow soldering conditions



#### Classification of reflow soldering profile

Profile Features	Value
Preheat temperature min.	$T_{s\ min}$ 150 °C
Preheat temperature max.	$T_{s\ max}$ 180 °C
Preheat time $t_s$ from $T_{s\ min}$ to $T_{s\ max}$	$t_s$ 120 seconds
Ramp-up rate ( $T_L$ to $T_p$ )	max. 3 °C/second
Liquidous temperature	$T_L$ 217 °C
Time $t_L$ maintained above $T_L$	$t_L$ See reference table below for $\varnothing$ Diameter / Rated Voltage $V_R$ combination
Peak package body temperature	$T_p$ See reference table below for $\varnothing$ Diameter / Rated Voltage $V_R$ combination
Timeframe of within 5°C below and up to max actual peak body temperature	$t_p$ See reference table below for $\varnothing$ Diameter / Rated Voltage $V_R$ combination
Ramp-down rate ( $T_L$ to $T_p$ )	max. 6 °C/second
Time 25°C to peak temperature	max. 8 minutes

\* Limitations of ramp rates to JEDEC-J-STD020E

#### Package classification reflow temperature for SMD – Aluminum Electrolytic Capacitors

$\varnothing$ Diameter (mm)	$V_R$ - Rated Voltage (V)	$t_L$ - Time above 217°C	Time above 230°C	$T_p$ Peak Temperature	$t_p$ Timing (seconds)	Allowed Reflow Runs
4 up to 6.3	4 to 50	90 sec. max.	30 sec. max.	260 °C	10	max. twice
	63 to 100	60 sec. max.	30 sec. max.	255 °C	5	max. twice
8 up to 10	4 to 50	60 sec. max.	30 sec. max.	250 °C	5	max. twice
	63 to 450	40 sec. max.	30 sec. max.	240. °C	5	max. twice
12.5 up to 18	4 to 50	30 sec. max.	20 sec. max.	245 °C	5	max. twice
	63 to 450	20 sec. max.	5 sec. max.	235 °C	5	max. twice





# CAPXON

IATF 16949

AEC-Q200

ISO 9001

ISO 14001

QC 080000



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